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The New Regional geographies

BOOK II

ASIA AND AUSTRALASIA

JUNIOR REGIONAL GEOGRAPHIES

By W H BARKER, B Sc
 formerly Reader in Geography, Manchester University,
 and Head of the Geography Department of University
 College, Southampton, and
 LIONARD BROOKS, M A.
 formerly Second Master and Geography Master at William
 Elms School, Gospel Oak

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A REGIONAL GEOGRAPHY
OF
ASIA AND
AUSTRALASIA

BY

LEONARD BROOKS, M.A. (Cantab. and Lond.)

FORMERLY OND MASTER AND GEOGRAPHY MASTER AT THE
EILLIAM ELLIS SCHOOL

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EDITOR'S INTRODUCTION

THE time has gone by when it was thought possible that a textbook of geography should be equally suitable for pupils at different stages of advancement, so that a series of books suited to different stages is necessary for use in schools. Regions may be studied in different orders suited to different circumstances and aims, and, to be entirely satisfying, each scheme of study should have a special series of books. The series, of which this book forms one, is designed to fit a particular scheme—i.e. that in a secondary school in the years at the end of which is one of the First Public Examinations of the type of the London General School Examination, a scheme which has for many years been found in practice to be extremely satisfactory at the William Ellis School.

Three of the volumes cover the world regionally in three years; the fourth contains much of the preceding matter in a condensed form, together with a few additions on subjects which are more profitably studied after other work has been done. Account is taken of the fact that the pupils are advancing in ability, so that, while there is a certain uniformity in that each book provides a north and south section of the world, yet the arrangement is such that the matter increase in difficulty. The series supplies textbooks for a complete school course in geography which includes physical as well as regional geography, and the order in which regions are taken depends to some extent on the desirability of studying particular sections of physical geography in a suitable order.

After the Americas in Book I, Asia and Australasia are selected for treatment in Book II. Here the geography of man is much more complicated, and the related physical geography, including, as it does, such phenomena as monsoons, necessitates the study of more climatic material than is found in Book I. At the same time the fact that the volume treats of a north and south section of the world allows of revision of previous work by comparison and contrast.

JAMES FAIRGRIEVE.

PREFACE

THIS book is the second of a series of four intended to cover the geography course for the four years leading up to and including the year in which an examination of matriculation standard is taken. From the very earliest years of teaching reference is constantly being made to matters pertaining to climate. The writer has found from experience that pupils who have arrived at this age are particularly interested in the meteorological side of geography, and are old enough and sufficiently advanced to draw together and organize, as well as to add to, previous teaching. Therefore the first seven chapters are designed to accomplish this, and to show in a clear and simple manner the broad connections existing between temperature, pressure and winds, rainfall, etc., and to carry these connections one step farther by showing the influence of all upon the distribution of natural vegetation. More difficult matters, such as the study of the Daily Weather Report and the division of the world into its major natural regions, are left for full consideration at a later stage. Chapters VIII to XVIII deal with the regional geography of Asia, and whilst the work covered in the earlier chapters is illustrated and emphasized in a concrete manner, the treatment is not unduly biased, and the method follows broad lines. The remaining chapters are devoted to Australasia, in studying which it is possible, not only to test whether the principles already learned have been understood, but also to note the differences that occur through its position in the southern hemisphere as contrasted with the situation of Asia north of the equator.

At the end of each chapter there will be found a number of questions and exercises. They are designed to test the pupil's powers of assimilation and originality; and of course it is not intended that answers should be *written* to all, nor are they by any means the only suitable exercises which may be set.

Teachers will find Book II, the *New Regional Map Books*, by V. C. Spary, B.Sc., published by the University of London Press Ltd. (price *is.*) of considerable value for use with this book.

As the author is a Divisional Inspector of Schools under the London County Council, the rules of that Authority make it necessary for him to state that the Council is in no way responsible for the book or for any of the statements in it.

L. B.

**44 Wildwood Road,
Hampstead Garden Suburb, N W. 11.
June 1938.**

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BOOK II

ASIA AND AUSTRALASIA

CHAPTER I.

THE EARTH AS A GLOBE.

LONG before the birth of Christ men believed that the earth was a sphere, and in support of their views put forward some of the arguments with which we are now so familiar. But during the Middle Ages, and right up to the time of Columbus, the most absurd views of the earth's shape were held. Sailors believed that the earth was like a shield, and that if they arrived at the edge, their vessels would fall off into space. It was the voyage of Columbus which compelled men to pay more attention to the older and truer notions of the earth's shape.

Over three hundred years before the Christian Era, it was noticed that when the earth came between the sun and the moon, thus causing the shadow of the earth to be cast on the moon, the edge of the shadow was always part of a circle. Cones, cylinders and bodies shaped like a penny can be made to cast circular shadows in some positions, but the only body which casts a circular shadow *in all positions* is a sphere.

Early in the first century, sailors had already noticed that as they approached land, the latter was first visible from the top of the mast. We now generally state this

from the standpoint of an observer looking out to sea, from which point of view the mast becomes visible first, and later, the hull. Again, the horizon, as seen from the deck of a ship, is circular in shape, and if you climb high up the mast, the horizon still remains circular, but its distance from the ship has increased. The same would be noticed on land, but it is not so easy to see the circular horizon, owing to the hills, trees and buildings. Many other reasons for believing that the earth is spherical, or nearly so, could be given, but since they are mainly the result of somewhat complicated observations by astronomers and mathematicians, it will not be necessary to discuss them here. One very simple fact, which proves that the earth cannot be flat, should be mentioned. A ship can leave Liverpool, sail westwards across the Atlantic Ocean, pass through the Panama Canal, and continue its journey across the Pacific Ocean. It can return to Liverpool *via* the Red Sea, the Sue/ Canal and the Mediterranean, after having sailed round the world. If there were no land masses to interfere, it would be possible for our ship to sail round the world on any parallel of latitude.

Scientific men have determined for us not only the shape, but the size of the earth. We know that it is not quite spherical, and that it is very slightly flattened at the poles. This flattening is so slight that an observer would not be able to detect it on the largest of artificial globes made to scale, for the polar diameter is only 26 miles less than the equatorial diameter. The circumference of the earth is rather less than 25,000 miles, and the diameter nearly 8,000 miles.

So far as we know, the first attempt at measuring the size of the earth was made by a Greek named Eratosthenes, who lived about 200 years before the birth of Christ. At Syene, now Assuan, there was a very deep well, and noticing that the image of the sun could be seen on midsummer day at the bottom of the well, he came to the conclusion that on that day the sun was overhead, and therefore the place was on the Northern

Tropic. Eratosthenes lived at Alexandria, and he set himself the task of finding out what was the angular difference between the height of the sun on midsummer day at Syene and at Alexandria. By observations at Alexandria he found that this difference was $7^{\circ} 12'$. The next thing he required was the linear distance between

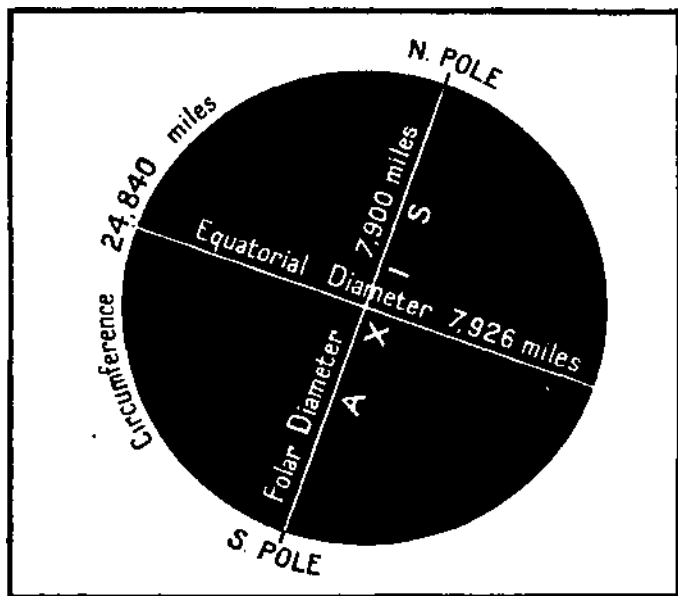


FIG. I.—Diagram illustrating some earth measurements.

Alexandria and Syene, and since even in those early days there was a good system of land survey in the Nile Valley owing to the annual floods, he had no great difficulty in obtaining this. He found the distance required was 5,000 stadia, which is 500 miles. Then he reasoned that, since a distance of 5,000 stadia subtended an angle of $7^{\circ} 12'$, the circumference of the world must

THE EARTH AS A GLOBE

be as many times 5,000 stadia as $7^{\circ} 12'$ are contained in 360° . Thus he calculated:—

$$\begin{aligned}\text{The world's circumference} &= \frac{360}{7^{\circ} 12'} 12' \times 5,000 \text{ stadia} \\ &= 250,000 \text{ stadia,} \\ &= 25,000 \text{ miles (10 stadia = 1 mile).}\end{aligned}$$

Many faults can be found in this calculation. For example, a map will show that the two towns are not on the same meridian; Syene is not quite on the Tropic of Cancer, whilst the distance from Syene to Alexandria is not exactly 5,000 stadia. Despite these drawbacks, this first measurement is very interesting.

GLOBES AND MAPS.—Since the earth is a spheroid, *i.e.*, a sphere slightly flattened at the poles, you will readily understand that the only correct representation of any part of its surface is that which we have on an artificial globe. You must have noticed how the shape of any large country or continent differs on different maps. The only correct map must be on a curved surface, for it represents a part of the curved surface of the earth, and therefore all flat maps are wrong in some respect. It is very necessary that constant reference should be made to a globe in order that wrong impressions derived from flat maps may be corrected.

CHAPTER II

THE MOVEMENTS OF THE EARTH AND THEIR RESULTS.

THE APPARENT MOVEMENTS OF THE SUN.

ALTHOUGH in this chapter we shall discuss the movements of the earth, we shall first of all learn something of the apparent movements of the sun as seen in our own country from our standpoint as spectators. If the height of the sun is measured each day at noon (see Ex. 1),¹ it will be found that its height above the horizon changes a little from day to day. If the path which the sun appears to take in its journey across the heavens is noted, it will be discovered that every day the sun gets higher and higher between sunrise and noon, at the same time appearing to move from the east towards the south. When it is due south, about noon, it is also highest in the sky. During the afternoon the sun sinks lower and lower, at the same time moving westwards. If these observations are made throughout the year, it will be seen that the sun is lowest in the sky at noon about December 21, and highest about June 21, but that it is always seen in the south about twelve o'clock. If we note the point of the compass at which the sun appears to rise, we shall find that in winter it is south-east, on March 21 due east, in summer north-east, and on September 21 due east. In winter the sun appears to set south-west, on March 21 due west, in summer north-

¹ The observations suggested are best carried out in the lower forms, but in case this has not been done, it is advisable to take them at this stage.

6 THE MOVEMENTS OF THE EARTH

west, and on September 21 due west once more. If we could see the sun at midnight it would be in the north, but since it is below the horizon we cannot see it.

THE CAUSE OF NIGHT AND DAY.

We must now explain why it is that the sun appears to make these movements. This is very simple when we realize that it is not the sun which moves, but the earth. We imagine that the earth rotates on its axis, a line passing through the earth from pole to pole. It takes the earth one day to make a complete rotation on its axis. This turning of the earth on its axis is, of course, the cause of day and night, for only half the globe can receive the sun's rays at once. The earth rotates from west to east, so that as each place comes into the light the sun appears to rise in the east. Further turning causes the sun to appear higher and higher, and to reach its greatest height about noon. After noon the continued rotation causes the sun to become lower and lower, and finally to set in the west.

THE CAUSE OF THE SEASONS.

But the earth has another motion: it makes a yearly revolution round the sun. This is illustrated in Fig. 2, which represents a tub filled with water. The water surface represents the *plane of the ecliptic*, that is, the plane in which the earth moves during its revolution round the sun. Two balls are placed on the water, one to represent the earth and the other the sun. The former is moved round the sun-ball, and its path represents the orbit of the earth.

Fig. 2 shows that needles have been passed through the earth-ball to represent the axis, and it will be seen that these are not vertical; they have been inserted so as to make an angle of $66\frac{1}{2}^{\circ}$ with the surface of the water, for the earth's axis is inclined to the plane of its orbit at that angle. We must also observe that the axis

points in the same direction during the whole period of the earth's yearly revolution round the sun. Fig. 3

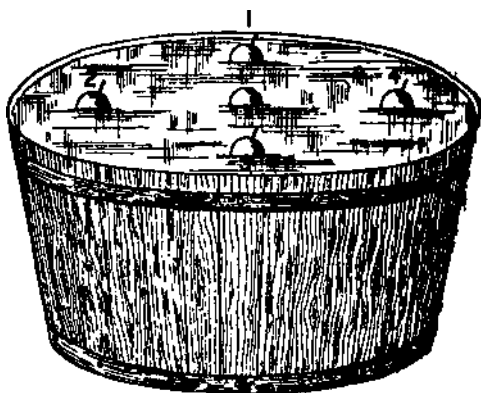


FIG. 2.—This diagram illustrates the revolution of the earth. illustrates the position of the earth with regard to the sun on certain days of the year, the unshaded area

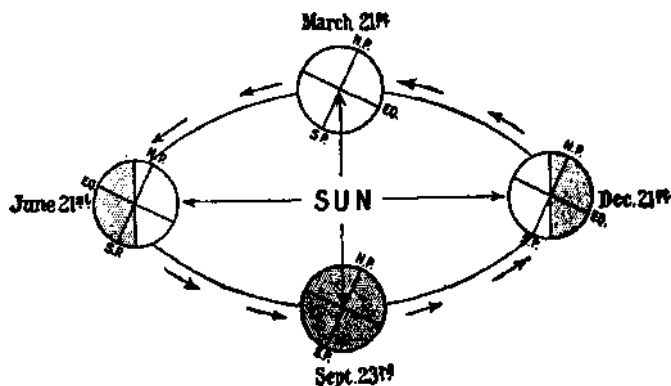


FIG. 3.—Diagram showing the position of the earth with regard to the sun at the equinoxes and solstices.

representing that part of the earth reached by the rays of the sun. It will be seen that on June 21 the northern

8 THE MOVEMENTS OF THE EARTH

end of the earth's axis, *i.e.*, the North Pole, is tilted *towards the sun* and *away from it* on December 21, so that on June 21 the sun's rays pass $23\frac{1}{2}^{\circ}$ beyond the North Pole, and fall short of the South Pole by the same angle. These conditions are reversed on December 21. On March 21 and September 23, the earth is illuminated from North to South Poles, so that the sun's rays reach the poles, but do not pass beyond them.

Now this yearly revolution of the earth round the sun is the cause of the seasons. In the next chapter we shall learn that the more overhead the rays of the sun strike the earth's surface, the warmer is the temperature*. The revolution of the earth round the sun causes the sun's rays to strike the same place at different angles at different times, and thus we have the seasons.

THE APPARENT MOVEMENT OF THE SUN IN DIFFERENT LATITUDES.

(1) AT THE EQUATOR.—Fig. 4 is a diagram which shows the apparent path of the sun at different times of the year. The point *x* represents the position of the observer, his horizon being shown by the ellipse. On March 21 the sun rises due east at six o'clock in the morning, and gradually gets higher and higher, until at noon the observer at *x* would see the sun immediately overhead. At six o'clock in the evening it sets due west. From March 21 to June 21 the sun appears to rise every day a little farther north of east, and to set a little farther north of west, whilst at the same time the elevation at noon decreases. On June 21 this northward movement ends, and on each successive day the sun rises nearer east, sets nearer west, and has a higher noon elevation. On September 23 the conditions observed on March 21 are repeated, the sun rising due east, setting due west, and being overhead at noon. Between September 23 and December 21, the sun rises each day farther south of east, and sets farther south of west, the farthest southern limits being

APPARENT MOVEMENT OF THE SUN 9

reached on December 21, when it is $66\frac{1}{2}^{\circ}$ above the horizon, which is the same elevation as on June 21, when the northern limit was reached. Between December 21 and March 21 every day sees the sun rising nearer east and setting nearer west, so that by the time the latter date is reached the sun once more rises due

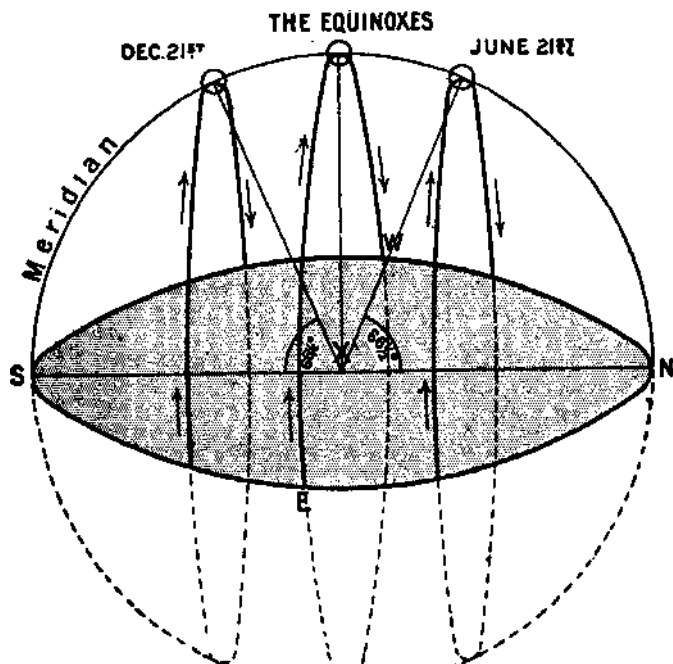


FIG. 4.—The apparent path of the sun at the equator at the solstices and equinoxes.

east, sets due west, and has an elevation above the horizon of 90° . One point must be noted, and that is, that on every day of the year at the equator, the sun rises and sets at the same time, i.e. 6 a.m. and 6 p.m. respectively.

10 THE MOVEMENTS OF THE EARTH

(2) AT LONDON.—The symbols used in Fig. 5 are the same as in Fig. 4, and since reference was made at the beginning of the chapter to the apparent movements of the sun in our own country, there is no necessity to go into detail again. The important points

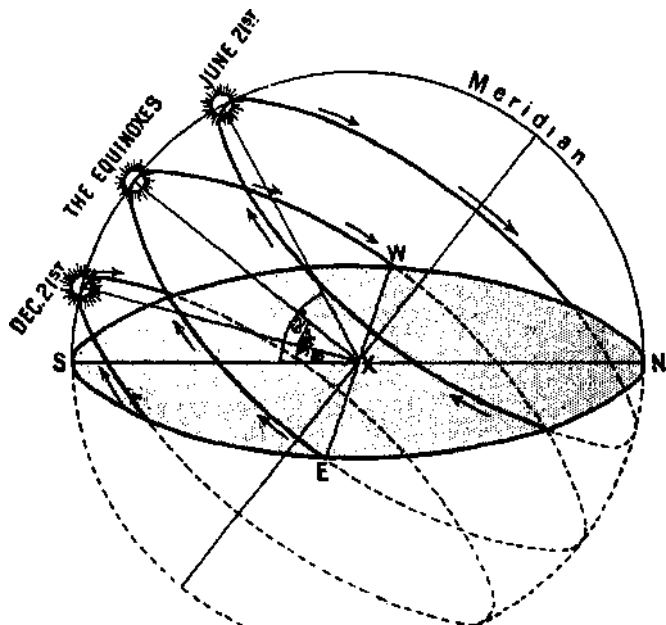


Fig. 5—The apparent path of the sun at London at the solstices and equinoxes.

to notice are (a) the long summer day, (6) the short winter day, (c) the similar conditions on March 21 and September 23.

(3) AT THE NORTH POLE.—Fig. 6 shows that on March 21 an observer at the poles would see the sun circle round the sky on the horizon. Between March 21 and June 21 it appears to circle round in the heavens,

APPARENT MOVEMENT OF THE SUN ii

gradually increasing in height, until on the latter day it reaches an elevation of $23\frac{1}{2}^{\circ}$. On each succeeding day the sun continues to circle the sky but is getting lower and lower, until, on September 23, it is once more on the horizon. But between September 23 and March 21 the sun cannot be seen at the North Pole, for it is below the horizon, reaching its lowest point on December 21. Thus we see that at the North Pole

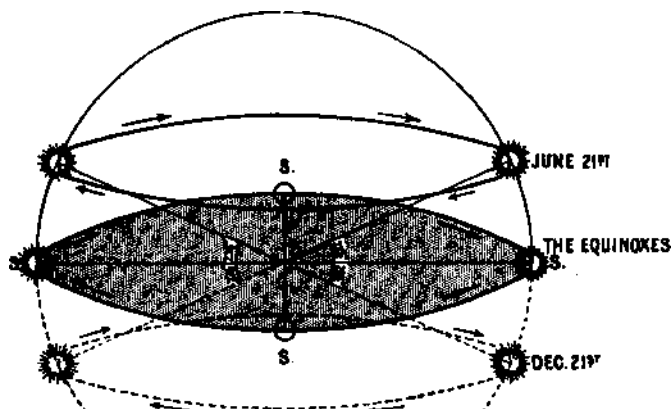


FIG. 6.—The apparent path of the sun at the North Pole at the solstices and equinoxes.

the sun never sets for six months, and never rises above the horizon for the same period. This is true at the South Pole, too, but the seasons are reversed. It must not be supposed that this means that the poles have six months light and six months darkness, for we must note that there is twilight until the sun reaches a certain distance below the horizon, and since the sun at the poles increases and decreases in height very slowly, twilight lasts for a whole month.

12 THE MOVEMENTS OF THE EARTH

HOW THE TROPICS, THE ARCTIC AND ANTARCTIC CIRCLES ARE FIXED.

We have learned that on June 21 the North Pole is tilted towards the sun, whilst on December 21 it is pointed away from the sun. It is this tilting of the earth's axis which causes the sun to be overhead at noon on June 21 as far north of the equator as $23\frac{1}{2}^{\circ}$ N. This is, naturally, what may be expected, for the earth's axis is inclined at that angle from the vertical. Similarly, on December 21, the sun is seen overhead at noon $23\frac{1}{2}^{\circ}$ S. of the equator (see Fig. 7). If, as

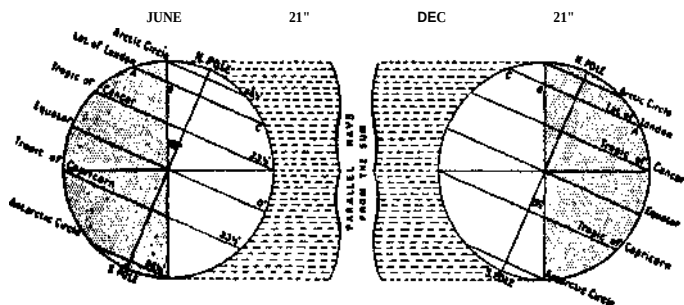


FIG. 7.—The position of the earth with regard to the sun at the solstices.

the earth rotates on its axis on these days, the sun were to trace on the earth a line along which it is seen overhead, we should have two circles which mark the northern and southern limits of the belt within which the sun can be seen overhead on certain days of the year. Thus we have the Tropics of Capricorn and Cancer fixed. The word "tropic" means a "turning point." Fig. 7 also shows that the rays of the sun fall $23\frac{1}{2}^{\circ}$ beyond the North Pole at the northern mid-summer and fall short of the South Pole by the same angle; whilst at the northern midwinter, the rays pass beyond the South Pole and fall short of the North Pole. In this way, the Arctic and Antarctic Circles are fixed.

THE EQUINOXES AND SOLSTICES.

On March 21 and September 21, when the rays reach both poles, the sun can be seen overhead at the equator, and every place has equal day and night, the sun rising at 6 a.m. and setting at 6 p.m. Therefore these days are called respectively, the *Vernal or Spring and Autumnal Equinoxes*. We have also seen that on June 21 the sun reaches the northern limit of its apparent migration into the northern hemisphere. This day is said to be the *Solstice*, which means, that the sun, as it were, stands still before its migration southwards, and since it is this apparent movement of the sun which causes summer, June 21 is called the *Summer Solstice*. Similarly, December 21 is known as the *Winter Solstice*.

EXERCISES.

1. (a) Keep a record of the noon height of the sun, if you have not done so in a lower form or class. Any sufficiently accurate instrument may be used. (6) Push a knitting-needle into a drawing-board and place the board where the sun's rays will fall upon it during school hours. Draw a line along the shadow every half-hour. From the lines so drawn, what can you learn about the height of the sun during the day? (c) By means of drawing-pins, fasten a piece of white cardboard to a drawing-board. Draw a circle of about four or five inches radius. Draw a diameter. Divide half of the circle into angles of 15° , and erect a knitting-needle at the point where each radius touches the circumference. By means of a cork-borer, obtain several pieces of cork about a quarter of an inch long and push these on the knitting-needles. The drawing-board must then be placed in a spot (best of all a window facing south) upon which the sun shines during school hours. At nine o'clock in the morning, turn the board so that the left knitting-needle and the centre of the circle are in a line with the sun. Push the cork down the needle until its shadow falls upon the centre of the circle. Repeat the process every hour, and at the end the small corks will give a representation of the path of the sun during the day. This may be repeated at other times, using different corks.

2. Draw diagrams similar to Figs. 4, 5 and 6 to show the apparent path of the sun at the solstices and equinoxes as seen by an observer at (a) the Arctic Circle, (6) the Tropic of Capricorn.

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3. Give in tabular form the height of the sun at noon on the days of the equinoxes and solstices at the poles, the Arctic and Antarctic Circles, London and the Equator. Arrange the table so as to give the dates on the left column and the places at the heads of columns.

4. Explain points of geographical interest in each of the following quotations-

- (a) The sun above the mast
Had fixed her to the Ocean.
- (b) The days grew longer and longer
Till they became as one.

5. What would be the effect (a) if the earth's axis were not tilted? (6) If the South Pole were always tilted towards the sun?

6. What are (a) the Tropics of Cancer and Capricorn, (b) the Arctic and Antarctic Circles?

CHAPTER III.

THE DISTRIBUTION OF TEMPERATURE.

TEMPERATURE is measured by means of the thermometer, and in English-speaking countries, except for scientific purposes, the Fahrenheit thermometer is in most general use, although continental countries use the Centigrade thermometer. On the former, freezing-point is 32° and boiling-point 212° , whilst on the latter these are 0° and 100° respectively. On the maps used in illustrating this chapter both scales are given.

The envelope of air which surrounds the earth can be heated in two ways; either from the earth itself, and we know that the interior of the earth has a very high temperature indeed, or from the sun. The amount of heat which the air derives from the heated interior of the earth is very small indeed, and this is illustrated by the fact that polar regions must have the same amount of heat from this source as equatorial regions, but we know that there are enormous differences between the temperature conditions in these areas. For all practical purposes we must confine our attention to the sun as the source of heat.

THE DISTRIBUTION OF INSOLATION.

Fig. 8 represents the earth, and A, B and C are bundles of sun's rays of equal width. It is clear that the nearer the rays fall to the equator, the greater is the angle at which they strike the earth, and the less the area which they have to heat. This is one reason why equatorial regions are warmer than polar regions. It is very

16 THE DISTRIBUTION OF TEMPERATURE

useful to use a term which expresses the amount of heat energy we receive from the sun. The term is *insolation*. The insolation for any day is the total amount of radiant energy received from the sun during that particular day. It is very important to notice that figures which give the amount of insolation at different latitudes

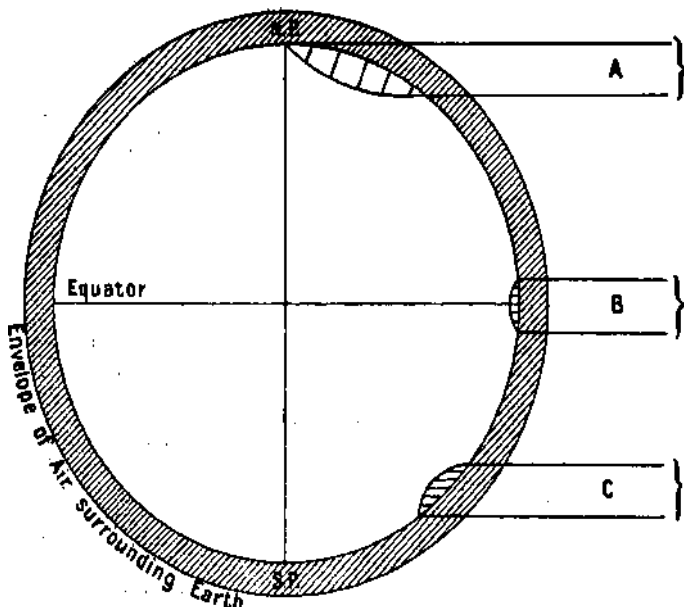


FIG. 8.—Diagram showing bundles of the sun's rays striking the earth's surface at different angles.

at certain times of the year, do not take into account the important facts that the earth is surrounded by an atmosphere, and that the land and sea surfaces of the globe differ very greatly in their power of heating and cooling. They do, however, take into account the length of time the sun is above the horizon.

It might be supposed that on June 21, when the sun is overhead at the northern tropic, insolation will be

greatest there. This is not so, for we must not forget that on that day, day and night are not of equal length as at the equinoxes, when the amount of heat received from the sun is greatest at the Equator, and decreases towards the poles. At the summer solstice, there is still equal day and night at the Equator, but as we go towards the North Pole the length of day increases, being 13 hrs. 56 min. in lat. 30° , and $18\frac{1}{2}$ hrs. in lat. 60° ; whilst regions within the Arctic Circle have a longest day varying from 24 hours to 6 months, according to their positions. Thus it is evident, that although the sun will be hotter at the Tropic of Cancer, it is longer in the sky in latitudes farther north, so that the total amount of radiant energy or insolation received is not very easy to calculate. If we let the insolation at the equator for the vernal equinox be represented by the number 1,000, that at different latitudes on June 21 is given in the following table :—

Latitude N.			
0°	881	50°	1105
10°	975	60°	1093
20°	1045	70°	1130
30°	1088	80°	1184
40°	1107	90°	1202

From these figures it will be seen that the insolation on June 21 is greater at the North Pole than at the Equator. But there are certain facts which must be pointed out, or a wrong impression might be gained. Firstly, the figures represent the total amount of insolation received during the whole day, and do not show the temperature *reached* during the day. We know that the polar regions do not attain the same temperatures as equatorial regions. Secondly, since the table imagines the earth to have no atmosphere, it does not take into account the loss of heat owing to absorption by the atmosphere. Thirdly, the figures do not allow for the fact that the earth has both land and

18 THE DISTRIBUTION OF TEMPERATURE

water surfaces, and that these affect the distribution of temperature very considerably. Let us first consider the influence of the atmosphere upon insolation.

THE INFLUENCE OF THE ATMOSPHERE ON INSOLATION.

Before they can reach the earth, the sun's rays have to pass through the air envelope which surrounds the earth to a height of some 200 miles. In passing through the atmosphere, the sun's rays must lose some heat even if the air were quite free from all impurities. But there are dust particles and water vapour in the air, and these absorb the sun's rays to such an extent that a large proportion of heat does not reach the earth. It will readily be seen that more heat will be absorbed by the atmosphere, the denser and thicker the envelope of air and the more dust and water particles that air contains. Fig. 8 shows that ray B has to pass through less air than those which fall obliquely (A and C), and therefore will not lose so much heat to the atmosphere. Therefore, since the sun's rays reach equatorial regions in a far less slanting direction than polar regions we have here another reason why the latter regions are colder. We shall now learn of the influence of land and water upon temperature.

THE INFLUENCE OF LAND AND WATER UPON TEMPERATURE.

Land and water do not take in heat at the same rates. If we heat a cubic foot of sand and the same quantity of water, we should find that the latter requires about twice as much heat to raise the temperature 1° as is required to raise the temperature of the sand by the same amount. On cooling, water gives out more heat than land. Again, the water in the ocean is in constant motion, so that the heat received from the sun is distributed, whereas rays falling on land heat only the

ALTITUDE AND TEMPERATURE

area on which they fall. Water is heated to a greater depth than land, and this is another reason why water takes longer to heat. In brief, we may say that the water surfaces of the earth take longer to heat in summer than the land surfaces, and cool at a slower rate in winter—that is, the oceans will be cooler than the continents in the same latitudes in summer, and warmer in winter (see Ex. 4 at the end of chapter). Lastly, let us turn to the influence of altitude upon temperature.

THE EFFECT OF ALTITUDE ON TEMPERATURE.

It has been seen that the atmosphere receives some heat from the rays of the sun as they pass through it. But only a small proportion of the heat received is acquired in this way. The sun's rays heat the surface of the earth, and by the process of radiation some of this heat is absorbed by the air. But the air is probably affected most by actually coming in contact with the earth, for it is easily heated by contact with something warmer than itself and cooled by something colder than itself. Thus the layers of air in contact with the earth are heated, and becoming lighter than the surrounding air, are displaced by the latter and forced to rise. The air which now comes in contact with the earth is warmed, and in its turn is compelled to rise. The ascending particles of air lose some of their heat to the air with which they come into contact. In this way the whole of the lower layers of the atmosphere are gradually warmed. Since the air is largely heated by contact with the earth, it is natural that the temperature falls as altitude increases. But this does not fully explain why it is colder on the top of a mountain than at its base, for the air at the summit is as near the ground as the air at the base. The question of pressure comes in here, and although we shall speak of atmospheric pressure in the next chapter we can now mention that air pressure decreases as sea-level is left behind.

20 THE DISTRIBUTION OF TEMPERATURE

As the air at high altitudes is not so dense as near sea-level, and is freer from water vapour and dust, it follows that the amount of insolation reaching the surface is greater than at sea-level. But for the same reasons the heat is very quickly radiated to the atmosphere, and the ground cannot retain its temperature for long. The total effect is to lower the temperature on mountains or plateaux.

The rate at which the temperature falls varies very much according to the place and season, but it may be taken as about 1° F. for 300 feet of ascent (see Ex. 3 at the end of this chapter). We have now covered all the points which will help us to understand the temperature maps of the world. Before studying them, however, let us just put together, from what we have learned, the causes which make summer warmer than winter.

WHY IT IS WARMER IN SUMMER THAN IN WINTER.

Fig. 7 shows that the North Pole is tilted towards the sun in June, and away from the sun in December. This not only gives us longer days in summer, but causes the sun to be higher in the sky in summer than in winter. Thus it is warmer in summer than in winter, for these reasons—

(1) The amount of insolation is greater, partly on account of the greater angle at which the sun's rays are received, and partly because the days are longer. (2) Less heat is absorbed as the sun's rays pass through the air. The lines A, B, C, in Fig. 7, represent the latitude of London, and the thickened rays are those which reach this latitude at June 21 and December 21. It will be seen that the summer ray reaches the latitude of London in a less slanting direction and passes through less air in June than in December. Notice the parts of the lines A, B, C, which are in the unshaded portion of the diagrams. These represent the relative length of days in June and December. It is at once

evident that the tilting of the earth's axis gives to London a longer day in summer and therefore more heat.

Temperature distributions are shown by means of *isotherms*, which may be defined as lines along which the temperature is everywhere the same. The method of drawing isotherms is illustrated in Ex. 1 at the end of this chapter. It is very important to notice that most isothermal maps are reduced to sea-level. Temperature varies with elevation, and therefore it is necessary to correct the thermometer readings at each station to what they would be at sea-level, if we wish to learn from the map the effects upon temperature of causes other than elevation.

TEMPERATURE MAPS OF THE WORLD.

Figs. 9, 10 and 11 show the mean sea-level temperatures for April, January and July. April (or October) is the best month for showing the temperature conditions when the maximum temperature is near the equator. January and July maps give the distribution of temperature in the winter and summer months of temperate latitudes. Theoretically, Figs. 9, 10 and 11 should be made for the days of the vernal or spring equinox and the solstices, but there is what may be described as a "lagging of the seasons," which must be taken into account.

Some isotherms are of greater importance than others; for example, the summer isotherm of 50° F. approximately marks the poleward limit of trees, for the latter cannot thrive unless this temperature is reached during at least one month. On Figs. 9, 10 and 11 the isotherms of 32° , 50° , 68° and 86° F. have been inserted. In order to bring out more clearly the great winter cold of the Eurasian land mass, other isotherms have been added to the January map.

APRIL TEMPERATURES.—Fig. 9 shows the **April** temperatures reduced to sea-level. It will be seen that

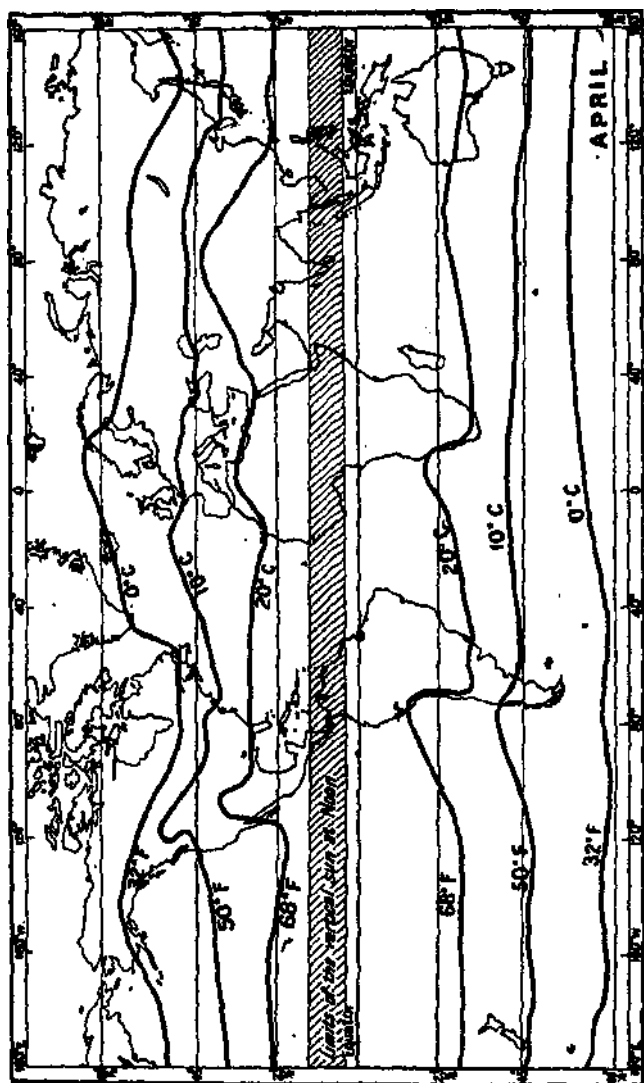


FIG. 9.—Mean sea-level temperatures for April.

TEMPERATURE MAPS OF THE WORLD 23

the region of greatest heat lies in equatorial regions, and that the temperature decreases gradually as the poles are approached. The isotherm of 50° follows very roughly the parallels of latitude 45° N. and S. The explanation of this general distribution of temperature is found in the fact that this map is made for a month immediately following the spring equinox, so that we should expect temperatures to decrease gradually from the equator to the poles.

JANUARY TEMPERATURES.—This map shows that the heat belt has migrated southwards with the sun, for the latter is overhead at noon on December 21 at the Tropic of Capricorn. The hottest belt is distinctly south of the equator, for it is in the summer season in the southern hemisphere. The highest temperatures (over 86°) are to be found over the land masses, on account of the fact that the temperature of land rises more quickly than that of water. The isotherm for 50° almost keeps parallel to the lines of latitude, and the reason for this should be apparent, as it is almost entirely over water. As a contrast, the isotherms for the northern hemisphere show a most marked bend southwards on the west of continents, and northwards on the east of continents, whilst over the land masses themselves they bend southwards. The isotherm for 32° F. gives the best illustration of this. This irregularity is accounted for partly by the unequal heating of land and water, and partly by ocean currents. With regard to the effect of the latter, we shall make fuller reference in Chapter V, but one other example of their influence on temperature may be pointed out now. In both January and July, the isotherms of the southern hemisphere bend northwards off the west coasts of land masses and southwards off their eastern shores. The reason for this is, that cold currents flow northwards along their western shores, and warm currents flow southwards along their eastern margins.

The coldest region is in Northern Siberia, where there is an area which has been called the "cold pole,"

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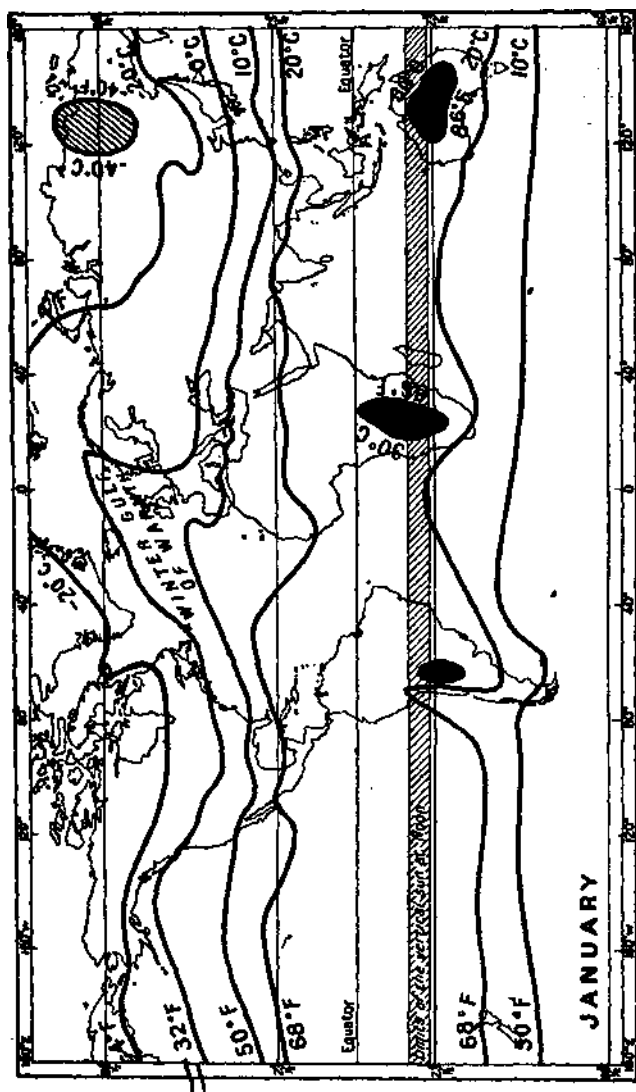


FIG. 10.—Mean sea-level temperatures for January.

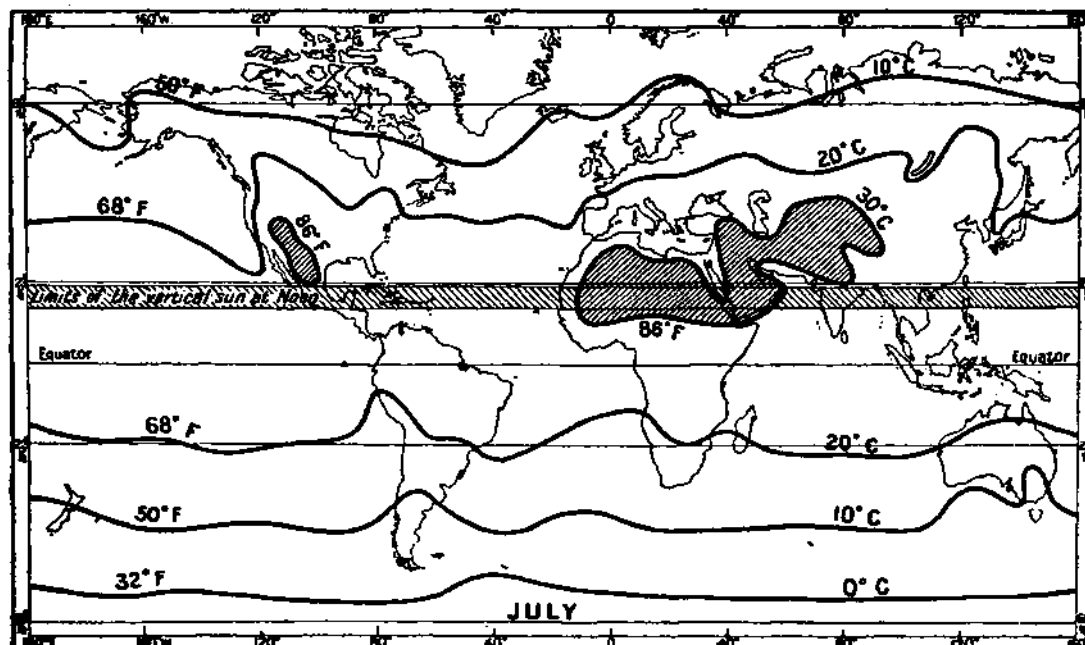


FIG. II.—Mean sea-level temperatures for July.

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whose temperature is below -48° F. A vast area of Eurasia has a temperature below freezing-point. So great is the land mass that this temperature is experienced within 3° of the Tropic of Cancer. The interior lands of North America are also very cold, but since the land area is not so great as in the old world, the temperatures are relatively not so low.

JULY TEMPERATURES.—Fig. 11 shows the temperature for July, when it is evident that the heat belt has migrated into the northern hemisphere, where the highest temperatures are seen to be over the land masses. Since the latter are warmer than the oceans in the same latitudes, the isotherms of the northern hemisphere bend northwards over the land. Over Asia, the isotherm of 68° F. reaches within 7° of the Arctic Circle. The southern hemisphere shows a more equable distribution of temperature south of the equator, due to the great extent of ocean.

EXERCISES.

1. On two outline maps of the British Isles plot the positions of the stations used (or the reports of the Meteorological Office. On one map print by the side of each station the mean temperature for January, as given in Appendix 1 of the D.W.R. On the other do the same for July. Then draw the isotherms for every even number of degrees (*i.e.* 38° , 40° , 42° F., etc., for January, and 56° , 58° , 60° F., etc., for July).

2. Draw a map of the coast-lines of the North Atlantic Ocean, and on it mark the January isotherm of 32° F. Shade the area which has a temperature of over 32° F. The great gulf-like tongue of warmer water off the West of Europe is sometimes called "The Winter Gulf of Warmth."

3.

Place.	Height in feet above sea.	Jan. temp.	July temp.
Fort William . Ben Nevis summit .	S.L. 4,400	$38^{\circ}7'$ F. $23^{\circ}4'$ F.	$57^{\circ}1'$ F. $41^{\circ}7'$ F.

Find these places on the map. Account fully for their differences in temperature.

EXERCISES

4.

Place.	Jan. temp.	July temp.	Range of temp.
Cambridge .	37-6° F.	61'5° F.	23'9 ⁰ F.
Berlin .	31'3° F.	64'5° F.	33'2' F.
Warsaw • •	23'9 ⁸ F.	65'5° F.	41'6° F.
Saratof. • •	13'5° F.	71'0° F.	57'5 ⁰ F.

These places are in approximately the same latitude. Account for the different temperature conditions shown by the figures.

5. On outline maps of the Old World north of the equator mark the isotherms for January and for July. Shade the maps so as to emphasize cold in winter and heat in summer. Write short accounts bringing out the leading features shown by the maps.

6. On outline maps of the southern hemisphere draw the isotherms for January and for July. Shade the map as suggested in Exercise 5. State the chief differences between the distribution of temperature in Eurasia and North Africa and in the southern hemisphere.

7. Why is it warmer in equatorial regions than in polar regions? Draw diagrams to illustrate your answer.

CHAPTER IV.

THE PRESSURE OF THE ATMOSPHERE AND ITS INFLUENCE ON WINDS.

IN previous chapters we have learned that the earth is surrounded by an air envelope. It is known that this extends to a height of about 200 miles from the earth's surface, and that the higher we go the lighter the air becomes. Since we know that air has weight, it follows that it exerts a pressure upon the surface of the earth, and that this pressure will be greater at sea-level than on the top of a high mountain, for there is not so much air above the latter as there is above a place at sea-level. Air pressure is measured by means of the barometer. A barometer consists of a glass tube which is closed at one end. This tube is filled with mercury, inverted, and the open end placed into a cup of mercury. The mercury column then falls a little, and some of the mercury runs back into the cup, leaving in the tube a column about thirty inches high.

When the air pressure upon the surface of the mercury in the cup is increased, the column is pushed higher up the tube; but if the air pressure decreases mercury flows from the tube to the cup, and the height of the column is decreased. Thus it is seen that when the column stands at a height of 30 inches the pressure of the atmosphere is equal to that of a layer of mercury 30 inches deep. It is usual to express the pressure of the atmosphere in inches or millimetres of mercury, and the normal pressure at sea-level is about 29.9 inches or 760 millimetres. It is more scientific, however, to use a pressure unit, hence the increasing use of the terms *bar*

and *millibar* (see Exercise 7 at the end of this chapter). When the pressure is more than 29.9 inches **or 1012.5** millibars we speak of it as being "high," and when it is below this we speak of it as being "low." Since we know the density of mercury it is easy to calculate that this pressure is equal to one of 14.7 pounds per square inch.

PRESSURE AND ALTITUDE.

We have seen that the air extends to a height of about 200 miles, but at that height it is extremely rare. Since the upper layers of air press upon the lower layers, the latter are denser and therefore heavier, for the particles of air are closer together. If a barometer were carried up the sides of a high mountain it would be found that the reading would continually fall, and that at an elevation of 900 feet from sea-level the reading would be one inch less than at sea-level. To cause a fall of another inch, however, we should have to make an ascent of more than 900 feet, because, as we are now increasing our elevation, the air is less dense than it was at lower levels. At an elevation of 3½ miles the pressure is only about half what it is at sea-level, so that half of the atmosphere would be below that elevation; whilst at a height of seven miles we should have three-fourths of the atmosphere below us.

So rarefied is the atmosphere at great elevations that it is very difficult to breathe sufficient air for the wants of the body. Some men and animals have become accustomed to living at great elevations; but it is a well-known fact that travellers *unaccustomed* to living in high altitudes find great difficulty in breathing, and even at lower levels, suffer from headaches, dizziness and sickness. It will readily be seen that barometer readings can be used for determining roughly the heights of mountains.

PRESSURE AND WINDS.

If the pressure at any place is high, and that of the surrounding area low, air flows outwards from the higher

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pressure towards the lower. Air always flows from places of high pressure towards places of low pressure. But this statement requires some modification, for the rotation of the earth causes winds to be deflected to the right in the northern hemisphere, and to the left in the southern hemisphere. Pressures are represented by means of *isobars*, or lines along which the pressure is everywhere the same (see Ex. I on p. 40). Fig. 12 A shows an area of high pressure surrounded by lower

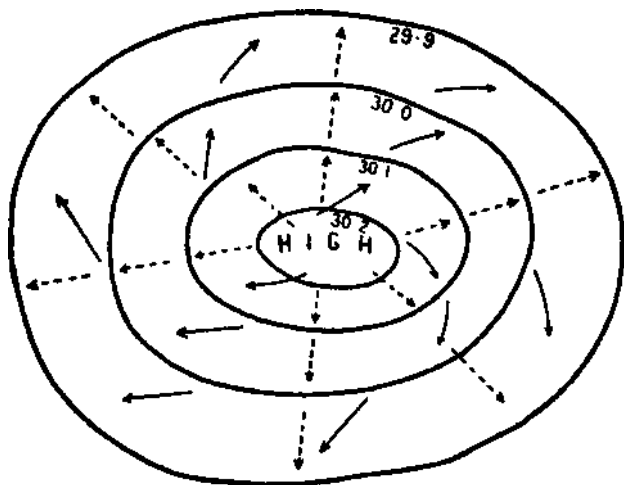


FIG. 12 A.—The relation between pressure and winds.

pressure, and if the earth stood still winds would flow outwards as indicated by the dotted arrows. If this represents a pressure system in the northern hemisphere the actual winds will be as shown by the straight-lined arrows. This law of the deflection of winds to the right in the northern hemisphere, and to the left in the southern hemisphere, due to the earth's rotation, is known as *Ferrers Law*. It must be noted that rivers are also influenced, but not nearly to the same extent as the lighter, easily influenced air currents.

PRESSURE AND WINDS

A full explanation of this deflection cannot be entered into here, but it may be illustrated in several ways.

Push a knitting-needle through the centre of a card-board disc, and rotate the disc from right to left. From the centre of the disc allow an inked marble to run towards the edges, and then notice its track. The marble does not reach the point originally aimed at, but is deflected to the right. This illustrates the deflection of a northern hemisphere air current moving equatorwards, for the edge of the disc represents the equator, and the centre the North Pole. If the disc be rotated from left to right the deflection is then to the left, and this illustrates the deflection of air currents

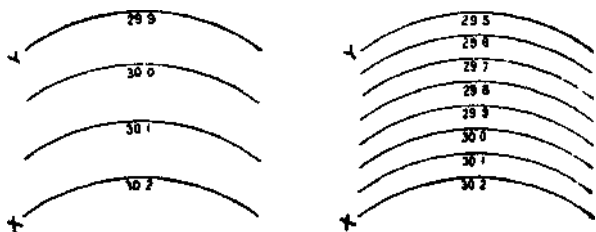


FIG. 12 B.—Steep and less steep gradients.

moving from the South Pole towards the equator from the standpoint of a person looking down upon the South Pole. The deflection of currents moving equatorwards can also be shown as follows: Rotate a globe in the same direction as the earth's rotation, *Le.* from west to east. Whilst the globe is turning round, by means of a piece of chalk, try to draw due north and south lines. Draw several for each hemisphere, taking care that each line is drawn towards, and not away from, the equator. Stop the globe, and it will be seen that the lines show deflection, as stated in Ferrel's Law. Currents moving polewards are also deflected to the right in the northern hemisphere, and **to the left in the southern hemisphere.**

There is one more point to which **reference** must be

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EDITOR'S INTRODUCTION

THE time has gone by when it was thought possible that a textbook of geography should be equally suitable for pupils at different stages of advancement, so that a series of books suited to different stages is necessary for use in schools. Regions may be studied in different orders suited to different circumstances and aims, and, to be entirely satisfying, each scheme of study should have a special series of books. The series, of which this book forms one, is designed to fit a particular scheme—i.e. that in a secondary school in the years at the end of which is one of the First Public Examinations of the type of the London General School Examination, a scheme which has for many years been found in practice to be extremely satisfactory at the William Ellis School.

Three of the volumes cover the world regionally in three years; the fourth contains much of the preceding matter in a condensed form, together with a few additions on subjects which are more profitably studied after other work has been done. Account is taken of the fact that the pupils are advancing in ability, so that, while there is a certain uniformity in that each book provides a north and south section of the world, yet the arrangement is such that the matter increase in difficulty. The series supplies textbooks for a complete school course in geography which includes physical as well as regional geography, and the order in which regions are taken depends to some extent on the desirability of studying particular sections of physical geography in a suitable order.

After the Americas in Book I, Asia and Australasia are selected for treatment in Book II. Here the geography of man is much more complicated, and the related physical geography, including, as it does, such phenomena as monsoons, necessitates the study of more climatic material than is found in Book I. At the same time the fact that the volume treats of a north and south section of the world allows of revision of previous work by comparison and contrast.

JAMES FAIRGRIEVE.

PREFACE

THIS book is the second of a series of four intended to cover the geography course for the four years leading up to and including the year in which an examination of matriculation standard is taken. From the very earliest years of teaching reference is constantly being made to matters pertaining to climate. The writer has found from experience that pupils who have arrived at this age are particularly interested in the meteorological side of geography, and are old enough and sufficiently advanced to draw together and organize, as well as to add to, previous teaching. Therefore the first seven chapters are designed to accomplish this, and to show in a clear and simple manner the broad connections existing between temperature, pressure and winds, rainfall, etc., and to carry these connections one step farther by showing the influence of all upon the distribution of natural vegetation. More difficult matters, such as the study of the Daily Weather Report and the division of the world into its major natural regions, are left for full consideration at a later stage. Chapters VIII to XVIII deal with the regional geography of Asia, and whilst the work covered in the earlier chapters is illustrated and emphasized in a concrete manner, the treatment is not unduly biased, and the method follows broad lines. The remaining chapters are devoted to Australasia, in studying which it is possible, not only to test whether the principles already learned have been understood, but also to note the differences that occur through its position in the southern hemisphere as contrasted with the situation of Asia north of the equator.

At the end of each chapter there will be found a number of questions and exercises. They are designed to test the pupil's powers of assimilation and originality; and of course it is not intended that answers should be *written* to all, nor are they by any means the only suitable exercises which may be set.

Teachers will find Book II, the *New Regional Map Books*, by V. C. Spary, B.Sc., published by the University of London Press Ltd. (price *is.*) of considerable value for use with this book.

As the author is a Divisional Inspector of Schools under the London County Council, the rules of that Authority make it necessary for him to state that the Council is in no way responsible for the book or for any of the statements in it.

L. B.

**44 Wildwood Road,
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BOOK II

ASIA AND AUSTRALASIA

CHAPTER I.

THE EARTH AS A GLOBE.

LONG before the birth of Christ men believed that the earth was a sphere, and in support of their views put forward some of the arguments with which we are now so familiar. But during the Middle Ages, and right up to the time of Columbus, the most absurd views of the earth's shape were held. Sailors believed that the earth was like a shield, and that if they arrived at the edge, their vessels would fall off into space. It was the voyage of Columbus which compelled men to pay more attention to the older and truer notions of the earth's shape.

Over three hundred years before the Christian Era, it was noticed that when the earth came between the sun and the moon, thus causing the shadow of the earth to be cast on the moon, the edge of the shadow was always part of a circle. Cones, cylinders and bodies shaped like a penny can be made to cast circular shadows in some positions, but the only body which casts a circular shadow *in all positions* is a sphere.

Early in the first century, sailors had already noticed that as they approached land, the latter was first visible from the top of the mast. We now generally state this

from the standpoint of an observer looking out to sea, from which point of view the mast becomes visible first, and later, the hull. Again, the horizon, as seen from the deck of a ship, is circular in shape, and if you climb high up the mast, the horizon still remains circular, but its distance from the ship has increased. The same would be noticed on land, but it is not so easy to see the circular horizon, owing to the hills, trees and buildings. Many other reasons for believing that the earth is spherical, or nearly so, could be given, but since they are mainly the result of somewhat complicated observations by astronomers and mathematicians, it will not be necessary to discuss them here. One very simple fact, which proves that the earth cannot be flat, should be mentioned. A ship can leave Liverpool, sail westwards across the Atlantic Ocean, pass through the Panama Canal, and continue its journey across the Pacific Ocean. It can return to Liverpool *via* the Red Sea, the Sue/ Canal and the Mediterranean, after having sailed round the world. If there were no land masses to interfere, it would be possible for our ship to sail round the world on any parallel of latitude.

Scientific men have determined for us not only the shape, but the size of the earth. We know that it is not quite spherical, and that it is very slightly flattened at the poles. This flattening is so slight that an observer would not be able to detect it on the largest of artificial globes made to scale, for the polar diameter is only 26 miles less than the equatorial diameter. The circumference of the earth is rather less than 25,000 miles, and the diameter nearly 8,000 miles.

So far as we know, the first attempt at measuring the size of the earth was made by a Greek named Eratosthenes, who lived about 200 years before the birth of Christ. At Syene, now Assuan, there was a very deep well, and noticing that the image of the sun could be seen on midsummer day at the bottom of the well, he came to the conclusion that on that day the sun was overhead, and therefore the place was on the Northern

Tropic. Eratosthenes lived at Alexandria, and he set himself the task of finding out what was the angular difference between the height of the sun on midsummer day at Syene and at Alexandria. By observations at Alexandria he found that this difference was $7^{\circ} 12'$. The next thing he required was the linear distance between

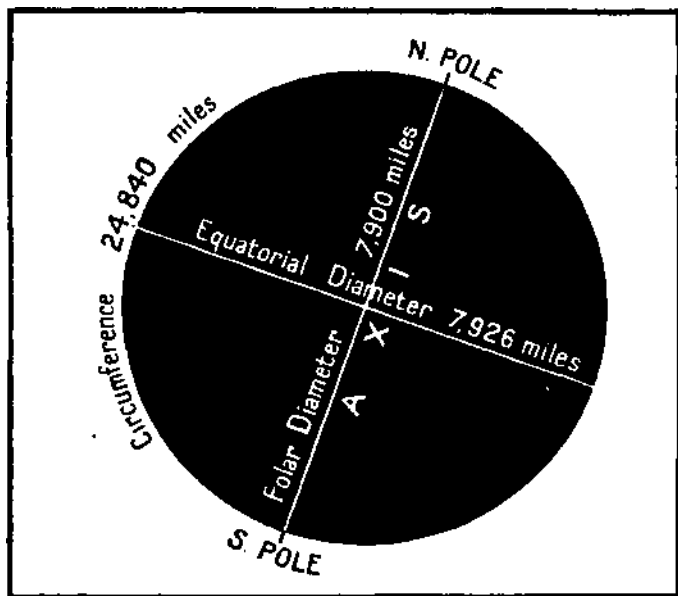


FIG. I.—Diagram illustrating some earth measurements.

Alexandria and Syene, and since even in those early days there was a good system of land survey in the Nile Valley owing to the annual floods, he had no great difficulty in obtaining this. He found the distance required was 5,000 stadia, which is 500 miles. Then he reasoned that, since a distance of 5,000 stadia subtended an angle of $7^{\circ} 12'$, the circumference of the world must

THE EARTH AS A GLOBE

be as many times 5,000 stadia as $7^{\circ} 12'$ are contained in 360° . Thus he calculated:—

$$\begin{aligned}\text{The world's circumference} &= \frac{360}{7^{\circ} 12'} 12' \times 5,000 \text{ stadia} \\ &= 250,000 \text{ stadia,} \\ &= 25,000 \text{ miles (10 stadia = 1 mile).}\end{aligned}$$

Many faults can be found in this calculation. For example, a map will show that the two towns are not on the same meridian; Syene is not quite on the Tropic of Cancer, whilst the distance from Syene to Alexandria is not exactly 5,000 stadia. Despite these drawbacks, this first measurement is very interesting.

GLOBES AND MAPS.—Since the earth is a spheroid, *i.e.*, a sphere slightly flattened at the poles, you will readily understand that the only correct representation of any part of its surface is that which we have on an artificial globe. You must have noticed how the shape of any large country or continent differs on different maps. The only correct map must be on a curved surface, for it represents a part of the curved surface of the earth, and therefore all flat maps are wrong in some respect. It is very necessary that constant reference should be made to a globe in order that wrong impressions derived from flat maps may be corrected.

CHAPTER II

THE MOVEMENTS OF THE EARTH AND THEIR RESULTS.

THE APPARENT MOVEMENTS OF THE SUN.

ALTHOUGH in this chapter we shall discuss the movements of the earth, we shall first of all learn something of the apparent movements of the sun as seen in our own country from our standpoint as spectators. If the height of the sun is measured each day at noon (see Ex. 1),¹ it will be found that its height above the horizon changes a little from day to day. If the path which the sun appears to take in its journey across the heavens is noted, it will be discovered that every day the sun gets higher and higher between sunrise and noon, at the same time appearing to move from the east towards the south. When it is due south, about noon, it is also highest in the sky. During the afternoon the sun sinks lower and lower, at the same time moving westwards. If these observations are made throughout the year, it will be seen that the sun is lowest in the sky at noon about December 21, and highest about June 21, but that it is always seen in the south about twelve o'clock. If we note the point of the compass at which the sun appears to rise, we shall find that in winter it is south-east, on March 21 due east, in summer north-east, and on September 21 due east. In winter the sun appears to set south-west, on March 21 due west, in summer north-

¹ The observations suggested are best carried out in the lower forms, but in case this has not been done, it is advisable to take them at this stage.

6 THE MOVEMENTS OF THE EARTH

west, and on September 21 due west once more. If we could see the sun at midnight it would be in the north, but since it is below the horizon we cannot see it.

THE CAUSE OF NIGHT AND DAY.

We must now explain why it is that the sun appears to make these movements. This is very simple when we realize that it is not the sun which moves, but the earth. We imagine that the earth rotates on its axis, a line passing through the earth from pole to pole. It takes the earth one day to make a complete rotation on its axis. This turning of the earth on its axis is, of course, the cause of day and night, for only half the globe can receive the sun's rays at once. The earth rotates from west to east, so that as each place comes into the light the sun appears to rise in the east. Further turning causes the sun to appear higher and higher, and to reach its greatest height about noon. After noon the continued rotation causes the sun to become lower and lower, and finally to set in the west.

THE CAUSE OF THE SEASONS.

But the earth has another motion: it makes a yearly revolution round the sun. This is illustrated in Fig. 2, which represents a tub filled with water. The water surface represents the *plane of the ecliptic*, that is, the plane in which the earth moves during its revolution round the sun. Two balls are placed on the water, one to represent the earth and the other the sun. The former is moved round the sun-ball, and its path represents the orbit of the earth.

Fig. 2 shows that needles have been passed through the earth-ball to represent the axis, and it will be seen that these are not vertical; they have been inserted so as to make an angle of $66\frac{1}{2}^{\circ}$ with the surface of the water, for the earth's axis is inclined to the plane of its orbit at that angle. We must also observe that the axis

points in the same direction during the whole period of the earth's yearly revolution round the sun. Fig. 3

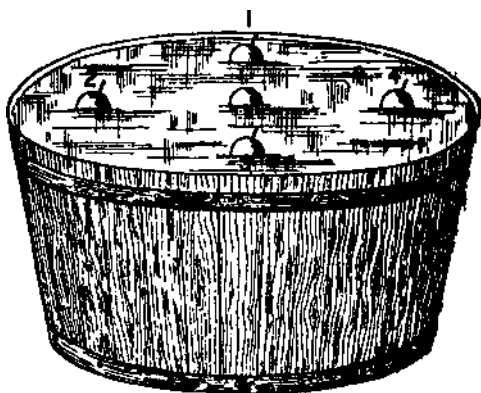


FIG. 2.—This diagram illustrates the revolution of the earth. illustrates the position of the earth with regard to the sun on certain days of the year, the unshaded area

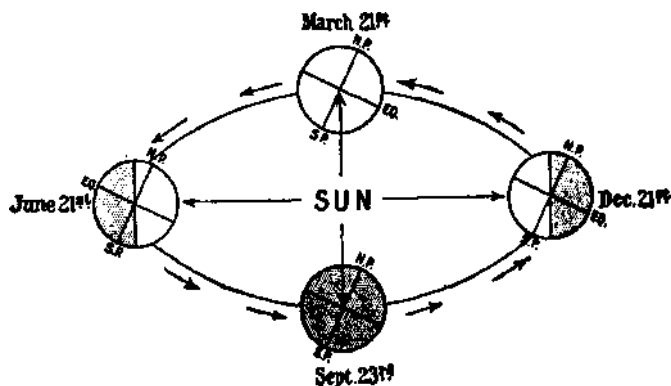


FIG. 3.—Diagram showing the position of the earth with regard to the sun at the equinoxes and solstices.

representing that part of the earth reached by the rays of the sun. It will be seen that on June 21 the northern

8 THE MOVEMENTS OF THE EARTH

end of the earth's axis, *i.e.*, the North Pole, is tilted *towards the sun* and *away from it* on December 21, so that on June 21 the sun's rays pass $23\frac{1}{2}^{\circ}$ beyond the North Pole, and fall short of the South Pole by the same angle. These conditions are reversed on December 21. On March 21 and September 23, the earth is illuminated from North to South Poles, so that the sun's rays reach the poles, but do not pass beyond them.

Now this yearly revolution of the earth round the sun is the cause of the seasons. In the next chapter we shall learn that the more overhead the rays of the sun strike the earth's surface, the warmer is the temperature*. The revolution of the earth round the sun causes the sun's rays to strike the same place at different angles at different times, and thus we have the seasons.

THE APPARENT MOVEMENT OF THE SUN IN DIFFERENT LATITUDES.

(1) AT THE EQUATOR.—Fig. 4 is a diagram which shows the apparent path of the sun at different times of the year. The point *x* represents the position of the observer, his horizon being shown by the ellipse. On March 21 the sun rises due east at six o'clock in the morning, and gradually gets higher and higher, until at noon the observer at *x* would see the sun immediately overhead. At six o'clock in the evening it sets due west. From March 21 to June 21 the sun appears to rise every day a little farther north of east, and to set a little farther north of west, whilst at the same time the elevation at noon decreases. On June 21 this northward movement ends, and on each successive day the sun rises nearer east, sets nearer west, and has a higher noon elevation. On September 23 the conditions observed on March 21 are repeated, the sun rising due east, setting due west, and being overhead at noon. Between September 23 and December 21, the sun rises each day farther south of east, and sets farther south of west, the farthest southern limits being

APPARENT MOVEMENT OF THE SUN 9

reached on December 21, when it is $66\frac{1}{2}^{\circ}$ above the horizon, which is the same elevation as on June 21, when the northern limit was reached. Between December 21 and March 21 every day sees the sun rising nearer east and setting nearer west, so that by the time the latter date is reached the sun once more rises due

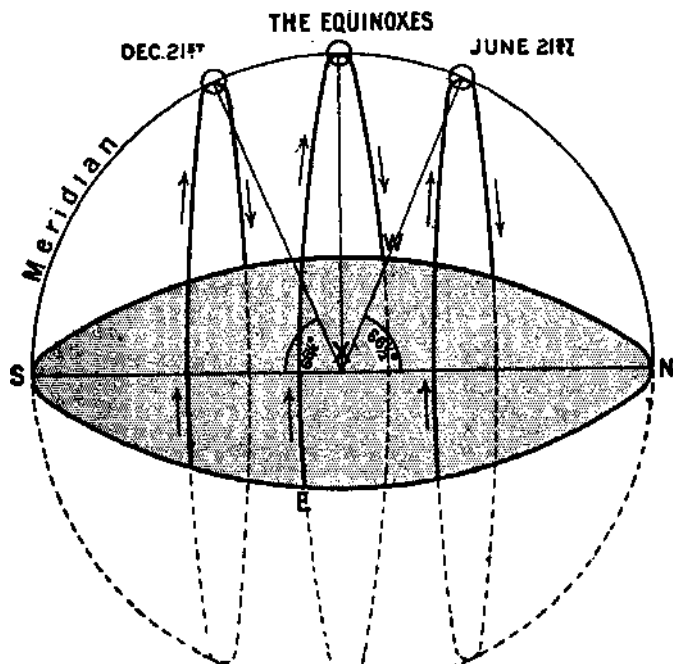


FIG. 4.—The apparent path of the sun at the equator at the solstices and equinoxes.

east, sets due west, and has an elevation above the horizon of 90° . One point must be noted, and that is, that on every day of the year at the equator, the sun rises and sets at the same time, i.e. 6 a.m. and 6 p.m. respectively.

10 THE MOVEMENTS OF THE EARTH

(2) AT LONDON.—The symbols used in Fig. 5 are the same as in Fig. 4, and since reference was made at the beginning of the chapter to the apparent movements of the sun in our own country, there is no necessity to go into detail again. The important points

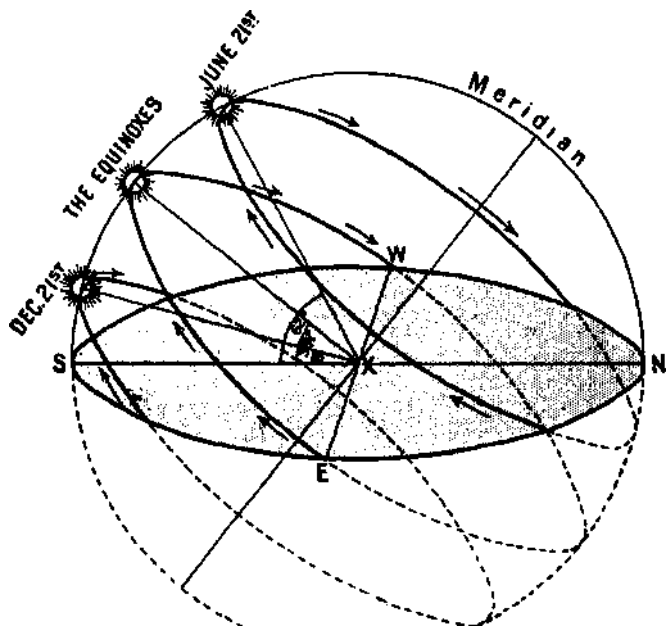


Fig. 5—The apparent path of the sun at London at the solstices and equinoxes.

to notice are (a) the long summer day, (6) the short winter day, (c) the similar conditions on March 21 and September 23.

(3) AT THE NORTH POLE.—Fig. 6 shows that on March 21 an observer at the poles would see the sun circle round the sky on the horizon. Between March 21 and June 21 it appears to circle round in the heavens,

APPARENT MOVEMENT OF THE SUN il

gradually increasing in height, until on the latter day it reaches an elevation of $23\frac{1}{2}^{\circ}$. On each succeeding day the sun continues to circle the sky but is getting lower and lower, until, on September 23, it is once more on the horizon. But between September 23 and March 21 the sun cannot be seen at the North Pole, for it is below the horizon, reaching its lowest point on December 21. Thus we see that at the North Pole

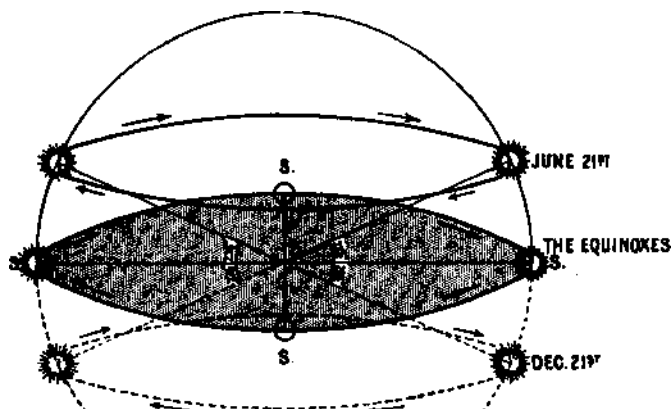


FIG. 6.—The apparent path of the sun at the North Pole at the solstices and equinoxes.

the sun never sets for six months, and never rises above the horizon for the same period. This is true at the South Pole, too, but the seasons are reversed. It must not be supposed that this means that the poles have six months light and six months darkness, for we must note that there is twilight until the sun reaches a certain distance below the horizon, and since the sun at the poles increases and decreases in height very slowly, twilight lasts for a whole month.

12 THE MOVEMENTS OF THE EARTH

HOW THE TROPICS, THE ARCTIC AND ANTARCTIC CIRCLES ARE FIXED.

We have learned that on June 21 the North Pole is tilted towards the sun, whilst on December 21 it is pointed away from the sun. It is this tilting of the earth's axis which causes the sun to be overhead at noon on June 21 as far north of the equator as $23\frac{1}{2}^{\circ}$ N. This is, naturally, what may be expected, for the earth's axis is inclined at that angle from the vertical. Similarly, on December 21, the sun is seen overhead at noon $23\frac{1}{2}^{\circ}$ S. of the equator (see Fig. 7). If, as

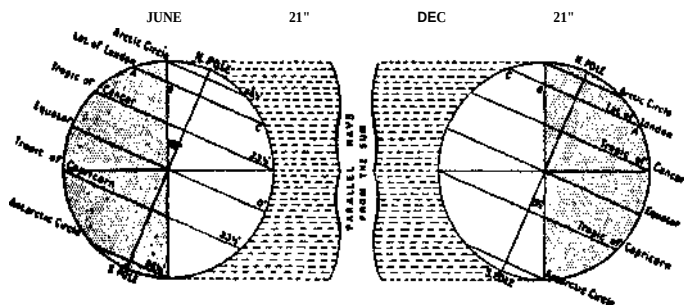


FIG. 7.—The position of the earth with regard to the sun at the solstices.

the earth rotates on its axis on these days, the sun were to trace on the earth a line along which it is seen overhead, we should have two circles which mark the northern and southern limits of the belt within which the sun can be seen overhead on certain days of the year. Thus we have the Tropics of Capricorn and Cancer fixed. The word "tropic" means a "turning point." Fig. 7 also shows that the rays of the sun fall $23\frac{1}{2}^{\circ}$ beyond the North Pole at the northern mid-summer and fall short of the South Pole by the same angle; whilst at the northern midwinter, the rays pass beyond the South Pole and fall short of the North Pole. In this way, the Arctic and Antarctic Circles are fixed.

THE EQUINOXES AND SOLSTICES.

On March 21 and September 21, when the rays reach both poles, the sun can be seen overhead at the equator, and every place has equal day and night, the sun rising at 6 a.m. and setting at 6 p.m. Therefore these days are called respectively, the *Vernal or Spring and Autumnal Equinoxes*. We have also seen that on June 21 the sun reaches the northern limit of its apparent migration into the northern hemisphere. This day is said to be the *Solstice*, which means, that the sun, as it were, stands still before its migration southwards, and since it is this apparent movement of the sun which causes summer, June 21 is called the *Summer Solstice*. Similarly, December 21 is known as the *Winter Solstice*.

EXERCISES.

1. (a) Keep a record of the noon height of the sun, if you have not done so in a lower form or class. Any sufficiently accurate instrument may be used. (b) Push a knitting-needle into a drawing-board and place the board where the sun's rays will fall upon it during school hours. Draw a line along the shadow every half-hour. From the lines so drawn, what can you learn about the height of the sun during the day? (c) By means of drawing-pins, fasten a piece of white cardboard to a drawing-board. Draw a circle of about four or five inches radius. Draw a diameter. Divide half of the circle into angles of 15° , and erect a knitting-needle at the point where each radius touches the circumference. By means of a cork-borer, obtain several pieces of cork about a quarter of an inch long and push these on the knitting-needles. The drawing-board must then be placed in a spot (best of all a window facing south) upon which the sun shines during school hours. At nine o'clock in the morning, turn the board so that the left knitting-needle and the centre of the circle are in a line with the sun. Push the cork down the needle until its shadow falls upon the centre of the circle. Repeat the process every hour, and at the end the small corks will give a representation of the path of the sun during the day. This may be repeated at other times, using different corks.

2. Draw diagrams similar to Figs. 4, 5 and 6 to show the apparent path of the sun at the solstices and equinoxes as seen by an observer at (a) the Arctic Circle, (b) the Tropic of Capricorn.

14 THE MOVEMENTS OF THE EARTH

3. Give in tabular form the height of the sun at noon on the days of the equinoxes and solstices at the poles, the Arctic and Antarctic Circles, London and the Equator. Arrange the table so as to give the dates on the left column and the places at the heads of columns.

4. Explain points of geographical interest in each of the following quotations-

- (a) The sun above the mast
Had fixed her to the Ocean.
- (b) The days grew longer and longer
Till they became as one.

5. What would be the effect (a) if the earth's axis were not tilted? (6) If the South Pole were always tilted towards the sun?

6. What are (a) the Tropics of Cancer and Capricorn, (b) the Arctic and Antarctic Circles?

CHAPTER III.

THE DISTRIBUTION OF TEMPERATURE.

TEMPERATURE is measured by means of the thermometer, and in English-speaking countries, except for scientific purposes, the Fahrenheit thermometer is in most general use, although continental countries use the Centigrade thermometer. On the former, freezing-point is 32° and boiling-point 212° , whilst on the latter these are 0° and 100° respectively. On the maps used in illustrating this chapter both scales are given.

The envelope of air which surrounds the earth can be heated in two ways; either from the earth itself, and we know that the interior of the earth has a very high temperature indeed, or from the sun. The amount of heat which the air derives from the heated interior of the earth is very small indeed, and this is illustrated by the fact that polar regions must have the same amount of heat from this source as equatorial regions, but we know that there are enormous differences between the temperature conditions in these areas. For all practical purposes we must confine our attention to the sun as the source of heat.

THE DISTRIBUTION OF INSOLATION.

Fig. 8 represents the earth, and A, B and C are bundles of sun's rays of equal width. It is clear that the nearer the rays fall to the equator, the greater is the angle at which they strike the earth, and the less the area which they have to heat. This is one reason why equatorial regions are warmer than polar regions. It is very

16 THE DISTRIBUTION OF TEMPERATURE

useful to use a term which expresses the amount of heat energy we receive from the sun. The term is *insolation*. The insolation for any day is the total amount of radiant energy received from the sun during that particular day. It is very important to notice that figures which give the amount of insolation at different latitudes

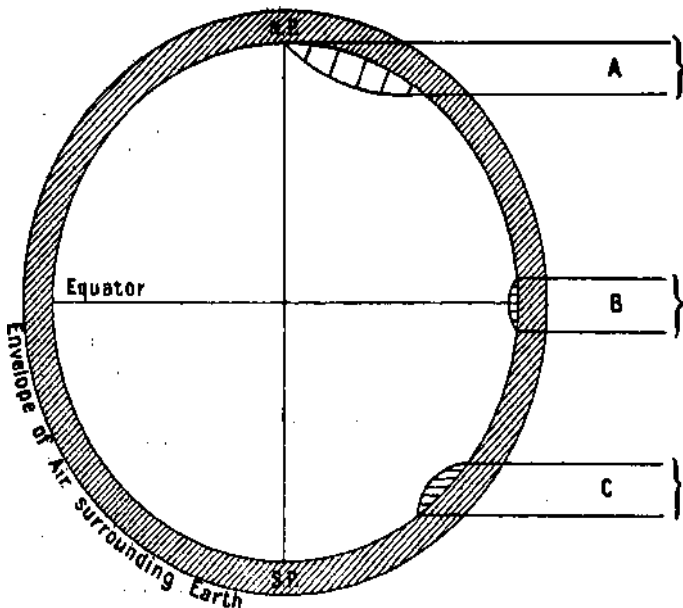


FIG. 8.—Diagram showing bundles of the sun's rays striking the earth's surface at different angles.

at certain times of the year, do not take into account the important facts that the earth is surrounded by an atmosphere, and that the land and sea surfaces of the globe differ very greatly in their power of heating and cooling. They do, however, take into account the length of time the sun is above the horizon.

It might be supposed that on June 21, when the sun is overhead at the northern tropic, insolation will be

greatest there. This is not so, for we must not forget that on that day, day and night are not of equal length as at the equinoxes, when the amount of heat received from the sun is greatest at the Equator, and decreases towards the poles. At the summer solstice, there is still equal day and night at the Equator, but as we go towards the North Pole the length of day increases, being 13 hrs. 56 min. in lat. 30° , and $18\frac{1}{2}$ hrs. in lat. 60° ; whilst regions within the Arctic Circle have a longest day varying from 24 hours to 6 months, according to their positions. Thus it is evident, that although the sun will be hotter at the Tropic of Cancer, it is longer in the sky in latitudes farther north, so that the total amount of radiant energy or insolation received is not very easy to calculate. If we let the insolation at the equator for the vernal equinox be represented by the number 1,000, that at different latitudes on June 21 is given in the following table :—

Latitude N.			
0°	881	50°	1105
10°	975	60°	1093
20°	1045	70°	1130
30°	1088	80°	1184
40°	1107	90°	1202

From these figures it will be seen that the insolation on June 21 is greater at the North Pole than at the Equator. But there are certain facts which must be pointed out, or a wrong impression might be gained. Firstly, the figures represent the total amount of insolation received during the whole day, and do not show the temperature *reached* during the day. We know that the polar regions do not attain the same temperatures as equatorial regions. Secondly, since the table imagines the earth to have no atmosphere, it does not take into account the loss of heat owing to absorption by the atmosphere. Thirdly, the figures do not allow for the fact that the earth has both land and

18 THE DISTRIBUTION OF TEMPERATURE

water surfaces, and that these affect the distribution of temperature very considerably. Let us first consider the influence of the atmosphere upon insolation.

THE INFLUENCE OF THE ATMOSPHERE ON INSOLATION.

Before they can reach the earth, the sun's rays have to pass through the air envelope which surrounds the earth to a height of some 200 miles. In passing through the atmosphere, the sun's rays must lose some heat even if the air were quite free from all impurities. But there are dust particles and water vapour in the air, and these absorb the sun's rays to such an extent that a large proportion of heat does not reach the earth. It will readily be seen that more heat will be absorbed by the atmosphere, the denser and thicker the envelope of air and the more dust and water particles that air contains. Fig. 8 shows that ray B has to pass through less air than those which fall obliquely (A and C), and therefore will not lose so much heat to the atmosphere. Therefore, since the sun's rays reach equatorial regions in a far less slanting direction than polar regions we have here another reason why the latter regions are colder. We shall now learn of the influence of land and water upon temperature.

THE INFLUENCE OF LAND AND WATER UPON TEMPERATURE.

Land and water do not take in heat at the same rates. If we heat a cubic foot of sand and the same quantity of water, we should find that the latter requires about twice as much heat to raise the temperature 1° as is required to raise the temperature of the sand by the same amount. On cooling, water gives out more heat than land. Again, the water in the ocean is in constant motion, so that the heat received from the sun is distributed, whereas rays falling on land heat only the

ALTITUDE AND TEMPERATURE

area on which they fall. Water is heated to a greater depth than land, and this is another reason why water takes longer to heat. In brief, we may say that the water surfaces of the earth take longer to heat in summer than the land surfaces, and cool at a slower rate in winter—that is, the oceans will be cooler than the continents in the same latitudes in summer, and warmer in winter (see Ex. 4 at the end of chapter). Lastly, let us turn to the influence of altitude upon temperature.

THE EFFECT OF ALTITUDE ON TEMPERATURE.

It has been seen that the atmosphere receives some heat from the rays of the sun as they pass through it. But only a small proportion of the heat received is acquired in this way. The sun's rays heat the surface of the earth, and by the process of radiation some of this heat is absorbed by the air. But the air is probably affected most by actually coming in contact with the earth, for it is easily heated by contact with something warmer than itself and cooled by something colder than itself. Thus the layers of air in contact with the earth are heated, and becoming lighter than the surrounding air, are displaced by the latter and forced to rise. The air which now comes in contact with the earth is warmed, and in its turn is compelled to rise. The ascending particles of air lose some of their heat to the air with which they come into contact. In this way the whole of the lower layers of the atmosphere are gradually warmed. Since the air is largely heated by contact with the earth, it is natural that the temperature falls as altitude increases. But this does not fully explain why it is colder on the top of a mountain than at its base, for the air at the summit is as near the ground as the air at the base. The question of pressure comes in here, and although we shall speak of atmospheric pressure in the next chapter we can now mention that air pressure decreases as sea-level is left behind.

20 THE DISTRIBUTION OF TEMPERATURE

As the air at high altitudes is not so dense as near sea-level, and is freer from water vapour and dust, it follows that the amount of insolation reaching the surface is greater than at sea-level. But for the same reasons the heat is very quickly radiated to the atmosphere, and the ground cannot retain its temperature for long. The total effect is to lower the temperature on mountains or plateaux.

The rate at which the temperature falls varies very much according to the place and season, but it may be taken as about 1° F. for 300 feet of ascent (see Ex. 3 at the end of this chapter). We have now covered all the points which will help us to understand the temperature maps of the world. Before studying them, however, let us just put together, from what we have learned, the causes which make summer warmer than winter.

WHY IT IS WARMER IN SUMMER THAN IN WINTER.

Fig. 7 shows that the North Pole is tilted towards the sun in June, and away from the sun in December. This not only gives us longer days in summer, but causes the sun to be higher in the sky in summer than in winter. Thus it is warmer in summer than in winter, for these reasons—

(1) The amount of insolation is greater, partly on account of the greater angle at which the sun's rays are received, and partly because the days are longer. (2) Less heat is absorbed as the sun's rays pass through the air. The lines A, B, C, in Fig. 7, represent the latitude of London, and the thickened rays are those which reach this latitude at June 21 and December 21. It will be seen that the summer ray reaches the latitude of London in a less slanting direction and passes through less air in June than in December. Notice the parts of the lines A, B, C, which are in the unshaded portion of the diagrams. These represent the relative length of days in June and December. It is at once

evident that the tilting of the earth's axis gives to London a longer day in summer and therefore more heat.

Temperature distributions are shown by means of *isotherms*, which may be defined as lines along which the temperature is everywhere the same. The method of drawing isotherms is illustrated in Ex. 1 at the end of this chapter. It is very important to notice that most isothermal maps are reduced to sea-level. Temperature varies with elevation, and therefore it is necessary to correct the thermometer readings at each station to what they would be at sea-level, if we wish to learn from the map the effects upon temperature of causes other than elevation.

TEMPERATURE MAPS OF THE WORLD.

Figs. 9, 10 and 11 show the mean sea-level temperatures for April, January and July. April (or October) is the best month for showing the temperature conditions when the maximum temperature is near the equator. January and July maps give the distribution of temperature in the winter and summer months of temperate latitudes. Theoretically, Figs. 9, 10 and 11 should be made for the days of the vernal or spring equinox and the solstices, but there is what may be described as a "lagging of the seasons," which must be taken into account.

Some isotherms are of greater importance than others; for example, the summer isotherm of 50° F. approximately marks the poleward limit of trees, for the latter cannot thrive unless this temperature is reached during at least one month. On Figs. 9, 10 and 11 the isotherms of 32° , 50° , 68° and 86° F. have been inserted. In order to bring out more clearly the great winter cold of the Eurasian land mass, other isotherms have been added to the January map.

APRIL TEMPERATURES.—Fig. 9 shows the **April** temperatures reduced to sea-level. It will be seen that

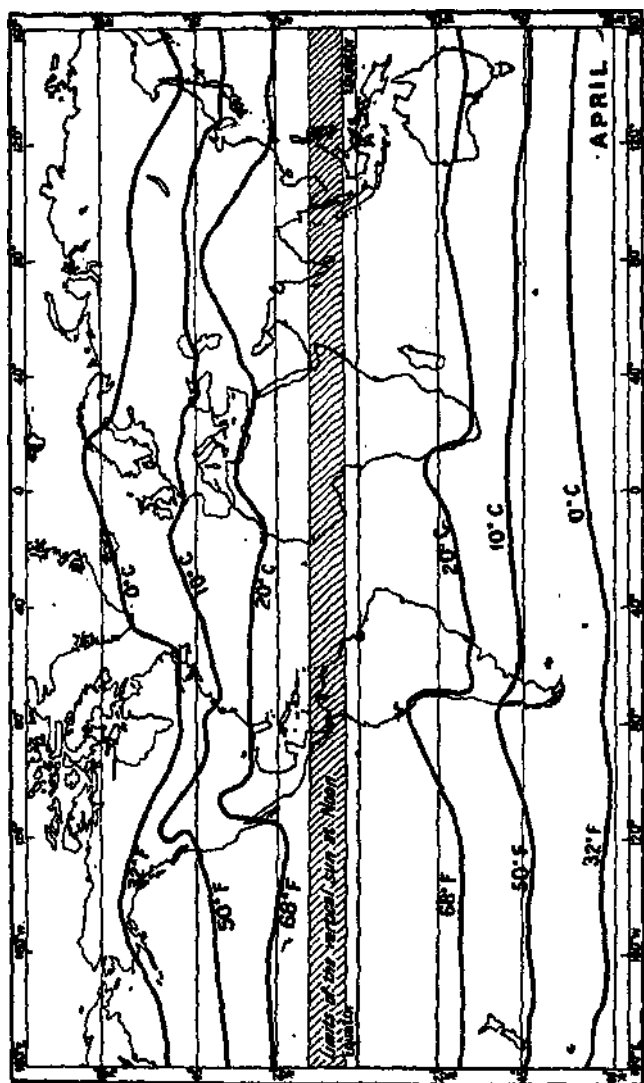


FIG. 9.—Mean sea-level temperatures for April.

TEMPERATURE MAPS OF THE WORLD 23

the region of greatest heat lies in equatorial regions, and that the temperature decreases gradually as the poles are approached. The isotherm of 50° follows very roughly the parallels of latitude 45° N. and S. The explanation of this general distribution of temperature is found in the fact that this map is made for a month immediately following the spring equinox, so that we should expect temperatures to decrease gradually from the equator to the poles.

JANUARY TEMPERATURES.—This map shows that the heat belt has migrated southwards with the sun, for the latter is overhead at noon on December 21 at the Tropic of Capricorn. The hottest belt is distinctly south of the equator, for it is in the summer season in the southern hemisphere. The highest temperatures (over 86°) are to be found over the land masses, on account of the fact that the temperature of land rises more quickly than that of water. The isotherm for 50° almost keeps parallel to the lines of latitude, and the reason for this should be apparent, as it is almost entirely over water. As a contrast, the isotherms for the northern hemisphere show a most marked bend southwards on the west of continents, and northwards on the east of continents, whilst over the land masses themselves they bend southwards. The isotherm for 32° F. gives the best illustration of this. This irregularity is accounted for partly by the unequal heating of land and water, and partly by ocean currents. With regard to the effect of the latter, we shall make fuller reference in Chapter V, but one other example of their influence on temperature may be pointed out now. In both January and July, the isotherms of the southern hemisphere bend northwards off the west coasts of land masses and southwards off their eastern shores. The reason for this is, that cold currents flow northwards along their western shores, and warm currents flow southwards along their eastern margins.

The coldest region is in Northern Siberia, where there is an area which has been called the "cold pole,"

24 THE DISTRIBUTION OF TEMPERATURE

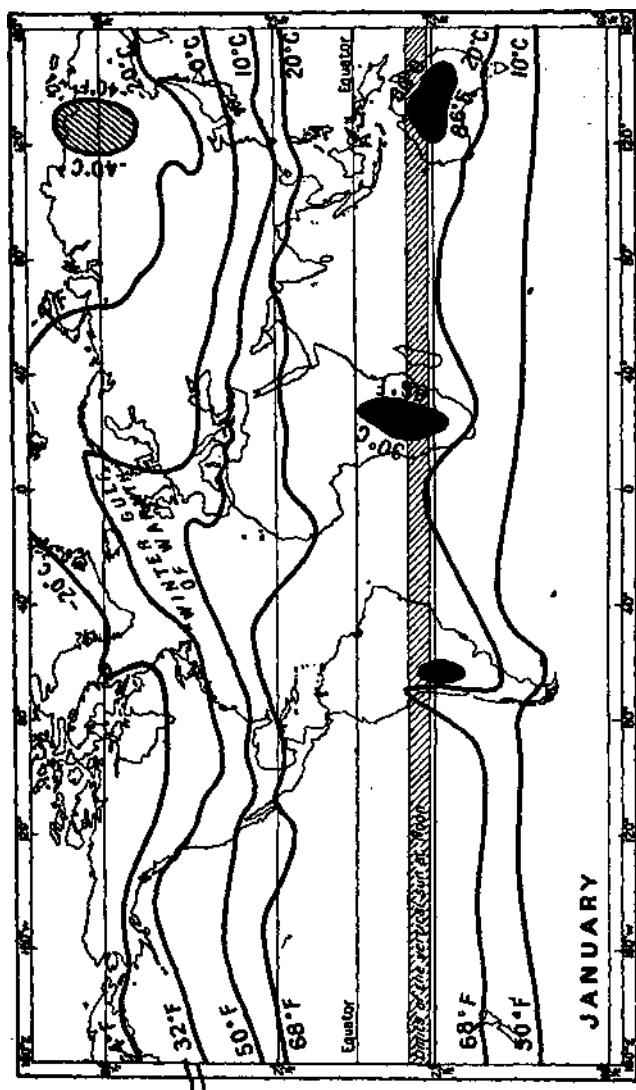


FIG. 10.—Mean sea-level temperatures for January.

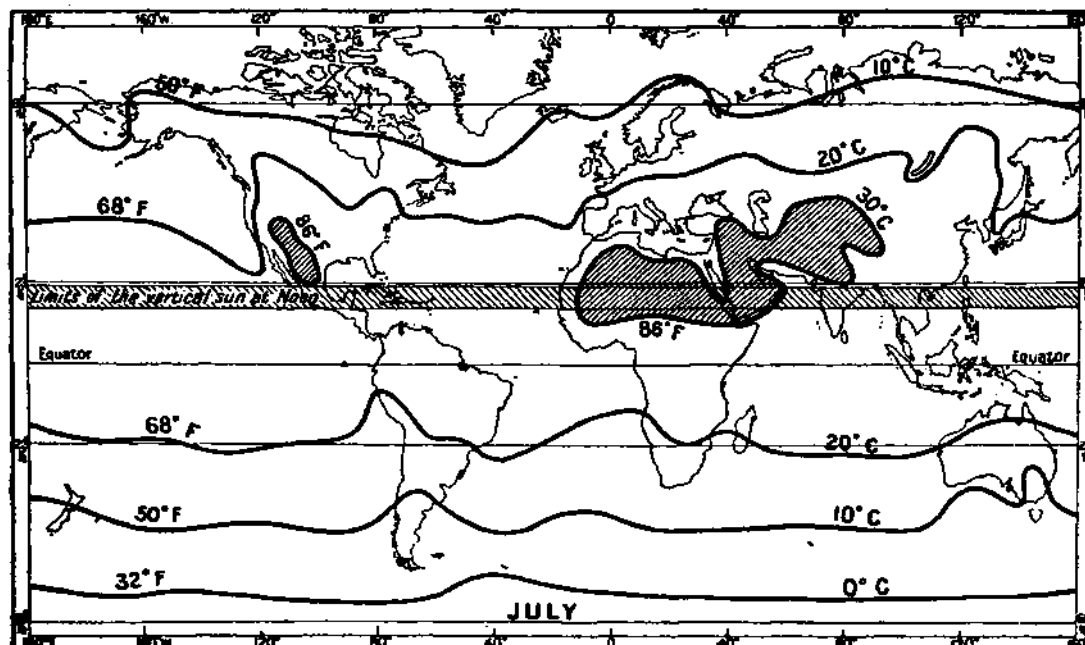


FIG. II.—Mean sea-level temperatures for July.

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whose temperature is below -48° F. A vast area of Eurasia has a temperature below freezing-point. So great is the land mass that this temperature is experienced within 3° of the Tropic of Cancer. The interior lands of North America are also very cold, but since the land area is not so great as in the old world, the temperatures are relatively not so low.

JULY TEMPERATURES.—Fig. 11 shows the temperature for July, when it is evident that the heat belt has migrated into the northern hemisphere, where the highest temperatures are seen to be over the land masses. Since the latter are warmer than the oceans in the same latitudes, the isotherms of the northern hemisphere bend northwards over the land. Over Asia, the isotherm of 68° F. reaches within 7° of the Arctic Circle. The southern hemisphere shows a more equable distribution of temperature south of the equator, due to the great extent of ocean.

EXERCISES.

1. On two outline maps of the British Isles plot the positions of the stations used (or the reports of the Meteorological Office. On one map print by the side of each station the mean temperature for January, as given in Appendix 1 of the D.W.R. On the other do the same for July. Then draw the isotherms for every even number of degrees (*i.e.* 38° , 40° , 42° F., etc., for January, and 56° , 58° , 60° F., etc., for July).

2. Draw a map of the coast-lines of the North Atlantic Ocean, and on it mark the January isotherm of 32° F. Shade the area which has a temperature of over 32° F. The great gulf-like tongue of warmer water off the West of Europe is sometimes called "The Winter Gulf of Warmth."

3.

Place.	Height in feet above sea.	Jan. temp.	July temp.
Fort William . Ben Nevis summit .	S.L. 4,400	$38^{\circ}7'$ F. $23^{\circ}4'$ F.	$57^{\circ}1'$ F. $41^{\circ}7'$ F.

Find these places on the map. Account fully for their differences in temperature.

EXERCISES

4.

Place.	Jan. temp.	July temp.	Range of temp.
Cambridge .	37-6° F.	61'5° F.	23'9 ⁰ F.
Berlin .	31'3° F.	64'5° F.	33'2' F.
Warsaw • •	23'9 ⁸ F.	65'5° F.	41'6° F.
Saratof. • •	13'5° F.	71'0° F.	57'5 ⁰ F.

These places are in approximately the same latitude. Account for the different temperature conditions shown by the figures.

5. On outline maps of the Old World north of the equator mark the isotherms for January and for July. Shade the maps so as to emphasize cold in winter and heat in summer. Write short accounts bringing out the leading features shown by the maps.

6. On outline maps of the southern hemisphere draw the isotherms for January and for July. Shade the map as suggested in Exercise 5. State the chief differences between the distribution of temperature in Eurasia and North Africa and in the southern hemisphere.

7. Why is it warmer in equatorial regions than in polar regions? Draw diagrams to illustrate your answer.

CHAPTER IV.

THE PRESSURE OF THE ATMOSPHERE AND ITS INFLUENCE ON WINDS.

IN previous chapters we have learned that the earth is surrounded by an air envelope. It is known that this extends to a height of about 200 miles from the earth's surface, and that the higher we go the lighter the air becomes. Since we know that air has weight, it follows that it exerts a pressure upon the surface of the earth, and that this pressure will be greater at sea-level than on the top of a high mountain, for there is not so much air above the latter as there is above a place at sea-level. Air pressure is measured by means of the barometer. A barometer consists of a glass tube which is closed at one end. This tube is filled with mercury, inverted, and the open end placed into a cup of mercury. The mercury column then falls a little, and some of the mercury runs back into the cup, leaving in the tube a column about thirty inches high.

When the air pressure upon the surface of the mercury in the cup is increased, the column is pushed higher up the tube; but if the air pressure decreases mercury flows from the tube to the cup, and the height of the column is decreased. Thus it is seen that when the column stands at a height of 30 inches the pressure of the atmosphere is equal to that of a layer of mercury 30 inches deep. It is usual to express the pressure of the atmosphere in inches or millimetres of mercury, and the normal pressure at sea-level is about 29.9 inches or 760 millimetres. It is more scientific, however, to use a pressure unit, hence the increasing use of the terms *bar*

and *millibar* (see Exercise 7 at the end of this chapter). When the pressure is more than 29.9 inches **or 1012.5** millibars we speak of it as being "high," and when it is below this we speak of it as being "low." Since we know the density of mercury it is easy to calculate that this pressure is equal to one of 147 pounds per square inch.

PRESSURE AND ALTITUDE.

We have seen that the air extends to a height of about 200 miles, but at that height it is extremely rare. Since the upper layers of air press upon the lower layers, the latter are denser and therefore heavier, for the particles of air are closer together. If a barometer were carried up the sides of a high mountain it would be found that the reading would continually fall, and that at an elevation of 900 feet from sea-level the reading would be one inch less than at sea-level. To cause a fall of another inch, however, we should have to make an ascent of more than 900 feet, because, as we are now increasing our elevation, the air is less dense than it was at lower levels. At an elevation of 3½ miles the pressure is only about half what it is at sea-level, so that half of the atmosphere would be below that elevation; whilst at a height of seven miles we should have three-fourths of the atmosphere below us.

So rarefied is the atmosphere at great elevations that it is very difficult to breathe sufficient air for the wants of the body. Some men and animals have become accustomed to living at great elevations; but it is a well-known fact that travellers *unaccustomed* to living in high altitudes find great difficulty in breathing, and even at lower levels, suffer from headaches, dizziness and sickness. It will readily be seen that barometer readings can be used for determining roughly the heights of mountains.

PRESSURE AND WINDS.

If the pressure at any place is high, and that of the surrounding area low, air flows outwards from the higher

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pressure towards the lower. Air always flows from places of high pressure towards places of low pressure. But this statement requires some modification, for the rotation of the earth causes winds to be deflected to the right in the northern hemisphere, and to the left in the southern hemisphere. Pressures are represented by means of *isobars*, or lines along which the pressure is everywhere the same (see Ex. I on p. 40). Fig. 12 A shows an area of high pressure surrounded by lower

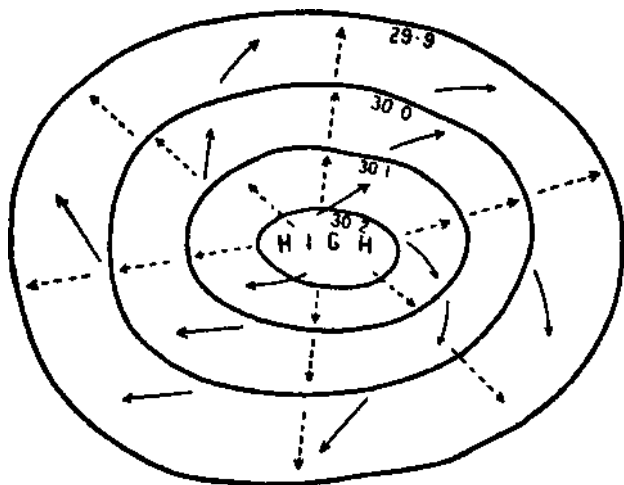


FIG. 12 A.—The relation between pressure and winds.

pressure, and if the earth stood still winds would flow outwards as indicated by the dotted arrows. If this represents a pressure system in the northern hemisphere the actual winds will be as shown by the straight-lined arrows. This law of the deflection of winds to the right in the northern hemisphere, and to the left in the southern hemisphere, due to the earth's rotation, is known as *Ferrers Law*. It must be noted that rivers are also influenced, but not nearly to the same extent as the lighter, easily influenced air currents.

PRESSURE AND WINDS

A full explanation of this deflection cannot be entered into here, but it may be illustrated in several ways.

Push a knitting-needle through the centre of a card-board disc, and rotate the disc from right to left. From the centre of the disc allow an inked marble to run towards the edges, and then notice its track. The marble does not reach the point originally aimed at, but is deflected to the right. This illustrates the deflection of a northern hemisphere air current moving equatorwards, for the edge of the disc represents the equator, and the centre the North Pole. If the disc be rotated from left to right the deflection is then to the left, and this illustrates the deflection of air currents

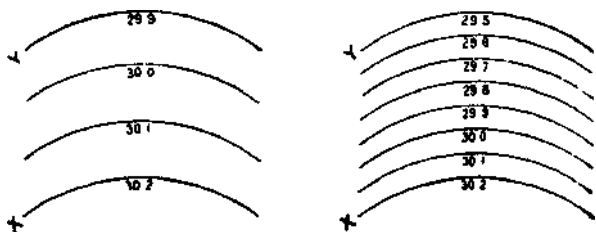


FIG. 12 B.—Steep and less steep gradients.

moving from the South Pole towards the equator from the standpoint of a person looking down upon the South Pole. The deflection of currents moving equatorwards can also be shown as follows: Rotate a globe in the same direction as the earth's rotation, *Le.* from west to east. Whilst the globe is turning round, by means of a piece of chalk, try to draw due north and south lines. Draw several for each hemisphere, taking care that each line is drawn towards, and not away from, the equator. Stop the globe, and it will be seen that the lines show deflection, as stated in Ferrel's Law. Currents moving polewards are also deflected to the right in the northern hemisphere, and **to the left in the southern hemisphere.**

There is one more point to which **reference** must be

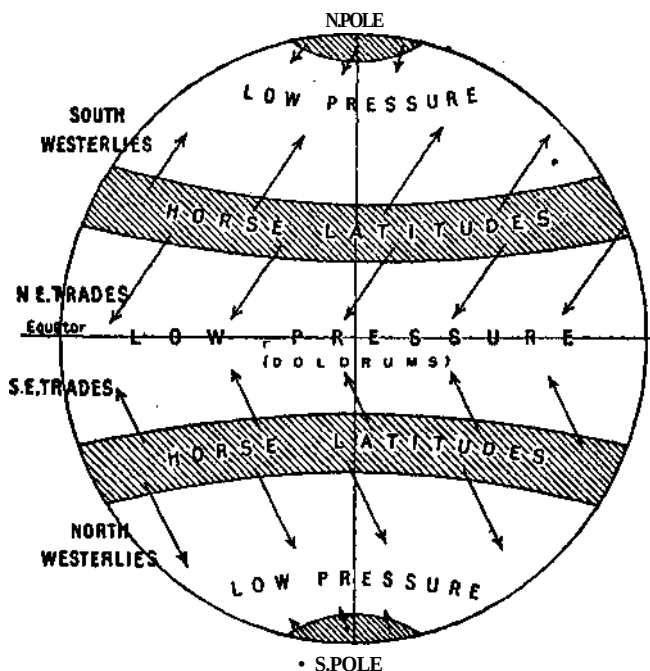
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made. At the beginning of this section we learned that winds are due to differences of pressure. From this it follows that the greater the difference in pressure between two places the stronger will be the resulting wind. In the isobars on the left of Fig. 12 B the difference between the readings at x and y is three-tenths of an inch. In those on the right x and y are the same number of miles apart, but the pressure difference is seven-tenths of an inch. In the latter case, the winds experienced will be much stronger than in the former, for the air will be pushed outwards with much greater force. In each case the isobars are drawn to show differences of pressure at one-tenth of an inch intervals, but it is evident that they are closer together in one than in the other. Thus we reach a statement which is sufficient for present purposes: winds are generally stronger where the isobars are closer together than where they are farther apart.

GENERAL DESCRIPTION OF THE DISTRIBUTION OF PRESSURE AND THE PLANETARY WINDS.

We are now in a position to consider the distribution of pressure over the surface of the globe. In the last chapter we learned that the equatorial belt has great heat. Now this causes the development of an area of low pressure known as the Doldrums, towards which there are inflowing winds at the surface and above which there is a drift of air forced upwards by the meeting of the inflowing air currents. About 30° to 35° north and south of the equator are two belts of high pressure. These are known as the Horse Latitudes. Small areas of high pressure are also found at the poles, whilst in sub-arctic regions there are low-pressure areas. All these will be found on Fig. 13. Now if the world stood still, we should have winds blowing from high-pressure belts to low-pressure belts; but, as the rotation of the earth causes the winds to be deflected, we have air currents moving equatorwards and polewards from

the Horse Latitudes, and being deflected to the right in the northern hemisphere and to the left in the southern hemisphere. Those blowing towards the equator are the steady *Trade Winds*, and those blowing pole-



high Pressure Areas.

FIG. 13.—A diagrammatic representation of the prevailing winds of the world.

wards are the *Westerlies*. In addition to these, there are the winds which blow from the polar high-pressure areas. All these winds will be found marked in Fig. 13. The *Westerlies* are stronger than the *Trades*, but do not blow with such regularity, and on this account are best referred to as the "Prevailing *Westerlies*." The pic-

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turesque name " Brave West Winds " has been given to the Westerlies of the southern hemisphere, whilst the latitudes in which they are most reliable and are very strong, have been named " The Roaring Forties." These names help to indicate the strength of the southern hemisphere Westerlies.

One other point must be made clearer. The Horse Latitudes and the Doldrums are " calms "—that is, little movement of air is felt. Very often sailing ships are becalmed in these latitudes for many days together. This is due mainly to the fact that the chief movement of air in these places is a vertical one. Air rises at the Doldrums and, in the upper layers of the atmosphere, flows out towards the poles. By the time the Horse Latitudes are reached, the air has sufficiently increased in density, due to cooling, that it falls to the surface, and flows either to the equator or towards the poles as a surface wind. Thus it is seen that since the movement of air at the Horse Latitudes and Doldrums is not a horizontal movement, these regions will be calms. This explains, too, why there are high-pressure belts from 30° to 35° north and south of the equator. The air which descends to the surface in these latitudes increases very rapidly in density as it falls, so that the pressure is bound to be high.

WORLD DISTRIBUTION OF PRESSURE.

In explaining Fig. 13, we have not taken into consideration the fact that the earth's surface consists of land and water, and that these, owing to their different capacities for heating and cooling, will affect pressure. Nor have we taken into account seasonal changes in pressure distribution. We shall now consider these points.

Figs. 14, 15 and 16 show the distribution of pressure in October, January and July. For the purposes of comparison, all the readings from which pressure maps are constructed have certain corrections applied to them,

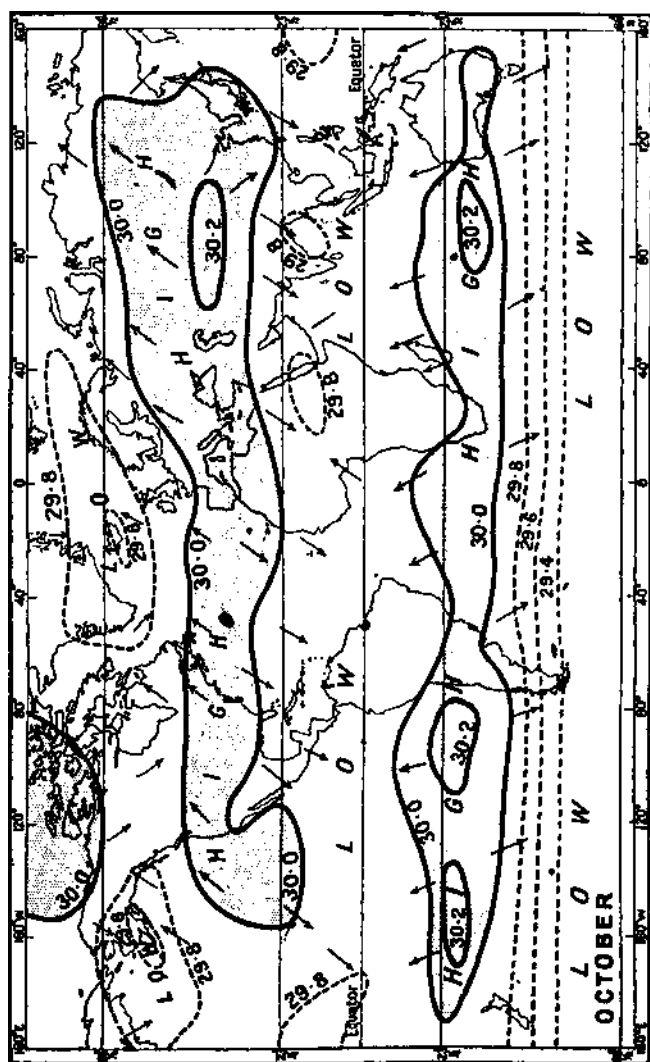


FIG. 14.—Isobars and winds for October. (After Buchan.)

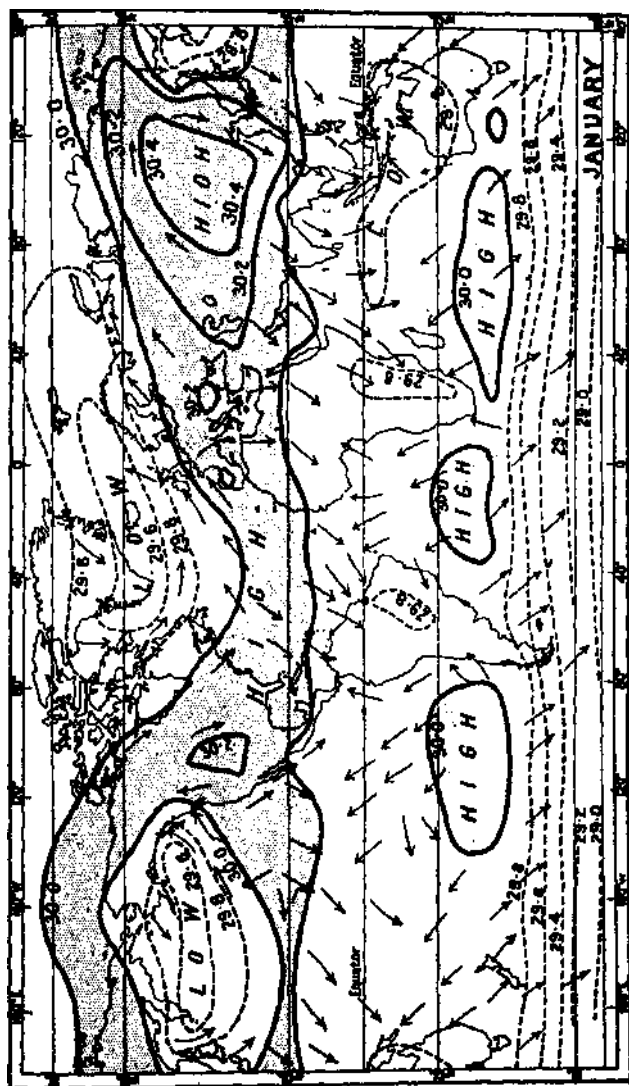
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the chief being for altitude and temperature. As all readings have been corrected to sea-level readings, it follows that the actual pressure over such a high plateau as Tibet is much less than these maps show. Temperature, too, has an important influence upon pressure, so that pressure maps are corrected to a standard reading at 32° F., but this correction is not nearly so large as that for altitude.

PRESSURE DISTRIBUTION IN OCTOBER.—Fig. 14 shows that at this month there is a marked low-pressure belt corresponding to the equatorial heat belt. The pressure increases until the latitudes 30° — 40° N. and S. are reached, and here we have belts of high pressure. In higher latitudes still, the pressure again diminishes. This distribution more nearly corresponds with that shown in the diagram Fig. 13, and this is due to the fact that October is very near to the equinox, when the sun is seen overhead at noon at the equator.

PRESSURE AND WINDS IN JANUARY.—We can see very clearly from Fig. 15 that in this month the equatorial low-pressure area has moved southwards. This is in accordance with the migration of the temperature belts. We can also see that the southern high-pressure belt, the Horse Latitudes, is not so continuous as in October, for there are distinct low-pressure areas over the land masses of South America, Africa and Australia. Remembering that January is the southern summer, this is easily accounted for by the unequal heating of land and water. In the northern hemisphere, the high-pressure belt is a very marked feature, especially over the land masses, where the pressure is the highest. This is best shown over Asia, where the area of high pressure is very large indeed. Over the North Atlantic and Pacific Oceans are well-defined low-pressure areas. The influence of land and water upon the pressure distribution just outlined should be obvious.

The arrows show the winds which will be found to blow from high to low pressure, and to be deflected according to Ferret's Law. Notice the continuous belt



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of north-westerlies compared with the south-westerlies of the northern hemisphere. The latter tend to get into great swirls of air blowing spirally round the ocean centres of low pressure. One more point should be observed. In North-western Australia the ordinary S.E. Trades are not experienced at this season (southern summer). Owing to heat, a low-pressure system is formed, towards which air flows, thus giving a north-west monsoon.

PRESSURE AND WINDS IN JULY.—This is the winter month of the southern hemisphere, where we find the actual distribution of pressure closely corresponding to Fig. 13. The reason is, that in this hemisphere the disturbing factor of the temperature differences between land and sea is not so important as in the other hemisphere, because the land masses are not nearly so large. The Doldrums belt of low pressure and the southern Horse Latitudes high-pressure belt are clearly shown, but when we turn to the northern hemisphere Horse Latitudes, it is apparent that there is no continuous belt of high pressure at this season. Over the oceans are areas of high pressure, and over the continents areas of low pressure, that over Asia being very well marked. It will thus be seen that the distribution of pressure shown in Fig. 13 has to be modified in the case of Asia, owing to the enormous area of the land mass. In January, Asia has a system of high pressure, with out-flowing winds; in July, it is under the influence of a low-pressure system with inflowing winds. It is this great change in the distribution of pressure that gives to Asia, south-east of a line drawn from Karachi to Korea, a distinctive type of climate of alternating dry and wet seasons. The full consideration of this is reserved for another chapter, but one point must be mentioned. Fig. 16 shows that the S.W. wind which blows over India in July is simply the S.E. Trade Wind, which, having crossed the equator, is deflected to the right by the rotation of the earth, and proceeds towards India as a south-west wind. The term " Mon-

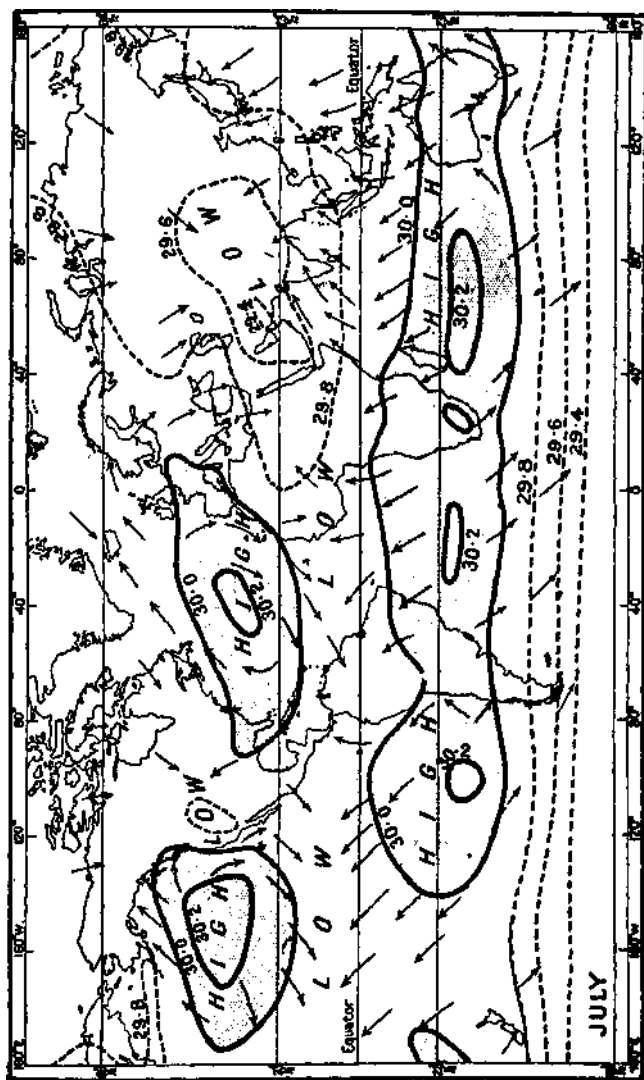


Fig. 16.—Isobars and winds for July. (After Buchan.)

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soon" (= a seasonal wind) is given to the summer winds of S.E. Asia.

We have learned that in January there is a distinct southerly migration of the pressure belts, and if the pressure maps for October and July be compared, it will be apparent that in the latter month there is a similar migration northwards. This is exceedingly important, for there are certain latitudes which will be transition areas, *i.e.* will be in high-pressure belts at one season, and in low-pressure belts at another. In order to prevent exaggerated ideas concerning the amount of the migration you will do well to consult a set of monthly charts of the North Atlantic Ocean.

EXERCISES.

1. Draw an outline map of Western Europe. Mark the positions of the places shown in the first column of the Daily Weather Report. Beside each, mark neatly the reading of the barometer at 7 a.m. and draw the isobars at intervals of one-tenth of an inch. Compare your results with those on p. 3 of the Weather Report.

2. Make maps showing the distribution of pressure in the southern hemisphere for January and July. Show winds by arrows. Write an account of the distribution of pressure as shown in the map.

3. Make maps showing the distribution of pressure in the northern hemisphere for January and July. Show winds by arrows. Describe the distribution in writing, accounting for the differences noted between these maps and those for the southern hemisphere.

4. On an outline map of the world plot the probable course of a sailing vessel from London to Melbourne and home again. (The direction of the prevailing winds must be kept in mind in order to accomplish this exercise successfully.)

5. Explain very carefully:—high pressure, Roaring Forties, Horse Latitudes, Doldrums, Ferrers Law.

6. Draw a circle of $2\frac{1}{2}$ " radius. Mark the equator and the tropics. Shade or mark the polar high-pressure regions and the Horse Latitudes. By means of arrows, show the prevailing winds of the world.

7. What is a millibar? Why is air pressure now recorded in millibars in the Daily Weather Report?

8. What special precautions had to be taken by the Mt. Everest climbing parties in order to carry on their work at high altitudes? Why **were these** necessary?

CHAPTER V.

OCEAN CURRENTS.

FIG. 17 shows a small tank containing water. At one end a strainer containing ice is fixed, and at the other the lid of a small tin box is held in position by a piece of wire. A bunsen burner is fixed or held so that the flame heats the lid. The water in contact with the heated lid is raised in temperature and thus expands, whilst that in contact with the ice is chilled and contracts. This causes the cooled water to sink and the heated water to flow towards the ice. In this way a circulation of water is set up as indicated in Fig. 17 by the arrows.

Now let us apply this simple experiment to the waters of the ocean. The heated end of the tank may be compared with the surface waters of the ocean at the equator, and the cool end with polar waters. In polar regions water sinks to the bottom of the ocean on account of increasing density due to cold, whilst at the equator, where the heat of the sun warms the surface water, expansion takes place and water is set in motion polewards.

There is no doubt that there is a general equatorwards creep of cold water along the ocean bed, and a surface flow towards the poles; but this is not sufficient to account for the extensive movements which take place in the surface waters of the oceans. The chief cause of these must be looked for in another direction.

If, by means of a pair of bellows, air is blown upon the surface of a tank filled with water, the force of the air is quite sufficient to set up surface currents of water.

There can be little doubt that the prevailing winds are the chief factors in the production of ocean currents, for in regions where winds change with the seasons, the change of wind is accompanied by a change in the direction of the currents. This is very clearly shown in the North Indian Ocean. We have learned that at one time of the year (Nov.-April) the wind is from the north-east; at the other time (May-Oct.) it blows from the south-west. Fig. 18 shows the currents of the Indian Ocean, from which it will be seen that a change of wind

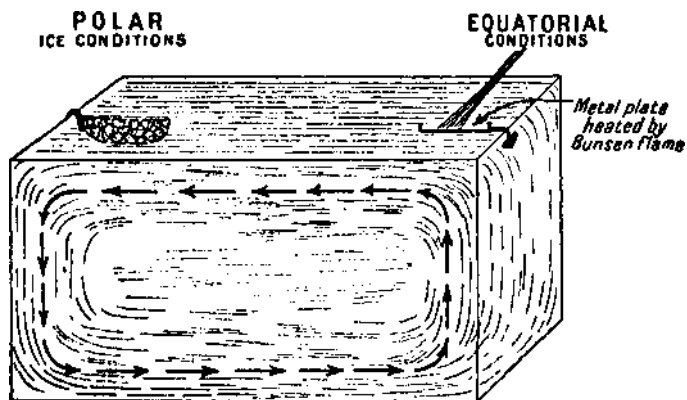


FIG. 17.—Diagrams showing currents caused by unequal temperatures.

is accompanied by a change in the direction of the ocean currents.

Let us at the outset notice two ways in which ocean currents may be classified. In the first place, we can distinguish between *relatively warm* and *relatively cold* currents, as is done in Fig. 18. A current will be relatively warm when it is flowing towards regions which are colder than those from which it has come, and, on the other hand, a current will be relatively cold when it is flowing towards warmer regions.

Ocean currents may also be classified as *stream* or *drift* currents. The former may be likened to broad

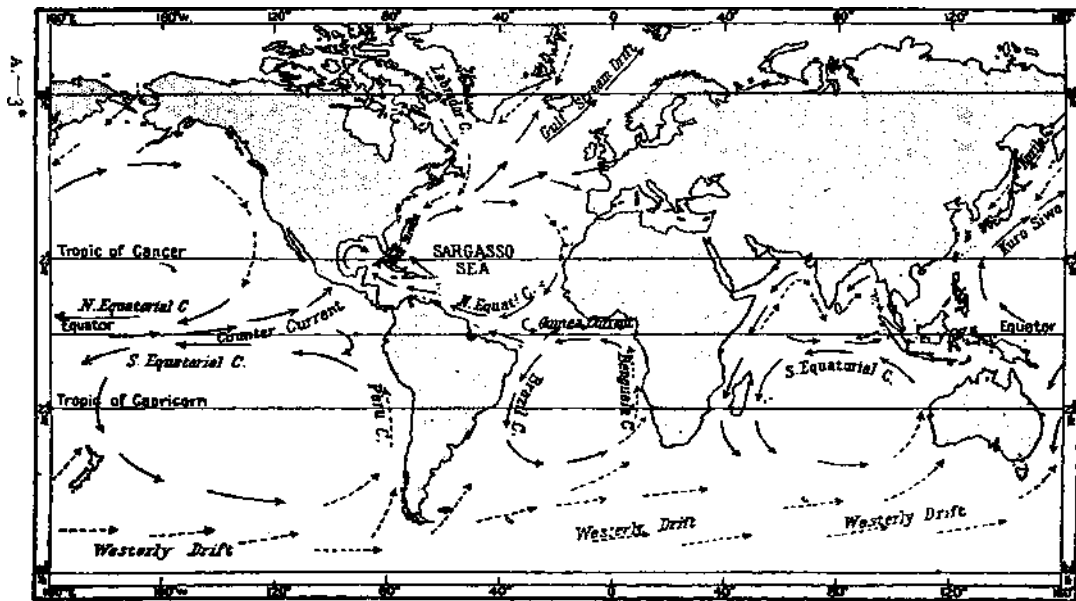


FIG. 18.—Ocean currents. The dotted arrows in the N. Indian Ocean show the currents during the S.W. Monsoon, the other arrows those during the season of the N.E. Trades. Elsewhere on the map the dotted arrows show relatively cold currents, the others relatively warm currents.

ocean rivers flowing between comparatively still waters. They flow faster than drift currents, and are caused by water which has been heaped up, seeking to find its own level. Drift currents move more slowly, and are simply a general drift of the surface water due to the force of the prevailing winds.

Keeping clearly in mind the prevailing winds, there should be no difficulty in understanding the direction of the chief ocean currents as given in Fig. 18. Let us consider the currents in the Atlantic Ocean. Off the north-west coast of Africa, in the region of the N.E. Trades, the surface waters are compelled by the winds to drift westwards until they are turned, partly by the shape of the mainland of North America, and partly, as in the case of winds, by the influence of deflection. A similar drift of waters is set up by the influence of the S.E. Trades, and the result is the South Equatorial Current, which is split into two by the wedge-shaped corner of South America, part of the waters flowing northwards to join those of the North Equatorial Current, and part passing along the shores of Brazil, from which country the branch is named the Brazilian Current. As all this water is blown across the Atlantic, it will be seen that the level of the sea off the American coast in these latitudes tends to be rather higher than on the corresponding African shores, and so it is.

But water cannot continue to be piled up, however steady and strong the winds may be. Some of it is bound to return, and it does so in the region of Doldrum Calms, which is between the North and South Equatorial Currents. This return, or counter-stream current, is known as the Guinea Current.

Now let us return to the North Equatorial Current, which is reinforced by a portion of its southern counterpart. Some of its waters pass through the Caribbean Sea and the Gulf of Mexico, and cause such a piling up of waters that a strong and steady stream current of water flows from the Gulf of Mexico between Cuba and Florida. This is the much misunderstood Gulf Stream.

This stream of warm water, which can be quite plainly distinguished from the surrounding waters, then flows along the south-eastern coast of the United States, although it is impossible that all the water in the stream has come from the Gulf of Mexico; some must have come from the current which did not enter the Caribbean Sea, but kept outside the West Indies. Soon after Cape Hatteras has been passed, the Gulf Stream spreads out its waters like an enormous fan, and it is no longer a stream flowing between comparatively still water, but a general drift of the warm surface waters of the ocean, blown by the westerlies towards the shores of Europe. The various branches of the Gulf Stream Drift, or North Atlantic Drift, are shown on Fig. 18, and it will be noticed that one branch returns to the north-west coast of Africa, thus completing a great clockwise motion of water, in the centre of which is the Sargasso Sea, where huge masses of floating seaweed, called sargassum, are sometimes very troublesome to ships. Fig. 18 shows that a great quantity of water from the North Atlantic is forced into the Arctic Ocean, where, as in the Gulf of Mexico, we have a piling up of waters. This cannot proceed indefinitely, and so we have return cold-stream currents re-entering the North Atlantic on either side of Greenland. These surface currents are in addition to the "cold creep" of water referred to in the beginning of this chapter. The Labrador current flows from amongst the islands of North America, past the coasts of Labrador, Newfoundland, Nova Scotia and New England, and finally sinks in the vicinity of Cape Hatteras, owing to its density being high in comparison with that of the warmer waters of those latitudes. The meeting of currents of air warmed by the Gulf Stream or its great drift, with air which has been cooled by the Labrador current, is the cause of the dense fogs which make Nova Scotia and Newfoundland the foggiest area in the world. These fogs are a source of great trouble to sailors.

Returning to the South Atlantic Ocean we find that, partly under the influence of deflection and partly **due**

to having reached the area of the westerly winds, the Brazilian Current passes across the ocean and proceeds equator wards up the coast of south-west Africa, where it is joined by the cold Antarctic Drift, a great drift of cold water blown by the westerly winds. As in the North Atlantic, there is in this part of the ocean a great circulation of water, moving in this case in a counter-clockwise direction, and having at its centre another Sargasso Sea.

The currents of the Pacific Ocean should now present no difficulty. There are equatorial drifts beginning in trade wind areas off the American coasts. Between them is the Counter Equatorial Current, which can be compared with the Guinea Current. The Kuro Siwo, or Black Stream of Japan, is the counterpart of the Gulf Stream; the north-western American coasts receive warm southern waters which may be compared with the North Atlantic Drift, whilst the counterpart of the Labrador Current is seen in the Kurile Current, which enters the North Pacific Ocean through the Bering Strait. Similarly, the currents of the South Pacific are comparable with those of the South Atlantic.

Reference has been made to the seasonal changes which occur in the North Indian Ocean, so that it is only necessary to add that in the southern portion of that ocean are currents in every essential respect similar to those of the South Atlantic and Pacific Ocean. Since the currents of the northern part of the ocean are not constant, the Counter Equatorial Current is uncertain and irregular, as may be expected.

OCEAN CURRENTS AND CLIMATE.

Finally, ocean currents have a very important influence upon climate. In Chapter III, we have seen how the warm water that is drifted past the western shores of Europe influences the climate of the western margin of that continent. This is very clearly shown in Fig. 19, for the direction taken by the January

isotherm of 32° F. is very considerably influenced by this factor. There is a striking difference between the winter temperature of the coast lands on opposite temperate shores of the North Atlantic.

Fig. 19 represents a land mass stretching from north to south temperate latitudes. The vast amount of water carried eastwards by the westerly winds causes a piling up of warm surface water on the western shores of temperate latitudes, whilst these waters tend to be blown away from eastern shores in the same latitudes,

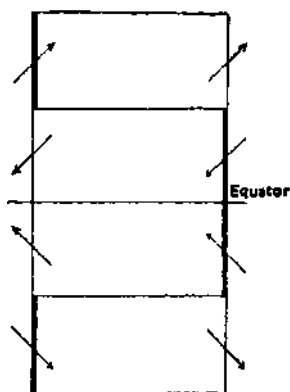


FIG. 19.—This diagram illustrates the piling up of waters by on-shore winds

and much lower temperatures are experienced. In trade-wind latitudes the conditions are reversed and the warm surface waters are piled up on the east coast and carried away from the west. A map showing the distribution of coral will show coral reefs, etc., on the eastern shores of tropical countries, but not on the west, for the tiny coral polyp cannot live unless the temperature of the water is always over 70° F. These warm conditions are not found on the western margins, where the colder water takes the place of the surface water drifted away from the coast by the prevailing winds.

EXERCISES.

1. Describe the courses which might be taken by a sealed bottle cast into the sea from a boat passing the Canary Islands.

2. How far is it true to say that the circulation of the surface waters of the North Atlantic Ocean is as if the water had been stirred in the direction of the hands of a clock, and in the South Atlantic in a direction opposite to those of the hands of a clock?

3. What effect have ocean currents upon the directions taken by the southern hemisphere isotherms of 68° F. (January and July)? See Figs. 10 and 11.

4. Explain what is meant by warm and cold currents, stream and drift currents. Give examples.

5. Draw a diagram to show the ocean currents of the North Atlantic Ocean. Show their connection with the prevailing winds.

CHAPTER VI.

RAINFALL: ITS CAUSES AND DISTRIBUTION.

EVAPORATION AND CONDENSATION.

AFTER rains a considerable quantity of water remains on the surface of the ground in small pools, but quickly disappears. Wet clothes are hung out and are taken down quite dry. In both of these instances the water has disappeared into the atmosphere in the form of water vapour which we cannot see—that is, it has evaporated. On the surface of the earth are oceans, lakes, rivers, etc., exposed to the atmosphere, and from all these water is constantly being evaporated and received into the atmosphere. If a mass of air which contains water vapour is cooled, some of the vapour may condense into very tiny drops of water which are not too heavy to be held in the air. It is in this way that mists, fogs and clouds are produced. Should the condensation proceed further, the tiny drops of water run together and form a raindrop that is too heavy for the air to carry in suspension, and rain results. Of course, only a portion of the rain which falls on the land is directly evaporated into the air; much finds its way into rivers, and is carried off to the oceans, whilst some remains in the soil and is used by plants and animals. It is interesting to think of the great oceans as the chief places where evaporation is taking place; that this water-laden air is carried by means of winds towards the lands, where it is forced to rise—perhaps on meeting mountains—and is therefore cooled, and a fall of rain occurs. The rainwater is carried off to the oceans

largely by rivers, and thus the cycle is going on throughout the centuries.

It is very important to notice that warm air can hold much more water vapour than cold air, as the following figures show—

Temperature.	Maximum amount of water vapour which can be held by a cubic metre of air.
— 10° C	2.28 grammes
0°	487 „
+ 10°	936 »
20°	17.1 „
30°	3008 „
40°	50.67 „

This table shows that the maximum amount of water vapour which can be held by a cubic metre of air at a temperature of — 10° C. is 2.28 grammes, whilst the same volume at 10° C. can hold 9.36 grammes. It will be observed that the amount of water vapour held at different temperatures increases very considerably with increase of temperature. Saturated air, or air at a certain temperature, containing the maximum amount of water vapour for that temperature, can be made to hold more by being warmed, but if it be cooled, some of the vapour will condense. The temperature to which air must be cooled in order that some water vapour may be condensed, is called its *dew-point*. Another glance at the table will show that if saturated masses of air at different temperatures, say 10° C. and 30° C, are cooled, there will be much greater precipitation in the case of the warm air than in the case of the cooler air. This has a great deal to do with the heavy rainfall in equatorial latitudes.

There are innumerable particles of dust in the atmosphere, and these appear to play a very important part in assisting condensation, for when water vapour is condensed, it is upon a nucleus of a dust particle that the tiny water drops grow.

How RAINFALL IS MEASURED.

Rainfall is measured by means of a rain-gauge. In essence, this consists of a funnel which catches the rain and leads it into some kind of vessel. If the vessel is cylindrical and the area of its opening is the same as that of the opening of the funnel, the depth of water in it represents the amount of rain which has fallen in that area. In order to measure accurately small amounts of rainfall, it is necessary to have a specially graduated measuring glass whose diameter is less than that of the funnel. If the area of the mouth of the funnel is 15 square inches, it is obvious that 15 cubic inches of water will be necessary to cover that area to a depth of one inch. Therefore, if 15 cubic inches of water are carefully measured and poured into a measuring glass, the height of the column of water will represent a fall of one inch upon the area of the funnel's opening. The measuring glass can then be graduated so as to read such small amounts of rainfall as one-hundredth of an inch.

To get correct results, it is very necessary to place the rain-gauge in a suitable position, in order that all the rain which falls may be registered. It should be placed about twice as far from the nearest building as the latter is high, and raised from the ground about one foot. The latter precaution prevents water splashing upwards from entering the funnel.

Of course, all condensed water vapour does not fall in the form of rain. Falls of snow and hail are common. The former requires very careful measuring, for the funnel of the gauge may be filled before the snow ceases to fall. Snow has to be melted before the amount can be read in rainfall equivalents. About ten inches of untouched snow yields one inch of rainfall.

THE CAUSES OF RAINFALL.

Rain is the result of the cooling of air containing water vapour. The cooling may be accomplished in several ways:—

(i) Air moving from warm to cooler latitudes will not be able to hold as great a quantity of water vapour, and there will be a tendency to precipitation. The best examples are the Westerlies, which blow towards colder latitudes.

(2) The cooling of air due to a forced ascent on meeting a mountain barrier. Rains caused by this means are spoken of as *relief* rains. Fig. 20 shows a moisture-laden wind approaching a mountain chain. It is compelled to rise and this causes the air to expand. Expansion causes a lowering in temperature and this produces rain. When the temperature falls to freezing point, snow will fall instead of rain. On reaching the leeward side of the mountains, the air begins to descend and consequently to increase in density and in temperature, and therefore

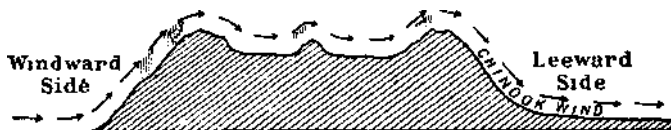


FIG. 20.—Chinook or Fohn wind.

in its capacity for holding water vapour. The increase in temperature is greater than that which was lost in ascending the windward slopes, so that the wind reaches the foot of the mountains on the leeward side a warm, dry wind. The names *Chinook* and *Fohn* have been given to such a wind. The former name applies particularly to the winds descending the leeward slopes of the Canadian Rockies, and the latter to the warm winds experienced in Swiss valleys, but the principle holds good in all particular cases, and therefore we may think of all such winds as Chinook or Fohn winds (see Ex. 1, at the end of the chapter).

There is a very close connection between the relief and rainfall maps of most countries, especially of those

in temperate latitudes. An examination of the two maps for the British Isles will show how close these relationships are in our own islands.

(3) The movement of air in cyclones causes expansion and therefore cooling and condensation. A cyclone is a pressure system in which the lowest pressure is in the centre from which the pressure rises towards the edges. In such a system the winds blow towards the centre and are deflected according to Ferrel's Law, so that, in the northern hemisphere, the whole system is rotating about its centre in a direction opposite to that of the hands of the clock. The centre of the cyclone remains an area of low pressure because the air which flows towards it is constantly rising and expanding. It is on account of this rising of air that cyclones are accompanied by falling rain. Cyclones are commonly experienced in the area of the westerly winds, and it is by their means that much of the rain that falls in these latitudes is brought.

(4) The meeting of air currents causes air to rise and expand, and therefore causes rainfall. This cause of rainfall is very similar to that which has just been considered. In the Doldrums belt, the N.E. and S.E. Trades meet, and air being forced upwards on a very large scale causes this region to be one of very heavy rainfall.

THE CAUSES OF DROUGHT.

Since any cause which can force large masses of air to be cooled will produce rainfall, any cause whereby air is warmed will tend to produce drought. It will not be necessary to go into these causes at length, for they are the opposite of those which produce rain. They are—

(1) Air flowing steadily from warm latitudes towards regions warmer still will increase its capacity for holding water vapour and condensation will not usually occur, unless by some means the air is suddenly cooled. The best examples of such air currents are the Trade Winds, and it is very striking that all the great deserts of the world are in trade-wind latitudes.

(2) There will be dry areas on the leeward side of most high mountain ranges.

(3) Anticyclones, usually masses of almost inert air, are systems of pressure, having the highest pressure in the centre and the lowest pressure towards the edges, and are fed by air descending from the upper atmosphere. They bring little or no rainfall.

(4) The Horse Latitudes are areas in which there is a descending of air, and they, too, are marked by drought.

THE DISTRIBUTION OF RAINFALL.

Figs. 21, 23 and 24 show respectively the annual, January and July distribution of rainfall over the surface of the globe. In studying these maps, constant reference must be made to the pressure and wind maps, and to the physical maps in an atlas.

MEAN ANNUAL RAINFALL.

A very general connection between Figs. 14 and 21 is evident. The belts of low pressure are areas of considerable rainfall, whilst the high-pressure belts are deficient in rain. This is illustrated in Fig. 22. The equatorial low-pressure area, the Doldrums, is one of heavy rainfall; the trade-wind areas contain most of the great deserts of the world, and in the low-pressure belts between the Horse Latitudes and the polar high-pressure areas there are other regions of considerable rainfall. Naturally, this requires to be considerably modified, for the actual distribution of pressure, as we saw in the last chapter, is not so regular as is shown in a diagrammatic manner in Fig. 22. Nevertheless, it is important to notice that there is a very close relationship between pressure and rainfall.

Fig. 21 is shaded to show areas which may be described as being well watered (over 25 ins.), moderately watered, or as having a deficient supply of rain. If this map is studied in connection with a relief map, and the dis-

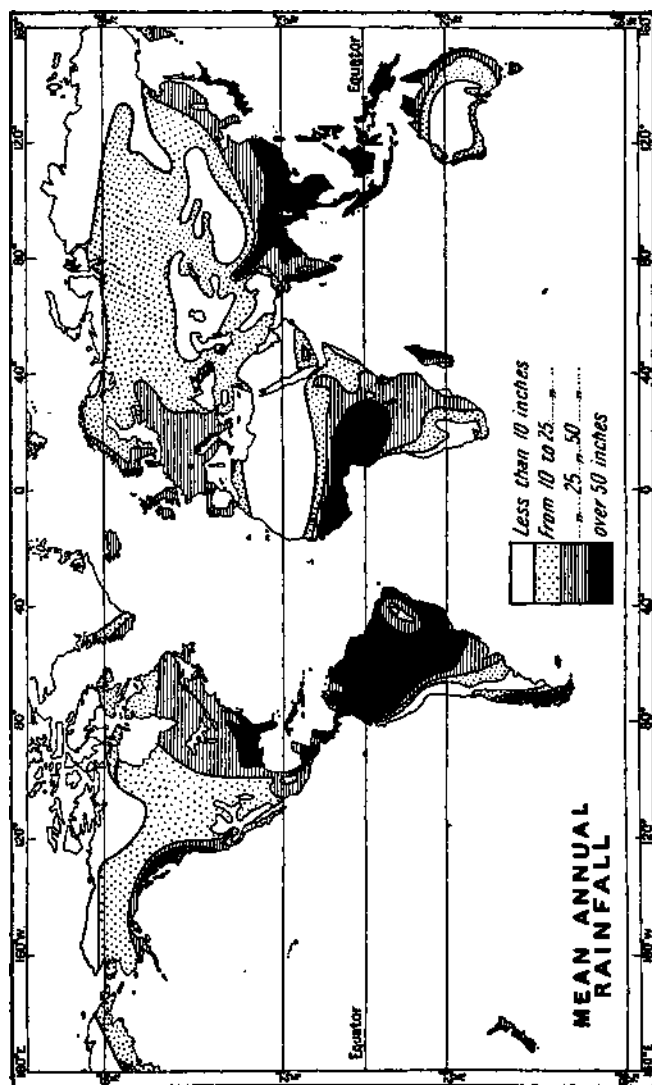


FIG. 21.—The mean annual distribution of rainfall.

tribution of pressure and the direction of the prevailing winds are kept in mind, Ex. 2 at the end of this chapter will serve as a test as to whether the principles which have been explained have been grasped or not.

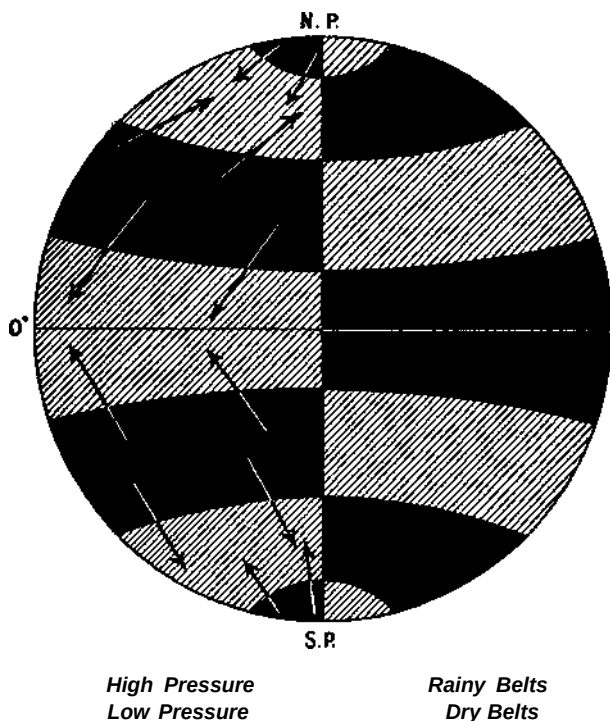


FIG. 22.—The relations between pressure and rainfall

DISTRIBUTION OF RAINFALL IN JANUARY AND JULY.

In January, the typical summer month of the southern hemisphere, the belt of greatest heat is south of the equator (Fig. 10). It is in January that the pressure

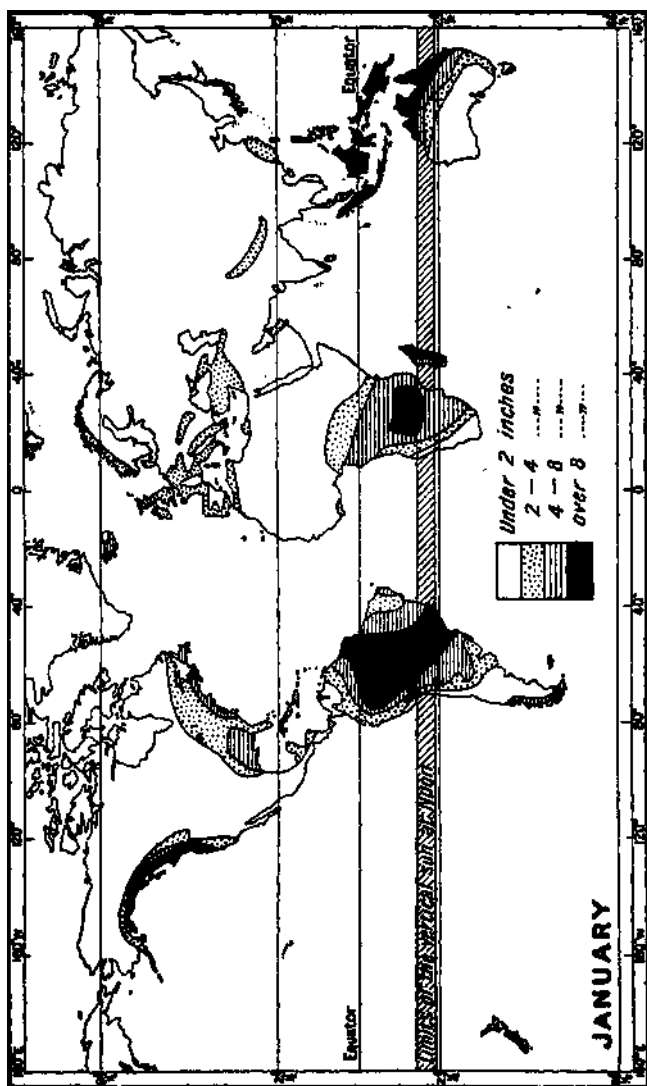
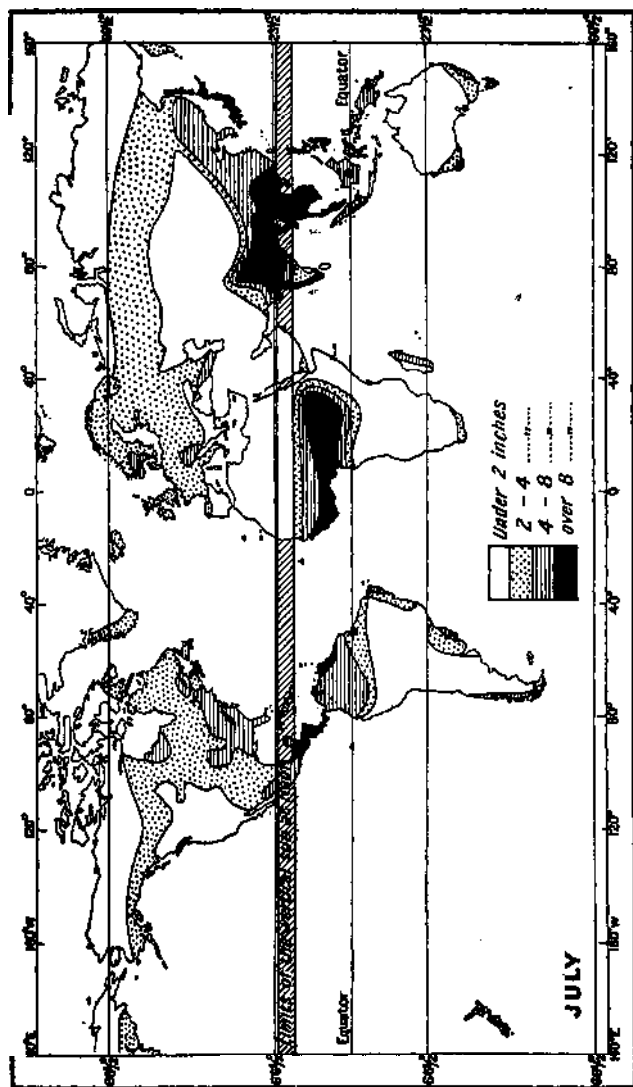


FIG. 23.—Mean rainfall for January. (After Herbertson.)

belts reach the southern limits of their migration. For these reasons, the regions of heaviest rainfall are all south of the equator in this month (Fig. 23). In July, the areas of heaviest rainfall are north of the equator, and this is due to the northerly migration of the temperature and pressure belts, a movement caused by the apparent migration of the sun (Fig. 24). These seasonal changes produce interesting results, as will be seen from an examination of Fig. 25. In the first column the approximate position of the high and low pressure belts is given for July, the month in which they are at their northern limit of migration. The second column gives the position of the various belts in the southern summer. It is at once clear that in the equatorial regions is an area which has low pressure all the year round. North and south of these are belts having low pressure in summer and high pressure in winter; these are succeeded by belts which have high pressure at all seasons. North and south of the latter are belts of low pressure at all seasons. Since areas of high pressure have little rainfall, it follows that certain of these belts will be wet at one season and dry at another, but it must be carefully observed that Fig. 25 only applies to the western margins of continents, for a wind which is there on-shore, *i.e.* blows from the sea to the land, will be an off-shore wind on the eastern lands in similar latitudes.

Let us apply Fig. 25 to the western coasts of Europe and Africa. From the north of Norway to the north of Spain is an area of rain all the year round, for the Westerlies are at all seasons the prevailing winds. From the Cantabrian Mountains to the Atlas Mountains is an area of winter rainfall and dry summers. This is succeeded by a belt of very little rainfall, and it is here that the Sahara Desert reaches the west coast of Africa. South of this is an area of summer rainfall, the Gambia and Senegal rivers having their mouths in this belt. The Guinea Coast and the Congo Basin receive rain at all seasons. South of the equator, the belts are repeated in reverse order, although there is



no counterpart of the West European type, for Africa

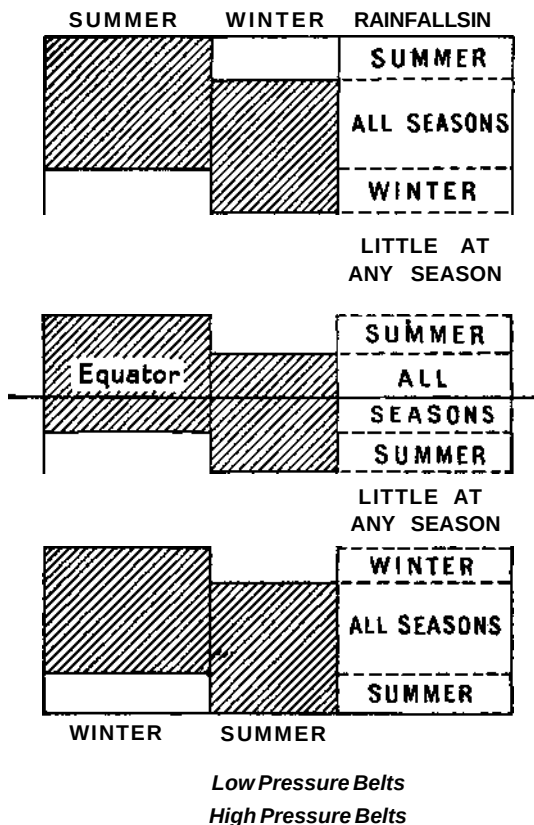


FIG. 25.—The influence of the migration of the pressure belts on the distribution of rain on the western margins on continents.

does not extend far enough south to have a belt in the prevailing north-westerly winds all the year round.

If we consider Figs. 23 and 24 together, it will be evident that some regions receive rain in winter and are dry in summer. They are on the west of continents and in the same latitudes as the two African winter rain areas which we have just considered. They are the lands bordering the Mediterranean Sea, the Valley of California, Central Chile, the south-west corner of Africa, the two southern protuberances of Australia and the north island of New Zealand. The winter rains and dry summers of all these lands are due to the migration of the pressure belts.

If we turn to Asia, we see a very striking contrast between the rainfall for January and that for July. In January, owing to this continent being under the influence of a huge high-pressure system (see Fig. 15), there are outflowing winds, and since these are dry, very little rain falls in this month except on the north-east coastlands, western Japan, in the Mediterranean lands to the east of the Mediterranean Sea, and on the Himalayas. In July, when a low-pressure system holds sway (see Fig. 16), there are inflowing winds, and since these have come over vast expanses of ocean, very great precipitation takes place, most of the continent, excepting the centre and the south-west, having a considerable amount of rain. The same causes in Australia give heavy rainfall in the southern summer to the northern margins. The winds which bring the heavy summer rain in south-east Asia and northern Australia are, as we have already learned, called monsoons.

Other lands of summer rainfall we should expect to find in the same positions as the African belts of summer rain, to which reference has already been made. In America we find that the north of South America, Central America, Mexico and the West Indies receive their rain mainly in summer; south of the Amazonian region of rain at all seasons is the Brazilian highland region of summer rain.

Owing to their great distance from the sea, we also

find that the interior lands of the great continents receive rain in summer, when they are under the influence of low pressure; but as they are far from the sea, such places have only a moderate rainfall.

EXERCISES.

1. Why is it that—

- (a) Sweden is drier than Norway?
- (b) The east of the South Island of New Zealand is drier than the west?
- (c) The northern Andes have heavy rainfall on their eastern slopes and an almost rainless area on their western slopes, and that these conditions are reversed in the southern Andes?

2. Write a short account of the mean annual distribution of rainfall as shown in Fig. 21. Give reasons for heavy rainfall in equatorial latitudes, the presence of rainless areas in the trade-wind regions, the heavy rainfall of the western margins in temperate latitudes, and the slight rainfall in the interior of the great land masses.

3. What is meant by saying that the mean annual rainfall of London is 25 inches? How has this figure been obtained?

4. Explain clearly why it is that the rain belts migrate northwards in our summer and southwards in the southern summer. What are the principal results of this migration?

5. On p. 50 figures are given showing the amount of water vapour which air at different temperatures can hold. Represent these figures graphically and write a summary of the important facts illustrated by the graph.

6. Describe a coastal region of deficient rainfall. Account for its aridity.

CHAPTER VII.

THE DISTRIBUTION OF NATURAL VEGETATION.

THE land surface of the earth is covered naturally with plants, except in those regions where it is either too high, too cold or too dry for any vegetation to exist. Generally speaking, regions of heavy nunjfallare forested, regions of light-rainfall are grasslands, and~those which lack moisture are deserts. The type of forest, grassland or desert will depend largely upon the temperature, so that there are tropical and temperate forests and grasslands, and tropical, temperate and cold deserts.

., Soil has an important influence upon-vegetetion,for some plants thrive best upon particular soils, as, for example, the beech thrives on a soil rich in lime. For most plants the presence of salt is fatal, but the mangrove and the coconut palm appear to like its presence. Different soils vary very much in their capacity for holding moisture, whilst plants differ in their capacities for extracting moisture from different soils. Some soils, again, are naturally very in fertile owing to the character of the rocks from which they havel been formed.

Fig. 26 shows the general distribution of natural vegetation, but it must not be supposed that the boundaries between the various types can be defined very clearly, for there is a gradual merging of one type into another. Deserts gradually become grasslands through an intermediate scrubland which is notable for its scattered grass patches and low, dry bushes. Grasslands merge into forests very gradually, for between areas which are typical forests and those which are typical grasslands, the scenery first resembles natural parkland—

a mixture of grasslands and woodlands—and very gradually becomes more wooded as the true forests are approached.

In studying Fig. 26 it is very important that constant reference should be made to the temperature and rainfall maps in Chapters III and VI, so that the connections between temperature, rainfall and natural vegetation may be clearly understood.

HOT WET FORESTS.

Forests of this type are found in (i) the hot wet equatorial belt; (ii) in lands having so much rain in their wet season that the soil holds a considerable amount of moisture all the year round. The former are sometimes called equatorial forests, and the latter monsoon rain forests. Equatorial forests are found chiefly in the Amazon basin and on the wet east coasts in South America; on the Guinea coast, and in the Congo basin in Africa; and in the Malay Peninsula and the East Indies. In these forests the vegetation is exceedingly dense, even the undergrowth attaining forest dimensions, whilst the giant trees are linked together by a mass of creepers and parasitic vegetation. The floor of the forest is gloomy in the extreme, and its inhabitants are amongst the most backward races in the world. So solid are these forests that the rivers, which at the rainy seasons resemble long, narrow lakes, are the only easy ways of communication. The various trees which yield rubber are the most important trees, although there are valuable cabinet and dye woods, such as mahogany, ebony, logwood, etc., but the present difficulty of access is so great that these sources of wealth are practically untouched. Guttapercha trees are of great importance in the East Indies, and oil palms in the equatorial forests of Africa.

The forests of S.E. Asia and North Australia are not so dense, as here there is a well-marked dry season.

THE HOT GRASSLANDS OR SAVANNAHS.

Savannahs, or parklands, are grasslands interrupted by isolated patches of trees. They are found in tropical latitudes, in regions which have warm, dry winters and hot summers, with a small rainfall in summer. Fig. 26 shows that their distribution is closely related to the summer rainfall belts north and south of the equatorial belt of rain at all seasons. As the summer rainfall is not heavy, trees cannot grow excepting in places where there is a constant supply of water, *e.g.* near rivers, for the rainfall is not sufficient to keep the soil moist at all seasons. The climatic conditions are suitable for the growth of grass which springs up, produces flowers and seeds, and dies in a short time. As we should expect, one of the chief occupations on the savannahs is cattle rearing. The temperature is unsuitable for sheep.

In South America there are extensive savannahs north of the equator in the Guinea highlands and the llanos of the Orinoco Valley, and south of the equator in the Brazilian highlands. In Africa they are found north, east and south of the equatorial forests, and in a very similar position in Australia. Asiatic regions in these latitudes receive so much summer rain that, as we have already seen, they are forested.

THE HOT DESERTS.

The savannahs gradually merge, through intermediate scrublands, into deserts. The hot deserts lie chiefly on the west of continents in the latitudes of the Trade Winds. In North Africa there is the enormous Sahara desert stretching from the Atlantic Ocean to the Red Sea, and continued eastwards in Asia by the deserts of Arabia and Thar. South Africa has the Kalahari desert. In similar latitudes in South America are the long, narrow, west coast deserts of northern Chile and Peru. They lie to the lee of the Andes. In North America we have the Colorado desert, and in Australia the great western desert. There are also the extensive desert lands on

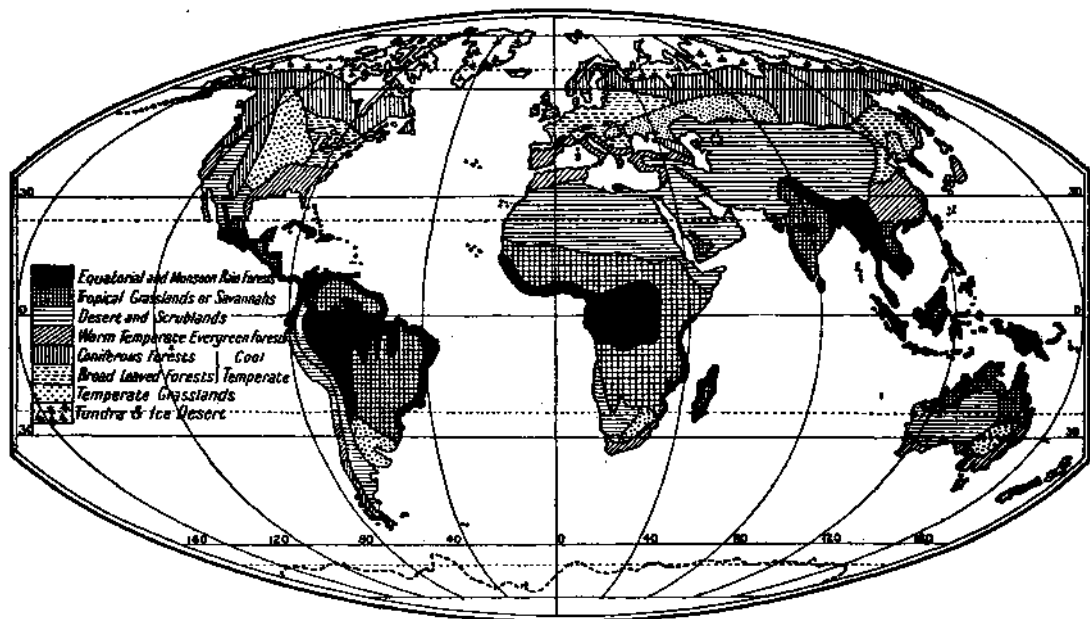


FIG. 26.—The distribution of natural vegetation.

high plateaux and in the interior of the great Asiatic land mass. Examples of these plateaux and interior desert and semi-desert lands are found in the western cordillera of North America, in the plateau of Iran, and in the deserts of Turan and Gobi.

Except where there are underground supplies of water, there are very few plants on deserts. Desert plants must either have very long roots, so that they can reach this underground water, or thick, fleshy leaves to store up water. The leaves, which are designed to resist the evaporation of moisture from the plant, are often very small and protected by means of thorns. On the scrub edges of the desert, trees which exude gum in the dry season are often met with. The acacia is a good example.

Even in the desert, wherever there is a permanent supply of water from wells or from rivers which flow across deserts but rise in wet lands, cultivation can take place, while by means of irrigation, many arid lands have been reclaimed, especially in North Africa, North America and Australia.

TEMPERATE FORESTS.

These are of two varieties: (1) *warm temperate*, which are found roughly from latitude 30° to latitude 45° , and (2) *cool temperate*, from latitude 45° to latitude 60° .

(1) WARM TEMPERATE FORESTS.—Fig. 26 shows that these are found on both east and west sides of continents. The rainfall maps show that whilst the western regions receive most of their rain in winter, the eastern regions have summer rainfall. This will naturally have its influence upon the vegetation. Whether on the east or the west, these forests are evergreen; but in the eastern forests the leaves are usually very large and thick, as, for example, the leaves of camellias and magnolias, whilst the trees in the various "Mediterranean" regions of winter rainfall

have usually either small, dry leaves, as, for example, the olive, or leathery leaves like those of the laurel.

Forests of the western or Mediterranean type are found in the lands of winter rains bordering the Mediterranean Sea; in California, Central Chile, south-west Africa, south-west and south-east Australia, and in the north island of New Zealand. The chief trees are evergreen oaks, including the cork oak, walnut, chestnut, and some species of pine. In most of these regions, vines, olives and mulberries are cultivated. In Australia the chief trees are the acacia and the eucalyptus, each of which has its leaves hanging edgewise, so that little shade from the sun's heat is given.

(2) COOL TEMPERATE FORESTS.—As in the case of the warm temperate forests, the cool temperate forests may be divided into two groups: the coniferous and deciduous forests. The former are found where the winters are severe, the summers short and the rainfall inclined to be deficient, whilst the deciduous or broad-leaved forests are found in regions where the temperature conditions are more genial and the rainfall is fairly abundant.

(a) *Coniferous Forests*.—The chief conifers are pines, hemlocks, firs and larches, but the hardy birch, which is deciduous, is a common tree in coniferous forests. The leaves of most of these trees are needle-like in structure, and thus transpiration is checked, for little surface is exposed. As a general rule, these trees retain their leaves during the long winter, which is not with all species a resting season, for the summer is so short that the comparatively warm periods at the beginning and end of winter are taken advantage of.

The most extensive coniferous forests are found in northern Europe, Asia and America. They give shelter to large numbers of fur-bearing animals, and thus trapping is usually the first occupation carried on. Later come the lumber-men, who cut down the trees, which are used for many different purposes, such as doors, window-frames, flooring, etc., whilst they also

yield turpentine, pitch, resin and wood pulp. In deforested areas where the climatic conditions are suitable, agriculture is carried on. Some regions have undergone all these stages of development, whilst some, as, for example, the forests of eastern and northern Siberia, are still in the trapping and hunting stage.

Coniferous forests are sometimes found in regions of more genial climates than those of the ordinary forests of this type. Under these conditions, the trees often attain gigantic dimensions, as on the west coast of North America, where the famous Douglas firs and giant pines are found.

(b) *The Broad-leaved Forests.*—The chief trees in these forests are the oak, beech, elm and maple. In autumn the leaves fall, and thus transpiration is checked. The flowers are not very prominent, and most of them are wind fertilized. In this respect these forests offer a marked contrast to those of hot lands, where the trees have brilliantly coloured flowers. The distribution of broad-leaved forests is shown in Fig. 26, and their positions as compared with those of the coniferous forests should be noticed. From the greater part of Western Europe and eastern North America the natural deciduous forests have disappeared, and in their place we find agricultural and industrial regions.

TEMPERATE GRASSLANDS.

These, known in particular places as prairies, pampas or steppes, are found in regions having very warm summers and cold winters, with a moderate to slight rainfall in summer. Fig. 26 shows that these regions are usually in the interior of great land masses, for it is there that these climatic conditions are met with. The rainfall is not sufficient to keep the soil moist at all seasons, so that trees are found only near rivers. It should be noted, however, that in some places there are other reasons, *e.g.* strong winds or porous soil, why trees do not grow. The prevailing vegetation everywhere is grass, so that these

NATURAL VEGETATION

regions are noted pasture lands, whilst in those parts where the rainfall is sufficient, large tracts are used for the growth of cereals. Most of the wheat of the world is now grown in areas which were once natural grasslands.

The seasonal changes, the green of late spring and early summer, the brown of late summer and autumn, the snowy mantle of winter, and the carpet of bulbous flowers in early spring, form a most enchanting cycle of changes.

THE TUNDRA AND ICE-DESERTS.

The poleward limit of coniferous forests is approximately the July isotherm of 50° F., for unless that temperature is attained during at least one month, trees cannot thrive. North of that line is the tundra, which is really a cold desert whose total precipitation is less than 10" per year. In the long winter the ground is snow-covered, but during the short, warm summers the lowlands often assume a meadow-like appearance, bright with numerous flowers. They are not merely lands where only stunted berry-bearing bushes, mosses and lichens grow. There are no tundra lands in the southern hemisphere.

Towards the poles are wildernesses of ice and snow which are practically devoid of life. Such lands are found in Greenland, in many of the islands to the north of Canada and Asia, and in the Antarctic continent.

THE INFLUENCE OF ALTITUDE UPON VEGETATION.

We have seen that latitude has a great influence upon vegetation; the equatorial forests are very different from the temperate forests and the hot deserts from the tundra. Altitude, too, has a great influence. Many mountains in equatorial latitudes are snow-capped all the year round. The dense equatorial forests at the bases of these high mountains, e.g. Ruwenzori in Central Africa, give way very gradually to evergreen, warm temperate, broad-leaved coniferous forests. Above

these levels the trees become scattered and dwarfed, and there are parts which are snow-covered in winter, but the melting of the snow in spring provides moisture for the growth of grass and many kinds of beautifully coloured flowering plants. Still higher than these meadow-like lands are areas resembling the tundra, whilst beyond that the snow lies on the ground all the year round. Thus, in ascending a high mountain situated close to the equator, somewhat the same changes in vegetation are experienced as in a journey from the equator to the polar regions, such is the great effect of altitude upon vegetation (see Fig. 41).

On the high dry plateaux, *e.g.* Tibet and Bolivia, there are extensive areas with a semi-desert type of vegetation, consisting chiefly of coarse grasses and scattered patches of bush.

EXERCISES.

1. Explain why it is that the vegetation belts on the west of continents differ from those on the east.
2. State and account for the distribution of Equatorial forests.
3. Examine the different types of natural vegetation found in your home district.
4. What are the climatic reasons for the distribution of the great deserts of the world?
5. What are the chief types of natural vegetation that would be encountered in a journey (*a*) from the White Sea to the Caspian Sea, (*b*) from the mouth of the Nile to Lake Victoria, (*c*) across Canada by the Canadian Pacific Railway? Account for the differences you mention.
6. Give examples of the connections between the natural vegetation and the chief occupations of a region.
7. Obtain pictures of each type of vegetation and fix them in your note-book, along with your notes.

CHAPTER VIII.

ASIA: PHYSICAL FEATURES.

IN previous chapters we have been considering the outlines of the world distribution of temperature, pressure, winds, ocean currents, rainfall, and natural vegetation, and we have shown the relations which exist between these various factors. We shall now turn our attention to the continent of Asia; and, whilst studying it, we shall pay particular attention to the principles which we have learned and apply them in more detail, although, of course, it is necessary that our study should have a wider outlook than merely the study of questions involving climate and natural vegetation.

THE POSITION AND SIZE OF ASIA.

If we examined a globe, we should see that Asia lies to the east of Europe and North Africa, and that the whole of the mainland is north of the equator. Its most northerly point, Cape Chelyuskin, is within 13° of the North Pole, and its most southerly, Cape Romania, is only 1° north of the equator. The distance "Between these capes is over 5,000 miles, whilst in an east and west direction the continent extends for an even greater distance. Asia is thus an enormous land mass. It is the greatest of all the continents, being four and a half times the size of Europe, and containing within its frontiers about one-third of the total land surfaces of the world. In shape, Asia is a rough quadrilateral, with three very large southern peninsulas, Arabia,

PHYSICAL FEATURES AND STRUCTURE 73

India, and Indo-China. On the east coast are the smaller peninsulas of Kamchatka and Korea, and on the west the plateau peninsula of Asia Minor.

PHYSICAL FEATURES AND STRUCTURE.¹

A physical map of Asia shows a great belt of highlands stretching across the continent from west to east. In Asia Minor this belt is fairly wide. It widens out in the plateau of Iran, but in the Pamir Plateau, to the north-west of India, it is very narrow. From this point it rapidly widens, until in the east it occupies an area stretching through almost the whole breadth of the continent. North of this high belt are vast plains stretching to the Arctic Ocean, into which they are drained, except in the west, where the lowest parts of the plains are occupied by the salt Caspian and Aral seas. In the south of Asia there is the deeply trenched plateau of South India, the Deccan, which is an old block so tilted that it presents in the west a steep face to the Arabian Sea, and gradually slopes eastwards to the Bay of Bengal. The Deccan is separated from the central belt of highlands by the plains of the Ganges and the Indus. In the south-west there is the Arabian plateau, tilted in the same manner as the Deccan, and separated from the central highlands by the Persian Gulf and the plains of the Tigris and Euphrates. In the east are many broad plains, drained by great rivers. The chief are those of the Amur, Hwang-ho, Yangtse-kiang, and Si-kiang. Lastly, we have the archipelago of the East Indies, and the eastern festoon of mountainous islands stretching from the peninsula of Kamchatka, through the Kurile Islands, Japan, and Formosa to the Philippines.

From this brief account, it will be seen that Asia may be divided into four physical units—

¹ See Book I of this series for an account of the formation of plateaux, plains, folded mountains, etc.

- I. The north-western lowlands.
- II. The central highlands and plateaux.
- III. The southern plateaux.
- IV. The eastern margins and island ranges.

Reference to the map will at once show that the great north-western lowlands, the central highlands east of the Pamirs, and the Indian plateau are all triangular.

I. THE NORTH-WESTERN LOWLANDS.

The only important break in the continuity of the great plain which stretches from the North Sea to the central highlands of Asia is formed by the Ural Mountains. But these mountains are not high enough to form a really serious barrier, either as regards climate, vegetation or communications, so that we must regard the whole of this vast plain—the greatest in the world—as one, although in this book we shall only consider its eastern or Asiatic portion. Fig. 27 shows the structural divisions of Asia. It will be seen that these vast plains consist, for the most part, of sedimentary rocks, which lie in horizontal layers, unfolded and undisturbed. One addition to this statement must be made. The greater part of the West Siberian portion of the 'plain' is shown as being covered with recent deposits. This region is very flat and low, so that the rivers have not sufficient speed to carry along the load of silt which they bring from the mountains. They are compelled to spread this over the land in times of flood, and in this way this portion of the plain has been largely covered by alluvium. The eastern lowlands, drained by the Yenisei and the Lena, are narrower, but higher, and therefore less swampy.

Whilst the great north-west lowlands are drained mainly to the Arctic Ocean by the three long rivers, Obi, Yenisei and Lena, the south-western Turan plains contain the large Aral Sea, which is the centre of an area of continental or inland drainage, for the rivers flowing into it never reach the sea.

THE CENTRAL HIGHLANDS

IL THE CENTRAL HIGHLANDS.

These highlands are continuous with those of Europe, and form the highest and greatest mass of mountains in

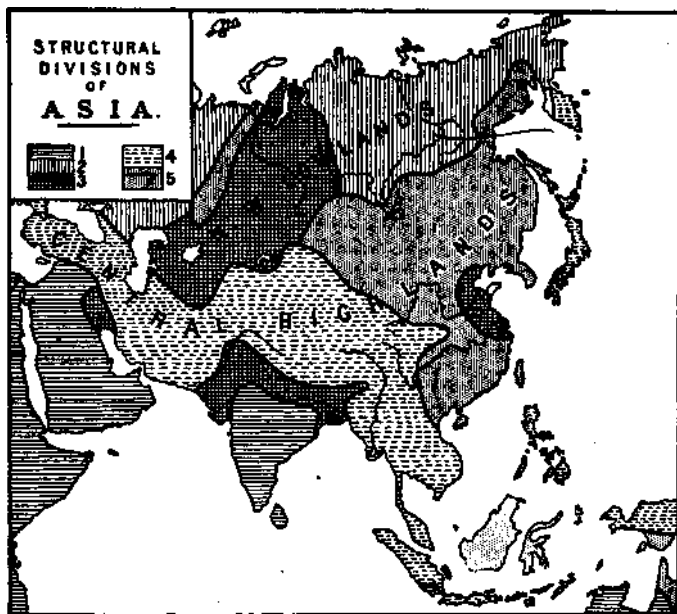


FIG. 27.—The structural divisions of Asia,

- x. Plateaux of unfolded rocks.
- 9. Unfolded lowlands.
- 3. Unfolded lowlands of recent deposits.
- 4. Folded mountains and enclosed plateaux.
- 5. Highlands of rocks folded in ancient times, now greatly denuded and fractured.

the world. They consist of mountain chains, generally running in an east and west direction, between which are lofty plateaux, which are wider in the east than in the west. Fig. 27 shows that the central highlands may be divided into two structural groups, a series of parallel folded ranges enclosing plateaux and

valleys, and a much older eastern mass which originally consisted of folded ranges, but has been very much worn down. In the first group three distinct chains can be traced by the aid of a physical map. The three chains' come very close together in the Pamirs, and on that account we find there the highest region in the world. It is often called the "roof of the world." The first chain is represented by the Caucasus and Tien Shan mountains: the second, or central chain, by the Pontic, Elburz, Hindu Kush, and Kwen Lun mountains. Between these chains lie the great basins of the Black Sea, the Caspian Sea, and the Tarim basin. The third, or southern range, is a series of great loops, and includes the Taurus, Zagros, Sulaiman, and Himalaya mountains, whilst between the central and southern ranges are the plateaux of Asia Minor, Iran, and Tibet. To the east of Tibet, where the older highlands formed a great centre of resistance and turned the folded ranges southwards, is a series of north and south chains, traversing Indo-China. Between these ranges are densely forested valleys, drained by such large streams as the Irawadi, Salwin, and Mekong. The ranges of western Burmah are continued through the Andaman and Nicobar Islands, Sumatra, Java, and the Lesser Sundas, where they once more become east and west in direction. Fig. 48 shows that the islands west of a line passing between Bali and Lombok (east of Java), and between Borneo and Celebes, stand on a shallow submerged platform. At one time they were joined to Asia, as were the Philippines, although the latter appear to have been separated from the mainland at a much earlier time than the others. We shall find further evidence of the former connection of these islands with Asia when we speak of their plants and animals.

The older, eastern highlands are not so lofty as the younger mountains we have just traced. They consist of:—(i) the mountainous area surrounding Lake Baikal and extending from the Altai Mountains to the south-west of the lake, to the Yablonoi Mountains to the east;

(ii) the plateau of Mongolia, which ends abruptly in the Khingan Mountains in the east and stretches as far southwards as the North China Highlands. The Khingan Mountains have a steep slope to the Manchurian Plains and a gradual one to the Desert of Gobi. They owe their origin to the faulting and tilting of a huge block of the earth's crust. The east and west ranges of South China, known as the South China Highlands, the mountains to the east of the plain of Manchuria, the highlands of Korea, and the island of Borneo also belong to the older eastern highlands.

III. THE SOUTHERN PLATEAUX.

These are the plateaux of Arabia and the Deccan in Southern India. Arabia is very similar to the African plateau, from which it has been separated by the subsidences which made the Red Sea. It is composed of sedimentary rocks of great age and is tilted, so that it has a long, gradual, eastern slope and a steep slope to the west and south-west. The map shows that the Deccan is tilted in the same way as the Arabian plateau, so that its longest rivers run eastwards to the Bay of Bengal, and it presents a steep face, the Western Ghats, to the Arabian Sea. South of the Deccan is the island of Ceylon, and between the two are the island stepping stones known as Adam's bridge. Ceylon is a detached portion of the Deccan, to which it was formerly joined.

These two plateaux at one time formed part of an ancient continent which stretched thousands! of miles in an east and west direction. Extensive faultings and subsidences caused the breaking up of this old land mass, and formed the present oceans which now separate the remaining portions from each other. The remnants of this old continent are shown in Fig. 28.

Between Arabia and the plateau of Iran, and between the Deccan and the folded mountains to the north of India are extensive lowlands drained by very long rivers. The Persian Gulf at one time extended much

farther to the north-west, but it has been filled up by the sediment brought from the surrounding mountains by the Tigris and Euphrates and their tributaries, and in this way the alluvial plain of Mesopotamia has been made. In the same way, the rivers of the Indus and

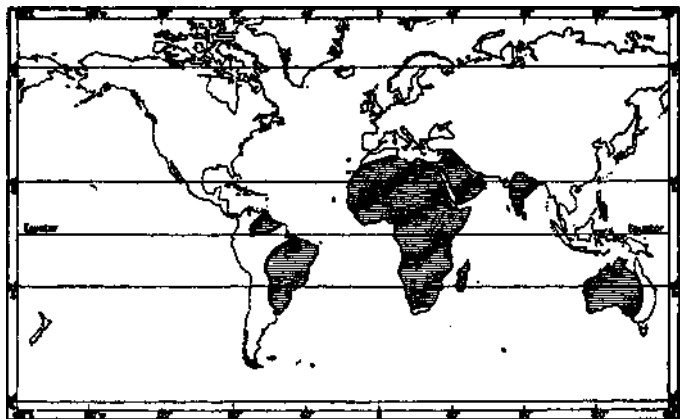


FIG. 28.—The great southern plateaux of unfolded strata. It is thought that they were once part of an ancient continent which geologists call Gondwanaland.

the Ganges systems have built the extensive alluvial plains which now separate the Deccan from the northern mountains of India. All these rivers have deltas which are being pushed out farther and farther every year.

IV. THE EASTERN MARGINS AND ISLAND RANGES.

The true eastern limits of Asia are to be found in the festoons of islands south of the peninsula of Kamchatka. This peninsula is continued southwards through the Kurile Islands, the Japanese Islands, the Lu-chu Islands and the Philippines. The ranges of these islands are largely volcanic.

Of the volcanoes, Fuji-San, Japan's sacred moun-

tain, has the most perfect cone. Fig. 66 shows that this volcanic belt extends all round the margins of the Pacific Ocean; it is sometimes called "The Fiery Ring of the Pacific." Between the mainland and the inland chain are the seas of Okhotsk, Japan, Yellow, East and South China. Of these, the Yellow and East China seas are the shallowest. They all occupy basins made by the subsidence of blocks of the earth's crust.

The chief rivers draining the eastern margin are the Amur, the Hwang-ho or Yellow River, and the Yangtse-kiang. The map shows that they rise far away in the central highlands and have extensive lowlands in their lower courses.

In this short account of the physical features and structure of Asia we have seen that the continent is of enormous size. It stretches through about 76 degrees of latitude, it has extensive plateaux, it has the highest mountain ranges in the world as well as vast plains, whilst tracts along the shores of the Caspian Sea are below sea-level. We shall, therefore, expect to find strong climatic and vegetation contrasts, ranging from the cold deserts of the north to the equatorial forests of the south, from the bleak, sparsely peopled plateau of Tibet to the densely peopled lowlands of China and north India. Asia is a continent of great contrasts.

EXERCISES.

1. On an outline map of Asia mark all the chief rivers and shade the map so as to show the land drained:—(a) to the Arctic Ocean, (b) to the Pacific Ocean, (c) to the Indian Ocean, (d) to the Mediterranean, (e) area of inland or continental drainage. Write a brief description of this map.

2. Draw a map of Eastern Asia, and the eastern volcanic chain of islands. Shade boldly the sea deeper than 100 fathoms, and the land above 600 feet. Mark the chief rivers.

3. Using the relief map in your atlas, draw a section from the Ganges plains to the north coast of Asia.

4. Give reasons why you would expect many political frontiers to meet in the Armenian Highlands and in the Pamirs.

5. Explain the terms:—alluvial plain; folded mountain; inland basin; escarpment. Give Asiatic examples of each.

CHAPTER IX,

ASIA: CLIMATE AND NATURAL VEGETATION.

IN earlier chapters we have considered temperature, pressure and winds, and rainfall as applied to the whole world. We must now summarize the chief facts as they concern the continent of Asia. From what we have learned in the last chapter it is not difficult to see that two outstanding factors will have a very considerable influence upon the climate of Asia. The first is its great extent in latitude, and the second its very varied relief. As regards the latter, it must constantly be borne in mind that the temperature and pressure maps have been corrected to sea-level readings.

TEMPERATURE.

Fig. 10 shows that a large proportion of the land has a temperature below freezing point in January.-The isotherm of 32° F. is a very important one, for it means that those plants which cannot flourish where there are severe winter frosts, will not grow in parts where the temperature falls below the freezing point for a whole month or more. It will be seen that the only parts which are free from frosts in winter are in the south and south-east. Now turn to Fig. 11, which shows that in July the greater part of the continent has a temperature exceeding 68° F., whilst the areas in which little rain falls (Iran and Arabia) have a very high temperature indeed, as there is little or no covering of cloud to lessen the heat. Notice the position of the isotherm of 48° F. This is important, because it marks

the northern limit of trees which must have at least that temperature during the warmest month. The influence of the Indian and Pacific oceans is seen in the lower temperature of the coastlands compared with those of the dry areas just mentioned, and in the northerly bends of the isotherms on the east coasts. The great facts to keep in mind are the contrasts between the cold of winter and the heat of summer experienced by the interior lands. Now let us consider a few actual figures—

Place.	Lat.	Long.	Height in feet.	Mean temperature in coldest month.	Mean tempera- ture in hottest month.
Verkhoyansk .	67° N.	133° E.	330	- 60° F.	60° F.
Yakutsk .	62	129	330	- 47	66
Tomsk .	56	85	395	- 3	66
Tobolsk .	58	68	345	— 2	64
Tashkent	41	68	300	30	81
Trebizond	41	40	100	41	75
Smyrna .	38	27	33	47	80
Aden	12	13	0	76	84
Bombay	19	73	35	75	85
Calcutta	22	88	20	65	86
Rangoon	16	96	40	75	85
Singapore	1	103	10	78	82
Hankow	3°	114	140	38	83
Shanghai	31	121	35	38	81
Peking .	40	116	130	23	80
Tokyo	35	140	65	37	78

The first group is taken from the great north-west low-lands. All have an extreme climate which is more extreme in the north-east than in the south-west, although the south-west portion of the plains has a much **hotter**

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EDITOR'S INTRODUCTION

THE time has gone by when it was thought possible that a textbook of geography should be equally suitable for pupils at different stages of advancement, so that a series of books suited to different stages is necessary for use in schools. Regions may be studied in different orders suited to different circumstances and aims, and, to be entirely satisfying, each scheme of study should have a special series of books. The series, of which this book forms one, is designed to fit a particular scheme—i.e. that in a secondary school in the years at the end of which is one of the First Public Examinations of the type of the London General School Examination, a scheme which has for many years been found in practice to be extremely satisfactory at the William Ellis School.

Three of the volumes cover the world regionally in three years; the fourth contains much of the preceding matter in a condensed form, together with a few additions on subjects which are more profitably studied after other work has been done. Account is taken of the fact that the pupils are advancing in ability, so that, while there is a certain uniformity in that each book provides a north and south section of the world, yet the arrangement is such that the matter increases in difficulty. The series supplies textbooks for a complete school course in geography which includes physical as well as regional geography, and the order in which regions are taken depends to some extent on the desirability of studying particular sections of physical geography in a suitable order.

After the Americas in Book I, Asia and Australasia are selected for treatment in Book II. Here the geography of man is much more complicated, and the related physical geography, including, as it does, such phenomena as monsoons, necessitates the study of more climatic material than is found in Book I. At the same time the fact that the volume treats of a north and south section of the world allows of revision of previous work by comparison and contrast.

JAMES FAIRGRIEVE.

PREFACE

THIS book is the second of a series of four intended to cover the geography course for the four years leading up to and including the year in which an examination of matriculation standard is taken. From the very earliest years of teaching reference is constantly being made to matters pertaining to climate. The writer has found from experience that pupils who have arrived at this age are particularly interested in the meteorological side of geography, and are old enough and sufficiently advanced to draw together and organize, as well as to add to, previous teaching. Therefore the first seven chapters are designed to accomplish this, and to show in a clear and simple manner the broad connections existing between temperature, pressure and winds, rainfall, etc., and to carry these connections one step farther by showing the influence of all upon the distribution of natural vegetation. More difficult matters, such as the study of the Daily Weather Report and the division of the world into its major natural regions, are left for full consideration at a later stage. Chapters VIII to XVIII deal with the regional geography of Asia, and whilst the work covered in the earlier chapters is illustrated and emphasized in a concrete manner, the treatment is not unduly biased, and the method follows broad lines. The remaining chapters are devoted to Australasia, in studying which it is possible, not only to test whether the principles already learned have been understood, but also to note the differences that occur through its position in the southern hemisphere as contrasted with the situation of Asia north of the equator.

At the end of each chapter there will be found a number of questions and exercises. They are designed to test the pupil's powers of assimilation and originality; and of course it is not intended that answers should be *written* to all, nor are they by any means the only suitable exercises which may be set.

Teachers will find Book II, the *New Regional Map Books*, by V. C. Spary, B.Sc., published by the University of London Press Ltd. (price *is.*) of considerable value for use with this book.

As the author is a Divisional Inspector of Schools under the London County Council, the rules of that Authority make it necessary for him to state that the Council is in no way responsible for the book or for any of the statements in it.

L. B.

**44 Wildwood Road,
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June 1938.**

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BOOK II

ASIA AND AUSTRALASIA

CHAPTER I.

THE EARTH AS A GLOBE.

LONG before the birth of Christ men believed that the earth was a sphere, and in support of their views put forward some of the arguments with which we are now so familiar. But during the Middle Ages, and right up to the time of Columbus, the most absurd views of the earth's shape were held. Sailors believed that the earth was like a shield, and that if they arrived at the edge, their vessels would fall off into space. It was the voyage of Columbus which compelled men to pay more attention to the older and truer notions of the earth's shape.

Over three hundred years before the Christian Era, it was noticed that when the earth came between the sun and the moon, thus causing the shadow of the earth to be cast on the moon, the edge of the shadow was always part of a circle. Cones, cylinders and bodies shaped like a penny can be made to cast circular shadows in some positions, but the only body which casts a circular shadow *in all positions* is a sphere.

Early in the first century, sailors had already noticed that as they approached land, the latter was first visible from the top of the mast. We now generally state this

from the standpoint of an observer looking out to sea, from which point of view the mast becomes visible first, and later, the hull. Again, the horizon, as seen from the deck of a ship, is circular in shape, and if you climb high up the mast, the horizon still remains circular, but its distance from the ship has increased. The same would be noticed on land, but it is not so easy to see the circular horizon, owing to the hills, trees and buildings. Many other reasons for believing that the earth is spherical, or nearly so, could be given, but since they are mainly the result of somewhat complicated observations by astronomers and mathematicians, it will not be necessary to discuss them here. One very simple fact, which proves that the earth cannot be flat, should be mentioned. A ship can leave Liverpool, sail westwards across the Atlantic Ocean, pass through the Panama Canal, and continue its journey across the Pacific Ocean. It can return to Liverpool *via* the Red Sea, the Sue/ Canal and the Mediterranean, after having sailed round the world. If there were no land masses to interfere, it would be possible for our ship to sail round the world on any parallel of latitude.

Scientific men have determined for us not only the shape, but the size of the earth. We know that it is not quite spherical, and that it is very slightly flattened at the poles. This flattening is so slight that an observer would not be able to detect it on the largest of artificial globes made to scale, for the polar diameter is only 26 miles less than the equatorial diameter. The circumference of the earth is rather less than 25,000 miles, and the diameter nearly 8,000 miles.

So far as we know, the first attempt at measuring the size of the earth was made by a Greek named Eratosthenes, who lived about 200 years before the birth of Christ. At Syene, now Assuan, there was a very deep well, and noticing that the image of the sun could be seen on midsummer day at the bottom of the well, he came to the conclusion that on that day the sun was overhead, and therefore the place was on the Northern

Tropic. Eratosthenes lived at Alexandria, and he set himself the task of finding out what was the angular difference between the height of the sun on midsummer day at Syene and at Alexandria. By observations at Alexandria he found that this difference was $7^{\circ} 12'$. The next thing he required was the linear distance between

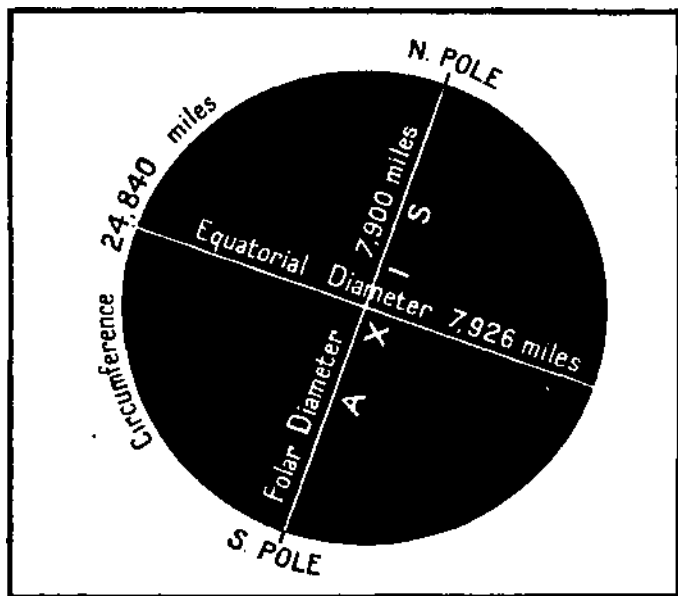


FIG. I.—Diagram illustrating some earth measurements.

Alexandria and Syene, and since even in those early days there was a good system of land survey in the Nile Valley owing to the annual floods, he had no great difficulty in obtaining this. He found the distance required was 5,000 stadia, which is 500 miles. Then he reasoned that, since a distance of 5,000 stadia subtended an angle of $7^{\circ} 12'$, the circumference of the world must

THE EARTH AS A GLOBE

be as many times 5,000 stadia as $7^{\circ} 12'$ are contained in 360° . Thus he calculated:—

$$\begin{aligned}\text{The world's circumference} &= \frac{360}{7^{\circ} 12'} 12' \times 5,000 \text{ stadia} \\ &= 250,000 \text{ stadia,} \\ &= 25,000 \text{ miles (10 stadia = 1 mile).}\end{aligned}$$

Many faults can be found in this calculation. For example, a map will show that the two towns are not on the same meridian; Syene is not quite on the Tropic of Cancer, whilst the distance from Syene to Alexandria is not exactly 5,000 stadia. Despite these drawbacks, this first measurement is very interesting.

GLOBES AND MAPS.—Since the earth is a spheroid, *i.e.*, a sphere slightly flattened at the poles, you will readily understand that the only correct representation of any part of its surface is that which we have on an artificial globe. You must have noticed how the shape of any large country or continent differs on different maps. The only correct map must be on a curved surface, for it represents a part of the curved surface of the earth, and therefore all flat maps are wrong in some respect. It is very necessary that constant reference should be made to a globe in order that wrong impressions derived from flat maps may be corrected.

CHAPTER II

THE MOVEMENTS OF THE EARTH AND THEIR RESULTS.

THE APPARENT MOVEMENTS OF THE SUN.

ALTHOUGH in this chapter we shall discuss the movements of the earth, we shall first of all learn something of the apparent movements of the sun as seen in our own country from our standpoint as spectators. If the height of the sun is measured each day at noon (see Ex. 1),¹ it will be found that its height above the horizon changes a little from day to day. If the path which the sun appears to take in its journey across the heavens is noted, it will be discovered that every day the sun gets higher and higher between sunrise and noon, at the same time appearing to move from the east towards the south. When it is due south, about noon, it is also highest in the sky. During the afternoon the sun sinks lower and lower, at the same time moving westwards. If these observations are made throughout the year, it will be seen that the sun is lowest in the sky at noon about December 21, and highest about June 21, but that it is always seen in the south about twelve o'clock. If we note the point of the compass at which the sun appears to rise, we shall find that in winter it is south-east, on March 21 due east, in summer north-east, and on September 21 due east. In winter the sun appears to set south-west, on March 21 due west, in summer north-

¹ The observations suggested are best carried out in the lower forms, but in case this has not been done, it is advisable to take them at this stage.

6 THE MOVEMENTS OF THE EARTH

west, and on September 21 due west once more. If we could see the sun at midnight it would be in the north, but since it is below the horizon we cannot see it.

THE CAUSE OF NIGHT AND DAY.

We must now explain why it is that the sun appears to make these movements. This is very simple when we realize that it is not the sun which moves, but the earth. We imagine that the earth rotates on its axis, a line passing through the earth from pole to pole. It takes the earth one day to make a complete rotation on its axis. This turning of the earth on its axis is, of course, the cause of day and night, for only half the globe can receive the sun's rays at once. The earth rotates from west to east, so that as each place comes into the light the sun appears to rise in the east. Further turning causes the sun to appear higher and higher, and to reach its greatest height about noon. After noon the continued rotation causes the sun to become lower and lower, and finally to set in the west.

THE CAUSE OF THE SEASONS.

But the earth has another motion: it makes a yearly revolution round the sun. This is illustrated in Fig. 2, which represents a tub filled with water. The water surface represents the *plane of the ecliptic*, that is, the plane in which the earth moves during its revolution round the sun. Two balls are placed on the water, one to represent the earth and the other the sun. The former is moved round the sun-ball, and its path represents the orbit of the earth.

Fig. 2 shows that needles have been passed through the earth-ball to represent the axis, and it will be seen that these are not vertical; they have been inserted so as to make an angle of $66\frac{1}{2}^{\circ}$ with the surface of the water, for the earth's axis is inclined to the plane of its orbit at that angle. We must also observe that the axis

points in the same direction during the whole period of the earth's yearly revolution round the sun. Fig. 3

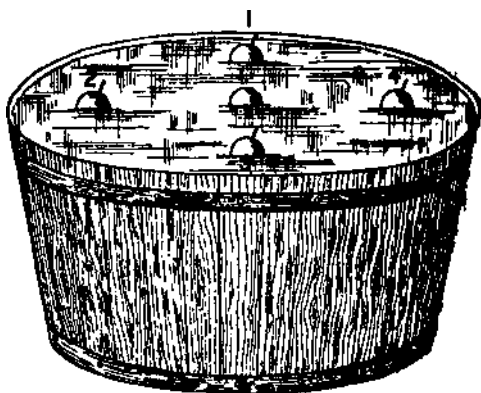


FIG. 2.—This diagram illustrates the revolution of the earth. illustrates the position of the earth with regard to the sun on certain days of the year, the unshaded area

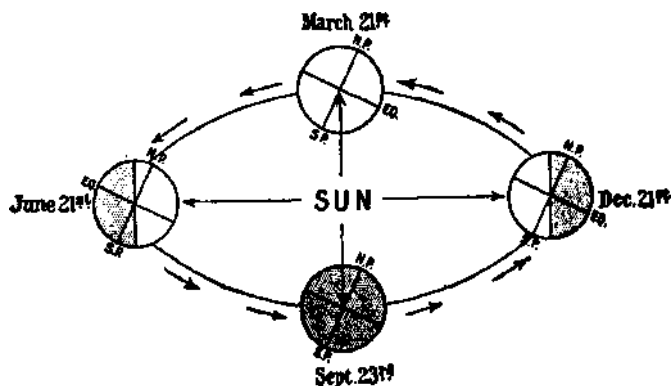


FIG. 3.—Diagram showing the position of the earth with regard to the sun at the equinoxes and solstices.

representing that part of the earth reached by the rays of the sun. It will be seen that on June 21 the northern

8 THE MOVEMENTS OF THE EARTH

end of the earth's axis, *i.e.*, the North Pole, is tilted *towards the sun* and *away from it* on December 21, so that on June 21 the sun's rays pass $23\frac{1}{2}^{\circ}$ beyond the North Pole, and fall short of the South Pole by the same angle. These conditions are reversed on December 21. On March 21 and September 23, the earth is illuminated from North to South Poles, so that the sun's rays reach the poles, but do not pass beyond them.

Now this yearly revolution of the earth round the sun is the cause of the seasons. In the next chapter we shall learn that the more overhead the rays of the sun strike the earth's surface, the warmer is the temperature*. The revolution of the earth round the sun causes the sun's rays to strike the same place at different angles at different times, and thus we have the seasons.

THE APPARENT MOVEMENT OF THE SUN IN DIFFERENT LATITUDES.

(1) AT THE EQUATOR.—Fig. 4 is a diagram which shows the apparent path of the sun at different times of the year. The point *x* represents the position of the observer, his horizon being shown by the ellipse. On March 21 the sun rises due east at six o'clock in the morning, and gradually gets higher and higher, until at noon the observer at *x* would see the sun immediately overhead. At six o'clock in the evening it sets due west. From March 21 to June 21 the sun appears to rise every day a little farther north of east, and to set a little farther north of west, whilst at the same time the elevation at noon decreases. On June 21 this northward movement ends, and on each successive day the sun rises nearer east, sets nearer west, and has a higher noon elevation. On September 23 the conditions observed on March 21 are repeated, the sun rising due east, setting due west, and being overhead at noon. Between September 23 and December 21, the sun rises each day farther south of east, and sets farther south of west, the farthest southern limits being

APPARENT MOVEMENT OF THE SUN 9

reached on December 21, when it is $66\frac{1}{2}^{\circ}$ above the horizon, which is the same elevation as on June 21, when the northern limit was reached. Between December 21 and March 21 every day sees the sun rising nearer east and setting nearer west, so that by the time the latter date is reached the sun once more rises due

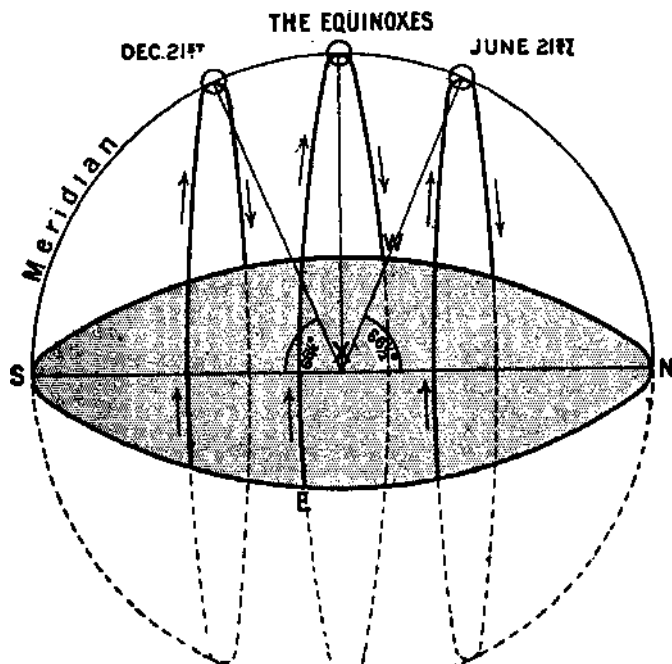


FIG. 4.—The apparent path of the sun at the equator at the solstices and equinoxes.

east, sets due west, and has an elevation above the horizon of 90° . One point must be noted, and that is, that on every day of the year at the equator, the sun rises and sets at the same time, i.e. 6 a.m. and 6 p.m. respectively.

10 THE MOVEMENTS OF THE EARTH

(2) AT LONDON.—The symbols used in Fig. 5 are the same as in Fig. 4, and since reference was made at the beginning of the chapter to the apparent movements of the sun in our own country, there is no necessity to go into detail again. The important points

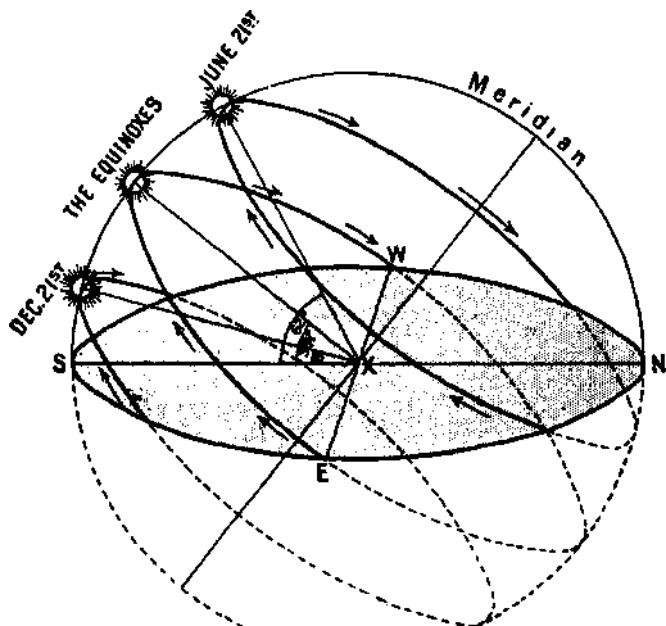


Fig. 5—The apparent path of the sun at London at the solstices and equinoxes.

to notice are (a) the long summer day, (6) the short winter day, (c) the similar conditions on March 21 and September 23.

(3) AT THE NORTH POLE.—Fig. 6 shows that on March 21 an observer at the poles would see the sun circle round the sky on the horizon. Between March 21 and June 21 it appears to circle round in the heavens,

APPARENT MOVEMENT OF THE SUN ii

gradually increasing in height, until on the latter day it reaches an elevation of $23\frac{1}{2}^{\circ}$. On each succeeding day the sun continues to circle the sky but is getting lower and lower, until, on September 23, it is once more on the horizon. But between September 23 and March 21 the sun cannot be seen at the North Pole, for it is below the horizon, reaching its lowest point on December 21. Thus we see that at the North Pole

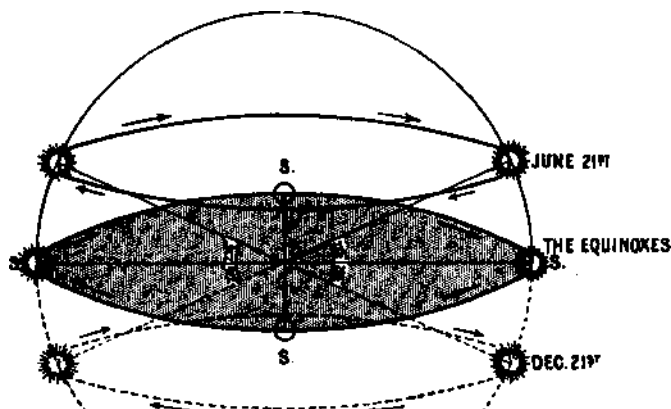


FIG. 6.—The apparent path of the sun at the North Pole at the solstices and equinoxes.

the sun never sets for six months, and never rises above the horizon for the same period. This is true at the South Pole, too, but the seasons are reversed. It must not be supposed that this means that the poles have six months light and six months darkness, for we must note that there is twilight until the sun reaches a certain distance below the horizon, and since the sun at the poles increases and decreases in height very slowly, twilight lasts for a whole month.

12 THE MOVEMENTS OF THE EARTH

HOW THE TROPICS, THE ARCTIC AND ANTARCTIC CIRCLES ARE FIXED.

We have learned that on June 21 the North Pole is tilted towards the sun, whilst on December 21 it is pointed away from the sun. It is this tilting of the earth's axis which causes the sun to be overhead at noon on June 21 as far north of the equator as $23\frac{1}{2}^{\circ}$ N. This is, naturally, what may be expected, for the earth's axis is inclined at that angle from the vertical. Similarly, on December 21, the sun is seen overhead at noon $23\frac{1}{2}^{\circ}$ S. of the equator (see Fig. 7). If, as

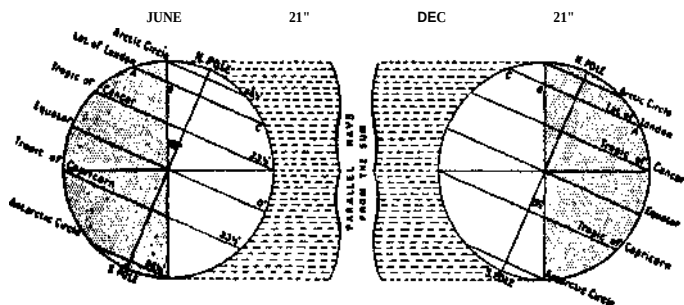


FIG. 7.—The position of the earth with regard to the sun at the solstices.

the earth rotates on its axis on these days, the sun were to trace on the earth a line along which it is seen overhead, we should have two circles which mark the northern and southern limits of the belt within which the sun can be seen overhead on certain days of the year. Thus we have the Tropics of Capricorn and Cancer fixed. The word "tropic" means a "turning point." Fig. 7 also shows that the rays of the sun fall $23\frac{1}{2}^{\circ}$ beyond the North Pole at the northern mid-summer and fall short of the South Pole by the same angle; whilst at the northern midwinter, the rays pass beyond the South Pole and fall short of the North Pole. In this way, the Arctic and Antarctic Circles are fixed.

THE EQUINOXES AND SOLSTICES.

On March 21 and September 21, when the rays reach both poles, the sun can be seen overhead at the equator, and every place has equal day and night, the sun rising at 6 a.m. and setting at 6 p.m. Therefore these days are called respectively, the *Vernal or Spring and Autumnal Equinoxes*. We have also seen that on June 21 the sun reaches the northern limit of its apparent migration into the northern hemisphere. This day is said to be the *Solstice*, which means, that the sun, as it were, stands still before its migration southwards, and since it is this apparent movement of the sun which causes summer, June 21 is called the *Summer Solstice*. Similarly, December 21 is known as the *Winter Solstice*.

EXERCISES.

1. (a) Keep a record of the noon height of the sun, if you have not done so in a lower form or class. Any sufficiently accurate instrument may be used. (b) Push a knitting-needle into a drawing-board and place the board where the sun's rays will fall upon it during school hours. Draw a line along the shadow every half-hour. From the lines so drawn, what can you learn about the height of the sun during the day? (c) By means of drawing-pins, fasten a piece of white cardboard to a drawing-board. Draw a circle of about four or five inches radius. Draw a diameter. Divide half of the circle into angles of 15° , and erect a knitting-needle at the point where each radius touches the circumference. By means of a cork-borer, obtain several pieces of cork about a quarter of an inch long and push these on the knitting-needles. The drawing-board must then be placed in a spot (best of all a window facing south) upon which the sun shines during school hours. At nine o'clock in the morning, turn the board so that the left knitting-needle and the centre of the circle are in a line with the sun. Push the cork down the needle until its shadow falls upon the centre of the circle. Repeat the process every hour, and at the end the small corks will give a representation of the path of the sun during the day. This may be repeated at other times, using different corks.

2. Draw diagrams similar to Figs. 4, 5 and 6 to show the apparent path of the sun at the solstices and equinoxes as seen by an observer at (a) the Arctic Circle, (b) the Tropic of Capricorn.

14 THE MOVEMENTS OF THE EARTH

3. Give in tabular form the height of the sun at noon on the days of the equinoxes and solstices at the poles, the Arctic and Antarctic Circles, London and the Equator. Arrange the table so as to give the dates on the left column and the places at the heads of columns.

4. Explain points of geographical interest in each of the following quotations-

- (a) The sun above the mast
Had fixed her to the Ocean.
- (b) The days grew longer and longer
Till they became as one.

5. What would be the effect (a) if the earth's axis were not tilted? (6) If the South Pole were always tilted towards the sun?

6. What are (a) the Tropics of Cancer and Capricorn, (b) the Arctic and Antarctic Circles?

CHAPTER III.

THE DISTRIBUTION OF TEMPERATURE.

TEMPERATURE is measured by means of the thermometer, and in English-speaking countries, except for scientific purposes, the Fahrenheit thermometer is in most general use, although continental countries use the Centigrade thermometer. On the former, freezing-point is 32° and boiling-point 212° , whilst on the latter these are 0° and 100° respectively. On the maps used in illustrating this chapter both scales are given.

The envelope of air which surrounds the earth can be heated in two ways; either from the earth itself, and we know that the interior of the earth has a very high temperature indeed, or from the sun. The amount of heat which the air derives from the heated interior of the earth is very small indeed, and this is illustrated by the fact that polar regions must have the same amount of heat from this source as equatorial regions, but we know that there are enormous differences between the temperature conditions in these areas. For all practical purposes we must confine our attention to the sun as the source of heat.

THE DISTRIBUTION OF INSOLATION.

Fig. 8 represents the earth, and A, B and C are bundles of sun's rays of equal width. It is clear that the nearer the rays fall to the equator, the greater is the angle at which they strike the earth, and the less the area which they have to heat. This is one reason why equatorial regions are warmer than polar regions. It is very

16 THE DISTRIBUTION OF TEMPERATURE

useful to use a term which expresses the amount of heat energy we receive from the sun. The term is *insolation*. The insolation for any day is the total amount of radiant energy received from the sun during that particular day. It is very important to notice that figures which give the amount of insolation at different latitudes

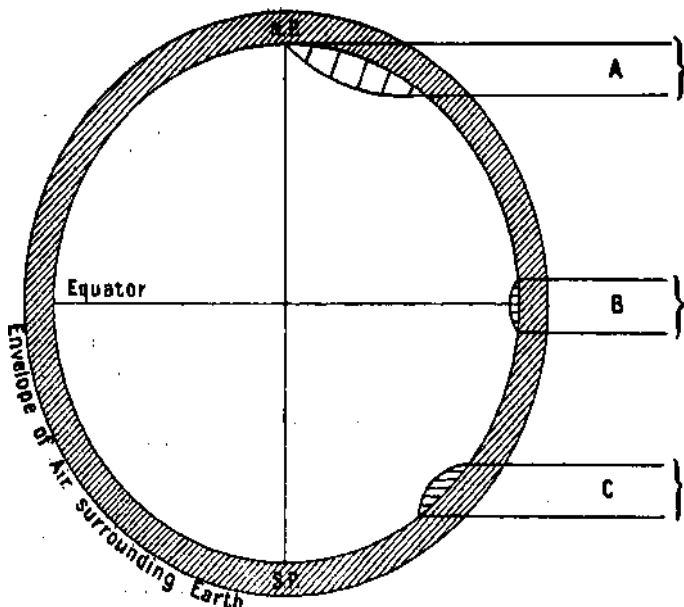


FIG. 8.—Diagram showing bundles of the sun's rays striking the earth's surface at different angles.

at certain times of the year, do not take into account the important facts that the earth is surrounded by an atmosphere, and that the land and sea surfaces of the globe differ very greatly in their power of heating and cooling. They do, however, take into account the length of time the sun is above the horizon.

It might be supposed that on June 21, when the sun is overhead at the northern tropic, insolation will be

greatest there. This is not so, for we must not forget that on that day, day and night are not of equal length as at the equinoxes, when the amount of heat received from the sun is greatest at the Equator, and decreases towards the poles. At the summer solstice, there is still equal day and night at the Equator, but as we go towards the North Pole the length of day increases, being 13 hrs. 56 min. in lat. 30° , and $18\frac{1}{2}$ hrs. in lat. 60° ; whilst regions within the Arctic Circle have a longest day varying from 24 hours to 6 months, according to their positions. Thus it is evident, that although the sun will be hotter at the Tropic of Cancer, it is longer in the sky in latitudes farther north, so that the total amount of radiant energy or insolation received is not very easy to calculate. If we let the insolation at the equator for the vernal equinox be represented by the number 1,000, that at different latitudes on June 21 is given in the following table :—

Latitude N.			
0°	881	50°	1105
10°	975	60°	1093
20°	1045	70°	1130
30°	1088	80°	1184
40°	1107	90°	1202

From these figures it will be seen that the insolation on June 21 is greater at the North Pole than at the Equator. But there are certain facts which must be pointed out, or a wrong impression might be gained. Firstly, the figures represent the total amount of insolation received during the whole day, and do not show the temperature *reached* during the day. We know that the polar regions do not attain the same temperatures as equatorial regions. Secondly, since the table imagines the earth to have no atmosphere, it does not take into account the loss of heat owing to absorption by the atmosphere. Thirdly, the figures do not allow for the fact that the earth has both land and

18 THE DISTRIBUTION OF TEMPERATURE

water surfaces, and that these affect the distribution of temperature very considerably. Let us first consider the influence of the atmosphere upon insolation.

THE INFLUENCE OF THE ATMOSPHERE ON INSOLATION.

Before they can reach the earth, the sun's rays have to pass through the air envelope which surrounds the earth to a height of some 200 miles. In passing through the atmosphere, the sun's rays must lose some heat even if the air were quite free from all impurities. But there are dust particles and water vapour in the air, and these absorb the sun's rays to such an extent that a large proportion of heat does not reach the earth. It will readily be seen that more heat will be absorbed by the atmosphere, the denser and thicker the envelope of air and the more dust and water particles that air contains. Fig. 8 shows that ray B has to pass through less air than those which fall obliquely (A and C), and therefore will not lose so much heat to the atmosphere. Therefore, since the sun's rays reach equatorial regions in a far less slanting direction than polar regions we have here another reason why the latter regions are colder. We shall now learn of the influence of land and water upon temperature.

THE INFLUENCE OF LAND AND WATER UPON TEMPERATURE.

Land and water do not take in heat at the same rates. If we heat a cubic foot of sand and the same quantity of water, we should find that the latter requires about twice as much heat to raise the temperature 1° as is required to raise the temperature of the sand by the same amount. On cooling, water gives out more heat than land. Again, the water in the ocean is in constant motion, so that the heat received from the sun is distributed, whereas rays falling on land heat only the

ALTITUDE AND TEMPERATURE

area on which they fall. Water is heated to a greater depth than land, and this is another reason why water takes longer to heat. In brief, we may say that the water surfaces of the earth take longer to heat in summer than the land surfaces, and cool at a slower rate in winter—that is, the oceans will be cooler than the continents in the same latitudes in summer, and warmer in winter (see Ex. 4 at the end of chapter). Lastly, let us turn to the influence of altitude upon temperature.

THE EFFECT OF ALTITUDE ON TEMPERATURE.

It has been seen that the atmosphere receives some heat from the rays of the sun as they pass through it. But only a small proportion of the heat received is acquired in this way. The sun's rays heat the surface of the earth, and by the process of radiation some of this heat is absorbed by the air. But the air is probably affected most by actually coming in contact with the earth, for it is easily heated by contact with something warmer than itself and cooled by something colder than itself. Thus the layers of air in contact with the earth are heated, and becoming lighter than the surrounding air, are displaced by the latter and forced to rise. The air which now comes in contact with the earth is warmed, and in its turn is compelled to rise. The ascending particles of air lose some of their heat to the air with which they come into contact. In this way the whole of the lower layers of the atmosphere are gradually warmed. Since the air is largely heated by contact with the earth, it is natural that the temperature falls as altitude increases. But this does not fully explain why it is colder on the top of a mountain than at its base, for the air at the summit is as near the ground as the air at the base. The question of pressure comes in here, and although we shall speak of atmospheric pressure in the next chapter we can now mention that air pressure decreases as sea-level is left behind.

20 THE DISTRIBUTION OF TEMPERATURE

As the air at high altitudes is not so dense as near sea-level, and is freer from water vapour and dust, it follows that the amount of insolation reaching the surface is greater than at sea-level. But for the same reasons the heat is very quickly radiated to the atmosphere, and the ground cannot retain its temperature for long. The total effect is to lower the temperature on mountains or plateaux.

The rate at which the temperature falls varies very much according to the place and season, but it may be taken as about 1° F. for 300 feet of ascent (see Ex. 3 at the end of this chapter). We have now covered all the points which will help us to understand the temperature maps of the world. Before studying them, however, let us just put together, from what we have learned, the causes which make summer warmer than winter.

WHY IT IS WARMER IN SUMMER THAN IN WINTER.

Fig. 7 shows that the North Pole is tilted towards the sun in June, and away from the sun in December. This not only gives us longer days in summer, but causes the sun to be higher in the sky in summer than in winter. Thus it is warmer in summer than in winter, for these reasons—

(1) The amount of insolation is greater, partly on account of the greater angle at which the sun's rays are received, and partly because the days are longer. (2) Less heat is absorbed as the sun's rays pass through the air. The lines A, B, C, in Fig. 7, represent the latitude of London, and the thickened rays are those which reach this latitude at June 21 and December 21. It will be seen that the summer ray reaches the latitude of London in a less slanting direction and passes through less air in June than in December. Notice the parts of the lines A, B, C, which are in the unshaded portion of the diagrams. These represent the relative length of days in June and December. It is at once

evident that the tilting of the earth's axis gives to London a longer day in summer and therefore more heat.

Temperature distributions are shown by means of *isotherms*, which may be defined as lines along which the temperature is everywhere the same. The method of drawing isotherms is illustrated in Ex. 1 at the end of this chapter. It is very important to notice that most isothermal maps are reduced to sea-level. Temperature varies with elevation, and therefore it is necessary to correct the thermometer readings at each station to what they would be at sea-level, if we wish to learn from the map the effects upon temperature of causes other than elevation.

TEMPERATURE MAPS OF THE WORLD.

Figs. 9, 10 and 11 show the mean sea-level temperatures for April, January and July. April (or October) is the best month for showing the temperature conditions when the maximum temperature is near the equator. January and July maps give the distribution of temperature in the winter and summer months of temperate latitudes. Theoretically, Figs. 9, 10 and 11 should be made for the days of the vernal or spring equinox and the solstices, but there is what may be described as a "lagging of the seasons," which must be taken into account.

Some isotherms are of greater importance than others; for example, the summer isotherm of 50° F. approximately marks the poleward limit of trees, for the latter cannot thrive unless this temperature is reached during at least one month. On Figs. 9, 10 and 11 the isotherms of 32° , 50° , 68° and 86° F. have been inserted. In order to bring out more clearly the great winter cold of the Eurasian land mass, other isotherms have been added to the January map.

APRIL TEMPERATURES.—Fig. 9 shows the **April** temperatures reduced to sea-level. It will be seen that

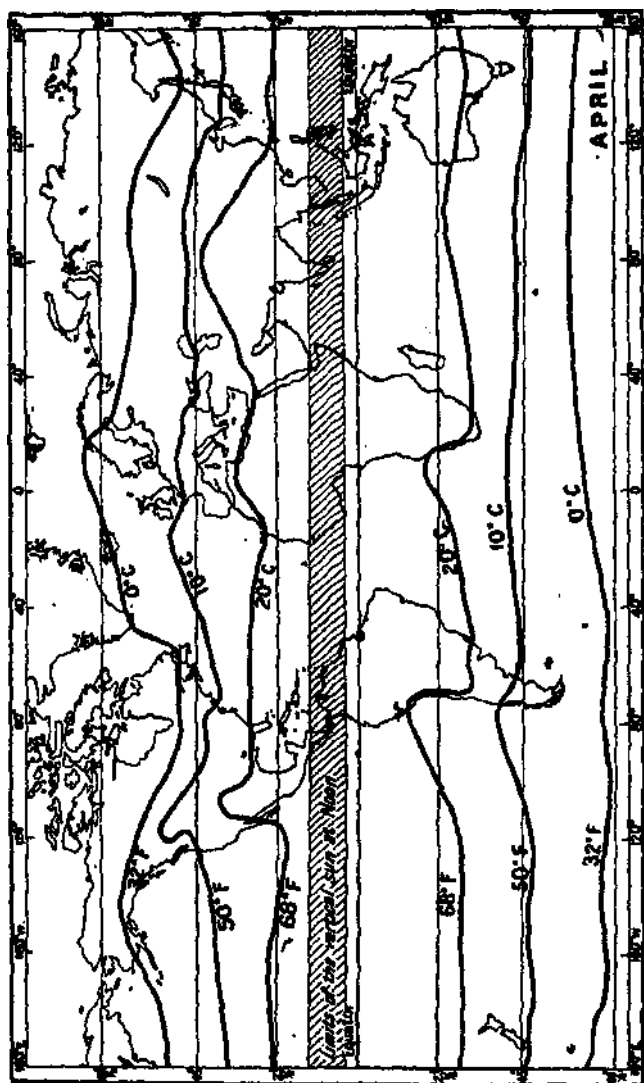


FIG. 9.—Mean sea-level temperatures for April.

TEMPERATURE MAPS OF THE WORLD 23

the region of greatest heat lies in equatorial regions, and that the temperature decreases gradually as the poles are approached. The isotherm of 50° follows very roughly the parallels of latitude 45° N. and S. The explanation of this general distribution of temperature is found in the fact that this map is made for a month immediately following the spring equinox, so that we should expect temperatures to decrease gradually from the equator to the poles.

JANUARY TEMPERATURES.—This map shows that the heat belt has migrated southwards with the sun, for the latter is overhead at noon on December 21 at the Tropic of Capricorn. The hottest belt is distinctly south of the equator, for it is in the summer season in the southern hemisphere. The highest temperatures (over 86°) are to be found over the land masses, on account of the fact that the temperature of land rises more quickly than that of water. The isotherm for 50° almost keeps parallel to the lines of latitude, and the reason for this should be apparent, as it is almost entirely over water. As a contrast, the isotherms for the northern hemisphere show a most marked bend southwards on the west of continents, and northwards on the east of continents, whilst over the land masses themselves they bend southwards. The isotherm for 32° F. gives the best illustration of this. This irregularity is accounted for partly by the unequal heating of land and water, and partly by ocean currents. With regard to the effect of the latter, we shall make fuller reference in Chapter V, but one other example of their influence on temperature may be pointed out now. In both January and July, the isotherms of the southern hemisphere bend northwards off the west coasts of land masses and southwards off their eastern shores. The reason for this is, that cold currents flow northwards along their western shores, and warm currents flow southwards along their eastern margins.

The coldest region is in Northern Siberia, where there is an area which has been called the "cold pole,"

24 THE DISTRIBUTION OF TEMPERATURE

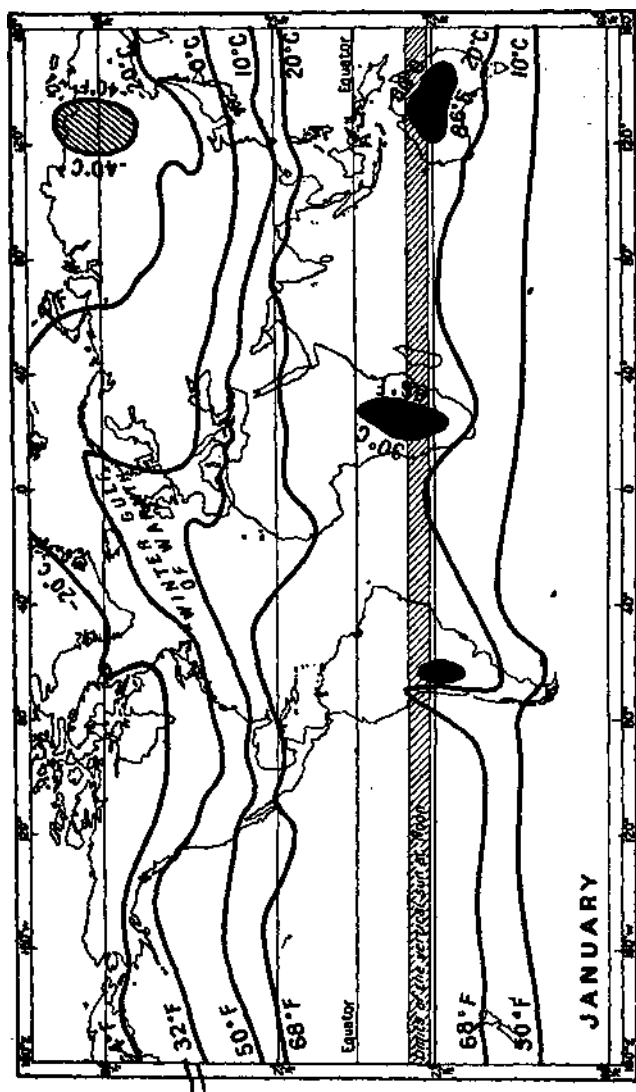


FIG. 10.—Mean sea-level temperatures for January.

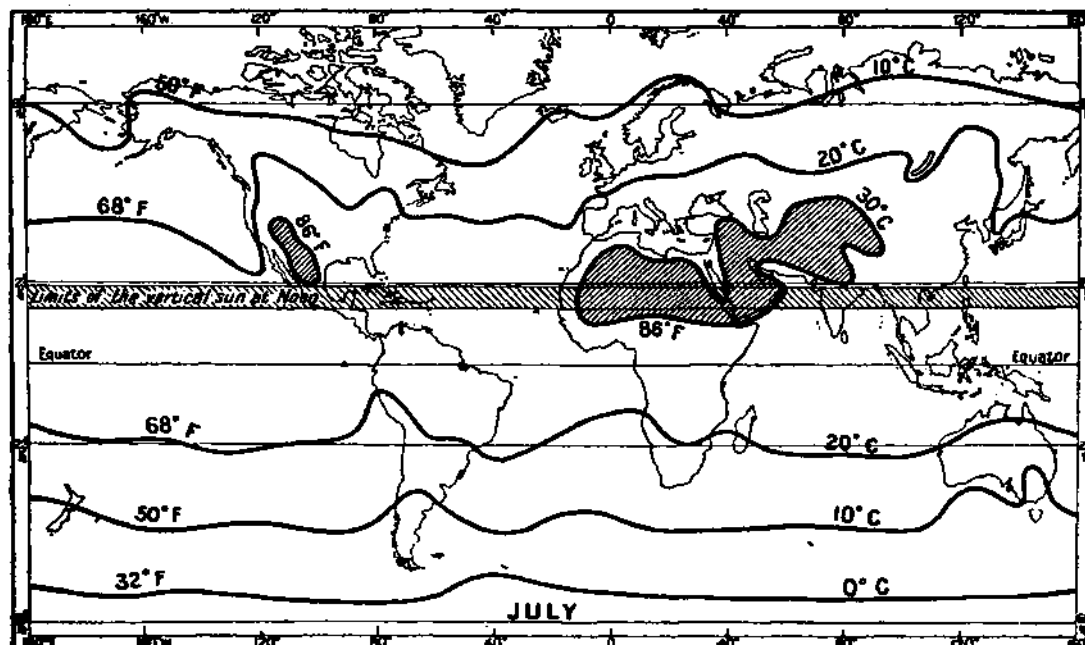


FIG. II.—Mean sea-level temperatures for July.

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whose temperature is below -48° F. A vast area of Eurasia has a temperature below freezing-point. So great is the land mass that this temperature is experienced within 3° of the Tropic of Cancer. The interior lands of North America are also very cold, but since the land area is not so great as in the old world, the temperatures are relatively not so low.

JULY TEMPERATURES.—Fig. 11 shows the temperature for July, when it is evident that the heat belt has migrated into the northern hemisphere, where the highest temperatures are seen to be over the land masses. Since the latter are warmer than the oceans in the same latitudes, the isotherms of the northern hemisphere bend northwards over the land. Over Asia, the isotherm of 68° F. reaches within 7° of the Arctic Circle. The southern hemisphere shows a more equable distribution of temperature south of the equator, due to the great extent of ocean.

EXERCISES.

1. On two outline maps of the British Isles plot the positions of the stations used (or the reports of the Meteorological Office. On one map print by the side of each station the mean temperature for January, as given in Appendix 1 of the D.W.R. On the other do the same for July. Then draw the isotherms for every even number of degrees (*i.e.* 38° , 40° , 42° F., etc., for January, and 56° , 58° , 60° F., etc., for July).

2. Draw a map of the coast-lines of the North Atlantic Ocean, and on it mark the January isotherm of 32° F. Shade the area which has a temperature of over 32° F. The great gulf-like tongue of warmer water off the West of Europe is sometimes called "The Winter Gulf of Warmth."

3.

Place.	Height in feet above sea.	Jan. temp.	July temp.
Fort William . Ben Nevis summit .	S.L. 4,400	$38^{\circ}7'$ F. $23^{\circ}4'$ F.	$57^{\circ}1'$ F. $41^{\circ}7'$ F.

Find these places on the map. Account fully for their differences in temperature.

EXERCISES

4.

Place.	Jan. temp.	July temp.	Range of temp.
Cambridge .	37-6° F.	61'5° F.	23'9 ⁰ F.
Berlin .	31'3° F.	64'5° F.	33'2' F.
Warsaw • •	23'9 ⁸ F.	65'5° F.	41'6° F.
Saratof. • •	13'5° F.	71'0° F.	57'5 ⁰ F.

These places are in approximately the same latitude. Account for the different temperature conditions shown by the figures.

5. On outline maps of the Old World north of the equator mark the isotherms for January and for July. Shade the maps so as to emphasize cold in winter and heat in summer. Write short accounts bringing out the leading features shown by the maps.

6. On outline maps of the southern hemisphere draw the isotherms for January and for July. Shade the map as suggested in Exercise 5. State the chief differences between the distribution of temperature in Eurasia and North Africa and in the southern hemisphere.

7. Why is it warmer in equatorial regions than in polar regions? Draw diagrams to illustrate your answer.

CHAPTER IV.

THE PRESSURE OF THE ATMOSPHERE AND ITS INFLUENCE ON WINDS.

IN previous chapters we have learned that the earth is surrounded by an air envelope. It is known that this extends to a height of about 200 miles from the earth's surface, and that the higher we go the lighter the air becomes. Since we know that air has weight, it follows that it exerts a pressure upon the surface of the earth, and that this pressure will be greater at sea-level than on the top of a high mountain, for there is not so much air above the latter as there is above a place at sea-level. Air pressure is measured by means of the barometer. A barometer consists of a glass tube which is closed at one end. This tube is filled with mercury, inverted, and the open end placed into a cup of mercury. The mercury column then falls a little, and some of the mercury runs back into the cup, leaving in the tube a column about thirty inches high.

When the air pressure upon the surface of the mercury in the cup is increased, the column is pushed higher up the tube; but if the air pressure decreases mercury flows from the tube to the cup, and the height of the column is decreased. Thus it is seen that when the column stands at a height of 30 inches the pressure of the atmosphere is equal to that of a layer of mercury 30 inches deep. It is usual to express the pressure of the atmosphere in inches or millimetres of mercury, and the normal pressure at sea-level is about 29.9 inches or 760 millimetres. It is more scientific, however, to use a pressure unit, hence the increasing use of the terms *bar*

and *millibar* (see Exercise 7 at the end of this chapter). When the pressure is more than 29.9 inches **or 1012.5** millibars we speak of it as being "high," and when it is below this we speak of it as being "low." Since we know the density of mercury it is easy to calculate that this pressure is equal to one of 147 pounds per square inch.

PRESSURE AND ALTITUDE.

We have seen that the air extends to a height of about 200 miles, but at that height it is extremely rare. Since the upper layers of air press upon the lower layers, the latter are denser and therefore heavier, for the particles of air are closer together. If a barometer were carried up the sides of a high mountain it would be found that the reading would continually fall, and that at an elevation of 900 feet from sea-level the reading would be one inch less than at sea-level. To cause a fall of another inch, however, we should have to make an ascent of more than 900 feet, because, as we are now increasing our elevation, the air is less dense than it was at lower levels. At an elevation of 3½ miles the pressure is only about half what it is at sea-level, so that half of the atmosphere would be below that elevation; whilst at a height of seven miles we should have three-fourths of the atmosphere below us.

So rarefied is the atmosphere at great elevations that it is very difficult to breathe sufficient air for the wants of the body. Some men and animals have become accustomed to living at great elevations; but it is a well-known fact that travellers *unaccustomed* to living in high altitudes find great difficulty in breathing, and even at lower levels, suffer from headaches, dizziness and sickness. It will readily be seen that barometer readings can be used for determining roughly the heights of mountains.

PRESSURE AND WINDS.

If the pressure at any place is high, and that of the surrounding area low, air flows outwards from the higher

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pressure towards the lower. Air always flows from places of high pressure towards places of low pressure. But this statement requires some modification, for the rotation of the earth causes winds to be deflected to the right in the northern hemisphere, and to the left in the southern hemisphere. Pressures are represented by means of *isobars*, or lines along which the pressure is everywhere the same (see Ex. I on p. 40). Fig. 12 A shows an area of high pressure surrounded by lower

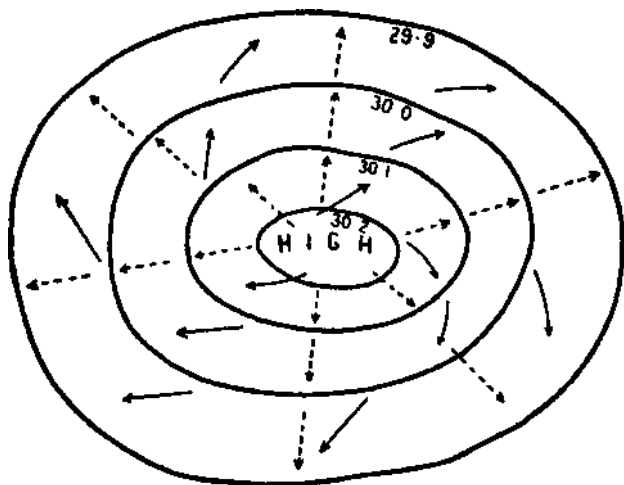


FIG. 12 A.—The relation between pressure and winds.

pressure, and if the earth stood still winds would flow outwards as indicated by the dotted arrows. If this represents a pressure system in the northern hemisphere the actual winds will be as shown by the straight-lined arrows. This law of the deflection of winds to the right in the northern hemisphere, and to the left in the southern hemisphere, due to the earth's rotation, is known as *Ferrers Law*. It must be noted that rivers are also influenced, but not nearly to the same extent as the lighter, easily influenced air currents.

PRESSURE AND WINDS

A full explanation of this deflection cannot be entered into here, but it may be illustrated in several ways.

Push a knitting-needle through the centre of a cardboard disc, and rotate the disc from right to left. From the centre of the disc allow an inked marble to run towards the edges, and then notice its track. The marble does not reach the point originally aimed at, but is deflected to the right. This illustrates the deflection of a northern hemisphere air current moving equatorwards, for the edge of the disc represents the equator, and the centre the North Pole. If the disc be rotated from left to right the deflection is then to the left, and this illustrates the deflection of air currents

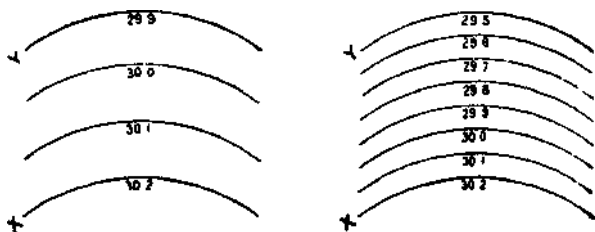


FIG. 12 B.—Steep and less steep gradients.

moving from the South Pole towards the equator from the standpoint of a person looking down upon the South Pole. The deflection of currents moving equatorwards can also be shown as follows: Rotate a globe in the same direction as the earth's rotation, *Le.* from west to east. Whilst the globe is turning round, by means of a piece of chalk, try to draw due north and south lines. Draw several for each hemisphere, taking care that each line is drawn towards, and not away from, the equator. Stop the globe, and it will be seen that the lines show deflection, as stated in Ferrel's Law. Currents moving polewards are also deflected to the right in the northern hemisphere, and **to the left in the southern hemisphere.**

There is one more point to which **reference** must be

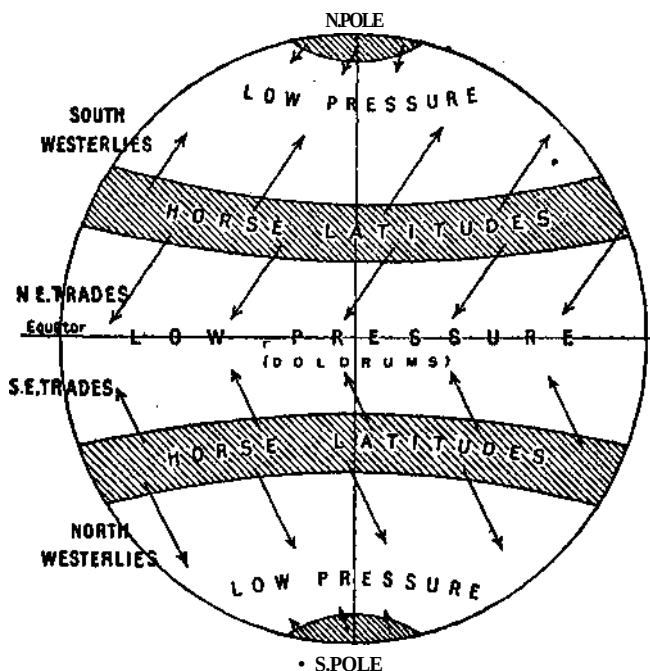
32 THE PRESSURE OF THE ATMOSPHERE

made. At the beginning of this section we learned that winds are due to differences of pressure. From this it follows that the greater the difference in pressure between two places the stronger will be the resulting wind. In the isobars on the left of Fig. 12 B the difference between the readings at x and y is three-tenths of an inch. In those on the right x and y are the same number of miles apart, but the pressure difference is seven-tenths of an inch. In the latter case, the winds experienced will be much stronger than in the former, for the air will be pushed outwards with much greater force. In each case the isobars are drawn to show differences of pressure at one-tenth of an inch intervals, but it is evident that they are closer together in one than in the other. Thus we reach a statement which is sufficient for present purposes: winds are generally stronger where the isobars are closer together than where they are farther apart.

GENERAL DESCRIPTION OF THE DISTRIBUTION OF PRESSURE AND THE PLANETARY WINDS.

We are now in a position to consider the distribution of pressure over the surface of the globe. In the last chapter we learned that the equatorial belt has great heat. Now this causes the development of an area of low pressure known as the Doldrums, towards which there are inflowing winds at the surface and above which there is a drift of air forced upwards by the meeting of the inflowing air currents. About 30° to 35° north and south of the equator are two belts of high pressure. These are known as the Horse Latitudes. Small areas of high pressure are also found at the poles, whilst in sub-arctic regions there are low-pressure areas. All these will be found on Fig. 13. Now if the world stood still, we should have winds blowing from high-pressure belts to low-pressure belts; but, as the rotation of the earth causes the winds to be deflected, we have air currents moving equatorwards and polewards from

the Horse Latitudes, and being deflected to the right in the northern hemisphere and to the left in the southern hemisphere. Those blowing towards the equator are the steady *Trade Winds*, and those blowing pole-



high Pressure Areas.

FIG. 13.—A diagrammatic representation of the prevailing winds of the world.

wards are the *Westerlies*. In addition to these, there are the winds which blow from the polar high-pressure areas. All these winds will be found marked in Fig. 13. The *Westerlies* are stronger than the *Trades*, but do not blow with such regularity, and on this account are best referred to as the "Prevailing *Westerlies*." The pic-

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turesque name " Brave West Winds " has been given to the Westerlies of the southern hemisphere, whilst the latitudes in which they are most reliable and are very strong, have been named " The Roaring Forties." These names help to indicate the strength of the southern hemisphere Westerlies.

One other point must be made clearer. The Horse Latitudes and the Doldrums are " calms "—that is, little movement of air is felt. Very often sailing ships are becalmed in these latitudes for many days together. This is due mainly to the fact that the chief movement of air in these places is a vertical one. Air rises at the Doldrums and, in the upper layers of the atmosphere, flows out towards the poles. By the time the Horse Latitudes are reached, the air has sufficiently increased in density, due to cooling, that it falls to the surface, and flows either to the equator or towards the poles as a surface wind. Thus it is seen that since the movement of air at the Horse Latitudes and Doldrums is not a horizontal movement, these regions will be calms. This explains, too, why there are high-pressure belts from 30° to 35° north and south of the equator. The air which descends to the surface in these latitudes increases very rapidly in density as it falls, so that the pressure is bound to be high.

WORLD DISTRIBUTION OF PRESSURE.

In explaining Fig. 13, we have not taken into consideration the fact that the earth's surface consists of land and water, and that these, owing to their different capacities for heating and cooling, will affect pressure. Nor have we taken into account seasonal changes in pressure distribution. We shall now consider these points.

Figs. 14, 15 and 16 show the distribution of pressure in October, January and July. For the purposes of comparison, all the readings from which pressure maps are constructed have certain corrections applied to them,

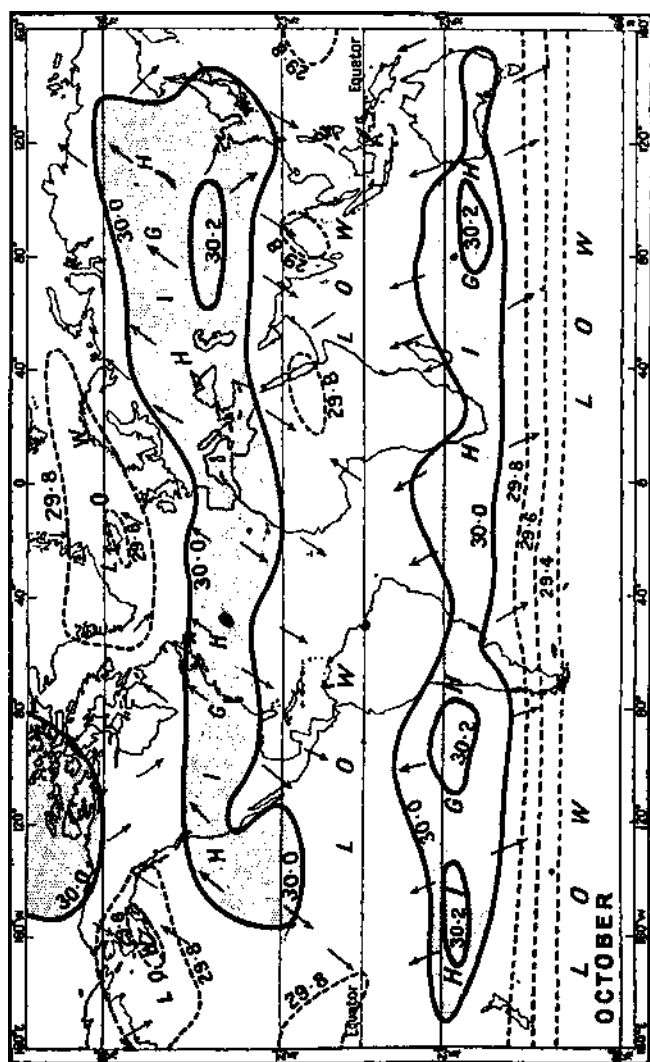


FIG. 14.—Isobars and winds for October. (After Buchan.)

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the chief being for altitude and temperature. As all readings have been corrected to sea-level readings, it follows that the actual pressure over such a high plateau as Tibet is much less than these maps show. Temperature, too, has an important influence upon pressure, so that pressure maps are corrected to a standard reading at 32° F., but this correction is not nearly so large as that for altitude.

PRESSURE DISTRIBUTION IN OCTOBER.—Fig. 14 shows that at this month there is a marked low-pressure belt corresponding to the equatorial heat belt. The pressure increases until the latitudes 30° — 40° N. and S. are reached, and here we have belts of high pressure. In higher latitudes still, the pressure again diminishes. This distribution more nearly corresponds with that shown in the diagram Fig. 13, and this is due to the fact that October is very near to the equinox, when the sun is seen overhead at noon at the equator.

PRESSURE AND WINDS IN JANUARY.—We can see very clearly from Fig. 15 that in this month the equatorial low-pressure area has moved southwards. This is in accordance with the migration of the temperature belts. We can also see that the southern high-pressure belt, the Horse Latitudes, is not so continuous as in October, for there are distinct low-pressure areas over the land masses of South America, Africa and Australia. Remembering that January is the southern summer, this is easily accounted for by the unequal heating of land and water. In the northern hemisphere, the high-pressure belt is a very marked feature, especially over the land masses, where the pressure is the highest. This is best shown over Asia, where the area of high pressure is very large indeed. Over the North Atlantic and Pacific Oceans are well-defined low-pressure areas. The influence of land and water upon the pressure distribution just outlined should be obvious.

The arrows show the winds which will be found to blow from high to low pressure, and to be deflected according to Ferret's Law. Notice the continuous belt

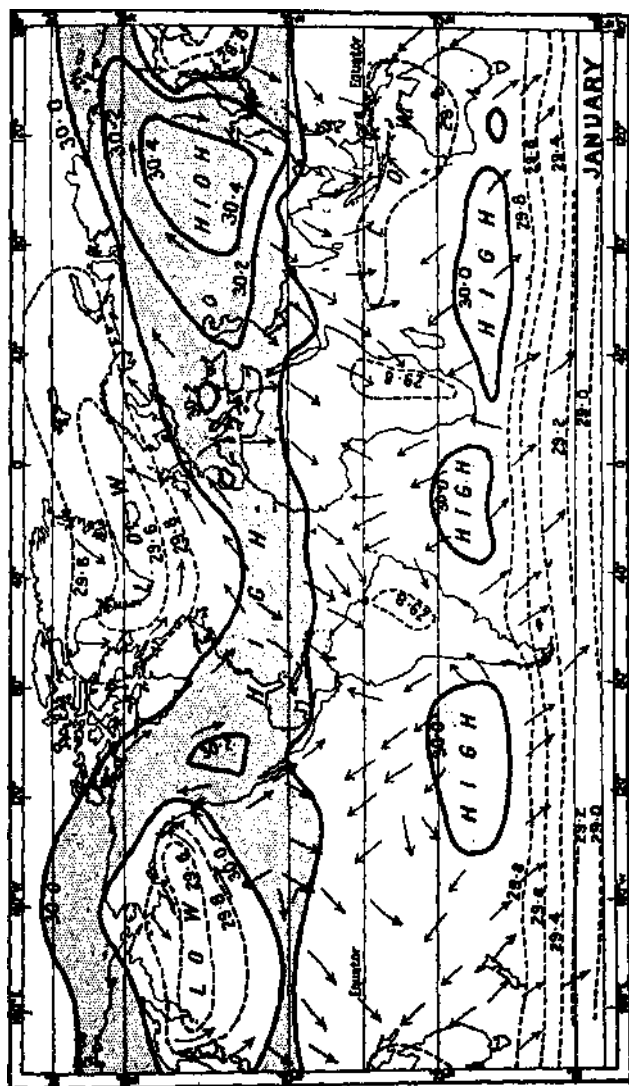


FIG. 15.—Isobars and winds for January. (After Buchan.)

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of north-westerlies compared with the south-westerlies of the northern hemisphere. The latter tend to get into great swirls of air blowing spirally round the ocean centres of low pressure. One more point should be observed. In North-western Australia the ordinary S.E. Trades are not experienced at this season (southern summer). Owing to heat, a low-pressure system is formed, towards which air flows, thus giving a north-west monsoon.

PRESSURE AND WINDS IN JULY.—This is the winter month of the southern hemisphere, where we find the actual distribution of pressure closely corresponding to Fig. 13. The reason is, that in this hemisphere the disturbing factor of the temperature differences between land and sea is not so important as in the other hemisphere, because the land masses are not nearly so large. The Doldrums belt of low pressure and the southern Horse Latitudes high-pressure belt are clearly shown, but when we turn to the northern hemisphere Horse Latitudes, it is apparent that there is no continuous belt of high pressure at this season. Over the oceans are areas of high pressure, and over the continents areas of low pressure, that over Asia being very well marked. It will thus be seen that the distribution of pressure shown in Fig. 13 has to be modified in the case of Asia, owing to the enormous area of the land mass. In January, Asia has a system of high pressure, with out-flowing winds; in July, it is under the influence of a low-pressure system with inflowing winds. It is this great change in the distribution of pressure that gives to Asia, south-east of a line drawn from Karachi to Korea, a distinctive type of climate of alternating dry and wet seasons. The full consideration of this is reserved for another chapter, but one point must be mentioned. Fig. 16 shows that the S.W. wind which blows over India in July is simply the S.E. Trade Wind, which, having crossed the equator, is deflected to the right by the rotation of the earth, and proceeds towards India as a south-west wind. The term " Mon-

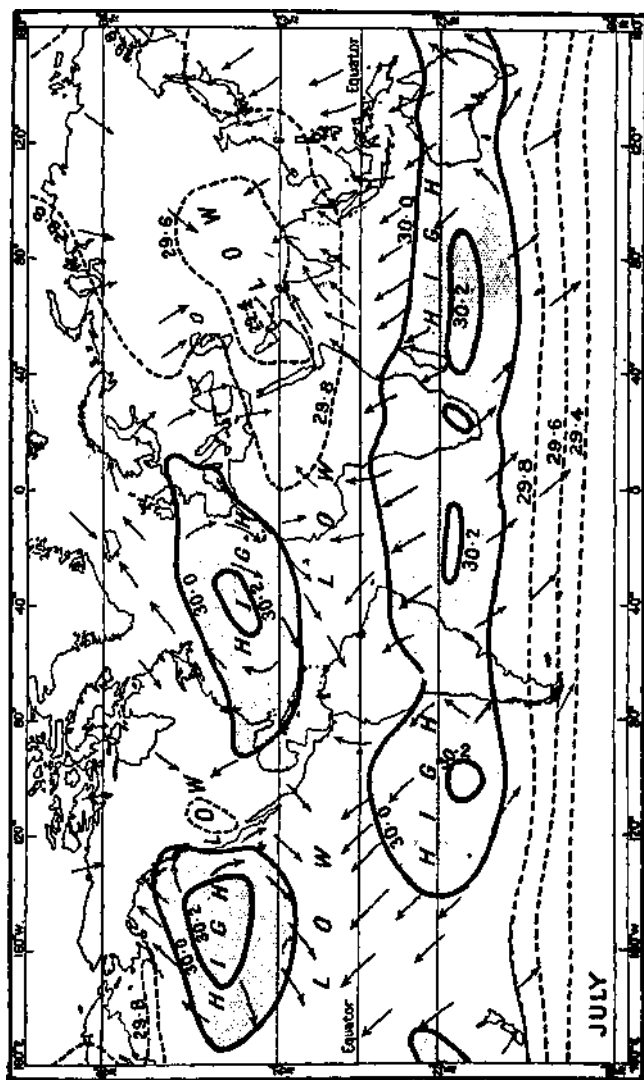


Fig. 16.—Isobars and winds for July. (After Buchan.)

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soon" (= a seasonal wind) is given to the summer winds of S.E. Asia.

We have learned that in January there is a distinct southerly migration of the pressure belts, and if the pressure maps for October and July be compared, it will be apparent that in the latter month there is a similar migration northwards. This is exceedingly important, for there are certain latitudes which will be transition areas, *i.e.* will be in high-pressure belts at one season, and in low-pressure belts at another. In order to prevent exaggerated ideas concerning the amount of the migration you will do well to consult a set of monthly charts of the North Atlantic Ocean.

EXERCISES.

1. Draw an outline map of Western Europe. Mark the positions of the places shown in the first column of the Daily Weather Report. Beside each, mark neatly the reading of the barometer at 7 a.m. and draw the isobars at intervals of one-tenth of an inch. Compare your results with those on p. 3 of the Weather Report.

2. Make maps showing the distribution of pressure in the southern hemisphere for January and July. Show winds by arrows. Write an account of the distribution of pressure as shown in the map.

3. Make maps showing the distribution of pressure in the northern hemisphere for January and July. Show winds by arrows. Describe the distribution in writing, accounting for the differences noted between these maps and those for the southern hemisphere.

4. On an outline map of the world plot the probable course of a sailing vessel from London to Melbourne and home again. (The direction of the prevailing winds must be kept in mind in order to accomplish this exercise successfully.)

5. Explain very carefully:—high pressure, Roaring Forties, Horse Latitudes, Doldrums, Ferrers Law.

6. Draw a circle of $2\frac{1}{2}$ " radius. Mark the equator and the tropics. Shade or mark the polar high-pressure regions and the Horse Latitudes. By means of arrows, show the prevailing winds of the world.

7. What is a millibar? Why is air pressure now recorded in millibars in the Daily Weather Report?

8. What special precautions had to be taken by the Mt. Everest climbing parties in order to carry on their work at high altitudes? Why **were these** necessary?

CHAPTER V.

OCEAN CURRENTS.

FIG. 17 shows a small tank containing water. At one end a strainer containing ice is fixed, and at the other the lid of a small tin box is held in position by a piece of wire. A bunsen burner is fixed or held so that the flame heats the lid. The water in contact with the heated lid is raised in temperature and thus expands, whilst that in contact with the ice is chilled and contracts. This causes the cooled water to sink and the heated water to flow towards the ice. In this way a circulation of water is set up as indicated in Fig. 17 by the arrows.

Now let us apply this simple experiment to the waters of the ocean. The heated end of the tank may be compared with the surface waters of the ocean at the equator, and the cool end with polar waters. In polar regions water sinks to the bottom of the ocean on account of increasing density due to cold, whilst at the equator, where the heat of the sun warms the surface water, expansion takes place and water is set in motion polewards.

There is no doubt that there is a general equatorwards creep of cold water along the ocean bed, and a surface flow towards the poles; but this is not sufficient to account for the extensive movements which take place in the surface waters of the oceans. The chief cause of these must be looked for in another direction.

If, by means of a pair of bellows, air is blown upon the surface of a tank filled with water, the force of the air is quite sufficient to set up surface currents of water.

There can be little doubt that the prevailing winds are the chief factors in the production of ocean currents, for in regions where winds change with the seasons, the change of wind is accompanied by a change in the direction of the currents. This is very clearly shown in the North Indian Ocean. We have learned that at one time of the year (Nov.-April) the wind is from the north-east; at the other time (May-Oct.) it blows from the south-west. Fig. 18 shows the currents of the Indian Ocean, from which it will be seen that a change of wind

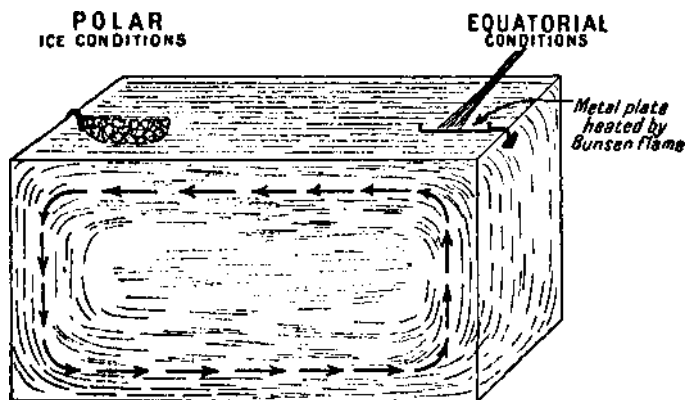


FIG. 17.—Diagrams showing currents caused by unequal temperatures.

is accompanied by a change in the direction of the ocean currents.

Let us at the outset notice two ways in which ocean currents may be classified. In the first place, we can distinguish between *relatively warm* and *relatively cold* currents, as is done in Fig. 18. A current will be relatively warm when it is flowing towards regions which are colder than those from which it has come, and, on the other hand, a current will be relatively cold when it is flowing towards warmer regions.

Ocean currents may also be classified as *stream* or *drift* currents. The former may be likened to broad

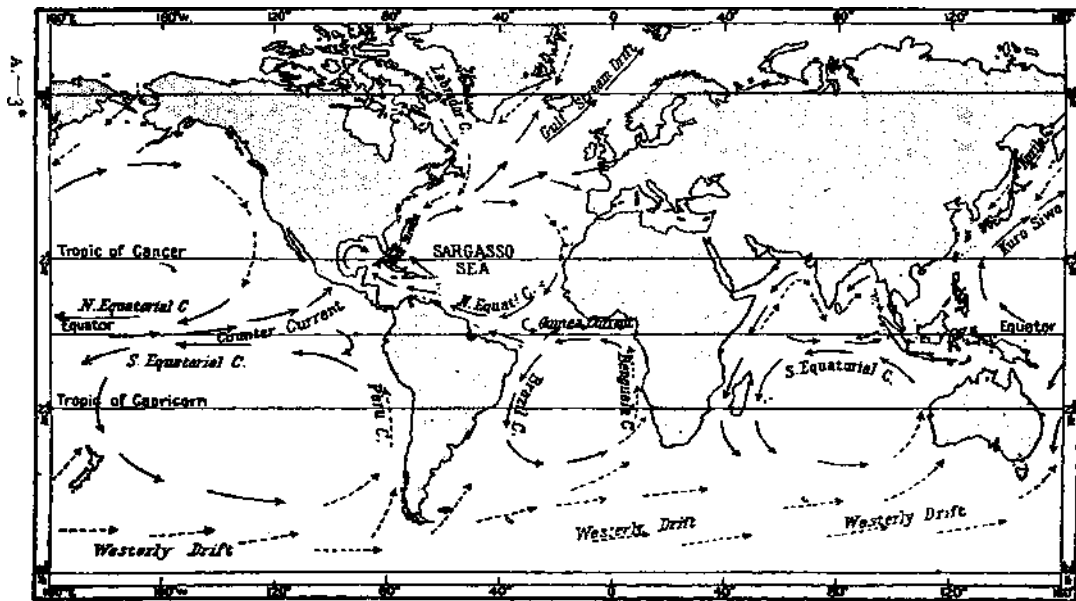


FIG. 18.—Ocean currents. The dotted arrows in the N. Indian Ocean show the currents during the S.W. Monsoon, the other arrows those during the season of the N.E. Trades. Elsewhere on the map the dotted arrows show relatively cold currents, the others relatively warm currents.

ocean rivers flowing between comparatively still waters. They flow faster than drift currents, and are caused by water which has been heaped up, seeking to find its own level. Drift currents move more slowly, and are simply a general drift of the surface water due to the force of the prevailing winds.

Keeping clearly in mind the prevailing winds, there should be no difficulty in understanding the direction of the chief ocean currents as given in Fig. 18. Let us consider the currents in the Atlantic Ocean. Off the north-west coast of Africa, in the region of the N.E. Trades, the surface waters are compelled by the winds to drift westwards until they are turned, partly by the shape of the mainland of North America, and partly, as in the case of winds, by the influence of deflection. A similar drift of waters is set up by the influence of the S.E. Trades, and the result is the South Equatorial Current, which is split into two by the wedge-shaped corner of South America, part of the waters flowing northwards to join those of the North Equatorial Current, and part passing along the shores of Brazil, from which country the branch is named the Brazilian Current. As all this water is blown across the Atlantic, it will be seen that the level of the sea off the American coast in these latitudes tends to be rather higher than on the corresponding African shores, and so it is.

But water cannot continue to be piled up, however steady and strong the winds may be. Some of it is bound to return, and it does so in the region of Doldrum Calms, which is between the North and South Equatorial Currents. This return, or counter-stream current, is known as the Guinea Current.

Now let us return to the North Equatorial Current, which is reinforced by a portion of its southern counterpart. Some of its waters pass through the Caribbean Sea and the Gulf of Mexico, and cause such a piling up of waters that a strong and steady stream current of water flows from the Gulf of Mexico between Cuba and Florida. This is the much misunderstood Gulf Stream.

This stream of warm water, which can be quite plainly distinguished from the surrounding waters, then flows along the south-eastern coast of the United States, although it is impossible that all the water in the stream has come from the Gulf of Mexico; some must have come from the current which did not enter the Caribbean Sea, but kept outside the West Indies. Soon after Cape Hatteras has been passed, the Gulf Stream spreads out its waters like an enormous fan, and it is no longer a stream flowing between comparatively still water, but a general drift of the warm surface waters of the ocean, blown by the westerlies towards the shores of Europe. The various branches of the Gulf Stream Drift, or North Atlantic Drift, are shown on Fig. 18, and it will be noticed that one branch returns to the north-west coast of Africa, thus completing a great clockwise motion of water, in the centre of which is the Sargasso Sea, where huge masses of floating seaweed, called sargassum, are sometimes very troublesome to ships. Fig. 18 shows that a great quantity of water from the North Atlantic is forced into the Arctic Ocean, where, as in the Gulf of Mexico, we have a piling up of waters. This cannot proceed indefinitely, and so we have return cold-stream currents re-entering the North Atlantic on either side of Greenland. These surface currents are in addition to the "cold creep" of water referred to in the beginning of this chapter. The Labrador current flows from amongst the islands of North America, past the coasts of Labrador, Newfoundland, Nova Scotia and New England, and finally sinks in the vicinity of Cape Hatteras, owing to its density being high in comparison with that of the warmer waters of those latitudes. The meeting of currents of air warmed by the Gulf Stream or its great drift, with air which has been cooled by the Labrador current, is the cause of the dense fogs which make Nova Scotia and Newfoundland the foggiest area in the world. These fogs are a source of great trouble to sailors.

Returning to the South Atlantic Ocean we find that, partly under the influence of deflection and partly **due**

to having reached the area of the westerly winds, the Brazilian Current passes across the ocean and proceeds equator wards up the coast of south-west Africa, where it is joined by the cold Antarctic Drift, a great drift of cold water blown by the westerly winds. As in the North Atlantic, there is in this part of the ocean a great circulation of water, moving in this case in a counter-clockwise direction, and having at its centre another Sargasso Sea.

The currents of the Pacific Ocean should now present no difficulty. There are equatorial drifts beginning in trade wind areas off the American coasts. Between them is the Counter Equatorial Current, which can be compared with the Guinea Current. The Kuro Siwo, or Black Stream of Japan, is the counterpart of the Gulf Stream; the north-western American coasts receive warm southern waters which may be compared with the North Atlantic Drift, whilst the counterpart of the Labrador Current is seen in the Kurile Current, which enters the North Pacific Ocean through the Bering Strait. Similarly, the currents of the South Pacific are comparable with those of the South Atlantic.

Reference has been made to the seasonal changes which occur in the North Indian Ocean, so that it is only necessary to add that in the southern portion of that ocean are currents in every essential respect similar to those of the South Atlantic and Pacific Ocean. Since the currents of the northern part of the ocean are not constant, the Counter Equatorial Current is uncertain and irregular, as may be expected.

OCEAN CURRENTS AND CLIMATE.

Finally, ocean currents have a very important influence upon climate. In Chapter III, we have seen how the warm water that is drifted past the western shores of Europe influences the climate of the western margin of that continent. This is very clearly shown in Fig. 19, for the direction taken by the January

isotherm of 32° F. is very considerably influenced by this factor. There is a striking difference between the winter temperature of the coast lands on opposite temperate shores of the North Atlantic.

Fig. 19 represents a land mass stretching from north to south temperate latitudes. The vast amount of water carried eastwards by the westerly winds causes a piling up of warm surface water on the western shores of temperate latitudes, whilst these waters tend to be blown away from eastern shores in the same latitudes,

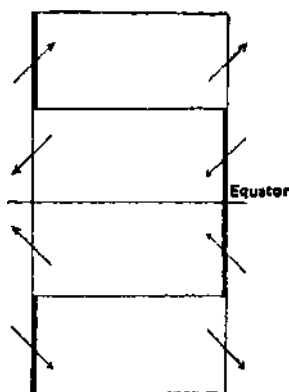


FIG. 19.—This diagram illustrates the piling up of waters by on-shore winds

and much lower temperatures are experienced. In trade-wind latitudes the conditions are reversed and the warm surface waters are piled up on the east coast and carried away from the west. A map showing the distribution of coral will show coral reefs, etc., on the eastern shores of tropical countries, but not on the west, for the tiny coral polyp cannot live unless the temperature of the water is always over 70° F. These warm conditions are not found on the western margins, where the colder water takes the place of the surface water drifted away from the coast by the prevailing winds.

EXERCISES.

1. Describe the courses which might be taken by a sealed bottle cast into the sea from a boat passing the Canary Islands.

2. How far is it true to say that the circulation of the surface waters of the North Atlantic Ocean is as if the water had been stirred in the direction of the hands of a clock, and in the South Atlantic in a direction opposite to those of the hands of a clock?

3. What effect have ocean currents upon the directions taken by the southern hemisphere isotherms of 68° F. (January and July)? See Figs. 10 and 11.

4. Explain what is meant by warm and cold currents, stream and drift currents. Give examples.

5. Draw a diagram to show the ocean currents of the North Atlantic Ocean. Show their connection with the prevailing winds.

CHAPTER VI.

RAINFALL: ITS CAUSES AND DISTRIBUTION.

EVAPORATION AND CONDENSATION.

AFTER rains a considerable quantity of water remains on the surface of the ground in small pools, but quickly disappears. Wet clothes are hung out and are taken down quite dry. In both of these instances the water has disappeared into the atmosphere in the form of water vapour which we cannot see—that is, it has evaporated. On the surface of the earth are oceans, lakes, rivers, etc., exposed to the atmosphere, and from all these water is constantly being evaporated and received into the atmosphere. If a mass of air which contains water vapour is cooled, some of the vapour may condense into very tiny drops of water which are not too heavy to be held in the air. It is in this way that mists, fogs and clouds are produced. Should the condensation proceed further, the tiny drops of water run together and form a raindrop that is too heavy for the air to carry in suspension, and rain results. Of course, only a portion of the rain which falls on the land is directly evaporated into the air; much finds its way into rivers, and is carried off to the oceans, whilst some remains in the soil and is used by plants and animals. It is interesting to think of the great oceans as the chief places where evaporation is taking place; that this water-laden air is carried by means of winds towards the lands, where it is forced to rise—perhaps on meeting mountains—and is therefore cooled, and a fall of rain occurs. The rainwater is carried off to the oceans

largely by rivers, and thus the cycle is going on throughout the centuries.

It is very important to notice that warm air can hold much more water vapour than cold air, as the following figures show—

Temperature.	Maximum amount of water vapour which can be held by a cubic metre of air.
— 10° C	2.28 grammes
0°	487 „
+ 10°	936 »
20°	17.1 „
30°	3008 „
40°	50.67 „

This table shows that the maximum amount of water vapour which can be held by a cubic metre of air at a temperature of — 10° C. is 2.28 grammes, whilst the same volume at 10° C. can hold 9.36 grammes. It will be observed that the amount of water vapour held at different temperatures increases very considerably with increase of temperature. Saturated air, or air at a certain temperature, containing the maximum amount of water vapour for that temperature, can be made to hold more by being warmed, but if it be cooled, some of the vapour will condense. The temperature to which air must be cooled in order that some water vapour may be condensed, is called its *dew-point*. Another glance at the table will show that if saturated masses of air at different temperatures, say 10° C. and 30° C, are cooled, there will be much greater precipitation in the case of the warm air than in the case of the cooler air. This has a great deal to do with the heavy rainfall in equatorial latitudes.

There are innumerable particles of dust in the atmosphere, and these appear to play a very important part in assisting condensation, for when water vapour is condensed, it is upon a nucleus of a dust particle that the tiny water drops grow.

How RAINFALL IS MEASURED.

Rainfall is measured by means of a rain-gauge. In essence, this consists of a funnel which catches the rain and leads it into some kind of vessel. If the vessel is cylindrical and the area of its opening is the same as that of the opening of the funnel, the depth of water in it represents the amount of rain which has fallen in that area. In order to measure accurately small amounts of rainfall, it is necessary to have a specially graduated measuring glass whose diameter is less than that of the funnel. If the area of the mouth of the funnel is 15 square inches, it is obvious that 15 cubic inches of water will be necessary to cover that area to a depth of one inch. Therefore, if 15 cubic inches of water are carefully measured and poured into a measuring glass, the height of the column of water will represent a fall of one inch upon the area of the funnel's opening. The measuring glass can then be graduated so as to read such small amounts of rainfall as one-hundredth of an inch.

To get correct results, it is very necessary to place the rain-gauge in a suitable position, in order that all the rain which falls may be registered. It should be placed about twice as far from the nearest building as the latter is high, and raised from the ground about one foot. The latter precaution prevents water splashing upwards from entering the funnel.

Of course, all condensed water vapour does not fall in the form of rain. Falls of snow and hail are common. The former requires very careful measuring, for the funnel of the gauge may be filled before the snow ceases to fall. Snow has to be melted before the amount can be read in rainfall equivalents. About ten inches of untouched snow yields one inch of rainfall.

THE CAUSES OF RAINFALL.

Rain is the result of the cooling of air containing water vapour. The cooling may be accomplished in several ways:—

(i) Air moving from warm to cooler latitudes will not be able to hold as great a quantity of water vapour, and there will be a tendency to precipitation. The best examples are the Westerlies, which blow towards colder latitudes.

(2) The cooling of air due to a forced ascent on meeting a mountain barrier. Rains caused by this means are spoken of as *relief* rains. Fig. 20 shows a moisture-laden wind approaching a mountain chain. It is compelled to rise and this causes the air to expand. Expansion causes a lowering in temperature and this produces rain. When the temperature falls to freezing point, snow will fall instead of rain. On reaching the leeward side of the mountains, the air begins to descend and consequently to increase in density and in temperature, and therefore

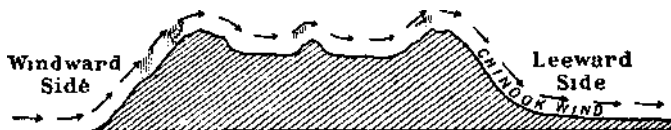


FIG. 20.—Chinook or Fohn wind.

in its capacity for holding water vapour. The increase in temperature is greater than that which was lost in ascending the windward slopes, so that the wind reaches the foot of the mountains on the leeward side a warm, dry wind. The names *Chinook* and *Fohn* have been given to such a wind. The former name applies particularly to the winds descending the leeward slopes of the Canadian Rockies, and the latter to the warm winds experienced in Swiss valleys, but the principle holds good in all particular cases, and therefore we may think of all such winds as Chinook or Fohn winds (see Ex. 1, at the end of the chapter).

There is a very close connection between the relief and rainfall maps of most countries, especially of those

in temperate latitudes. An examination of the two maps for the British Isles will show how close these relationships are in our own islands.

(3) The movement of air in cyclones causes expansion and therefore cooling and condensation. A cyclone is a pressure system in which the lowest pressure is in the centre from which the pressure rises towards the edges. In such a system the winds blow towards the centre and are deflected according to Ferrel's Law, so that, in the northern hemisphere, the whole system is rotating about its centre in a direction opposite to that of the hands of the clock. The centre of the cyclone remains an area of low pressure because the air which flows towards it is constantly rising and expanding. It is on account of this rising of air that cyclones are accompanied by falling rain. Cyclones are commonly experienced in the area of the westerly winds, and it is by their means that much of the rain that falls in these latitudes is brought.

(4) The meeting of air currents causes air to rise and expand, and therefore causes rainfall. This cause of rainfall is very similar to that which has just been considered. In the Doldrums belt, the N.E. and S.E. Trades meet, and air being forced upwards on a very large scale causes this region to be one of very heavy rainfall.

THE CAUSES OF DROUGHT.

Since any cause which can force large masses of air to be cooled will produce rainfall, any cause whereby air is warmed will tend to produce drought. It will not be necessary to go into these causes at length, for they are the opposite of those which produce rain. They are—

(1) Air flowing steadily from warm latitudes towards regions warmer still will increase its capacity for holding water vapour and condensation will not usually occur, unless by some means the air is suddenly cooled. The best examples of such air currents are the Trade Winds, and it is very striking that all the great deserts of the world are in trade-wind latitudes.

(2) There will be dry areas on the leeward side of most high mountain ranges.

(3) Anticyclones, usually masses of almost inert air, are systems of pressure, having the highest pressure in the centre and the lowest pressure towards the edges, and are fed by air descending from the upper atmosphere. They bring little or no rainfall.

(4) The Horse Latitudes are areas in which there is a descending of air, and they, too, are marked by drought.

THE DISTRIBUTION OF RAINFALL.

Figs. 21, 23 and 24 show respectively the annual, January and July distribution of rainfall over the surface of the globe. In studying these maps, constant reference must be made to the pressure and wind maps, and to the physical maps in an atlas.

MEAN ANNUAL RAINFALL.

A very general connection between Figs. 14 and 21 is evident. The belts of low pressure are areas of considerable rainfall, whilst the high-pressure belts are deficient in rain. This is illustrated in Fig. 22. The equatorial low-pressure area, the Doldrums, is one of heavy rainfall; the trade-wind areas contain most of the great deserts of the world, and in the low-pressure belts between the Horse Latitudes and the polar high-pressure areas there are other regions of considerable rainfall. Naturally, this requires to be considerably modified, for the actual distribution of pressure, as we saw in the last chapter, is not so regular as is shown in a diagrammatic manner in Fig. 22. Nevertheless, it is important to notice that there is a very close relationship between pressure and rainfall.

Fig. 21 is shaded to show areas which may be described as being well watered (over 25 ins.), moderately watered, or as having a deficient supply of rain. If this map is studied in connection with a relief map, and the dis-

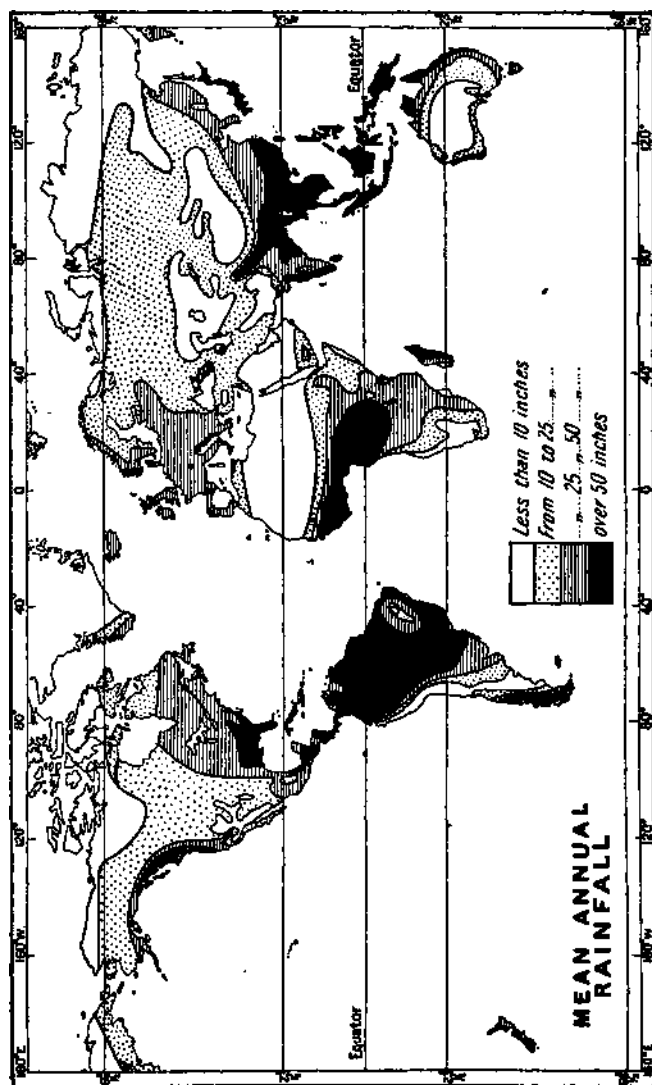


FIG. 21.—The mean annual distribution of rainfall.

tribution of pressure and the direction of the prevailing winds are kept in mind, Ex. 2 at the end of this chapter will serve as a test as to whether the principles which have been explained have been grasped or not.

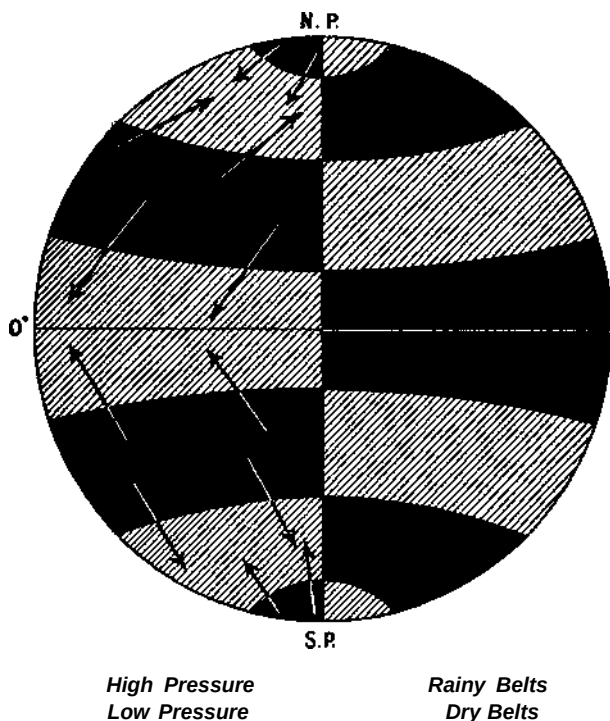


FIG. 22.—The relations between pressure and rainfall

DISTRIBUTION OF RAINFALL IN JANUARY AND JULY.

In January, the typical summer month of the southern hemisphere, the belt of greatest heat is south of the equator (Fig. 10). It is in January that the pressure

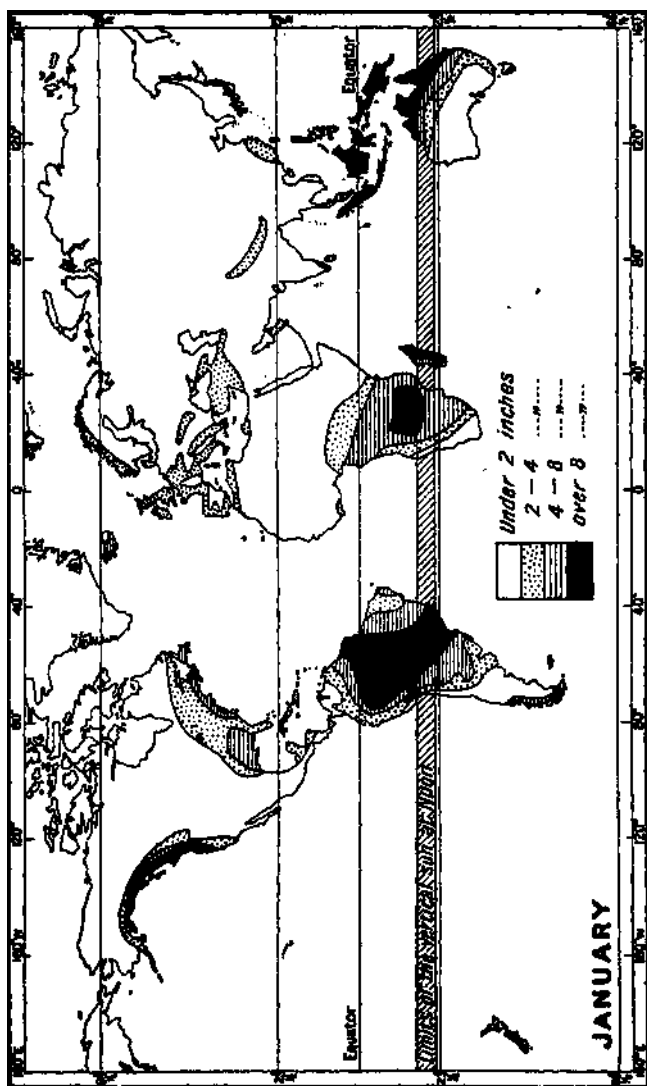
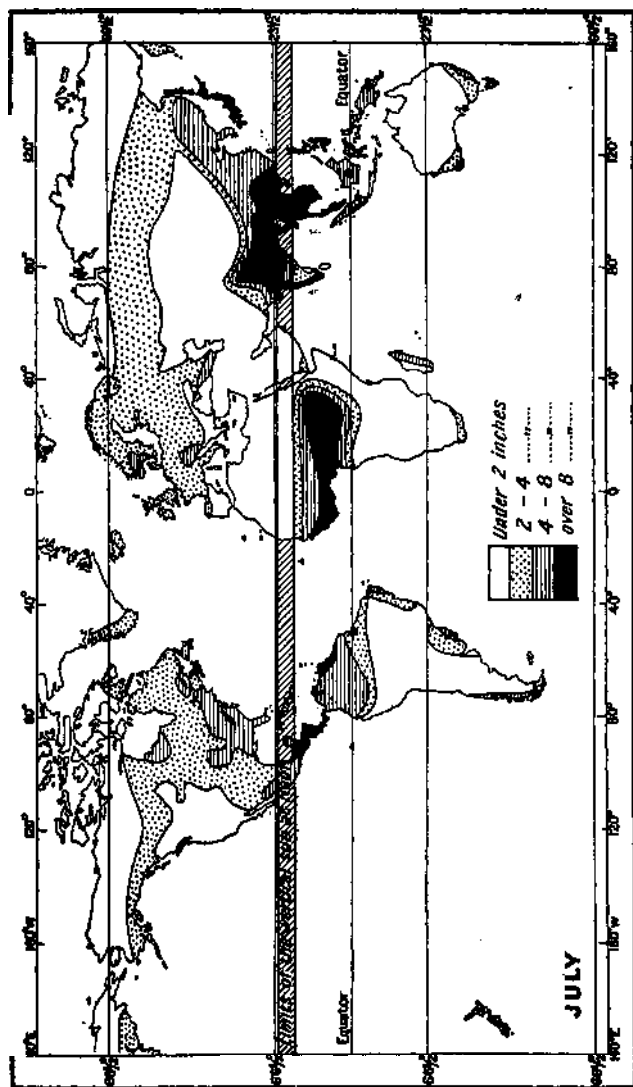


FIG. 23.—Mean rainfall for January. (After Herbertson.)

belts reach the southern limits of their migration. For these reasons, the regions of heaviest rainfall are all south of the equator in this month (Fig. 23). In July, the areas of heaviest rainfall are north of the equator, and this is due to the northerly migration of the temperature and pressure belts, a movement caused by the apparent migration of the sun (Fig. 24). These seasonal changes produce interesting results, as will be seen from an examination of Fig. 25. In the first column the approximate position of the high and low pressure belts is given for July, the month in which they are at their northern limit of migration. The second column gives the position of the various belts in the southern summer. It is at once clear that in the equatorial regions is an area which has low pressure all the year round. North and south of these are belts having low pressure in summer and high pressure in winter; these are succeeded by belts which have high pressure at all seasons. North and south of the latter are belts of low pressure at all seasons. Since areas of high pressure have little rainfall, it follows that certain of these belts will be wet at one season and dry at another, but it must be carefully observed that Fig. 25 only applies to the western margins of continents, for a wind which is there on-shore, *i.e.* blows from the sea to the land, will be an off-shore wind on the eastern lands in similar latitudes.

Let us apply Fig. 25 to the western coasts of Europe and Africa. From the north of Norway to the north of Spain is an area of rain all the year round, for the Westerlies are at all seasons the prevailing winds. From the Cantabrian Mountains to the Atlas Mountains is an area of winter rainfall and dry summers. This is succeeded by a belt of very little rainfall, and it is here that the Sahara Desert reaches the west coast of Africa. South of this is an area of summer rainfall, the Gambia and Senegal rivers having their mouths in this belt. The Guinea Coast and the Congo Basin receive rain at all seasons. South of the equator, the belts are repeated in reverse order, although there is



no counterpart of the West European type, for Africa

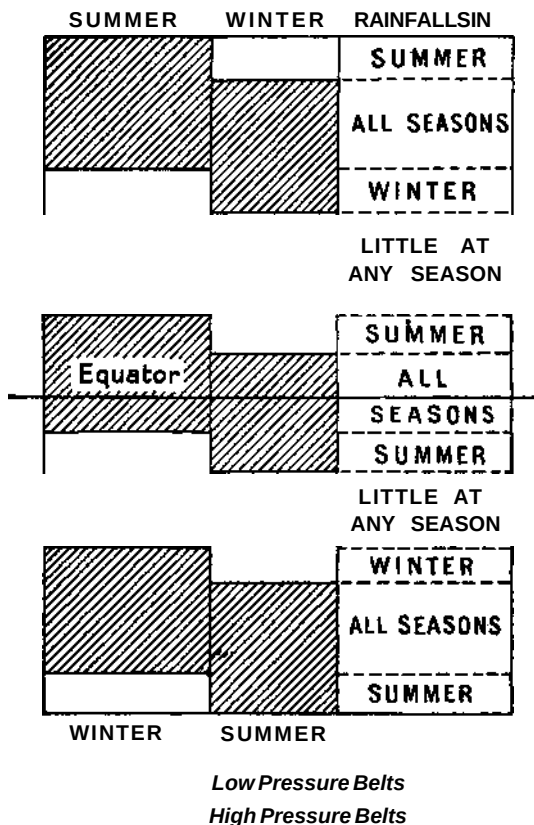


FIG. 25.—The influence of the migration of the pressure belts on the distribution of rain on the western margins on continents.

does not extend far enough south to have a belt in the prevailing north-westerly winds all the year round.

If we consider Figs. 23 and 24 together, it will be evident that some regions receive rain in winter and are dry in summer. They are on the west of continents and in the same latitudes as the two African winter rain areas which we have just considered. They are the lands bordering the Mediterranean Sea, the Valley of California, Central Chile, the south-west corner of Africa, the two southern protuberances of Australia and the north island of New Zealand. The winter rains and dry summers of all these lands are due to the migration of the pressure belts.

If we turn to Asia, we see a very striking contrast between the rainfall for January and that for July. In January, owing to this continent being under the influence of a huge high-pressure system (see Fig. 15), there are outflowing winds, and since these are dry, very little rain falls in this month except on the north-east coastlands, western Japan, in the Mediterranean lands to the east of the Mediterranean Sea, and on the Himalayas. In July, when a low-pressure system holds sway (see Fig. 16), there are inflowing winds, and since these have come over vast expanses of ocean, very great precipitation takes place, most of the continent, excepting the centre and the south-west, having a considerable amount of rain. The same causes in Australia give heavy rainfall in the southern summer to the northern margins. The winds which bring the heavy summer rain in south-east Asia and northern Australia are, as we have already learned, called monsoons.

Other lands of summer rainfall we should expect to find in the same positions as the African belts of summer rain, to which reference has already been made. In America we find that the north of South America, Central America, Mexico and the West Indies receive their rain mainly in summer; south of the Amazonian region of rain at all seasons is the Brazilian highland region of summer rain.

Owing to their great distance from the sea, we also

find that the interior lands of the great continents receive rain in summer, when they are under the influence of low pressure; but as they are far from the sea, such places have only a moderate rainfall.

EXERCISES.

1. Why is it that—

- (a) Sweden is drier than Norway?
- (b) The east of the South Island of New Zealand is drier than the west?
- (c) The northern Andes have heavy rainfall on their eastern slopes and an almost rainless area on their western slopes, and that these conditions are reversed in the southern Andes?

2. Write a short account of the mean annual distribution of rainfall as shown in Fig. 21. Give reasons for heavy rainfall in equatorial latitudes, the presence of rainless areas in the trade-wind regions, the heavy rainfall of the western margins in temperate latitudes, and the slight rainfall in the interior of the great land masses.

3. What is meant by saying that the mean annual rainfall of London is 25 inches? How has this figure been obtained?

4. Explain clearly why it is that the rain belts migrate northwards in our summer and southwards in the southern summer. What are the principal results of this migration?

5. On p. 50 figures are given showing the amount of water vapour which air at different temperatures can hold. Represent these figures graphically and write a summary of the important facts illustrated by the graph.

6. Describe a coastal region of deficient rainfall. Account for its aridity.

CHAPTER VII.

THE DISTRIBUTION OF NATURAL VEGETATION.

THE land surface of the earth is covered naturally with plants, except in those regions where it is either too high, too cold or too dry for any vegetation to exist. Generally speaking, regions of heavy nunjfallare forested, regions of light-rainfall are grasslands, and~those which lack moisture are deserts. The type of forest, grassland or desert will depend largely upon the temperature, so that there are tropical and temperate forests and grasslands, and tropical, temperate and cold deserts.

., Soil has an important influence upon-vegetetion,for some plants thrive best upon particular soils, as, for example, the beech thrives on a soil rich in lime. For most plants the presence of salt is fatal, but the mangrove and the coconut palm appear to like its presence. Different soils vary very much in their capacity for holding moisture, whilst plants differ in their capacities for extracting moisture from different soils. Some soils, again, are naturally very in fertile owing to the character of the rocks from which they havel been formed.

Fig. 26 shows the general distribution of natural vegetation, but it must not be supposed that the boundaries between the various types can be defined very clearly, for there is a gradual merging of one type into another. Deserts gradually become grasslands through an intermediate scrubland which is notable for its scattered grass patches and low, dry bushes. Grasslands merge into forests very gradually, for between areas which are typical forests and those which are typical grasslands, the scenery first resembles natural parkland—

a mixture of grasslands and woodlands—and very gradually becomes more wooded as the true forests are approached.

In studying Fig. 26 it is very important that constant reference should be made to the temperature and rainfall maps in Chapters III and VI, so that the connections between temperature, rainfall and natural vegetation may be clearly understood.

HOT WET FORESTS.

Forests of this type are found in (i) the hot wet equatorial belt; (ii) in lands having so much rain in their wet season that the soil holds a considerable amount of moisture all the year round. The former are sometimes called equatorial forests, and the latter monsoon rain forests. Equatorial forests are found chiefly in the Amazon basin and on the wet east coastlands in South America; on the Guinea coast, and in the Congo basin in Africa; and in the Malay Peninsula and the East Indies. In these forests the vegetation is exceedingly dense, even the undergrowth attaining forest dimensions, whilst the giant trees are linked together by a mass of creepers and parasitic vegetation. The floor of the forest is gloomy in the extreme, and its inhabitants are amongst the most backward races in the world. So solid are these forests that the rivers, which at the rainy seasons resemble long, narrow lakes, are the only easy ways of communication. The various trees which yield rubber are the most important trees, although there are valuable cabinet and dye woods, such as mahogany, ebony, logwood, etc., but the present difficulty of access is so great that these sources of wealth are practically untouched. Guttapercha trees are of great importance in the East Indies, and oil palms in the equatorial forests of Africa.

The forests of S.E. Asia and North Australia are not so dense, as here there is a well-marked dry season.

THE HOT GRASSLANDS OR SAVANNAHS.

Savannahs, or parklands, are grasslands interrupted by isolated patches of trees. They are found in tropical latitudes, in regions which have warm, dry winters and hot summers, with a small rainfall in summer. Fig. 26 shows that their distribution is closely related to the summer rainfall belts north and south of the equatorial belt of rain at all seasons. As the summer rainfall is not heavy, trees cannot grow excepting in places where there is a constant supply of water, *e.g.* near rivers, for the rainfall is not sufficient to keep the soil moist at all seasons. The climatic conditions are suitable for the growth of grass which springs up, produces flowers and seeds, and dies in a short time. As we should expect, one of the chief occupations on the savannahs is cattle rearing. The temperature is unsuitable for sheep.

In South America there are extensive savannahs north of the equator in the Guinea highlands and the llanos of the Orinoco Valley, and south of the equator in the Brazilian highlands. In Africa they are found north, east and south of the equatorial forests, and in a very similar position in Australia. Asiatic regions in these latitudes receive so much summer rain that, as we have already seen, they are forested.

THE HOT DESERTS.

The savannahs gradually merge, through intermediate scrublands, into deserts. The hot deserts lie chiefly on the west of continents in the latitudes of the Trade Winds. In North Africa there is the enormous Sahara desert stretching from the Atlantic Ocean to the Red Sea, and continued eastwards in Asia by the deserts of Arabia and Thar. South Africa has the Kalahari desert. In similar latitudes in South America are the long, narrow, west coast deserts of northern Chile and Peru. They lie to the lee of the Andes. In North America we have the Colorado desert, and in Australia the great western desert. There are also the extensive desert lands on

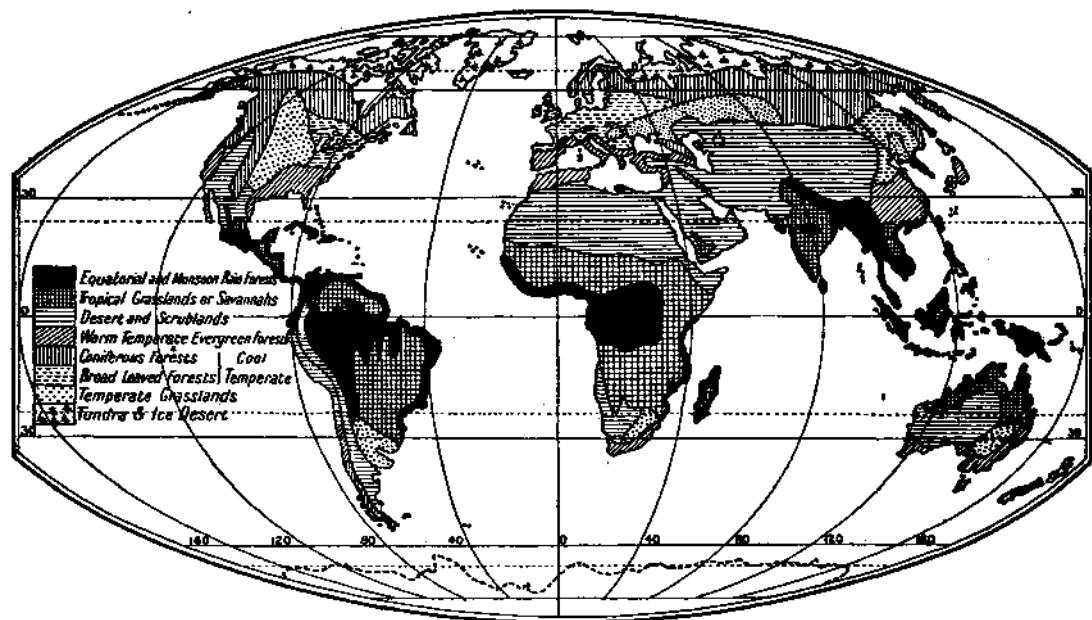


FIG. 26.—The distribution of natural vegetation.

high plateaux and in the interior of the great Asiatic land mass. Examples of these plateaux and interior desert and semi-desert lands are found in the western cordillera of North America, in the plateau of Iran, and in the deserts of Turan and Gobi.

Except where there are underground supplies of water, there are very few plants on deserts. Desert plants must either have very long roots, so that they can reach this underground water, or thick, fleshy leaves to store up water. The leaves, which are designed to resist the evaporation of moisture from the plant, are often very small and protected by means of thorns. On the scrub edges of the desert, trees which exude gum in the dry season are often met with. The acacia is a good example.

Even in the desert, wherever there is a permanent supply of water from wells or from rivers which flow across deserts but rise in wet lands, cultivation can take place, while by means of irrigation, many arid lands have been reclaimed, especially in North Africa, North America and Australia.

TEMPERATE FORESTS.

These are of two varieties: (1) *warm temperate*, which are found roughly from latitude 30° to latitude 45° , and (2) *cool temperate*, from latitude 45° to latitude 60° .

(1) WARM TEMPERATE FORESTS.—Fig. 26 shows that these are found on both east and west sides of continents. The rainfall maps show that whilst the western regions receive most of their rain in winter, the eastern regions have summer rainfall. This will naturally have its influence upon the vegetation. Whether on the east or the west, these forests are evergreen; but in the eastern forests the leaves are usually very large and thick, as, for example, the leaves of camellias and magnolias, whilst the trees in the various "Mediterranean" regions of winter rainfall

have usually either small, dry leaves, as, for example, the olive, or leathery leaves like those of the laurel.

Forests of the western or Mediterranean type are found in the lands of winter rains bordering the Mediterranean Sea; in California, Central Chile, south-west Africa, south-west and south-east Australia, and in the north island of New Zealand. The chief trees are evergreen oaks, including the cork oak, walnut, chestnut, and some species of pine. In most of these regions, vines, olives and mulberries are cultivated. In Australia the chief trees are the acacia and the eucalyptus, each of which has its leaves hanging edgewise, so that little shade from the sun's heat is given.

(2) COOL TEMPERATE FORESTS.—As in the case of the warm temperate forests, the cool temperate forests may be divided into two groups: the coniferous and deciduous forests. The former are found where the winters are severe, the summers short and the rainfall inclined to be deficient, whilst the deciduous or broad-leaved forests are found in regions where the temperature conditions are more genial and the rainfall is fairly abundant.

(a) *Coniferous Forests*.—The chief conifers are pines, hemlocks, firs and larches, but the hardy birch, which is deciduous, is a common tree in coniferous forests. The leaves of most of these trees are needle-like in structure, and thus transpiration is checked, for little surface is exposed. As a general rule, these trees retain their leaves during the long winter, which is not with all species a resting season, for the summer is so short that the comparatively warm periods at the beginning and end of winter are taken advantage of.

The most extensive coniferous forests are found in northern Europe, Asia and America. They give shelter to large numbers of fur-bearing animals, and thus trapping is usually the first occupation carried on. Later come the lumber-men, who cut down the trees, which are used for many different purposes, such as doors, window-frames, flooring, etc., whilst they also

yield turpentine, pitch, resin and wood pulp. In deforested areas where the climatic conditions are suitable, agriculture is carried on. Some regions have undergone all these stages of development, whilst some, as, for example, the forests of eastern and northern Siberia, are still in the trapping and hunting stage.

Coniferous forests are sometimes found in regions of more genial climates than those of the ordinary forests of this type. Under these conditions, the trees often attain gigantic dimensions, as on the west coast of North America, where the famous Douglas firs and giant pines are found.

(b) *The Broad-leaved Forests.*—The chief trees in these forests are the oak, beech, elm and maple. In autumn the leaves fall, and thus transpiration is checked. The flowers are not very prominent, and most of them are wind fertilized. In this respect these forests offer a marked contrast to those of hot lands, where the trees have brilliantly coloured flowers. The distribution of broad-leaved forests is shown in Fig. 26, and their positions as compared with those of the coniferous forests should be noticed. From the greater part of Western Europe and eastern North America the natural deciduous forests have disappeared, and in their place we find agricultural and industrial regions.

TEMPERATE GRASSLANDS.

These, known in particular places as prairies, pampas or steppes, are found in regions having very warm summers and cold winters, with a moderate to slight rainfall in summer. Fig. 26 shows that these regions are usually in the interior of great land masses, for it is there that these climatic conditions are met with. The rainfall is not sufficient to keep the soil moist at all seasons, so that trees are found only near rivers. It should be noted, however, that in some places there are other reasons, *e.g.* strong winds or porous soil, why trees do not grow. The prevailing vegetation everywhere is grass, so that these

NATURAL VEGETATION

regions are noted pasture lands, whilst in those parts where the rainfall is sufficient, large tracts are used for the growth of cereals. Most of the wheat of the world is now grown in areas which were once natural grasslands.

The seasonal changes, the green of late spring and early summer, the brown of late summer and autumn, the snowy mantle of winter, and the carpet of bulbous flowers in early spring, form a most enchanting cycle of changes.

THE TUNDRA AND ICE-DESERTS.

The poleward limit of coniferous forests is approximately the July isotherm of 50° F., for unless that temperature is attained during at least one month, trees cannot thrive. North of that line is the tundra, which is really a cold desert whose total precipitation is less than 10" per year. In the long winter the ground is snow-covered, but during the short, warm summers the lowlands often assume a meadow-like appearance, bright with numerous flowers. They are not merely lands where only stunted berry-bearing bushes, mosses and lichens grow. There are no tundra lands in the southern hemisphere.

Towards the poles are wildernesses of ice and snow which are practically devoid of life. Such lands are found in Greenland, in many of the islands to the north of Canada and Asia, and in the Antarctic continent.

THE INFLUENCE OF ALTITUDE UPON VEGETATION.

We have seen that latitude has a great influence upon vegetation; the equatorial forests are very different from the temperate forests and the hot deserts from the tundra. Altitude, too, has a great influence. Many mountains in equatorial latitudes are snow-capped all the year round. The dense equatorial forests at the bases of these high mountains, e.g. Ruwenzori in Central Africa, give way very gradually to evergreen, warm temperate, broad-leaved coniferous forests. Above

these levels the trees become scattered and dwarfed, and there are parts which are snow-covered in winter, but the melting of the snow in spring provides moisture for the growth of grass and many kinds of beautifully coloured flowering plants. Still higher than these meadow-like lands are areas resembling the tundra, whilst beyond that the snow lies on the ground all the year round. Thus, in ascending a high mountain situated close to the equator, somewhat the same changes in vegetation are experienced as in a journey from the equator to the polar regions, such is the great effect of altitude upon vegetation (see Fig. 41).

On the high dry plateaux, *e.g.* Tibet and Bolivia, there are extensive areas with a semi-desert type of vegetation, consisting chiefly of coarse grasses and scattered patches of bush.

EXERCISES.

1. Explain why it is that the vegetation belts on the west of continents differ from those on the east.
2. State and account for the distribution of Equatorial forests.
3. Examine the different types of natural vegetation found in your home district.
4. What are the climatic reasons for the distribution of the great deserts of the world?
5. What are the chief types of natural vegetation that would be encountered in a journey (*a*) from the White Sea to the Caspian Sea, (*b*) from the mouth of the Nile to Lake Victoria, (*c*) across Canada by the Canadian Pacific Railway? Account for the differences you mention.
6. Give examples of the connections between the natural vegetation and the chief occupations of a region.
7. Obtain pictures of each type of vegetation and fix them in your note-book, along with your notes.

CHAPTER VIII.

ASIA: PHYSICAL FEATURES.

IN previous chapters we have been considering the outlines of the world distribution of temperature, pressure, winds, ocean currents, rainfall, and natural vegetation, and we have shown the relations which exist between these various factors. We shall now turn our attention to the continent of Asia; and, whilst studying it, we shall pay particular attention to the principles which we have learned and apply them in more detail, although, of course, it is necessary that our study should have a wider outlook than merely the study of questions involving climate and natural vegetation.

THE POSITION AND SIZE OF ASIA.

If we examined a globe, we should see that Asia lies to the east of Europe and North Africa, and that the whole of the mainland is north of the equator. Its most northerly point, Cape Chelyuskin, is within 13° of the North Pole, and its most southerly, Cape Romania, is only 1° north of the equator. The distance "Between these capes is over 5,000 miles, whilst in an east and west direction the continent extends for an even greater distance. Asia is thus an enormous land mass. It is the greatest of all the continents, being four and a half times the size of Europe, and containing within its frontiers about one-third of the total land surfaces of the world. In shape, Asia is a rough quadrilateral, with three very large southern peninsulas, Arabia,

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India, and Indo-China. On the east coast are the smaller peninsulas of Kamchatka and Korea, and on the west the plateau peninsula of Asia Minor.

PHYSICAL FEATURES AND STRUCTURE.¹

A physical map of Asia shows a great belt of highlands stretching across the continent from west to east. In Asia Minor this belt is fairly wide. It widens out in the plateau of Iran, but in the Pamir Plateau, to the north-west of India, it is very narrow. From this point it rapidly widens, until in the east it occupies an area stretching through almost the whole breadth of the continent. North of this high belt are vast plains stretching to the Arctic Ocean, into which they are drained, except in the west, where the lowest parts of the plains are occupied by the salt Caspian and Aral seas. In the south of Asia there is the deeply trenched plateau of South India, the Deccan, which is an old block so tilted that it presents in the west a steep face to the Arabian Sea, and gradually slopes eastwards to the Bay of Bengal. The Deccan is separated from the central belt of highlands by the plains of the Ganges and the Indus. In the south-west there is the Arabian plateau, tilted in the same manner as the Deccan, and separated from the central highlands by the Persian Gulf and the plains of the Tigris and Euphrates. In the east are many broad plains, drained by great rivers. The chief are those of the Amur, Hwang-ho, Yangtse-kiang, and Si-kiang. Lastly, we have the archipelago of the East Indies, and the eastern festoon of mountainous islands stretching from the peninsula of Kamchatka, through the Kurile Islands, Japan, and Formosa to the Philippines.

From this brief account, it will be seen that Asia may be divided into four physical units—

¹ See Book I of this series for an account of the formation of plateaux, plains, folded mountains, etc.

- I. The north-western lowlands.
- II. The central highlands and plateaux.
- III. The southern plateaux.
- IV. The eastern margins and island ranges.

Reference to the map will at once show that the great north-western lowlands, the central highlands east of the Pamirs, and the Indian plateau are all triangular.

I. THE NORTH-WESTERN LOWLANDS.

The only important break in the continuity of the great plain which stretches from the North Sea to the central highlands of Asia is formed by the Ural Mountains. But these mountains are not high enough to form a really serious barrier, either as regards climate, vegetation or communications, so that we must regard the whole of this vast plain—the greatest in the world—as one, although in this book we shall only consider its eastern or Asiatic portion. Fig. 27 shows the structural divisions of Asia. It will be seen that these vast plains consist, for the most part, of sedimentary rocks, which lie in horizontal layers, unfolded and undisturbed. One addition to this statement must be made. The greater part of the West Siberian portion of the 'plain' is shown as being covered with recent deposits. This region is very flat and low, so that the rivers have not sufficient speed to carry along the load of silt which they bring from the mountains. They are compelled to spread this over the land in times of flood, and in this way this portion of the plain has been largely covered by alluvium. The eastern lowlands, drained by the Yenisei and the Lena, are narrower, but higher, and therefore less swampy.

Whilst the great north-west lowlands are drained mainly to the Arctic Ocean by the three long rivers, Obi, Yenisei and Lena, the south-western Turan plains contain the large Aral Sea, which is the centre of an area of continental or inland drainage, for the rivers flowing into it never reach the sea.

THE CENTRAL HIGHLANDS

IL THE CENTRAL HIGHLANDS.

These highlands are continuous with those of Europe, and form the highest and greatest mass of mountains in

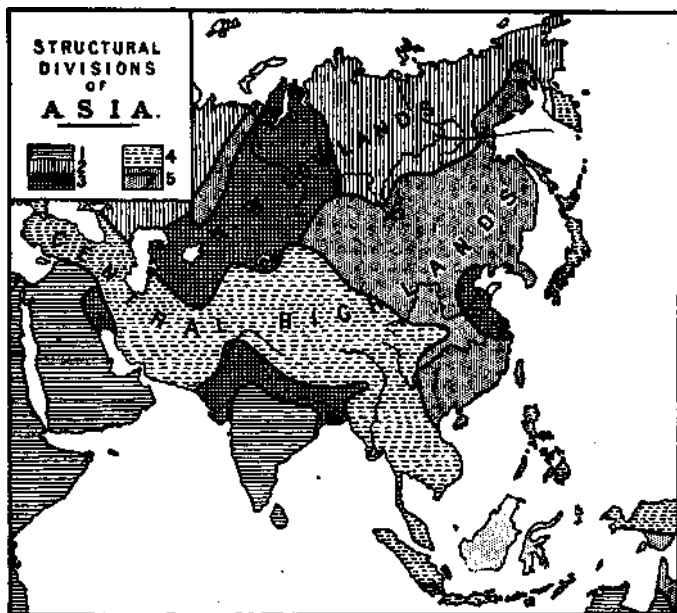


FIG. 27.—The structural divisions of Asia,

- x. Plateaux of unfolded rocks.
- 9. Unfolded lowlands.
- 3. Unfolded lowlands of recent deposits.
- 4. Folded mountains and enclosed plateaux.
- 5. Highlands of rocks folded in ancient times, now greatly denuded and fractured.

the world. They consist of mountain chains, generally running in an east and west direction, between which are lofty plateaux, which are wider in the east than in the west. Fig. 27 shows that the central highlands may be divided into two structural groups, a series of parallel folded ranges enclosing plateaux and

valleys, and a much older eastern mass which originally consisted of folded ranges, but has been very much worn down. In the first group three distinct chains can be traced by the aid of a physical map. The three chains' come very close together in the Pamirs, and on that account we find there the highest region in the world. It is often called the "roof of the world." The first chain is represented by the Caucasus and Tien Shan mountains: the second, or central chain, by the Pontic, Elburz, Hindu Kush, and Kwen Lun mountains. Between these chains lie the great basins of the Black Sea, the Caspian Sea, and the Tarim basin. The third, or southern range, is a series of great loops, and includes the Taurus, Zagros, Sulaiman, and Himalaya mountains, whilst between the central and southern ranges are the plateaux of Asia Minor, Iran, and Tibet. To the east of Tibet, where the older highlands formed a great centre of resistance and turned the folded ranges southwards, is a series of north and south chains, traversing Indo-China. Between these ranges are densely forested valleys, drained by such large streams as the Irawadi, Salwin, and Mekong. The ranges of western Burmah are continued through the Andaman and Nicobar Islands, Sumatra, Java, and the Lesser Sundas, where they once more become east and west in direction. Fig. 48 shows that the islands west of a line passing between Bali and Lombok (east of Java), and between Borneo and Celebes, stand on a shallow submerged platform. At one time they were joined to Asia, as were the Philippines, although the latter appear to have been separated from the mainland at a much earlier time than the others. We shall find further evidence of the former connection of these islands with Asia when we speak of their plants and animals.

The older, eastern highlands are not so lofty as the younger mountains we have just traced. They consist of:—(i) the mountainous area surrounding Lake Baikal and extending from the Altai Mountains to the south-west of the lake, to the Yablonoi Mountains to the east;

(ii) the plateau of Mongolia, which ends abruptly in the Khingan Mountains in the east and stretches as far southwards as the North China Highlands. The Khingan Mountains have a steep slope to the Manchurian Plains and a gradual one to the Desert of Gobi. They owe their origin to the faulting and tilting of a huge block of the earth's crust. The east and west ranges of South China, known as the South China Highlands, the mountains to the east of the plain of Manchuria, the highlands of Korea, and the island of Borneo also belong to the older eastern highlands.

III. THE SOUTHERN PLATEAUX.

These are the plateaux of Arabia and the Deccan in Southern India. Arabia is very similar to the African plateau, from which it has been separated by the subsidences which made the Red Sea. It is composed of sedimentary rocks of great age and is tilted, so that it has a long, gradual, eastern slope and a steep slope to the west and south-west. The map shows that the Deccan is tilted in the same way as the Arabian plateau, so that its longest rivers run eastwards to the Bay of Bengal, and it presents a steep face, the Western Ghats, to the Arabian Sea. South of the Deccan is the island of Ceylon, and between the two are the island stepping stones known as Adam's bridge. Ceylon is a detached portion of the Deccan, to which it was formerly joined.

These two plateaux at one time formed part of an ancient continent which stretched thousands! of miles in an east and west direction. Extensive faultings and subsidences caused the breaking up of this old land mass, and formed the present oceans which now separate the remaining portions from each other. The remnants of this old continent are shown in Fig. 28.

Between Arabia and the plateau of Iran, and between the Deccan and the folded mountains to the north of India are extensive lowlands drained by very long rivers. The Persian Gulf at one time extended much

farther to the north-west, but it has been filled up by the sediment brought from the surrounding mountains by the Tigris and Euphrates and their tributaries, and in this way the alluvial plain of Mesopotamia has been made. In the same way, the rivers of the Indus and

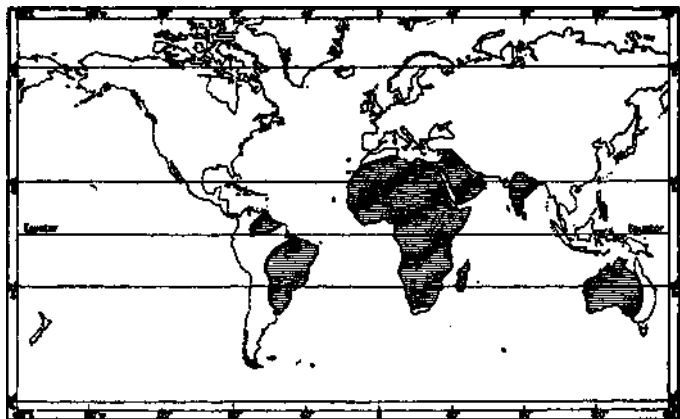


FIG. 28.—The great southern plateaux of unfolded strata. It is thought that they were once part of an ancient continent which geologists call Gondwanaland.

the Ganges systems have built the extensive alluvial plains which now separate the Deccan from the northern mountains of India. All these rivers have deltas which are being pushed out farther and farther every year.

IV. THE EASTERN MARGINS AND ISLAND RANGES.

The true eastern limits of Asia are to be found in the festoons of islands south of the peninsula of Kamchatka. This peninsula is continued southwards through the Kurile Islands, the Japanese Islands, the Lu-chu Islands and the Philippines. The ranges of these islands are largely volcanic.

Of the volcanoes, Fuji-San, Japan's sacred moun-

tain, has the most perfect cone. Fig. 66 shows that this volcanic belt extends all round the margins of the Pacific Ocean; it is sometimes called "The Fiery Ring of the Pacific." Between the mainland and the inland chain are the seas of Okhotsk, Japan, Yellow, East and South China. Of these, the Yellow and East China seas are the shallowest. They all occupy basins made by the subsidence of blocks of the earth's crust.

The chief rivers draining the eastern margin are the Amur, the Hwang-ho or Yellow River, and the Yangtse-kiang. The map shows that they rise far away in the central highlands and have extensive lowlands in their lower courses.

In this short account of the physical features and structure of Asia we have seen that the continent is of enormous size. It stretches through about 76 degrees of latitude, it has extensive plateaux, it has the highest mountain ranges in the world as well as vast plains, whilst tracts along the shores of the Caspian Sea are below sea-level. We shall, therefore, expect to find strong climatic and vegetation contrasts, ranging from the cold deserts of the north to the equatorial forests of the south, from the bleak, sparsely peopled plateau of Tibet to the densely peopled lowlands of China and north India. Asia is a continent of great contrasts.

EXERCISES.

1. On an outline map of Asia mark all the chief rivers and shade the map so as to show the land drained:—(a) to the Arctic Ocean, (b) to the Pacific Ocean, (c) to the Indian Ocean, (d) to the Mediterranean, (e) area of inland or continental drainage. Write a brief description of this map.

2. Draw a map of Eastern Asia, and the eastern volcanic chain of islands. Shade boldly the sea deeper than 100 fathoms, and the land above 600 feet. Mark the chief rivers.

3. Using the relief map in your atlas, draw a section from the Ganges plains to the north coast of Asia.

4. Give reasons why you would expect many political frontiers to meet in the Armenian Highlands and in the Pamirs.

5. Explain the terms:—alluvial plain; folded mountain; inland basin; escarpment. Give Asiatic examples of each.

CHAPTER IX,

ASIA: CLIMATE AND NATURAL VEGETATION.

IN earlier chapters we have considered temperature, pressure and winds, and rainfall as applied to the whole world. We must now summarize the chief facts as they concern the continent of Asia. From what we have learned in the last chapter it is not difficult to see that two outstanding factors will have a very considerable influence upon the climate of Asia. The first is its great extent in latitude, and the second its very varied relief. As regards the latter, it must constantly be borne in mind that the temperature and pressure maps have been corrected to sea-level readings.

TEMPERATURE.

Fig. 10 shows that a large proportion of the land has a temperature below freezing point in January.-The isotherm of 32° F. is a very important one, for it means that those plants which cannot flourish where there are severe winter frosts, will not grow in parts where the temperature falls below the freezing point for a whole month or more. It will be seen that the only parts which are free from frosts in winter are in the south and south-east. Now turn to Fig. 11, which shows that in July the greater part of the continent has a temperature exceeding 68° F., whilst the areas in which little rain falls (Iran and Arabia) have a very high temperature indeed, as there is little or no covering of cloud to lessen the heat. Notice the position of the isotherm of 48° F. This is important, because it marks

the northern limit of trees which must have at least that temperature during the warmest month. The influence of the Indian and Pacific oceans is seen in the lower temperature of the coastlands compared with those of the dry areas just mentioned, and in the northerly bends of the isotherms on the east coasts. The great facts to keep in mind are the contrasts between the cold of winter and the heat of summer experienced by the interior lands. Now let us consider a few actual figures—

Place.	Lat.	Long.	Height in feet.	Mean temperature in coldest month.	Mean tempera- ture in hottest month.
Verkhoyansk .	67° N.	133° E.	330	- 60° F.	60° F.
Yakutsk .	62	129	330	- 47	66
Tomsk .	56	85	395	- 3	66
Tobolsk .	58	68	345	— 2	64
Tashkent	41	68	300	30	81
Trebizond	41	40	100	41	75
Smyrna .	38	27	33	47	80
Aden	12	13	0	76	84
Bombay	19	73	35	75	85
Calcutta	22	88	20	65	86
Rangoon	16	96	40	75	85
Singapore	1	103	10	78	82
Hankow	3°	114	140	38	83
Shanghai	31	121	35	38	81
Peking .	40	116	130	23	80
Tokyo	35	140	65	37	78

The first group is taken from the great north-west low-lands. All have an extreme climate which is more extreme in the north-east than in the south-west, although the south-west portion of the plains has a much **hotter**

summer, as is illustrated by the summer temperature at Tashkent. Verkhoyansk has the lowest recorded temperature in the whole world, and has the exceedingly large range of 120° F. In places like this, where the winters are long and severe, most of the year's work has to be accomplished during the summer months, when work is carried on at high pressure in order that enough of the necessities of life may be obtained to last through the winter.

Trebizond and Smyrna are on the Black Sea and Mediterranean Sea respectively, and have cool winters and hot summers. The towns in the third group have only a small range of temperature, and are hot at all seasons, although Calcutta's coldest month may be described as very warm. They are all within the tropics. The last group illustrates the hot summers and relatively cold winters of the south-eastern margins. These places have colder winters than have western margins in the same latitude, this being due to the cold, dry winds which blow from the high-pressure system centred towards the middle of the cold land mass. If figures were given for towns on the great central—plateaux of Tibet, the Tarim basin and Mongolia, they would show cold winters below freezing point, *and* very hot summers.

PRESSURES AND WINDS.

Owing to the land becoming very hot in summer, a low-pressure area is created towards which winds flow from the oceans, where the pressure is higher. -Since this inflowing air is cooler and denser than the heated air, the latter is forced to ascend: Thus the greater part of Asia receives inflowing winds in July (see Fig. 16). In January the conditions are reversed (see Fig. 15). The land masses in the heart of the continent are extremely cold, and this produces a great high-pressure system which hangs over Central Asia like a heavy cap. From this system winds flow outwards towards the

oceans, where the pressure is less, so that the greater part of Asia has cold outflowing in winter.

RAINFALL.

Fig. 21 shows the mean annual rainfall of Asia. About two-thirds of the continent receives very little rain. It will be seen that these areas are found, (i) in the south-western part of the great northern lowlands, (ii) on the central plateaux. (iii) on the plateaux of Arabia and Iran, (iv) in the extreme north. The little rainfall is due in the first region to the great distance from the ocean, in the second to the fact that these plateaux are to the lee of the highlands of northern India and China, which have already received most of the moisture brought by the wet summer winds, and in the third region (the south-western plateaux) to the dryness of the prevailing N.E. Trades, for the monsoon rain-bearing winds of summer do not affect this part of Asia. The north coastlands lack rain, as the low temperature causes very little evaporation to take place, and therefore limits the rainfall.

A comparison of Figs. 23 and 24 will show that most rain falls in summer when there are the inflowing winds. If Fig. 24 is studied in connection with a relief map, it will be seen that these summer winds deposit most of their moisture on the mountains with which they first come into contact, and pass on as dry winds. South of a line from the mouth of the Indus to Korea is a region over the greater part of which there is a heavy summer rainfall. Summer rainfall, though small in amount, is also experienced in a broad band stretching across the north of the *the lands bordering the eastern Mediterranean* have the dry summers and wet winters typical of the Mediterranean shorelands. Ceylon, the Malay Peninsula, the coastlands of China, the islands in the eastern volcanic Chain and the East Indies all have rain at all seasons. Fig. 29 shows the season at which most rain falls in the different parts of Asia.

VEGETATION AND ANIMALS.

Fig. 26 shows the world distribution of vegetation. It will be seen that the tundra, the cool temperate forests and the steppe of Europe are all continued eastwards

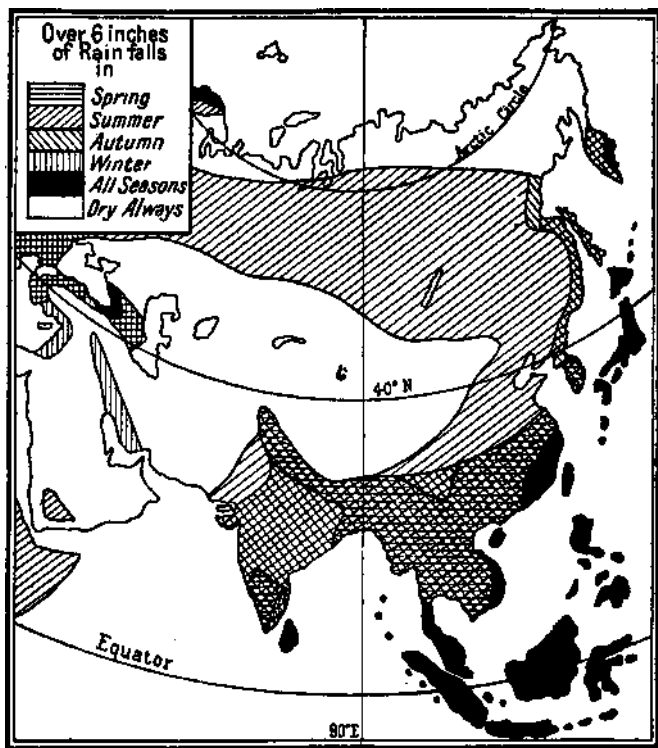


FIG. 29.—The Seasonal distribution of rain in Asia.
(After Herbertson and Supan.)

into Asia. The chief animal of the tundra is the reindeer. The coniferous forests of Siberia are very dense, and give shelter to many kinds of fur-bearing animals, of which the chief are the sable, fox, mink and ermine. These forests gradually give place to the grassy steppes,

the richer parts of which are rapidly becoming important wheat-producing lands.

Towards the Sea of Aral, the steppes merge into semi-desert or scrublands in which are extensive areas of true desert. Deserts are also found in the rainless parts of Arabia, Iran, Tibet, and Mongolia. In the higher parts of Arabia, and over considerable areas of the central plateaux, are tracts of slight rainfall having a very poor type of pasture, not unlike the drier steppes. Yet even this is sufficient to support wandering tribes of herdsmen, who follow their sheep and goats from pasture to pasture. Fleet-footed grazing animals, such as gazelles and asses, run wild. In Arabia, the chief animal is the camel, whilst the famous Arab horses are reared on the poor pastures. In Tibet, the yak, the native ox, is the chief beast of burden and also provides food and clothing.

In the Mediterranean region of winter rainfall the plants adapted to summer drought are found. The chief are the vine, fig, mulberry and olive.

The monsoon lands of the south-east have rain mainly in summer, and, since this is generally considerable in quantity, the natural covering is usually forests. In North China, Korea and Japan, these are of the warm, temperate type, and in Southern China, Indo-China and India, of the hot, wet variety, although there are parts having a smaller rainfall, in which savannah, or mixed grass and woodlands are found. The Deccan is an example of this type. In the forests and jungles are many species of wild animals, amongst which may be mentioned the elephant, which can be domesticated and taught to do useful work, the dreaded tiger of Bengal and the Malay Peninsula, the leopard, the tapir (found in Asia only in the Malay Peninsula and in Sumatra), as well as many varieties of monkeys, apes and snakes, of which the cobra is perhaps the most dreaded. Mention should also be made of the buffaloes and humped cattle of India, for they are very important for draught purposes.

In the hot, wet equatorial forests of the South Malay

Peninsula and the East Indies the heat and rainfall are constant, so that dense tropical vegetation is met with, except in the higher parts of Borneo. The chief trees are sago-palms, bananas, coconut palms, gutta-perchas, bread-fruits, and trees and shrubs from which spices are obtained. From these the natives can obtain most of the necessities of life. The great naturalist, Wallace, fixed the line separating the Asiatic animals from those distinctly Australian in type, as running between the islands of Bali and Lombok, east of Java, and between Borneo and Celebes (see Fig. 48). Others have fixed the line so as to include Celebes as having an Asiatic type of fauna. As a matter of fact, the fauna along the boundary line drawn by Wallace is of a mixed type, and this is what we should expect to find. We have already learned that the islands west of Wallace's line stand on a submarine platform less than 100 fathoms below sea-level, whilst those to the east have surrounding seas which are very much deeper. Wallace thought this indicated that Australia was separated from other land masses very early indeed, so that it had been able to develop a typical flora and fauna. The typical Australian tree is the eucalyptus, whilst the characteristic animals are marsupials—that is, they are pouched, as, for example, the kangaroo.

EXERCISES.

1. Why is it that (a) Asia Minor receives its rain chiefly in winter, (6) the East Indies at all seasons, (c) south-east Asia chiefly in summer, (d) the central plateaux are deficient in rainfall?

2. Describe the climatic conditions which produce (a) tundra, (b) steppe. What animals are best suited for each?

3. What zones of vegetation would be passed through in a journey from the south of India to the arctic coast of Asia? Account for the changes you notice.

4. On an outline map of Asia shade all regions receiving a mean annual rainfall of less than 10 inches. On the same map mark the desert lands of the continent. What connections do you notice between the two sets of factors?

5. What are monsoon winds? Draw sketch map to illustrate **their** causes, and, in writing, briefly describe the maps.

CHAPTER X.

THE MAJOR NATURAL REGIONS OF ASIA.

ASIA may be divided into several large units or major natural regions. In so dividing the continent, the physical features, climate, vegetation and leading occupations must be taken into account. One of these factors alone is not sufficient, for a physical unit may be so large that the climate and vegetation in different parts vary very much. It will thus be seen that natural regions are not simply physical units. Ideal natural regions would be those which were physical, climatic and vegetative units—that is, regions of the same physical type throughout (plains, plateaux or highlands) in which the same set of climatic conditions obtained in all parts of the unit, and produced the same general result as seen in the natural vegetation and occupations. To carry out this thoroughly we should have to divide the continent into a great many units. For our present purpose, it is sufficient to take very large divisions, in each of which are certain outstanding characteristics, which allow of the region being considered as a unit. In selecting the major natural regions the chief factor which has been considered is natural vegetation, for in the distribution of vegetation we also have the influence of relief and of climate playing important parts. That is, if a region has the same type of natural vegetation in all parts, it is obvious that the climate is approximately the same throughout the region, and that there will be a similarity in the natural occupations. Much of this chapter will therefore resemble Chapter VII, although here we shall confine our attention to Asia.

It will be seen that a division of Asia into large natural regions takes no account of the political boundaries but as the importance of these is not inconsiderable, we must not neglect them. We must also notice that it is often impossible to draw an exact boundary line between natural regions, for one type merges into another very gradually.

(A) THE TUNDRA.

This region occupies most of the land lying within the Arctic Circle. The physical map will show that the tundra consists mainly of lowlands. Short summers and long, cold winters, a total precipitation of less than 10 inches, and a natural vegetation consisting chiefly of berry-bearing bushes, mosses and lichens, and numerous flowering plants, are the outstanding characteristics of this region. Life here is very hard indeed, and the hard work necessary to keep alive is not rewarded by the comforts of more fortunate climates.

(B) THE NORTHERN TEMPERATE FORESTS.

This region is a great belt stretching across northern Asia, south of the tundra. In the west it covers lowlands, and in the east, highlands. The chief trees are conifers, although towards the south broad-leaved trees appear. Little lumbering is done in these forests, for the means of export are at present very difficult indeed. The trapping of fur-bearing animals is the chief occupation. Throughout the area the climate is one of extremes, although the summers are much warmer than those of the tundra, and the rainfall is greater. This, of course, accounts for this region being forested, whilst the tundra is a gold desert.

(C) THE GRASSY STEPPE.

This is a great grassy plain with a rich soil. Owing to distance from the sea the climate is one of extremes,

The rainfall is not very heavy—in parts it is deficient in quantity—and falls in summer. The natural occupation is stock-rearing, although a great change is taking place in the richer parts immediately south of the forest belt. Here every year sees an increase in the area of



FIG. 30.—The major natural regions of Asia.

A. Tundra.	B. The northern temperate forests.
C. The steppes.	D. The Mediterranean lands.
E. The deserts and semi-deserts.	F. The monsoon lands.
G. The South-Eastern Archipelago.	

land devoted to the growing of cereals, especially wheat

Towards the south-east the steppe becomes arid and desert-like, so that we shall include this southern portion of the north-west lowlands in the Great Desert Belt.

(D) THE MEDITERRANEAN LANDS.

This region stretches from the Mediterranean Sea to the plateau of Iran. Politically it includes Turkey, Syria, Palestine, Iraq, the Republics of Armenia, Georgia and Azerbaijan, and the western districts of Persia. Only the coaslnds have the typical Mediterranean type of climate of very warm, dry summers, mild winters and winter rains, for the rainfall diminishes and the summer heat and winter cold increase as we go southwards and eastwards away from the sea. The plateaux have an extreme climate, whilst towards the south and south-east it is difficult to draw a boundary between the Mediterranean region and the Desert.

Evergreen trees and shrubs are the characteristic vegetation of the coastlands, whose chief cereals and cultivated plants are wheat, maize, barley, the vine, mulberry and olive. Farther inland pomegranates and apricots are more important, while the drier plateau interior is at best a poor grassland.

(E) THE DESERT BELT.

This belt of dry deserts stretches north-eastwards across Asia from the Red Sea to the Khingan mountains, including within its limits the plateaux of Arabia, Iran, Tibet, the Tarim basin and Mongolia. It also includes the deserts of Western Turkestan and the lower Indus valley. All these regions receive very little rainfall, for the high central plateaux and Turkestan are shut off from rain-bearing winds, whilst Arabia and the Lower Indus Valley are off the track of the summer monsoons.

As regards temperature, the various parts of this belt differ very considerably owing to differences of latitude and altitude. In Arabia and the Lower Indus Valley the winters are warm and the summers very hot; but in the other parts of this desert belt the winters are very

THE MONSOON LANDS

cold indeed, and the summers, as a rule, not quite so hot. In all parts of the region settled life is only possible where there are permanent supplies of water.

(F) THE MONSOON LANDS.

These are lands of hot, wet summers and dry winters. The winter temperatures differ according to elevation, distance from the sea, and distance from the equator. Indeed, there is such a great difference between the temperatures of the northern and southern parts of this region that we must divide it into (i) a temperate region, (2) a sub-tropical region, and (3) a tropical region. The first region, which has cold winters, includes Korea, the plains of Manchuria and northern China, and the islands of Sakhalin and Yezo. The uplands are clothed with mixed coniferous and broad-leaved forests. The second region has warmer winters than those of the lands farther north; it also has a heavier and more evenly distributed rainfall. It includes Japan and Central China. The vegetation is of the warm temperate type. The third or tropical region includes India, Indo-China, and southern China, and it is distinguished from the others by its warm to very warm winters. The coastal lands, especially those nearest the equator, have very little difference between summer and winter temperatures.

The climatic characteristics common to the whole monsoon region are the comparatively dry winters and the wet summers. Where the summer rains are sufficient to keep the soil moist all the year round, forests are found, and these vary according to the temperature. In those parts where the rainfall is deficient, for example, on the Deccan to the leeside of the western Ghats, the vegetation is of a poorer type, such as mixed scrubland or savannah.

The chief products of this monsoon region are such as require considerable heat and moisture at the same time. They are:—rice, sugar-cane, cotton, opium, indigo,

tea, and coffee. In the drier parts where a sufficient temperature is reached, wheat is grown as a winter crop. The forests provide such useful timber as teak and bamboo, whilst in China and Japan, the mulberry is cultivated in order to feed silkworms. The fertile lowlands of the monsoon region are amongst the most thickly populated regions in the world, and this is rendered possible by the ease with which the necessities of life—here chiefly rice—can be obtained.

(G) THE SOUTH-EASTERN ARCHIPELAGO.

This region includes Ceylon, the East Indies, the Philippines, and the southern portion of the Malay Peninsula. A high temperature and abundant rainfall at all seasons are its chief characteristics.

In consequence of these climatic conditions, the lowlands are densely forested with vegetation of the equatorial forest type, whilst on the highlands are considerable areas of grasslands. In these hot regions we find a very backward type of man, for nature plenteously supplies him with all his needs. In return for the minimum of exertion on his part. The cultivation of tropical products such as sago-palms, coconuts, bananas, rubber, and spices is extending, but there are still considerable areas which remain in a natural condition, and even cannibalism is not unknown.

EXERCISES.

1. Name the chief parts of Asia in which each of the following is a very important product—rice, tea, cotton, wheat. Give full reasons for your answer.
2. Contrast, as vividly as you can, the differences between Northern Siberia and Java.
3. A, B, C, etc., are towns in Asia. From an examination of the climatic statistics quoted can you identify each? If you cannot mention a town try to state a region. Give reasons for your selections.

Place.	Height in feet.	Jan. temp.	July temp.	Mean annual rainfall in inches.
A	90	75° F.	85° F.	3
B	SL.	75° F.	78° F.	101 (mainly in summer)
C	250	-4° F.	68° F.	15 (two-thirds in summer)
D	20	80° F.	81° F.	94 (at all seasons)
E	26	47° F.	80° F.	27 (mainly in winter)

4. In what other parts of the world would you expect to find similar regions to the Asiatic tundra, the steppes, and the northern temperate forests? (see Chapter VII).

5. What is a major natural region? Give examples from Asia.

CHAPTER XL

THE RUSSIAN LANDS.¹

Natural Regions.—The Russian lands of Asia include (i) the tundra, (ii) the coniferous forest belt, (iii) the steppes, (iv) the semi-desert and desert lands of Turan, (v) portions of marginal lands of the central highlands, (vi) northern portions of the temperate monsoon region.

The total area of these lands is about one-third of the whole continent, but the total population numbers only about one-fortieth of the people of Asia.

The map shows that the greater part of Russian Asia consists of the great north-western plain, and that to the east and south of this plain are high mountain uplifts.

THE NORTH-WESTERN LOWLANDS.

Physical Conditions.—Let us first realize the size of this plain. From south-west to north-east it stretches through more than 4,000 miles—as far as from London to Chicago; at its greatest width it exceeds 1,200 miles, whilst by far the greater part is below an elevation of 600 ft. above sea-level. And this plain, great as it is, is only a part of a very much larger lowland which extends beyond the Urals to the North and Baltic Seas.

This vast triangle-shaped plain is drained to the

¹As the result of the Russian Revolution of 1917, the political geography of the Asiatic lands of the Old Russian Empire is very complicated. Many socialist soviet republics have been formed, but these, together with the republics of European Russia, are federated or allied to form the Russian Socialist Federal Soviet Republic (R.S.F.S.R.). We shall, therefore, think of them all under the general title—"The Russian Lands." See Exercise 8 on page 109.

Arctic Ocean by many large rivers, of which the Ob, the Yenisei and the Lena are the most important. These mighty streams—the Ob is 3,230 miles in length—and their network of east and west flowing streams are the chief means of communication, but, unfortunately, they suffer from the great disadvantage of flowing into an ocean which is frozen for at least eight months every year. Besides this, their lower courses are frozen for many months, whilst the thaws of spring turn the country bordering their banks into enormous lakes. For these reasons the main streams have been little used for commerce, although their east and west flowing tributaries have had a great deal to do with Russian expansion eastwards. The western movement of Mongol horsemen from Eastern Asia to Europe was*along the great grassy plains of the steppes, for here pasture and firm ground were found. The Russian eastward expansion was not confined to the grasslands and the use of horses, for the rivers and boats offered an excellent method of progress, especially through the forests. To-day, the vigorous Russian Government is working hard successfully to develop lines of export along the rivers to the Arctic Ocean. This is only possible for a limited period in summer, but most promising experience has been gained.

Turning to the climate, the severity of the winters rapidly increases as we go from west to east. Siberia is everywhere colder than Russia in the same latitude. It is also drier. These conditions are what we should expect to find as we approach the centre of the great Eurasian land mass. In the Turan lowlands of the south-west the winters are cold, and as we go towards the north-east they become colder and colder, until at Verkhoyansk we reach the exceedingly low mean January temperature of -60° F. or 92° F. below freezing point. In summer the south-west lowlands are very hot, and the temperature decreases, although not so rapidly as it falls in winter, as we go towards the north-east. As regards rainfall, the extreme north and the Turan lowlands have a very slight rainfall, less than 10 inches, and

between these there is a broad, belt where the mean annual rainfall is from 10 to 20 inches.

It is on account of the vast size of the north-west lowlands and the consequent different climatic conditions that we find it contains several natural regions, which we will now discuss in more detail.

(1) THE TUNDRA AND ITS INHABITANTS.

As will be seen from Fig. 31, the tundra occupies the most northerly part of the area. We have already learned that in this region the summers are short and warm, the winters long and cold, the rainfall is slight, and that as a result of these conditions instead of trees we find mosses, lichens, small bushes and berry-bearing plants, and, in summer, a great variety of flowers.

The rivers which cross the tundra flow from south to north, so that in spring, when the thaw comes, their upper courses are supplied with water from the melting of ice and snow, whilst their lower courses are still frozen. This is the cause of large tracts being under water in summer. Millions of mosquitoes make life in these swampy lowlands almost unbearable, so that the inhabitants have to keep as far as possible to the higher portion of the tundra.

The inhabitants of the tundra belong to various races, and are known by different names. In northern Norway and Russia are the Lapps and Finns, and in northern Asia the Ostyaks, Samoyads, Yakuts and other similar tribes. Mention has just been made of the fact that several races are represented. This is very interesting, for we find that men of the same races as some of those inhabiting the tundra, are much taller in more southerly lands, whilst in these cold, barren wastes all the inhabitants, whatever their origin, are small and undersized. This is undoubtedly an example of the influence of climate upon man. The climatic conditions not only influence stature, but the whole mode of life, for all tundra dwellers appear to have been compelled to adopt similar ways and means of existence.

The tundra has very little to offer to its inhabitants as a reward for their labour. The ground is permanently frozen below a depth of one or two feet, so that, apart from the climatic conditions, agriculture is impossible. The sparse vegetation is, fortunately, able to support herds of reindeer, but provides nothing for the support of human life except certain berries. The dwellers in

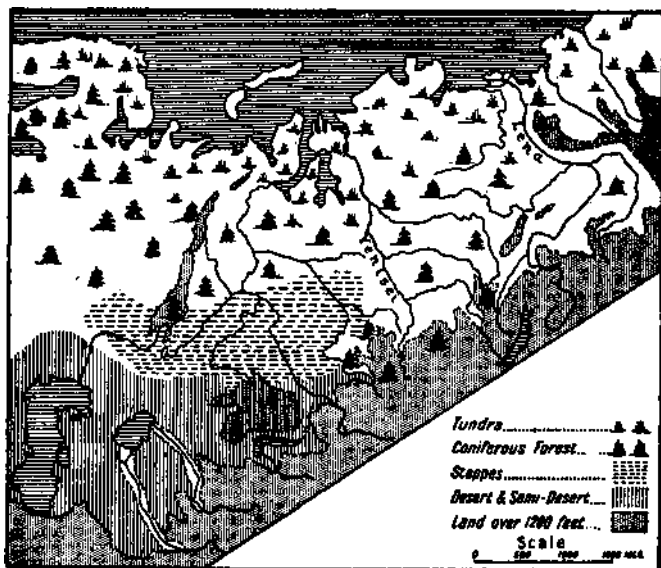


FIG. 31.—The north-western lowlands of Asia. Relief and vegetation.

the tundra are therefore compelled to depend for their food upon the reindeer, the fish which they catch in the rivers and sea, and the wild animals which they can hunt. Reindeer are indispensable to the people of the tundra. They roam about in a semi-domesticated condition in search of reindeer moss, in discovering which they show extraordinary sagacity, their owners meanwhile following them from place to place. The possession of a few reindeer means that a man and his family have most of their

needs supplied. To own a large number is to be quite a rich man. Alive, the reindeer is used as a beast of burden, and provides milk. When killed, every part of its body supplies something useful—the skin for clothing and tent covers, the flesh for food, the horns and bones for tools and implements, and the sinews for thread, etc. Fishing is carried on chiefly in the late spring and summer, when the rivers thaw and fish are abundant. The men catch the fish, and to the women falls the task of drying enough for use in the long winter when fishing is impossible. The families dependent upon fishing alone have a far more insecure existence than those supported partly by fishing and partly by the reindeer. A certain amount of hunting is possible, especially in winter, when it is the custom to migrate as far southwards as the northern edges of the great forest belt.

From what has been already stated it will be evident that tundra dwellers live nomadic or wandering lives, and that the summer will be the season of most changes. For this reason a fixed house is impossible, but the winter dwelling is of a more permanent type than the summer one, indeed, in many cases, one dwelling is used throughout the whole of that season. The summer houses are tents which are easily carried, erected, or pulled down. They are made of a framework of poles covered with skins or bark. The winter houses are generally made of a framework of wood covered with turf or earth.

We have seen that for food and clothing tundra dwellers depend very largely upon the reindeer. Some tea and tobacco are obtained from traders, and are greatly prized. Important articles of winter clothing are the hood, the thick, skin gloves which are attached to the sleeves, and the warm, fur boots. A mother carries her baby in her hood. She covers it with furs, and laces it into a skin cradle which she carries on her back. Travellers tell us that children are generally kindly treated, although tundra boys and girls can never enjoy real home life when the home comforts are

so few, and the place of habitation is constantly being changed. The position of the aged, the sick, and those who are not strong enough to take their part in the hard struggle for existence is often very hard indeed. They are sometimes neglected and left to perish.

(2) THE BELT OF NORTHERN TEMPERATE FORESTS.

As shown in Fig. 31, this is a broad belt of forests south of the tundra. The trees are mainly conifers, although many broad-leaved trees appear towards the southern margins. This enormous area is almost entirely virgin forest. It is the greatest hunting ground for fur-bearing animals in the whole world, although, except on its margins, it is almost uninhabited. The trapping is done chiefly by Ostyak and Samoyad hunters who live on the northern fringes, and whose settlements are regularly visited by traders who transact their business by means of barter.

Better means of communication are already making lumbering an important occupation; but even at present comparatively little is done in this direction. Towards the south the forests gradually thin out, and, owing chiefly to the drier conditions, the prevailing vegetation is grass.

(3) THE STEPPE.

As regards the climate and vegetation of the steppe, it is not necessary to add to what has been learned in previous chapters. We shall only recall that the rain-fall is small and falls chiefly in summer, and that the range of temperature is *very considerable*. But, as in the tundra, we shall go into more detail in connection with the way in which the primitive steppe dwellers live, so that we may see how geographical conditions affect modes of life. The majority of the inhabitants of these great areas of grass-covered lowlands are shepherds who rear large herds of sheep, camels, horses, goats and cattle, and since the grass in a particular place is soon exhausted, it follows that the animals have to be constantly moved from place to place. Thus the steppe shepherd, like

the tundra hunter, leads a nomadic life. It is necessary, therefore, that the house, furniture and household utensils should be of as simple and light a character as possible, so as to be moved with as much ease and comfort as circumstances permit. The people, therefore, live in tents which are usually round in shape and are most comfortable. The framework is made of willow sticks which are obtained from the banks of rivers. The sticks are made into a lattice-work which can be expanded or contracted according to the size desired. This lattice-work is then covered with skins or felt, and the whole held together by cords or bands. The only furniture consists of carpets, cushions and rugs, whilst most of the household utensils are made of leather or wood, because articles so made are not easily broken. The work of erecting or taking down the tent falls, as is customary with most nomadic peoples, to the women, who can easily accomplish **the** task in about half an hour.

The winter houses are more durable, and are sometimes built of stone. Since the winters are usually severe and often snowy, stables have to be erected for the animals, which are fed upon hay that has been stored for winter use. The site of the winter dwelling is very important, for it must be near to a reliable water supply and in as sheltered a place as possible. Therefore a river valley is often chosen. We have said that steppe dwellers are nomads, but one point must be noted. In however many places the summer tent is pitched, it is very seldom that **the** shepherd does not return to the same winter quarters. Although the chief work is looking after the animals and keeping them from any harm, some hunting is usually possible in winter, as at this season the hungry animals of the forest venture farther south in search of food.

As a rule, primitive steppe dwellers despise a settled life, and glory in their nomadic existence. Their flocks and herds provide them with all they require, and therefore they are content. The felt for the tent covering is made from wool. The hair of the camel is woven into camel's-hair cloth. Wool and hair are also used

in the making of the cushions, rugs and carpets which are noted all over the world for their beauty of design, and the excellence of the work. Leather and skins can be obtained very easily, and are made into bottles and clothing. Milk and flesh form by far the most important food, although other things can be obtained from the trading caravans which carry on commerce with the steppe dwellers. The favourite drink, koomiss, is made from the fermentation of milk, whilst large quantities of milk are also used in the making of cheese and butter. When we consider that the people are constantly moving in summer, we see that the camel and horse are very important indeed as beasts of burden. Steppe dwellers are noted horsemen. The Kirghiz give themselves the name of Kazak, which means "horsemen." Without the help of horses it would be impossible to keep the flocks in order whilst moving from place to place, or to prevent them from straying during a temporary halt. Even the children are expert in horsemanship, and they are placed on horseback when about four or five years of age.

In most other occupations, the introduction of machinery has made great changes, but the shepherding of animals is still carried on in much the same way as in the days of the Bible patriarchs. Indeed, some of the best accounts of steppe life are found in the Old Testament. Since there is little or no change, steppe dwellers are opposed to everything new, and are very much attached to tradition. The unit is the family, and as the wealth of the family is reckoned by the number of animals possessed, we find that the families are very large. Indeed, it is the practice for the wealthy steppe dwellers to have more than one wife. The head of the family is an autocrat who is a law unto himself, and is obeyed by all. Again, since wealth consists of livestock, drought or severe winters, storms or disease may reduce the richest of men to poverty in a short time. Such a disaster has always to be reckoned with, and it has the effect of making steppe dwellers fatalists, for no action of theirs can avert these unforeseen disasters.

The hardy horsemen of the steppe make splendid fighting men. Many times they have passed across southern Russia, and even reached as far as the Alps. The Magyars of Hungary are descended from such twelfth-century invaders. The once famous Russian cavalry, the Cossacks, were steppe dwellers. Cossack is an altered form of the word Kazak (see page 101).

The northern portion of the steppe is arable land—that is, it may be cultivated. It is in this region that great changes have been made in recent years. Settlers from places where a higher civilization than a pastoral type has been reached, have settled and brought with them the knowledge of the use of machinery, of irrigation, of the digging of deeper wells. In short, the modern settler in this part of the steppe knows how to live a settled life. Russian colonists are now raising large quantities of wheat, oats, rye and root crops, for the soil is very fertile and the rainfall generally sufficient, although dangers such as long droughts and early frosts are by no means unknown. Cattle are also reared in large numbers, and the manufacture of butter, introduced by the Danes, is to-day one of the chief industries in Siberia. As more and more areas are developed and used for stock-keeping, dairy farming, and the growing of cereals, the nomadic Kirghiz, who cling to their mode of life, are being pressed farther south towards the less fertile parts of the steppe. The development of this portion of Siberia may be compared with that of the North American prairie. As in the latter region, the construction of railways has led to rapid progress. Fig. 32 shows the great *Trans-Siberian Railway*. From Moscow the main line goes to Perm and across the Urals to Omsk. An alternative route is via Samara. The Urals do not present a serious obstacle, for their gradients are not difficult, and convenient gaps can be used. By means of easy descents, the main line reaches the steppe of south-west Siberia, and crosses the Irtish, an important tributary of the Ob, at *Omsk*. This town lies in a rich, black earth region in which wheat growing, dairy

farming, and stock-keeping are important occupations. It is the most important town in the agricultural area of Siberia. North-west of Omsk, at the confluence of the Irtysh and the Tobol, is *Tobolsk*, which, although not on the railway line, commands routes via the Tobol to the Kirghiz steppe, along the Irtysh to the Zungarian Gate, between the Altai and the Tien Shan mountains (see Fig. 32), and beyond that to the Far East. The latter advantage has also helped the growth of Omsk, which is more

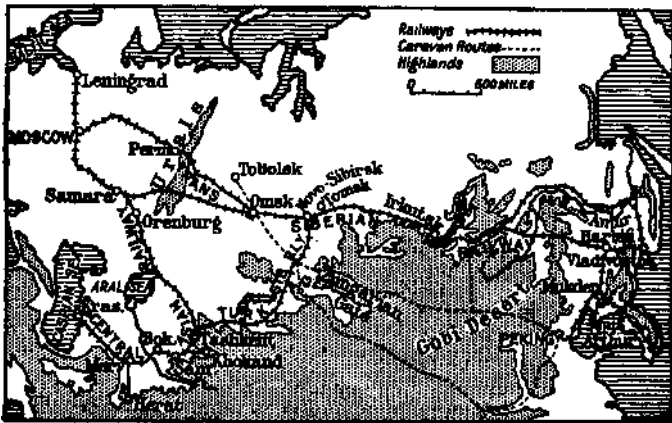


FIG. 32.—The Trans-Siberian, Central Asian and Turk-Sib. railways.

important to-day than Tobolsk. From Omsk, the railway continues eastwards to *Novo-Sibirsk*, the capital of Western Siberia, which has a fine position where the Trans-Siberian Railway crosses the Ob and is joined by the "Turk-Sib." Railway from Turkestan. Continuing eastwards, a branch line goes to *Tomsk*, a rising Siberian city noted as the centre of a gold-mining district, and crosses the Yenisei at Krasnoyarsk. For some 300 miles before reaching this town, which, like Tomsk, is a mining centre, the railway passes through coniferous forests. Beyond Krasnoyarsk, open country is again reached, and the

line continues to Irkutsk, to the west of Lake Baikal. After skirting the southern shores of this lake, the line forks, one branch following the general direction of the Amur, but some 40 or 50 miles north of that river, the other continuing across Manchuria via Harbin to Vladivostok, and via Mukden to Port Arthur, which the Russians lost in the war with Japan in 1905. The Amur valley line was developed with a view to giving a route to Vladivostok entirely through Russian territory. From Khabarovsk, on the Amur, the line utilizes the valley of the important north-flowing Usuri river, which offers a good route southwards to Vladivostok.

Let us return to that portion of the railway which is on the central plains. North of Lat. 56° N., and between the Urals and the Yenisei, is a great swamp region, whilst to the south lie the dry steppes. It was along this firmer ground that many Mongol invaders passed into Europe, and it was naturally here that the Trans-Siberian railway was built, passing through Omsk instead of Tobolsk, which is in the swamp region.

4. TURAN OR RUSSIAN CENTRAL ASIA.

This fourth region of the north-west lowlands occupies the semi-desert and desert lands lying between the central highlands in the east and the Caspian Sea on the west, and stretches southwards to the Iran plateau. The map shows that, except in the north, it is shut in by high mountains, which shut it off from rain-bearing winds. But since the mountains themselves receive rain and are often snow-capped, the Turan rivers rising in them are supplied with water. Of these, the Syr and the Amu flow into the Sea of Aral, and are the most important, but there are many which lose themselves in the sand.

The only fertile parts are those which are irrigated. About one-tenth is fit for settlement, and much of this is of a very poor type of pasture, and can be used for a short time only. The chief occupation on these poorer

pastures is stock-keeping, which is carried on in **the** same way as in the better-watered steppe lands already considered. It has been said that these Turan shepherds are half shepherds and half robbers, and this is hardly to be wondered at. In the river valleys a settled life, based on irrigation, is possible, and wheat, maize, wine, cotton and tobacco are produced, whilst the mulberry is grown in order to feed the silkworm.

The Russians have built railways, by means of which the chief towns in Turan can be reached with much greater speed and safety than is possible by caravan. Fig. 32 shows that the *Central Asian Railway* leaves the old Trans-Siberian line at Samara, and crosses the Ural river at *Orenburg*. After skirting the western margins of the Kirghiz steppe, which separates Siberia from Turan, the line reaches the valley of the Syr, one of the rivers draining into the Aral Sea, and continues to *Tashkent*. In common with other Turan rivers from the central highlands, the Syr carries little water except in early summer, when the melting of the snow fills the river channels. So fast do these rivers flow in their upper courses at this time of the year, that they bring down quantities of silt and rock waste, which is spread out like a fan where the current receives a check, and this, of course, takes place when the lowlands are reached. These fertile land deltas can be made very productive by means of irrigation. *Tashkent*, the political and commercial centre of Turan, is situated in the best part of the Syr valley. *Kokand*, reached by a branch line, is also irrigated by the waters of the Syr.

Leaving Tashkent, the railway proceeds to *Samarkand* and *Bokhara*. These ancient cities are in the valley of the Zarafshan, a river which loses itself in the sand. Bokhara is at the end of the river. Conquered by the Arabs in the eighth century, these oasis cities became Mohammedan centres of learning, but many of the famous buildings were destroyed during Mongol invasions of the thirteenth century. The greatest of all the Mongols, Tamerlane, made Samarkand his capital, and erected

splendid buildings, the ruins of which may be seen to-day. The thirteenth-century traveller, Marco Polo, visited Turan, and has left on record excellent accounts of its cities and their inhabitants. From Bokhara, the railway turns south-westwards, and runs to *Merv*, a very old route centre from which a branch line runs southwards as far as the frontier of Afghanistan. Leaving *Merv* the main line winds across the desert, and has its terminus at *Kfasnovodsk*, on the Caspian Sea.

The new Turkestan-Siberian (Turk-Sib.) railway links the Trans-Siberian and Central Asian railways. It was built as part of the famous *Five Years Plan* and will do much to develop the areas through which it passes, especially the rich mines of copper, silver and other metals in the region south of Omsk and at Semipalatinsk.

We have so far considered that part of the Russian Lands which lie within the great north-western lowland. We will now turn to Eastern Siberia.

EASTERN SIBERIA.

Eastern Siberia, as will be seen from the map, is higher than Western Siberia. South of the tundra, it is mainly an elevated region bordered on the east by the Stanovoi mountains, and extending south-westwards to the forested highlands surrounding *Lake Baikal*. It is drained by the Amur, Lena, and the eastern tributaries of the Yenisei, and lies wholly within the tundra and forest zones.

Between the Yenisei and the Lena is a low plateau, above which rise table-shaped mountains. It is here that the world's greatest extremes of temperature are met with. The river Lena, whose source is close to Lake Baikal, is the least useful of the great Siberian rivers. Notice on the map (a) its very circuitous course, (b) the highlands which border its right bank, thus giving a continuous wall, and (c) the large delta which it is building at its mouth. The whole of its course is through forests or tundra. The only town of any importance on its banks is *Yakutsk*, situated on the great eastern bend of the river. It is the chief centre of the Siberian fur trade, and was

formerly a penal settlement for convicts. The east and west flowing tributaries of the Yenisei have already been mentioned in connection with the help that they gave to Russian expansion eastwards (see p. 95). Its Angara tributary drains *Lake Baikal*, the deepest known fresh-water lake in the world—its depth in places reaching nearly one mile. Its area is almost twice that of Wales. The lake, which is shut in by steep mountain walls, occupies two long parallel troughs separated by a ridge, above which the water is at places less than twenty-five fathoms deep. In winter it is frozen over for four or five months, so that the summer steamship service is replaced by sledges. *Irkutsk*, the largest town in Siberia and the seat of government for Eastern Siberia, stands on the Angara, forty miles from Lake Baikal. In the mountainous region for which it is the centre, gold-mining is an important occupation. The town has gained very considerably in importance since the construction of the Trans-Siberian railway, which passes through it. It is also reached by a camel caravan route, which crosses the Gobi desert on its way from Peking.

The river Amur can hardly be considered a Siberian river. Its lower valley and mouth are in Russian territory, but for the greater part of its course it forms the boundary between Eastern Siberia and Manchuria. It drains a little-developed pine-forested area, whose climate is very severe. Gold-mining and trapping are the most important occupations, whilst in many of the fertile valleys cereals are now cultivated. *Vladivostok*, on an arm of Peter the Great Bay, is a terminus of the Trans-Siberian railway, and is the chief port. It is unfortunate that its fine harbour is closed for about three months every year, owing to being ice-blocked.

Modern Siberia.—It is strange what wrong ideas many people have about Siberia. It is often imagined that the whole country is a land of snow and ice—a great lone land—for which the old Russian Empire had no use except as a place of punishment for criminals and political prisoners. In one sense it may be said that the Russians

themselves only discovered Siberia with the making of the great railway. The old government granted help to people who emigrated to the arable lands of the steppe, and took part in the great agricultural development which took place there in the years before the Great War. It is true that great tracts will always be unable to support many people, *e.g.* the tundra. But Siberia is a large country—half as large again as the whole of Europe—and contains vast forests, the fringe of whose wealth has been scarcely touched, as well as agricultural and pastoral lands with vast possibilities, not to mention the enormous mineral wealth of Eastern Siberia.

The Soviet government is actively exploiting the agricultural and mineral wealth of both Western and Eastern Siberia. Eastern Siberia already grows more wheat than she requires, while the great new metal works of the Kuznetsk Basin depend upon the rich deposits of coal and iron found locally. The successful attempts to export Siberian products via the rivers and the Arctic Ocean are important, and may be compared with similar Canadian efforts through Churchill on Hudson Bay.

Since 1932 very many ships have fully navigated the north-east passage in the summer. *The Northern Sea Route Administration* has established a large number of scientific stations (wireless, meteorological, biological, etc.) along the northern coast-line and on many of the islands, and sea routes are supplemented by air routes. Ports have been constructed on the Ob, Yenisei and Lena. *Port Ingara* on the Yenisei is the largest. It is built entirely of timber, and its population of about 15,000 men, women and children have all left Russia to settle there. Work goes on all the year round, even in winter when the temperature falls much below freezing-point, when there is little daylight, and the town is floodlit by electricity! The principal occupation is the preparation for export of the timber floated down the river during the summer months. *Ingara* exports the timber the following summer, for the river is frozen over in winter and the port is 400 miles from the mouth.

This astonishing achievement is typical of changes that are going on in Asiatic Russia. Perhaps the most astonishing thing is the way the new forms of organization in Russia in Europe, *e.g.* collective and state farms, state ownership of all mines, means of transport, etc., have penetrated to every part of Russia in Asia—tundra, forest, steppes and desert.

EXERCISES.

1. Describe the climatic changes that you would notice in a journey from the Siberian Arctic coast to the Sea of Aral. What other changes would be observed?

2. Write an account of the connection between the physical conditions and the life of the peoples of the tundra and the steppe.

3. What factors have led to the growth and importance of: Omsk, Irkutsk, Samarkand and Vladivostok?

Draw sketch maps to illustrate your answers.

4. What are the leading natural resources of Siberia? State their location, and describe their present state of development.

5. Describe a railway journey from Leningrad to Vladivostok. Describe the character of the country passed through at different stages of the journey, and draw a sketch map in illustration.

6. The Russian Lands occupy about one-third of Asia, but their population is only about one-fortieth of that of the continent.

Explain fully the reasons for this.

7. Which part of the north-west lowlands may be described as a "Land of hunger and privation"? Which part is a "Land of wandering"? How have Russians in recent years shown that settled life can be supported in both regions?

8. Consult the *Statesman's Year Book* and find out the political changes which have taken place since the Great War in the Asiatic part of the former Russian Empire. Do the new subdivisions appear to you to show much relation to the geographical conditions of this area?

CHAPTER XII.

SOUTH-WEST ASIA.

Natural Regions.—(i) The lands having a Mediterranean type of climate. (2) The deserts of Iran and Arabia.

Physical Features.—South-west Asia is composed chiefly of plateaux. In the north-west there is the plateau of Asia Minor, which rises eastwards into the still higher plateau of Armenia, above which tower such lofty peaks as the extinct volcano of Mount Ararat. To the north are the great ranges of the Caucasus, whilst to the south-east the plateau of Iran, comparable in elevation with Asia Minor, stretches as far as the mountain wall to the north-west of India. All these mountains and plateaux are part of the great belt of the central highlands (see p. 74). In the south-west there is the old tilted block of Arabia separated from the Iran plateau by the lowlands drained by the Tigris and the Euphrates. Six seas wash the shores of these lands. They are the Caspian, Black, Mediterranean, Red and Arabian seas, and the Persian Gulf.

THE GREAT ROUTES.

From the very dawn of history south-western Asia has been of great importance. It was in Mesopotamia, the land between the rivers, *i.e.*, the Tigris and Euphrates, that the early civilizations of Babylon and Assyria appeared, whilst the still earlier Egyptian civilization developed along the lower valley of the Nile, which, although not in Asia, is intimately con*

nected with the region we are considering, for the earliest commerce of which we have any knowledge was between Mesopotamia and Egypt.

It was not very difficult for travellers from Babylon to follow the Euphrates north-westwards, and then to strike westwards, via the oasis of Palmyra to Damascus. Turning south-west, this ancient route reached the coastal plains of Palestine, and after passing the fertile land of the Philistines, continued to its destination across the narrow strip of desert to the north of the Sinai peninsula (see Fig. 33). It may appear to be easier to strike due westwards from Babylon across the country separating it from Palestine; but this intervening land is arid desert, and therefore the longer, but safer, route was followed. It will be seen that if this route is continued along the Euphrates, it reaches the coast at Antioch, a point upon which the routes coming from the plateau of Asia Minor also converge. Fig. 33 also shows that Antioch is in the great gateway between the highlands of Asia Minor and those of Syria.

In connection with these routes notice the position of the ancient cities of *Tyre* and *Sidon*. These were the chief cities of the Phoenicians, who thus held a very important position between Mesopotamia and Egypt. When in the course of time the Phoenicians went on the sea and became seamen, they grew to be the greatest sailors of their day, visiting and trading with lands not only on the shores of the Mediterranean, but even daring to pass through the Straits of Gibraltar, the Pillars of Hercules. It is generally believed that the tin-producing islands with which they traded were our own islands, for we know that tin is mined in Cornwall. But since Phoenicia itself is not a very rich country, the decay of the great civilizations between which it lay, resulted, in the end, in the decay of Phoenicia itself.

Let us now return to Antioch, where the route following the Euphrates reached the coast. To-day,

Aleppo is the most important town in that important gap between the plateaux of Asia Minor and Syria. It stands midway between the Euphrates and the Mediterranean, and, through its modern port of Alexandretta, reaps all the advantages formerly enjoyed by -Antioch. From Aleppo, the caravan routes from Syria and Palestine on the one hand, and from the

FIG. 33.—S.W. Asia. Relief and routes.

Euphrates on the other, strike northwards across the plateau of Asia Minor, reaching the coast at Trebizond, Scutari and Smyrna. Another route follows the Tigris from Baghdad, and, passing through Mosul, proceeds west of Lake Van via Erzerum to Trebizond. Thus we see how routes via the Persian Gulf and the great rivers Tigris and Euphrates reach the Mediterranean, the iEgean and the Black seas.

The map shows the importance of the Red Sea as a great highway of trade passing to and from the Mediterranean and the Indian Ocean. In modern times the cutting of the Suez Canal has given a through water passage, but it must not be supposed that the making of this canal discovered the route. It has been known and used for centuries, although it was formerly not so important as the route following the Euphrates.

Mecca, the great centre of Mohammedanism, has been the objective of pilgrims ever since the days of the prophet. Fig. 33 shows the routes by which many of them reach the holy city. Notice that the route which goes from Mecca to Baghdad, via Medina and the comparatively well-watered Nejd plateau, is continued to Teheran, the capital of Persia. The map shows a small river entering the Tigris from the east. It is the valley of this river which makes the crossing of the Zagros mountains comparatively easy.

Other ancient routes are those which traverse the plateau of Iran, avoiding the barren depressions of the centre and keeping to the bases of the better-watered mountains, *e.g.* that from Meshed, via Teheran and Tabriz to Erzerum, or one from Teheran, via Kashan and Kerman to Quetta and the Indus.

In modern times, the great importance of the routes across south-western Asia has led to the construction of railways, of which the most important is the *Baghdad Railway*. When completed, this line will offer a land route to the east in rivalry to the sea route via the Red Sea and the Suez Canal. If a bridge were built across the straits between Constantinople and Scutari—or a tunnel were made under them—the completed railway would give communication from the North Sea to the Persian Gulf, whilst in the future it is certain to be extended to meet the Indian railways at Karachi (see Fig. 33). In Asia Minor, branch lines reach Angora and Smyrna, taking to the latter port the produce of the plateau. The map shows that in the south-east of Asia

Minor, the Taurus mountains bend away from the coast and become a barrier to the line. Here there is the famous pass, the *Cilician Gates*, through which the traffic of many centuries has passed, but the passes are too difficult to be traversed by railways so that tunnels have been constructed. During the Great War the line was constructed as far as Nisibin. From the Basra end the railway now extends beyond Baghdad and Samarra to a point some 50 miles south of Mosul, thus leaving a short middle section to be completed.

Ten miles north of Aleppo the Baghdad railway makes a junction with the French line which runs southwards and passes through Damascus to Medina, with branch lines reaching the coast at Beirut and Haifa. On account of the large number of Mecca pilgrims carried on this railway, it is known as the *Pilgrims' Railway*. The other important railway of S.W. Asia runs from Baku, on the Caspian Sea, to Batum on the Black Sea. This line is linked to the main Russian system by a line which runs round the eastern end of the Caucasus.

Thus we see that one of the most important things in the geography of S.W. Asia—perhaps the most important—is that, owing to the fact that it sits astride the great highways of trade between Europe and the Far East and Australia, and to the presence of the long Red Sea and Persian Gulf arms of sea, routes of great importance will pass across it. Of all the routes, two stand out as of first-class importance—the "through" water route, and the land route from Constantinople to the Persian Gulf. Fig. 33 also shows part of the air route from Britain to India, Malaya and Australia. This quick route is rapidly increasing in importance, especially for mails and passengers. The oil pipe lines mentioned on pages 124 and 126 are also of importance.

Now let us return to our regional study of south-west Asia. For climatic reasons we shall consider the area under the following headings: (1) The Lands of the Five Seas. (2) The Arabian and Iran Deserts.

(i) THE LANDS OF THE FIVE SEAS.

This picturesque name is given to the land bordered by the Caspian, Black, Mediterranean and Red seas, and the Persian Gulf, and, as Fig. 34 shows, it is very suitably named. The Mediterranean and Black Sea coastlands have the dry summer and winter rainfall peculiar to lands having a Mediterranean type of climate (see p. 90). The plateaux lack moisture, and are very

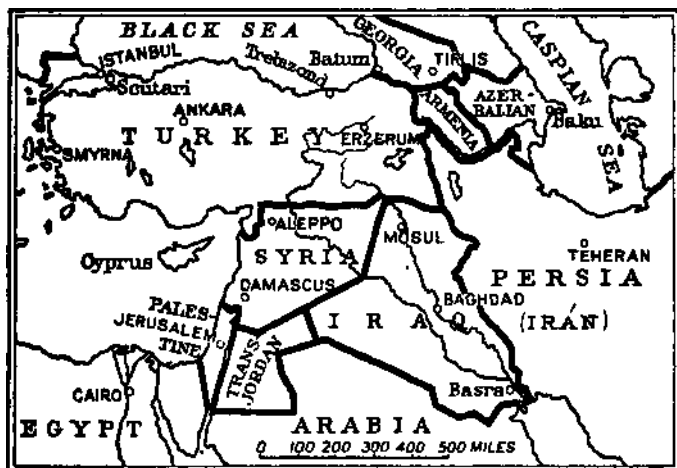


FIG. 34~The Land of the Five Seas.

hot in summer and cold in winter. The rainfall everywhere decreases with distance from the sea, so that the typical Mediterranean trees, the mulberry, olive and vine, give place to pomegranates and dates.

ASIA MINOR.

The plateau of Asia Minor or Anatolia is lowest on the west and highest on the east, where it rises to the high Armenian plateau. It is also crossed by mountain ranges which run from west to east, and the influence of these factors is seen in the drainage and routes of

the country, for both largely follow the same direction. In the north, the plateau descends so steeply to the Black Sea that there are no good harbours; in the south, the Taurus mountains rise very steeply from the sea coast, except in the east, where they bend away from the coast, leaving the very fertile plain of Cilicia. In the west the coast is much indented and there are numerous islands, which are the remnants of the mountain chains which once were continuous with those of Greece. Many rivers flowing between the east and west ranges drain the broad valleys which give easy access to the plateau.

Asia Minor forms the greater part of the Republic of Turkey, for the European possessions of that country are now very small and even Constantinople has ceased to be capital in favour of the centrally placed Ankara.

The coastal lands, including the mountains bordering the plateau, are forested with evergreen trees, with an undergrowth of shrubs, such as the rhododendron. The valleys opening westwards are also well wooded. In both valleys and plains the inhabitants follow settled occupations, and produce, in addition to the Mediterranean fruits (mulberries, olives, grapes, oranges, figs), tobacco, cotton, wheat and barley, whilst along the west coast sponge fishing is important. A considerable amount of silk manufacturing is carried on, especially at *Brussa*, at the foot of Mount Olympus, and other manufactures are of cotton and wool, the latter being used in making fine Turkey carpets and rugs. *Smyrna*, situated on a splendid harbour between two fertile valleys opening out to the *Ægean Sea*, is the chief port, its exports being representative of all the products of the country. Formerly Smyrna and the coastlands generally were largely inhabited by Greeks. To-day not only in Asia Minor but also in European Turkey, except in Constantinople, there are extremely few Greeks.

The plateau lacks moisture and has very cold winters, so that there is little vegetation beyond grass, and parts are even deserts in which are oases where the date palm,

as in the Saharan oases, is of the greatest importance. The plateau dwellers are, therefore, largely nomads, who move about from place to place attending to the wants of herds of camels, horses, goats and sheep. In the east the plateaux are more rugged. They are crossed by high ranges which here come close together and sometimes enclose fertile valleys. Erzerum, the largest town in this part of the country, lies over a mile above sea level and is so exposed that it is sometimes called the "Siberia of Turkey." Trebizond, on the Black Sea, is the port for this area.

Ankara, on the lower western plateau, is noted for fine goats' hair, greatly prized in the manufacture of mohair cloths. The city has fine modern buildings and is centrally placed for its function as capital of modern, progressive Turkey.

TRANS-CAUCASIA.

Trans-Caucasia is largely drained by the Kura river. The Caucasus mountains consist of rugged parallel ranges, in which are numerous glaciers. Their southern slopes are densely forested and contain valleys in which Mediterranean fruits and cereals are produced. The lower valley of the Kura is an extensive fertile plain opening to the Caspian Sea. Tobacco, cotton, and maize, as well as the vine, are produced here. South of the Kura are the plateaux of the Lower Caucasus. Here lies the Republic of Armenia, whose capital is Erivan. Note the large lake, Sevan, which is 6,300 ft. above sea-level. Agricultural occupations, especially the growing of cotton on irrigated fields, occupy most of the inhabitants.

Baku, an important port on the Caspian Sea, stands at the north of the plain, and is the centre of a very important petroleum area. It is not a very inviting town, for even the air is pervaded by the smell of oil, whilst the numerous refineries and pumping

stations are not buildings which can enhance its appearance. Since it is on an enclosed sea, the oil is sent by pipeline to *Batum*, on the Black Sea. Here it is pumped into oil-steamers and shipped to all parts of Europe. Between Baku and Batum the line passes through *Tiflis*, the capital of Georgia. The city is beautifully situated on the precipitous cliffs of the ravines of the upper Kura. In addition to its position on this important railway, it also commands the easiest north and south route across the Caucasus via the Georgian Highway. This route is very important, and has been followed by a splendid road, built primarily for military purposes. Eventually it will be followed by a railway line. The Georgian Highway is, of course, snow-bound in winter.

SYRIA AND PALESTINE.

Syria and Palestine, lands full of interest on account of their Scriptural connections, lie along the eastern shores of the Mediterranean Sea. The former is a high plateau, whilst in Palestine, north of Mount Carmel, the highlands are farther away from the coast, leaving a fertile coastal plain everywhere less than 600 ft. above sea-level. Rising abruptly from the plains is the plateau of Judea and Samaria, which is not so high as that of Syria, farther north. The plateaux of Syria and Palestine slope gradually towards the east, and form the Syrian desert. Notice the north and south direction of the Jordan and the Gulf of Akabah, which is the more easterly of the two gulfs at the northern end of the Red Sea. The greater part of the Jordan valley is below sea-level, the surfaces of the Sea of Galilee and the Dead Sea being 682 ft. and 1,291 ft. below sea-level respectively. These lakes occupy part of the floor of what is known as a *rift valley*, a type of valley which we will now proceed to explain.

Rift Valleys.—During the formation of a fold in the crust of the earth the pressure is generally so steadily

exerted that even rocks are gradually forced into folds. But in some cases the beds of rock cannot withstand the strain of the bending required, and they accordingly fracture. This causes blocks of the earth's crust to be raised and others to be depressed relatively to each other. Such crustal blocks are bounded by faults (see

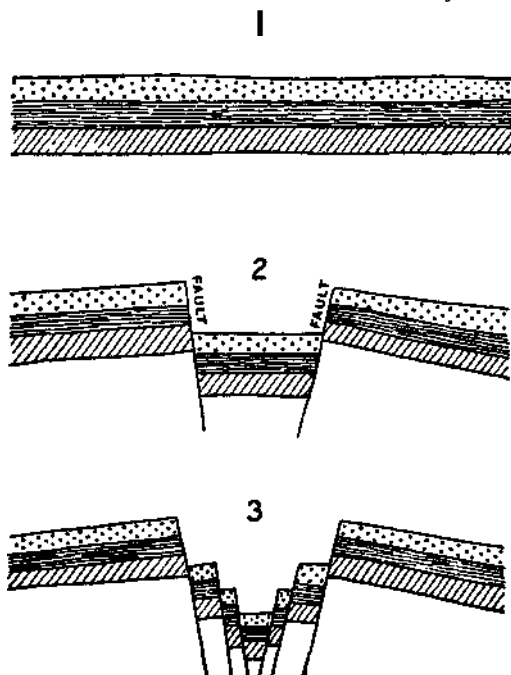


FIG. 35.—Sections illustrating the formation of a rift valley.

Fig- 35). Very often the land between two parallel faults is let down, and a comparatively narrow depression is formed. This is known as a rift valley. The Red Sea, as is indicated by its length and width and its steep, straight sides, occupies such a valley, which is a continuation of that of Palestine. Turning south-westwards at the southern end of the Red Sea, this

great rift is met by another which contains the Gulf of Aden, and is then continued across Africa as far as the south of Lake Nyassa. The connection between the Asiatic and African rift valleys is shown in Fig. 36.

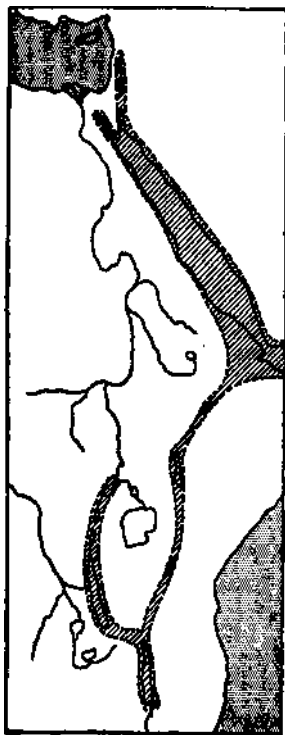


FIG. 36.—The Great Rift Valley.

In Palestine all the Mediterranean plants can be cultivated, and great quantities of wheat and barley used to be grown on the coastal plains. The hill sides were terraced for the culture of the vine, and irrigation works were carefully constructed, whilst the hill country was inhabited by prosperous shepherds. The Turks sadly neglected these lands, and in the place of fertility they left behind them poverty and waste. At the present time, however, great schemes for barraging the Jordan below Lake Tiberias are in progress. These will provide water for the fields and power for industries and are expected to do much to bring back prosperity to this ancient land. Already the population of Palestine has doubled since the Great War, and this is chiefly due to Jewish immigration.

In modern times the most important port is *Beirut*, which is surrounded by a very fertile tract of land, and is connected by rail with *Damascus*, the capital of Syria. *Damascus* is an oasis made by the waters of a small river at the base of the Anti-Lebanon mountains. It owes its importance to its control of routes—eastward to Mesopotamia,

and southward, via the Pilgrims' Railway, to Mecca.

The ancient city of *Jerusalem*, the capital of Palestine, has a central position, and one that could be easily defended, for it is protected on three sides by deep ravines. It is a walled city, and is visited every year by thousands of pilgrims and tourists, who are attracted by its sacred associations. From Jerusalem a railway runs to its port, *Jaffa*, but at present it has no connection with the Mecca railway owing to the difficulty presented by the Jordan rift valley. There is also a frequent service of motor omnibuses between the two towns. The journey takes about two hours. *Jaffa* has a very important export of oranges. Its near neighbour, *Tel Aviv*, has been built by Jewish enterprise. *Haifa* has increased in importance with the coming of the Jewish settlers, and has a modern harbour opened in 1933.

MESOPOTAMIA OR IRAQ.

As we have seen, the word Mesopotamia means "between the rivers," that is, the Tigris and Euphrates. We shall here use it to include all the lowlands shut in between the Arabian plateau and the Zagros mountains. Upper Mesopotamia, which was roughly the ancient land of Assyria, has a much more varied relief than the lowlands of southern Mesopotamia, which was occupied by Babylon. The latter lowlands consist mainly of alluvial deposits so low lying that many parts are swamps. The Euphrates and Tigris rise amidst the snows of the Armenian mountains, and their upper courses are very wild. Before reaching the Persian Gulf they join and flow through a region rendered swampy by the uncontrolled flood waters. The combined river is busily engaged in filling up the Persian Gulf, and is pushing its delta onwards at the rate of about 70 ft. per year. Close to the rivers, where irrigation is rendered easy, fields of cotton, wheat, tobacco and maize are found, whilst sugar and date palms are important in the lower valley. The rainfall, however,

is so small that without irrigation agriculture cannot be carried on, and since the same story of Turkish neglect has to be told of this land as of Syria and Palestine, the present condition of the greater part of the country is little better than a poor steppe land in which nomadic Arabs and Kurds pasture their flocks. There is no doubt that, given wise government, Mesopotamia would once again become one of the gardens of the world. As in Egypt, great barriers could be put across the rivers in order that water may be held up for use when the rivers are low. Large irrigation schemes are already in hand.

Even to-day the most important towns stand on the rivers. *Mosul* stands at the navigation limit of the Tigris, and is built mainly upon rising ground so as to be above the level of the river floods. Its name means "Central Gates," and was bestowed upon the city because it is situated at the intersection of routes from the Black Sea to the Persian Gulf, and from the Mediterranean Sea to the Caspian. On account of its site at the intersection of these routes, and at the navigation limit of the Tigris, it has been said that whatever military power holds Mosul must eventually become the possessor, sooner or later, of the whole of the Tigris valley, and even of the whole plain as far as the Persian Gulf. The ruins of the ancient Assyrian capital, Nineveh, stand on the opposite bank of the river. In ancient times, as now, in a country which has little stone for building purposes, the chief substance used in house making was sun-dried brick, made of clay. One point about the site of Mosul must be mentioned. Nineveh fell into decay, but Mosul arose near its ruins. Should Mosul disappear, another city will arise somewhere near by, for here is one of those places where the geographical conditions make it inevitable that there should be a town.

At *Kirkuk*, nearly 100 miles south-east of Mosul, **are** rich oil wells belonging to the Anglo-Iranian Oil Co. (see p. 126). The oil is pumped along a pipe to Haditha

on the Euphrates. From this point the pipe line bifurcates, one branch going to Tripoli, the other to Haifa. At these ports the oil is pumped directly into tankers. The construction of these pipe lines was a magnificent achievement (see Ex. 4 on p. 128).

Baghdad, famous in the *Arabian Nights*, is a walled city, standing on both banks of the Tigris, at the point at which that river comes very close to the Euphrates. The latter fact is of importance, as it may be possible to unite the rivers by canals, used for navigation as well as irrigation. A tributary from the Zagros mountains enters the Tigris at Baghdad and adds to its importance, for a route to Teheran, the capital of Iran, follows the valley of this river, and gains a fairly easy crossing of the Zagros mountains. South of Baghdad, but on the Euphrates, stood Babylon, now in ruins.

Basra stands near the Shat-el-Arab, the combined Tigris and Euphrates, and is the port for the delta lands. It is built about a mile from the river; but the district is so cut up by canals that all communication takes place by water. The surrounding country is dreary, owing to the extent of the marshes which are a source of malaria, but near Basra itself there are extensive plantations of date palms. The town is reached by ocean vessels. *Abadan* is the port for the Iranian oil-fields (see p. 126).

(2) ARABIA AND IRAN.

These arid lands are both plateaux, Arabia an old fractured and tilted block, and Iran a plateau whose uplift accompanied the growth of the young folded ranges which border and cross it.

ARABIA.____)

The Arabian plateau, very little of which is less than 1,500 ft. above sea-level, is highest along the Red Sea shores, from which it slopes eastwards to Mesopotamia and the Persian gulf. The map shows that the south-west, the south, the centre, and the land bordering the

Gulf of Oman are all high. The central highland is the large plateau of Nejd.

Arabia is one of the driest lands in the world. The higher districts, especially those of the south-west and the centre, receive slight rains, and on that account pastoral occupations can be carried on there; but elsewhere the land is practically rainless. Except in the south-west, there are no permanent streams, only wadis, or channels which are supplied with water after the occasional rains, but even then the streams never reach the sea. There are, however, oases where underground sources of water can be reached, or where springs occur, and in these date palms and cereals can be cultivated. Such oases are found in the valleys of the Nejd plateau, where rain falls during spring and autumn in sufficient quantity to give a covering of grass for a short time. It is on account of this that the Nejd region is famous for its breeds of horses, camels, donkeys, and sheep.

In Yemen, in the south-west, there are permanent streams flowing to the Red Sea, and, owing to the elevation, the high parts enjoy a warm, temperate climate. Fields of wheat and fruit-trees are numerous, and coffee is an important product. Coffee is grown on the lower south-west slopes, where the climate is hot and moist, and mists from the sea are very common. *Mocha*, whose name is usually associated with the coffee from this region, is not now so important for this article as *Hodeida*, the chief port.

The remainder of the west coastlands, and those in the south, are hot and dry, and almost uninhabited. In the region of the Oman highlands, in the south-east, some rain falls, and there are parts which are suitable for pasture. Notice the Bahrein Islands, in the Persian Gulf. They are British, and have important pearl fisheries. Another British Arabian possession of very great importance is *Aden* in the south-west, more than one hundred miles from the narrow straits of Bab-el-Mandeb, by which the Red Sea is entered, but sufficiently near to that entrance to be of great value as a naval

and commercial depot. In the straits themselves is the small island of Perim, which is also British, and is attached politically to Aden. The latter town is built in the crater of an extinct volcano. Rain falls very irregularly, often at intervals of more than a year, so that fresh water has to be obtained by means of the evaporation of sea water. In addition to this, large tanks have been cut in the rock, in order to receive and store the storm-brought rains. Aden's chief importance lies in its strategic position, and therefore it is strongly fortified, whilst it is on the great ocean trade route to India, the Far East and Australia.

The most interesting town in all Arabia is Mecca, famous as the birthplace of Mohammed. Every year it is visited by thousands of pilgrims, who make long journeys to the tomb of the prophet. Except the great mosque, there are few handsome buildings, for it is desired that no other building should rival the sacred edifice. The port of Mecca is Jiddah. Medina, north of Mecca, contains the tomb of Mohammed, and is also much visited by pilgrims. It can now be reached by railway from Aleppo and Damascus. Apart from this line, the chief means of communication in Arabia are naturally by means of caravans.

IRAN.

The Iran plateau, the greater part of which is about a mile above sea-level, is really a depression, bounded on the north by mountains stretching from the Elburz to the Hindu Kush (=Slayer of the Hindu, *i.e.* by means of avalanches); on the east by the Sulaiman and Hala mountains, and on the south and west by the coastal highlands and the Zagros Mountains. Communication in a region like this is naturally very difficult, and depends chiefly on the use of camels and mules, for, excepting the roads leading from Teheran, the Persian capital, to the Black Sea, there are no roads upon which wheeled conveyances can be used with ease. The two great caravan routes avoid the central depressions, of

which the two largest are the Great Salt Desert in the north-west, and the Seistan depression in the east. The sandy soil of the former is impregnated with salt, whilst the few rivers which traverse the latter, lose themselves in extensive salt marshes. In the latter connection, notice the Halmand river.

With regard to the climate of Iran, there are marked contrasts between (a) the Persian Gulf coastlands, where the climate is unhealthy, owing to a damp heat, with a low rainfall; (b) the greater part of the plateau, where there are extremes of winter cold and summer heat, together with a small rainfall; and (c) the lands bordering the Caspian Sea, where the climate is of the warm, temperate type. In the latter region there is ample rainfall, and the slopes of the mountains are forested.

The products of Iran closely correspond to the climates. On the plateau the poor pasture supports goats, sheep, and camels, and pastoral products are of chief importance, and have been the means of making Persian carpets and cloths famed the world over. On leaving the mountains, the rivers in many cases disappear underground, owing to the porous nature of the limestone, of which much of the plateau is composed. An elaborate system of underground canals, or *kanats*, partly natural, partly artificial, is often found in the vicinity of the larger plateau towns. By means of these less water is evaporated by the heat of the sun, and water can be obtained for irrigation in order that otherwise desert areas may become oases, and rice, tobacco, etc., be cultivated. Along the south coast the date palm is the typical product, whilst in the lowlands bordering the Caspian Sea, silk, cotton, and sugar are produced.

The mineral wealth of Iran is considerable, but is not worked, except for the valuable petroleum deposits which have been found along a zone extending in the west of Persia from Kurdistan to the Persian Gulf. The chief Persian wells are some 150 miles north-east of *Abadan*, the port of Iraq, to which the oil is brought by pipe line. This oil-field, and the newer one in Iraq (see

p. 122), are worked by the Anglo-Iranian Oil Company.

The chief Towns of Iran.—*Teheran*, the capital of Iran, the new name for Persia, lies at the southern base of the Elburz in sight of Mount Demavend, a snow-capped volcano of majestic appearance. It is the converging point of routes (see Fig. 33). One of the most important of these passes through *Ispahan* and *Shiraz*, both oasis towns, to its termination at *Bushire*, the chief port. Another route goes westwards to *Tabriz*, next to the capital the largest city in the country, and eastwards to *Meshed*, famed for its shawls and carpets. A Trans-Iranian railway runs from *Bandar Shapour* on the Persian Gulf via *Hamadan* to *Teheran* and *Bandar Shah* on the Caspian.

The capital of Afghanistan is *Kabul*, a town of great strategic importance, since it controls the Khaibar Pass, a narrow defile some thirty-three miles long. This pass, which does not follow the *Kabul* river, leads to the plains of north-west India, and can be held by a few good marksmen against a large number of attackers, for in places it is very narrow indeed. *Kandahar* and *Quetta*, the former in Afghanistan and the latter in Baluchistan, are on another route, which also leads to the plains of the Indus, via the *Bolan* Pass.

THE POLITICAL UNITS OF SOUTH-WEST ASIA.

Changes as a result of the Great War are indicated on Fig. 34. At first the collapse of the central Russian government and the difficulty of communication across the Caucasus led to the secession of the Trans-Caucasian peoples and their formation into semi-independent states. Round *Erivan* an *Armenian Republic* has been formed which also includes some former Turkish territory. The area round *Tiflis* and *Batum* has become the *Republic of Georgia*, whilst in the lower valley of the *Kura* and along the shores of the *Caspian* we have the *Republic of Azerbaijan*, with *Baku* as capital. These three republics belong to the Union of Soviet Socialist Republics. Their capitals are connected by railway with each other and also with *Erzerum* (Turkey) and *Tabriz* (Iran).

The peace treaty with Turkey, itself now a republic, demanded that she recognized the independence of *Armenia, Iraq, Syria, Palestine* and the *Hejaz* (Arabia). Greece held the city and district of Smyrna for a time, but they have now been returned to Turkey. Thus all that is left to Turkey of her former vast Asiatic possessions is Asia Minor. Under mandates from the League of Nations, Britain guides the affairs of Palestine, and France those of Syria. In 1929 *Trans-Jordan* was given a government, independent of Palestine, under its Arab prince. It is still part of the territory mandated to Britain, and the High Commissioner of Palestine is also High Commissioner of Trans-Jordan. Iraq, which was ruled under mandate by Britain until 1927, is now independent. It has a native government with an Arab king. In Palestine an effort is being made to create a national home for the Jewish people. Some success has already been achieved in this direction, for the total population in the new settlements is about 50,000. The settlers have come from many countries in order to make homes in the ancient Jewish homeland. Unfortunately, Jews and Arabs have so far failed to agree to live peaceably together.

The political units of the Iran plateau remain unchanged. *Iran* (Persia) and *Afghanistan* are independent, and *Baluchistan*, a stony desert with a few oases, forms part of the British Indian Empire. All three occupy positions of great political and strategic importance, especially was this so in the days when they were "buffer states" between powerful Russian and British interests.

EXERCISES.

1. Of what importance is Aden? What is its annual rainfall? How is the town provided with fresh water?

a. What special features are there in the physical geography of the Jordan valley? Are these features to be found in Britain?

3. Why are the following cities important to-day, and why were they important in ancient times: Baghdad, Jerusalem, Damascus, Aleppo?

4. Find out how the construction of the oil pipe lines (pp. 123, 126) has affected the life, distribution and education of the people. Make a map of these pipe lines and, in writing, give an account of the difficulties overcome during their construction.

CHAPTER XIII.

INDIA AND CEYLON.

PHYSICAL FEATURES, CLIMATE AND VEGETATION.

OUR Indian empire, as defined by Act of Parliament, includes not only the great peninsula south of the Himalaya mountains, but Baluchistan, of which we learned in the last chapter, in the west, and Assam and Burma in the east. It covers an area of about a million and a half square miles, and can be regarded as a small continent in itself, rather than as a country. Its population numbers about 353 millions, who belong to many races and religions, and speak many languages. Some of its cities are among the finest in the world, whilst many of its inhabitants are extremely backward. It is a land of great contrasts.

PHYSICAL FEATURES.

An examination of the physical map will at once show—

1. The great mountain barrier in the north-west, the north and the north-east.
2. The extensive plains of the Indus and the Ganges.
3. The triangular plateau of the Deccan, bordered by much wider plains on the east than on the west. Ceylon is a detached portion of this plateau.

I. THE NORTHERN RANGES.

To the north of India is the high plateau of Tibet, to the south of which rise the Himalaya mountains.

As seen from the plains of the Ganges, these mountains rise very suddenly from land which is almost dead level. The Himalayas are a series of parallel earth folds which rise, ridge behind ridge, until the highest central crest is reached. This central ridge, known as

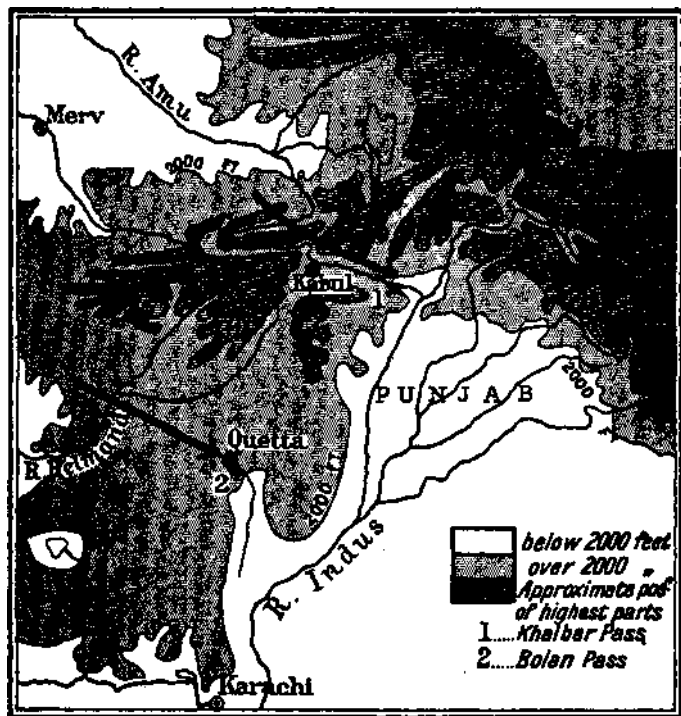


FIG. 37.—The north-west gates to India.

the snowy Himalayas, contains all the highest peaks, including Mount Everest, the highest mountain in the world. This giant has a summit over 29,000 ft. above sea level. The crests of the Himalayan ranges are snow-covered, and glaciers are numerous. Owing to the great width and height of this system (no pass is

THE INDO-GANGETIC PLAIN

lower than 17,000 ft.), they have always been a great obstruction to communications between the bleak plateau of Tibet and India. North of the western Himalayas, and separated from them by the upper Indus, are the Karakoram mountains, an eastern continuation of the Hindu Kush.

In the north-west of India, the Iran plateau, bordered by the Sulaiman and Hala mountains, rises above the plain of the Indus. The mountain barrier here is not so continuous as in the Himalaya region, and there are two passes which give fairly easy access to India from the north-west. They are the Khaibar and Bolan passes (see Fig. 37). These are the great gateways leading into India from Iran and the Turan lowlands, and have been followed by many conquerors and invaders.

In the north-east, the Himalayan ranges bend south and traverse Indo-China. The mountains here are much more of an obstacle to invaders than those of the north-west, but not so great as the Himalayas. Many Mongols have entered India from the north-east, but their numbers have been few compared with those invaders who came through the north-west gates. The Andaman and Nicobar islands mark the tops of continuations of one of these north and south-eastern chains.

2. THE INDO-GANGETIC PLAIN.

This extensive lowland lies between the northern ranges and the Deccan. It has been very slowly built up by the sediment brought from the mountains by rivers. So fine is this alluvium that it is very rare to find stones or pebbles. The map shows that the Ganges is nearer to the northern edge of the Deccan than to the Himalayas, and this is partly due to the fact that the Himalayan rivers have higher sources and greater volumes than those from the Deccan, and consequently push the river southwards, and partly to the raising of the land on the north of the plain due

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A REGIONAL GEOGRAPHY
OF
ASIA AND
AUSTRALASIA

BY

LEONARD BROOKS, M.A. (Cantab. and Lond.)

FORMERLY OND MASTER AND GEOGRAPHY MASTER AT THE
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EDITOR'S INTRODUCTION

THE time has gone by when it was thought possible that a textbook of geography should be equally suitable for pupils at different stages of advancement, so that a series of books suited to different stages is necessary for use in schools. Regions may be studied in different orders suited to different circumstances and aims, and, to be entirely satisfying, each scheme of study should have a special series of books. The series, of which this book forms one, is designed to fit a particular scheme—i.e. that in a secondary school in the years at the end of which is one of the First Public Examinations of the type of the London General School Examination, a scheme which has for many years been found in practice to be extremely satisfactory at the William Ellis School.

Three of the volumes cover the world regionally in three years; the fourth contains much of the preceding matter in a condensed form, together with a few additions on subjects which are more profitably studied after other work has been done. Account is taken of the fact that the pupils are advancing in ability, so that, while there is a certain uniformity in that each book provides a north and south section of the world, yet the arrangement is such that the matter increase in difficulty. The series supplies textbooks for a complete school course in geography which includes physical as well as regional geography, and the order in which regions are taken depends to some extent on the desirability of studying particular sections of physical geography in a suitable order.

After the Americas in Book I, Asia and Australasia are selected for treatment in Book II. Here the geography of man is much more complicated, and the related physical geography, including, as it does, such phenomena as monsoons, necessitates the study of more climatic material than is found in Book I. At the same time the fact that the volume treats of a north and south section of the world allows of revision of previous work by comparison and contrast.

JAMES FAIRGRIEVE.

PREFACE

THIS book is the second of a series of four intended to cover the geography course for the four years leading up to and including the year in which an examination of matriculation standard is taken. From the very earliest years of teaching reference is constantly being made to matters pertaining to climate. The writer has found from experience that pupils who have arrived at this age are particularly interested in the meteorological side of geography, and are old enough and sufficiently advanced to draw together and organize, as well as to add to, previous teaching. Therefore the first seven chapters are designed to accomplish this, and to show in a clear and simple manner the broad connections existing between temperature, pressure and winds, rainfall, etc., and to carry these connections one step farther by showing the influence of all upon the distribution of natural vegetation. More difficult matters, such as the study of the Daily Weather Report and the division of the world into its major natural regions, are left for full consideration at a later stage. Chapters VIII to XVIII deal with the regional geography of Asia, and whilst the work covered in the earlier chapters is illustrated and emphasized in a concrete manner, the treatment is not unduly biased, and the method follows broad lines. The remaining chapters are devoted to Australasia, in studying which it is possible, not only to test whether the principles already learned have been understood, but also to note the differences that occur through its position in the southern hemisphere as contrasted with the situation of Asia north of the equator.

At the end of each chapter there will be found a number of questions and exercises. They are designed to test the pupil's powers of assimilation and originality; and of course it is not intended that answers should be *written* to all, nor are they by any means the only suitable exercises which may be set.

Teachers will find Book II, the *New Regional Map Books*, by V. C. Spary, B.Sc., published by the University of London Press Ltd. (price *is.*) of considerable value for use with this book.

As the author is a Divisional Inspector of Schools under the London County Council, the rules of that Authority make it necessary for him to state that the Council is in no way responsible for the book or for any of the statements in it.

L. B.

**44 Wildwood Road,
Hampstead Garden Suburb, N W. 11.
June 1938.**

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BOOK II

ASIA AND AUSTRALASIA

CHAPTER I.

THE EARTH AS A GLOBE.

LONG before the birth of Christ men believed that the earth was a sphere, and in support of their views put forward some of the arguments with which we are now so familiar. But during the Middle Ages, and right up to the time of Columbus, the most absurd views of the earth's shape were held. Sailors believed that the earth was like a shield, and that if they arrived at the edge, their vessels would fall off into space. It was the voyage of Columbus which compelled men to pay more attention to the older and truer notions of the earth's shape.

Over three hundred years before the Christian Era, it was noticed that when the earth came between the sun and the moon, thus causing the shadow of the earth to be cast on the moon, the edge of the shadow was always part of a circle. Cones, cylinders and bodies shaped like a penny can be made to cast circular shadows in some positions, but the only body which casts a circular shadow *in all positions* is a sphere.

Early in the first century, sailors had already noticed that as they approached land, the latter was first visible from the top of the mast. We now generally state this

from the standpoint of an observer looking out to sea, from which point of view the mast becomes visible first, and later, the hull. Again, the horizon, as seen from the deck of a ship, is circular in shape, and if you climb high up the mast, the horizon still remains circular, but its distance from the ship has increased. The same would be noticed on land, but it is not so easy to see the circular horizon, owing to the hills, trees and buildings. Many other reasons for believing that the earth is spherical, or nearly so, could be given, but since they are mainly the result of somewhat complicated observations by astronomers and mathematicians, it will not be necessary to discuss them here. One very simple fact, which proves that the earth cannot be flat, should be mentioned. A ship can leave Liverpool, sail westwards across the Atlantic Ocean, pass through the Panama Canal, and continue its journey across the Pacific Ocean. It can return to Liverpool *via* the Red Sea, the Sue/ Canal and the Mediterranean, after having sailed round the world. If there were no land masses to interfere, it would be possible for our ship to sail round the world on any parallel of latitude.

Scientific men have determined for us not only the shape, but the size of the earth. We know that it is not quite spherical, and that it is very slightly flattened at the poles. This flattening is so slight that an observer would not be able to detect it on the largest of artificial globes made to scale, for the polar diameter is only 26 miles less than the equatorial diameter. The circumference of the earth is rather less than 25,000 miles, and the diameter nearly 8,000 miles.

So far as we know, the first attempt at measuring the size of the earth was made by a Greek named Eratosthenes, who lived about 200 years before the birth of Christ. At Syene, now Assuan, there was a very deep well, and noticing that the image of the sun could be seen on midsummer day at the bottom of the well, he came to the conclusion that on that day the sun was overhead, and therefore the place was on the Northern

Tropic. Eratosthenes lived at Alexandria, and he set himself the task of finding out what was the angular difference between the height of the sun on midsummer day at Syene and at Alexandria. By observations at Alexandria he found that this difference was $7^{\circ} 12'$. The next thing he required was the linear distance between

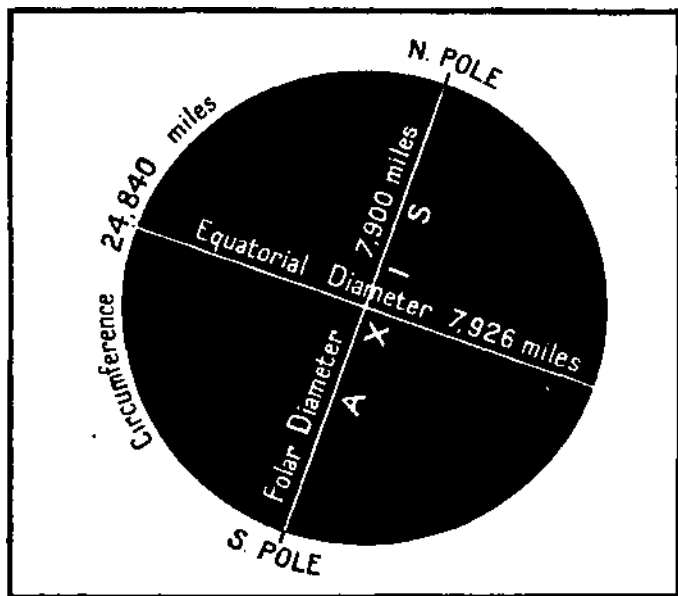


FIG. I.—Diagram illustrating some earth measurements.

Alexandria and Syene, and since even in those early days there was a good system of land survey in the Nile Valley owing to the annual floods, he had no great difficulty in obtaining this. He found the distance required was 5,000 stadia, which is 500 miles. Then he reasoned that, since a distance of 5,000 stadia subtended an angle of $7^{\circ} 12'$, the circumference of the world must

THE EARTH AS A GLOBE

be as many times 5,000 stadia as $7^{\circ} 12'$ are contained in 360° . Thus he calculated:—

$$\begin{aligned}\text{The world's circumference} &= \frac{360}{7^{\circ} 12'} 12' \times 5,000 \text{ stadia} \\ &= 250,000 \text{ stadia,} \\ &= 25,000 \text{ miles (10 stadia = 1 mile).}\end{aligned}$$

Many faults can be found in this calculation. For example, a map will show that the two towns are not on the same meridian; Syene is not quite on the Tropic of Cancer, whilst the distance from Syene to Alexandria is not exactly 5,000 stadia. Despite these drawbacks, this first measurement is very interesting.

GLOBES AND MAPS.—Since the earth is a spheroid, *i.e.*, a sphere slightly flattened at the poles, you will readily understand that the only correct representation of any part of its surface is that which we have on an artificial globe. You must have noticed how the shape of any large country or continent differs on different maps. The only correct map must be on a curved surface, for it represents a part of the curved surface of the earth, and therefore all flat maps are wrong in some respect. It is very necessary that constant reference should be made to a globe in order that wrong impressions derived from flat maps may be corrected.

CHAPTER II

THE MOVEMENTS OF THE EARTH AND THEIR RESULTS.

THE APPARENT MOVEMENTS OF THE SUN.

ALTHOUGH in this chapter we shall discuss the movements of the earth, we shall first of all learn something of the apparent movements of the sun as seen in our own country from our standpoint as spectators. If the height of the sun is measured each day at noon (see Ex. 1),¹ it will be found that its height above the horizon changes a little from day to day. If the path which the sun appears to take in its journey across the heavens is noted, it will be discovered that every day the sun gets higher and higher between sunrise and noon, at the same time appearing to move from the east towards the south. When it is due south, about noon, it is also highest in the sky. During the afternoon the sun sinks lower and lower, at the same time moving westwards. If these observations are made throughout the year, it will be seen that the sun is lowest in the sky at noon about December 21, and highest about June 21, but that it is always seen in the south about twelve o'clock. If we note the point of the compass at which the sun appears to rise, we shall find that in winter it is south-east, on March 21 due east, in summer north-east, and on September 21 due east. In winter the sun appears to set south-west, on March 21 due west, in summer north-

¹ The observations suggested are best carried out in the lower forms, but in case this has not been done, it is advisable to take them at this stage.

6 THE MOVEMENTS OF THE EARTH

west, and on September 21 due west once more. If we could see the sun at midnight it would be in the north, but since it is below the horizon we cannot see it.

THE CAUSE OF NIGHT AND DAY.

We must now explain why it is that the sun appears to make these movements. This is very simple when we realize that it is not the sun which moves, but the earth. We imagine that the earth rotates on its axis, a line passing through the earth from pole to pole. It takes the earth one day to make a complete rotation on its axis. This turning of the earth on its axis is, of course, the cause of day and night, for only half the globe can receive the sun's rays at once. The earth rotates from west to east, so that as each place comes into the light the sun appears to rise in the east. Further turning causes the sun to appear higher and higher, and to reach its greatest height about noon. After noon the continued rotation causes the sun to become lower and lower, and finally to set in the west.

THE CAUSE OF THE SEASONS.

But the earth has another motion: it makes a yearly revolution round the sun. This is illustrated in Fig. 2, which represents a tub filled with water. The water surface represents the *plane of the ecliptic*, that is, the plane in which the earth moves during its revolution round the sun. Two balls are placed on the water, one to represent the earth and the other the sun. The former is moved round the sun-ball, and its path represents the orbit of the earth.

Fig. 2 shows that needles have been passed through the earth-ball to represent the axis, and it will be seen that these are not vertical; they have been inserted so as to make an angle of $66\frac{1}{2}^{\circ}$ with the surface of the water, for the earth's axis is inclined to the plane of its orbit at that angle. We must also observe that the axis

points in the same direction during the whole period of the earth's yearly revolution round the sun. Fig. 3

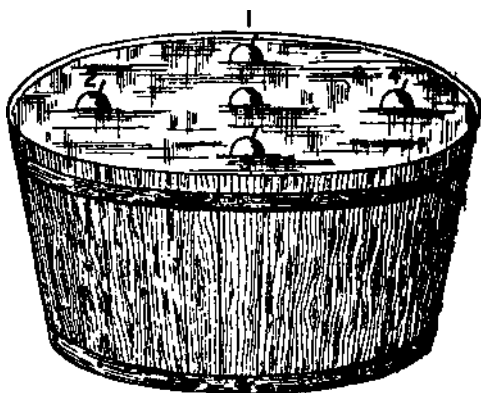


FIG. 2.—This diagram illustrates the revolution of the earth. illustrates the position of the earth with regard to the sun on certain days of the year, the unshaded area

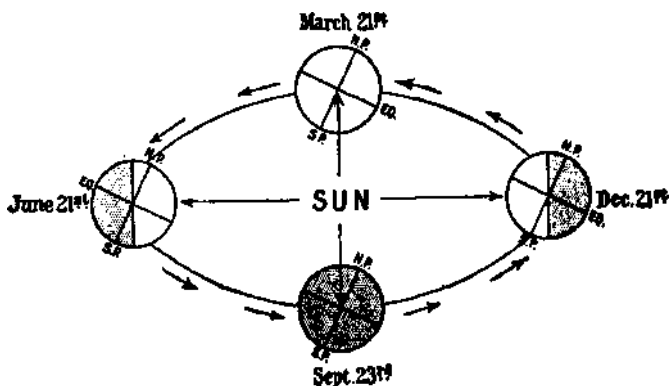


FIG. 3.—Diagram showing the position of the earth with regard to the sun at the equinoxes and solstices.

representing that part of the earth reached by the rays of the sun. It will be seen that on June 21 the northern

8 THE MOVEMENTS OF THE EARTH

end of the earth's axis, *i.e.*, the North Pole, is tilted *towards the sun* and *away from it* on December 21, so that on June 21 the sun's rays pass $23\frac{1}{2}^{\circ}$ beyond the North Pole, and fall short of the South Pole by the same angle. These conditions are reversed on December 21. On March 21 and September 23, the earth is illuminated from North to South Poles, so that the sun's rays reach the poles, but do not pass beyond them.

Now this yearly revolution of the earth round the sun is the cause of the seasons. In the next chapter we shall learn that the more overhead the rays of the sun strike the earth's surface, the warmer is the temperature*. The revolution of the earth round the sun causes the sun's rays to strike the same place at different angles at different times, and thus we have the seasons.

THE APPARENT MOVEMENT OF THE SUN IN DIFFERENT LATITUDES.

(1) AT THE EQUATOR.—Fig. 4 is a diagram which shows the apparent path of the sun at different times of the year. The point *x* represents the position of the observer, his horizon being shown by the ellipse. On March 21 the sun rises due east at six o'clock in the morning, and gradually gets higher and higher, until at noon the observer at *x* would see the sun immediately overhead. At six o'clock in the evening it sets due west. From March 21 to June 21 the sun appears to rise every day a little farther north of east, and to set a little farther north of west, whilst at the same time the elevation at noon decreases. On June 21 this northward movement ends, and on each successive day the sun rises nearer east, sets nearer west, and has a higher noon elevation. On September 23 the conditions observed on March 21 are repeated, the sun rising due east, setting due west, and being overhead at noon. Between September 23 and December 21, the sun rises each day farther south of east, and sets farther south of west, the farthest southern limits being

APPARENT MOVEMENT OF THE SUN 9

reached on December 21, when it is $66\frac{1}{2}^{\circ}$ above the horizon, which is the same elevation as on June 21, when the northern limit was reached. Between December 21 and March 21 every day sees the sun rising nearer east and setting nearer west, so that by the time the latter date is reached the sun once more rises due

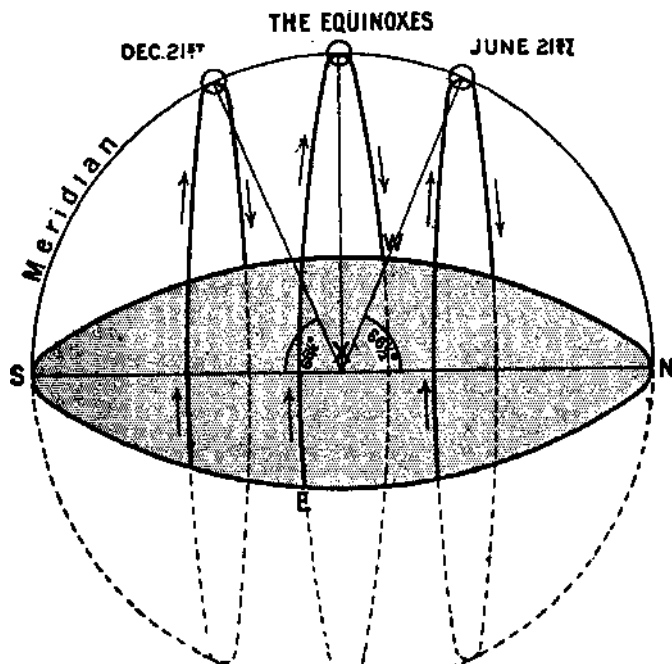


FIG. 4.—The apparent path of the sun at the equator at the solstices and equinoxes.

east, sets due west, and has an elevation above the horizon of 90° . One point must be noted, and that is, that on every day of the year at the equator, the sun rises and sets at the same time, i.e. 6 a.m. and 6 p.m. respectively.

10 THE MOVEMENTS OF THE EARTH

(2) AT LONDON.—The symbols used in Fig. 5 are the same as in Fig. 4, and since reference was made at the beginning of the chapter to the apparent movements of the sun in our own country, there is no necessity to go into detail again. The important points

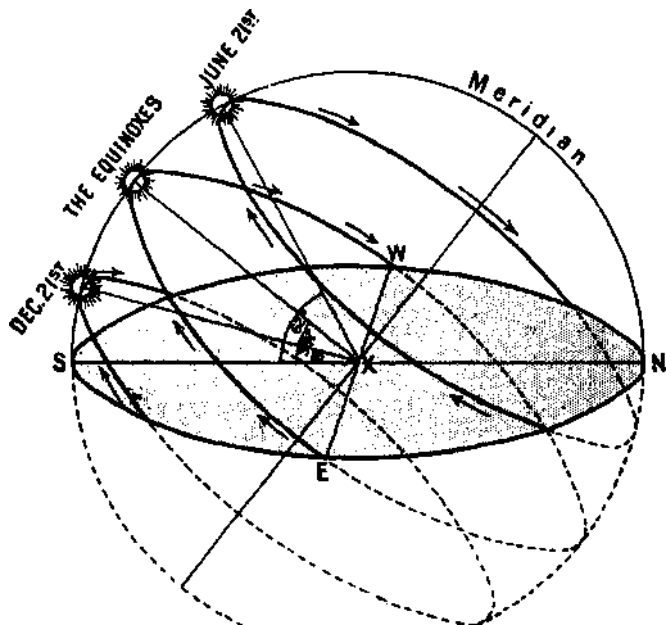


Fig. 5—The apparent path of the sun at London at the solstices and equinoxes.

to notice are (a) the long summer day, (6) the short winter day, (c) the similar conditions on March 21 and September 23.

(3) AT THE NORTH POLE.—Fig. 6 shows that on March 21 an observer at the poles would see the sun circle round the sky on the horizon. Between March 21 and June 21 it appears to circle round in the heavens,

APPARENT MOVEMENT OF THE SUN ii

gradually increasing in height, until on the latter day it reaches an elevation of $23\frac{1}{2}^{\circ}$. On each succeeding day the sun continues to circle the sky but is getting lower and lower, until, on September 23, it is once more on the horizon. But between September 23 and March 21 the sun cannot be seen at the North Pole, for it is below the horizon, reaching its lowest point on December 21. Thus we see that at the North Pole

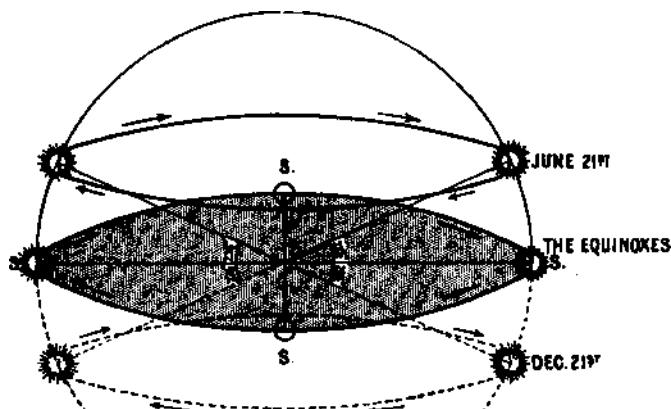


FIG. 6.—The apparent path of the sun at the North Pole at the solstices and equinoxes.

the sun never sets for six months, and never rises above the horizon for the same period. This is true at the South Pole, too, but the seasons are reversed. It must not be supposed that this means that the poles have six months light and six months darkness, for we must note that there is twilight until the sun reaches a certain distance below the horizon, and since the sun at the poles increases and decreases in height very slowly, twilight lasts for a whole month.

12 THE MOVEMENTS OF THE EARTH

HOW THE TROPICS, THE ARCTIC AND ANTARCTIC CIRCLES ARE FIXED.

We have learned that on June 21 the North Pole is tilted towards the sun, whilst on December 21 it is pointed away from the sun. It is this tilting of the earth's axis which causes the sun to be overhead at noon on June 21 as far north of the equator as $23\frac{1}{2}^{\circ}$ N. This is, naturally, what may be expected, for the earth's axis is inclined at that angle from the vertical. Similarly, on December 21, the sun is seen overhead at noon $23\frac{1}{2}^{\circ}$ S. of the equator (see Fig. 7). If, as

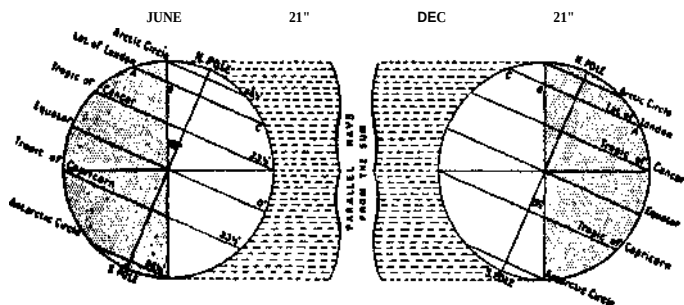


FIG. 7.—The position of the earth with regard to the sun at the solstices.

the earth rotates on its axis on these days, the sun were to trace on the earth a line along which it is seen overhead, we should have two circles which mark the northern and southern limits of the belt within which the sun can be seen overhead on certain days of the year. Thus we have the Tropics of Capricorn and Cancer fixed. The word "tropic" means a "turning point." Fig. 7 also shows that the rays of the sun fall $23\frac{1}{2}^{\circ}$ beyond the North Pole at the northern mid-summer and fall short of the South Pole by the same angle; whilst at the northern midwinter, the rays pass beyond the South Pole and fall short of the North Pole. In this way, the Arctic and Antarctic Circles are fixed.

THE EQUINOXES AND SOLSTICES.

On March 21 and September 21, when the rays reach both poles, the sun can be seen overhead at the equator, and every place has equal day and night, the sun rising at 6 a.m. and setting at 6 p.m. Therefore these days are called respectively, the *Vernal or Spring and Autumnal Equinoxes*. We have also seen that on June 21 the sun reaches the northern limit of its apparent migration into the northern hemisphere. This day is said to be the *Solstice*, which means, that the sun, as it were, stands still before its migration southwards, and since it is this apparent movement of the sun which causes summer, June 21 is called the *Summer Solstice*. Similarly, December 21 is known as the *Winter Solstice*.

EXERCISES.

1. (a) Keep a record of the noon height of the sun, if you have not done so in a lower form or class. Any sufficiently accurate instrument may be used. (b) Push a knitting-needle into a drawing-board and place the board where the sun's rays will fall upon it during school hours. Draw a line along the shadow every half-hour. From the lines so drawn, what can you learn about the height of the sun during the day? (c) By means of drawing-pins, fasten a piece of white cardboard to a drawing-board. Draw a circle of about four or five inches radius. Draw a diameter. Divide half of the circle into angles of 15° , and erect a knitting-needle at the point where each radius touches the circumference. By means of a cork-borer, obtain several pieces of cork about a quarter of an inch long and push these on the knitting-needles. The drawing-board must then be placed in a spot (best of all a window facing south) upon which the sun shines during school hours. At nine o'clock in the morning, turn the board so that the left knitting-needle and the centre of the circle are in a line with the sun. Push the cork down the needle until its shadow falls upon the centre of the circle. Repeat the process every hour, and at the end the small corks will give a representation of the path of the sun during the day. This may be repeated at other times, using different corks.

2. Draw diagrams similar to Figs. 4, 5 and 6 to show the apparent path of the sun at the solstices and equinoxes as seen by an observer at (a) the Arctic Circle, (b) the Tropic of Capricorn.

14 THE MOVEMENTS OF THE EARTH

3. Give in tabular form the height of the sun at noon on the days of the equinoxes and solstices at the poles, the Arctic and Antarctic Circles, London and the Equator. Arrange the table so as to give the dates on the left column and the places at the heads of columns.

4. Explain points of geographical interest in each of the following quotations-

- (a) The sun above the mast
Had fixed her to the Ocean.
- (b) The days grew longer and longer
Till they became as one.

5. What would be the effect (a) if the earth's axis were not tilted? (6) If the South Pole were always tilted towards the sun?

6. What are (a) the Tropics of Cancer and Capricorn, (b) the Arctic and Antarctic Circles?

CHAPTER III.

THE DISTRIBUTION OF TEMPERATURE.

TEMPERATURE is measured by means of the thermometer, and in English-speaking countries, except for scientific purposes, the Fahrenheit thermometer is in most general use, although continental countries use the Centigrade thermometer. On the former, freezing-point is 32° and boiling-point 212° , whilst on the latter these are 0° and 100° respectively. On the maps used in illustrating this chapter both scales are given.

The envelope of air which surrounds the earth can be heated in two ways; either from the earth itself, and we know that the interior of the earth has a very high temperature indeed, or from the sun. The amount of heat which the air derives from the heated interior of the earth is very small indeed, and this is illustrated by the fact that polar regions must have the same amount of heat from this source as equatorial regions, but we know that there are enormous differences between the temperature conditions in these areas. For all practical purposes we must confine our attention to the sun as the source of heat.

THE DISTRIBUTION OF INSOLATION.

Fig. 8 represents the earth, and A, B and C are bundles of sun's rays of equal width. It is clear that the nearer the rays fall to the equator, the greater is the angle at which they strike the earth, and the less the area which they have to heat. This is one reason why equatorial regions are warmer than polar regions. It is very

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useful to use a term which expresses the amount of heat energy we receive from the sun. The term is *insolation*. The insolation for any day is the total amount of radiant energy received from the sun during that particular day. It is very important to notice that figures which give the amount of insolation at different latitudes

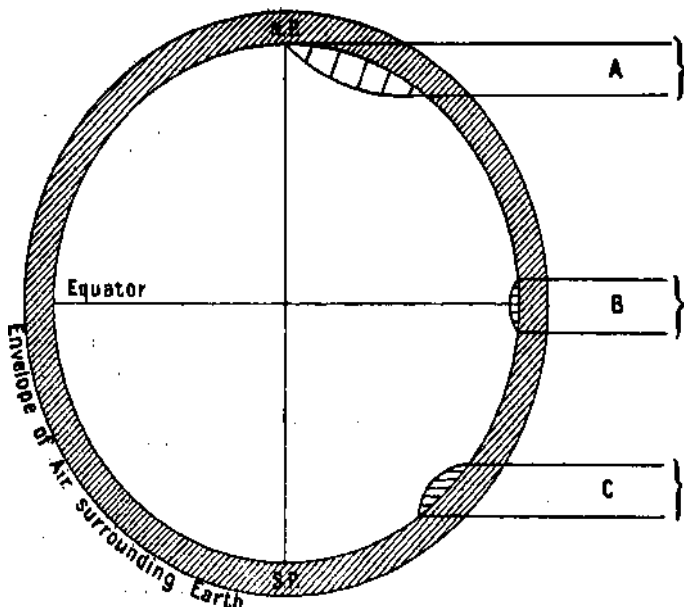


FIG. 8.—Diagram showing bundles of the sun's rays striking the earth's surface at different angles.

at certain times of the year, do not take into account the important facts that the earth is surrounded by an atmosphere, and that the land and sea surfaces of the globe differ very greatly in their power of heating and cooling. They do, however, take into account the length of time the sun is above the horizon.

It might be supposed that on June 21, when the sun is overhead at the northern tropic, insolation will be

greatest there. This is not so, for we must not forget that on that day, day and night are not of equal length as at the equinoxes, when the amount of heat received from the sun is greatest at the Equator, and decreases towards the poles. At the summer solstice, there is still equal day and night at the Equator, but as we go towards the North Pole the length of day increases, being 13 hrs. 56 min. in lat. 30° , and $18\frac{1}{2}$ hrs. in lat. 60° ; whilst regions within the Arctic Circle have a longest day varying from 24 hours to 6 months, according to their positions. Thus it is evident, that although the sun will be hotter at the Tropic of Cancer, it is longer in the sky in latitudes farther north, so that the total amount of radiant energy or insolation received is not very easy to calculate. If we let the insolation at the equator for the vernal equinox be represented by the number 1,000, that at different latitudes on June 21 is given in the following table :—

Latitude N.			
0°	881	50°	1105
10°	975	60°	1093
20°	1045	70°	1130
30°	1088	80°	1184
40°	1107	90°	1202

From these figures it will be seen that the insolation on June 21 is greater at the North Pole than at the Equator. But there are certain facts which must be pointed out, or a wrong impression might be gained. Firstly, the figures represent the total amount of insolation received during the whole day, and do not show the temperature *reached* during the day. We know that the polar regions do not attain the same temperatures as equatorial regions. Secondly, since the table imagines the earth to have no atmosphere, it does not take into account the loss of heat owing to absorption by the atmosphere. Thirdly, the figures do not allow for the fact that the earth has both land and

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water surfaces, and that these affect the distribution of temperature very considerably. Let us first consider the influence of the atmosphere upon insolation.

THE INFLUENCE OF THE ATMOSPHERE ON INSOLATION.

Before they can reach the earth, the sun's rays have to pass through the air envelope which surrounds the earth to a height of some 200 miles. In passing through the atmosphere, the sun's rays must lose some heat even if the air were quite free from all impurities. But there are dust particles and water vapour in the air, and these absorb the sun's rays to such an extent that a large proportion of heat does not reach the earth. It will readily be seen that more heat will be absorbed by the atmosphere, the denser and thicker the envelope of air and the more dust and water particles that air contains. Fig. 8 shows that ray B has to pass through less air than those which fall obliquely (A and C), and therefore will not lose so much heat to the atmosphere. Therefore, since the sun's rays reach equatorial regions in a far less slanting direction than polar regions we have here another reason why the latter regions are colder. We shall now learn of the influence of land and water upon temperature.

THE INFLUENCE OF LAND AND WATER UPON TEMPERATURE.

Land and water do not take in heat at the same rates. If we heat a cubic foot of sand and the same quantity of water, we should find that the latter requires about twice as much heat to raise the temperature 1° as is required to raise the temperature of the sand by the same amount. On cooling, water gives out more heat than land. Again, the water in the ocean is in constant motion, so that the heat received from the sun is distributed, whereas rays falling on land heat only the

ALTITUDE AND TEMPERATURE

area on which they fall. Water is heated to a greater depth than land, and this is another reason why water takes longer to heat. In brief, we may say that the water surfaces of the earth take longer to heat in summer than the land surfaces, and cool at a slower rate in winter—that is, the oceans will be cooler than the continents in the same latitudes in summer, and warmer in winter (see Ex. 4 at the end of chapter). Lastly, let us turn to the influence of altitude upon temperature.

THE EFFECT OF ALTITUDE ON TEMPERATURE.

It has been seen that the atmosphere receives some heat from the rays of the sun as they pass through it. But only a small proportion of the heat received is acquired in this way. The sun's rays heat the surface of the earth, and by the process of radiation some of this heat is absorbed by the air. But the air is probably affected most by actually coming in contact with the earth, for it is easily heated by contact with something warmer than itself and cooled by something colder than itself. Thus the layers of air in contact with the earth are heated, and becoming lighter than the surrounding air, are displaced by the latter and forced to rise. The air which now comes in contact with the earth is warmed, and in its turn is compelled to rise. The ascending particles of air lose some of their heat to the air with which they come into contact. In this way the whole of the lower layers of the atmosphere are gradually warmed. Since the air is largely heated by contact with the earth, it is natural that the temperature falls as altitude increases. But this does not fully explain why it is colder on the top of a mountain than at its base, for the air at the summit is as near the ground as the air at the base. The question of pressure comes in here, and although we shall speak of atmospheric pressure in the next chapter we can now mention that air pressure decreases as sea-level is left behind.

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As the air at high altitudes is not so dense as near sea-level, and is freer from water vapour and dust, it follows that the amount of insolation reaching the surface is greater than at sea-level. But for the same reasons the heat is very quickly radiated to the atmosphere, and the ground cannot retain its temperature for long. The total effect is to lower the temperature on mountains or plateaux.

The rate at which the temperature falls varies very much according to the place and season, but it may be taken as about 1° F. for 300 feet of ascent (see Ex. 3 at the end of this chapter). We have now covered all the points which will help us to understand the temperature maps of the world. Before studying them, however, let us just put together, from what we have learned, the causes which make summer warmer than winter.

WHY IT IS WARMER IN SUMMER THAN IN WINTER.

Fig. 7 shows that the North Pole is tilted towards the sun in June, and away from the sun in December. This not only gives us longer days in summer, but causes the sun to be higher in the sky in summer than in winter. Thus it is warmer in summer than in winter, for these reasons—

(1) The amount of insolation is greater, partly on account of the greater angle at which the sun's rays are received, and partly because the days are longer. (2) Less heat is absorbed as the sun's rays pass through the air. The lines A, B, C, in Fig. 7, represent the latitude of London, and the thickened rays are those which reach this latitude at June 21 and December 21. It will be seen that the summer ray reaches the latitude of London in a less slanting direction and passes through less air in June than in December. Notice the parts of the lines A, B, C, which are in the unshaded portion of the diagrams. These represent the relative length of days in June and December. It is at once

evident that the tilting of the earth's axis gives to London a longer day in summer and therefore more heat.

Temperature distributions are shown by means of *isotherms*, which may be defined as lines along which the temperature is everywhere the same. The method of drawing isotherms is illustrated in Ex. 1 at the end of this chapter. It is very important to notice that most isothermal maps are reduced to sea-level. Temperature varies with elevation, and therefore it is necessary to correct the thermometer readings at each station to what they would be at sea-level, if we wish to learn from the map the effects upon temperature of causes other than elevation.

TEMPERATURE MAPS OF THE WORLD.

Figs. 9, 10 and 11 show the mean sea-level temperatures for April, January and July. April (or October) is the best month for showing the temperature conditions when the maximum temperature is near the equator. January and July maps give the distribution of temperature in the winter and summer months of temperate latitudes. Theoretically, Figs. 9, 10 and 11 should be made for the days of the vernal or spring equinox and the solstices, but there is what may be described as a "lagging of the seasons," which must be taken into account.

Some isotherms are of greater importance than others; for example, the summer isotherm of 50° F. approximately marks the poleward limit of trees, for the latter cannot thrive unless this temperature is reached during at least one month. On Figs. 9, 10 and 11 the isotherms of 32° , 50° , 68° and 86° F. have been inserted. In order to bring out more clearly the great winter cold of the Eurasian land mass, other isotherms have been added to the January map.

APRIL TEMPERATURES.—Fig. 9 shows the **April** temperatures reduced to sea-level. It will be seen that

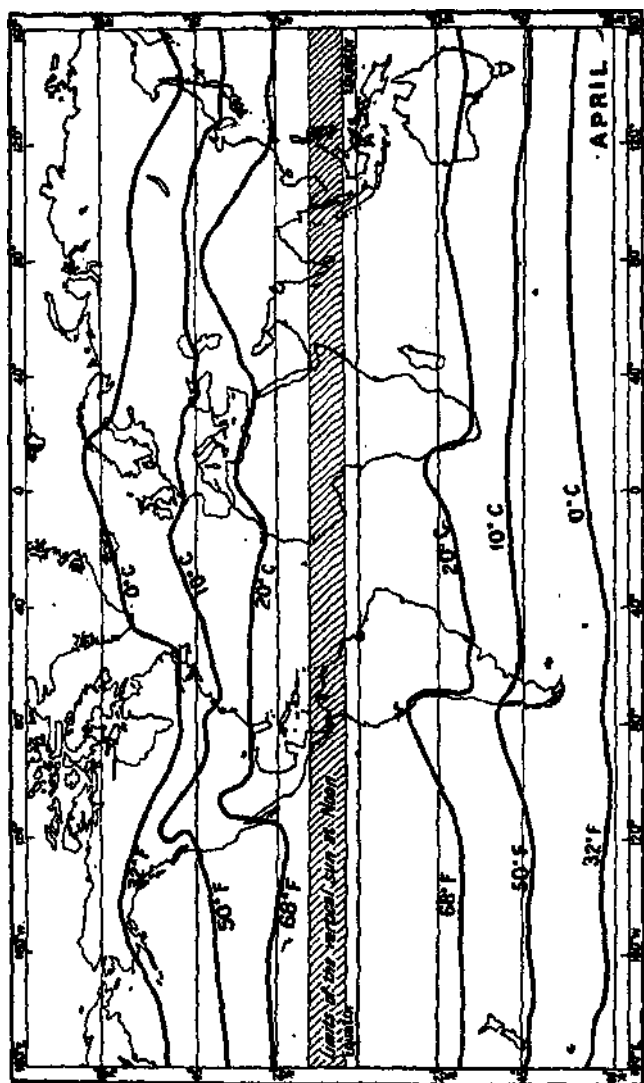


FIG. 9.—Mean sea-level temperatures for April.

TEMPERATURE MAPS OF THE WORLD 23

the region of greatest heat lies in equatorial regions, and that the temperature decreases gradually as the poles are approached. The isotherm of 50° follows very roughly the parallels of latitude 45° N. and S. The explanation of this general distribution of temperature is found in the fact that this map is made for a month immediately following the spring equinox, so that we should expect temperatures to decrease gradually from the equator to the poles.

JANUARY TEMPERATURES.—This map shows that the heat belt has migrated southwards with the sun, for the latter is overhead at noon on December 21 at the Tropic of Capricorn. The hottest belt is distinctly south of the equator, for it is in the summer season in the southern hemisphere. The highest temperatures (over 86°) are to be found over the land masses, on account of the fact that the temperature of land rises more quickly than that of water. The isotherm for 50° almost keeps parallel to the lines of latitude, and the reason for this should be apparent, as it is almost entirely over water. As a contrast, the isotherms for the northern hemisphere show a most marked bend southwards on the west of continents, and northwards on the east of continents, whilst over the land masses themselves they bend southwards. The isotherm for 32° F. gives the best illustration of this. This irregularity is accounted for partly by the unequal heating of land and water, and partly by ocean currents. With regard to the effect of the latter, we shall make fuller reference in Chapter V, but one other example of their influence on temperature may be pointed out now. In both January and July, the isotherms of the southern hemisphere bend northwards off the west coasts of land masses and southwards off their eastern shores. The reason for this is, that cold currents flow northwards along their western shores, and warm currents flow southwards along their eastern margins.

The coldest region is in Northern Siberia, where there is an area which has been called the "cold pole,"

24 THE DISTRIBUTION OF TEMPERATURE

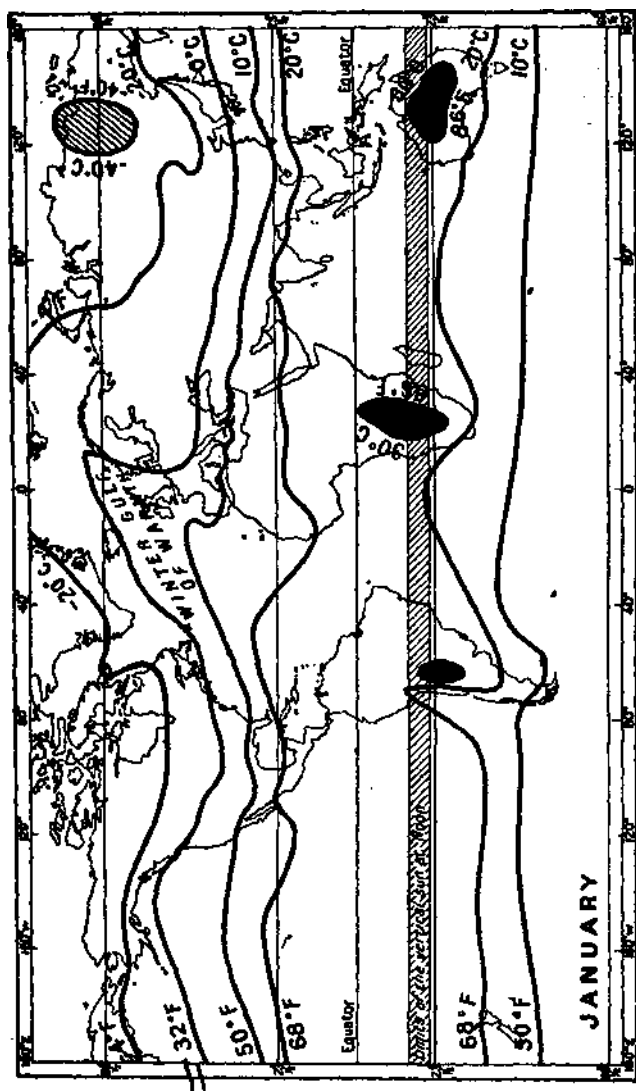


FIG. 10.—Mean sea-level temperatures for January.

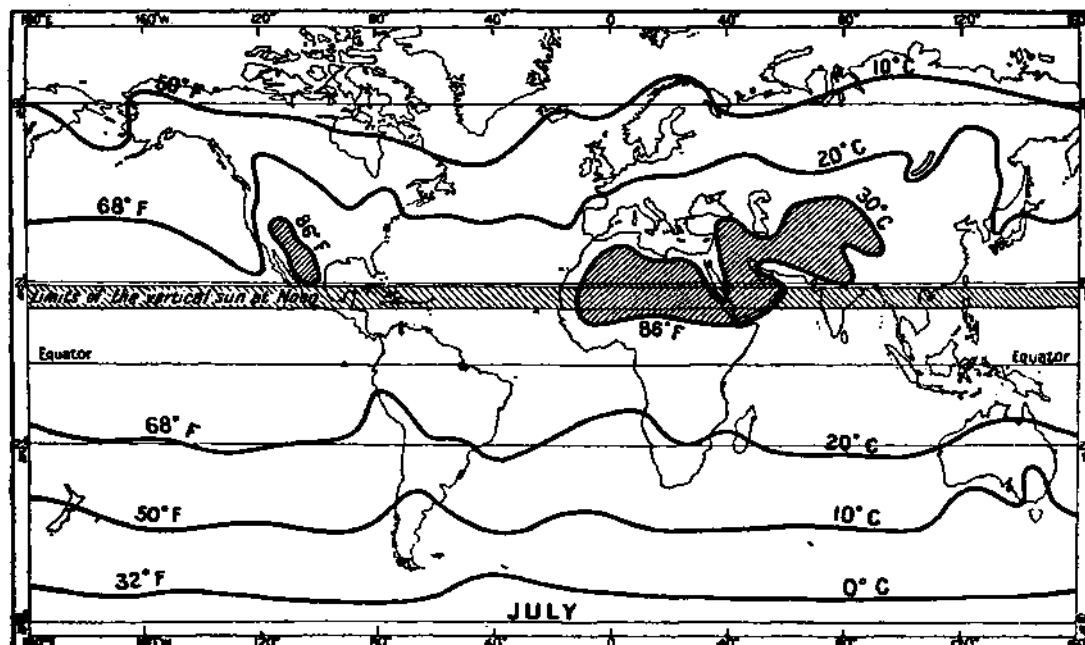


FIG. II.—Mean sea-level temperatures for July.

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whose temperature is below -48° F. A vast area of Eurasia has a temperature below freezing-point. So great is the land mass that this temperature is experienced within 3° of the Tropic of Cancer. The interior lands of North America are also very cold, but since the land area is not so great as in the old world, the temperatures are relatively not so low.

JULY TEMPERATURES.—Fig. 11 shows the temperature for July, when it is evident that the heat belt has migrated into the northern hemisphere, where the highest temperatures are seen to be over the land masses. Since the latter are warmer than the oceans in the same latitudes, the isotherms of the northern hemisphere bend northwards over the land. Over Asia, the isotherm of 68° F. reaches within 7° of the Arctic Circle. The southern hemisphere shows a more equable distribution of temperature south of the equator, due to the great extent of ocean.

EXERCISES.

1. On two outline maps of the British Isles plot the positions of the stations used (or the reports of the Meteorological Office. On one map print by the side of each station the mean temperature for January, as given in Appendix 1 of the D.W.R. On the other do the same for July. Then draw the isotherms for every even number of degrees (*i.e.* 38° , 40° , 42° F., etc., for January, and 56° , 58° , 60° F., etc., for July).

2. Draw a map of the coast-lines of the North Atlantic Ocean, and on it mark the January isotherm of 32° F. Shade the area which has a temperature of over 32° F. The great gulf-like tongue of warmer water off the West of Europe is sometimes called "The Winter Gulf of Warmth."

3.

Place.	Height in feet above sea.	Jan. temp.	July temp.
Fort William . Ben Nevis summit .	S.L. 4,400	$38^{\circ}7'$ F. $23^{\circ}4'$ F.	$57^{\circ}1'$ F. $41^{\circ}7'$ F.

Find these places on the map. Account fully for their differences in temperature.

EXERCISES

4.

Place.	Jan. temp.	July temp.	Range of temp.
Cambridge .	37-6° F.	61'5° F.	23'9 ⁰ F.
Berlin .	31'3° F.	64'5° F.	33'2' F.
Warsaw • •	23'9 ⁸ F.	65'5° F.	41'6° F.
Saratof. • •	13'5° F.	71'0° F.	57'5 ⁰ F.

These places are in approximately the same latitude. Account for the different temperature conditions shown by the figures.

5. On outline maps of the Old World north of the equator mark the isotherms for January and for July. Shade the maps so as to emphasize cold in winter and heat in summer. Write short accounts bringing out the leading features shown by the maps.

6. On outline maps of the southern hemisphere draw the isotherms for January and for July. Shade the map as suggested in Exercise 5. State the chief differences between the distribution of temperature in Eurasia and North Africa and in the southern hemisphere.

7. Why is it warmer in equatorial regions than in polar regions? Draw diagrams to illustrate your answer.

CHAPTER IV.

THE PRESSURE OF THE ATMOSPHERE AND ITS INFLUENCE ON WINDS.

IN previous chapters we have learned that the earth is surrounded by an air envelope. It is known that this extends to a height of about 200 miles from the earth's surface, and that the higher we go the lighter the air becomes. Since we know that air has weight, it follows that it exerts a pressure upon the surface of the earth, and that this pressure will be greater at sea-level than on the top of a high mountain, for there is not so much air above the latter as there is above a place at sea-level. Air pressure is measured by means of the barometer. A barometer consists of a glass tube which is closed at one end. This tube is filled with mercury, inverted, and the open end placed into a cup of mercury. The mercury column then falls a little, and some of the mercury runs back into the cup, leaving in the tube a column about thirty inches high.

When the air pressure upon the surface of the mercury in the cup is increased, the column is pushed higher up the tube; but if the air pressure decreases mercury flows from the tube to the cup, and the height of the column is decreased. Thus it is seen that when the column stands at a height of 30 inches the pressure of the atmosphere is equal to that of a layer of mercury 30 inches deep. It is usual to express the pressure of the atmosphere in inches or millimetres of mercury, and the normal pressure at sea-level is about 29.9 inches or 760 millimetres. It is more scientific, however, to use a pressure unit, hence the increasing use of the terms *bar*

and *millibar* (see Exercise 7 at the end of this chapter). When the pressure is more than 29.9 inches **or 1012.5** millibars we speak of it as being "high," and when it is below this we speak of it as being "low." Since we know the density of mercury it is easy to calculate that this pressure is equal to one of 147 pounds per square inch.

PRESSURE AND ALTITUDE.

We have seen that the air extends to a height of about 200 miles, but at that height it is extremely rare. Since the upper layers of air press upon the lower layers, the latter are denser and therefore heavier, for the particles of air are closer together. If a barometer were carried up the sides of a high mountain it would be found that the reading would continually fall, and that at an elevation of 900 feet from sea-level the reading would be one inch less than at sea-level. To cause a fall of another inch, however, we should have to make an ascent of more than 900 feet, because, as we are now increasing our elevation, the air is less dense than it was at lower levels. At an elevation of 3½ miles the pressure is only about half what it is at sea-level, so that half of the atmosphere would be below that elevation; whilst at a height of seven miles we should have three-fourths of the atmosphere below us.

So rarefied is the atmosphere at great elevations that it is very difficult to breathe sufficient air for the wants of the body. Some men and animals have become accustomed to living at great elevations; but it is a well-known fact that travellers *unaccustomed* to living in high altitudes find great difficulty in breathing, and even at lower levels, suffer from headaches, dizziness and sickness. It will readily be seen that barometer readings can be used for determining roughly the heights of mountains.

PRESSURE AND WINDS.

If the pressure at any place is high, and that of the surrounding area low, air flows outwards from the higher

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pressure towards the lower. Air always flows from places of high pressure towards places of low pressure. But this statement requires some modification, for the rotation of the earth causes winds to be deflected to the right in the northern hemisphere, and to the left in the southern hemisphere. Pressures are represented by means of *isobars*, or lines along which the pressure is everywhere the same (see Ex. I on p. 40). Fig. 12 A shows an area of high pressure surrounded by lower

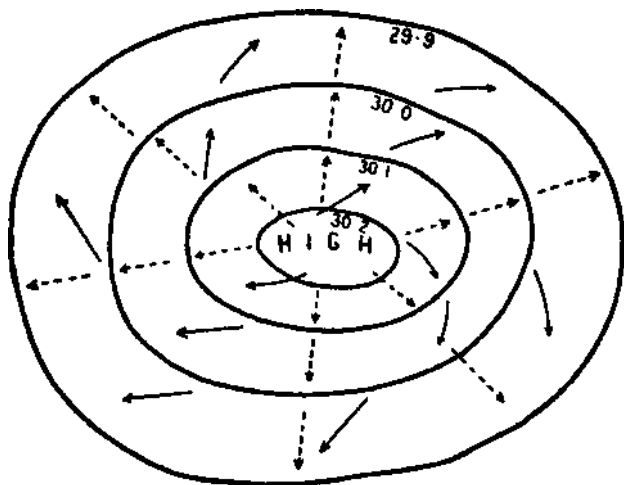


FIG. 12 A.—The relation between pressure and winds.

pressure, and if the earth stood still winds would flow outwards as indicated by the dotted arrows. If this represents a pressure system in the northern hemisphere the actual winds will be as shown by the straight-lined arrows. This law of the deflection of winds to the right in the northern hemisphere, and to the left in the southern hemisphere, due to the earth's rotation, is known as *Ferrers Law*. It must be noted that rivers are also influenced, but not nearly to the same extent as the lighter, easily influenced air currents.

PRESSURE AND WINDS

A full explanation of this deflection cannot be entered into here, but it may be illustrated in several ways.

Push a knitting-needle through the centre of a card-board disc, and rotate the disc from right to left. From the centre of the disc allow an inked marble to run towards the edges, and then notice its track. The marble does not reach the point originally aimed at, but is deflected to the right. This illustrates the deflection of a northern hemisphere air current moving equatorwards, for the edge of the disc represents the equator, and the centre the North Pole. If the disc be rotated from left to right the deflection is then to the left, and this illustrates the deflection of air currents

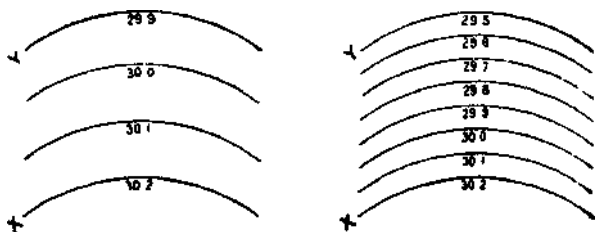


FIG. 12 B.—Steep and less steep gradients.

moving from the South Pole towards the equator from the standpoint of a person looking down upon the South Pole. The deflection of currents moving equatorwards can also be shown as follows: Rotate a globe in the same direction as the earth's rotation, *Le.* from west to east. Whilst the globe is turning round, by means of a piece of chalk, try to draw due north and south lines. Draw several for each hemisphere, taking care that each line is drawn towards, and not away from, the equator. Stop the globe, and it will be seen that the lines show deflection, as stated in Ferrel's Law. Currents moving polewards are also deflected to the right in the northern hemisphere, and **to the left in the southern hemisphere.**

There is one more point to which **reference** must be

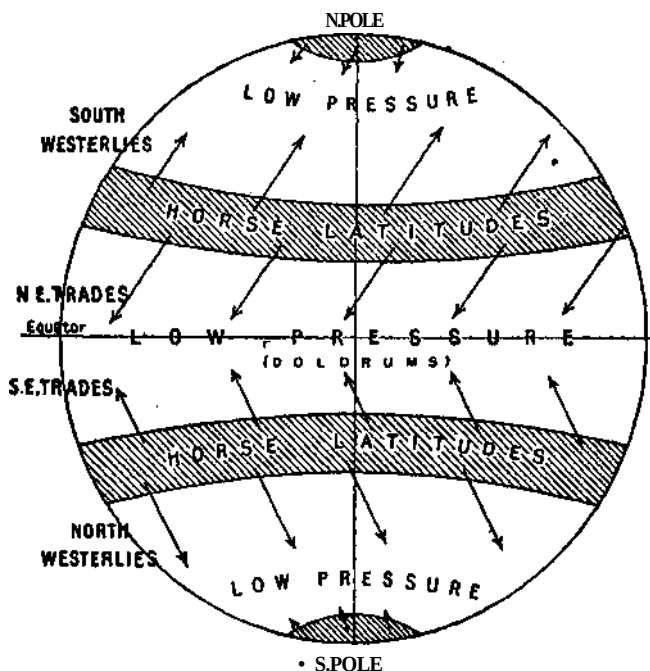
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made. At the beginning of this section we learned that winds are due to differences of pressure. From this it follows that the greater the difference in pressure between two places the stronger will be the resulting wind. In the isobars on the left of Fig. 12 B the difference between the readings at x and y is three-tenths of an inch. In those on the right x and y are the same number of miles apart, but the pressure difference is seven-tenths of an inch. In the latter case, the winds experienced will be much stronger than in the former, for the air will be pushed outwards with much greater force. In each case the isobars are drawn to show differences of pressure at one-tenth of an inch intervals, but it is evident that they are closer together in one than in the other. Thus we reach a statement which is sufficient for present purposes: winds are generally stronger where the isobars are closer together than where they are farther apart.

GENERAL DESCRIPTION OF THE DISTRIBUTION OF PRESSURE AND THE PLANETARY WINDS.

We are now in a position to consider the distribution of pressure over the surface of the globe. In the last chapter we learned that the equatorial belt has great heat. Now this causes the development of an area of low pressure known as the Doldrums, towards which there are inflowing winds at the surface and above which there is a drift of air forced upwards by the meeting of the inflowing air currents. About 30° to 35° north and south of the equator are two belts of high pressure. These are known as the Horse Latitudes. Small areas of high pressure are also found at the poles, whilst in sub-arctic regions there are low-pressure areas. All these will be found on Fig. 13. Now if the world stood still, we should have winds blowing from high-pressure belts to low-pressure belts; but, as the rotation of the earth causes the winds to be deflected, we have air currents moving equatorwards and polewards from

the Horse Latitudes, and being deflected to the right in the northern hemisphere and to the left in the southern hemisphere. Those blowing towards the equator are the steady *Trade Winds*, and those blowing pole-



high Pressure Areas.

FIG. 13.—A diagrammatic representation of the prevailing winds of the world.

wards are the *Westerlies*. In addition to these, there are the winds which blow from the polar high-pressure areas. All these winds will be found marked in Fig. 13. The *Westerlies* are stronger than the *Trades*, but do not blow with such regularity, and on this account are best referred to as the "Prevailing *Westerlies*." The pic-

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turesque name " Brave West Winds " has been given to the Westerlies of the southern hemisphere, whilst the latitudes in which they are most reliable and are very strong, have been named " The Roaring Forties." These names help to indicate the strength of the southern hemisphere Westerlies.

One other point must be made clearer. The Horse Latitudes and the Doldrums are " calms "—that is, little movement of air is felt. Very often sailing ships are becalmed in these latitudes for many days together. This is due mainly to the fact that the chief movement of air in these places is a vertical one. Air rises at the Doldrums and, in the upper layers of the atmosphere, flows out towards the poles. By the time the Horse Latitudes are reached, the air has sufficiently increased in density, due to cooling, that it falls to the surface, and flows either to the equator or towards the poles as a surface wind. Thus it is seen that since the movement of air at the Horse Latitudes and Doldrums is not a horizontal movement, these regions will be calms. This explains, too, why there are high-pressure belts from 30° to 35° north and south of the equator. The air which descends to the surface in these latitudes increases very rapidly in density as it falls, so that the pressure is bound to be high.

WORLD DISTRIBUTION OF PRESSURE.

In explaining Fig. 13, we have not taken into consideration the fact that the earth's surface consists of land and water, and that these, owing to their different capacities for heating and cooling, will affect pressure. Nor have we taken into account seasonal changes in pressure distribution. We shall now consider these points.

Figs. 14, 15 and 16 show the distribution of pressure in October, January and July. For the purposes of comparison, all the readings from which pressure maps are constructed have certain corrections applied to them,

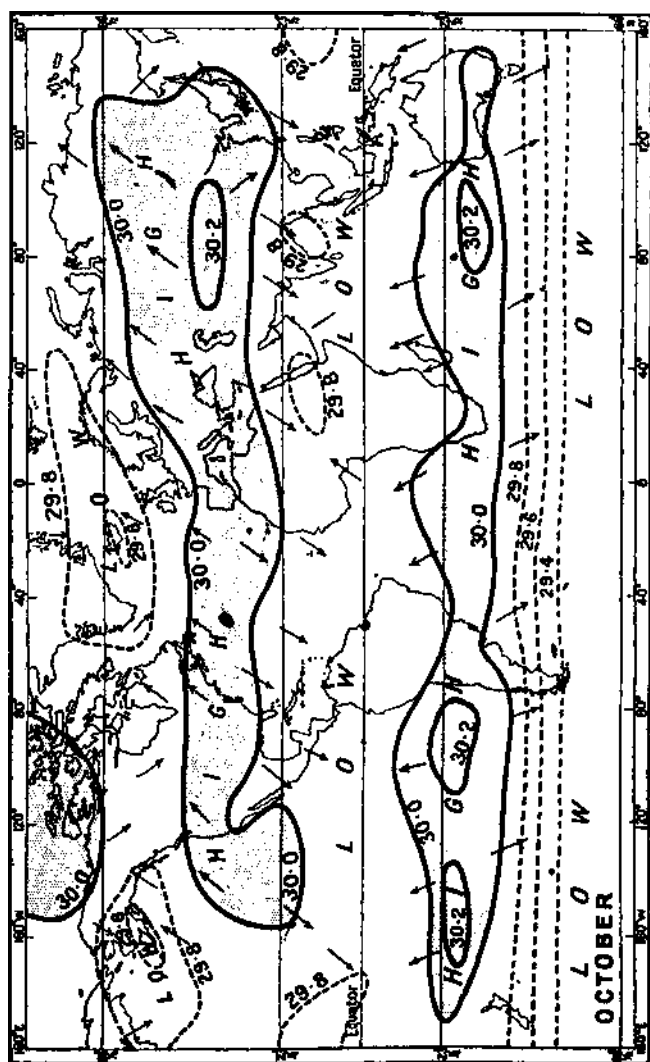


FIG. 14.—Isobars and winds for October. (After Buchan.)

36 THE PRESSURE OF THE ATMOSPHERE

the chief being for altitude and temperature. As all readings have been corrected to sea-level readings, it follows that the actual pressure over such a high plateau as Tibet is much less than these maps show. Temperature, too, has an important influence upon pressure, so that pressure maps are corrected to a standard reading at 32° F., but this correction is not nearly so large as that for altitude.

PRESSURE DISTRIBUTION IN OCTOBER.—Fig. 14 shows that at this month there is a marked low-pressure belt corresponding to the equatorial heat belt. The pressure increases until the latitudes 30° — 40° N. and S. are reached, and here we have belts of high pressure. In higher latitudes still, the pressure again diminishes. This distribution more nearly corresponds with that shown in the diagram Fig. 13, and this is due to the fact that October is very near to the equinox, when the sun is seen overhead at noon at the equator.

PRESSURE AND WINDS IN JANUARY.—We can see very clearly from Fig. 15 that in this month the equatorial low-pressure area has moved southwards. This is in accordance with the migration of the temperature belts. We can also see that the southern high-pressure belt, the Horse Latitudes, is not so continuous as in October, for there are distinct low-pressure areas over the land masses of South America, Africa and Australia. Remembering that January is the southern summer, this is easily accounted for by the unequal heating of land and water. In the northern hemisphere, the high-pressure belt is a very marked feature, especially over the land masses, where the pressure is the highest. This is best shown over Asia, where the area of high pressure is very large indeed. Over the North Atlantic and Pacific Oceans are well-defined low-pressure areas. The influence of land and water upon the pressure distribution just outlined should be obvious.

The arrows show the winds which will be found to blow from high to low pressure, and to be deflected according to Ferret's Law. Notice the continuous belt

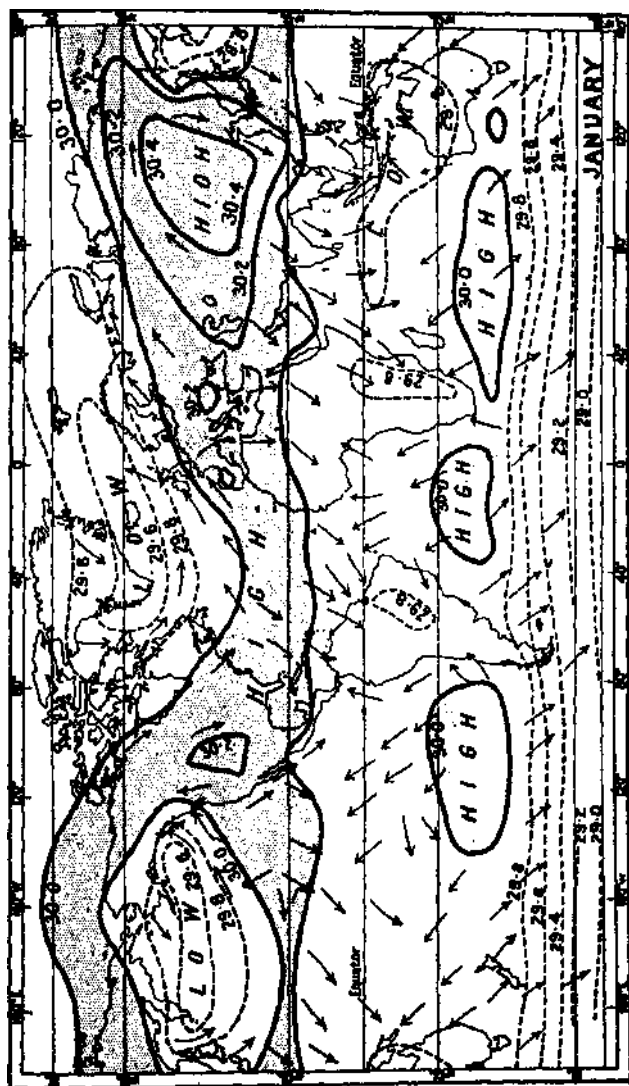


FIG. 15.—Isobars and winds for January. (After Buchan.)

38 THE PRESSURE OF THE ATMOSPHERE

of north-westerlies compared with the south-westerlies of the northern hemisphere. The latter tend to get into great swirls of air blowing spirally round the ocean centres of low pressure. One more point should be observed. In North-western Australia the ordinary S.E. Trades are not experienced at this season (southern summer). Owing to heat, a low-pressure system is formed, towards which air flows, thus giving a north-west monsoon.

PRESSURE AND WINDS IN JULY.—This is the winter month of the southern hemisphere, where we find the actual distribution of pressure closely corresponding to Fig. 13. The reason is, that in this hemisphere the disturbing factor of the temperature differences between land and sea is not so important as in the other hemisphere, because the land masses are not nearly so large. The Doldrums belt of low pressure and the southern Horse Latitudes high-pressure belt are clearly shown, but when we turn to the northern hemisphere Horse Latitudes, it is apparent that there is no continuous belt of high pressure at this season. Over the oceans are areas of high pressure, and over the continents areas of low pressure, that over Asia being very well marked. It will thus be seen that the distribution of pressure shown in Fig. 13 has to be modified in the case of Asia, owing to the enormous area of the land mass. In January, Asia has a system of high pressure, with out-flowing winds; in July, it is under the influence of a low-pressure system with inflowing winds. It is this great change in the distribution of pressure that gives to Asia, south-east of a line drawn from Karachi to Korea, a distinctive type of climate of alternating dry and wet seasons. The full consideration of this is reserved for another chapter, but one point must be mentioned. Fig. 16 shows that the S.W. wind which blows over India in July is simply the S.E. Trade Wind, which, having crossed the equator, is deflected to the right by the rotation of the earth, and proceeds towards India as a south-west wind. The term " Mon-

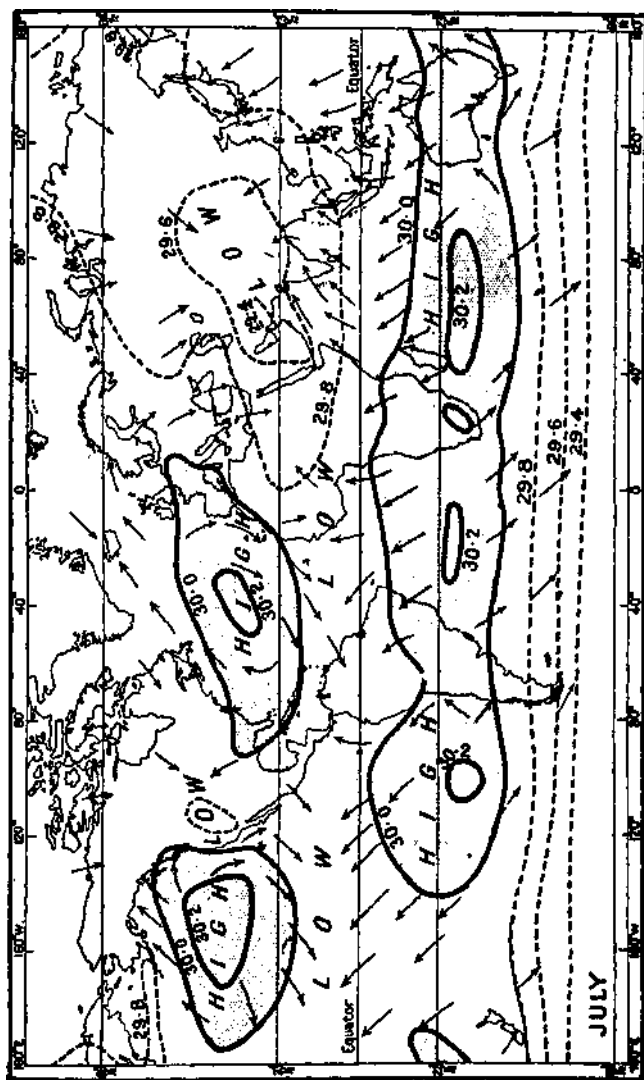


Fig. 16.—Isobars and winds for July. (After Buchan.)

40 THE PRESSURE OF THE ATMOSPHERE

soon" (= a seasonal wind) is given to the summer winds of S.E. Asia.

We have learned that in January there is a distinct southerly migration of the pressure belts, and if the pressure maps for October and July be compared, it will be apparent that in the latter month there is a similar migration northwards. This is exceedingly important, for there are certain latitudes which will be transition areas, *i.e.* will be in high-pressure belts at one season, and in low-pressure belts at another. In order to prevent exaggerated ideas concerning the amount of the migration you will do well to consult a set of monthly charts of the North Atlantic Ocean.

EXERCISES.

1. Draw an outline map of Western Europe. Mark the positions of the places shown in the first column of the Daily Weather Report. Beside each, mark neatly the reading of the barometer at 7 a.m. and draw the isobars at intervals of one-tenth of an inch. Compare your results with those on p. 3 of the Weather Report.

2. Make maps showing the distribution of pressure in the southern hemisphere for January and July. Show winds by arrows. Write an account of the distribution of pressure as shown in the map.

3. Make maps showing the distribution of pressure in the northern hemisphere for January and July. Show winds by arrows. Describe the distribution in writing, accounting for the differences noted between these maps and those for the southern hemisphere.

4. On an outline map of the world plot the probable course of a sailing vessel from London to Melbourne and home again. (The direction of the prevailing winds must be kept in mind in order to accomplish this exercise successfully.)

5. Explain very carefully:—high pressure, Roaring Forties, Horse Latitudes, Doldrums, Ferrers Law.

6. Draw a circle of $2\frac{1}{2}$ " radius. Mark the equator and the tropics. Shade or mark the polar high-pressure regions and the Horse Latitudes. By means of arrows, show the prevailing winds of the world.

7. What is a millibar? Why is air pressure now recorded in millibars in the Daily Weather Report?

8. What special precautions had to be taken by the Mt. Everest climbing parties in order to carry on their work at high altitudes? Why **were these** necessary?

CHAPTER V.

OCEAN CURRENTS.

FIG. 17 shows a small tank containing water. At one end a strainer containing ice is fixed, and at the other the lid of a small tin box is held in position by a piece of wire. A bunsen burner is fixed or held so that the flame heats the lid. The water in contact with the heated lid is raised in temperature and thus expands, whilst that in contact with the ice is chilled and contracts. This causes the cooled water to sink and the heated water to flow towards the ice. In this way a circulation of water is set up as indicated in Fig. 17 by the arrows.

Now let us apply this simple experiment to the waters of the ocean. The heated end of the tank may be compared with the surface waters of the ocean at the equator, and the cool end with polar waters. In polar regions water sinks to the bottom of the ocean on account of increasing density due to cold, whilst at the equator, where the heat of the sun warms the surface water, expansion takes place and water is set in motion polewards.

There is no doubt that there is a general equatorwards creep of cold water along the ocean bed, and a surface flow towards the poles; but this is not sufficient to account for the extensive movements which take place in the surface waters of the oceans. The chief cause of these must be looked for in another direction.

If, by means of a pair of bellows, air is blown upon the surface of a tank filled with water, the force of the air is quite sufficient to set up surface currents of water.

There can be little doubt that the prevailing winds are the chief factors in the production of ocean currents, for in regions where winds change with the seasons, the change of wind is accompanied by a change in the direction of the currents. This is very clearly shown in the North Indian Ocean. We have learned that at one time of the year (Nov.-April) the wind is from the north-east; at the other time (May-Oct.) it blows from the south-west. Fig. 18 shows the currents of the Indian Ocean, from which it will be seen that a change of wind

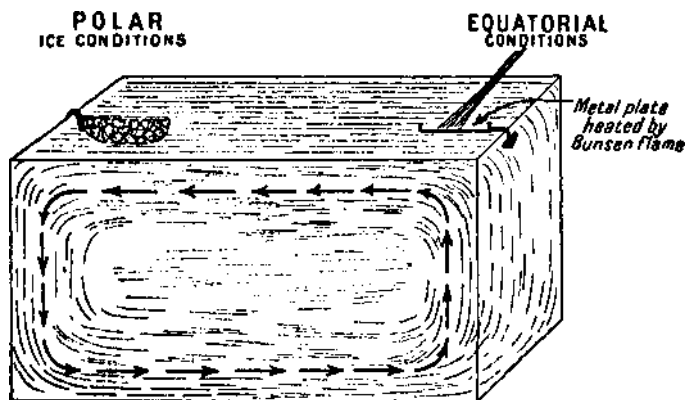


FIG. 17.—Diagrams showing currents caused by unequal temperatures.

is accompanied by a change in the direction of the ocean currents.

Let us at the outset notice two ways in which ocean currents may be classified. In the first place, we can distinguish between *relatively warm* and *relatively cold* currents, as is done in Fig. 18. A current will be relatively warm when it is flowing towards regions which are colder than those from which it has come, and, on the other hand, a current will be relatively cold when it is flowing towards warmer regions.

Ocean currents may also be classified as *stream* or *drift* currents. The former may be likened to broad

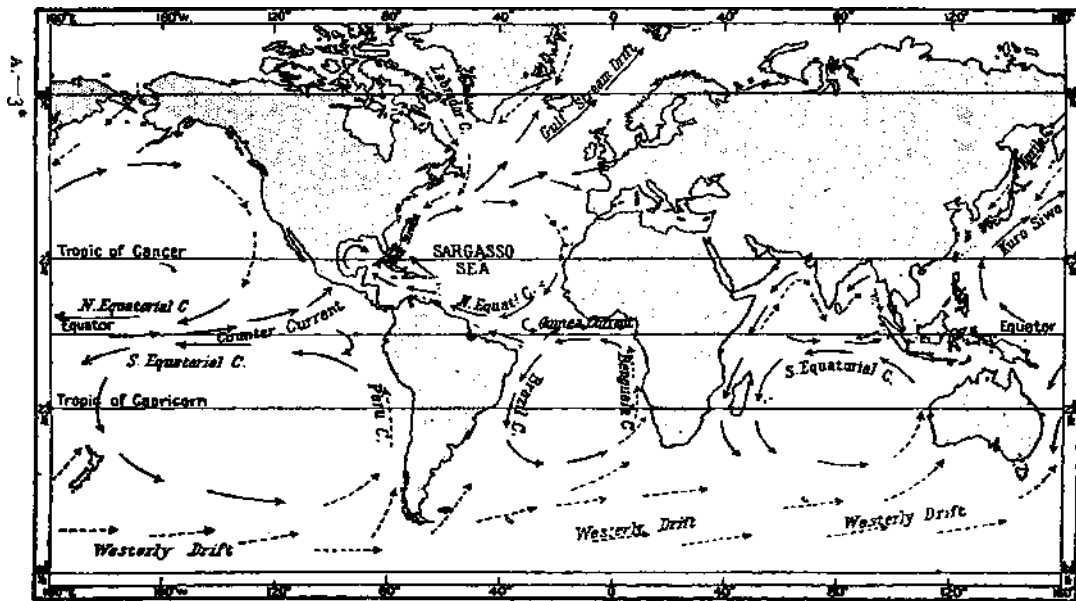


FIG. 18.—Ocean currents. The dotted arrows in the N. Indian Ocean show the currents during the S.W. Monsoon, the other arrows those during the season of the N.E. Trades. Elsewhere on the map the dotted arrows show relatively cold currents, the others relatively warm currents.

ocean rivers flowing between comparatively still waters. They flow faster than drift currents, and are caused by water which has been heaped up, seeking to find its own level. Drift currents move more slowly, and are simply a general drift of the surface water due to the force of the prevailing winds.

Keeping clearly in mind the prevailing winds, there should be no difficulty in understanding the direction of the chief ocean currents as given in Fig. 18. Let us consider the currents in the Atlantic Ocean. Off the north-west coast of Africa, in the region of the N.E. Trades, the surface waters are compelled by the winds to drift westwards until they are turned, partly by the shape of the mainland of North America, and partly, as in the case of winds, by the influence of deflection. A similar drift of waters is set up by the influence of the S.E. Trades, and the result is the South Equatorial Current, which is split into two by the wedge-shaped corner of South America, part of the waters flowing northwards to join those of the North Equatorial Current, and part passing along the shores of Brazil, from which country the branch is named the Brazilian Current. As all this water is blown across the Atlantic, it will be seen that the level of the sea off the American coast in these latitudes tends to be rather higher than on the corresponding African shores, and so it is.

But water cannot continue to be piled up, however steady and strong the winds may be. Some of it is bound to return, and it does so in the region of Doldrum Calms, which is between the North and South Equatorial Currents. This return, or counter-stream current, is known as the Guinea Current.

Now let us return to the North Equatorial Current, which is reinforced by a portion of its southern counterpart. Some of its waters pass through the Caribbean Sea and the Gulf of Mexico, and cause such a piling up of waters that a strong and steady stream current of water flows from the Gulf of Mexico between Cuba and Florida. This is the much misunderstood Gulf Stream.

This stream of warm water, which can be quite plainly distinguished from the surrounding waters, then flows along the south-eastern coast of the United States, although it is impossible that all the water in the stream has come from the Gulf of Mexico; some must have come from the current which did not enter the Caribbean Sea, but kept outside the West Indies. Soon after Cape Hatteras has been passed, the Gulf Stream spreads out its waters like an enormous fan, and it is no longer a stream flowing between comparatively still water, but a general drift of the warm surface waters of the ocean, blown by the westerlies towards the shores of Europe. The various branches of the Gulf Stream Drift, or North Atlantic Drift, are shown on Fig. 18, and it will be noticed that one branch returns to the north-west coast of Africa, thus completing a great clockwise motion of water, in the centre of which is the Sargasso Sea, where huge masses of floating seaweed, called sargassum, are sometimes very troublesome to ships. Fig. 18 shows that a great quantity of water from the North Atlantic is forced into the Arctic Ocean, where, as in the Gulf of Mexico, we have a piling up of waters. This cannot proceed indefinitely, and so we have return cold-stream currents re-entering the North Atlantic on either side of Greenland. These surface currents are in addition to the "cold creep" of water referred to in the beginning of this chapter. The Labrador current flows from amongst the islands of North America, past the coasts of Labrador, Newfoundland, Nova Scotia and New England, and finally sinks in the vicinity of Cape Hatteras, owing to its density being high in comparison with that of the warmer waters of those latitudes. The meeting of currents of air warmed by the Gulf Stream or its great drift, with air which has been cooled by the Labrador current, is the cause of the dense fogs which make Nova Scotia and Newfoundland the foggiest area in the world. These fogs are a source of great trouble to sailors.

Returning to the South Atlantic Ocean we find that, partly under the influence of deflection and partly **due**

to having reached the area of the westerly winds, the Brazilian Current passes across the ocean and proceeds equator wards up the coast of south-west Africa, where it is joined by the cold Antarctic Drift, a great drift of cold water blown by the westerly winds. As in the North Atlantic, there is in this part of the ocean a great circulation of water, moving in this case in a counter-clockwise direction, and having at its centre another Sargasso Sea.

The currents of the Pacific Ocean should now present no difficulty. There are equatorial drifts beginning in trade wind areas off the American coasts. Between them is the Counter Equatorial Current, which can be compared with the Guinea Current. The Kuro Siwo, or Black Stream of Japan, is the counterpart of the Gulf Stream; the north-western American coasts receive warm southern waters which may be compared with the North Atlantic Drift, whilst the counterpart of the Labrador Current is seen in the Kurile Current, which enters the North Pacific Ocean through the Bering Strait. Similarly, the currents of the South Pacific are comparable with those of the South Atlantic.

Reference has been made to the seasonal changes which occur in the North Indian Ocean, so that it is only necessary to add that in the southern portion of that ocean are currents in every essential respect similar to those of the South Atlantic and Pacific Ocean. Since the currents of the northern part of the ocean are not constant, the Counter Equatorial Current is uncertain and irregular, as may be expected.

OCEAN CURRENTS AND CLIMATE.

Finally, ocean currents have a very important influence upon climate. In Chapter III, we have seen how the warm water that is drifted past the western shores of Europe influences the climate of the western margin of that continent. This is very clearly shown in Fig. 19, for the direction taken by the January

isotherm of 32° F. is very considerably influenced by this factor. There is a striking difference between the winter temperature of the coast lands on opposite temperate shores of the North Atlantic.

Fig. 19 represents a land mass stretching from north to south temperate latitudes. The vast amount of water carried eastwards by the westerly winds causes a piling up of warm surface water on the western shores of temperate latitudes, whilst these waters tend to be blown away from eastern shores in the same latitudes,

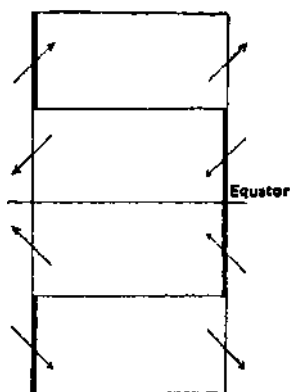


FIG. 19.—This diagram illustrates the piling up of waters by on-shore winds

and much lower temperatures are experienced. In trade-wind latitudes the conditions are reversed and the warm surface waters are piled up on the east coast and carried away from the west. A map showing the distribution of coral will show coral reefs, etc., on the eastern shores of tropical countries, but not on the west, for the tiny coral polyp cannot live unless the temperature of the water is always over 70° F. These warm conditions are not found on the western margins, where the colder water takes the place of the surface water drifted away from the coast by the prevailing winds.

EXERCISES.

1. Describe the courses which might be taken by a sealed bottle cast into the sea from a boat passing the Canary Islands.

2. How far is it true to say that the circulation of the surface waters of the North Atlantic Ocean is as if the water had been stirred in the direction of the hands of a clock, and in the South Atlantic in a direction opposite to those of the hands of a clock?

3. What effect have ocean currents upon the directions taken by the southern hemisphere isotherms of 68° F. (January and July)? See Figs. 10 and 11.

4. Explain what is meant by warm and cold currents, stream and drift currents. Give examples.

5. Draw a diagram to show the ocean currents of the North Atlantic Ocean. Show their connection with the prevailing winds.

CHAPTER VI.

RAINFALL: ITS CAUSES AND DISTRIBUTION.

EVAPORATION AND CONDENSATION.

AFTER rains a considerable quantity of water remains on the surface of the ground in small pools, but quickly disappears. Wet clothes are hung out and are taken down quite dry. In both of these instances the water has disappeared into the atmosphere in the form of water vapour which we cannot see—that is, it has evaporated. On the surface of the earth are oceans, lakes, rivers, etc., exposed to the atmosphere, and from all these water is constantly being evaporated and received into the atmosphere. If a mass of air which contains water vapour is cooled, some of the vapour may condense into very tiny drops of water which are not too heavy to be held in the air. It is in this way that mists, fogs and clouds are produced. Should the condensation proceed further, the tiny drops of water run together and form a raindrop that is too heavy for the air to carry in suspension, and rain results. Of course, only a portion of the rain which falls on the land is directly evaporated into the air; much finds its way into rivers, and is carried off to the oceans, whilst some remains in the soil and is used by plants and animals. It is interesting to think of the great oceans as the chief places where evaporation is taking place; that this water-laden air is carried by means of winds towards the lands, where it is forced to rise—perhaps on meeting mountains—and is therefore cooled, and a fall of rain occurs. The rainwater is carried off to the oceans

largely by rivers, and thus the cycle is going on throughout the centuries.

It is very important to notice that warm air can hold much more water vapour than cold air, as the following figures show—

Temperature.	Maximum amount of water vapour which can be held by a cubic metre of air.
— 10° C	2.28 grammes
0°	487 „
+ 10°	936 »
20°	17.1 „
30°	3008 „
40°	50.67 „

This table shows that the maximum amount of water vapour which can be held by a cubic metre of air at a temperature of — 10° C. is 2.28 grammes, whilst the same volume at 10° C. can hold 9.36 grammes. It will be observed that the amount of water vapour held at different temperatures increases very considerably with increase of temperature. Saturated air, or air at a certain temperature, containing the maximum amount of water vapour for that temperature, can be made to hold more by being warmed, but if it be cooled, some of the vapour will condense. The temperature to which air must be cooled in order that some water vapour may be condensed, is called its *dew-point*. Another glance at the table will show that if saturated masses of air at different temperatures, say 10° C. and 30° C, are cooled, there will be much greater precipitation in the case of the warm air than in the case of the cooler air. This has a great deal to do with the heavy rainfall in equatorial latitudes.

There are innumerable particles of dust in the atmosphere, and these appear to play a very important part in assisting condensation, for when water vapour is condensed, it is upon a nucleus of a dust particle that the tiny water drops grow.

How RAINFALL IS MEASURED.

Rainfall is measured by means of a rain-gauge. In essence, this consists of a funnel which catches the rain and leads it into some kind of vessel. If the vessel is cylindrical and the area of its opening is the same as that of the opening of the funnel, the depth of water in it represents the amount of rain which has fallen in that area. In order to measure accurately small amounts of rainfall, it is necessary to have a specially graduated measuring glass whose diameter is less than that of the funnel. If the area of the mouth of the funnel is 15 square inches, it is obvious that 15 cubic inches of water will be necessary to cover that area to a depth of one inch. Therefore, if 15 cubic inches of water are carefully measured and poured into a measuring glass, the height of the column of water will represent a fall of one inch upon the area of the funnel's opening. The measuring glass can then be graduated so as to read such small amounts of rainfall as one-hundredth of an inch.

To get correct results, it is very necessary to place the rain-gauge in a suitable position, in order that all the rain which falls may be registered. It should be placed about twice as far from the nearest building as the latter is high, and raised from the ground about one foot. The latter precaution prevents water splashing upwards from entering the funnel.

Of course, all condensed water vapour does not fall in the form of rain. Falls of snow and hail are common. The former requires very careful measuring, for the funnel of the gauge may be filled before the snow ceases to fall. Snow has to be melted before the amount can be read in rainfall equivalents. About ten inches of untouched snow yields one inch of rainfall.

THE CAUSES OF RAINFALL.

Rain is the result of the cooling of air containing water vapour. The cooling may be accomplished in several ways:—

(i) Air moving from warm to cooler latitudes will not be able to hold as great a quantity of water vapour, and there will be a tendency to precipitation. The best examples are the Westerlies, which blow towards colder latitudes.

(2) The cooling of air due to a forced ascent on meeting a mountain barrier. Rains caused by this means are spoken of as *relief* rains. Fig. 20 shows a moisture-laden wind approaching a mountain chain. It is compelled to rise and this causes the air to expand. Expansion causes a lowering in temperature and this produces rain. When the temperature falls to freezing point, snow will fall instead of rain. On reaching the leeward side of the mountains, the air begins to descend and consequently to increase in density and in temperature, and therefore

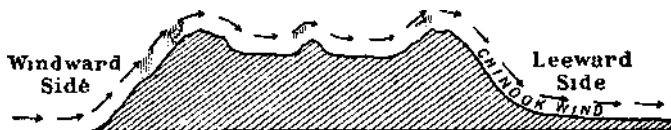


FIG. 20.—Chinook or Fohn wind.

in its capacity for holding water vapour. The increase in temperature is greater than that which was lost in ascending the windward slopes, so that the wind reaches the foot of the mountains on the leeward side a warm, dry wind. The names *Chinook* and *Fohn* have been given to such a wind. The former name applies particularly to the winds descending the leeward slopes of the Canadian Rockies, and the latter to the warm winds experienced in Swiss valleys, but the principle holds good in all particular cases, and therefore we may think of all such winds as Chinook or Fohn winds (see Ex. 1, at the end of the chapter).

There is a very close connection between the relief and rainfall maps of most countries, especially of those

in temperate latitudes. An examination of the two maps for the British Isles will show how close these relationships are in our own islands.

(3) The movement of air in cyclones causes expansion and therefore cooling and condensation. A cyclone is a pressure system in which the lowest pressure is in the centre from which the pressure rises towards the edges. In such a system the winds blow towards the centre and are deflected according to Ferrel's Law, so that, in the northern hemisphere, the whole system is rotating about its centre in a direction opposite to that of the hands of the clock. The centre of the cyclone remains an area of low pressure because the air which flows towards it is constantly rising and expanding. It is on account of this rising of air that cyclones are accompanied by falling rain. Cyclones are commonly experienced in the area of the westerly winds, and it is by their means that much of the rain that falls in these latitudes is brought.

(4) The meeting of air currents causes air to rise and expand, and therefore causes rainfall. This cause of rainfall is very similar to that which has just been considered. In the Doldrums belt, the N.E. and S.E. Trades meet, and air being forced upwards on a very large scale causes this region to be one of very heavy rainfall.

THE CAUSES OF DROUGHT.

Since any cause which can force large masses of air to be cooled will produce rainfall, any cause whereby air is warmed will tend to produce drought. It will not be necessary to go into these causes at length, for they are the opposite of those which produce rain. They are—

(1) Air flowing steadily from warm latitudes towards regions warmer still will increase its capacity for holding water vapour and condensation will not usually occur, unless by some means the air is suddenly cooled. The best examples of such air currents are the Trade Winds, and it is very striking that all the great deserts of the world are in trade-wind latitudes.

(2) There will be dry areas on the leeward side of most high mountain ranges.

(3) Anticyclones, usually masses of almost inert air, are systems of pressure, having the highest pressure in the centre and the lowest pressure towards the edges, and are fed by air descending from the upper atmosphere. They bring little or no rainfall.

(4) The Horse Latitudes are areas in which there is a descending of air, and they, too, are marked by drought.

THE DISTRIBUTION OF RAINFALL.

Figs. 21, 23 and 24 show respectively the annual, January and July distribution of rainfall over the surface of the globe. In studying these maps, constant reference must be made to the pressure and wind maps, and to the physical maps in an atlas.

MEAN ANNUAL RAINFALL.

A very general connection between Figs. 14 and 21 is evident. The belts of low pressure are areas of considerable rainfall, whilst the high-pressure belts are deficient in rain. This is illustrated in Fig. 22. The equatorial low-pressure area, the Doldrums, is one of heavy rainfall; the trade-wind areas contain most of the great deserts of the world, and in the low-pressure belts between the Horse Latitudes and the polar high-pressure areas there are other regions of considerable rainfall. Naturally, this requires to be considerably modified, for the actual distribution of pressure, as we saw in the last chapter, is not so regular as is shown in a diagrammatic manner in Fig. 22. Nevertheless, it is important to notice that there is a very close relationship between pressure and rainfall.

Fig. 21 is shaded to show areas which may be described as being well watered (over 25 ins.), moderately watered, or as having a deficient supply of rain. If this map is studied in connection with a relief map, and the dis-

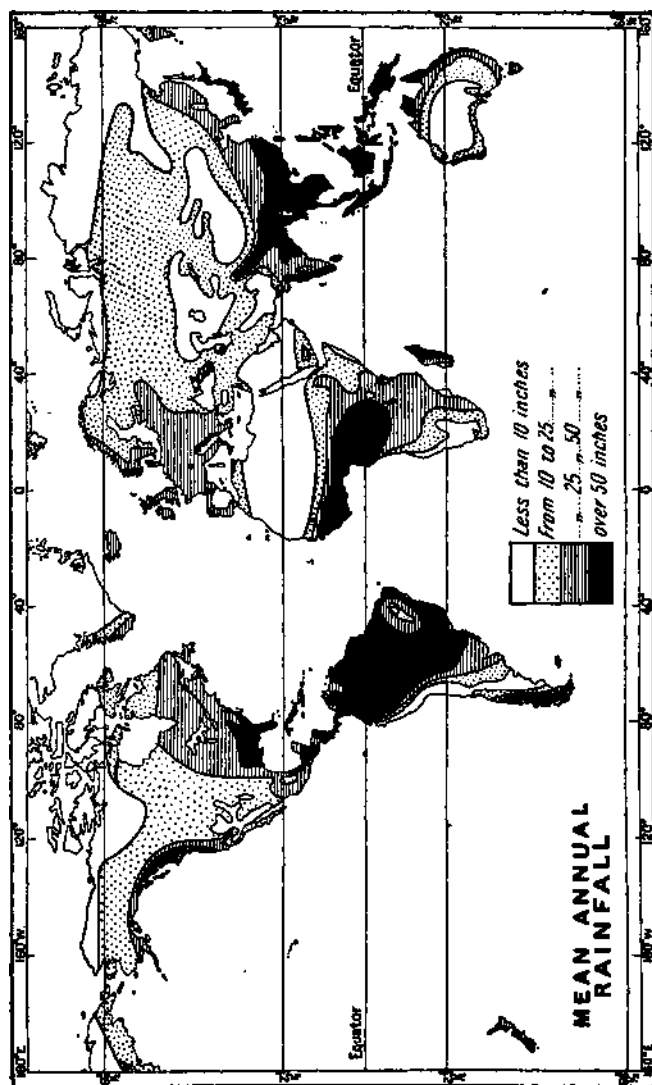


FIG. 21.—The mean annual distribution of rainfall.

tribution of pressure and the direction of the prevailing winds are kept in mind, Ex. 2 at the end of this chapter will serve as a test as to whether the principles which have been explained have been grasped or not.

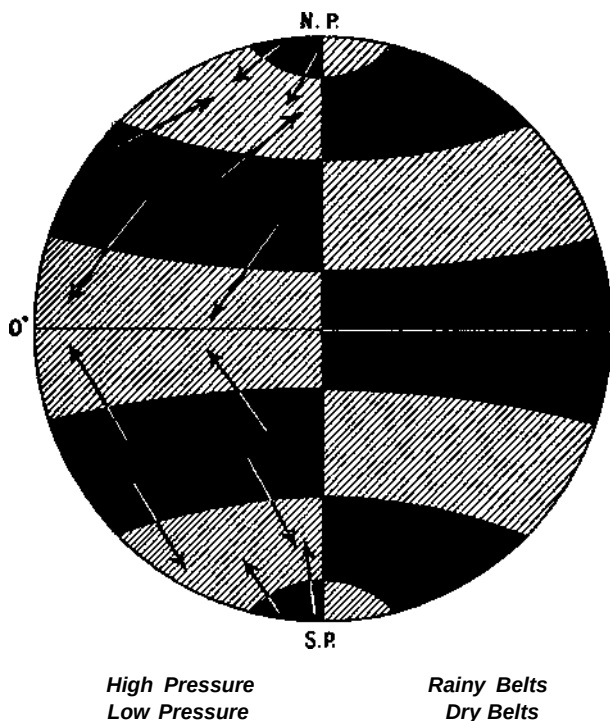


FIG. 22.—The relations between pressure and rainfall

DISTRIBUTION OF RAINFALL IN JANUARY AND JULY.

In January, the typical summer month of the southern hemisphere, the belt of greatest heat is south of the equator (Fig. 10). It is in January that the pressure

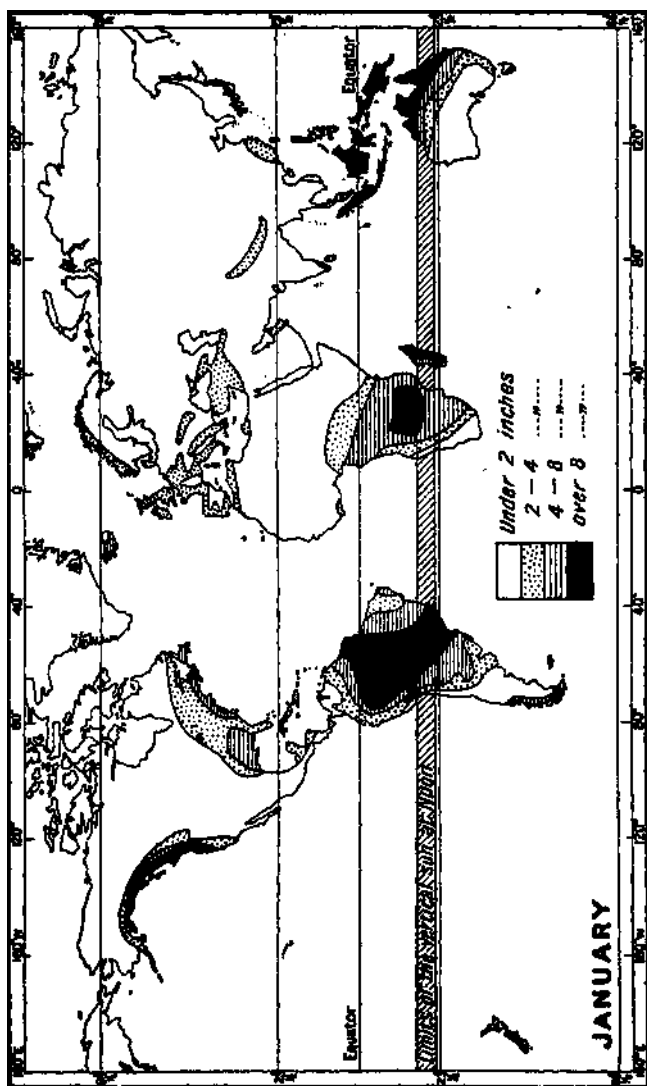
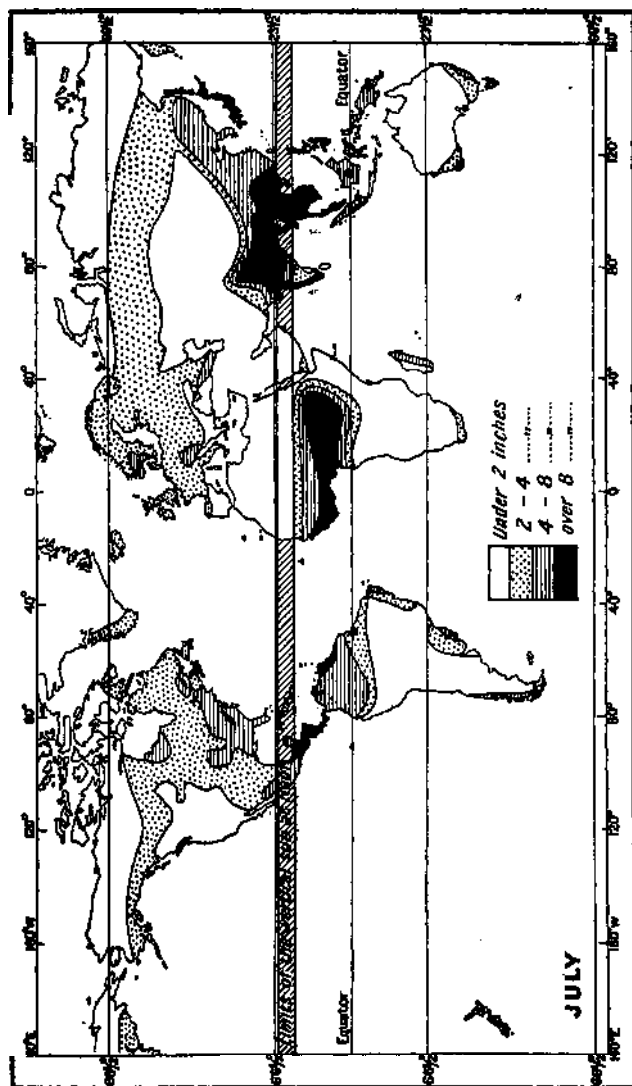


FIG. 23.—Mean rainfall for January. (After Herbertson.)

belts reach the southern limits of their migration. For these reasons, the regions of heaviest rainfall are all south of the equator in this month (Fig. 23). In July, the areas of heaviest rainfall are north of the equator, and this is due to the northerly migration of the temperature and pressure belts, a movement caused by the apparent migration of the sun (Fig. 24). These seasonal changes produce interesting results, as will be seen from an examination of Fig. 25. In the first column the approximate position of the high and low pressure belts is given for July, the month in which they are at their northern limit of migration. The second column gives the position of the various belts in the southern summer. It is at once clear that in the equatorial regions is an area which has low pressure all the year round. North and south of these are belts having low pressure in summer and high pressure in winter; these are succeeded by belts which have high pressure at all seasons. North and south of the latter are belts of low pressure at all seasons. Since areas of high pressure have little rainfall, it follows that certain of these belts will be wet at one season and dry at another, but it must be carefully observed that Fig. 25 only applies to the western margins of continents, for a wind which is there on-shore, *i.e.* blows from the sea to the land, will be an off-shore wind on the eastern lands in similar latitudes.

Let us apply Fig. 25 to the western coasts of Europe and Africa. From the north of Norway to the north of Spain is an area of rain all the year round, for the Westerlies are at all seasons the prevailing winds. From the Cantabrian Mountains to the Atlas Mountains is an area of winter rainfall and dry summers. This is succeeded by a belt of very little rainfall, and it is here that the Sahara Desert reaches the west coast of Africa. South of this is an area of summer rainfall, the Gambia and Senegal rivers having their mouths in this belt. The Guinea Coast and the Congo Basin receive rain at all seasons. South of the equator, the belts are repeated in reverse order, although there is



no counterpart of the West European type, for Africa

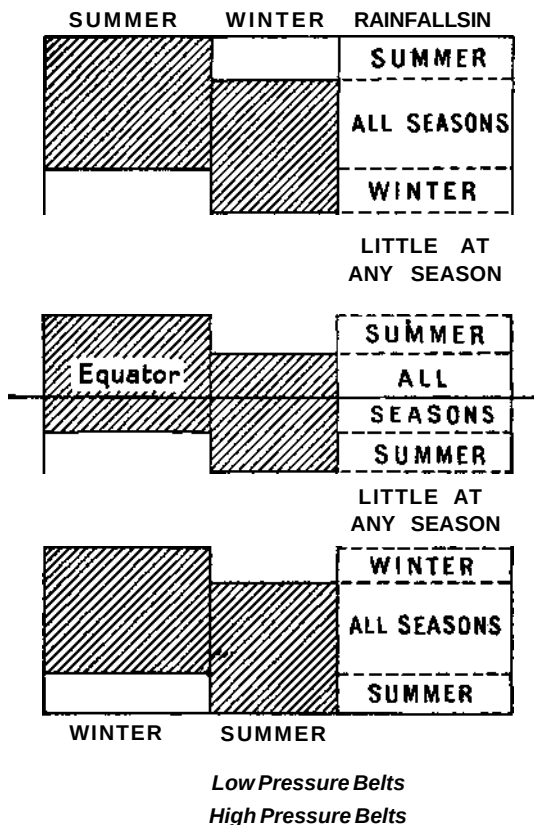


FIG. 25.—The influence of the migration of the pressure belts on the distribution of rain on the western margins on continents.

does not extend far enough south to have a belt in the prevailing north-westerly winds all the year round.

If we consider Figs. 23 and 24 together, it will be evident that some regions receive rain in winter and are dry in summer. They are on the west of continents and in the same latitudes as the two African winter rain areas which we have just considered. They are the lands bordering the Mediterranean Sea, the Valley of California, Central Chile, the south-west corner of Africa, the two southern protuberances of Australia and the north island of New Zealand. The winter rains and dry summers of all these lands are due to the migration of the pressure belts.

If we turn to Asia, we see a very striking contrast between the rainfall for January and that for July. In January, owing to this continent being under the influence of a huge high-pressure system (see Fig. 15), there are outflowing winds, and since these are dry, very little rain falls in this month except on the north-east coastlands, western Japan, in the Mediterranean lands to the east of the Mediterranean Sea, and on the Himalayas. In July, when a low-pressure system holds sway (see Fig. 16), there are inflowing winds, and since these have come over vast expanses of ocean, very great precipitation takes place, most of the continent, excepting the centre and the south-west, having a considerable amount of rain. The same causes in Australia give heavy rainfall in the southern summer to the northern margins. The winds which bring the heavy summer rain in south-east Asia and northern Australia are, as we have already learned, called monsoons.

Other lands of summer rainfall we should expect to find in the same positions as the African belts of summer rain, to which reference has already been made. In America we find that the north of South America, Central America, Mexico and the West Indies receive their rain mainly in summer; south of the Amazonian region of rain at all seasons is the Brazilian highland region of summer rain.

Owing to their great distance from the sea, we also

find that the interior lands of the great continents receive rain in summer, when they are under the influence of low pressure; but as they are far from the sea, such places have only a moderate rainfall.

EXERCISES.

1. Why is it that—

- (a) Sweden is drier than Norway?
- (b) The east of the South Island of New Zealand is drier than the west?
- (c) The northern Andes have heavy rainfall on their eastern slopes and an almost rainless area on their western slopes, and that these conditions are reversed in the southern Andes?

2. Write a short account of the mean annual distribution of rainfall as shown in Fig. 21. Give reasons for heavy rainfall in equatorial latitudes, the presence of rainless areas in the trade-wind regions, the heavy rainfall of the western margins in temperate latitudes, and the slight rainfall in the interior of the great land masses.

3. What is meant by saying that the mean annual rainfall of London is 25 inches? How has this figure been obtained?

4. Explain clearly why it is that the rain belts migrate northwards in our summer and southwards in the southern summer. What are the principal results of this migration?

5. On p. 50 figures are given showing the amount of water vapour which air at different temperatures can hold. Represent these figures graphically and write a summary of the important facts illustrated by the graph.

6. Describe a coastal region of deficient rainfall. Account for its aridity.

CHAPTER VII.

THE DISTRIBUTION OF NATURAL VEGETATION.

THE land surface of the earth is covered naturally with plants, except in those regions where it is either too high, too cold or too dry for any vegetation to exist. Generally speaking, regions of heavy nunjfallare forested, regions of light-rainfall are grasslands, and~those which lack moisture are deserts. The type of forest, grassland or desert will depend largely upon the temperature, so that there are tropical and temperate forests and grasslands, and tropical, temperate and cold deserts.

., Soil has an important influence upon-vegetetion,for some plants thrive best upon particular soils, as, for example, the beech thrives on a soil rich in lime. For most plants the presence of salt is fatal, but the mangrove and the coconut palm appear to like its presence. Different soils vary very much in their capacity for holding moisture, whilst plants differ in their capacities for extracting moisture from different soils. Some soils, again, are naturally very in fertile owing to the character of the rocks from which they havel been formed.

Fig. 26 shows the general distribution of natural vegetation, but it must not be supposed that the boundaries between the various types can be defined very clearly, for there is a gradual merging of one type into another. Deserts gradually become grasslands through an intermediate scrubland which is notable for its scattered grass patches and low, dry bushes. Grasslands merge into forests very gradually, for between areas which are typical forests and those which are typical grasslands, the scenery first resembles natural parkland—

a mixture of grasslands and woodlands—and very gradually becomes more wooded as the true forests are approached.

In studying Fig. 26 it is very important that constant reference should be made to the temperature and rainfall maps in Chapters III and VI, so that the connections between temperature, rainfall and natural vegetation may be clearly understood.

HOT WET FORESTS.

Forests of this type are found in (i) the hot wet equatorial belt; (ii) in lands having so much rain in their wet season that the soil holds a considerable amount of moisture all the year round. The former are sometimes called equatorial forests, and the latter monsoon rain forests. Equatorial forests are found chiefly in the Amazon basin and on the wet east coastlands in South America; on the Guinea coast, and in the Congo basin in Africa; and in the Malay Peninsula and the East Indies. In these forests the vegetation is exceedingly dense, even the undergrowth attaining forest dimensions, whilst the giant trees are linked together by a mass of creepers and parasitic vegetation. The floor of the forest is gloomy in the extreme, and its inhabitants are amongst the most backward races in the world. So solid are these forests that the rivers, which at the rainy seasons resemble long, narrow lakes, are the only easy ways of communication. The various trees which yield rubber are the most important trees, although there are valuable cabinet and dye woods, such as mahogany, ebony, logwood, etc., but the present difficulty of access is so great that these sources of wealth are practically untouched. Guttapercha trees are of great importance in the East Indies, and oil palms in the equatorial forests of Africa.

The forests of S.E. Asia and North Australia are not so dense, as here there is a well-marked dry season.

THE HOT GRASSLANDS OR SAVANNAHS.

Savannahs, or parklands, are grasslands interrupted by isolated patches of trees. They are found in tropical latitudes, in regions which have warm, dry winters and hot summers, with a small rainfall in summer. Fig. 26 shows that their distribution is closely related to the summer rainfall belts north and south of the equatorial belt of rain at all seasons. As the summer rainfall is not heavy, trees cannot grow excepting in places where there is a constant supply of water, *e.g.* near rivers, for the rainfall is not sufficient to keep the soil moist at all seasons. The climatic conditions are suitable for the growth of grass which springs up, produces flowers and seeds, and dies in a short time. As we should expect, one of the chief occupations on the savannahs is cattle rearing. The temperature is unsuitable for sheep.

In South America there are extensive savannahs north of the equator in the Guinea highlands and the llanos of the Orinoco Valley, and south of the equator in the Brazilian highlands. In Africa they are found north, east and south of the equatorial forests, and in a very similar position in Australia. Asiatic regions in these latitudes receive so much summer rain that, as we have already seen, they are forested.

THE HOT DESERTS.

The savannahs gradually merge, through intermediate scrublands, into deserts. The hot deserts lie chiefly on the west of continents in the latitudes of the Trade Winds. In North Africa there is the enormous Sahara desert stretching from the Atlantic Ocean to the Red Sea, and continued eastwards in Asia by the deserts of Arabia and Thar. South Africa has the Kalahari desert. In similar latitudes in South America are the long, narrow, west coast deserts of northern Chile and Peru. They lie to the lee of the Andes. In North America we have the Colorado desert, and in Australia the great western desert. There are also the extensive desert lands on

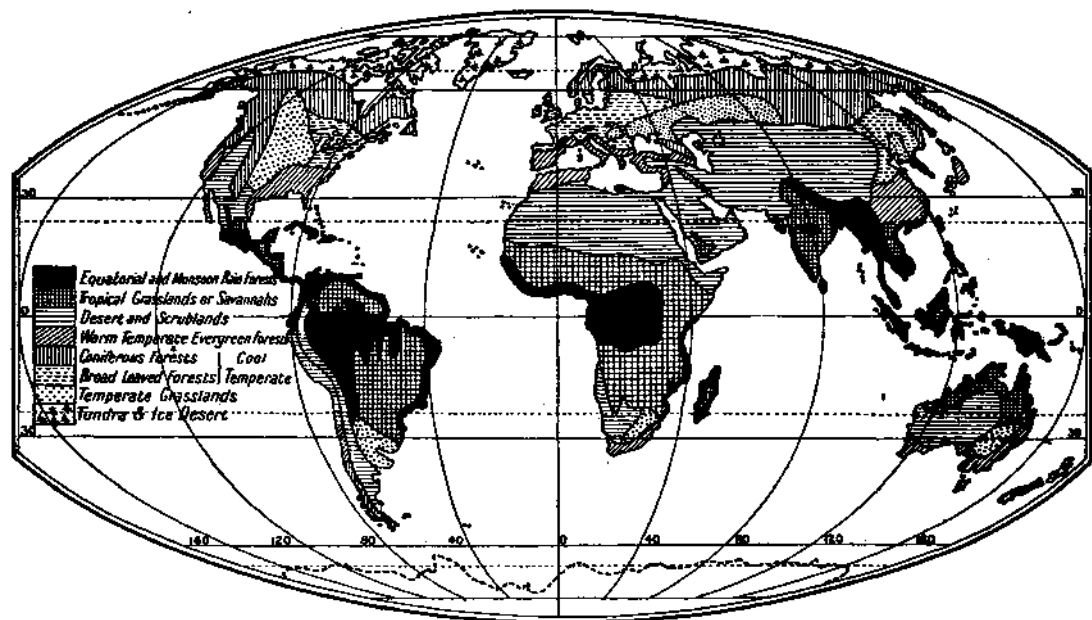


FIG. 26.—The distribution of natural vegetation.

high plateaux and in the interior of the great Asiatic land mass. Examples of these plateaux and interior desert and semi-desert lands are found in the western cordillera of North America, in the plateau of Iran, and in the deserts of Turan and Gobi.

Except where there are underground supplies of water, there are very few plants on deserts. Desert plants must either have very long roots, so that they can reach this underground water, or thick, fleshy leaves to store up water. The leaves, which are designed to resist the evaporation of moisture from the plant, are often very small and protected by means of thorns. On the scrub edges of the desert, trees which exude gum in the dry season are often met with. The acacia is a good example.

Even in the desert, wherever there is a permanent supply of water from wells or from rivers which flow across deserts but rise in wet lands, cultivation can take place, while by means of irrigation, many arid lands have been reclaimed, especially in North Africa, North America and Australia.

TEMPERATE FORESTS.

These are of two varieties: (1) *warm temperate*, which are found roughly from latitude 30° to latitude 45° , and (2) *cool temperate*, from latitude 45° to latitude 60° .

(1) WARM TEMPERATE FORESTS.—Fig. 26 shows that these are found on both east and west sides of continents. The rainfall maps show that whilst the western regions receive most of their rain in winter, the eastern regions have summer rainfall. This will naturally have its influence upon the vegetation. Whether on the east or the west, these forests are evergreen; but in the eastern forests the leaves are usually very large and thick, as, for example, the leaves of camellias and magnolias, whilst the trees in the various "Mediterranean" regions of winter rainfall

have usually either small, dry leaves, as, for example, the olive, or leathery leaves like those of the laurel.

Forests of the western or Mediterranean type are found in the lands of winter rains bordering the Mediterranean Sea; in California, Central Chile, south-west Africa, south-west and south-east Australia, and in the north island of New Zealand. The chief trees are evergreen oaks, including the cork oak, walnut, chestnut, and some species of pine. In most of these regions, vines, olives and mulberries are cultivated. In Australia the chief trees are the acacia and the eucalyptus, each of which has its leaves hanging edgewise, so that little shade from the sun's heat is given.

(2) COOL TEMPERATE FORESTS.—As in the case of the warm temperate forests, the cool temperate forests may be divided into two groups: the coniferous and deciduous forests. The former are found where the winters are severe, the summers short and the rainfall inclined to be deficient, whilst the deciduous or broad-leaved forests are found in regions where the temperature conditions are more genial and the rainfall is fairly abundant.

(a) *Coniferous Forests*.—The chief conifers are pines, hemlocks, firs and larches, but the hardy birch, which is deciduous, is a common tree in coniferous forests. The leaves of most of these trees are needle-like in structure, and thus transpiration is checked, for little surface is exposed. As a general rule, these trees retain their leaves during the long winter, which is not with all species a resting season, for the summer is so short that the comparatively warm periods at the beginning and end of winter are taken advantage of.

The most extensive coniferous forests are found in northern Europe, Asia and America. They give shelter to large numbers of fur-bearing animals, and thus trapping is usually the first occupation carried on. Later come the lumber-men, who cut down the trees, which are used for many different purposes, such as doors, window-frames, flooring, etc., whilst they also

yield turpentine, pitch, resin and wood pulp. In deforested areas where the climatic conditions are suitable, agriculture is carried on. Some regions have undergone all these stages of development, whilst some, as, for example, the forests of eastern and northern Siberia, are still in the trapping and hunting stage.

Coniferous forests are sometimes found in regions of more genial climates than those of the ordinary forests of this type. Under these conditions, the trees often attain gigantic dimensions, as on the west coast of North America, where the famous Douglas firs and giant pines are found.

(b) *The Broad-leaved Forests.*—The chief trees in these forests are the oak, beech, elm and maple. In autumn the leaves fall, and thus transpiration is checked. The flowers are not very prominent, and most of them are wind fertilized. In this respect these forests offer a marked contrast to those of hot lands, where the trees have brilliantly coloured flowers. The distribution of broad-leaved forests is shown in Fig. 26, and their positions as compared with those of the coniferous forests should be noticed. From the greater part of Western Europe and eastern North America the natural deciduous forests have disappeared, and in their place we find agricultural and industrial regions.

TEMPERATE GRASSLANDS.

These, known in particular places as prairies, pampas or steppes, are found in regions having very warm summers and cold winters, with a moderate to slight rainfall in summer. Fig. 26 shows that these regions are usually in the interior of great land masses, for it is there that these climatic conditions are met with. The rainfall is not sufficient to keep the soil moist at all seasons, so that trees are found only near rivers. It should be noted, however, that in some places there are other reasons, *e.g.* strong winds or porous soil, why trees do not grow. The prevailing vegetation everywhere is grass, so that these

NATURAL VEGETATION

regions are noted pasture lands, whilst in those parts where the rainfall is sufficient, large tracts are used for the growth of cereals. Most of the wheat of the world is now grown in areas which were once natural grasslands.

The seasonal changes, the green of late spring and early summer, the brown of late summer and autumn, the snowy mantle of winter, and the carpet of bulbous flowers in early spring, form a most enchanting cycle of changes.

THE TUNDRA AND ICE-DESERTS.

The poleward limit of coniferous forests is approximately the July isotherm of 50° F., for unless that temperature is attained during at least one month, trees cannot thrive. North of that line is the tundra, which is really a cold desert whose total precipitation is less than 10" per year. In the long winter the ground is snow-covered, but during the short, warm summers the lowlands often assume a meadow-like appearance, bright with numerous flowers. They are not merely lands where only stunted berry-bearing bushes, mosses and lichens grow. There are no tundra lands in the southern hemisphere.

Towards the poles are wildernesses of ice and snow which are practically devoid of life. Such lands are found in Greenland, in many of the islands to the north of Canada and Asia, and in the Antarctic continent.

THE INFLUENCE OF ALTITUDE UPON VEGETATION.

We have seen that latitude has a great influence upon vegetation; the equatorial forests are very different from the temperate forests and the hot deserts from the tundra. Altitude, too, has a great influence. Many mountains in equatorial latitudes are snow-capped all the year round. The dense equatorial forests at the bases of these high mountains, e.g. Ruwenzori in Central Africa, give way very gradually to evergreen, warm temperate, broad-leaved coniferous forests. Above

these levels the trees become scattered and dwarfed, and there are parts which are snow-covered in winter, but the melting of the snow in spring provides moisture for the growth of grass and many kinds of beautifully coloured flowering plants. Still higher than these meadow-like lands are areas resembling the tundra, whilst beyond that the snow lies on the ground all the year round. Thus, in ascending a high mountain situated close to the equator, somewhat the same changes in vegetation are experienced as in a journey from the equator to the polar regions, such is the great effect of altitude upon vegetation (see Fig. 41).

On the high dry plateaux, *e.g.* Tibet and Bolivia, there are extensive areas with a semi-desert type of vegetation, consisting chiefly of coarse grasses and scattered patches of bush.

EXERCISES.

1. Explain why it is that the vegetation belts on the west of continents differ from those on the east.
2. State and account for the distribution of Equatorial forests.
3. Examine the different types of natural vegetation found in your home district.
4. What are the climatic reasons for the distribution of the great deserts of the world?
5. What are the chief types of natural vegetation that would be encountered in a journey (*a*) from the White Sea to the Caspian Sea, (*b*) from the mouth of the Nile to Lake Victoria, (*c*) across Canada by the Canadian Pacific Railway? Account for the differences you mention.
6. Give examples of the connections between the natural vegetation and the chief occupations of a region.
7. Obtain pictures of each type of vegetation and fix them in your note-book, along with your notes.

CHAPTER VIII.

ASIA: PHYSICAL FEATURES.

IN previous chapters we have been considering the outlines of the world distribution of temperature, pressure, winds, ocean currents, rainfall, and natural vegetation, and we have shown the relations which exist between these various factors. We shall now turn our attention to the continent of Asia; and, whilst studying it, we shall pay particular attention to the principles which we have learned and apply them in more detail, although, of course, it is necessary that our study should have a wider outlook than merely the study of questions involving climate and natural vegetation.

THE POSITION AND SIZE OF ASIA.

If we examined a globe, we should see that Asia lies to the east of Europe and North Africa, and that the whole of the mainland is north of the equator. Its most northerly point, Cape Chelyuskin, is within 13° of the North Pole, and its most southerly, Cape Romania, is only 1° north of the equator. The distance "Between these capes is over 5,000 miles, whilst in an east and west direction the continent extends for an even greater distance. Asia is thus an enormous land mass. It is the greatest of all the continents, being four and a half times the size of Europe, and containing within its frontiers about one-third of the total land surfaces of the world. In shape, Asia is a rough quadrilateral, with three very large southern peninsulas, Arabia,

PHYSICAL FEATURES AND STRUCTURE 73

India, and Indo-China. On the east coast are the smaller peninsulas of Kamchatka and Korea, and on the west the plateau peninsula of Asia Minor.

PHYSICAL FEATURES AND STRUCTURE.¹

A physical map of Asia shows a great belt of highlands stretching across the continent from west to east. In Asia Minor this belt is fairly wide. It widens out in the plateau of Iran, but in the Pamir Plateau, to the north-west of India, it is very narrow. From this point it rapidly widens, until in the east it occupies an area stretching through almost the whole breadth of the continent. North of this high belt are vast plains stretching to the Arctic Ocean, into which they are drained, except in the west, where the lowest parts of the plains are occupied by the salt Caspian and Aral seas. In the south of Asia there is the deeply trenched plateau of South India, the Deccan, which is an old block so tilted that it presents in the west a steep face to the Arabian Sea, and gradually slopes eastwards to the Bay of Bengal. The Deccan is separated from the central belt of highlands by the plains of the Ganges and the Indus. In the south-west there is the Arabian plateau, tilted in the same manner as the Deccan, and separated from the central highlands by the Persian Gulf and the plains of the Tigris and Euphrates. In the east are many broad plains, drained by great rivers. The chief are those of the Amur, Hwang-ho, Yangtse-kiang, and Si-kiang. Lastly, we have the archipelago of the East Indies, and the eastern festoon of mountainous islands stretching from the peninsula of Kamchatka, through the Kurile Islands, Japan, and Formosa to the Philippines.

From this brief account, it will be seen that Asia may be divided into four physical units—

¹ See Book I of this series for an account of the formation of plateaux, plains, folded mountains, etc.

- I. The north-western lowlands.
- II. The central highlands and plateaux.
- III. The southern plateaux.
- IV. The eastern margins and island ranges.

Reference to the map will at once show that the great north-western lowlands, the central highlands east of the Pamirs, and the Indian plateau are all triangular.

I. THE NORTH-WESTERN LOWLANDS.

The only important break in the continuity of the great plain which stretches from the North Sea to the central highlands of Asia is formed by the Ural Mountains. But these mountains are not high enough to form a really serious barrier, either as regards climate, vegetation or communications, so that we must regard the whole of this vast plain—the greatest in the world—as one, although in this book we shall only consider its eastern or Asiatic portion. Fig. 27 shows the structural divisions of Asia. It will be seen that these vast plains consist, for the most part, of sedimentary rocks, which lie in horizontal layers, unfolded and undisturbed. One addition to this statement must be made. The greater part of the West Siberian portion of the 'plain' is shown as being covered with recent deposits. This region is very flat and low, so that the rivers have not sufficient speed to carry along the load of silt which they bring from the mountains. They are compelled to spread this over the land in times of flood, and in this way this portion of the plain has been largely covered by alluvium. The eastern lowlands, drained by the Yenisei and the Lena, are narrower, but higher, and therefore less swampy.

Whilst the great north-west lowlands are drained mainly to the Arctic Ocean by the three long rivers, Obi, Yenisei and Lena, the south-western Turan plains contain the large Aral Sea, which is the centre of an area of continental or inland drainage, for the rivers flowing into it never reach the sea.

THE CENTRAL HIGHLANDS

IL THE CENTRAL HIGHLANDS.

These highlands are continuous with those of Europe, and form the highest and greatest mass of mountains in

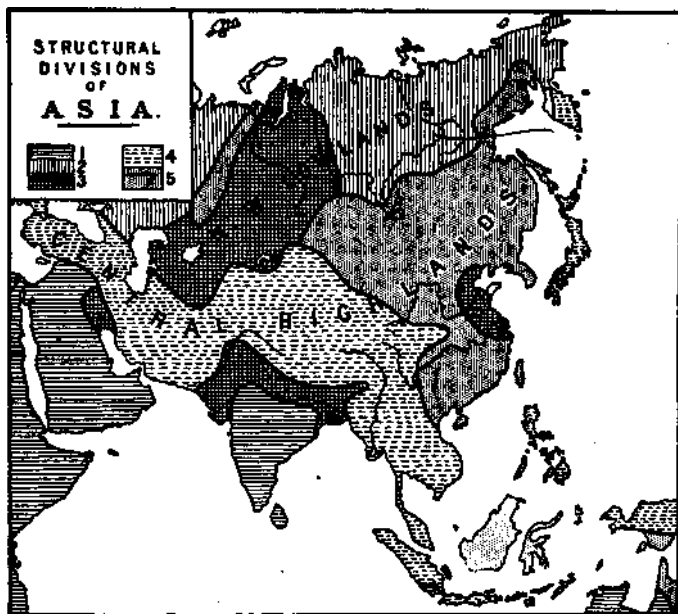


FIG. 27.—The structural divisions of Asia,

- x. Plateaux of unfolded rocks.
- 9. Unfolded lowlands.
- 3. Unfolded lowlands of recent deposits.
- 4. Folded mountains and enclosed plateaux.
- 5. Highlands of rocks folded in ancient times, now greatly denuded and fractured.

the world. They consist of mountain chains, generally running in an east and west direction, between which are lofty plateaux, which are wider in the east than in the west. Fig. 27 shows that the central highlands may be divided into two structural groups, a series of parallel folded ranges enclosing plateaux and

valleys, and a much older eastern mass which originally consisted of folded ranges, but has been very much worn down. In the first group three distinct chains can be traced by the aid of a physical map. The three chains' come very close together in the Pamirs, and on that account we find there the highest region in the world. It is often called the "roof of the world." The first chain is represented by the Caucasus and Tien Shan mountains: the second, or central chain, by the Pontic, Elburz, Hindu Kush, and Kwen Lun mountains. Between these chains lie the great basins of the Black Sea, the Caspian Sea, and the Tarim basin. The third, or southern range, is a series of great loops, and includes the Taurus, Zagros, Sulaiman, and Himalaya mountains, whilst between the central and southern ranges are the plateaux of Asia Minor, Iran, and Tibet. To the east of Tibet, where the older highlands formed a great centre of resistance and turned the folded ranges southwards, is a series of north and south chains, traversing Indo-China. Between these ranges are densely forested valleys, drained by such large streams as the Irawadi, Salwin, and Mekong. The ranges of western Burmah are continued through the Andaman and Nicobar Islands, Sumatra, Java, and the Lesser Sundas, where they once more become east and west in direction. Fig. 48 shows that the islands west of a line passing between Bali and Lombok (east of Java), and between Borneo and Celebes, stand on a shallow submerged platform. At one time they were joined to Asia, as were the Philippines, although the latter appear to have been separated from the mainland at a much earlier time than the others. We shall find further evidence of the former connection of these islands with Asia when we speak of their plants and animals.

The older, eastern highlands are not so lofty as the younger mountains we have just traced. They consist of:—(i) the mountainous area surrounding Lake Baikal and extending from the Altai Mountains to the south-west of the lake, to the Yablonoi Mountains to the east;

(ii) the plateau of Mongolia, which ends abruptly in the Khingan Mountains in the east and stretches as far southwards as the North China Highlands. The Khingan Mountains have a steep slope to the Manchurian Plains and a gradual one to the Desert of Gobi. They owe their origin to the faulting and tilting of a huge block of the earth's crust. The east and west ranges of South China, known as the South China Highlands, the mountains to the east of the plain of Manchuria, the highlands of Korea, and the island of Borneo also belong to the older eastern highlands.

III. THE SOUTHERN PLATEAUX.

These are the plateaux of Arabia and the Deccan in Southern India. Arabia is very similar to the African plateau, from which it has been separated by the subsidences which made the Red Sea. It is composed of sedimentary rocks of great age and is tilted, so that it has a long, gradual, eastern slope and a steep slope to the west and south-west. The map shows that the Deccan is tilted in the same way as the Arabian plateau, so that its longest rivers run eastwards to the Bay of Bengal, and it presents a steep face, the Western Ghats, to the Arabian Sea. South of the Deccan is the island of Ceylon, and between the two are the island stepping stones known as Adam's bridge. Ceylon is a detached portion of the Deccan, to which it was formerly joined.

These two plateaux at one time formed part of an ancient continent which stretched thousands! of miles in an east and west direction. Extensive faultings and subsidences caused the breaking up of this old land mass, and formed the present oceans which now separate the remaining portions from each other. The remnants of this old continent are shown in Fig. 28.

Between Arabia and the plateau of Iran, and between the Deccan and the folded mountains to the north of India are extensive lowlands drained by very long rivers. The Persian Gulf at one time extended much

farther to the north-west, but it has been filled up by the sediment brought from the surrounding mountains by the Tigris and Euphrates and their tributaries, and in this way the alluvial plain of Mesopotamia has been made. In the same way, the rivers of the Indus and

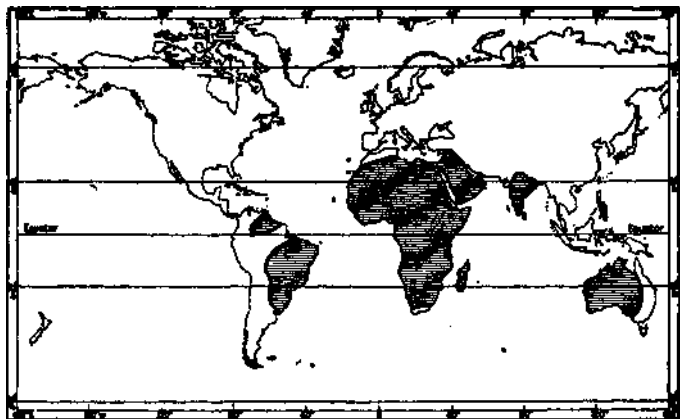


FIG. 28.—The great southern plateaux of unfolded strata. It is thought that they were once part of an ancient continent which geologists call Gondwanaland.

the Ganges systems have built the extensive alluvial plains which now separate the Deccan from the northern mountains of India. All these rivers have deltas which are being pushed out farther and farther every year.

IV. THE EASTERN MARGINS AND ISLAND RANGES.

The true eastern limits of Asia are to be found in the festoons of islands south of the peninsula of Kamchatka. This peninsula is continued southwards through the Kurile Islands, the Japanese Islands, the Lu-chu Islands and the Philippines. The ranges of these islands are largely volcanic.

Of the volcanoes, Fuji-San, Japan's sacred moun-

tain, has the most perfect cone. Fig. 66 shows that this volcanic belt extends all round the margins of the Pacific Ocean; it is sometimes called "The Fiery Ring of the Pacific." Between the mainland and the inland chain are the seas of Okhotsk, Japan, Yellow, East and South China. Of these, the Yellow and East China seas are the shallowest. They all occupy basins made by the subsidence of blocks of the earth's crust.

The chief rivers draining the eastern margin are the Amur, the Hwang-ho or Yellow River, and the Yangtse-kiang. The map shows that they rise far away in the central highlands and have extensive lowlands in their lower courses.

In this short account of the physical features and structure of Asia we have seen that the continent is of enormous size. It stretches through about 76 degrees of latitude, it has extensive plateaux, it has the highest mountain ranges in the world as well as vast plains, whilst tracts along the shores of the Caspian Sea are below sea-level. We shall, therefore, expect to find strong climatic and vegetation contrasts, ranging from the cold deserts of the north to the equatorial forests of the south, from the bleak, sparsely peopled plateau of Tibet to the densely peopled lowlands of China and north India. Asia is a continent of great contrasts.

EXERCISES.

1. On an outline map of Asia mark all the chief rivers and shade the map so as to show the land drained:—(a) to the Arctic Ocean, (b) to the Pacific Ocean, (c) to the Indian Ocean, (d) to the Mediterranean, (e) area of inland or continental drainage. Write a brief description of this map.
2. Draw a map of Eastern Asia, and the eastern volcanic chain of islands. Shade boldly the sea deeper than 100 fathoms, and the land above 600 feet. Mark the chief rivers.
3. Using the relief map in your atlas, draw a section from the Ganges plains to the north coast of Asia.
4. Give reasons why you would expect many political frontiers to meet in the Armenian Highlands and in the Pamirs.
5. Explain the terms:—alluvial plain; folded mountain; inland basin; escarpment. Give Asiatic examples of each.

CHAPTER IX,

ASIA: CLIMATE AND NATURAL VEGETATION.

IN earlier chapters we have considered temperature, pressure and winds, and rainfall as applied to the whole world. We must now summarize the chief facts as they concern the continent of Asia. From what we have learned in the last chapter it is not difficult to see that two outstanding factors will have a very considerable influence upon the climate of Asia. The first is its great extent in latitude, and the second its very varied relief. As regards the latter, it must constantly be borne in mind that the temperature and pressure maps have been corrected to sea-level readings.

TEMPERATURE.

Fig. 10 shows that a large proportion of the land has a temperature below freezing point in January.-The isotherm of 32° F. is a very important one, for it means that those plants which cannot flourish where there are severe winter frosts, will not grow in parts where the temperature falls below the freezing point for a whole month or more. It will be seen that the only parts which are free from frosts in winter are in the south and south-east. Now turn to Fig. 11, which shows that in July the greater part of the continent has a temperature exceeding 68° F., whilst the areas in which little rain falls (Iran and Arabia) have a very high temperature indeed, as there is little or no covering of cloud to lessen the heat. Notice the position of the isotherm of 48° F. This is important, because it marks

the northern limit of trees which must have at least that temperature during the warmest month. The influence of the Indian and Pacific oceans is seen in the lower temperature of the coastlands compared with those of the dry areas just mentioned, and in the northerly bends of the isotherms on the east coasts. The great facts to keep in mind are the contrasts between the cold of winter and the heat of summer experienced by the interior lands. Now let us consider a few actual figures—

Place.	Lat.	Long.	Height in feet.	Mean temperature in coldest month.	Mean tempera- ture in hottest month.
Verkhoyansk .	67° N.	133° E.	330	- 60° F.	60° F.
Yakutsk .	62	129	330	- 47	66
Tomsk .	56	85	395	- 3	66
Tobolsk .	58	68	345	— 2	64
Tashkent	41	68	300	30	81
Trebizond	41	40	100	41	75
Smyrna .	38	27	33	47	80
Aden	12	13	0	76	84
Bombay	19	73	35	75	85
Calcutta	22	88	20	65	86
Rangoon	16	96	40	75	85
Singapore	1	103	10	78	82
Hankow	3°	114	140	38	83
Shanghai	31	121	35	38	81
Peking .	40	116	130	23	80
Tokyo	35	140	65	37	78

The first group is taken from the great north-west low-lands. All have an extreme climate which is more extreme in the north-east than in the south-west, although the south-west portion of the plains has a much **hotter**

summer, as is illustrated by the summer temperature at Tashkent. Verkhoyansk has the lowest recorded temperature in the whole world, and has the exceedingly large range of 120° F. In places like this, where the winters are long and severe, most of the year's work has to be accomplished during the summer months, when work is carried on at high pressure in order that enough of the necessities of life may be obtained to last through the winter.

Trebizond and Smyrna are on the Black Sea and Mediterranean Sea respectively, and have cool winters and hot summers. The towns in the third group have only a small range of temperature, and are hot at all seasons, although Calcutta's coldest month may be described as very warm. They are all within the tropics. The last group illustrates the hot summers and relatively cold winters of the south-eastern margins. These places have colder winters than have western margins in the same latitude, this being due to the cold, dry winds which blow from the high-pressure system centred towards the middle of the cold land mass. If figures were given for towns on the great central—plateaux of Tibet, the Tarim basin and Mongolia, they would show cold winters below freezing point, *and* very hot summers.

PRESSURES AND WINDS.

Owing to the land becoming very hot in summer, a low-pressure area is created towards which winds flow from the oceans, where the pressure is higher. -Since this inflowing air is cooler and denser than the heated air, the latter is forced to ascend: Thus the greater part of Asia receives inflowing winds in July (see Fig. 16). In January the conditions are reversed (see Fig. 15). The land masses in the heart of the continent are extremely cold, and this produces a great high-pressure system which hangs over Central Asia like a heavy cap. From this system winds flow outwards towards the

oceans, where the pressure is less, so that the greater part of Asia has cold outflowing in winter.

RAINFALL.

Fig. 21 shows the mean annual rainfall of Asia. About two-thirds of the continent receives very little rain. It will be seen that these areas are found, (i) in the south-western part of the great northern lowlands, (ii) on the central plateaux. (iii) on the plateaux of Arabia and Iran, (iv) in the extreme north. The little rainfall is due in the first region to the great distance from the ocean, in the second to the fact that these plateaux are to the lee of the highlands of northern India and China, which have already received most of the moisture brought by the wet summer winds, and in the third region (the south-western plateaux) to the dryness of the prevailing N.E. Trades, for the monsoon rain-bearing winds of summer do not affect this part of Asia. The north coastlands lack rain, as the low temperature causes very little evaporation to take place, and therefore limits the rainfall.

A comparison of Figs. 23 and 24 will show that most rain falls in summer when there are the inflowing winds. If Fig. 24 is studied in connection with a relief map, it will be seen that these summer winds deposit most of their moisture on the mountains with which they first come into contact, and pass on as dry winds. South of a line from the mouth of the Indus to Korea is a region over the greater part of which there is a heavy summer rainfall. Summer rainfall, though small in amount, is also experienced in a broad band stretching across the north of the *the lands bordering the eastern Mediterranean* have the dry summers and wet winters typical of the Mediterranean shorelands. Ceylon, the Malay Peninsula, the coastlands of China, the islands in the eastern volcanic Chain and the East Indies all have rain at all seasons. Fig. 29 shows the season at which most rain falls in the different parts of Asia.

VEGETATION AND ANIMALS.

Fig. 26 shows the world distribution of vegetation. It will be seen that the tundra, the cool temperate forests and the steppe of Europe are all continued eastwards

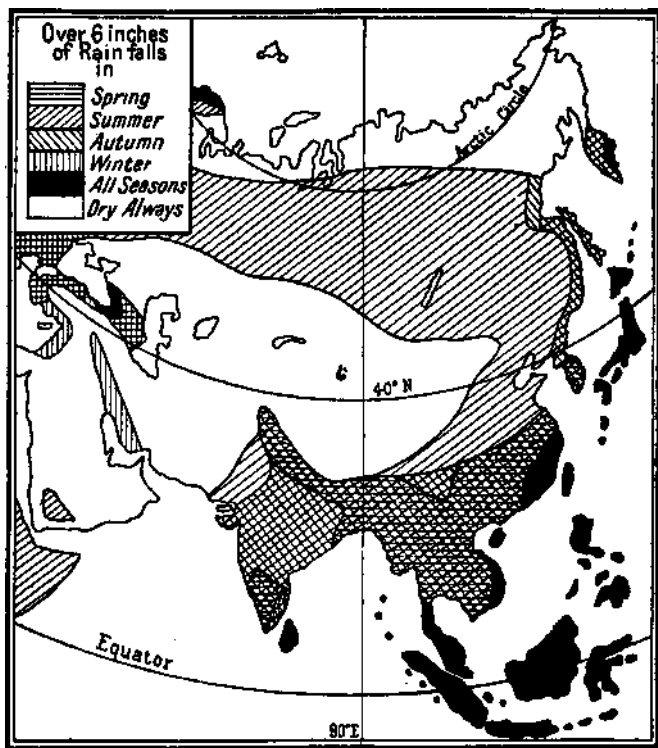


FIG. 29.—The Seasonal distribution of rain in Asia.
(After Herbertson and Supan.)

into Asia. The chief animal of the tundra is the reindeer. The coniferous forests of Siberia are very dense, and give shelter to many kinds of fur-bearing animals, of which the chief are the sable, fox, mink and ermine. These forests gradually give place to the grassy steppes,

the richer parts of which are rapidly becoming important wheat-producing lands.

Towards the Sea of Aral, the steppes merge into semi-desert or scrublands in which are extensive areas of true desert. Deserts are also found in the rainless parts of Arabia, Iran, Tibet, and Mongolia. In the higher parts of Arabia, and over considerable areas of the central plateaux, are tracts of slight rainfall having a very poor type of pasture, not unlike the drier steppes. Yet even this is sufficient to support wandering tribes of herdsmen, who follow their sheep and goats from pasture to pasture. Fleet-footed grazing animals, such as gazelles and asses, run wild. In Arabia, the chief animal is the camel, whilst the famous Arab horses are reared on the poor pastures. In Tibet, the yak, the native ox, is the chief beast of burden and also provides food and clothing.

In the Mediterranean region of winter rainfall the plants adapted to summer drought are found. The chief are the vine, fig, mulberry and olive.

The monsoon lands of the south-east have rain mainly in summer, and, since this is generally considerable in quantity, the natural covering is usually forests. In North China, Korea and Japan, these are of the warm, temperate type, and in Southern China, Indo-China and India, of the hot, wet variety, although there are parts having a smaller rainfall, in which savannah, or mixed grass and woodlands are found. The Deccan is an example of this type. In the forests and jungles are many species of wild animals, amongst which may be mentioned the elephant, which can be domesticated and taught to do useful work, the dreaded tiger of Bengal and the Malay Peninsula, the leopard, the tapir (found in Asia only in the Malay Peninsula and in Sumatra), as well as many varieties of monkeys, apes and snakes, of which the cobra is perhaps the most dreaded. Mention should also be made of the buffaloes and humped cattle of India, for they are very important for draught purposes.

In the hot, wet equatorial forests of the South Malay

Peninsula and the East Indies the heat and rainfall are constant, so that dense tropical vegetation is met with, except in the higher parts of Borneo. The chief trees are sago-palms, bananas, coconut palms, gutta-perchas, bread-fruits, and trees and shrubs from which spices are obtained. From these the natives can obtain most of the necessities of life. The great naturalist, Wallace, fixed the line separating the Asiatic animals from those distinctly Australian in type, as running between the islands of Bali and Lombok, east of Java, and between Borneo and Celebes (see Fig. 48). Others have fixed the line so as to include Celebes as having an Asiatic type of fauna. As a matter of fact, the fauna along the boundary line drawn by Wallace is of a mixed type, and this is what we should expect to find. We have already learned that the islands west of Wallace's line stand on a submarine platform less than 100 fathoms below sea-level, whilst those to the east have surrounding seas which are very much deeper. Wallace thought this indicated that Australia was separated from other land masses very early indeed, so that it had been able to develop a typical flora and fauna. The typical Australian tree is the eucalyptus, whilst the characteristic animals are marsupials—that is, they are pouched, as, for example, the kangaroo.

EXERCISES.

1. Why is it that (a) Asia Minor receives its rain chiefly in winter, (6) the East Indies at all seasons, (c) south-east Asia chiefly in summer, (d) the central plateaux are deficient in rainfall?

2. Describe the climatic conditions which produce (a) tundra, (b) steppe. What animals are best suited for each?

3. What zones of vegetation would be passed through in a journey from the south of India to the arctic coast of Asia? Account for the changes you notice.

4. On an outline map of Asia shade all regions receiving a mean annual rainfall of less than 10 inches. On the same map mark the desert lands of the continent. What connections do you notice between the two sets of factors?

5. What are monsoon winds? Draw sketch map to illustrate **their** causes, and, in writing, briefly describe the maps.

CHAPTER X.

THE MAJOR NATURAL REGIONS OF ASIA.

ASIA may be divided into several large units or major natural regions. In so dividing the continent, the physical features, climate, vegetation and leading occupations must be taken into account. One of these factors alone is not sufficient, for a physical unit may be so large that the climate and vegetation in different parts vary very much. It will thus be seen that natural regions are not simply physical units. Ideal natural regions would be those which were physical, climatic and vegetative units—that is, regions of the same physical type throughout (plains, plateaux or highlands) in which the same set of climatic conditions obtained in all parts of the unit, and produced the same general result as seen in the natural vegetation and occupations. To carry out this thoroughly we should have to divide the continent into a great many units. For our present purpose, it is sufficient to take very large divisions, in each of which are certain outstanding characteristics, which allow of the region being considered as a unit. In selecting the major natural regions the chief factor which has been considered is natural vegetation, for in the distribution of vegetation we also have the influence of relief and of climate playing important parts. That is, if a region has the same type of natural vegetation in all parts, it is obvious that the climate is approximately the same throughout the region, and that there will be a similarity in the natural occupations. Much of this chapter will therefore resemble Chapter VII, although here we shall confine our attention to Asia.

It will be seen that a division of Asia into large natural regions takes no account of the political boundaries but as the importance of these is not inconsiderable, we must not neglect them. We must also notice that it is often impossible to draw an exact boundary line between natural regions, for one type merges into another very gradually.

(A) THE TUNDRA.

This region occupies most of the land lying within the Arctic Circle. The physical map will show that the tundra consists mainly of lowlands. Short summers and long, cold winters, a total precipitation of less than 10 inches, and a natural vegetation consisting chiefly of berry-bearing bushes, mosses and lichens, and numerous flowering plants, are the outstanding characteristics of this region. Life here is very hard indeed, and the hard work necessary to keep alive is not rewarded by the comforts of more fortunate climates.

(B) THE NORTHERN TEMPERATE FORESTS.

This region is a great belt stretching across northern Asia, south of the tundra. In the west it covers lowlands, and in the east, highlands. The chief trees are conifers, although towards the south broad-leaved trees appear. Little lumbering is done in these forests, for the means of export are at present very difficult indeed. The trapping of fur-bearing animals is the chief occupation. Throughout the area the climate is one of extremes, although the summers are much warmer than those of the tundra, and the rainfall is greater. This, of course, accounts for this region being forested, whilst the tundra is a gold desert.

(C) THE GRASSY STEPPE.

This is a great grassy plain with a rich soil. Owing to distance from the sea the climate is one of extremes,

The rainfall is not very heavy—in parts it is deficient in quantity—and falls in summer. The natural occupation is stock-rearing, although a great change is taking place in the richer parts immediately south of the forest belt. Here every year sees an increase in the area of



FIG. 30.—The major natural regions of Asia.

A. Tundra.	B. The northern temperate forests.
C. The steppes.	D. The Mediterranean lands.
E. The deserts and semi-deserts.	F. The monsoon lands.
G. The South-Eastern Archipelago.	

land devoted to the growing of cereals, especially wheat

Towards the south-east the steppe becomes arid and desert-like, so that we shall include this southern portion of the north-west lowlands in the Great Desert Belt.

(D) THE MEDITERRANEAN LANDS.

This region stretches from the Mediterranean Sea to the plateau of Iran. Politically it includes Turkey, Syria, Palestine, Iraq, the Republics of Armenia, Georgia and Azerbaijan, and the western districts of Persia. Only the coaslnds have the typical Mediterranean type of climate of very warm, dry summers, mild winters and winter rains, for the rainfall diminishes and the summer heat and winter cold increase as we go southwards and eastwards away from the sea. The plateaux have an extreme climate, whilst towards the south and south-east it is difficult to draw a boundary between the Mediterranean region and the Desert.

Evergreen trees and shrubs are the characteristic vegetation of the coastlands, whose chief cereals and cultivated plants are wheat, maize, barley, the vine, mulberry and olive. Farther inland pomegranates and apricots are more important, while the drier plateau interior is at best a poor grassland.

(E) THE DESERT BELT.

This belt of dry deserts stretches north-eastwards across Asia from the Red Sea to the Khingan mountains, including within its limits the plateaux of Arabia, Iran, Tibet, the Tarim basin and Mongolia. It also includes the deserts of Western Turkestan and the lower Indus valley. All these regions receive very little rainfall, for the high central plateaux and Turkestan are shut off from rain-bearing winds, whilst Arabia and the Lower Indus Valley are off the track of the summer monsoons.

As regards temperature, the various parts of this belt differ very considerably owing to differences of latitude and altitude. In Arabia and the Lower Indus Valley the winters are warm and the summers very hot; but in the other parts of this desert belt the winters are very

THE MONSOON LANDS

cold indeed, and the summers, as a rule, not quite so hot. In all parts of the region settled life is only possible where there are permanent supplies of water.

(F) THE MONSOON LANDS.

These are lands of hot, wet summers and dry winters. The winter temperatures differ according to elevation, distance from the sea, and distance from the equator. Indeed, there is such a great difference between the temperatures of the northern and southern parts of this region that we must divide it into (i) a temperate region, (2) a sub-tropical region, and (3) a tropical region. The first region, which has cold winters, includes Korea, the plains of Manchuria and northern China, and the islands of Sakhalin and Yezo. The uplands are clothed with mixed coniferous and broad-leaved forests. The second region has warmer winters than those of the lands farther north; it also has a heavier and more evenly distributed rainfall. It includes Japan and Central China. The vegetation is of the warm temperate type. The third or tropical region includes India, Indo-China, and southern China, and it is distinguished from the others by its warm to very warm winters. The coastal lands, especially those nearest the equator, have very little difference between summer and winter temperatures.

The climatic characteristics common to the whole monsoon region are the comparatively dry winters and the wet summers. Where the summer rains are sufficient to keep the soil moist all the year round, forests are found, and these vary according to the temperature. In those parts where the rainfall is deficient, for example, on the Deccan to the leeside of the western Ghats, the vegetation is of a poorer type, such as mixed scrubland or savannah.

The chief products of this monsoon region are such as require considerable heat and moisture at the same time. They are:—rice, sugar-cane, cotton, opium, indigo,

tea, and coffee. In the drier parts where a sufficient temperature is reached, wheat is grown as a winter crop. The forests provide such useful timber as teak and bamboo, whilst in China and Japan, the mulberry is cultivated in order to feed silkworms. The fertile lowlands of the monsoon region are amongst the most thickly populated regions in the world, and this is rendered possible by the ease with which the necessities of life—here chiefly rice—can be obtained.

(G) THE SOUTH-EASTERN ARCHIPELAGO.

This region includes Ceylon, the East Indies, the Philippines, and the southern portion of the Malay Peninsula. A high temperature and abundant rainfall at all seasons are its chief characteristics.

In consequence of these climatic conditions, the lowlands are densely forested with vegetation of the equatorial forest type, whilst on the highlands are considerable areas of grasslands. In these hot regions we find a very backward type of man, for nature plenteously supplies him with all his needs. In return for the minimum of exertion on his part. The cultivation of tropical products such as sago-palms, coconuts, bananas, rubber, and spices is extending, but there are still considerable areas which remain in a natural condition, and even cannibalism is not unknown.

EXERCISES.

1. Name the chief parts of Asia in which each of the following is a very important product—rice, tea, cotton, wheat. Give full reasons for your answer.
2. Contrast, as vividly as you can, the differences between Northern Siberia and Java.
3. A, B, C, etc., are towns in Asia. From an examination of the climatic statistics quoted can you identify each? If you cannot mention a town try to state a region. Give reasons for your selections.

Place.	Height in feet.	Jan. temp.	July temp.	Mean annual rainfall in inches.
A	90	75° F.	85° F.	3
B	SL.	75° F.	78° F.	101 (mainly in summer)
C	250	-4° F.	68° F.	15 (two-thirds in summer)
D	20	80° F.	81° F.	94 (at all seasons)
E	26	47° F.	80° F.	27 (mainly in winter)

4. In what other parts of the world would you expect to find similar regions to the Asiatic tundra, the steppes, and the northern temperate forests? (see Chapter VII).

5. What is a major natural region? Give examples from Asia.

CHAPTER XL

THE RUSSIAN LANDS.¹

Natural Regions.—The Russian lands of Asia include (i) the tundra, (ii) the coniferous forest belt, (iii) the steppes, (iv) the semi-desert and desert lands of Turan, (v) portions of marginal lands of the central highlands, (vi) northern portions of the temperate monsoon region.

The total area of these lands is about one-third of the whole continent, but the total population numbers only about one-fortieth of the people of Asia.

The map shows that the greater part of Russian Asia consists of the great north-western plain, and that to the east and south of this plain are high mountain uplifts.

THE NORTH-WESTERN LOWLANDS.

Physical Conditions.—Let us first realize the size of this plain. From south-west to north-east it stretches through more than 4,000 miles—as far as from London to Chicago; at its greatest width it exceeds 1,200 miles, whilst by far the greater part is below an elevation of 600 ft. above sea-level. And this plain, great as it is, is only a part of a very much larger lowland which extends beyond the Urals to the North and Baltic Seas.

This vast triangle-shaped plain is drained to the

¹As the result of the Russian Revolution of 1917, the political geography of the Asiatic lands of the Old Russian Empire is very complicated. Many socialist soviet republics have been formed, but these, together with the republics of European Russia, are federated or allied to form the Russian Socialist Federal Soviet Republic (R.S.F.S.R.). We shall, therefore, think of them all under the general title—"The Russian Lands." See Exercise 8 on page 109.

Arctic Ocean by many large rivers, of which the Ob, the Yenisei and the Lena are the most important. These mighty streams—the Ob is 3,230 miles in length—and their network of east and west flowing streams are the chief means of communication, but, unfortunately, they suffer from the great disadvantage of flowing into an ocean which is frozen for at least eight months every year. Besides this, their lower courses are frozen for many months, whilst the thaws of spring turn the country bordering their banks into enormous lakes. For these reasons the main streams have been little used for commerce, although their east and west flowing tributaries have had a great deal to do with Russian expansion eastwards. The western movement of Mongol horsemen from Eastern Asia to Europe was*along the great grassy plains of the steppes, for here pasture and firm ground were found. The Russian eastward expansion was not confined to the grasslands and the use of horses, for the rivers and boats offered an excellent method of progress, especially through the forests. To-day, the vigorous Russian Government is working hard successfully to develop lines of export along the rivers to the Arctic Ocean. This is only possible for a limited period in summer, but most promising experience has been gained.

Turning to the climate, the severity of the winters rapidly increases as we go from west to east. Siberia is everywhere colder than Russia in the same latitude. It is also drier. These conditions are what we should expect to find as we approach the centre of the great Eurasian land mass. In the Turan lowlands of the south-west the winters are cold, and as we go towards the north-east they become colder and colder, until at Verkhoyansk we reach the exceedingly low mean January temperature of -60° F. or 92° F. below freezing point. In summer the south-west lowlands are very hot, and the temperature decreases, although not so rapidly as it falls in winter, as we go towards the north-east. As regards rainfall, the extreme north and the Turan lowlands have a very slight rainfall, less than 10 inches, and

between these there is a broad, belt where the mean annual rainfall is from 10 to 20 inches.

It is on account of the vast size of the north-west lowlands and the consequent different climatic conditions that we find it contains several natural regions, which we will now discuss in more detail.

(1) THE TUNDRA AND ITS INHABITANTS.

As will be seen from Fig. 31, the tundra occupies the most northerly part of the area. We have already learned that in this region the summers are short and warm, the winters long and cold, the rainfall is slight, and that as a result of these conditions instead of trees we find mosses, lichens, small bushes and berry-bearing plants, and, in summer, a great variety of flowers.

The rivers which cross the tundra flow from south to north, so that in spring, when the thaw comes, their upper courses are supplied with water from the melting of ice and snow, whilst their lower courses are still frozen. This is the cause of large tracts being under water in summer. Millions of mosquitoes make life in these swampy lowlands almost unbearable, so that the inhabitants have to keep as far as possible to the higher portion of the tundra.

The inhabitants of the tundra belong to various races, and are known by different names. In northern Norway and Russia are the Lapps and Finns, and in northern Asia the Ostyaks, Samoyads, Yakuts and other similar tribes. Mention has just been made of the fact that several races are represented. This is very interesting, for we find that men of the same races as some of those inhabiting the tundra, are much taller in more southerly lands, whilst in these cold, barren wastes all the inhabitants, whatever their origin, are small and undersized. This is undoubtedly an example of the influence of climate upon man. The climatic conditions not only influence stature, but the whole mode of life, for all tundra dwellers appear to have been compelled to adopt similar ways and means of existence.

The tundra has very little to offer to its inhabitants as a reward for their labour. The ground is permanently frozen below a depth of one or two feet, so that, apart from the climatic conditions, agriculture is impossible. The sparse vegetation is, fortunately, able to support herds of reindeer, but provides nothing for the support of human life except certain berries. The dwellers in

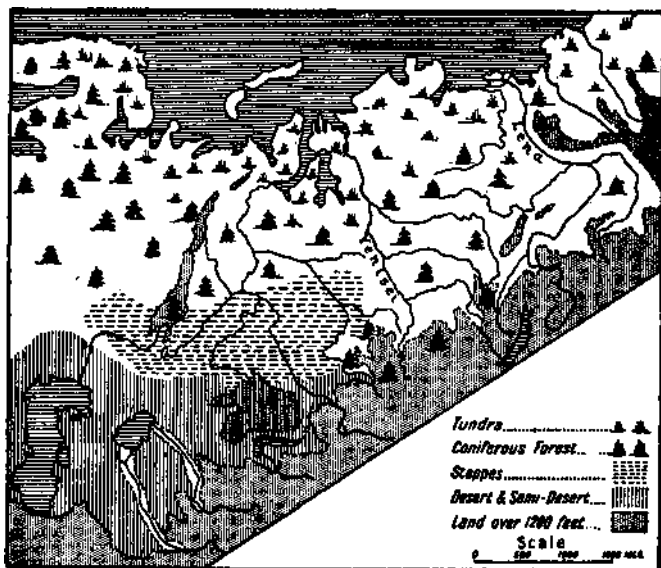


FIG. 31.—The north-western lowlands of Asia. Relief and vegetation.

the tundra are therefore compelled to depend for their food upon the reindeer, the fish which they catch in the rivers and sea, and the wild animals which they can hunt. Reindeer are indispensable to the people of the tundra. They roam about in a semi-domesticated condition in search of reindeer moss, in discovering which they show extraordinary sagacity, their owners meanwhile following them from place to place. The possession of a few reindeer means that a man and his family have most of their

needs supplied. To own a large number is to be quite a rich man. Alive, the reindeer is used as a beast of burden, and provides milk. When killed, every part of its body supplies something useful—the skin for clothing and tent covers, the flesh for food, the horns and bones for tools and implements, and the sinews for thread, etc. Fishing is carried on chiefly in the late spring and summer, when the rivers thaw and fish are abundant. The men catch the fish, and to the women falls the task of drying enough for use in the long winter when fishing is impossible. The families dependent upon fishing alone have a far more insecure existence than those supported partly by fishing and partly by the reindeer. A certain amount of hunting is possible, especially in winter, when it is the custom to migrate as far southwards as the northern edges of the great forest belt.

From what has been already stated it will be evident that tundra dwellers live nomadic or wandering lives, and that the summer will be the season of most changes. For this reason a fixed house is impossible, but the winter dwelling is of a more permanent type than the summer one, indeed, in many cases, one dwelling is used throughout the whole of that season. The summer houses are tents which are easily carried, erected, or pulled down. They are made of a framework of poles covered with skins or bark. The winter houses are generally made of a framework of wood covered with turf or earth.

We have seen that for food and clothing tundra dwellers depend very largely upon the reindeer. Some tea and tobacco are obtained from traders, and are greatly prized. Important articles of winter clothing are the hood, the thick, skin gloves which are attached to the sleeves, and the warm, fur boots. A mother carries her baby in her hood. She covers it with furs, and laces it into a skin cradle which she carries on her back. Travellers tell us that children are generally kindly treated, although tundra boys and girls can never enjoy real home life when the home comforts are

so few, and the place of habitation is constantly being changed. The position of the aged, the sick, and those who are not strong enough to take their part in the hard struggle for existence is often very hard indeed. They are sometimes neglected and left to perish.

(2) THE BELT OF NORTHERN TEMPERATE FORESTS.

As shown in Fig. 31, this is a broad belt of forests south of the tundra. The trees are mainly conifers, although many broad-leaved trees appear towards the southern margins. This enormous area is almost entirely virgin forest. It is the greatest hunting ground for fur-bearing animals in the whole world, although, except on its margins, it is almost uninhabited. The trapping is done chiefly by Ostyak and Samoyad hunters who live on the northern fringes, and whose settlements are regularly visited by traders who transact their business by means of barter.

Better means of communication are already making lumbering an important occupation; but even at present comparatively little is done in this direction. Towards the south the forests gradually thin out, and, owing chiefly to the drier conditions, the prevailing vegetation is grass.

(3) THE STEPPE.

As regards the climate and vegetation of the steppe, it is not necessary to add to what has been learned in previous chapters. We shall only recall that the rain-fall is small and falls chiefly in summer, and that the range of temperature is *very considerable*. But, as in the tundra, we shall go into more detail in connection with the way in which the primitive steppe dwellers live, so that we may see how geographical conditions affect modes of life. The majority of the inhabitants of these great areas of grass-covered lowlands are shepherds who rear large herds of sheep, camels, horses, goats and cattle, and since the grass in a particular place is soon exhausted, it follows that the animals have to be constantly moved from place to place. Thus the steppe shepherd, like

the tundra hunter, leads a nomadic life. It is necessary, therefore, that the house, furniture and household utensils should be of as simple and light a character as possible, so as to be moved with as much ease and comfort as circumstances permit. The people, therefore, live in tents which are usually round in shape and are most comfortable. The framework is made of willow sticks which are obtained from the banks of rivers. The sticks are made into a lattice-work which can be expanded or contracted according to the size desired. This lattice-work is then covered with skins or felt, and the whole held together by cords or bands. The only furniture consists of carpets, cushions and rugs, whilst most of the household utensils are made of leather or wood, because articles so made are not easily broken. The work of erecting or taking down the tent falls, as is customary with most nomadic peoples, to the women, who can easily accomplish **the** task in about half an hour.

The winter houses are more durable, and are sometimes built of stone. Since the winters are usually severe and often snowy, stables have to be erected for the animals, which are fed upon hay that has been stored for winter use. The site of the winter dwelling is very important, for it must be near to a reliable water supply and in as sheltered a place as possible. Therefore a river valley is often chosen. We have said that steppe dwellers are nomads, but one point must be noted. In however many places the summer tent is pitched, it is very seldom that **the** shepherd does not return to the same winter quarters. Although the chief work is looking after the animals and keeping them from any harm, some hunting is usually possible in winter, as at this season the hungry animals of the forest venture farther south in search of food.

As a rule, primitive steppe dwellers despise a settled life, and glory in their nomadic existence. Their flocks and herds provide them with all they require, and therefore they are content. The felt for the tent covering is made from wool. The hair of the camel is woven into camel's-hair cloth. Wool and hair are also used

in the making of the cushions, rugs and carpets which are noted all over the world for their beauty of design, and the excellence of the work. Leather and skins can be obtained very easily, and are made into bottles and clothing. Milk and flesh form by far the most important food, although other things can be obtained from the trading caravans which carry on commerce with the steppe dwellers. The favourite drink, koomiss, is made from the fermentation of milk, whilst large quantities of milk are also used in the making of cheese and butter. When we consider that the people are constantly moving in summer, we see that the camel and horse are very important indeed as beasts of burden. Steppe dwellers are noted horsemen. The Kirghiz give themselves the name of Kazak, which means "horsemen." Without the help of horses it would be impossible to keep the flocks in order whilst moving from place to place, or to prevent them from straying during a temporary halt. Even the children are expert in horsemanship, and they are placed on horseback when about four or five years of age.

In most other occupations, the introduction of machinery has made great changes, but the shepherding of animals is still carried on in much the same way as in the days of the Bible patriarchs. Indeed, some of the best accounts of steppe life are found in the Old Testament. Since there is little or no change, steppe dwellers are opposed to everything new, and are very much attached to tradition. The unit is the family, and as the wealth of the family is reckoned by the number of animals possessed, we find that the families are very large. Indeed, it is the practice for the wealthy steppe dwellers to have more than one wife. The head of the family is an autocrat who is a law unto himself, and is obeyed by all. Again, since wealth consists of livestock, drought or severe winters, storms or disease may reduce the richest of men to poverty in a short time. Such a disaster has always to be reckoned with, and it has the effect of making steppe dwellers fatalists, for no action of theirs can avert these unforeseen disasters.

The hardy horsemen of the steppe make splendid fighting men. Many times they have passed across southern Russia, and even reached as far as the Alps. The Magyars of Hungary are descended from such twelfth-century invaders. The once famous Russian cavalry, the Cossacks, were steppe dwellers. Cossack is an altered form of the word Kazak (see page 101).

The northern portion of the steppe is arable land—that is, it may be cultivated. It is in this region that great changes have been made in recent years. Settlers from places where a higher civilization than a pastoral type has been reached, have settled and brought with them the knowledge of the use of machinery, of irrigation, of the digging of deeper wells. In short, the modern settler in this part of the steppe knows how to live a settled life. Russian colonists are now raising large quantities of wheat, oats, rye and root crops, for the soil is very fertile and the rainfall generally sufficient, although dangers such as long droughts and early frosts are by no means unknown. Cattle are also reared in large numbers, and the manufacture of butter, introduced by the Danes, is to-day one of the chief industries in Siberia. As more and more areas are developed and used for stock-keeping, dairy farming, and the growing of cereals, the nomadic Kirghiz, who cling to their mode of life, are being pressed farther south towards the less fertile parts of the steppe. The development of this portion of Siberia may be compared with that of the North American prairie. As in the latter region, the construction of railways has led to rapid progress. Fig. 32 shows the great *Trans-Siberian Railway*. From Moscow the main line goes to Perm and across the Urals to Omsk. An alternative route is via Samara. The Urals do not present a serious obstacle, for their gradients are not difficult, and convenient gaps can be used. By means of easy descents, the main line reaches the steppe of south-west Siberia, and crosses the Irtish, an important tributary of the Ob, at *Omsk*. This town lies in a rich, black earth region in which wheat growing, dairy

farming, and stock-keeping are important occupations. It is the most important town in the agricultural area of Siberia. North-west of Omsk, at the confluence of the Irtysh and the Tobol, is *Tobolsk*, which, although not on the railway line, commands routes via the Tobol to the Kirghiz steppe, along the Irtysh to the Zungarian Gate, between the Altai and the Tien Shan mountains (see Fig. 32), and beyond that to the Far East. The latter advantage has also helped the growth of Omsk, which is more

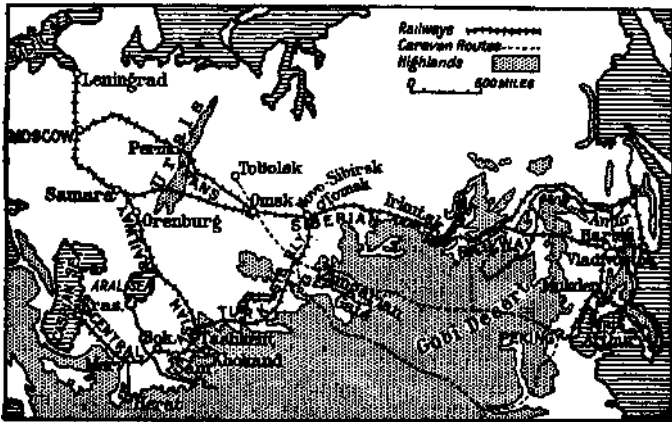


FIG. 32.—The Trans-Siberian, Central Asian and Turk-Sib. railways.

important to-day than Tobolsk. From Omsk, the railway continues eastwards to *Novo-Sibirsk*, the capital of Western Siberia, which has a fine position where the Trans-Siberian Railway crosses the Ob and is joined by the "Turk-Sib." Railway from Turkestan. Continuing eastwards, a branch line goes to *Tomsk*, a rising Siberian city noted as the centre of a gold-mining district, and crosses the Yenisei at Krasnoyarsk. For some 300 miles before reaching this town, which, like Tomsk, is a mining centre, the railway passes through coniferous forests. Beyond Krasnoyarsk, open country is again reached, and the

line continues to Irkutsk, to the west of Lake Baikal. After skirting the southern shores of this lake, the line forks, one branch following the general direction of the Amur, but some 40 or 50 miles north of that river, the other continuing across Manchuria via Harbin to Vladivostok, and via Mukden to Port Arthur, which the Russians lost in the war with Japan in 1905. The Amur valley line was developed with a view to giving a route to Vladivostok entirely through Russian territory. From Khabarovsk, on the Amur, the line utilizes the valley of the important north-flowing Usuri river, which offers a good route southwards to Vladivostok.

Let us return to that portion of the railway which is on the central plains. North of Lat. 56° N., and between the Urals and the Yenisei, is a great swamp region, whilst to the south lie the dry steppes. It was along this firmer ground that many Mongol invaders passed into Europe, and it was naturally here that the Trans-Siberian railway was built, passing through Omsk instead of Tobolsk, which is in the swamp region.

4. TURAN OR RUSSIAN CENTRAL ASIA.

This fourth region of the north-west lowlands occupies the semi-desert and desert lands lying between the central highlands in the east and the Caspian Sea on the west, and stretches southwards to the Iran plateau. The map shows that, except in the north, it is shut in by high mountains, which shut it off from rain-bearing winds. But since the mountains themselves receive rain and are often snow-capped, the Turan rivers rising in them are supplied with water. Of these, the Syr and the Amu flow into the Sea of Aral, and are the most important, but there are many which lose themselves in the sand.

The only fertile parts are those which are irrigated. About one-tenth is fit for settlement, and much of this is of a very poor type of pasture, and can be used for a short time only. The chief occupation on these poorer

pastures is stock-keeping, which is carried on in **the** same way as in the better-watered steppe lands already considered. It has been said that these Turan shepherds are half shepherds and half robbers, and this is hardly to be wondered at. In the river valleys a settled life, based on irrigation, is possible, and wheat, maize, wine, cotton and tobacco are produced, whilst the mulberry is grown in order to feed the silkworm.

The Russians have built railways, by means of which the chief towns in Turan can be reached with much greater speed and safety than is possible by caravan. Fig. 32 shows that the *Central Asian Railway* leaves the old Trans-Siberian line at Samara, and crosses the Ural river at *Orenburg*. After skirting the western margins of the Kirghiz steppe, which separates Siberia from Turan, the line reaches the valley of the Syr, one of the rivers draining into the Aral Sea, and continues to *Tashkent*. In common with other Turan rivers from the central highlands, the Syr carries little water except in early summer, when the melting of the snow fills the river channels. So fast do these rivers flow in their upper courses at this time of the year, that they bring down quantities of silt and rock waste, which is spread out like a fan where the current receives a check, and this, of course, takes place when the lowlands are reached. These fertile land deltas can be made very productive by means of irrigation. *Tashkent*, the political and commercial centre of Turan, is situated in the best part of the Syr valley. *Kokand*, reached by a branch line, is also irrigated by the waters of the Syr.

Leaving Tashkent, the railway proceeds to *Samarkand* and *Bokhara*. These ancient cities are in the valley of the Zarafshan, a river which loses itself in the sand. Bokhara is at the end of the river. Conquered by the Arabs in the eighth century, these oasis cities became Mohammedan centres of learning, but many of the famous buildings were destroyed during Mongol invasions of the thirteenth century. The greatest of all the Mongols, Tamerlane, made Samarkand his capital, and erected

splendid buildings, the ruins of which may be seen to-day. The thirteenth-century traveller, Marco Polo, visited Turan, and has left on record excellent accounts of its cities and their inhabitants. From Bokhara, the railway turns south-westwards, and runs to *Merv*, a very old route centre from which a branch line runs southwards as far as the frontier of Afghanistan. Leaving *Merv* the main line winds across the desert, and has its terminus at *Kfasnovodsk*, on the Caspian Sea.

The new Turkestan-Siberian (Turk-Sib.) railway links the Trans-Siberian and Central Asian railways. It was built as part of the famous *Five Years Plan* and will do much to develop the areas through which it passes, especially the rich mines of copper, silver and other metals in the region south of Omsk and at Semipalatinsk.

We have so far considered that part of the Russian Lands which lie within the great north-western lowland. We will now turn to Eastern Siberia.

EASTERN SIBERIA.

Eastern Siberia, as will be seen from the map, is higher than Western Siberia. South of the tundra, it is mainly an elevated region bordered on the east by the Stanovoi mountains, and extending south-westwards to the forested highlands surrounding *Lake Baikal*. It is drained by the Amur, Lena, and the eastern tributaries of the Yenisei, and lies wholly within the tundra and forest zones.

Between the Yenisei and the Lena is a low plateau, above which rise table-shaped mountains. It is here that the world's greatest extremes of temperature are met with. The river Lena, whose source is close to Lake Baikal, is the least useful of the great Siberian rivers. Notice on the map (a) its very circuitous course, (b) the highlands which border its right bank, thus giving a continuous wall, and (c) the large delta which it is building at its mouth. The whole of its course is through forests or tundra. The only town of any importance on its banks is *Yakutsk*, situated on the great eastern bend of the river. It is the chief centre of the Siberian fur trade, and was

formerly a penal settlement for convicts. The east and west flowing tributaries of the Yenisei have already been mentioned in connection with the help that they gave to Russian expansion eastwards (see p. 95). Its Angara tributary drains *Lake Baikal*, the deepest known fresh-water lake in the world—its depth in places reaching nearly one mile. Its area is almost twice that of Wales. The lake, which is shut in by steep mountain walls, occupies two long parallel troughs separated by a ridge, above which the water is at places less than twenty-five fathoms deep. In winter it is frozen over for four or five months, so that the summer steamship service is replaced by sledges. *Irkutsk*, the largest town in Siberia and the seat of government for Eastern Siberia, stands on the Angara, forty miles from Lake Baikal. In the mountainous region for which it is the centre, gold-mining is an important occupation. The town has gained very considerably in importance since the construction of the Trans-Siberian railway, which passes through it. It is also reached by a camel caravan route, which crosses the Gobi desert on its way from Peking.

The river Amur can hardly be considered a Siberian river. Its lower valley and mouth are in Russian territory, but for the greater part of its course it forms the boundary between Eastern Siberia and Manchuria. It drains a little-developed pine-forested area, whose climate is very severe. Gold-mining and trapping are the most important occupations, whilst in many of the fertile valleys cereals are now cultivated. *Vladivostok*, on an arm of Peter the Great Bay, is a terminus of the Trans-Siberian railway, and is the chief port. It is unfortunate that its fine harbour is closed for about three months every year, owing to being ice-blocked.

Modern Siberia.—It is strange what wrong ideas many people have about Siberia. It is often imagined that the whole country is a land of snow and ice—a great lone land—for which the old Russian Empire had no use except as a place of punishment for criminals and political prisoners. In one sense it may be said that the Russians

themselves only discovered Siberia with the making of the great railway. The old government granted help to people who emigrated to the arable lands of the steppe, and took part in the great agricultural development which took place there in the years before the Great War. It is true that great tracts will always be unable to support many people, *e.g.* the tundra. But Siberia is a large country—half as large again as the whole of Europe—and contains vast forests, the fringe of whose wealth has been scarcely touched, as well as agricultural and pastoral lands with vast possibilities, not to mention the enormous mineral wealth of Eastern Siberia.

The Soviet government is actively exploiting the agricultural and mineral wealth of both Western and Eastern Siberia. Eastern Siberia already grows more wheat than she requires, while the great new metal works of the Kuznetsk Basin depend upon the rich deposits of coal and iron found locally. The successful attempts to export Siberian products via the rivers and the Arctic Ocean are important, and may be compared with similar Canadian efforts through Churchill on Hudson Bay.

Since 1932 very many ships have fully navigated the north-east passage in the summer. *The Northern Sea Route Administration* has established a large number of scientific stations (wireless, meteorological, biological, etc.) along the northern coast-line and on many of the islands, and sea routes are supplemented by air routes. Ports have been constructed on the Ob, Yenisei and Lena. *Port Ingara* on the Yenisei is the largest. It is built entirely of timber, and its population of about 15,000 men, women and children have all left Russia to settle there. Work goes on all the year round, even in winter when the temperature falls much below freezing-point, when there is little daylight, and the town is floodlit by electricity! The principal occupation is the preparation for export of the timber floated down the river during the summer months. *Ingara* exports the timber the following summer, for the river is frozen over in winter and the port is 400 miles from the mouth.

This astonishing achievement is typical of changes that are going on in Asiatic Russia. Perhaps the most astonishing thing is the way the new forms of organization in Russia in Europe, *e.g.* collective and state farms, state ownership of all mines, means of transport, etc., have penetrated to every part of Russia in Asia—tundra, forest, steppes and desert.

EXERCISES.

1. Describe the climatic changes that you would notice in a journey from the Siberian Arctic coast to the Sea of Aral. What other changes would be observed?

2. Write an account of the connection between the physical conditions and the life of the peoples of the tundra and the steppe.

3. What factors have led to the growth and importance of: Omsk, Irkutsk, Samarkand and Vladivostok?

Draw sketch maps to illustrate your answers.

4. What are the leading natural resources of Siberia? State their location, and describe their present state of development.

5. Describe a railway journey from Leningrad to Vladivostok. Describe the character of the country passed through at different stages of the journey, and draw a sketch map in illustration.

6. The Russian Lands occupy about one-third of Asia, but their population is only about one-fortieth of that of the continent.

Explain fully the reasons for this.

7. Which part of the north-west lowlands may be described as a "Land of hunger and privation"? Which part is a "Land of wandering"? How have Russians in recent years shown that settled life can be supported in both regions?

8. Consult the *Statesman's Year Book* and find out the political changes which have taken place since the Great War in the Asiatic part of the former Russian Empire. Do the new subdivisions appear to you to show much relation to the geographical conditions of this area?

CHAPTER XII.

SOUTH-WEST ASIA.

Natural Regions.—(i) The lands having a Mediterranean type of climate. (2) The deserts of Iran and Arabia.

Physical Features.—South-west Asia is composed chiefly of plateaux. In the north-west there is the plateau of Asia Minor, which rises eastwards into the still higher plateau of Armenia, above which tower such lofty peaks as the extinct volcano of Mount Ararat. To the north are the great ranges of the Caucasus, whilst to the south-east the plateau of Iran, comparable in elevation with Asia Minor, stretches as far as the mountain wall to the north-west of India. All these mountains and plateaux are part of the great belt of the central highlands (see p. 74). In the south-west there is the old tilted block of Arabia separated from the Iran plateau by the lowlands drained by the Tigris and the Euphrates. Six seas wash the shores of these lands. They are the Caspian, Black, Mediterranean, Red and Arabian seas, and the Persian Gulf.

THE GREAT ROUTES.

From the very dawn of history south-western Asia has been of great importance. It was in Mesopotamia, the land between the rivers, *i.e.*, the Tigris and Euphrates, that the early civilizations of Babylon and Assyria appeared, whilst the still earlier Egyptian civilization developed along the lower valley of the Nile, which, although not in Asia, is intimately con*

nected with the region we are considering, for the earliest commerce of which we have any knowledge was between Mesopotamia and Egypt.

It was not very difficult for travellers from Babylon to follow the Euphrates north-westwards, and then to strike westwards, via the oasis of Palmyra to Damascus. Turning south-west, this ancient route reached the coastal plains of Palestine, and after passing the fertile land of the Philistines, continued to its destination across the narrow strip of desert to the north of the Sinai peninsula (see Fig. 33). It may appear to be easier to strike due westwards from Babylon across the country separating it from Palestine; but this intervening land is arid desert, and therefore the longer, but safer, route was followed. It will be seen that if this route is continued along the Euphrates, it reaches the coast at Antioch, a point upon which the routes coming from the plateau of Asia Minor also converge. Fig. 33 also shows that Antioch is in the great gateway between the highlands of Asia Minor and those of Syria.

In connection with these routes notice the position of the ancient cities of *Tyre* and *Sidon*. These were the chief cities of the Phoenicians, who thus held a very important position between Mesopotamia and Egypt. When in the course of time the Phoenicians went on the sea and became seamen, they grew to be the greatest sailors of their day, visiting and trading with lands not only on the shores of the Mediterranean, but even daring to pass through the Straits of Gibraltar, the Pillars of Hercules. It is generally believed that the tin-producing islands with which they traded were our own islands, for we know that tin is mined in Cornwall. But since Phoenicia itself is not a very rich country, the decay of the great civilizations between which it lay, resulted, in the end, in the decay of Phoenicia itself.

Let us now return to Antioch, where the route following the Euphrates reached the coast. To-day,

Aleppo is the most important town in that important gap between the plateaux of Asia Minor and Syria. It stands midway between the Euphrates and the Mediterranean, and, through its modern port of Alexandretta, reaps all the advantages formerly enjoyed by -Antioch. From Aleppo, the caravan routes from Syria and Palestine on the one hand, and from the

FIG. 33.—S.W. Asia. Relief and routes.

Euphrates on the other, strike northwards across the plateau of Asia Minor, reaching the coast at Trebizond, Scutari and Smyrna. Another route follows the Tigris from Baghdad, and, passing through Mosul, proceeds west of Lake Van via Erzerum to Trebizond. Thus we see how routes via the Persian Gulf and the great rivers Tigris and Euphrates reach the Mediterranean, the iEgean and the Black seas.

The map shows the importance of the Red Sea as a great highway of trade passing to and from the Mediterranean and the Indian Ocean. In modern times the cutting of the Suez Canal has given a through water passage, but it must not be supposed that the making of this canal discovered the route. It has been known and used for centuries, although it was formerly not so important as the route following the Euphrates.

Mecca, the great centre of Mohammedanism, has been the objective of pilgrims ever since the days of the prophet. Fig. 33 shows the routes by which many of them reach the holy city. Notice that the route which goes from Mecca to Baghdad, via Medina and the comparatively well-watered Nejd plateau, is continued to Teheran, the capital of Persia. The map shows a small river entering the Tigris from the east. It is the valley of this river which makes the crossing of the Zagros mountains comparatively easy.

Other ancient routes are those which traverse the plateau of Iran, avoiding the barren depressions of the centre and keeping to the bases of the better-watered mountains, *e.g.* that from Meshed, via Teheran and Tabriz to Erzerum, or one from Teheran, via Kashan and Kerman to Quetta and the Indus.

In modern times, the great importance of the routes across south-western Asia has led to the construction of railways, of which the most important is the *Baghdad Railway*. When completed, this line will offer a land route to the east in rivalry to the sea route via the Red Sea and the Suez Canal. If a bridge were built across the straits between Constantinople and Scutari—or a tunnel were made under them—the completed railway would give communication from the North Sea to the Persian Gulf, whilst in the future it is certain to be extended to meet the Indian railways at Karachi (see Fig. 33). In Asia Minor, branch lines reach Angora and Smyrna, taking to the latter port the produce of the plateau. The map shows that in the south-east of Asia

Minor, the Taurus mountains bend away from the coast and become a barrier to the line. Here there is the famous pass, the *Cilician Gates*, through which the traffic of many centuries has passed, but the passes are too difficult to be traversed by railways so that tunnels have been constructed. During the Great War the line was constructed as far as Nisibin. From the Basra end the railway now extends beyond Baghdad and Samarra to a point some 50 miles south of Mosul, thus leaving a short middle section to be completed.

Ten miles north of Aleppo the Baghdad railway makes a junction with the French line which runs southwards and passes through Damascus to Medina, with branch lines reaching the coast at Beirut and Haifa. On account of the large number of Mecca pilgrims carried on this railway, it is known as the *Pilgrims' Railway*. The other important railway of S.W. Asia runs from Baku, on the Caspian Sea, to Batum on the Black Sea. This line is linked to the main Russian system by a line which runs round the eastern end of the Caucasus.

Thus we see that one of the most important things in the geography of S.W. Asia—perhaps the most important—is that, owing to the fact that it sits astride the great highways of trade between Europe and the Far East and Australia, and to the presence of the long Red Sea and Persian Gulf arms of sea, routes of great importance will pass across it. Of all the routes, two stand out as of first-class importance—the "through" water route, and the land route from Constantinople to the Persian Gulf. Fig. 33 also shows part of the air route from Britain to India, Malaya and Australia. This quick route is rapidly increasing in importance, especially for mails and passengers. The oil pipe lines mentioned on pages 124 and 126 are also of importance.

Now let us return to our regional study of south-west Asia. For climatic reasons we shall consider the area under the following headings: (1) The Lands of the Five Seas. (2) The Arabian and Iran Deserts.

(i) THE LANDS OF THE FIVE SEAS.

This picturesque name is given to the land bordered by the Caspian, Black, Mediterranean and Red seas, and the Persian Gulf, and, as Fig. 34 shows, it is very suitably named. The Mediterranean and Black Sea coastlands have the dry summer and winter rainfall peculiar to lands having a Mediterranean type of climate (see p. 90). The plateaux lack moisture, and are very

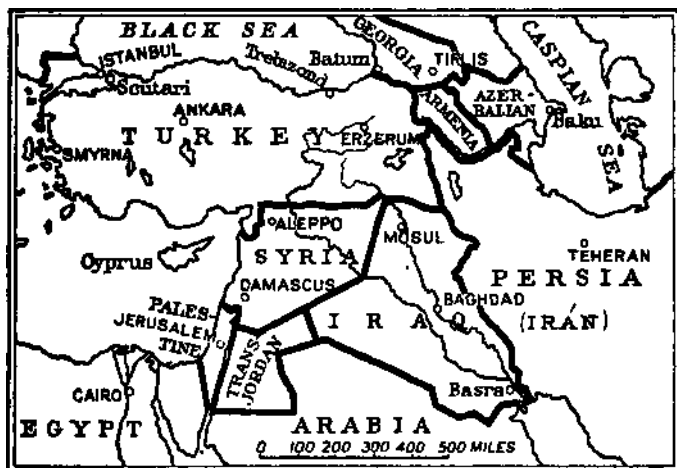


FIG. 34~The Land of the Five Seas.

hot in summer and cold in winter. The rainfall everywhere decreases with distance from the sea, so that the typical Mediterranean trees, the mulberry, olive and vine, give place to pomegranates and dates.

ASIA MINOR.

The plateau of Asia Minor or Anatolia is lowest on the west and highest on the east, where it rises to the high Armenian plateau. It is also crossed by mountain ranges which run from west to east, and the influence of these factors is seen in the drainage and routes of

the country, for both largely follow the same direction. In the north, the plateau descends so steeply to the Black Sea that there are no good harbours; in the south, the Taurus mountains rise very steeply from the sea coast, except in the east, where they bend away from the coast, leaving the very fertile plain of Cilicia. In the west the coast is much indented and there are numerous islands, which are the remnants of the mountain chains which once were continuous with those of Greece. Many rivers flowing between the east and west ranges drain the broad valleys which give easy access to the plateau.

Asia Minor forms the greater part of the Republic of Turkey, for the European possessions of that country are now very small and even Constantinople has ceased to be capital in favour of the centrally placed Ankara.

The coastal lands, including the mountains bordering the plateau, are forested with evergreen trees, with an undergrowth of shrubs, such as the rhododendron. The valleys opening westwards are also well wooded. In both valleys and plains the inhabitants follow settled occupations, and produce, in addition to the Mediterranean fruits (mulberries, olives, grapes, oranges, figs), tobacco, cotton, wheat and barley, whilst along the west coast sponge fishing is important. A considerable amount of silk manufacturing is carried on, especially at *Brussa*, at the foot of Mount Olympus, and other manufactures are of cotton and wool, the latter being used in making fine Turkey carpets and rugs. *Smyrna*, situated on a splendid harbour between two fertile valleys opening out to the *Ægean Sea*, is the chief port, its exports being representative of all the products of the country. Formerly *Smyrna* and the coastlands generally were largely inhabited by Greeks. To-day not only in Asia Minor but also in European Turkey, except in Constantinople, there are extremely few Greeks.

The plateau lacks moisture and has very cold winters, so that there is little vegetation beyond grass, and parts are even deserts in which are oases where the date palm,

as in the Saharan oases, is of the greatest importance. The plateau dwellers are, therefore, largely nomads, who move about from place to place attending to the wants of herds of camels, horses, goats and sheep. In the east the plateaux are more rugged. They are crossed by high ranges which here come close together and sometimes enclose fertile valleys. Erzerum, the largest town in this part of the country, lies over a mile above sea level and is so exposed that it is sometimes called the "Siberia of Turkey." Trebizond, on the Black Sea, is the port for this area.

Ankara, on the lower western plateau, is noted for fine goats' hair, greatly prized in the manufacture of mohair cloths. The city has fine modern buildings and is centrally placed for its function as capital of modern, progressive Turkey.

TRANS-CAUCASIA.

Trans-Caucasia is largely drained by the Kura river. The Caucasus mountains consist of rugged parallel ranges, in which are numerous glaciers. Their southern slopes are densely forested and contain valleys in which Mediterranean fruits and cereals are produced. The lower valley of the Kura is an extensive fertile plain opening to the Caspian Sea. Tobacco, cotton, and maize, as well as the vine, are produced here. South of the Kura are the plateaux of the Lower Caucasus. Here lies the Republic of Armenia, whose capital is Erivan. Note the large lake, Sevan, which is 6,300 ft. above sea-level. Agricultural occupations, especially the growing of cotton on irrigated fields, occupy most of the inhabitants.

Baku, an important port on the Caspian Sea, stands at the north of the plain, and is the centre of a very important petroleum area. It is not a very inviting town, for even the air is pervaded by the smell of oil, whilst the numerous refineries and pumping

stations are not buildings which can enhance its appearance. Since it is on an enclosed sea, the oil is sent by pipeline to *Batum*, on the Black Sea. Here it is pumped into oil-steamers and shipped to all parts of Europe. Between Baku and Batum the line passes through *Tiflis*, the capital of Georgia. The city is beautifully situated on the precipitous cliffs of the ravines of the upper Kura. In addition to its position on this important railway, it also commands the easiest north and south route across the Caucasus via the Georgian Highway. This route is very important, and has been followed by a splendid road, built primarily for military purposes. Eventually it will be followed by a railway line. The Georgian Highway is, of course, snow-bound in winter.

SYRIA AND PALESTINE.

Syria and Palestine, lands full of interest on account of their Scriptural connections, lie along the eastern shores of the Mediterranean Sea. The former is a high plateau, whilst in Palestine, north of Mount Carmel, the highlands are farther away from the coast, leaving a fertile coastal plain everywhere less than 600 ft. above sea-level. Rising abruptly from the plains is the plateau of Judea and Samaria, which is not so high as that of Syria, farther north. The plateaux of Syria and Palestine slope gradually towards the east, and form the Syrian desert. Notice the north and south direction of the Jordan and the Gulf of Akabah, which is the more easterly of the two gulfs at the northern end of the Red Sea. The greater part of the Jordan valley is below sea-level, the surfaces of the Sea of Galilee and the Dead Sea being 682 ft. and 1,291 ft. below sea-level respectively. These lakes occupy part of the floor of what is known as a *rift valley*, a type of valley which we will now proceed to explain.

Rift Valleys.—During the formation of a fold in the crust of the earth the pressure is generally so steadily

exerted that even rocks are gradually forced into folds. But in some cases the beds of rock cannot withstand the strain of the bending required, and they accordingly fracture. This causes blocks of the earth's crust to be raised and others to be depressed relatively to each other. Such crustal blocks are bounded by faults (see

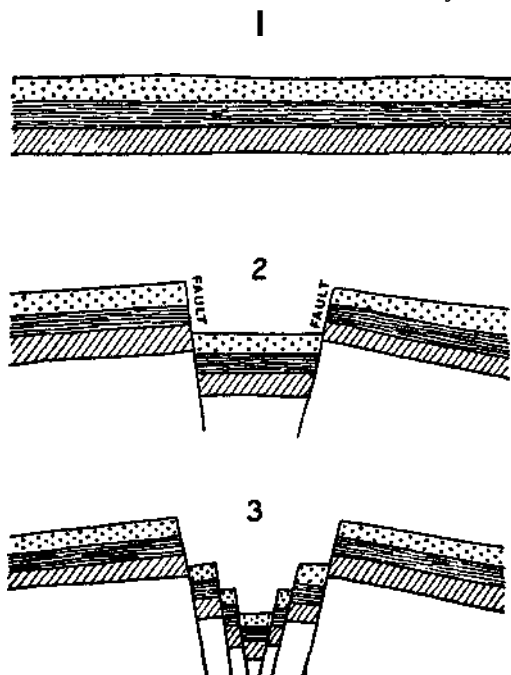


FIG. 35.—Sections illustrating the formation of a rift valley.

Fig- 35). Very often the land between two parallel faults is let down, and a comparatively narrow depression is formed. This is known as a rift valley. The Red Sea, as is indicated by its length and width and its steep, straight sides, occupies such a valley, which is a continuation of that of Palestine. Turning south-westwards at the southern end of the Red Sea, this

great rift is met by another which contains the Gulf of Aden, and is then continued across Africa as far as the south of Lake Nyassa. The connection between the Asiatic and African rift valleys is shown in Fig. 36.

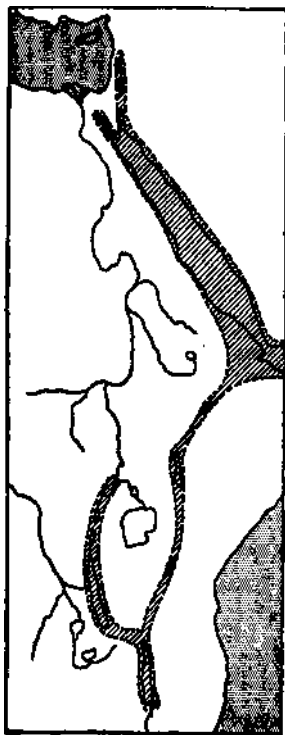


FIG. 36.—The Great Rift Valley.

In Palestine all the Mediterranean plants can be cultivated, and great quantities of wheat and barley used to be grown on the coastal plains. The hill sides were terraced for the culture of the vine, and irrigation works were carefully constructed, whilst the hill country was inhabited by prosperous shepherds. The Turks sadly neglected these lands, and in the place of fertility they left behind them poverty and waste. At the present time, however, great schemes for barraging the Jordan below Lake Tiberias are in progress. These will provide water for the fields and power for industries and are expected to do much to bring back prosperity to this ancient land. Already the population of Palestine has doubled since the Great War, and this is chiefly due to Jewish immigration.

In modern times the most important port is *Beirut*, which is surrounded by a very fertile tract of land, and is connected by rail with *Damascus*, the capital of Syria. *Damascus* is an oasis made by the waters of a small river at the base of the Anti-Lebanon mountains. It owes its importance to its control of routes—eastward to Mesopotamia,

and southward, via the Pilgrims' Railway, to Mecca.

The ancient city of *Jerusalem*, the capital of Palestine, has a central position, and one that could be easily defended, for it is protected on three sides by deep ravines. It is a walled city, and is visited every year by thousands of pilgrims and tourists, who are attracted by its sacred associations. From Jerusalem a railway runs to its port, *Jaffa*, but at present it has no connection with the Mecca railway owing to the difficulty presented by the Jordan rift valley. There is also a frequent service of motor omnibuses between the two towns. The journey takes about two hours. *Jaffa* has a very important export of oranges. Its near neighbour, *Tel Aviv*, has been built by Jewish enterprise. *Haifa* has increased in importance with the coming of the Jewish settlers, and has a modern harbour opened in 1933.

MESOPOTAMIA OR IRAQ.

As we have seen, the word Mesopotamia means "between the rivers," that is, the Tigris and Euphrates. We shall here use it to include all the lowlands shut in between the Arabian plateau and the Zagros mountains. Upper Mesopotamia, which was roughly the ancient land of Assyria, has a much more varied relief than the lowlands of southern Mesopotamia, which was occupied by Babylon. The latter lowlands consist mainly of alluvial deposits so low lying that many parts are swamps. The Euphrates and Tigris rise amidst the snows of the Armenian mountains, and their upper courses are very wild. Before reaching the Persian Gulf they join and flow through a region rendered swampy by the uncontrolled flood waters. The combined river is busily engaged in filling up the Persian Gulf, and is pushing its delta onwards at the rate of about 70 ft. per year. Close to the rivers, where irrigation is rendered easy, fields of cotton, wheat, tobacco and maize are found, whilst sugar and date palms are important in the lower valley. The rainfall, however,

is so small that without irrigation agriculture cannot be carried on, and since the same story of Turkish neglect has to be told of this land as of Syria and Palestine, the present condition of the greater part of the country is little better than a poor steppe land in which nomadic Arabs and Kurds pasture their flocks. There is no doubt that, given wise government, Mesopotamia would once again become one of the gardens of the world. As in Egypt, great barriers could be put across the rivers in order that water may be held up for use when the rivers are low. Large irrigation schemes are already in hand.

Even to-day the most important towns stand on the rivers. *Mosul* stands at the navigation limit of the Tigris, and is built mainly upon rising ground so as to be above the level of the river floods. Its name means "Central Gates," and was bestowed upon the city because it is situated at the intersection of routes from the Black Sea to the Persian Gulf, and from the Mediterranean Sea to the Caspian. On account of its site at the intersection of these routes, and at the navigation limit of the Tigris, it has been said that whatever military power holds Mosul must eventually become the possessor, sooner or later, of the whole of the Tigris valley, and even of the whole plain as far as the Persian Gulf. The ruins of the ancient Assyrian capital, Nineveh, stand on the opposite bank of the river. In ancient times, as now, in a country which has little stone for building purposes, the chief substance used in house making was sun-dried brick, made of clay. One point about the site of Mosul must be mentioned. Nineveh fell into decay, but Mosul arose near its ruins. Should Mosul disappear, another city will arise somewhere near by, for here is one of those places where the geographical conditions make it inevitable that there should be a town.

At *Kirkuk*, nearly 100 miles south-east of Mosul, **are** rich oil wells belonging to the Anglo-Iranian Oil Co. (see p. 126). The oil is pumped along a pipe to Haditha

on the Euphrates. From this point the pipe line bifurcates, one branch going to Tripoli, the other to Haifa. At these ports the oil is pumped directly into tankers. The construction of these pipe lines was a magnificent achievement (see Ex. 4 on p. 128).

Baghdad, famous in the *Arabian Nights*, is a walled city, standing on both banks of the Tigris, at the point at which that river comes very close to the Euphrates. The latter fact is of importance, as it may be possible to unite the rivers by canals, used for navigation as well as irrigation. A tributary from the Zagros mountains enters the Tigris at Baghdad and adds to its importance, for a route to Teheran, the capital of Iran, follows the valley of this river, and gains a fairly easy crossing of the Zagros mountains. South of Baghdad, but on the Euphrates, stood Babylon, now in ruins.

Basra stands near the Shat-el-Arab, the combined Tigris and Euphrates, and is the port for the delta lands. It is built about a mile from the river; but the district is so cut up by canals that all communication takes place by water. The surrounding country is dreary, owing to the extent of the marshes which are a source of malaria, but near Basra itself there are extensive plantations of date palms. The town is reached by ocean vessels. *Abadan* is the port for the Iranian oil-fields (see p. 126).

(2) ARABIA AND IRAN.

These arid lands are both plateaux, Arabia an old fractured and tilted block, and Iran a plateau whose uplift accompanied the growth of the young folded ranges which border and cross it.

ARABIA.____)

The Arabian plateau, very little of which is less than 1,500 ft. above sea-level, is highest along the Red Sea shores, from which it slopes eastwards to Mesopotamia and the Persian gulf. The map shows that the south-west, the south, the centre, and the land bordering the

Gulf of Oman are all high. The central highland is the large plateau of Nejd.

Arabia is one of the driest lands in the world. The higher districts, especially those of the south-west and the centre, receive slight rains, and on that account pastoral occupations can be carried on there; but elsewhere the land is practically rainless. Except in the south-west, there are no permanent streams, only wadis, or channels which are supplied with water after the occasional rains, but even then the streams never reach the sea. There are, however, oases where underground sources of water can be reached, or where springs occur, and in these date palms and cereals can be cultivated. Such oases are found in the valleys of the Nejd plateau, where rain falls during spring and autumn in sufficient quantity to give a covering of grass for a short time. It is on account of this that the Nejd region is famous for its breeds of horses, camels, donkeys, and sheep.

In Yemen, in the south-west, there are permanent streams flowing to the Red Sea, and, owing to the elevation, the high parts enjoy a warm, temperate climate. Fields of wheat and fruit-trees are numerous, and coffee is an important product. Coffee is grown on the lower south-west slopes, where the climate is hot and moist, and mists from the sea are very common. *Mocha*, whose name is usually associated with the coffee from this region, is not now so important for this article as *Hodeida*, the chief port.

The remainder of the west coastlands, and those in the south, are hot and dry, and almost uninhabited. In the region of the Oman highlands, in the south-east, some rain falls, and there are parts which are suitable for pasture. Notice the Bahrein Islands, in the Persian Gulf. They are British, and have important pearl fisheries. Another British Arabian possession of very great importance is *Aden* in the south-west, more than one hundred miles from the narrow straits of Bab-el-Mandeb, by which the Red Sea is entered, but sufficiently near to that entrance to be of great value as a naval

and commercial depot. In the straits themselves is the small island of Perim, which is also British, and is attached politically to Aden. The latter town is built in the crater of an extinct volcano. Rain falls very irregularly, often at intervals of more than a year, so that fresh water has to be obtained by means of the evaporation of sea water. In addition to this, large tanks have been cut in the rock, in order to receive and store the storm-brought rains. Aden's chief importance lies in its strategic position, and therefore it is strongly fortified, whilst it is on the great ocean trade route to India, the Far East and Australia.

The most interesting town in all Arabia is Mecca, famous as the birthplace of Mohammed. Every year it is visited by thousands of pilgrims, who make long journeys to the tomb of the prophet. Except the great mosque, there are few handsome buildings, for it is desired that no other building should rival the sacred edifice. The port of Mecca is Jiddah. Medina, north of Mecca, contains the tomb of Mohammed, and is also much visited by pilgrims. It can now be reached by railway from Aleppo and Damascus. Apart from this line, the chief means of communication in Arabia are naturally by means of caravans.

IRAN.

The Iran plateau, the greater part of which is about a mile above sea-level, is really a depression, bounded on the north by mountains stretching from the Elburz to the Hindu Kush (=Slayer of the Hindu, *i.e.* by means of avalanches); on the east by the Sulaiman and Hala mountains, and on the south and west by the coastal highlands and the Zagros Mountains. Communication in a region like this is naturally very difficult, and depends chiefly on the use of camels and mules, for, excepting the roads leading from Teheran, the Persian capital, to the Black Sea, there are no roads upon which wheeled conveyances can be used with ease. The two great caravan routes avoid the central depressions, of

which the two largest are the Great Salt Desert in the north-west, and the Seistan depression in the east. The sandy soil of the former is impregnated with salt, whilst the few rivers which traverse the latter, lose themselves in extensive salt marshes. In the latter connection, notice the Halmand river.

With regard to the climate of Iran, there are marked contrasts between (a) the Persian Gulf coastlands, where the climate is unhealthy, owing to a damp heat, with a low rainfall; (b) the greater part of the plateau, where there are extremes of winter cold and summer heat, together with a small rainfall; and (c) the lands bordering the Caspian Sea, where the climate is of the warm, temperate type. In the latter region there is ample rainfall, and the slopes of the mountains are forested.

The products of Iran closely correspond to the climates. On the plateau the poor pasture supports goats, sheep, and camels, and pastoral products are of chief importance, and have been the means of making Persian carpets and cloths famed the world over. On leaving the mountains, the rivers in many cases disappear underground, owing to the porous nature of the limestone, of which much of the plateau is composed. An elaborate system of underground canals, or *kanats*, partly natural, partly artificial, is often found in the vicinity of the larger plateau towns. By means of these less water is evaporated by the heat of the sun, and water can be obtained for irrigation in order that otherwise desert areas may become oases, and rice, tobacco, etc., be cultivated. Along the south coast the date palm is the typical product, whilst in the lowlands bordering the Caspian Sea, silk, cotton, and sugar are produced.

The mineral wealth of Iran is considerable, but is not worked, except for the valuable petroleum deposits which have been found along a zone extending in the west of Persia from Kurdistan to the Persian Gulf. The chief Persian wells are some 150 miles north-east of *Abadan*, the port of Iraq, to which the oil is brought by pipe line. This oil-field, and the newer one in Iraq (see

p. 122), are worked by the Anglo-Iranian Oil Company.

The chief Towns of Iran.—*Teheran*, the capital of Iran, the new name for Persia, lies at the southern base of the Elburz in sight of Mount Demavend, a snow-capped volcano of majestic appearance. It is the converging point of routes (see Fig. 33). One of the most important of these passes through *Ispahan* and *Shiraz*, both oasis towns, to its termination at *Bushire*, the chief port. Another route goes westwards to *Tabriz*, next to the capital the largest city in the country, and eastwards to *Meshed*, famed for its shawls and carpets. A Trans-Iranian railway runs from *Bandar Shapour* on the Persian Gulf via *Hamadan* to *Teheran* and *Bandar Shah* on the Caspian.

The capital of Afghanistan is *Kabul*, a town of great strategic importance, since it controls the Khaibar Pass, a narrow defile some thirty-three miles long. This pass, which does not follow the *Kabul* river, leads to the plains of north-west India, and can be held by a few good marksmen against a large number of attackers, for in places it is very narrow indeed. *Kandahar* and *Quetta*, the former in Afghanistan and the latter in Baluchistan, are on another route, which also leads to the plains of the Indus, via the *Bolan* Pass.

THE POLITICAL UNITS OF SOUTH-WEST ASIA.

Changes as a result of the Great War are indicated on Fig. 34. At first the collapse of the central Russian government and the difficulty of communication across the Caucasus led to the secession of the Trans-Caucasian peoples and their formation into semi-independent states. Round *Erivan* an *Armenian Republic* has been formed which also includes some former Turkish territory. The area round *Tiflis* and *Batum* has become the *Republic of Georgia*, whilst in the lower valley of the *Kura* and along the shores of the *Caspian* we have the *Republic of Azerbaijan*, with *Baku* as capital. These three republics belong to the Union of Soviet Socialist Republics. Their capitals are connected by railway with each other and also with *Erzerum* (Turkey) and *Tabriz* (Iran).

The peace treaty with Turkey, itself now a republic, demanded that she recognized the independence of *Armenia, Iraq, Syria, Palestine* and the *Hejaz* (Arabia). Greece held the city and district of Smyrna for a time, but they have now been returned to Turkey. Thus all that is left to Turkey of her former vast Asiatic possessions is Asia Minor. Under mandates from the League of Nations, Britain guides the affairs of Palestine, and France those of Syria. In 1929 *Trans-Jordan* was given a government, independent of Palestine, under its Arab prince. It is still part of the territory mandated to Britain, and the High Commissioner of Palestine is also High Commissioner of Trans-Jordan. Iraq, which was ruled under mandate by Britain until 1927, is now independent. It has a native government with an Arab king. In Palestine an effort is being made to create a national home for the Jewish people. Some success has already been achieved in this direction, for the total population in the new settlements is about 50,000. The settlers have come from many countries in order to make homes in the ancient Jewish homeland. Unfortunately, Jews and Arabs have so far failed to agree to live peaceably together.

The political units of the Iran plateau remain unchanged. *Iran* (Persia) and *Afghanistan* are independent, and *Baluchistan*, a stony desert with a few oases, forms part of the British Indian Empire. All three occupy positions of great political and strategic importance, especially was this so in the days when they were "buffer states" between powerful Russian and British interests.

EXERCISES.

1. Of what importance is Aden? What is its annual rainfall? How is the town provided with fresh water?

a. What special features are there in the physical geography of the Jordan valley? Are these features to be found in Britain?

3. Why are the following cities important to-day, and why were they important in ancient times: Baghdad, Jerusalem, Damascus, Aleppo?

4. Find out how the construction of the oil pipe lines (pp. 123, 126) has affected the life, distribution and education of the people. Make a map of these pipe lines and, in writing, give an account of the difficulties overcome during their construction.

CHAPTER XIII.

INDIA AND CEYLON.

PHYSICAL FEATURES, CLIMATE AND VEGETATION.

OUR Indian empire, as defined by Act of Parliament, includes not only the great peninsula south of the Himalaya mountains, but Baluchistan, of which we learned in the last chapter, in the west, and Assam and Burma in the east. It covers an area of about a million and a half square miles, and can be regarded as a small continent in itself, rather than as a country. Its population numbers about 353 millions, who belong to many races and religions, and speak many languages. Some of its cities are among the finest in the world, whilst many of its inhabitants are extremely backward. It is a land of great contrasts.

PHYSICAL FEATURES.

An examination of the physical map will at once show—

1. The great mountain barrier in the north-west, the north and the north-east.
2. The extensive plains of the Indus and the Ganges.
3. The triangular plateau of the Deccan, bordered by much wider plains on the east than on the west. Ceylon is a detached portion of this plateau.

I. THE NORTHERN RANGES.

To the north of India is the high plateau of Tibet, to the south of which rise the Himalaya mountains.

As seen from the plains of the Ganges, these mountains rise very suddenly from land which is almost dead level. The Himalayas are a series of parallel earth folds which rise, ridge behind ridge, until the highest central crest is reached. This central ridge, known as

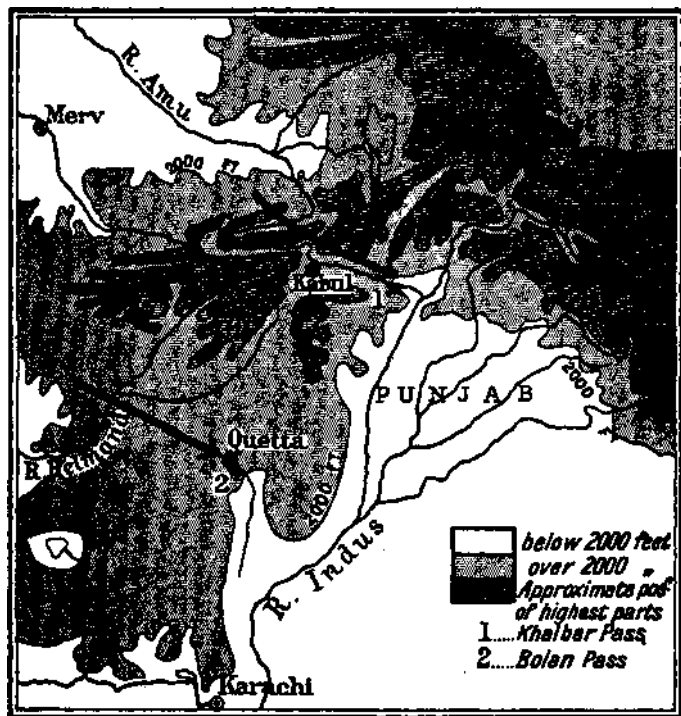


FIG. 37.—The north-west gates to India.

the snowy Himalayas, contains all the highest peaks, including Mount Everest, the highest mountain in the world. This giant has a summit over 29,000 ft. above sea level. The crests of the Himalayan ranges are snow-covered, and glaciers are numerous. Owing to the great width and height of this system (no pass is

THE INDO-GANGETIC PLAIN

lower than 17,000 ft.), they have always been a great obstruction to communications between the bleak plateau of Tibet and India. North of the western Himalayas, and separated from them by the upper Indus, are the Karakoram mountains, an eastern continuation of the Hindu Kush.

In the north-west of India, the Iran plateau, bordered by the Sulaiman and Hala mountains, rises above the plain of the Indus. The mountain barrier here is not so continuous as in the Himalaya region, and there are two passes which give fairly easy access to India from the north-west. They are the Khaibar and Bolan passes (see Fig. 37). These are the great gateways leading into India from Iran and the Turan lowlands, and have been followed by many conquerors and invaders.

In the north-east, the Himalayan ranges bend south and traverse Indo-China. The mountains here are much more of an obstacle to invaders than those of the north-west, but not so great as the Himalayas. Many Mongols have entered India from the north-east, but their numbers have been few compared with those invaders who came through the north-west gates. The Andaman and Nicobar islands mark the tops of continuations of one of these north and south-eastern chains.

2. THE INDO-GANGETIC PLAIN.

This extensive lowland lies between the northern ranges and the Deccan. It has been very slowly built up by the sediment brought from the mountains by rivers. So fine is this alluvium that it is very rare to find stones or pebbles. The map shows that the Ganges is nearer to the northern edge of the Deccan than to the Himalayas, and this is partly due to the fact that the Himalayan rivers have higher sources and greater volumes than those from the Deccan, and consequently push the river southwards, and partly to the raising of the land on the north of the plain due

to the deposition of sediment. In this connection it is interesting to notice the lower course of the Indus, where the river flows comparatively close to the mountains, as it receives no tributaries in this section. It is worthy of note that the three great rivers of India, the Indus, Ganges and Brahmaputra, have headstreams (in the case of the Ganges one of its tributaries) which have their sources north of the Himalayas, about the centre of the system (see Fig. 51). The rivers reach the Indo-Gangetic plain by means of difficult and often inaccessible gorges. It is very probable that the rivers existed before the mountain ranges, and that the latter were uplifted so slowly that the rivers were able to maintain their north and south direction by cutting gorges of constantly increasing depth. At their mouths they are building up great deltas, thus extending the area of the plain. The low-lying region at the mouth of the Ganges-Brahmaputra is known as the *Sundarbans* (= forests), a swampy region across which the deltaic streams meander, and in which they often change their courses, so that there are many towns which have become derelict owing to their being no longer on navigable waterways. The map shows that the watershed between the Indus and the Ganges is a very low swell of ground which extends from the Aravalli hills to the Himalayas.

3. THE DECCAN.

We have already learned that the Deccan is a fragment of the ancient southern continent, and that it is a plateau so tilted that it presents a steep face to the Arabian Sea, and has a long slope to the Bay of Bengal, along which are coastal lowlands much wider and more extensive than on the west. The western edge of the Deccan forms the Western Ghats (— steps) and its eastern margins the lower and much more broken Eastern Ghats. The Vindhya mountains form the water parting between the Deccan rivers and those

which **flow** to the Ganges. The longer Deccan rivers as, for example, the Godaveri, Kristna, and Cauvery, **flow** eastwards, their valleys having very considerably dissected the plateau. Their upper valleys are steep, contain many waterfalls and are often inaccessible.' The rivers flowing westwards are much shorter, except for the Narbada and the Tapti, between which are the Satpura mountains. On a first glance at the map it would appear as though those river valleys offered good routes from the Gulf of Cambay to the Ganges basin, but we shall learn later that this is not the case in their lower courses, on account of the dense forests which are found there. The easiest natural route across the western Ghats is south of the Nilgiri hills (see Fig. 43), where the Palghat Gap, about 1,000 ft. above sea level, forms a natural means of communication between the Malabar and Coromandel coasts.

In the north-west of the Deccan there are large areas covered with a very rich black soil, made by the decomposition of the basalt rock which is found in that region. This soil can hold moisture long after the rains have ceased, and as it is much used for the production of cotton, is often called "the black cotton soil of the Deccan."

CLIMATE.

The greater part of India has what is known as a monsoon type of climate—that is, the rain falls mainly in summer. We have seen that this is due to the position of India on the fringe of a great land mass which is greatly heated in summer and cooled in winter, so that, at the former season, winds blow from the oceans towards the low pressure areas on the land, and during the latter season from the high pressure areas situated over the land towards the ocean, where the pressure is less. We must now go into more detail. The great mountain barrier to the north of India is a climatic as well as a physical barrier. The winter, or cool season, winds of India blow from the north-east,

and those of summer from the south-west, but it does not appear that the former have come from the heart of the continent, or that the latter are making for the large low pressure system north of India. Fig. 38 gives temperature maps for January, May, July, and

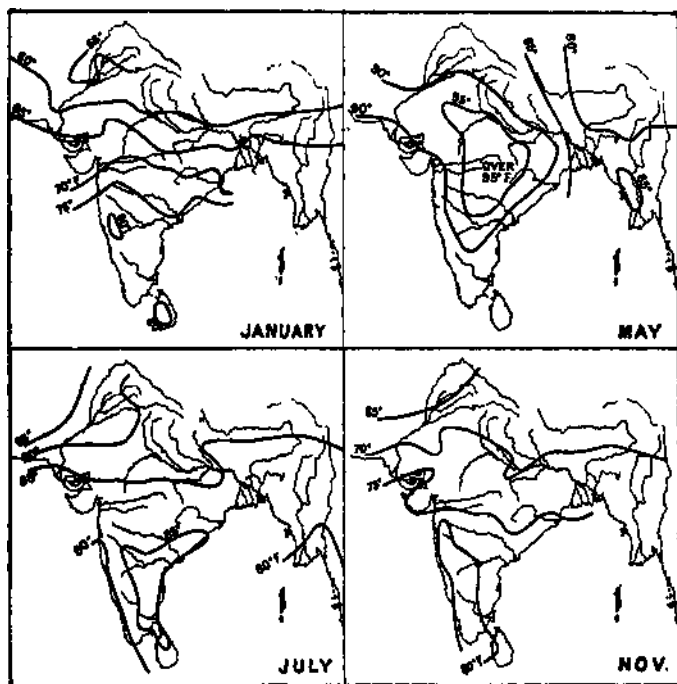


FIG. 38.—India. Temperature maps.

November. It will be seen that the coldest part of India in January is in the north-west, *ie.* the lower Indus basin and the Thar desert. Between January and May the heat is gradually increasing, until at the end of May the region of greatest heat is the centre of the peninsula. At this time of the year the sun is seen overhead at noon in the northern hemisphere nearer

and nearer the Tropic of Cancer every day, so that, in July, the region having the highest temperature is the same area which was coldest in January. This, of course, means that this region is a centre of high pressure in January, and of low pressure in July (see Fig. 39). Now it is from this local area of high pressure that India's winds blow in the cool season, and towards this area of low pressure that they blow during the wet season.

During January and February India has its *cool*

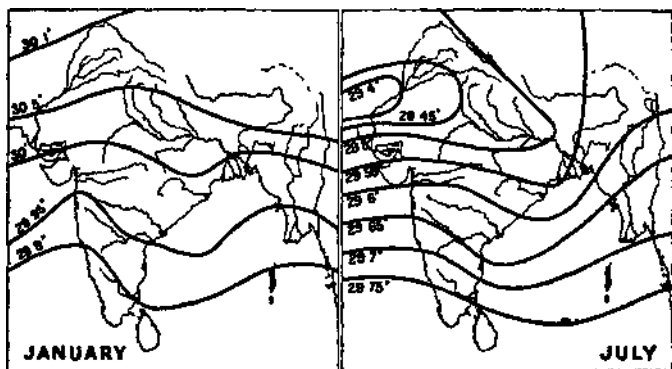


FIG. 39.—Pressure maps for January and July.

wather season, and in this month there is a movement of air from the north-west along the valleys of the Indus and the Ganges. Over the ocean these winds, obeying Ferrers Law, are deflected to the right and become N.E. winds—in fact, the N.E. Trades. Lying between the two great air currents, the Deccan, at this time of the year, receives few winds and is dry and dusty. March, April and May are the months of the *hot weather season*. The northerly migration of the sun causes India to be slowly heated, until at the end of May the heat, especially on the Deccan, is almost unbearable. The whole country is baked, the grass is

withered, even man languishes, and everything is ready for the coming of the monsoon. Some rain falls in the south and on the mountains, but in insufficient quantities to relieve the general state of depression. The region of greatest heat moves to the north-west, the winds of the earlier part of the year cease to blow, and, early in June, the monsoon winds reach Bombay. From June to October is the *Season of the South-west Monsoon*.

The coming of the monsoon is heralded by cyclonic storms of great violence, but they are soon over and calm reigns again, only to be broken by other storms, which usually occur about every fortnight. The periods of calm between the great storms are very important, for immediately following one of them the farmers put their plants in the ground (especially rice and indigo), so that they may be firmly rooted before the next storm arrives. What has really happened is, that the Doldrums low pressure area has moved as far north as northern India, so that the south-east Trades¹ cross the equator (see Fig. 40). Having done this, they are under the influence of deflection to the right, for they are now in the northern hemisphere. This great mass of air meets the wedge-shaped Deccan and we thus have one current proceeding into the Arabian Sea, the other into the Bay of Bengal. Under the influence of deflection the former current reaches the western Ghats, and is suddenly forced to ascend, and, since these winds have come over thousands of miles of water, the rainfall is tremendous. Indeed, so much is liberated that the winds continue eastwards across the Deccan as dry "Chinook" winds. • It is owing to this fact that the Deccan is indifferently watered, and is often troubled by famine. This danger has been somewhat mitigated by the construction of tanks of reservoirs for the storage of water. It must also be noted that the full force of the south-west winds is not felt north of the Gulf of Cutch, so that even at this season little rain is brought to the lower Indus basin, whilst, owing to the low elevation of this region,

there is less precipitation from those sea winds which it does receive.

The air currents passing up the Bay of Bengal water the greater area. Some of the winds blow towards the hills of Assam, and enormous quantities of rain fall there, Cherrapunji having a world's record—a mean annual rainfall of 460 in., or nearly 39 ft. Other currents, making for the low pressure area in the north-west, pass along the Ganges valley, dropping rain all the way. Very gradually these conditions change, and November and December may be named the *Season of*

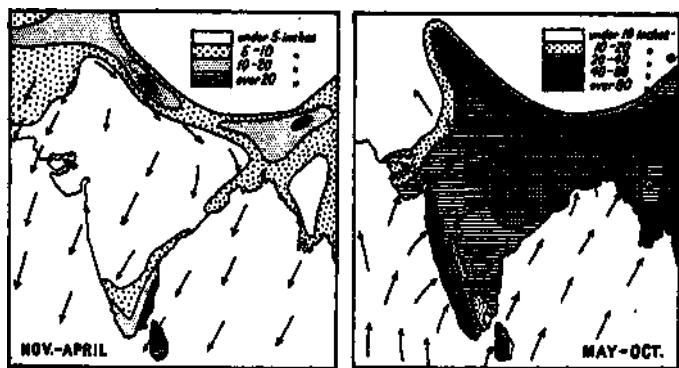


FIG. 40.—India. Winds and rainfall.

the Retreating Monsoon. The north-east winds begin to gain control in the north, and the south-west winds retreat farther and farther south; but before they finally disappear they bring rainfall to the south-eastern margin and to Ceylon.

Dividing the year into two periods, it will be seen that the drier six months are from November to April, and the wetter from May to October (see Fig. 40). All the rain which falls in the latter period is brought by the summer monsoon. From November to April, the greater part of India receives little rain because (except for the rain which is brought by the receding

monsoon) the only parts receiving winds from the ocean are the south-east and Ceylon.

NATURAL VEGETATION AND CULTIVATED PLANTS.

NATURAL VEGETATION.—The kind of vegetation a country has depends chiefly upon two factors—temperature and rainfall. As regards the former, we have seen that India may be said to have a hot climate. As regards rainfall, that of the Western Ghats, the Himalayas and the mountains of Assam and Burma is very heavy, resulting in dense forests on their lower slopes. Teak is one of the most valuable of the forest trees, and elephants are cleverly trained to move the heavy logs from place to place.

Of course elevation has a very important effect on natural vegetation. This may be illustrated from the vegetation of the Himalayas (see Fig. 41). The foothills are bordered by the swampy, malarial region known as the Terai, which in parts, especially in the wetter east, is wild jungle. Up to about 3,000 ft. the vegetation is tropical, and tall ferns, bamboo, teak and sal are found. From this elevation to about 7,000 ft. magnolias, oaks and chestnuts abound, and all are festooned by long convolvuluses. Forests of this type give way to gigantic conifers such as pines, firs and cedars, which are found up to an elevation of about 12,000 ft. Beyond this the trees disappear, and pasture lands, the Alp of the Himalayas, are met with, as well as fields of beautiful flowers. The pastures become poorer and poorer, and gradually merge into vegetation of the tundra type before the snow line (about 16,000 ft. on the southern slopes) is reached.

The monsoon winds also blow up the valleys of the Narbada and Tapti, and the heavy rains which fall account for the dense forests in the valleys of these rivers. The delta of the Ganges-Brahmaputra, the Sundarbans, is also a densely forested swamp, inhabited

by tigers, deer, wild boars, enormous crocodiles and reptiles. Much of Ceylon is forested.

On the borders of the desert of Thar there are considerable areas where, owing to the light rainfall, agriculture cannot be carried on, although it is possible to rear cattle, as the prevailing vegetation is that of poor grassland. Much of the Deccan is savannah, due

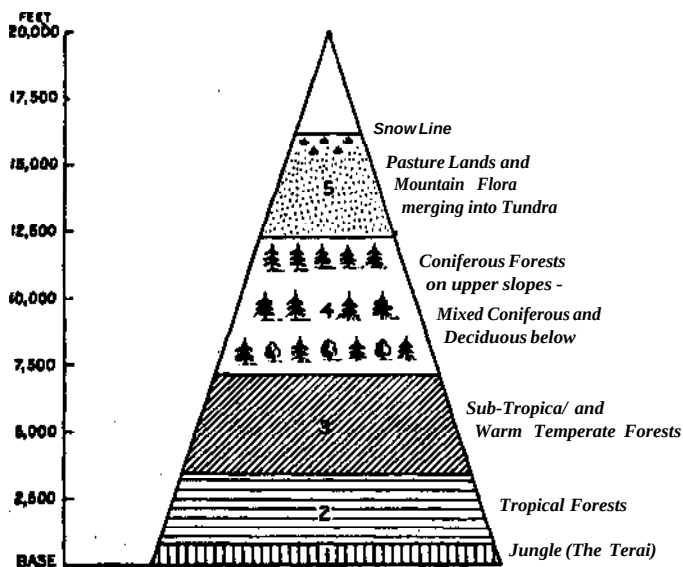


FIG. 41. -The vegetation belts on the southern slopes of the Himalaya Mountains.

to the lack of water, for it must be clearly understood that, as the greater part of India receives rain in summer only, forests will not be found in those places where the summer rain is not sufficient to keep the soil moist at all seasons.

CULTIVATION AND WATER SUPPLY.—Agriculture is by far the most important occupation in India, and since the type of climate to which that of this country belongs is

suitable for a great variety of plants, we have in India a very varied list of cultivated products. The great drawback is the occasional failure of the summer monsoons to bring an adequate supply of rains. When this occurs very serious famines are the result, and thousands of people die. In the areas which are indifferently watered it is absolutely necessary to practise irrigation if agriculture is to be successfully carried on.

In the Ganges valley, the low-lying lands of the delta and of the lower valleys of the two great rivers are so near sea-level that the land cannot be drained, and is actually too wet and swampy for full use to be made of it. Farther up the Ganges valley the land is a little higher, the rainfall is sufficient, and it is here that we have land most suitable for the production of India's chief product—rice. Proceeding towards the upper Ganges basin we come to an area where the rainfall is not sufficient for the needs of agriculture, and it is necessary to resort to irrigation, which has been carried on to such an extent that the whole region has been covered with a network of canals and pitted by thousands of wells. Continuing to the mouth of the Indus we cross the poorer grasslands, already referred to, and the arid lands of the lower Indus. But even here a great barrage has been built across the Indus just below Sukkur, where the river is a mile wide. The water held back by the barrage irrigates an area as large as the six northern counties of England.

In recent years many irrigation canals have been constructed in the Punjab, which is situated in the upper valley of the Indus, and is drained, as its name implies, by five great rivers, the Indus and four important tributaries. Some of these canals carry more water than the Thames at London, and all have enormously increased the area which can be used for production, although it must be borne in mind that irrigation has long been practised in this part of India.

In many parts of the Deccan it is also necessary to store water for use in the dry season, and this is done

in great tanks and reservoirs. At Bhatyar, about 30 miles south of Poona, the famous *Lloyd Dam*, one of the largest in the world, holds back a lake 17 miles long and supplies irrigation canals with water for an area of over 1,300 square miles.

CULTIVATED PLANTS.—Fig. 42 shows the distribution of the leading vegetable products of India. It will be seen that *rice* is grown chiefly in the well-watered lowlands of the Ganges basin and along the coastal plains bordering the Deccan and eastern Burma. Rice requires a high temperature, and must be planted in fields that can be easily flooded to a depth of several inches at certain stages of its growth. On deltas and the banks of rivers flowing over plains this is not difficult. In other places the fields must be flooded by means of irrigation canals or wells. Some kinds of rice can be cultivated on uplands, and require less moisture, but the hill rice produced in India is very small in comparison with the swamp variety. Rice is very exhausting to soil, so that it is of necessity most cultivated where the summer floods cause rivers to spread fertilizing silt over their low-lying lands. One other point must be noted. Rice is exceedingly prolific and a great amount can be produced on one field, especially as more than one crop can be obtained from the same ground during one summer. Now rice forms the chief article of food in south-east Asia, and it is partly owing to the great quantity which can be produced that the plains of this part of Asia are densely peopled. In India the best rice is grown in the area for which Patna, on the Ganges, is the centre. *Millet*, extensively grown as a food grain, is generally confined to those regions which, on account of lack of moisture or too poor soil, are not suitable for rice or wheat. Its distribution is shown on Fig. 42. *Tea*, like rice, requires considerable heat and a heavy rainfall, but, unlike rice, its roots must not be water-logged and the soil must be well-drained. It is, therefore, grown on hill slopes and on well-drained plains. It is a very hardy plant, and is able to withstand even winter frosts. Most of the tea

INDIA AND CEYLON

imported into the British Isles is produced on the hills of Assam and Ceylon. Darkling, situated on the slopes of the Himalayas, between the independent states of Nepal and Bhutan, is the centre of an important tea-producing region. *Coffee* cannot thrive in places where the winters are severe, and is, therefore, chiefly grown in southern India and in Ceylon, although in the latter island it has made way for other products in recent years. We have left wheat until last of the food crops because it is grown in India as a winter crop. Now India receives little rain in winter, so it is evident that much of the water required must be obtained by irrigation methods, although it is the rule to plant the seed just before the summer rains cease. The sunny cool season brings the crop to fruition, and it is generally harvested in February or March. The chief wheat producing areas are the Punjab and the well region of the upper Ganges.

Cotton is also a very important product. As will be seen from Fig. 42, its cultivation is confined chiefly to those parts of the Deccan which are covered by the fertile black soil (see p.133). This soil is especially suitable, for it can hold moisture even after the monsoon rains have ceased. The climatic conditions suitable for cotton are long, very warm, moist summers. Indian cotton is exported from Bombay, which is also a rising cotton manufacturing centre. Jute is one of India's most valuable exports. It requires a hot, damp climate, but the rainfall must not be too heavy, and, like rice, it exhausts soil very rapidly. For these reasons its cultivation is confined to the lower valleys of the Ganges and the Prahmaputra, and to the Sundarbans, for these areas are fertilized naturally by the river floods. One result of the production of jute in this part of India has been to make Calutta a very important jute manufacturing city. *Flax* is very largely grown, and oil seeds form one of the chief exports of the country. In hot countries like India, the fibre does not develop sufficiently well to be used for manufacture, but the seed (linseed) is more abundant than in temperate countries, in which the fibre is of more

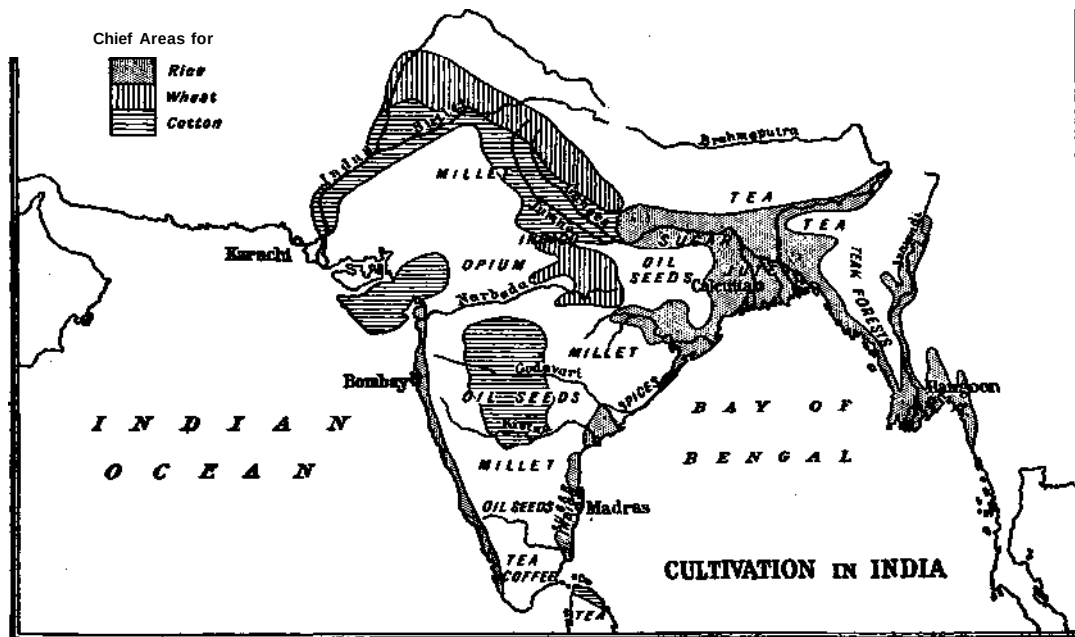


FIG 42. Cultivation in India.

INDIA AND CEYLON

value than the seed. The seeds are exported and used in the manufacture of linseed oil.

Indigo and *opium* are also produced, but not to the same extent as in former years. From the indigo plant a blue dye can be obtained, but since the discovery and manufacture of chemical dyes the demand for indigo has fallen off considerably. Opium, made from poppy seed-pods, is largely exported to China, but during the last few years the Chinese Government has taken commendable steps to stamp out the evil habit of opium smoking, and a large decrease in imports from India has been achieved.

CEYLON.

Ceylon produces *rubber* and *cinchona*, which have been introduced from South America with conspicuous success. Rubber is cultivated on the lowlands, and cinchona, from which quinine is obtained, on the hill slopes. Other products of Ceylon are coconuts, cacao and cinnamon, but tea, already mentioned, is its chief export. As will be seen, Ceylon's products are those of a more equatorial type of climate than those of India, and it is on this ground that it is included with the South-Eastern Archipelago in the classification of natural regions (see Fig- 30).

.MINERAL WEALTH.

Mining occupations are relatively unimportant in India. The chief minerals obtained are coal, iron ore, manganese ore, gold, silver and petroleum. In the Chota Nagpur plateau, west of Calcutta, 90 per cent, of the coal mined in India (normally from 20 to 25 million tons per annum) is found. Coal from this area is used in the Calcutta jute factories, in local industries and on the railways; but much has to be imported. India is rich in iron ore, but very little is found near the coalfields. Ninety-five per cent, of the gold output comes from the Kdar gold-field, situated some 40 miles north-east of "Bangalore. India is one of the world's chief producers of manganese ores, which are mined in the Central Provinces and ex-

ported unsmelted from both Calcutta and Bombay. Manganese ores are used in the manufacture of steel.

THE TRADE OF INDIA AND CEYLON.

As most of India's products are of an agricultural nature, we are in a position to discuss the trade of India at once. In order of value the most important exports are cotton, jute, rice, tea, oil-seeds, and wheat and flour. The chief customers are Great Britain, Japan, the United States, Germany, Italy and France.

The chief imports are manufactured cotton goods; metals and ores; machinery, railway plant and hardware; and sugar. Great Britain, Japan, the Dutch East Indies, Germany, and the United States are the chief places traded with.

Ceylon is governed separately from India. The island's chief exports are tea, rubber, fresh and dried coconuts and coconut oil, and copra. The leading imports are rice, cotton goods, coal and coke, sugar, and fertilizers. As in the case of India, Ceylon buys from and sells to Britain more goods than she buys from or sells to any other country.

EXERCISES.

1. Describe the belts of vegetation on the southern slopes of the Himalayas. Why is the snow line on the Himalayas (a) lower on their southern than on their northern slopes; (b) higher than in the Alps? Draw diagrams to illustrate your answer.

2. Divide India into physical units, and write a short descriptive account of each.

3. Explain clearly, using diagrams or sketch maps in illustration, why India has most of its rain in summer.

4. Obtain copies of the monthly charts of the Indian Ocean (Meteorological Office) and on outline maps of India, mark the winds shown on the January and July charts. Account for the leading differences between **the** two maps.

MEAN MONTHLY TEMPERATURE IN DEGREES FAHRENHEIT.

Stations	Height in ft above sea-level,	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
Bombay .	35	74.5	75	78	82	84.5	82.5	79.5	79	79	80.5	79.5	76.5	79
Calcutta .	18	65	70.5	79.5	85	85.5	84.5	83	82.5	82.5	80	72.5	65.5	78
Madras .	10	75.5	76.5	79.5	84.5	88.5	88	84.5	84.5	82.5 84	8x	77.5	75.5	82

MEAN MONTHLY RAINFALL IN INCHES.

	Jan.	Feb.	March	April	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec	Total for Year.
Bombay	.1	0	0	0	.5	20.5	24.6	15.0	11.0	1.8	.3	0	74.0
Calcutta	3	1.0	1.1	1.5	9.5	11.0	12.3	12.7	10.4	V9	.6	.3	64.6
Madras .	7	.3	.4	7	2.0	2.0	3.8	4.6	4.8	11.0	13.3	5.2	48.9
Cherrapunji .	7	2.2	11.1	32.3	52.0	106.0	110.0	77.0	53.5	14.0	15	.2	460.5

5. Represent the above statistics graphically, and in writing point out and account for their leading characteristics.

6. Write a short account of the physical features and climate of Ceylon.

7. Why is it that Lancashire textile manufacturers are far more interested in Indian trade than their Yorkshire neighbours? Why has Lancashire's export trade to India greatly declined in recent years?

8. "India's chief imports are manufactured goods and the chief exports agricultural products." Verify this statement by **reference** to **the Statesman's rear Book**.

9. From what country does India import sugar? What does India buy from Japan? Why are these articles not bought from Britain? Why is rice the chief import of Ceylon?

10. How does the government of India differ from that of Ceylon?

CHAPTER XIV.

INDIA AND CEYLON.

1. COMMUNICATIONS, CITIES-AND PEOPLE.

DURING recent years India's commerce with the outside world has developed very greatly, and this is in no small degree due to the construction of railways. Formerly, rivers had been the chief means of communication, but these were not of great value, except in the rivers in the Ganges system. Neither were there good roads, as in the Indo-Gangetic plain there is a great absence of road-making materials, and in other parts the irregularity of relief, and the fact that many roads become impassable during the rainy season, also prevented much intercourse. The chief beasts of burden are elephants and humped cattle, and they offer a very slow and expensive means of transport. Thus it was that the making of railways made many changes and especially gave a help to trade. The railways, however, were not built solely from the commercial standpoint, but in case of serious trouble to give the means of carrying soldiers from one part of India to another in as short a time as possible, and also to render it much easier to relieve distress in times of famine. Before they were made it was not uncommon for large numbers of people to die of starvation before help could arrive. Fig. 43 gives the chief railways of India marked on a map which shows relief. There are many railways besides these, but unfortunately the gauges upon which they have

be constructed differ very considerably, and as this prevents through running, it is a serious disadvantage.

As most of the chief cities of India are on these

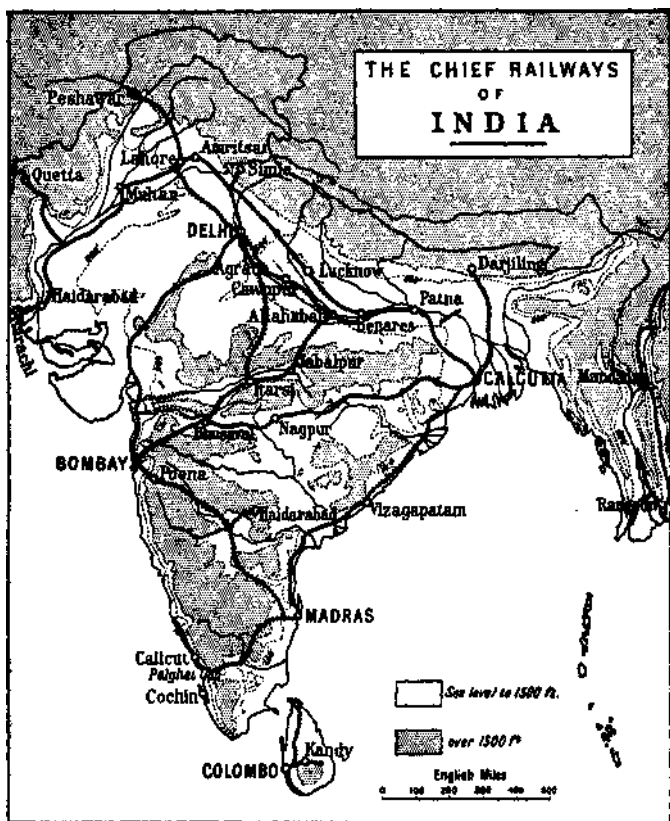


FIG. 43.—India. Relief and chief railways.

railway routes, we can learn about them whilst following the railways. There is one very important caution to be given here. The railways of India are comparatively

recent constructions, but all of the cities we shall mention were in existence long before the railways. It is, therefore, clear that the latter had nothing to do with the fixing of the sites of these places, and that we must look for other explanations of the question, "Why is this large city here?" Of course, many of them have greatly increased in importance owing to the making of railways, especially those situated at junctions, and the ports which have been brought into closer connection with their hinterlands.

Let us begin at *Calcutta*. It is built on the Hugh, a distributary of the Ganges, is eighty miles from the sea, and is the outlet of the rich Ganges lowlands. There is a great contrast between the European part of the city with its splendid buildings and wide streets, and the native town with its narrow streets and dirty brick houses. Within the last few years *Calcutta* has become the centre of a very important jute manufacturing industry. This, of course, is based on the large amount of jute grown in this part of India (see Fig. 42).

Leaving Howrah, on the opposite side of the river, the East Indian Railway traverses the plains of the Ganges, passing through Patna, Benares, Allahabad, Cawnpore, Tundla and Delhi. *Patna* is the centre of a rich rice-growing region, and also manufactures opium. *Benares* is the most sacred city of the Hindus, and is dependent chiefly on the large number of pilgrims who visit it. It is built high above the river, to which the descent is made by a series of wide, well-built steps. The chief objects of making a pilgrimage to Benares are to worship in the temples and to bathe in the sacred waters of the Ganges. The steps leading to the river from the temples and the palatial buildings for the reception of priests and pilgrims are never empty. From early morning until night there is a continuous throng of bathers, who come from all parts of the country. *Allahabad* stands at the junction of the Ganges and its chief tributary the Jumna,, a position which made it important before the construction of railways. It is now a great railway

centre, for it is at the junction of the railways from Calcutta, Bombay and Peshawar. It manufactures cotton goods. Cawnpore, on the Ganges, has become a modern manufacturing town, making cotton and leather goods. It will always be remembered as the scene of the horrible massacre which took place there during the Indian Mutiny.

We do not pass through the important cities of Lucknow and Agra, but this is the most convenient point to notice them. Lucknow, on the Gumti, is also remembered in connection with the prominent part it took during the Mutiny. It was the ancient capital of Oudh, and was formerly famous for its native manufactures, particularly of chased gold and silver, Agra, on the Jumna, is situated in a very rich agricultural district. It was formerly one of the chief cities of the Mogul Empire, and possesses some splendid monuments of the Mogul rule, the most beautiful being the famous Tai Mahal, which is esteemed the finest work of art in India, This magnificent building was erected in 1719 by Shah Jehan in memory of his wife, and, as its name implies, is a mausoleum and a palace.

Farther up the Jumna from Agra is Delhi, since 1912 the capital of India. The map will show that it stands at the eastern edge of the higher land (known as the Delhi ridge), which forms the watershed between the Indus and Ganges tributaries. It is also in the comparatively narrow gap between the Thar desert and the Aravalli Hills on the one side, and the Himalayas on the other. For these reasons, Delhi is well situated for control over both great river basins of northern India, and was the capital of several earlier empires than the British.

The reasons which prompted Britain to make an inland city the capital, instead of Calcutta which had been established by British sea-power, may be briefly stated as follows—

(1) For the reasons already given, Delhi is held in great reverence by Hindus.

(2) Its central situation between the populated Punjab and the Ganges plain, and the ease with which railway

communication can now be established with all parts of India, have made it a good centre for the seat of Government.

(3) During the hot season, the Viceroy moves his residence to Simla, a Himalayan hill station, north of

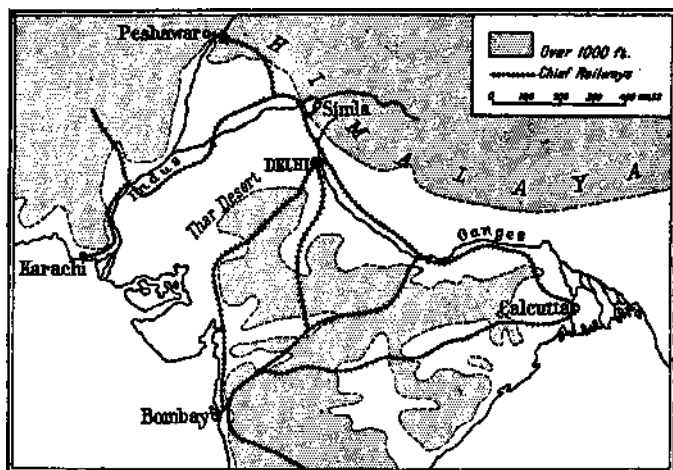


FIG. 44.—The position of Delhi.

Delhi. Now Calcutta is not so healthy as Delhi, and consequently it will not be necessary for the Viceroy, and, of course, a large number of officials, etc., to be absent from Delhi for so long a period as from Calcutta. Another evident advantage is the proximity of Simla to Delhi (see Fig. 44).

Delhi contains many reminders of the great part it has played in Indian history, from its ancient mosque and fort to its walls, which show the effects of the bombardments endured during the Mutiny. In modern days it has become an important cotton manufacturing town, and factory chimneys now darken the sky.

Continuing our journey to *Peshawar*, the next important town we should pass through is *Amritsar*. We are now in the basin of the Indus. *Amritsar*, a sacred city of the Sikhs, is one of a line of cities situated on or near the Indus tributaries in the wetter belt near to the base of the Himalayas. *Lahore*, about a mile from the left bank of the Ravi, is another of these towns. Fig. 43 shows that it is an important railway centre, for besides being on the great Calcutta—Peshawar trunk route, it is on a line which runs south-west to Karachi, near the mouth of the Indus. It is the largest city in the Punjab, and is the centre of a region producing great quantities of wheat. From Lahore we continue our journey to *Peshawar*, which is not far from where the Indus leaves the mountains for the lowlands, but the most important factor in its situation is, that it is on the Kabul river, near the entrance to the famous Khaibar Pass, which leads to Kabul, the capital of Afghanistan, and beyond Kabul to the plains of Turan. It is on account of this that it is strongly fortified.

Let us now return to Lahore, and from that city trace the North-Western Railway (by which the journey between Peshawar and Lahore is made) as it follows the Ravi towards *Multan*, a city so placed as to be near the confluence of the Punjab rivers. It is also on the margin of the desert of Thar. These factors have made it a good collecting centre for the wheat grown in the Punjab, as well as a meeting-place of important routes. Leaving Multan, the railway follows the Indus, which receives no large tributaries in its lower course, and runs to *Karachi*, the chief port for the produce of the Indus delta, and for the Punjab wheat. Note its situation to the west of the delta. This line has an important branch which goes a little beyond *Quetta*, a fortress city guarding the western entry to India, by way of the Bolan Pass.

Now let us consider the routes which radiate from *Bombay*, now the largest city in India. The city is built on an island, and the passage between the island and the mainland gives a splendid natural harbour.

Although England has owned Bombay since the days of Charles II, it was the opening of the Suez Canal which made it of first-class importance, for it is in a very favourable position for trade with Europe. We have learned that the Western Ghats present a very steep face to the Arabian Sea, and it will at once be seen that the construction of railways from Bombay to the Deccan was no light task. But the growth of Bombay depended upon means of quick communication with Calcutta and the Ganges basin, and a railway, which climbs the Ghats by a very difficult zigzag course, reaches both Delhi and Calcutta, whilst another follows the coastal plains northwards via Surat, and continues its journey between the Aravalli hills and the south-eastern edge of the Thar desert to Delhi, the capital (see Fig. 43). Now let us learn something of the commercial importance of Bombay. It is the largest jrgiton-manufacturing town in India, and this is owing to its proximity to the Deccan cotton-producing region. It also exports most of the raw cotton which is sent to other countries. Cotton manufacturing is quite an ancient industry in many parts of India, some of the cloths produced being noted for their very good quality. But in Bombay, huge modern mills, such as are found in south-east Lancashire, have been erected, and give employment to large numbers of people, although if the numbers employed in the three hundred and two cotton mills which India possessed in 1934 be compared with the number of cotton spinners and weavers exclusive of those working in the factories, it would be seen that less than one-tenth of the cotton workers in India are found in the big mills.

Leaving Bombay by the Great Indian Peninsular Railway, the train climbs the zigzag line on its way to the Deccan plateau. Passing through *Bhusaval*, the junction for Calcutta via Nagpur, and *Itarsi*, where the main line proceeds to Delhi via Agra, the more northern route to Calcutta follows the Narbada to *Jubbulpore*, an agricultural centre in which several cotton mills have been

recently established. From Jubbulpore the East Indian Railway system continues the route to Allahabad, and beyond to Calcutta. *Nagpur*, on the shorter route between Bombay and Calcutta, is another town owing its modern cotton mills to the cotton-producing region in which it is situated. The importance of these two lines between Bombay and Calcutta is very great indeed, for by means of them passengers and mails can reach Calcutta much sooner than if the journey had to be made entirely by water.

Another section of the G.I.P. Railway runs south-eastwards via Poona, traverses the Deccan, and after making a junction with the Madras railway, runs into *Madras*. Poona, in modern times, is to Bombay what Simla and Darjeeling are to Delhi and Calcutta. It is a hill station where Europeans may find the summer climatic conditions less oppressive than in Bombay. *Hyderabad* is reached by a branch line (see Fig. 43). It is the capital of a native state of the same name, and is ruled by the Nizam. Hyderabad state has more people than any other native state, and its capital is the fourth largest city in India, having a population of rather less than half a million. *Golconda*, near by, is noted for its diamond mines.

Madras, the third city in India, was one of the earliest British settlements, and it was from there that British influence spread westwards to the Deccan. It is the port for the rich plains of eastern India which produce great quantities of rice. As a port it is greatly hampered by not having a natural harbour, for it stands on a surf-beaten coast. Madras is connected with Calcutta by a line which follows the coast plains, and with the west coast by the Madras Railway, which utilizes the Palghat Gap, the only break in the Western Ghats between the mouth of the Tapti and the extreme south of India. The small port of *Calicut*, once a Portuguese trading settlement, controls the gap.

The large and important native state of Kashmir is not served by railways. It lies up in the western

Himalayas, and owing to its elevation, has a climate entirely different from that of other parts of India, as it is free from the great summer heat of the Deccan and the northern plains, whilst it is not so cold and bleak as the plateaux of Pamir and Tibet. It is crossed by lofty mountains, and contains many deep valleys, the most important of which is the vale of Kashmir, the upper valley of the Jehlam, one of the Punjab streams. The capital is *Srinagar*, which produces the famous Kashmir shawls, made from goats' hair. From this city, caravans start for Leh, and from there cross the Karakoram Pass on their way to Chinese Turkestan.

In Ceylon a railway has been built from Colombo to the north of the island, whilst a branch climbs to Kandy, the old capital. The journey from Colombo to Kandy takes about four hours, and the traveller is treated to a delightful series of everchanging views, for in that short space of time he is transported from the tropical heat of Colombo to the cooler temperature of the mountains. *Qglambo*, the capital and chiefport of Ceylon, is situated on a splendid artificial harbour, protected from the south-west monsoon by breakwaters. It is on the west coast, and is not only important as the port for the valuable products of Ceylon, but is a Port of call on the great routes from Europe, via the Suez Canal to Calcutta, Singapore, and the Far East on the one hand, and to Australia on the other. It has also a considerable trade with East and South African ports (see Fig. 45).

In Burma two railways leave Rangoon, one following the Irawadi, and the other striking northwards and reaching the same river at Mandalay (see Fig. 43). The latter is the more important. Notice that these railways follow the general north and south direction of the mountain ranges and rivers of Burma. In Upper Burma, where the river valleys are narrow, the chief source of wealth lies in the extensive forests of teak. Rice is easily the most important product of Lower Burma, and it is from this part of India that most rice

is exported. *Rangoon*, on the Irawadi delta, is the great port for rice and teak. Perhaps the most wonderful sight in Rangoon is the immense Glden pagoda which contains many temples and a number of gigantic and richly jewelled images. Temples are very common in Burma, where the prevailing religion is Buddhism. *Mandalay*, the chief city of Upper Burma, is the centre of the interior lowlands. It is the old capital and

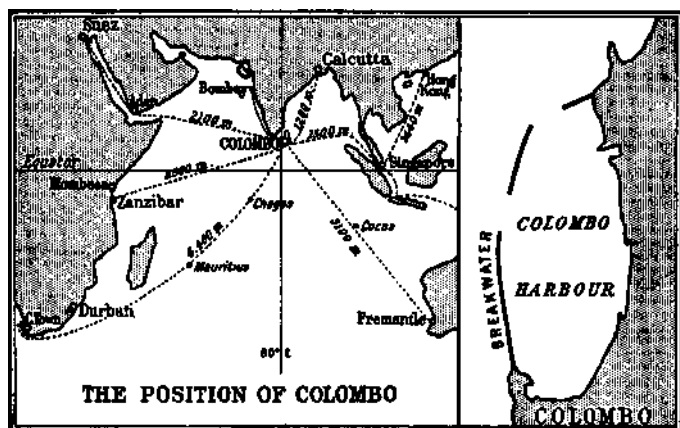


FIG. 45.—Colombo.

contains splendid pagodas and shrines dedicated to the worship of Buddha. Upper Burma produces the finest rubies in the world, the chief mining centres being in the mountains to the north-west of Mandalay.

2. THE PEOPLE OF INDIA.

India is essentially an agricultural country, and this has important influences upon the distribution of the population. In 1931, India had a population of 353 millions, that is, seven times as great as that of the United Kingdom in the same year or nearly three times

as great as that of all the British Empire without India. In the same year, the population of Ceylon was nearly five and a half millions. Despite this enormous number of people, there are only thirteen cities in India and one in Ceylon which have a population of more than 250,000. The vast majority of the people live in villages. Bombay (1,161,383) and Calcutta, with Howrah (1,485,582), are the only cities with more than a million inhabitants.

India includes not only districts subject to English law, but also native states. The latter are ruled by native princes, but in all cases the Indian Government is represented by an agent or resident. Over four-fifths of the people live in those parts directly ruled by the Indian Government. British India, as the result of administrative changes in 1912, is now divided into fifteen provinces, particulars of which are given below—

	Province.	Area in square miles.	Population at 1931 census.
1	Madras	144,000	47i millions
2	Bombay	152,000	26½
3	Bengal	83,000	51
4	United Provinces of Agra and Oudh	112,000	50
5	The Punjab	105,000	24
6	Burma	234,000	14¾ „
7	Bihar and Orissa .	112,000	42¼ „
8	Central Provinces and Berar .	131,000	18
9	Assam	67,000	9¼ „
10	North-west Frontier Province	36,000	4¾ „
11	Aj mer-Merwara	2,700	½ million
12	Coorg	1,580	164,000
13	Baluchistan	135,000	869,000
14	Delhi	593	636,000
15	Andaman and Nicobar Islands	3,140	29,000

Fig. 46 shows the parts of India which are directly under British rule, the numbers referring to those given in the table above. Fig. 47 gives the distribution of the

population. By comparing the two maps, it is obvious that the majority of the people are directly ruled by the Government of India.

One other point must be noted from Fig. 47. The

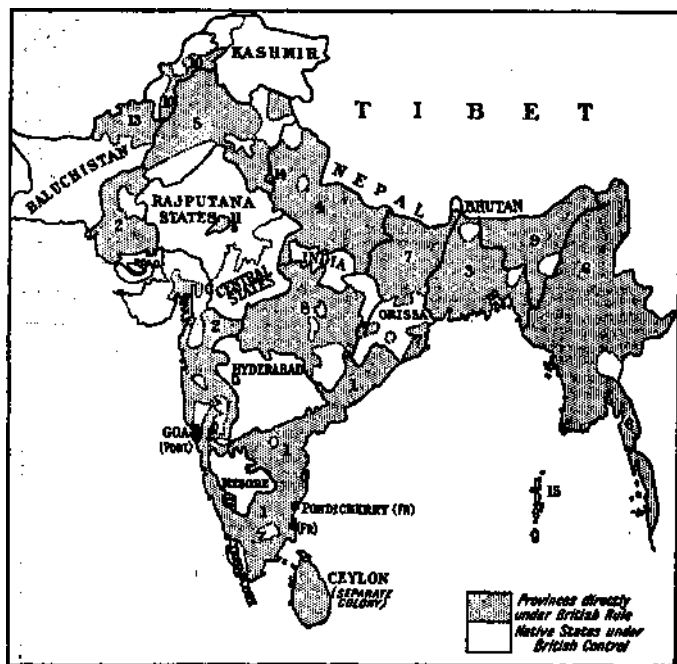


FIG. 46.—Map showing the Government of India.

bulk of the people are found in just those places we should have expected after our consideration of the relief, climate and vegetation of India. The greatest concentration is in the valley of the Ganges, the Punjab, and the east coast plain. The less productive parts, such as large areas of the Deccan and the Thar desert, support fewer people.

One interesting fact may be mentioned here. At the

census of 1931, English was the language of 319,000 people, of whom about one-third were of British birth. We have already pointed out that the climate of India is unsuitable for British immigrants, so that the English in India are chiefly traders, soldiers or officials who

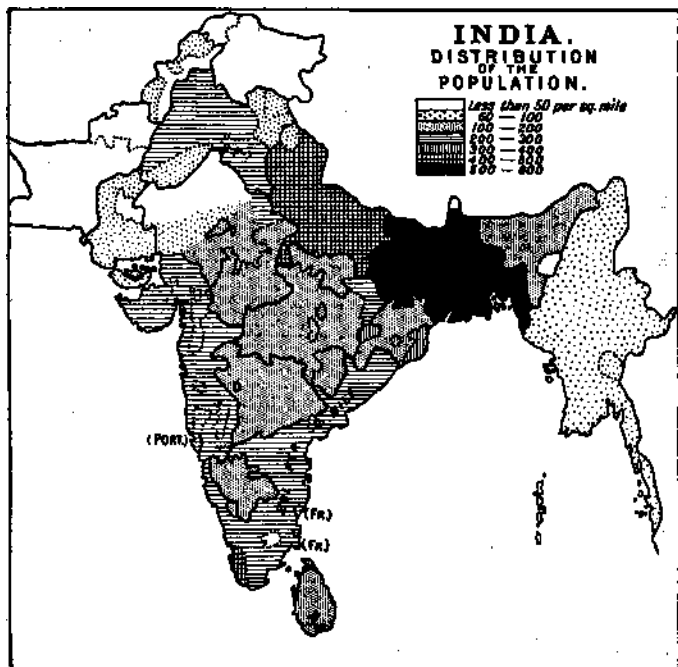


FIG. 47.—India. The distribution of the population.

are in the country for a term of years only. There is a constant change of officials and civil servants owing to retirement, etc., and it is largely owing to this that English rule in India has been so successful, for men never stay long enough to get stale, and new ideas, freshness, and greater energy are being constantly brought to the work of government.

Now let us learn more of the people themselves. India is so vast—nearly fifteen times as large as the British Isles—and has been entered by so many different peoples, some of whom settled in the land, that it is not surprising that many races and many religions are to be found. The descendants of the earliest inhabitants are found in the least accessible parts of the Deccan, in the swampy Ganges-Brahmaputra delta, and in Ceylon. They are darker skinned and smaller in stature than the people of northern India, whilst they speak languages which belong to quite a different group. They are called Dravidians, and it is thought that at one time they occupied the whole of India, but were pushed southwards and eastwards by more virile invaders, who probably entered India about 2000 B.C., by the great north-west gateways. These intruders were a taller, fairer race, quite different in appearance from the Dravidians, and akin to the people of Mediterranean Europe. They are known as the Indo-Aryans, and are best seen to-day in the Sikhs of the Punjab. The descendants of these early invaders are found in the north-west, nearest to the gateways by which they entered. In the upper basin of the Ganges, the prevailing type seems to be a mixed Indo-Aryan and Dravidian race, whilst in the lowlands, near the mouths of the Ganges and Brahmaputra, we find peoples of Dravidian blood.

Later, by the same north-western gateways, there came other conquerors, Darius of Persia and Alexander the Great, but their conquests were only temporary, and had little influence upon the people themselves.

During the first five or six centuries of the Christian era, continual inroads by steppe dwellers—Huns, Tartars and Scythians—occurred. Their plunderings were confined mainly to the north-west, for they met with opposition in the Ganges valley, but they appear to have settled in considerable numbers on the black earth lands of the Deccan, where they found a fertile land. In this area, even to-day, the predominant types appear to be

of mixed Mongol and Dravidian descent. Later, conquests by the Mohammedans took place. They, too, entered by the north-west gateways. They became very powerful, and established great empires, but they affected race very little, and except in the Punjab, they had also little effect upon the religion.

We learned in the last chapter that the approaches to India from the north-east are not so easy as those from the north-west. Many invaders have come, however, though in relatively small numbers, along the passes where the Brahmaputra enters India. These people were yellow-skinned, black-haired Mongols, whose descendants are still found in eastern India and in Burma, where the people are essentially Mongolian, and quite different from the inhabitants of India. In the lowlands of the Ganges-Brahmaputra, the Mongol immigrants mixed with the Dravidians, driven eastwards by the approach of the Indo-Aryans from the west.

The Himalayas form a great barrier, effectively preventing race migration into India from the north, except in small numbers. It is interesting, however, to notice that the people of Nepal and the Gurkhas appear to have crossed the Himalayas from Tibet. They are small, hardy people, and very fond of fighting.

This account of the people of India is, of course, not by any means complete, but it does show how the disposition of the chief races has been influenced by geographical conditions. All the invaders of whom we have learned entered India by the land routes, but we must not forget that India to-day is held by a nation whose approach was from the sea. In the seventeenth century, England, Portugal and France had coastal trading settlements, but it does not appear as though they thought of conquest at that time. At a later date the English made conquests from Madras and the French from Pondicherri. These places are on the east coast, where communication along the coastal lowlands and westward expansion to the Deccan are comparatively easy. Struggles between the English and **the French**

resulted in the victory going to the former. Living on the Deccan, east of Bombay, were the warlike Mahrattas, who extended their power northwards, and a struggle between them and the British for the possession of the Ganges plain was decided by the battle of Plassey (1757), in which the British were successful. Early in the nineteenth century, Delhi was captured, and this led to British power being established in the Indus valley, and to its final extension to practically the whole of the peninsula.

The Portuguese and the French still have trading stations, the most important being the west coast settlement of Goa (Portuguese), and the east coast settlement of Pondicherri (French).

Of the religions of India, little need be said here. Two-thirds of the people profess Hinduism, which is a most complicated religion. It appears to have as its basis the religious beliefs of the earliest inhabitants. The Aryan invaders adopted it, and largely added to it, but so complicated has it become that it differs considerably in various parts of the country, and is very often a strange mixture of superstition, elaborate worship of many gods, and the performance of innumerable duties and rites. Its distinguishing feature is the caste system. In the main there are four castes or groups, the Brahmans belonging to the highest, or priestly caste. All Brahmans are not priests, but may become so. All the leading professions are filled by Brahmans, who belong to their particular caste on account of birth alone. The other castes are the warriors, the farmers, and lastly, those who are neither Brahmans, warriors nor farmers. Those belonging to the lowest caste are regarded with great contempt by the others. The castes have many sub-divisions, so that to-day they number between three and four thousand. Each caste is commonly associated with some occupation, and since a man must follow the occupation of his father, the system exercises a very powerful influence over the people. At death, however, the soul

takes a higher or lower caste, according to the life the person has lived.

Rather more than one-fifth of the people are Mohammedans, who are found in all parts of the country, but in greatest numbers in the Indus basin, west of the Thar desert. They are the descendants of the Mohammedans who entered India by the great gateways of the north-west, between the sixth and the sixteenth centuries. The Mohammedan religion was founded in the sixth century by Mohammed, who was born in Mecca (see p. 125). It was called Islam by its founder, who wrote the sacred book, the Koran, in which he unifies the Arab worship of several gods, and taught, "There is one God, Allah, and Mohammed is His prophet."

In order of numbers the Buddhists come next, and they are found almost entirely in Burma, where the population is chiefly of Mongol extraction, and in Ceylon. This religion was founded by a man of the warrior caste who lived near the Ganges about six centuries before the birth of Christ. He was not satisfied with the state of Hinduism, and wished for a simpler religion. He taught that Nirvana, the final end of life, is to be reached by a life of self-denial and indifference to pleasure and pain. Such a belief has the effect of making its followers live quiet and peaceful lives, but is not helpful to national advancement. It is strange that to-day his religion is not followed in the land of its birth, but has its greatest number of followers in China.

These three religions, the Hindu, the Mohammedan and the Buddhist, are followed, more or less devoutly, by the great bulk of the people; but there are many others, such as those followed by the Parsis and the Sikhs, whilst there are about six million Christians.

We have seen that India is a large country, with a large population composed of many different races, and belonging to many different creeds. It is governed by a nation, the British, who are non-Indian in race and religion, who have entered the land by way of the sea, but

do not make it a permanent home. They have established law and justice, and have brought a considerable amount of prosperity, and there can be no doubt whatever that their rule has been of enormous value to India itself. As to the natives, although education is rapidly making headway, and large numbers have been advanced to administrative posts, the great bulk of the people are still unable to rule themselves. Experiments in self-government are being tried and are meeting with some success, but it will be a long time before the country as a whole is ready to guide its own destinies. The future holds many interesting questions for settlement, and among them, not the least important is, "Will India, like Australia and Canada, remain within the British Empire as a great self-governing dominion, or will she seek out her own salvation as an independent state?"

EXERCISES.

1. What geographical factors have given importance to the sites of each of the following Indian cities: Calcutta, Peshawar, Bombay, Madras, Allahabad, Delhi? Draw maps to illustrate your answer.
2. Draw a sketch-map to show the line of Punjab towns near the base of the Himalayas. Shade the high ground.
3. What factors affect the distribution of the population of India? Briefly describe the distribution.
4. How far are the routes of the chief Indian railways controlled by the relief of the land? Illustrate your answer by a sketch-map.
5. Draw a map to show the various sea-ways, land-ways, and air-ways from Britain to India.
6. "The great differences in surface and climate—much greater than those of Europe—with their consequent differences in racial habits and productivity of the soil, cause greater differences between a Pathan of the North-West Frontier and a Burman of Moulmein than between a Norwegian of Bergen and an Italian of Brindisi." Comment on this statement

CHAPTER XV.

INDO-CHINA AND THE EAST INDIES.

Natural Regions.—(i) Indo-China, with the exception of the southern Malay Peninsula, forms part of the Monsoon region. (2) The tropical islands of the East Indies.

INDO-CHINA.

Physical Features.—The name Indo-China is given to the large south-eastern peninsula which lies between India and China. A physical map will show that the mountain chains which traverse the peninsula from north to south are continuations of those of Eastern Tibet. The rivers Mekong, Menam, Salwin and Irawadi flow along little known gorges in their upper courses where the ranges come close together, but their lower courses occupy broad valleys. Three main series of chains can be traced in Indo-China. The eastern chain traverses Annam, the central chain lies between the Menam and the Salwin, whilst to the west of the latter river are the western ridges. A prolongation of the central chains forms the Malay peninsula. The rivers of Indo-China are swift flowing, and are loaded with sediment by means of which they have built up great deltas.

Climate and Products.—The climate of Indo-China resembles that of India, although there are naturally differences between the highlands and the lowlands; Most rain falls in summer, at which season the rivers

are often in flood, but Annam also receives rain from the north-east winds which blow in winter.

The vegetable products, too, resemble those of India. Rice, grown on the lowlands where water can easily be obtained for flooding the fields, is the most important crop, and forms the chief article of food. So much is grown that there is a large surplus for export. Coffee is grown on the hills of Annam, sugar in Annam and Cambodia, and in the hotter, wetter south, whilst rubber trees have been successfully planted in Cochin-China, which also produces pepper. In addition to these, the highlands, owing to the heavy rainfall, are densely forested, and teak forms an important export, especially from Siam.

Political Divisions.—The physical structure of Indo-China greatly influenced the formation of many independent native states, centred round the river lowlands, between which there was little communication on account of the mountain barriers which separate them from each other. Tongking occupies the delta of the Song-ka or Red River, Cambodia and Cochin-China are in the lowlands of the Mekong, Siam is largely the valley and delta of the Menam, Burma is the land of the Irawadi, whilst Annam is the narrow coastal plain between the eastern ridges and the South China Sea. In the upper courses of the great rivers are the Shan States, which, although owing nominal allegiance to England, China and Siam, are practically independent owing to difficulty of access. To-day France rules Tongking, Annam, Cochin-China and Cambodia in the east, Britain holds sway in the west, whilst between the possessions of these Powers there is the independent buffer kingdom of Siam.

The capital of Tongking, and since 1902, the capital of French Indo-China, is *Hanoi*, situated on the Red River about sixty miles from the sea. It is really a collection of many native villages and formerly was on the sea coast. Its present position so many miles inland illustrates the rapid growth of the river delta.

A railway has been constructed from Hanoi to Yunnan in south-western China, and has been the means of increasing the trade of Hanoi. One writer speaks of the natives of Hanoi as being very small, narrow-chested and thin-legged, and says their mouths are always stained, owing to their habit of chewing the areca-nut. He also declares that they are stupid beyond the power of words to tell. Hue, the capital of Annam, is a very poor port, and is situated on a coast which is dangerous for ships, owing to strong winds and storms. The government of Annam is administered by natives under the direction of the French Government. *Saigon* is the capital of Cochin-China. It has a good harbour and is connected by a waterway and railway—the first railway to be built in French Indo-China—to the Mekong. There is no very important town in Cambodia, but this country was once very powerful. The old kingdom had the large Lake Tonle Sap, which regulates the supply of water to the Mekong, at its centre, and its former importance is indicated by the extensive ruins which are to be seen there.

In passing it may be noted that the various governments of French Indo-China are unified under the control of a governor-general. Cochin-China is a French Colony (the other states are Protectorates) and is represented in the parliament at Paris by one deputy. There is a common budget for the whole of French Indo-China, and also a separate one for each state. The common budget deals with matters which concern the whole—customs, ports, telegraphs, defences, etc.

Bangkok, built nearly forty miles up the Menam, is the capital of Siam. Unfortunately the presence of a bar at the mouth of the river makes it impossible for large vessels to reach the city, which stands on the river, from which branch innumerable creeks or klongs. Bangkok has been called "the Venice of the East." The comparison fails in all points else except in the amount of traffic by water. One traveller says that there is no medium in Siam. One sees either gorge-

ously gilded palaces and fantastically adorned temples or filthy-looking huts. Bangkok offers no contradiction to this. The klongs, which are lined with shops and houses, have been compared with open sewers, full of garbage. The most famous building is the king's palace, in which there is a temple containing fabulous wealth in the form of a floor of silver, golden ornaments, statues of Buddha—the Siamese, like the Burmese, are Buddhists—altars glittering with precious stones, etc.

The people of Siam very much resemble the Chinese. It is probable that their ancestors came from China, and by gradual stages followed the Menam, eventually reaching its mouth, where they built Bangkok, their final capital.

West of Siam is Burma, which includes the basins of the Salwin and the Irawadi (see pp. 155-6).

MALAYA AND THE EAST INDIES.

PHYSICAL FEATURES.—The East Indies lie between Asia and Australia. We have learned in an earlier chapter (see p. 86) that Wallace's line separates those islands which are Australian in flora and fauna from those which are Asiatic. In this chapter we are concerned mainly with the Asiatic islands, although for structural reasons we shall take the boundary as lying east of the Moluccas and Timur Archipelago.

The archipelago is bounded on the west by the volcanic chains which traverse Sumatra, Java, and the smaller Sunda Islands (see Fig. 48). These are continued through the Moluccas or Spice Islands, and join the eastern volcanic chain (see p. 78) which passes through the Philippines. A continuation of the Malay Peninsula may be seen in the small islands of Banka and Billiton, east of Sumatra. Between this volcanic girdle and the mainland of Asia, Borneo stands on a continental shelf, and is separated from Celebes by a deep strait. Notice the peculiar shape of the latter island. It is evident that its lowlands have been drowned by

sinking. A physical map shows that Borneo would present a somewhat similar outline if it were to be submerged about 100 fathoms. Observe also the deep South China Sea between the Philippines and the mainland of Asia. This would suggest that the sinking which separated these islands from Asia took place long before that which detached Borneo. Owing to the western chains



FIG. 48.—The East Indies.

of islands forming a barrier, vessels from the Suez Canal and India proceeding to China and Japan must take one of two passages, either the Malacca Strait between Sumatra and the Malay Peninsula, or the Sunda Strait between Sumatra and Java (see Fig. 48). This has aided the growth of Singapore and Batavia.

CLIMATE AND VEGETATION.—NO part of this region is outside the Tropics. Since this means that every place will have the sun overhead on two occasions each year,

and that the sun will never be low in the sky, it follows that, except at high altitudes, the temperature will always be high. We have learned that these islands have rain at all seasons, and we have also seen that the rain belts follow the sun. Consequently we find that the equinoxes are the periods of heaviest rainfall in the parts of the region nearest to the equator, and that islands towards the northern margins, *e.g.* the Philippines, have most rain in our summer months, and those towards the southern margins, *e.g.* Java and Lesser Sundas, have their heaviest rainfall in the months of the southern summer.

One result of the climatic conditions is seen in the natural vegetation, which is of the equatorial type. The lowlands are often dense jungles, infested with snakes and wild animals. The vegetation of the volcanic islands, especially Java, is exceedingly luxuriant, partly due to the fertility of the volcanic soils.

THE INHABITANTS OF THE EAST INDIES.—Because the lowlands open to the sea, and the straits between the islands are not very wide, and are not as a rule visited by severe storms, the natives of the East Indies have readily taken to the sea, and there has been a great intermixture of races. It is clear that in such a region sea power is all important. On the other hand the lowlands, especially in Borneo, are separated from each other by mountain ridges, and there is often a lack of intercourse between the natives of the same island. One result of this has been the formation of several independent native states in the same island, the best example being seen in Borneo. On the whole the natives are very backward, and many of those who live in the little known interior regions and hill country are cannibals even to this day. The Malays, who are straight-haired Mongolians, resembling the Chinese in their oblique eyes, round heads and wide cheeks, are more numerous than peoples of other races. In religion the Malays are Mohammedans, and in temperament very much inclined to be morose and revengeful. There are also wavy-haired peoples of the

same race as the Dravidians of India as well as many very dark-skinned, woolly, or peppercorn-haired peoples of negro origin. Both of the latter types are small in stature, and are often so short as to be called pigmies. That descendants of diverse races should be found in these islands is probably due to the fact that the islands are on the "bridge" between continents, and the various races who have passed this connecting link have done something, however slight, to influence race.

POLITICAL PARTITION.—The Portuguese were the first Europeans to reach the East Indies, and they did so in the 15th century. They were closely followed by the Spaniards, who reached the islands by sailing westwards from Spam. The Philippines formed part of the Spanish possessions until 1898, when they were ceded to the United States. In the 16th century the Dutch established many trading settlements, and to-day their possessions are more extensive than those of any other Power. The British possessions are the Straits Settlements, the Federated Malay States and the British parts of Borneo, whilst all that remains to Portugal is the eastern portion of the island of Timor.

THE BRITISH POSSESSIONS.—These are in the Malay Peninsula and Borneo. In the Malay Peninsula there are the *Straits Settlements* and the *Federated Malay States*.

The Straits Settlements form a Crown Colony comprising Singapore, Penang (including Wellesley Province and the Dindings) and Malacca. The colony now includes the island of Lebuau, whilst the settlement of Singapore has been given the control of Christmas Island and the Cocos Islands. The most valuable of the Straits Settlements is *Singapore*, which owes its importance to its commanding position (see Fig. 48). It is an island about twenty-seven miles long by fourteen wide, and is separated from the Malay Peninsula by a strait about three-quarters of a mile in width. A causeway carrying railway lines has been built across the strait so that Singapore is now connected with the railways of the peninsula. The map shows that Singapore is situated at the

converging point of great ocean routes to and from India and the Suez Canal, China and Japan, and Australia. The port of Singapore has thus developed an enormous *entrepot* trade, and produce from all parts of the world may be found in its warehouses. The town is very cosmopolitan, having quite distinct European, Chinese, Javanese and Malay quarters. The Chinese are in greatest number, and carry on a large part of the port's trade. Besides being a great trading centre, Singapore is a strongly fortified coaling station, and possesses extensive dockyards. *Penang* is an island in the Straits of Malacca; *Wellesley Province*, the strip of mainland opposite; *the Bindings* comprise a small island and a strip of mainland, and *Malacca* another strip about forty miles in length and from eight to twenty-four in breadth.

Most of the trade of these settlements is done at Singapore, the chief articles exported being tin, sugar, pepper, nutmegs and other spices, sago, gutta-percha and rubber. Of these, rubber and tin far outweigh the others in importance and value. More than half the world's supplies of rubber and tin are produced in the plantations and mines of the Malay Peninsula. Of course during times of depression in the rubber and tin market the disadvantages of undue specialisation are severely felt in Malaya. To counter this every effort is being made to encourage the other industries.

Christmas Island and the *Cocos or Keeling Islands* are in the Indian Ocean, south-west of Java. The latter are coral islands covered by coconut palms, and the former possesses very valuable deposits of phosphate of lime. *Labuan* lies six miles from the north-west coast of Borneo, and is important on account of its coal mines, which supply the British warships on the China station as well as trading ships.

The Federated Malay States.—These are a number of native states which chiefly occupy the eastern portion of the southern Malay Peninsula. They are under British protection, the native rulers being advised or controlled by British representatives. *Perak* and *Selangor* are the

most important of these small states. As in Singapore, a large proportion of the inhabitants are Chinese who have emigrated to the peninsula in order to work in the tin and gold mines, and to supply labour in the fields. The agriculture is tropical, the chief cultivations being coconuts, rice, rubber, sugar, tapioca and pepper.

British Borneo,—The British possessions in this large island are *British North Borneo*, a territory under the jurisdiction of the British North Borneo Company; *Brunei*, a native state under British protection, and *Sarawak*. Sarawak is a native state whose head, Rajah Brooke, is an Englishman who rules under the protection of Britain. All have a very luxuriant natural vegetation, which differs with elevation, the coastal lowlands being covered with dense jungle, and the less known interior highlands with forests or savannahs. The chief cultivations are very similar to those of the Malay Peninsula. In addition, British North Borneo exports large quantities of tobacco, and Sarawak has rich deposits of coal and oil as well as some gold.

DUTCH POSSESSIONS.—These are more numerous and more extensive than those of any other nation. Although not the largest, Java, the "Garden of the East," is the most important, for by means of garden cultivation, the Dutch have made it the most productive and most densely peopled island in the archipelago. The total population of the Dutch East Indies is over sixty millions, and of these forty-two millions are in *Java*. This development has been helped by the great fertility of the volcanic soil and the abundant rainfall, as well as by the construction of railways and good roads. The range of products is very wide, but those for export are chiefly rubber, coffee, sugar, cinchona and tobacco, whilst the staple articles of food are rice and sago. The capital of Java is *Batavia*, which controls the Sunda Strait, between Sumatra and Java. In the chain of mountains which traverses Java from end to end, there are more than fifty volcanoes. The remainder of the Dutch East Indies have been little developed. Sumatra

and Dutch Borneo export pepper, coffee and tobacco; Celebes and the Moluccas are noted for spices. The Moluccas are the famous Spice Islands.

In the Sunda Strait is the volcanic island of *Krakatoa*, which was shattered in 1883 by the most terrible volcanic eruption of which we have any knowledge.¹ So tremendous was the outburst that a large part of the cone was blown into the air, and the site of the destroyed portion was occupied by water 1,000 ft. deep, whilst every vestige of life on the island was obliterated. A great water wave was caused, which spread all over the Pacific and Indian Oceans, and a great air wave passed three times round the earth. Prior to that catastrophe the volcano had been inactive for a century.

The Philippine Islands.—Discovered by the Spaniards, and named after King Philip II, these islands have belonged to the United States since the war with Spain in 1898. The group includes several thousand islands, the largest being Luzon and Mindanao. We have already learned that the Philippines form part of the great volcanic girdle of the Pacific. Throughout the islands destructive earthquakes are frequent, whilst they are often visited by terrific cyclonic storms called *typhoons*. These are accompanied by very heavy downpours of rain and by winds so strong that trees are uprooted and cities destroyed. The chief articles exported are tobacco, which is made into cigars (the only manufacture of importance); a fibre (Manilla hemp) obtained from a wild plantain very closely resembling the banana; copra and coconut oil; sugar and rubber. Rice is extensively grown for home consumption. The capital and chief town is *Manila*, which has the great advantage of being the point at which routes from Hongkong, Singapore, Australia and the west of the Americas meet. The map also shows that it is almost equidistant from all the chief ports of the mainland between Saigon and Foochow. It is the centre of the cigar manufacturing industry.

¹ See Book I of this series for the physical history of volcanoes.

EXERCISES.

1. What geographical conditions have aided the growth of Singapore, Manila and Batavia? Compare the relative importance of these ports. Illustrate your answer by sketch-maps.

2. "Both in Indo-China and in Borneo the configuration of the land helped to foster a large number of small independent native states." Explain this statement.

3. How far are the East Indies "Australasian," and how far "Asiatic"? Give reasons for your answer, and draw a map in illustration.

4. Give full reasons why Java is the most densely peopled island in the whole of the East Indies.

5. What difference would you expect to find between the seasonal distribution of temperature and rainfall at Manila, Singapore and Batavia?

6. Find out how many subjects the Queen of Holland has in (a) the motherland, (b) the Dutch East Indies? Comment on these figures. Of what value are the Dutch East Indies to the motherland?

7. Find out how the first rubber trees came to be planted in Malaya. Where did they come from? Why is the rubber grown in Malaya called Para rubber? Where is Para?

8. Describe three ways of travelling from Singapore to Bangkok.

CHAPTER XVI.

THE CHINESE LANDS.

THE Chinese Lands¹ cover a very large area, as they include Mongolia, Manchuria, Eastern Turkestan, and Tibet, as well as China Proper. The area of this portion of Asia exceeds four million square miles—larger than Europe—and has a population, probably, exceeding four hundred millions, although some authorities think that this is considerably overstated. At any rate 95 per cent, of the people are in China Proper, which includes less than half the area.

It is very evident that physical and climatic conditions will vary over such a large land mass, and although Fig. 30 shows that the area includes both desert lands and monsoon lands, we must recollect that the different parts of both the deserts and the summer rain lands vary considerably in elevation and latitude, and therefore in temperature.

We shall consider the Chinese Lands under two headings: (1) China Proper; (2) the outlying portions.

CHINA PROPER.

PHYSICAL FEATURES AND CLIMATE.—As the map will show, China is a country of high mountains opening to lowlands along the Pacific coast. The most extensive of these lowlands are in the lower valleys of the Hwang-ho and the Yangtse-kiang. China Proper is a very compact area, almost shut off from the rest of Asia by natural barriers in the form of (1) high, parallel, north and south ranges between China and

¹ The Japanese invaded China in 1937 and have occupied large areas. In this book temporary changes are disregarded.

India, (2) the high, inaccessible, desert-like plateaux of Tibet and Mongolia; yet easy of entry by land from the plains of Manchuria in the north, but most of all from the sea and along the great rivers. South of the Yangtse, China has a smaller extent of lowland than north of that river, but the land is not generally too high for settlement, although it naturally supports a smaller number of people, except in the plains bordering the rivers. Of the Chinese rivers, a glance at the map is sufficient to show that there are three rivers of outstanding importance, the Hwang-ho or Yellow River in the north, the Yangtse-kiang or Blue River in the centre, and the Si-kiang or West River in the south. (See Fig. 49.)

Turning to the climate, we are already familiar with the fact that China has a monsoon type of climate but important differences must be noted. In Chapter X (page 91) we have learned that owing to the differences of temperature, northern, central and southern China have temperate, sub-tropical, and tropical types of monsoon climate respectively. There are also differences in rainfall, as will be seen from a consideration of the following figures—

Place.	Lat. N.	Temperatures.		Rainfall in inches.				
		Coldest month.	Warmest month.	March- May.	June- Aug.	Sept- Nov.	Dec- Feb.	Total.
Peking	40°	23° F.	79	2'4	18'2	3'5	0'4	24'5
Hankow	30	38	83	17'6	19'9	8'9	4'3	50'7
Canton	23	55	83	17'6	29'2	14'8	3'9	65'5

These figures may be taken as typical of the three monsoon types. They show (1) that in all most rain falls in summer, although in Peking the early summer is drier than farther south, (2) that Southern China has a heavier rainfall than Northern China, (3) that for their latitudes all three towns have low winter tempera-

tures. The latter fact is accounted for by the cold winds which blow at that season.

Taking the three towns as typical of Northern, Central and Southern China, we may see from the figures that

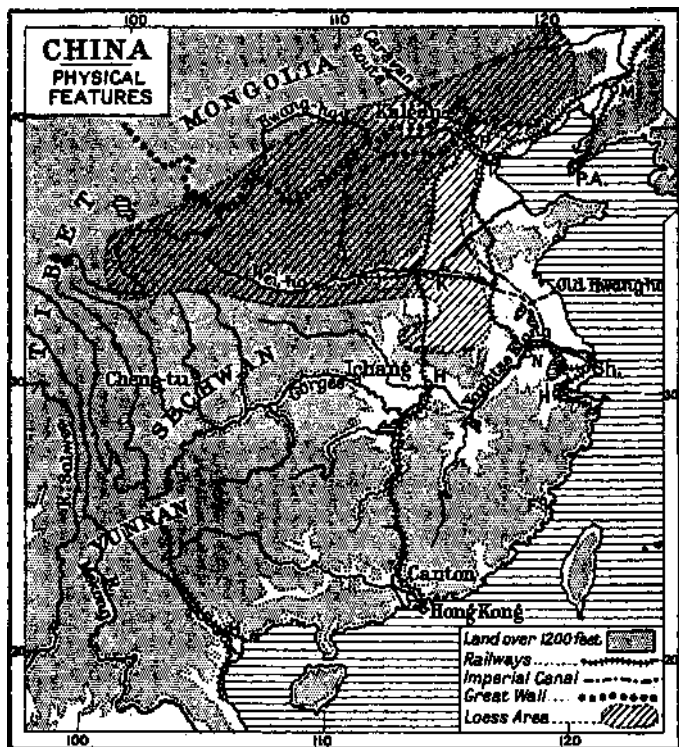


FIG. 49~Physical map of China.

Northern China has cold winters and hot summers, Central China cool winters and hot summers, and Southern China warm winters and hot summers. China falls so naturally into these three regions that we shall consider each in turn.

NORTHERN CHINA

NORTHERN CHINA.

Northern China is mountainous in the west and low in the east. Part of its southern boundary is clearly marked by the Tsingling-shan, which forms a mountainous boundary between the Wei-ho and the Yangtse-kiang. The boundary on the plains cannot be so clearly defined. A large part of Northern China is covered by a deposit called *loess* (see Fig. 49). We have seen that in winter time dry winds blow outwards from the heart of Asia. These winds carry with them very fine dust from the arid plateau regions over which they have passed. This dust has accumulated on the margin of the plateau, and in the course of time has completely buried not only the plain, but the mountains and hills with a mantle of loess often 1000 ft. thick. Looked at from above, a loess area presents a very smooth and monotonous outline, and usually consists of a number of basins, the raised rims bordering the basins representing the mountain ranges. It is typical of the region that each of these basins formed a little unit, having a centrally placed fortified city. The great disadvantage of loess is that it is porous, and so easily cut through that rivers and roads often cross it by intricate passages, on each side of which are very steep, often quite vertical, walls. It has, however, the great advantage of being fertile, although in this connection its porous nature is a drawback, and makes irrigation a necessity in most parts. In colour it is yellow, or brownish-yellow, hence the names of the Yellow river and the Yellow sea.

The chief rivers of Northern China are the Hwang-ho and Pei-ho or North River. The Hwang-ho is in some respects one of the most remarkable rivers in the world. It rises in Tibet, and its upper courses are fed by melting glaciers, which, together with the heavy summer rains of the mountainous region across which the upper stream and its tributaries flow, causes disastrous floods when the swollen river leaves its narrower

mountain bed for the low plains of its lower valley. In this part of its course it does not permanently follow a particular channel, as, owing to the deposition of sediment along the bed, the latter is constantly being raised, so that the river really runs on a self-created ridge that is increasing every year in height. This, of course, necessitates the construction of dykes or embankments in order to confine the river to its channel, and since the bed rises, so the height of the dykes must increase. There is thus the ever present danger that the river may burst the dykes and find a new course. This has happened several times in the past with terrible results, for when the last serious change took place in 1851, owing to the dykes near Kaifeng giving way, the river, which is here very wide and swift flowing, turned northwards and found a new mouth north of the Shan-tung peninsula. Kaifeng is now about twenty miles south of the river, and 20 ft. below its level. (Examine Fig. 49, and in order to realize what this change in the course of the river meant, work Ex. 1 at the end of this chapter.) In 1887 and again in 1898, the bursting of the dykes caused widespread devastation, the toll of those who lost their lives being measured in millions. It is no wonder that the Hwang-ho is called "China's Sorrow." As it flows fast, is not very deep and is liable to floods, it is not of very great commercial value, and in its lower course there are no large towns on its banks. But the fertile yellow silt which it brings down, and by means of which it is busily engaged in extending the lowlands into the Gulf of Pechili, is of great value to agriculture, the predominant Chinese occupation.

The important Wei-ho tributary of the Hwang-ho must be noticed. It is important not only because it was probably in its valley that the Chinese civilization had its birth, but also on account of the routes which continue the line of the Hwang-ho, and pass through Langchow, where they reach the Hwang-ho once more, and then strike across the central plateaux to the

Zurtgarian Gate, and beyond to the towns of Siberia, (seep. 103).

In the mountainous west of Northern China, agriculture is not so easily carried on as in the lowlands, and is in most cases dependent upon irrigation, which is often impossible in a loess-covered region. The plains, however, support a dense population engaged in the growing of wheat, barley, beans, millet maize, and, to a smaller extent, tobacco and cotton. Cultivation is carried on with the careful attention which we give to our gardens. The spade is the chief implement used. The Shan-tung peninsula, an isolated highland region, has areas of oak forests, and these are important owing to the use of the leaves for the feeding of silkworms. The naval and military importance of the peninsula is shown in the occupation of Wei-hai-wei by the British, and the former occupation of Kiaochow by the Germans. In the early part of the great European war, the latter was captured by combined Japanese and British forces.

The most famous town in Northern China is Peking until recently the capital of the whole country. At first sight it seems strange that a city right in the north-east corner of the country should be capital for many hundreds of years. Let us see why. China is easily entered by land routes from the plains of Manchuria, and it was the great importance of this gateway that led to the selection of Peking as capital, although the city itself was finally captured in the seventeenth century by Manchu invaders, who also made it their capital, from which the Manchu dynasty exercised its authority until the last Manchu emperor abdicated, so recently as February 1912. The danger of invasion from the north is also seen in the position of the Great Wall of China. This wonder of the world was completed two centuries before the birth of Christ, and runs westward from the Gulf of Chihli for some sixteen hundred miles (see Fig. 49). It climbs up to the steepest mountain sides, and descends into deep river valleys and even gorges. Peking not

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A REGIONAL GEOGRAPHY
OF
ASIA AND
AUSTRALASIA

BY

LEONARD BROOKS, M.A. (Cantab. and Lond.)

FORMERLY OND MASTER AND GEOGRAPHY MASTER AT THE
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EDITOR'S INTRODUCTION

THE time has gone by when it was thought possible that a textbook of geography should be equally suitable for pupils at different stages of advancement, so that a series of books suited to different stages is necessary for use in schools. Regions may be studied in different orders suited to different circumstances and aims, and, to be entirely satisfying, each scheme of study should have a special series of books. The series, of which this book forms one, is designed to fit a particular scheme—i.e. that in a secondary school in the years at the end of which is one of the First Public Examinations of the type of the London General School Examination, a scheme which has for many years been found in practice to be extremely satisfactory at the William Ellis School.

Three of the volumes cover the world regionally in three years; the fourth contains much of the preceding matter in a condensed form, together with a few additions on subjects which are more profitably studied after other work has been done. Account is taken of the fact that the pupils are advancing in ability, so that, while there is a certain uniformity in that each book provides a north and south section of the world, yet the arrangement is such that the matter increase in difficulty. The series supplies textbooks for a complete school course in geography which includes physical as well as regional geography, and the order in which regions are taken depends to some extent on the desirability of studying particular sections of physical geography in a suitable order.

After the Americas in Book I, Asia and Australasia are selected for treatment in Book II. Here the geography of man is much more complicated, and the related physical geography, including, as it does, such phenomena as monsoons, necessitates the study of more climatic material than is found in Book I. At the same time the fact that the volume treats of a north and south section of the world allows of revision of previous work by comparison and contrast.

JAMES FAIRGRIEVE.

PREFACE

THIS book is the second of a series of four intended to cover the geography course for the four years leading up to and including the year in which an examination of matriculation standard is taken. From the very earliest years of teaching reference is constantly being made to matters pertaining to climate. The writer has found from experience that pupils who have arrived at this age are particularly interested in the meteorological side of geography, and are old enough and sufficiently advanced to draw together and organize, as well as to add to, previous teaching. Therefore the first seven chapters are designed to accomplish this, and to show in a clear and simple manner the broad connections existing between temperature, pressure and winds, rainfall, etc., and to carry these connections one step farther by showing the influence of all upon the distribution of natural vegetation. More difficult matters, such as the study of the Daily Weather Report and the division of the world into its major natural regions, are left for full consideration at a later stage. Chapters VIII to XVIII deal with the regional geography of Asia, and whilst the work covered in the earlier chapters is illustrated and emphasized in a concrete manner, the treatment is not unduly biased, and the method follows broad lines. The remaining chapters are devoted to Australasia, in studying which it is possible, not only to test whether the principles already learned have been understood, but also to note the differences that occur through its position in the southern hemisphere as contrasted with the situation of Asia north of the equator.

At the end of each chapter there will be found a number of questions and exercises. They are designed to test the pupil's powers of assimilation and originality; and of course it is not intended that answers should be *written* to all, nor are they by any means the only suitable exercises which may be set.

Teachers will find Book II, the *New Regional Map Books*, by V. C. Spary, B.Sc., published by the University of London Press Ltd. (price *is.*) of considerable value for use with this book.

As the author is a Divisional Inspector of Schools under the London County Council, the rules of that Authority make it necessary for him to state that the Council is in no way responsible for the book or for any of the statements in it.

L. B.

**44 Wildwood Road,
Hampstead Garden Suburb, N W. 11.
June 1938.**

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BOOK II

ASIA AND AUSTRALASIA

CHAPTER I.

THE EARTH AS A GLOBE.

LONG before the birth of Christ men believed that the earth was a sphere, and in support of their views put forward some of the arguments with which we are now so familiar. But during the Middle Ages, and right up to the time of Columbus, the most absurd views of the earth's shape were held. Sailors believed that the earth was like a shield, and that if they arrived at the edge, their vessels would fall off into space. It was the voyage of Columbus which compelled men to pay more attention to the older and truer notions of the earth's shape.

Over three hundred years before the Christian Era, it was noticed that when the earth came between the sun and the moon, thus causing the shadow of the earth to be cast on the moon, the edge of the shadow was always part of a circle. Cones, cylinders and bodies shaped like a penny can be made to cast circular shadows in some positions, but the only body which casts a circular shadow *in all positions* is a sphere.

Early in the first century, sailors had already noticed that as they approached land, the latter was first visible from the top of the mast. We now generally state this

from the standpoint of an observer looking out to sea, from which point of view the mast becomes visible first, and later, the hull. Again, the horizon, as seen from the deck of a ship, is circular in shape, and if you climb high up the mast, the horizon still remains circular, but its distance from the ship has increased. The same would be noticed on land, but it is not so easy to see the circular horizon, owing to the hills, trees and buildings. Many other reasons for believing that the earth is spherical, or nearly so, could be given, but since they are mainly the result of somewhat complicated observations by astronomers and mathematicians, it will not be necessary to discuss them here. One very simple fact, which proves that the earth cannot be flat, should be mentioned. A ship can leave Liverpool, sail westwards across the Atlantic Ocean, pass through the Panama Canal, and continue its journey across the Pacific Ocean. It can return to Liverpool *via* the Red Sea, the Sue/ Canal and the Mediterranean, after having sailed round the world. If there were no land masses to interfere, it would be possible for our ship to sail round the world on any parallel of latitude.

Scientific men have determined for us not only the shape, but the size of the earth. We know that it is not quite spherical, and that it is very slightly flattened at the poles. This flattening is so slight that an observer would not be able to detect it on the largest of artificial globes made to scale, for the polar diameter is only 26 miles less than the equatorial diameter. The circumference of the earth is rather less than 25,000 miles, and the diameter nearly 8,000 miles.

So far as we know, the first attempt at measuring the size of the earth was made by a Greek named Eratosthenes, who lived about 200 years before the birth of Christ. At Syene, now Assuan, there was a very deep well, and noticing that the image of the sun could be seen on midsummer day at the bottom of the well, he came to the conclusion that on that day the sun was overhead, and therefore the place was on the Northern

Tropic. Eratosthenes lived at Alexandria, and he set himself the task of finding out what was the angular difference between the height of the sun on midsummer day at Syene and at Alexandria. By observations at Alexandria he found that this difference was $7^{\circ} 12'$. The next thing he required was the linear distance between

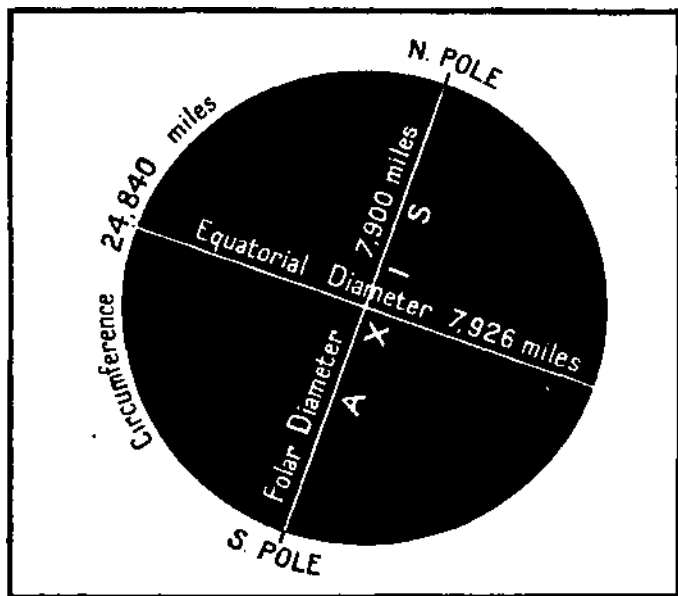


FIG. I.—Diagram illustrating some earth measurements.

Alexandria and Syene, and since even in those early days there was a good system of land survey in the Nile Valley owing to the annual floods, he had no great difficulty in obtaining this. He found the distance required was 5,000 stadia, which is 500 miles. Then he reasoned that, since a distance of 5,000 stadia subtended an angle of $7^{\circ} 12'$, the circumference of the world must

THE EARTH AS A GLOBE

be as many times 5,000 stadia as $7^{\circ} 12'$ are contained in 360° . Thus he calculated:—

$$\begin{aligned}\text{The world's circumference} &= \frac{360}{7^{\circ} 12'} 12' \cdot x 5,000 \text{ stadia} \\ &= 250,000 \text{ stadia,} \\ &= 25,000 \text{ miles (10 stadia = 1 mile).}\end{aligned}$$

Many faults can be found in this calculation. For example, a map will show that the two towns are not on the same meridian; Syene is not quite on the Tropic of Cancer, whilst the distance from Syene to Alexandria is not exactly 5,000 stadia. Despite these drawbacks, this first measurement is very interesting.

GLOBES AND MAPS.—Since the earth is a spheroid, *i.e.*, a sphere slightly flattened at the poles, you will readily understand that the only correct representation of any part of its surface is that which we have on an artificial globe. You must have noticed how the shape of any large country or continent differs on different maps. The only correct map must be on a curved surface, for it represents a part of the curved surface of the earth, and therefore all flat maps are wrong in some respect. It is very necessary that constant reference should be made to a globe in order that wrong impressions derived from flat maps may be corrected.

CHAPTER II

THE MOVEMENTS OF THE EARTH AND THEIR RESULTS.

THE APPARENT MOVEMENTS OF THE SUN.

ALTHOUGH in this chapter we shall discuss the movements of the earth, we shall first of all learn something of the apparent movements of the sun as seen in our own country from our standpoint as spectators. If the height of the sun is measured each day at noon (see Ex. 1),¹ it will be found that its height above the horizon changes a little from day to day. If the path which the sun appears to take in its journey across the heavens is noted, it will be discovered that every day the sun gets higher and higher between sunrise and noon, at the same time appearing to move from the east towards the south. When it is due south, about noon, it is also highest in the sky. During the afternoon the sun sinks lower and lower, at the same time moving westwards. If these observations are made throughout the year, it will be seen that the sun is lowest in the sky at noon about December 21, and highest about June 21, but that it is always seen in the south about twelve o'clock. If we note the point of the compass at which the sun appears to rise, we shall find that in winter it is south-east, on March 21 due east, in summer north-east, and on September 21 due east. In winter the sun appears to set south-west, on March 21 due west, in summer north-

¹ The observations suggested are best carried out in the lower forms, but in case this has not been done, it is advisable to take them at this stage.

6 THE MOVEMENTS OF THE EARTH

west, and on September 21 due west once more. If we could see the sun at midnight it would be in the north, but since it is below the horizon we cannot see it.

THE CAUSE OF NIGHT AND DAY.

We must now explain why it is that the sun appears to make these movements. This is very simple when we realize that it is not the sun which moves, but the earth. We imagine that the earth rotates on its axis, a line passing through the earth from pole to pole. It takes the earth one day to make a complete rotation on its axis. This turning of the earth on its axis is, of course, the cause of day and night, for only half the globe can receive the sun's rays at once. The earth rotates from west to east, so that as each place comes into the light the sun appears to rise in the east. Further turning causes the sun to appear higher and higher, and to reach its greatest height about noon. After noon the continued rotation causes the sun to become lower and lower, and finally to set in the west.

THE CAUSE OF THE SEASONS.

But the earth has another motion: it makes a yearly revolution round the sun. This is illustrated in Fig. 2, which represents a tub filled with water. The water surface represents the *plane of the ecliptic*, that is, the plane in which the earth moves during its revolution round the sun. Two balls are placed on the water, one to represent the earth and the other the sun. The former is moved round the sun-ball, and its path represents the orbit of the earth.

Fig. 2 shows that needles have been passed through the earth-ball to represent the axis, and it will be seen that these are not vertical; they have been inserted so as to make an angle of $66\frac{1}{2}^{\circ}$ with the surface of the water, for the earth's axis is inclined to the plane of its orbit at that angle. We must also observe that the axis

points in the same direction during the whole period of the earth's yearly revolution round the sun. Fig. 3

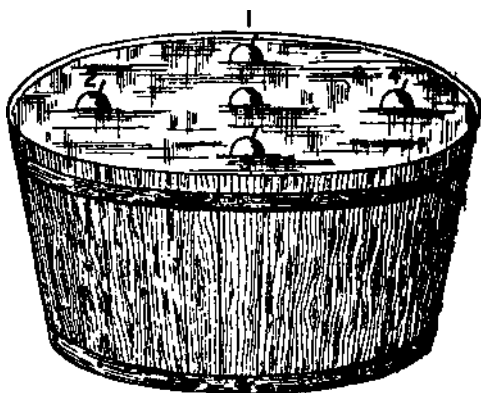


FIG. 2.—This diagram illustrates the revolution of the earth. illustrates the position of the earth with regard to the sun on certain days of the year, the unshaded area

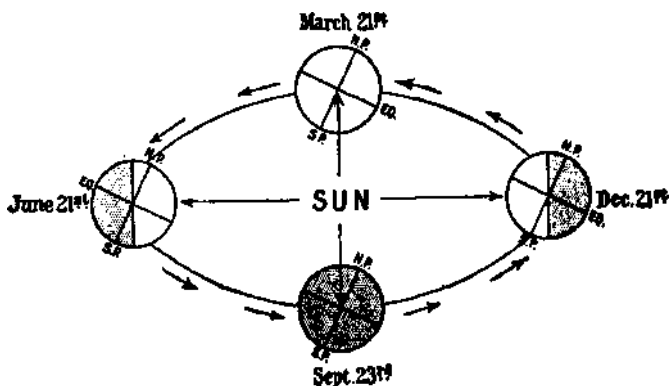


FIG. 3.—Diagram showing the position of the earth with regard to the sun at the equinoxes and solstices.

representing that part of the earth reached by the rays of the sun. It will be seen that on June 21 the northern

8 THE MOVEMENTS OF THE EARTH

end of the earth's axis, *i.e.*, the North Pole, is tilted *towards the sun* and *away from it* on December 21, so that on June 21 the sun's rays pass $23\frac{1}{2}^{\circ}$ beyond the North Pole, and fall short of the South Pole by the same angle. These conditions are reversed on December 21. On March 21 and September 23, the earth is illuminated from North to South Poles, so that the sun's rays reach the poles, but do not pass beyond them.

Now this yearly revolution of the earth round the sun is the cause of the seasons. In the next chapter we shall learn that the more overhead the rays of the sun strike the earth's surface, the warmer is the temperature*. The revolution of the earth round the sun causes the sun's rays to strike the same place at different angles at different times, and thus we have the seasons.

THE APPARENT MOVEMENT OF THE SUN IN DIFFERENT LATITUDES.

(1) AT THE EQUATOR.—Fig. 4 is a diagram which shows the apparent path of the sun at different times of the year. The point *x* represents the position of the observer, his horizon being shown by the ellipse. On March 21 the sun rises due east at six o'clock in the morning, and gradually gets higher and higher, until at noon the observer at *x* would see the sun immediately overhead. At six o'clock in the evening it sets due west. From March 21 to June 21 the sun appears to rise every day a little farther north of east, and to set a little farther north of west, whilst at the same time the elevation at noon decreases. On June 21 this northward movement ends, and on each successive day the sun rises nearer east, sets nearer west, and has a higher noon elevation. On September 23 the conditions observed on March 21 are repeated, the sun rising due east, setting due west, and being overhead at noon. Between September 23 and December 21, the sun rises each day farther south of east, and sets farther south of west, the farthest southern limits being

APPARENT MOVEMENT OF THE SUN 9

reached on December 21, when it is $66\frac{1}{2}^{\circ}$ above the horizon, which is the same elevation as on June 21, when the northern limit was reached. Between December 21 and March 21 every day sees the sun rising nearer east and setting nearer west, so that by the time the latter date is reached the sun once more rises due

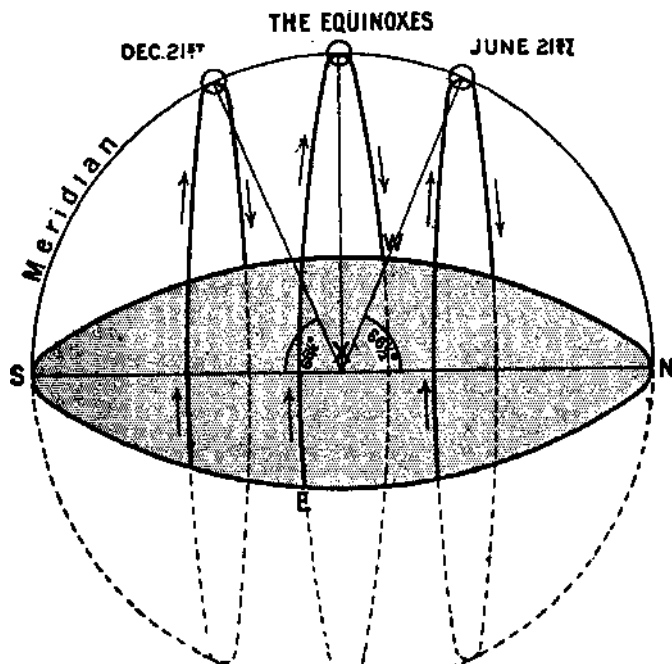


FIG. 4.—The apparent path of the sun at the equator at the solstices and equinoxes.

east, sets due west, and has an elevation above the horizon of 90° . One point must be noted, and that is, that on every day of the year at the equator, the sun rises and sets at the same time, i.e. 6 a.m. and 6 p.m. respectively.

10 THE MOVEMENTS OF THE EARTH

(2) AT LONDON.—The symbols used in Fig. 5 are the same as in Fig. 4, and since reference was made at the beginning of the chapter to the apparent movements of the sun in our own country, there is no necessity to go into detail again. The important points

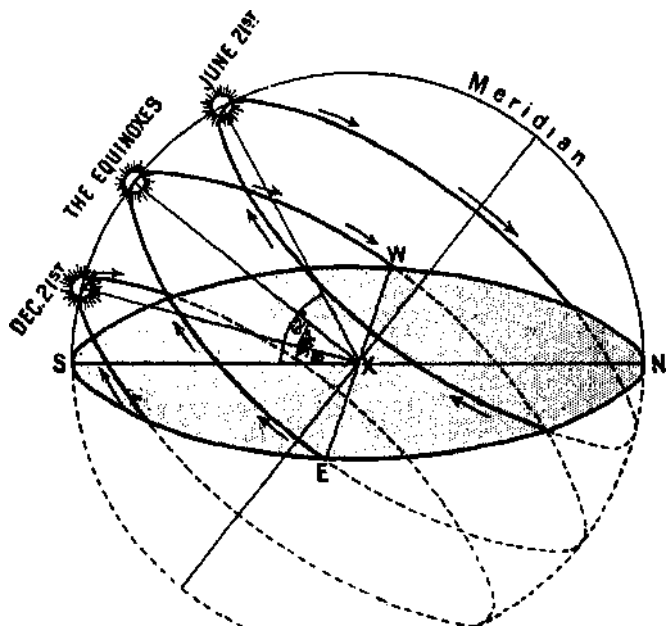


Fig. 5—The apparent path of the sun at London at the solstices and equinoxes.

to notice are (a) the long summer day, (6) the short winter day, (c) the similar conditions on March 21 and September 23.

(3) AT THE NORTH POLE.—Fig. 6 shows that on March 21 an observer at the poles would see the sun circle round the sky on the horizon. Between March 21 and June 21 it appears to circle round in the heavens,

APPARENT MOVEMENT OF THE SUN ii

gradually increasing in height, until on the latter day it reaches an elevation of $23\frac{1}{2}^{\circ}$. On each succeeding day the sun continues to circle the sky but is getting lower and lower, until, on September 23, it is once more on the horizon. But between September 23 and March 21 the sun cannot be seen at the North Pole, for it is below the horizon, reaching its lowest point on December 21. Thus we see that at the North Pole

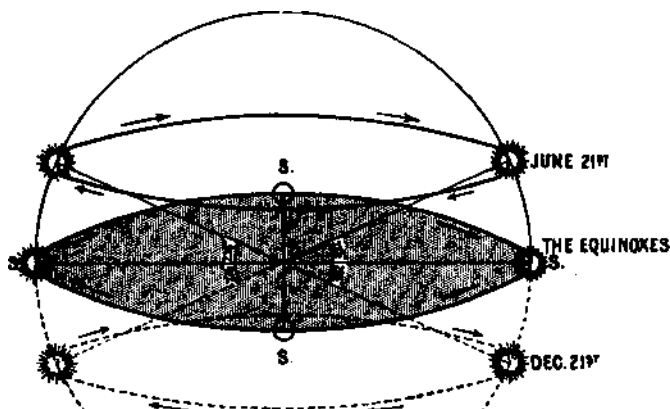


FIG. 6.—The apparent path of the sun at the North Pole at the solstices and equinoxes.

the sun never sets for six months, and never rises above the horizon for the same period. This is true at the South Pole, too, but the seasons are reversed. It must not be supposed that this means that the poles have six months light and six months darkness, for we must note that there is twilight until the sun reaches a certain distance below the horizon, and since the sun at the poles increases and decreases in height very slowly, twilight lasts for a whole month.

12 THE MOVEMENTS OF THE EARTH

HOW THE TROPICS, THE ARCTIC AND ANTARCTIC CIRCLES ARE FIXED.

We have learned that on June 21 the North Pole is tilted towards the sun, whilst on December 21 it is pointed away from the sun. It is this tilting of the earth's axis which causes the sun to be overhead at noon on June 21 as far north of the equator as $23\frac{1}{2}^{\circ}$ N. This is, naturally, what may be expected, for the earth's axis is inclined at that angle from the vertical. Similarly, on December 21, the sun is seen overhead at noon $23\frac{1}{2}^{\circ}$ S. of the equator (see Fig. 7). If, as

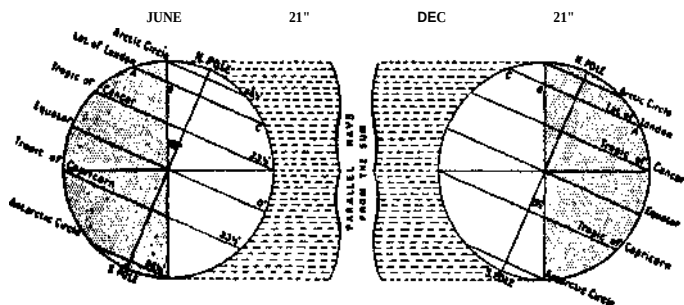


FIG. 7.—The position of the earth with regard to the sun at the solstices.

the earth rotates on its axis on these days, the sun were to trace on the earth a line along which it is seen overhead, we should have two circles which mark the northern and southern limits of the belt within which the sun can be seen overhead on certain days of the year. Thus we have the Tropics of Capricorn and Cancer fixed. The word "tropic" means a "turning point." Fig. 7 also shows that the rays of the sun fall $23\frac{1}{2}^{\circ}$ beyond the North Pole at the northern mid-summer and fall short of the South Pole by the same angle; whilst at the northern midwinter, the rays pass beyond the South Pole and fall short of the North Pole. In this way, the Arctic and Antarctic Circles are fixed.

THE EQUINOXES AND SOLSTICES.

On March 21 and September 21, when the rays reach both poles, the sun can be seen overhead at the equator, and every place has equal day and night, the sun rising at 6 a.m. and setting at 6 p.m. Therefore these days are called respectively, the *Vernal or Spring and Autumnal Equinoxes*. We have also seen that on June 21 the sun reaches the northern limit of its apparent migration into the northern hemisphere. This day is said to be the *Solstice*, which means, that the sun, as it were, stands still before its migration southwards, and since it is this apparent movement of the sun which causes summer, June 21 is called the *Summer Solstice*. Similarly, December 21 is known as the *Winter Solstice*.

EXERCISES.

1. (a) Keep a record of the noon height of the sun, if you have not done so in a lower form or class. Any sufficiently accurate instrument may be used. (b) Push a knitting-needle into a drawing-board and place the board where the sun's rays will fall upon it during school hours. Draw a line along the shadow every half-hour. From the lines so drawn, what can you learn about the height of the sun during the day? (c) By means of drawing-pins, fasten a piece of white cardboard to a drawing-board. Draw a circle of about four or five inches radius. Draw a diameter. Divide half of the circle into angles of 15° , and erect a knitting-needle at the point where each radius touches the circumference. By means of a cork-borer, obtain several pieces of cork about a quarter of an inch long and push these on the knitting-needles. The drawing-board must then be placed in a spot (best of all a window facing south) upon which the sun shines during school hours. At nine o'clock in the morning, turn the board so that the left knitting-needle and the centre of the circle are in a line with the sun. Push the cork down the needle until its shadow falls upon the centre of the circle. Repeat the process every hour, and at the end the small corks will give a representation of the path of the sun during the day. This may be repeated at other times, using different corks.

2. Draw diagrams similar to Figs. 4, 5 and 6 to show the apparent path of the sun at the solstices and equinoxes as seen by an observer at (a) the Arctic Circle, (b) the Tropic of Capricorn.

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3. Give in tabular form the height of the sun at noon on the days of the equinoxes and solstices at the poles, the Arctic and Antarctic Circles, London and the Equator. Arrange the table so as to give the dates on the left column and the places at the heads of columns.

4. Explain points of geographical interest in each of the following quotations-

- (a) The sun above the mast
Had fixed her to the Ocean.
- (b) The days grew longer and longer
Till they became as one.

5. What would be the effect (a) if the earth's axis were not tilted? (6) If the South Pole were always tilted towards the sun?

6. What are (a) the Tropics of Cancer and Capricorn, (b) the Arctic and Antarctic Circles?

CHAPTER III.

THE DISTRIBUTION OF TEMPERATURE.

TEMPERATURE is measured by means of the thermometer, and in English-speaking countries, except for scientific purposes, the Fahrenheit thermometer is in most general use, although continental countries use the Centigrade thermometer. On the former, freezing-point is 32° and boiling-point 212° , whilst on the latter these are 0° and 100° respectively. On the maps used in illustrating this chapter both scales are given.

The envelope of air which surrounds the earth can be heated in two ways; either from the earth itself, and we know that the interior of the earth has a very high temperature indeed, or from the sun. The amount of heat which the air derives from the heated interior of the earth is very small indeed, and this is illustrated by the fact that polar regions must have the same amount of heat from this source as equatorial regions, but we know that there are enormous differences between the temperature conditions in these areas. For all practical purposes we must confine our attention to the sun as the source of heat.

THE DISTRIBUTION OF INSOLATION.

Fig. 8 represents the earth, and A, B and C are bundles of sun's rays of equal width. It is clear that the nearer the rays fall to the equator, the greater is the angle at which they strike the earth, and the less the area which they have to heat. This is one reason why equatorial regions are warmer than polar regions. It is very

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useful to use a term which expresses the amount of heat energy we receive from the sun. The term is *insolation*. The insolation for any day is the total amount of radiant energy received from the sun during that particular day. It is very important to notice that figures which give the amount of insolation at different latitudes

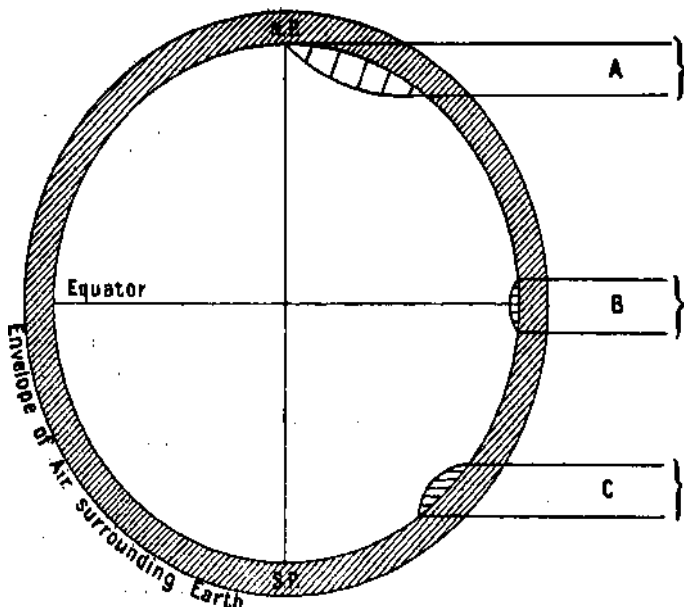


FIG. 8.—Diagram showing bundles of the sun's rays striking the earth's surface at different angles.

at certain times of the year, do not take into account the important facts that the earth is surrounded by an atmosphere, and that the land and sea surfaces of the globe differ very greatly in their power of heating and cooling. They do, however, take into account the length of time the sun is above the horizon.

It might be supposed that on June 21, when the sun is overhead at the northern tropic, insolation will be

greatest there. This is not so, for we must not forget that on that day, day and night are not of equal length as at the equinoxes, when the amount of heat received from the sun is greatest at the Equator, and decreases towards the poles. At the summer solstice, there is still equal day and night at the Equator, but as we go towards the North Pole the length of day increases, being 13 hrs. 56 min. in lat. 30° , and $18\frac{1}{2}$ hrs. in lat. 60° ; whilst regions within the Arctic Circle have a longest day varying from 24 hours to 6 months, according to their positions. Thus it is evident, that although the sun will be hotter at the Tropic of Cancer, it is longer in the sky in latitudes farther north, so that the total amount of radiant energy or insolation received is not very easy to calculate. If we let the insolation at the equator for the vernal equinox be represented by the number 1,000, that at different latitudes on June 21 is given in the following table :—

Latitude N.			
0°	881	50°	1105
10°	975	60°	1093
20°	1045	70°	1130
30°	1088	80°	1184
40°	1107	90°	1202

From these figures it will be seen that the insolation on June 21 is greater at the North Pole than at the Equator. But there are certain facts which must be pointed out, or a wrong impression might be gained. Firstly, the figures represent the total amount of insolation received during the whole day, and do not show the temperature *reached* during the day. We know that the polar regions do not attain the same temperatures as equatorial regions. Secondly, since the table imagines the earth to have no atmosphere, it does not take into account the loss of heat owing to absorption by the atmosphere. Thirdly, the figures do not allow for the fact that the earth has both land and

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water surfaces, and that these affect the distribution of temperature very considerably. Let us first consider the influence of the atmosphere upon insolation.

THE INFLUENCE OF THE ATMOSPHERE ON INSOLATION.

Before they can reach the earth, the sun's rays have to pass through the air envelope which surrounds the earth to a height of some 200 miles. In passing through the atmosphere, the sun's rays must lose some heat even if the air were quite free from all impurities. But there are dust particles and water vapour in the air, and these absorb the sun's rays to such an extent that a large proportion of heat does not reach the earth. It will readily be seen that more heat will be absorbed by the atmosphere, the denser and thicker the envelope of air and the more dust and water particles that air contains. Fig. 8 shows that ray B has to pass through less air than those which fall obliquely (A and C), and therefore will not lose so much heat to the atmosphere. Therefore, since the sun's rays reach equatorial regions in a far less slanting direction than polar regions we have here another reason why the latter regions are colder. We shall now learn of the influence of land and water upon temperature.

THE INFLUENCE OF LAND AND WATER UPON TEMPERATURE.

Land and water do not take in heat at the same rates. If we heat a cubic foot of sand and the same quantity of water, we should find that the latter requires about twice as much heat to raise the temperature 1° as is required to raise the temperature of the sand by the same amount. On cooling, water gives out more heat than land. Again, the water in the ocean is in constant motion, so that the heat received from the sun is distributed, whereas rays falling on land heat only the

ALTITUDE AND TEMPERATURE

area on which they fall. Water is heated to a greater depth than land, and this is another reason why water takes longer to heat. In brief, we may say that the water surfaces of the earth take longer to heat in summer than the land surfaces, and cool at a slower rate in winter—that is, the oceans will be cooler than the continents in the same latitudes in summer, and warmer in winter (see Ex. 4 at the end of chapter). Lastly, let us turn to the influence of altitude upon temperature.

THE EFFECT OF ALTITUDE ON TEMPERATURE.

It has been seen that the atmosphere receives some heat from the rays of the sun as they pass through it. But only a small proportion of the heat received is acquired in this way. The sun's rays heat the surface of the earth, and by the process of radiation some of this heat is absorbed by the air. But the air is probably affected most by actually coming in contact with the earth, for it is easily heated by contact with something warmer than itself and cooled by something colder than itself. Thus the layers of air in contact with the earth are heated, and becoming lighter than the surrounding air, are displaced by the latter and forced to rise. The air which now comes in contact with the earth is warmed, and in its turn is compelled to rise. The ascending particles of air lose some of their heat to the air with which they come into contact. In this way the whole of the lower layers of the atmosphere are gradually warmed. Since the air is largely heated by contact with the earth, it is natural that the temperature falls as altitude increases. But this does not fully explain why it is colder on the top of a mountain than at its base, for the air at the summit is as near the ground as the air at the base. The question of pressure comes in here, and although we shall speak of atmospheric pressure in the next chapter we can now mention that air pressure decreases as sea-level is left behind.

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As the air at high altitudes is not so dense as near sea-level, and is freer from water vapour and dust, it follows that the amount of insolation reaching the surface is greater than at sea-level. But for the same reasons the heat is very quickly radiated to the atmosphere, and the ground cannot retain its temperature for long. The total effect is to lower the temperature on mountains or plateaux.

The rate at which the temperature falls varies very much according to the place and season, but it may be taken as about 1° F. for 300 feet of ascent (see Ex. 3 at the end of this chapter). We have now covered all the points which will help us to understand the temperature maps of the world. Before studying them, however, let us just put together, from what we have learned, the causes which make summer warmer than winter.

WHY IT IS WARMER IN SUMMER THAN IN WINTER.

Fig. 7 shows that the North Pole is tilted towards the sun in June, and away from the sun in December. This not only gives us longer days in summer, but causes the sun to be higher in the sky in summer than in winter. Thus it is warmer in summer than in winter, for these reasons—

(1) The amount of insolation is greater, partly on account of the greater angle at which the sun's rays are received, and partly because the days are longer. (2) Less heat is absorbed as the sun's rays pass through the air. The lines A, B, C, in Fig. 7, represent the latitude of London, and the thickened rays are those which reach this latitude at June 21 and December 21. It will be seen that the summer ray reaches the latitude of London in a less slanting direction and passes through less air in June than in December. Notice the parts of the lines A, B, C, which are in the unshaded portion of the diagrams. These represent the relative length of days in June and December. It is at once

evident that the tilting of the earth's axis gives to London a longer day in summer and therefore more heat.

Temperature distributions are shown by means of *isotherms*, which may be defined as lines along which the temperature is everywhere the same. The method of drawing isotherms is illustrated in Ex. 1 at the end of this chapter. It is very important to notice that most isothermal maps are reduced to sea-level. Temperature varies with elevation, and therefore it is necessary to correct the thermometer readings at each station to what they would be at sea-level, if we wish to learn from the map the effects upon temperature of causes other than elevation.

TEMPERATURE MAPS OF THE WORLD.

Figs. 9, 10 and 11 show the mean sea-level temperatures for April, January and July. April (or October) is the best month for showing the temperature conditions when the maximum temperature is near the equator. January and July maps give the distribution of temperature in the winter and summer months of temperate latitudes. Theoretically, Figs. 9, 10 and 11 should be made for the days of the vernal or spring equinox and the solstices, but there is what may be described as a "lagging of the seasons," which must be taken into account.

Some isotherms are of greater importance than others; for example, the summer isotherm of 50° F. approximately marks the poleward limit of trees, for the latter cannot thrive unless this temperature is reached during at least one month. On Figs. 9, 10 and 11 the isotherms of 32° , 50° , 68° and 86° F. have been inserted. In order to bring out more clearly the great winter cold of the Eurasian land mass, other isotherms have been added to the January map.

APRIL TEMPERATURES.—Fig. 9 shows the **April** temperatures reduced to sea-level. It will be seen that

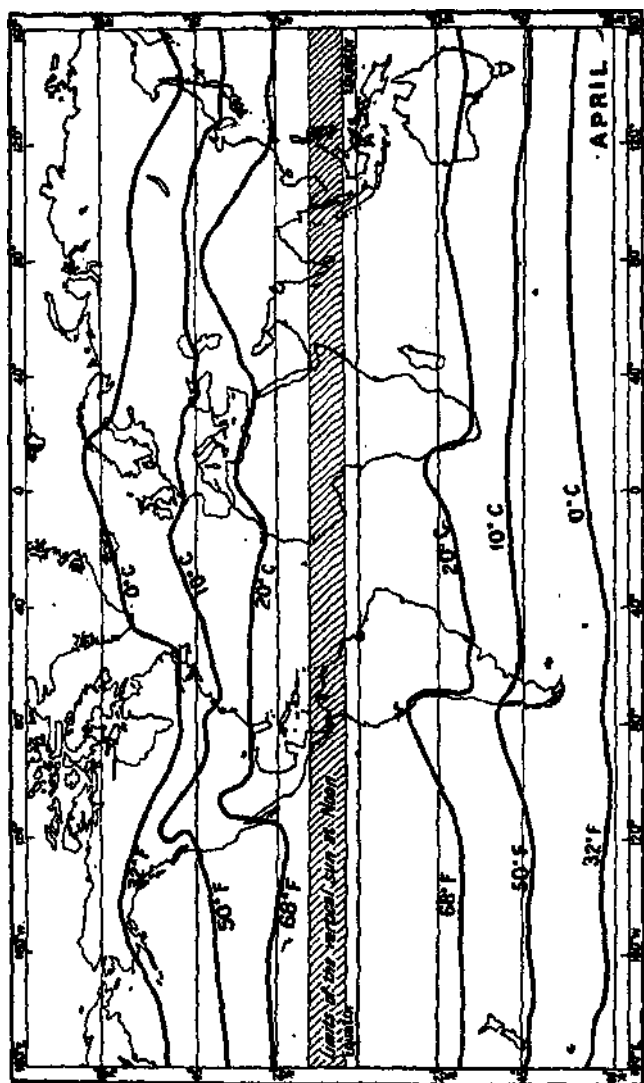


FIG. 9.—Mean sea-level temperatures for April.

TEMPERATURE MAPS OF THE WORLD 23

the region of greatest heat lies in equatorial regions, and that the temperature decreases gradually as the poles are approached. The isotherm of 50° follows very roughly the parallels of latitude 45° N. and S. The explanation of this general distribution of temperature is found in the fact that this map is made for a month immediately following the spring equinox, so that we should expect temperatures to decrease gradually from the equator to the poles.

JANUARY TEMPERATURES.—This map shows that the heat belt has migrated southwards with the sun, for the latter is overhead at noon on December 21 at the Tropic of Capricorn. The hottest belt is distinctly south of the equator, for it is in the summer season in the southern hemisphere. The highest temperatures (over 86°) are to be found over the land masses, on account of the fact that the temperature of land rises more quickly than that of water. The isotherm for 50° almost keeps parallel to the lines of latitude, and the reason for this should be apparent, as it is almost entirely over water. As a contrast, the isotherms for the northern hemisphere show a most marked bend southwards on the west of continents, and northwards on the east of continents, whilst over the land masses themselves they bend southwards. The isotherm for 32° F. gives the best illustration of this. This irregularity is accounted for partly by the unequal heating of land and water, and partly by ocean currents. With regard to the effect of the latter, we shall make fuller reference in Chapter V, but one other example of their influence on temperature may be pointed out now. In both January and July, the isotherms of the southern hemisphere bend northwards off the west coasts of land masses and southwards off their eastern shores. The reason for this is, that cold currents flow northwards along their western shores, and warm currents flow southwards along their eastern margins.

The coldest region is in Northern Siberia, where there is an area which has been called the "cold pole,"

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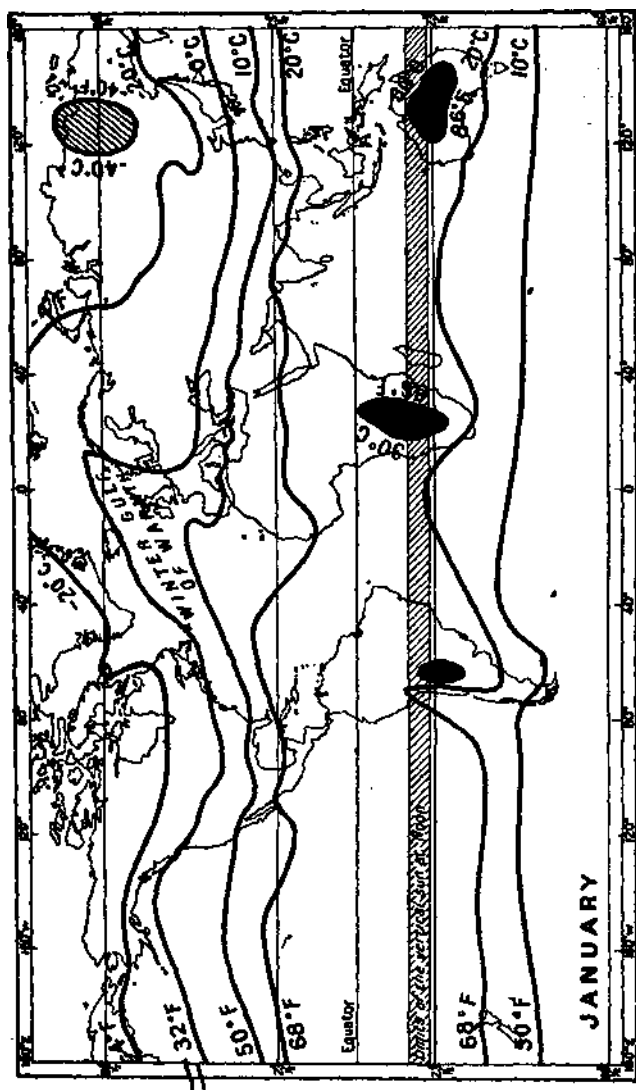


FIG. 10.—Mean sea-level temperatures for January.

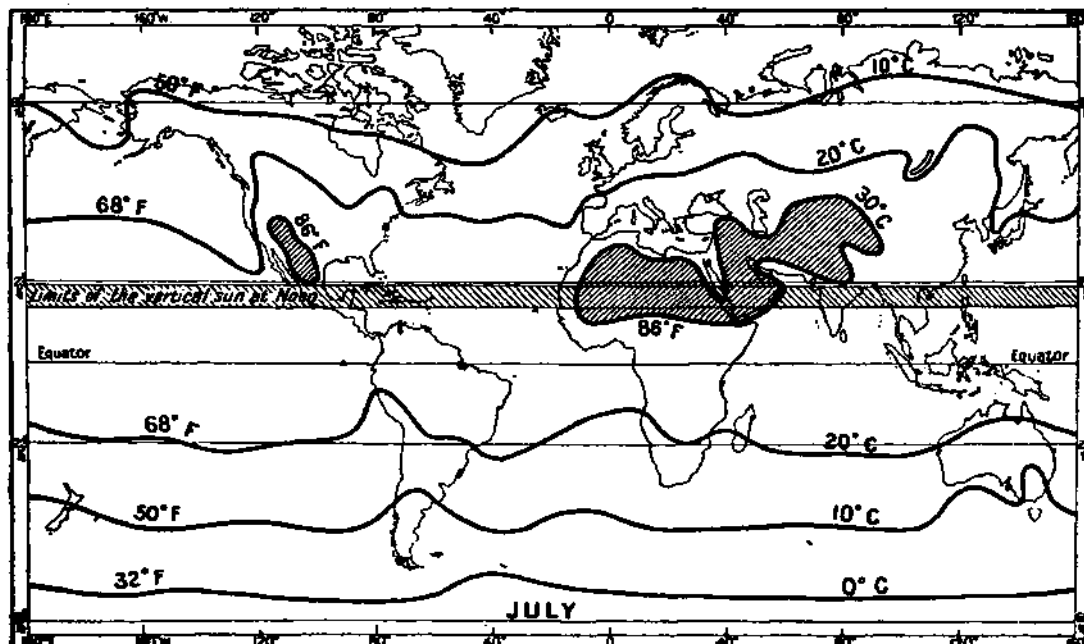


FIG. II.—Mean sea-level temperatures for July.

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whose temperature is below -48° F. A vast area of Eurasia has a temperature below freezing-point. So great is the land mass that this temperature is experienced within 3° of the Tropic of Cancer. The interior lands of North America are also very cold, but since the land area is not so great as in the old world, the temperatures are relatively not so low.

JULY TEMPERATURES.—Fig. 11 shows the temperature for July, when it is evident that the heat belt has migrated into the northern hemisphere, where the highest temperatures are seen to be over the land masses. Since the latter are warmer than the oceans in the same latitudes, the isotherms of the northern hemisphere bend northwards over the land. Over Asia, the isotherm of 68° F. reaches within 7° of the Arctic Circle. The southern hemisphere shows a more equable distribution of temperature south of the equator, due to the great extent of ocean.

EXERCISES.

1. On two outline maps of the British Isles plot the positions of the stations used (or the reports of the Meteorological Office. On one map print by the side of each station the mean temperature for January, as given in Appendix 1 of the D.W.R. On the other do the same for July. Then draw the isotherms for every even number of degrees (*i.e.* 38° , 40° , 42° F., etc., for January, and 56° , 58° , 60° F., etc., for July).

2. Draw a map of the coast-lines of the North Atlantic Ocean, and on it mark the January isotherm of 32° F. Shade the area which has a temperature of over 32° F. The great gulf-like tongue of warmer water off the West of Europe is sometimes called "The Winter Gulf of Warmth."

3.

Place.	Height in feet above sea.	Jan. temp.	July temp.
Fort William . Ben Nevis summit .	S.L. 4,400	$38^{\circ}7'$ F. $23^{\circ}4'$ F.	$57^{\circ}1'$ F. $41^{\circ}7'$ F.

Find these places on the map. Account fully for their differences in temperature.

EXERCISES

4.

Place.	Jan. temp.	July temp.	Range of temp.
Cambridge .	37-6° F.	61'5° F.	23'9 ⁰ F.
Berlin .	31'3° F.	64'5° F.	33'2' F.
Warsaw • •	23'9 ⁸ F.	65'5° F.	41'6° F.
Saratof. • •	13'5° F.	71'0° F.	57'5 ⁰ F.

These places are in approximately the same latitude. Account for the different temperature conditions shown by the figures.

5. On outline maps of the Old World north of the equator mark the isotherms for January and for July. Shade the maps so as to emphasize cold in winter and heat in summer. Write short accounts bringing out the leading features shown by the maps.

6. On outline maps of the southern hemisphere draw the isotherms for January and for July. Shade the map as suggested in Exercise 5. State the chief differences between the distribution of temperature in Eurasia and North Africa and in the southern hemisphere.

7. Why is it warmer in equatorial regions than in polar regions? Draw diagrams to illustrate your answer.

CHAPTER IV.

THE PRESSURE OF THE ATMOSPHERE AND ITS INFLUENCE ON WINDS.

IN previous chapters we have learned that the earth is surrounded by an air envelope. It is known that this extends to a height of about 200 miles from the earth's surface, and that the higher we go the lighter the air becomes. Since we know that air has weight, it follows that it exerts a pressure upon the surface of the earth, and that this pressure will be greater at sea-level than on the top of a high mountain, for there is not so much air above the latter as there is above a place at sea-level. Air pressure is measured by means of the barometer. A barometer consists of a glass tube which is closed at one end. This tube is filled with mercury, inverted, and the open end placed into a cup of mercury. The mercury column then falls a little, and some of the mercury runs back into the cup, leaving in the tube a column about thirty inches high.

When the air pressure upon the surface of the mercury in the cup is increased, the column is pushed higher up the tube; but if the air pressure decreases mercury flows from the tube to the cup, and the height of the column is decreased. Thus it is seen that when the column stands at a height of 30 inches the pressure of the atmosphere is equal to that of a layer of mercury 30 inches deep. It is usual to express the pressure of the atmosphere in inches or millimetres of mercury, and the normal pressure at sea-level is about 29.9 inches or 760 millimetres. It is more scientific, however, to use a pressure unit, hence the increasing use of the terms *bar*

and *millibar* (see Exercise 7 at the end of this chapter). When the pressure is more than 29.9 inches **or 1012.5** millibars we speak of it as being "high," and when it is below this we speak of it as being "low." Since we know the density of mercury it is easy to calculate that this pressure is equal to one of 147 pounds per square inch.

PRESSURE AND ALTITUDE.

We have seen that the air extends to a height of about 200 miles, but at that height it is extremely rare. Since the upper layers of air press upon the lower layers, the latter are denser and therefore heavier, for the particles of air are closer together. If a barometer were carried up the sides of a high mountain it would be found that the reading would continually fall, and that at an elevation of 900 feet from sea-level the reading would be one inch less than at sea-level. To cause a fall of another inch, however, we should have to make an ascent of more than 900 feet, because, as we are now increasing our elevation, the air is less dense than it was at lower levels. At an elevation of 3½ miles the pressure is only about half what it is at sea-level, so that half of the atmosphere would be below that elevation; whilst at a height of seven miles we should have three-fourths of the atmosphere below us.

So rarefied is the atmosphere at great elevations that it is very difficult to breathe sufficient air for the wants of the body. Some men and animals have become accustomed to living at great elevations; but it is a well-known fact that travellers *unaccustomed* to living in high altitudes find great difficulty in breathing, and even at lower levels, suffer from headaches, dizziness and sickness. It will readily be seen that barometer readings can be used for determining roughly the heights of mountains.

PRESSURE AND WINDS.

If the pressure at any place is high, and that of the surrounding area low, air flows outwards from the higher

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pressure towards the lower. Air always flows from places of high pressure towards places of low pressure. But this statement requires some modification, for the rotation of the earth causes winds to be deflected to the right in the northern hemisphere, and to the left in the southern hemisphere. Pressures are represented by means of *isobars*, or lines along which the pressure is everywhere the same (see Ex. I on p. 40). Fig. 12 A shows an area of high pressure surrounded by lower

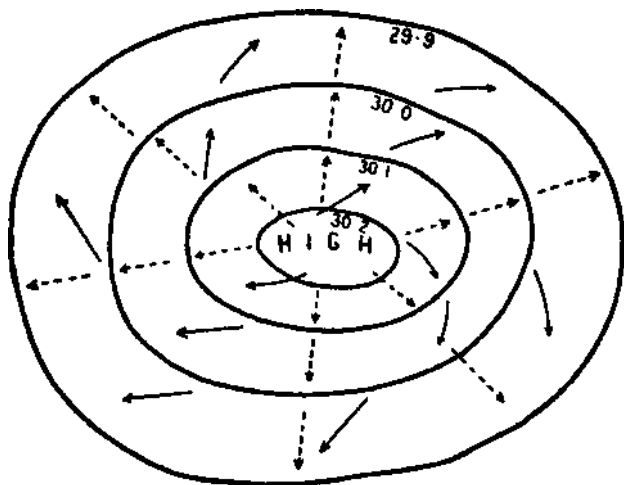


FIG. 12 A.—The relation between pressure and winds.

pressure, and if the earth stood still winds would flow outwards as indicated by the dotted arrows. If this represents a pressure system in the northern hemisphere the actual winds will be as shown by the straight-lined arrows. This law of the deflection of winds to the right in the northern hemisphere, and to the left in the southern hemisphere, due to the earth's rotation, is known as *Ferrers Law*. It must be noted that rivers are also influenced, but not nearly to the same extent as the lighter, easily influenced air currents.

PRESSURE AND WINDS

A full explanation of this deflection cannot be entered into here, but it may be illustrated in several ways.

Push a knitting-needle through the centre of a cardboard disc, and rotate the disc from right to left. From the centre of the disc allow an inked marble to run towards the edges, and then notice its track. The marble does not reach the point originally aimed at, but is deflected to the right. This illustrates the deflection of a northern hemisphere air current moving equatorwards, for the edge of the disc represents the equator, and the centre the North Pole. If the disc be rotated from left to right the deflection is then to the left, and this illustrates the deflection of air currents

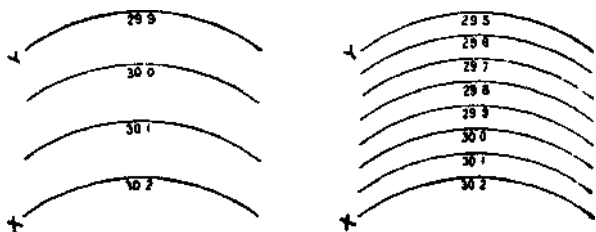


FIG. 12 B.—Steep and less steep gradients.

moving from the South Pole towards the equator from the standpoint of a person looking down upon the South Pole. The deflection of currents moving equatorwards can also be shown as follows: Rotate a globe in the same direction as the earth's rotation, *Le.* from west to east. Whilst the globe is turning round, by means of a piece of chalk, try to draw due north and south lines. Draw several for each hemisphere, taking care that each line is drawn towards, and not away from, the equator. Stop the globe, and it will be seen that the lines show deflection, as stated in Ferrel's Law. Currents moving polewards are also deflected to the right in the northern hemisphere, and **to the left in the southern hemisphere.**

There is one more point to which **reference** must be

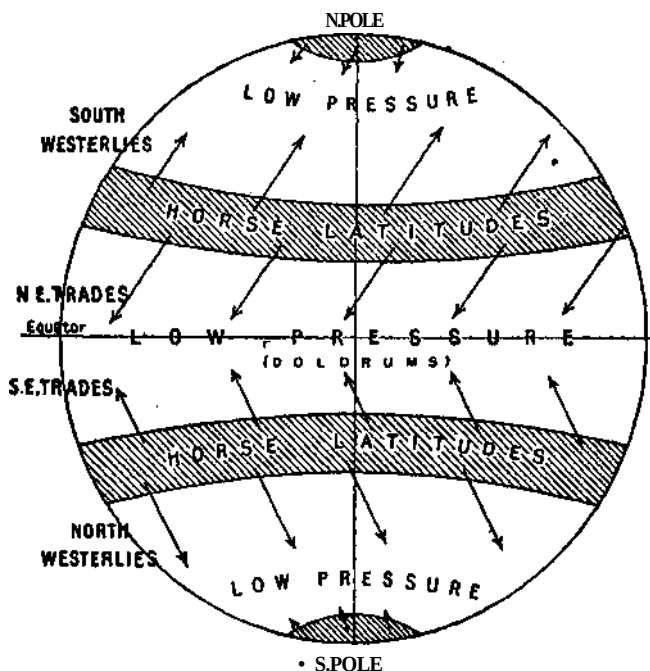
32 THE PRESSURE OF THE ATMOSPHERE

made. At the beginning of this section we learned that winds are due to differences of pressure. From this it follows that the greater the difference in pressure between two places the stronger will be the resulting wind. In the isobars on the left of Fig. 12 B the difference between the readings at x and y is three-tenths of an inch. In those on the right x and y are the same number of miles apart, but the pressure difference is seven-tenths of an inch. In the latter case, the winds experienced will be much stronger than in the former, for the air will be pushed outwards with much greater force. In each case the isobars are drawn to show differences of pressure at one-tenth of an inch intervals, but it is evident that they are closer together in one than in the other. Thus we reach a statement which is sufficient for present purposes: winds are generally stronger where the isobars are closer together than where they are farther apart.

GENERAL DESCRIPTION OF THE DISTRIBUTION OF PRESSURE AND THE PLANETARY WINDS.

We are now in a position to consider the distribution of pressure over the surface of the globe. In the last chapter we learned that the equatorial belt has great heat. Now this causes the development of an area of low pressure known as the Doldrums, towards which there are inflowing winds at the surface and above which there is a drift of air forced upwards by the meeting of the inflowing air currents. About 30° to 35° north and south of the equator are two belts of high pressure. These are known as the Horse Latitudes. Small areas of high pressure are also found at the poles, whilst in sub-arctic regions there are low-pressure areas. All these will be found on Fig. 13. Now if the world stood still, we should have winds blowing from high-pressure belts to low-pressure belts; but, as the rotation of the earth causes the winds to be deflected, we have air currents moving equatorwards and polewards from

the Horse Latitudes, and being deflected to the right in the northern hemisphere and to the left in the southern hemisphere. Those blowing towards the equator are the steady *Trade Winds*, and those blowing pole-



high Pressure Areas.

FIG. 13.—A diagrammatic representation of the prevailing winds of the world.

wards are the *Westerlies*. In addition to these, there are the winds which blow from the polar high-pressure areas. All these winds will be found marked in Fig. 13. The *Westerlies* are stronger than the *Trades*, but do not blow with such regularity, and on this account are best referred to as the "Prevailing *Westerlies*." The pic-

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turesque name " Brave West Winds " has been given to the Westerlies of the southern hemisphere, whilst the latitudes in which they are most reliable and are very strong, have been named " The Roaring Forties." These names help to indicate the strength of the southern hemisphere Westerlies.

One other point must be made clearer. The Horse Latitudes and the Doldrums are " calms "—that is, little movement of air is felt. Very often sailing ships are becalmed in these latitudes for many days together. This is due mainly to the fact that the chief movement of air in these places is a vertical one. Air rises at the Doldrums and, in the upper layers of the atmosphere, flows out towards the poles. By the time the Horse Latitudes are reached, the air has sufficiently increased in density, due to cooling, that it falls to the surface, and flows either to the equator or towards the poles as a surface wind. Thus it is seen that since the movement of air at the Horse Latitudes and Doldrums is not a horizontal movement, these regions will be calms. This explains, too, why there are high-pressure belts from 30° to 35° north and south of the equator. The air which descends to the surface in these latitudes increases very rapidly in density as it falls, so that the pressure is bound to be high.

WORLD DISTRIBUTION OF PRESSURE.

In explaining Fig. 13, we have not taken into consideration the fact that the earth's surface consists of land and water, and that these, owing to their different capacities for heating and cooling, will affect pressure. Nor have we taken into account seasonal changes in pressure distribution. We shall now consider these points.

Figs. 14, 15 and 16 show the distribution of pressure in October, January and July. For the purposes of comparison, all the readings from which pressure maps are constructed have certain corrections applied to them,

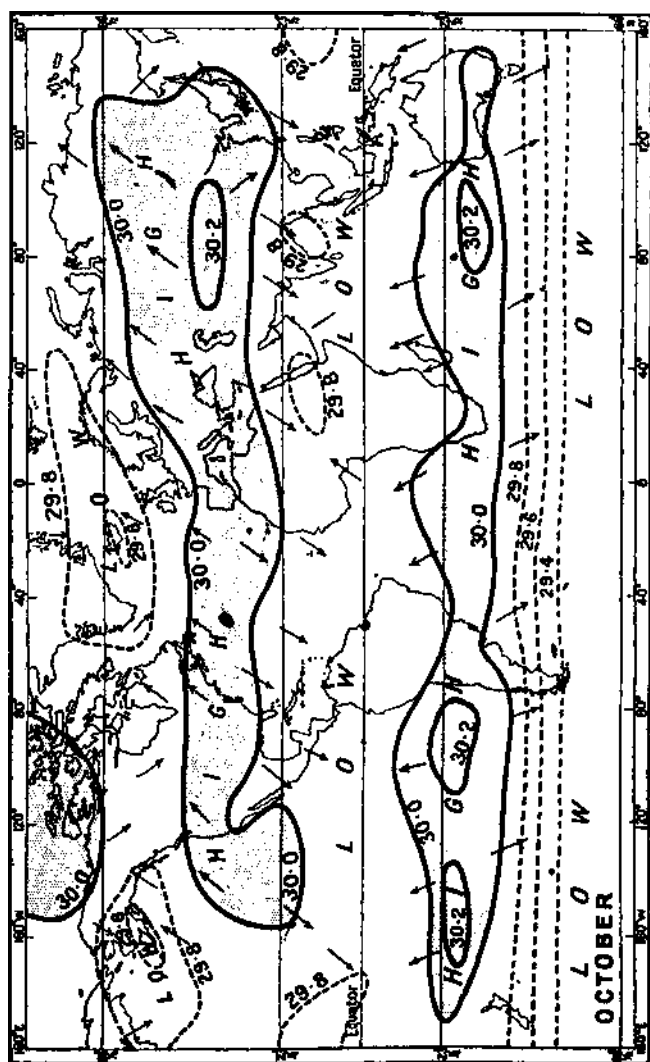


FIG. 14.—Isobars and winds for October. (After Buchan.)

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the chief being for altitude and temperature. As all readings have been corrected to sea-level readings, it follows that the actual pressure over such a high plateau as Tibet is much less than these maps show. Temperature, too, has an important influence upon pressure, so that pressure maps are corrected to a standard reading at 32° F., but this correction is not nearly so large as that for altitude.

PRESSURE DISTRIBUTION IN OCTOBER.—Fig. 14 shows that at this month there is a marked low-pressure belt corresponding to the equatorial heat belt. The pressure increases until the latitudes 30° — 40° N. and S. are reached, and here we have belts of high pressure. In higher latitudes still, the pressure again diminishes. This distribution more nearly corresponds with that shown in the diagram Fig. 13, and this is due to the fact that October is very near to the equinox, when the sun is seen overhead at noon at the equator.

PRESSURE AND WINDS IN JANUARY.—We can see very clearly from Fig. 15 that in this month the equatorial low-pressure area has moved southwards. This is in accordance with the migration of the temperature belts. We can also see that the southern high-pressure belt, the Horse Latitudes, is not so continuous as in October, for there are distinct low-pressure areas over the land masses of South America, Africa and Australia. Remembering that January is the southern summer, this is easily accounted for by the unequal heating of land and water. In the northern hemisphere, the high-pressure belt is a very marked feature, especially over the land masses, where the pressure is the highest. This is best shown over Asia, where the area of high pressure is very large indeed. Over the North Atlantic and Pacific Oceans are well-defined low-pressure areas. The influence of land and water upon the pressure distribution just outlined should be obvious.

The arrows show the winds which will be found to blow from high to low pressure, and to be deflected according to Ferret's Law. Notice the continuous belt

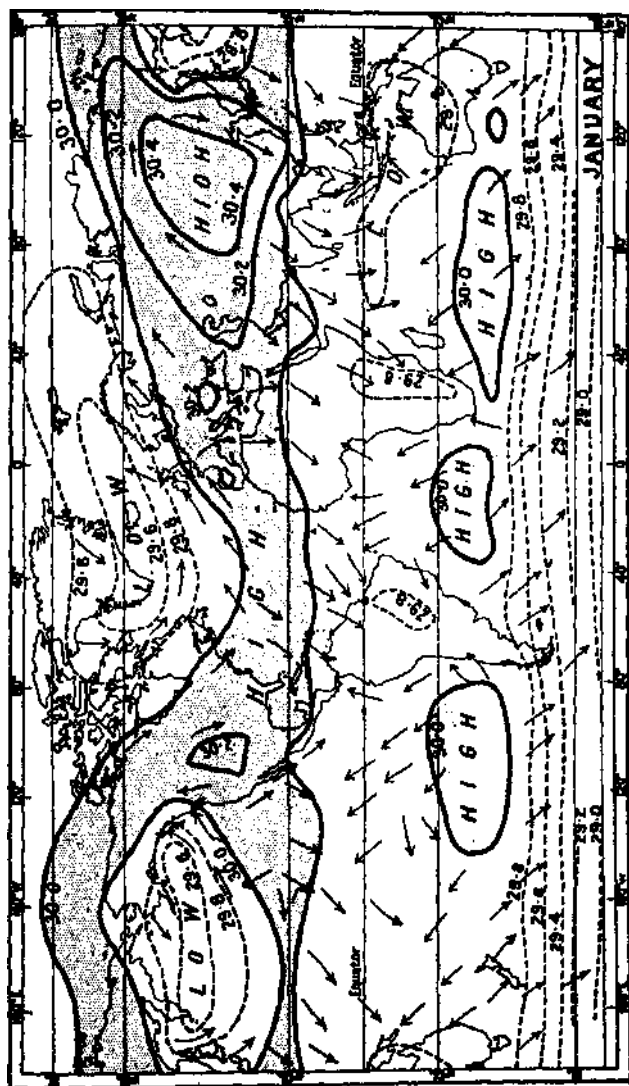


FIG. 15.—Isobars and winds for January. (After Buchan.)

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of north-westerlies compared with the south-westerlies of the northern hemisphere. The latter tend to get into great swirls of air blowing spirally round the ocean centres of low pressure. One more point should be observed. In North-western Australia the ordinary S.E. Trades are not experienced at this season (southern summer). Owing to heat, a low-pressure system is formed, towards which air flows, thus giving a north-west monsoon.

PRESSURE AND WINDS IN JULY.—This is the winter month of the southern hemisphere, where we find the actual distribution of pressure closely corresponding to Fig. 13. The reason is, that in this hemisphere the disturbing factor of the temperature differences between land and sea is not so important as in the other hemisphere, because the land masses are not nearly so large. The Doldrums belt of low pressure and the southern Horse Latitudes high-pressure belt are clearly shown, but when we turn to the northern hemisphere Horse Latitudes, it is apparent that there is no continuous belt of high pressure at this season. Over the oceans are areas of high pressure, and over the continents areas of low pressure, that over Asia being very well marked. It will thus be seen that the distribution of pressure shown in Fig. 13 has to be modified in the case of Asia, owing to the enormous area of the land mass. In January, Asia has a system of high pressure, with out-flowing winds; in July, it is under the influence of a low-pressure system with inflowing winds. It is this great change in the distribution of pressure that gives to Asia, south-east of a line drawn from Karachi to Korea, a distinctive type of climate of alternating dry and wet seasons. The full consideration of this is reserved for another chapter, but one point must be mentioned. Fig. 16 shows that the S.W. wind which blows over India in July is simply the S.E. Trade Wind, which, having crossed the equator, is deflected to the right by the rotation of the earth, and proceeds towards India as a south-west wind. The term " Mon-

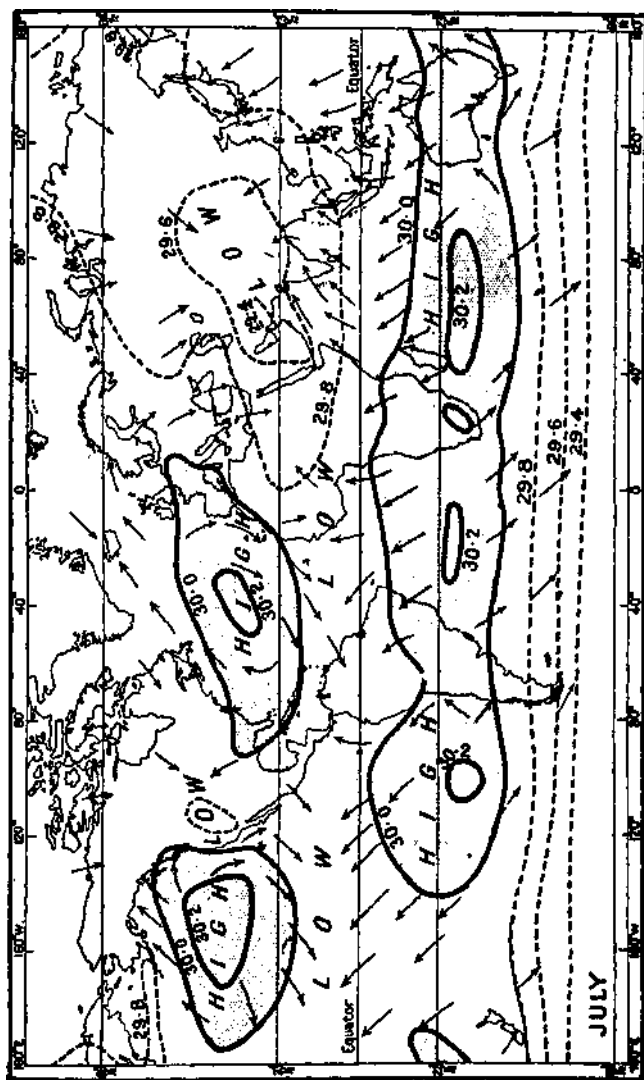


Fig. 16.—Isobars and winds for July. (After Buchan.)

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soon" (= a seasonal wind) is given to the summer winds of S.E. Asia.

We have learned that in January there is a distinct southerly migration of the pressure belts, and if the pressure maps for October and July be compared, it will be apparent that in the latter month there is a similar migration northwards. This is exceedingly important, for there are certain latitudes which will be transition areas, *i.e.* will be in high-pressure belts at one season, and in low-pressure belts at another. In order to prevent exaggerated ideas concerning the amount of the migration you will do well to consult a set of monthly charts of the North Atlantic Ocean.

EXERCISES.

1. Draw an outline map of Western Europe. Mark the positions of the places shown in the first column of the Daily Weather Report. Beside each, mark neatly the reading of the barometer at 7 a.m. and draw the isobars at intervals of one-tenth of an inch. Compare your results with those on p. 3 of the Weather Report.

2. Make maps showing the distribution of pressure in the southern hemisphere for January and July. Show winds by arrows. Write an account of the distribution of pressure as shown in the map.

3. Make maps showing the distribution of pressure in the northern hemisphere for January and July. Show winds by arrows. Describe the distribution in writing, accounting for the differences noted between these maps and those for the southern hemisphere.

4. On an outline map of the world plot the probable course of a sailing vessel from London to Melbourne and home again. (The direction of the prevailing winds must be kept in mind in order to accomplish this exercise successfully.)

5. Explain very carefully:—high pressure, Roaring Forties, Horse Latitudes, Doldrums, Ferrers Law.

6. Draw a circle of $2\frac{1}{2}$ " radius. Mark the equator and the tropics. Shade or mark the polar high-pressure regions and the Horse Latitudes. By means of arrows, show the prevailing winds of the world.

7. What is a millibar? Why is air pressure now recorded in millibars in the Daily Weather Report?

8. What special precautions had to be taken by the Mt. Everest climbing parties in order to carry on their work at high altitudes? Why **were these** necessary?

CHAPTER V.

OCEAN CURRENTS.

FIG. 17 shows a small tank containing water. At one end a strainer containing ice is fixed, and at the other the lid of a small tin box is held in position by a piece of wire. A bunsen burner is fixed or held so that the flame heats the lid. The water in contact with the heated lid is raised in temperature and thus expands, whilst that in contact with the ice is chilled and contracts. This causes the cooled water to sink and the heated water to flow towards the ice. In this way a circulation of water is set up as indicated in Fig. 17 by the arrows.

Now let us apply this simple experiment to the waters of the ocean. The heated end of the tank may be compared with the surface waters of the ocean at the equator, and the cool end with polar waters. In polar regions water sinks to the bottom of the ocean on account of increasing density due to cold, whilst at the equator, where the heat of the sun warms the surface water, expansion takes place and water is set in motion polewards.

There is no doubt that there is a general equatorwards creep of cold water along the ocean bed, and a surface flow towards the poles; but this is not sufficient to account for the extensive movements which take place in the surface waters of the oceans. The chief cause of these must be looked for in another direction.

If, by means of a pair of bellows, air is blown upon the surface of a tank filled with water, the force of the air is quite sufficient to set up surface currents of water.

There can be little doubt that the prevailing winds are the chief factors in the production of ocean currents, for in regions where winds change with the seasons, the change of wind is accompanied by a change in the direction of the currents. This is very clearly shown in the North Indian Ocean. We have learned that at one time of the year (Nov.-April) the wind is from the north-east; at the other time (May-Oct.) it blows from the south-west. Fig. 18 shows the currents of the Indian Ocean, from which it will be seen that a change of wind

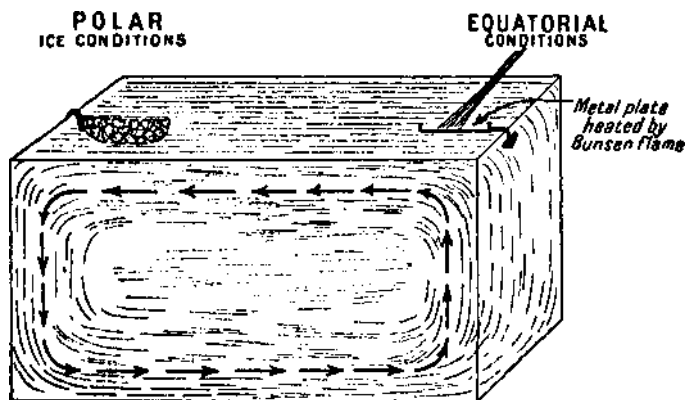


FIG. 17.—Diagrams showing currents caused by unequal temperatures.

is accompanied by a change in the direction of the ocean currents.

Let us at the outset notice two ways in which ocean currents may be classified. In the first place, we can distinguish between *relatively warm* and *relatively cold* currents, as is done in Fig. 18. A current will be relatively warm when it is flowing towards regions which are colder than those from which it has come, and, on the other hand, a current will be relatively cold when it is flowing towards warmer regions.

Ocean currents may also be classified as *stream* or *drift* currents. The former may be likened to broad

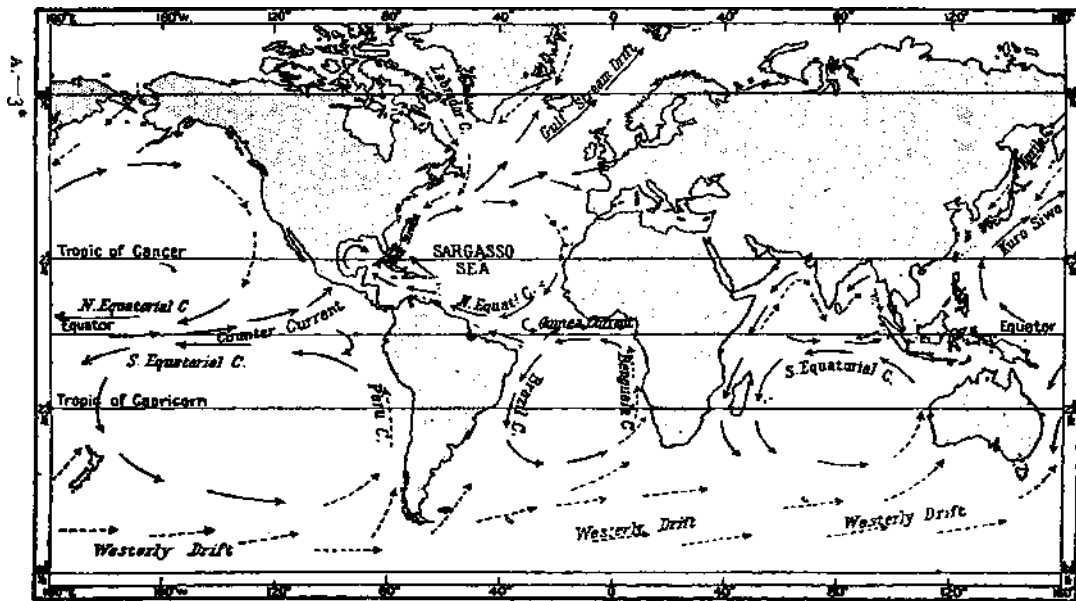


FIG. 18.—Ocean currents. The dotted arrows in the N. Indian Ocean show the currents during the S.W. Monsoon, the other arrows those during the season of the N.E. Trades. Elsewhere on the map the dotted arrows show relatively cold currents, the others relatively warm currents.

ocean rivers flowing between comparatively still waters. They flow faster than drift currents, and are caused by water which has been heaped up, seeking to find its own level. Drift currents move more slowly, and are simply a general drift of the surface water due to the force of the prevailing winds.

Keeping clearly in mind the prevailing winds, there should be no difficulty in understanding the direction of the chief ocean currents as given in Fig. 18. Let us consider the currents in the Atlantic Ocean. Off the north-west coast of Africa, in the region of the N.E. Trades, the surface waters are compelled by the winds to drift westwards until they are turned, partly by the shape of the mainland of North America, and partly, as in the case of winds, by the influence of deflection. A similar drift of waters is set up by the influence of the S.E. Trades, and the result is the South Equatorial Current, which is split into two by the wedge-shaped corner of South America, part of the waters flowing northwards to join those of the North Equatorial Current, and part passing along the shores of Brazil, from which country the branch is named the Brazilian Current. As all this water is blown across the Atlantic, it will be seen that the level of the sea off the American coast in these latitudes tends to be rather higher than on the corresponding African shores, and so it is.

But water cannot continue to be piled up, however steady and strong the winds may be. Some of it is bound to return, and it does so in the region of Doldrum Calms, which is between the North and South Equatorial Currents. This return, or counter-stream current, is known as the Guinea Current.

Now let us return to the North Equatorial Current, which is reinforced by a portion of its southern counterpart. Some of its waters pass through the Caribbean Sea and the Gulf of Mexico, and cause such a piling up of waters that a strong and steady stream current of water flows from the Gulf of Mexico between Cuba and Florida. This is the much misunderstood Gulf Stream.

This stream of warm water, which can be quite plainly distinguished from the surrounding waters, then flows along the south-eastern coast of the United States, although it is impossible that all the water in the stream has come from the Gulf of Mexico; some must have come from the current which did not enter the Caribbean Sea, but kept outside the West Indies. Soon after Cape Hatteras has been passed, the Gulf Stream spreads out its waters like an enormous fan, and it is no longer a stream flowing between comparatively still water, but a general drift of the warm surface waters of the ocean, blown by the westerlies towards the shores of Europe. The various branches of the Gulf Stream Drift, or North Atlantic Drift, are shown on Fig. 18, and it will be noticed that one branch returns to the north-west coast of Africa, thus completing a great clockwise motion of water, in the centre of which is the Sargasso Sea, where huge masses of floating seaweed, called sargassum, are sometimes very troublesome to ships. Fig. 18 shows that a great quantity of water from the North Atlantic is forced into the Arctic Ocean, where, as in the Gulf of Mexico, we have a piling up of waters. This cannot proceed indefinitely, and so we have return cold-stream currents re-entering the North Atlantic on either side of Greenland. These surface currents are in addition to the "cold creep" of water referred to in the beginning of this chapter. The Labrador current flows from amongst the islands of North America, past the coasts of Labrador, Newfoundland, Nova Scotia and New England, and finally sinks in the vicinity of Cape Hatteras, owing to its density being high in comparison with that of the warmer waters of those latitudes. The meeting of currents of air warmed by the Gulf Stream or its great drift, with air which has been cooled by the Labrador current, is the cause of the dense fogs which make Nova Scotia and Newfoundland the foggiest area in the world. These fogs are a source of great trouble to sailors.

Returning to the South Atlantic Ocean we find that, partly under the influence of deflection and partly **due**

to having reached the area of the westerly winds, the Brazilian Current passes across the ocean and proceeds equator wards up the coast of south-west Africa, where it is joined by the cold Antarctic Drift, a great drift of cold water blown by the westerly winds. As in the North Atlantic, there is in this part of the ocean a great circulation of water, moving in this case in a counter-clockwise direction, and having at its centre another Sargasso Sea.

The currents of the Pacific Ocean should now present no difficulty. There are equatorial drifts beginning in trade wind areas off the American coasts. Between them is the Counter Equatorial Current, which can be compared with the Guinea Current. The Kuro Siwo, or Black Stream of Japan, is the counterpart of the Gulf Stream; the north-western American coasts receive warm southern waters which may be compared with the North Atlantic Drift, whilst the counterpart of the Labrador Current is seen in the Kurile Current, which enters the North Pacific Ocean through the Bering Strait. Similarly, the currents of the South Pacific are comparable with those of the South Atlantic.

Reference has been made to the seasonal changes which occur in the North Indian Ocean, so that it is only necessary to add that in the southern portion of that ocean are currents in every essential respect similar to those of the South Atlantic and Pacific Ocean. Since the currents of the northern part of the ocean are not constant, the Counter Equatorial Current is uncertain and irregular, as may be expected.

OCEAN CURRENTS AND CLIMATE.

Finally, ocean currents have a very important influence upon climate. In Chapter III, we have seen how the warm water that is drifted past the western shores of Europe influences the climate of the western margin of that continent. This is very clearly shown in Fig. 19, for the direction taken by the January

isotherm of 32° F. is very considerably influenced by this factor. There is a striking difference between the winter temperature of the coast lands on opposite temperate shores of the North Atlantic.

Fig. 19 represents a land mass stretching from north to south temperate latitudes. The vast amount of water carried eastwards by the westerly winds causes a piling up of warm surface water on the western shores of temperate latitudes, whilst these waters tend to be blown away from eastern shores in the same latitudes,

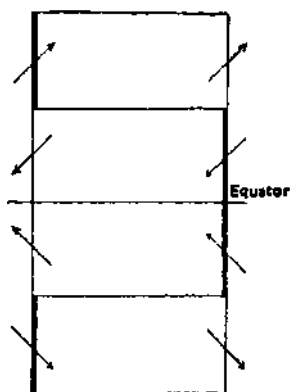


FIG. 19.—This diagram illustrates the piling up of waters by on-shore winds

and much lower temperatures are experienced. In trade-wind latitudes the conditions are reversed and the warm surface waters are piled up on the east coast and carried away from the west. A map showing the distribution of coral will show coral reefs, etc., on the eastern shores of tropical countries, but not on the west, for the tiny coral polyp cannot live unless the temperature of the water is always over 70° F. These warm conditions are not found on the western margins, where the colder water takes the place of the surface water drifted away from the coast by the prevailing winds.

EXERCISES.

1. Describe the courses which might be taken by a sealed bottle cast into the sea from a boat passing the Canary Islands.

2. How far is it true to say that the circulation of the surface waters of the North Atlantic Ocean is as if the water had been stirred in the direction of the hands of a clock, and in the South Atlantic in a direction opposite to those of the hands of a clock?

3. What effect have ocean currents upon the directions taken by the southern hemisphere isotherms of 68° F. (January and July)? See Figs. 10 and 11.

4. Explain what is meant by warm and cold currents, stream and drift currents. Give examples.

5. Draw a diagram to show the ocean currents of the North Atlantic Ocean. Show their connection with the prevailing winds.

CHAPTER VI.

RAINFALL: ITS CAUSES AND DISTRIBUTION.

EVAPORATION AND CONDENSATION.

AFTER rains a considerable quantity of water remains on the surface of the ground in small pools, but quickly disappears. Wet clothes are hung out and are taken down quite dry. In both of these instances the water has disappeared into the atmosphere in the form of water vapour which we cannot see—that is, it has evaporated. On the surface of the earth are oceans, lakes, rivers, etc., exposed to the atmosphere, and from all these water is constantly being evaporated and received into the atmosphere. If a mass of air which contains water vapour is cooled, some of the vapour may condense into very tiny drops of water which are not too heavy to be held in the air. It is in this way that mists, fogs and clouds are produced. Should the condensation proceed further, the tiny drops of water run together and form a raindrop that is too heavy for the air to carry in suspension, and rain results. Of course, only a portion of the rain which falls on the land is directly evaporated into the air; much finds its way into rivers, and is carried off to the oceans, whilst some remains in the soil and is used by plants and animals. It is interesting to think of the great oceans as the chief places where evaporation is taking place; that this water-laden air is carried by means of winds towards the lands, where it is forced to rise—perhaps on meeting mountains—and is therefore cooled, and a fall of rain occurs. The rainwater is carried off to the oceans

largely by rivers, and thus the cycle is going on throughout the centuries.

It is very important to notice that warm air can hold much more water vapour than cold air, as the following figures show—

Temperature.	Maximum amount of water vapour which can be held by a cubic metre of air.
— 10° C	2.28 grammes
0°	487 „
+ 10°	936 »
20°	17.1 „
30°	3008 „
40°	50.67 „

This table shows that the maximum amount of water vapour which can be held by a cubic metre of air at a temperature of — 10° C. is 2.28 grammes, whilst the same volume at 10° C. can hold 9.36 grammes. It will be observed that the amount of water vapour held at different temperatures increases very considerably with increase of temperature. Saturated air, or air at a certain temperature, containing the maximum amount of water vapour for that temperature, can be made to hold more by being warmed, but if it be cooled, some of the vapour will condense. The temperature to which air must be cooled in order that some water vapour may be condensed, is called its *dew-point*. Another glance at the table will show that if saturated masses of air at different temperatures, say 10° C. and 30° C, are cooled, there will be much greater precipitation in the case of the warm air than in the case of the cooler air. This has a great deal to do with the heavy rainfall in equatorial latitudes.

There are innumerable particles of dust in the atmosphere, and these appear to play a very important part in assisting condensation, for when water vapour is condensed, it is upon a nucleus of a dust particle that the tiny water drops grow.

How RAINFALL IS MEASURED.

Rainfall is measured by means of a rain-gauge. In essence, this consists of a funnel which catches the rain and leads it into some kind of vessel. If the vessel is cylindrical and the area of its opening is the same as that of the opening of the funnel, the depth of water in it represents the amount of rain which has fallen in that area. In order to measure accurately small amounts of rainfall, it is necessary to have a specially graduated measuring glass whose diameter is less than that of the funnel. If the area of the mouth of the funnel is 15 square inches, it is obvious that 15 cubic inches of water will be necessary to cover that area to a depth of one inch. Therefore, if 15 cubic inches of water are carefully measured and poured into a measuring glass, the height of the column of water will represent a fall of one inch upon the area of the funnel's opening. The measuring glass can then be graduated so as to read such small amounts of rainfall as one-hundredth of an inch.

To get correct results, it is very necessary to place the rain-gauge in a suitable position, in order that all the rain which falls may be registered. It should be placed about twice as far from the nearest building as the latter is high, and raised from the ground about one foot. The latter precaution prevents water splashing upwards from entering the funnel.

Of course, all condensed water vapour does not fall in the form of rain. Falls of snow and hail are common. The former requires very careful measuring, for the funnel of the gauge may be filled before the snow ceases to fall. Snow has to be melted before the amount can be read in rainfall equivalents. About ten inches of untouched snow yields one inch of rainfall.

THE CAUSES OF RAINFALL.

Rain is the result of the cooling of air containing water vapour. The cooling may be accomplished in several ways:—

(i) Air moving from warm to cooler latitudes will not be able to hold as great a quantity of water vapour, and there will be a tendency to precipitation. The best examples are the Westerlies, which blow towards colder latitudes.

(2) The cooling of air due to a forced ascent on meeting a mountain barrier. Rains caused by this means are spoken of as *relief* rains. Fig. 20 shows a moisture-laden wind approaching a mountain chain. It is compelled to rise and this causes the air to expand. Expansion causes a lowering in temperature and this produces rain. When the temperature falls to freezing point, snow will fall instead of rain. On reaching the leeward side of the mountains, the air begins to descend and consequently to increase in density and in temperature, and therefore

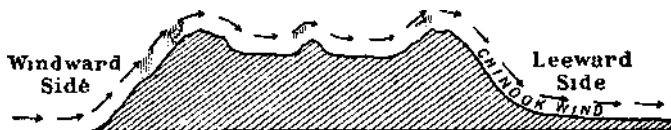


FIG. 20.—Chinook or Fohn wind.

in its capacity for holding water vapour. The increase in temperature is greater than that which was lost in ascending the windward slopes, so that the wind reaches the foot of the mountains on the leeward side a warm, dry wind. The names *Chinook* and *Fohn* have been given to such a wind. The former name applies particularly to the winds descending the leeward slopes of the Canadian Rockies, and the latter to the warm winds experienced in Swiss valleys, but the principle holds good in all particular cases, and therefore we may think of all such winds as Chinook or Fohn winds (see Ex. 1, at the end of the chapter).

There is a very close connection between the relief and rainfall maps of most countries, especially of those

in temperate latitudes. An examination of the two maps for the British Isles will show how close these relationships are in our own islands.

(3) The movement of air in cyclones causes expansion and therefore cooling and condensation. A cyclone is a pressure system in which the lowest pressure is in the centre from which the pressure rises towards the edges. In such a system the winds blow towards the centre and are deflected according to Ferrel's Law, so that, in the northern hemisphere, the whole system is rotating about its centre in a direction opposite to that of the hands of the clock. The centre of the cyclone remains an area of low pressure because the air which flows towards it is constantly rising and expanding. It is on account of this rising of air that cyclones are accompanied by falling rain. Cyclones are commonly experienced in the area of the westerly winds, and it is by their means that much of the rain that falls in these latitudes is brought.

(4) The meeting of air currents causes air to rise and expand, and therefore causes rainfall. This cause of rainfall is very similar to that which has just been considered. In the Doldrums belt, the N.E. and S.E. Trades meet, and air being forced upwards on a very large scale causes this region to be one of very heavy rainfall.

THE CAUSES OF DROUGHT.

Since any cause which can force large masses of air to be cooled will produce rainfall, any cause whereby air is warmed will tend to produce drought. It will not be necessary to go into these causes at length, for they are the opposite of those which produce rain. They are—

(1) Air flowing steadily from warm latitudes towards regions warmer still will increase its capacity for holding water vapour and condensation will not usually occur, unless by some means the air is suddenly cooled. The best examples of such air currents are the Trade Winds, and it is very striking that all the great deserts of the world are in trade-wind latitudes.

(2) There will be dry areas on the leeward side of most high mountain ranges.

(3) Anticyclones, usually masses of almost inert air, are systems of pressure, having the highest pressure in the centre and the lowest pressure towards the edges, and are fed by air descending from the upper atmosphere. They bring little or no rainfall.

(4) The Horse Latitudes are areas in which there is a descending of air, and they, too, are marked by drought.

THE DISTRIBUTION OF RAINFALL.

Figs. 21, 23 and 24 show respectively the annual, January and July distribution of rainfall over the surface of the globe. In studying these maps, constant reference must be made to the pressure and wind maps, and to the physical maps in an atlas.

MEAN ANNUAL RAINFALL.

A very general connection between Figs. 14 and 21 is evident. The belts of low pressure are areas of considerable rainfall, whilst the high-pressure belts are deficient in rain. This is illustrated in Fig. 22. The equatorial low-pressure area, the Doldrums, is one of heavy rainfall; the trade-wind areas contain most of the great deserts of the world, and in the low-pressure belts between the Horse Latitudes and the polar high-pressure areas there are other regions of considerable rainfall. Naturally, this requires to be considerably modified, for the actual distribution of pressure, as we saw in the last chapter, is not so regular as is shown in a diagrammatic manner in Fig. 22. Nevertheless, it is important to notice that there is a very close relationship between pressure and rainfall.

Fig. 21 is shaded to show areas which may be described as being well watered (over 25 ins.), moderately watered, or as having a deficient supply of rain. If this map is studied in connection with a relief map, and the dis-

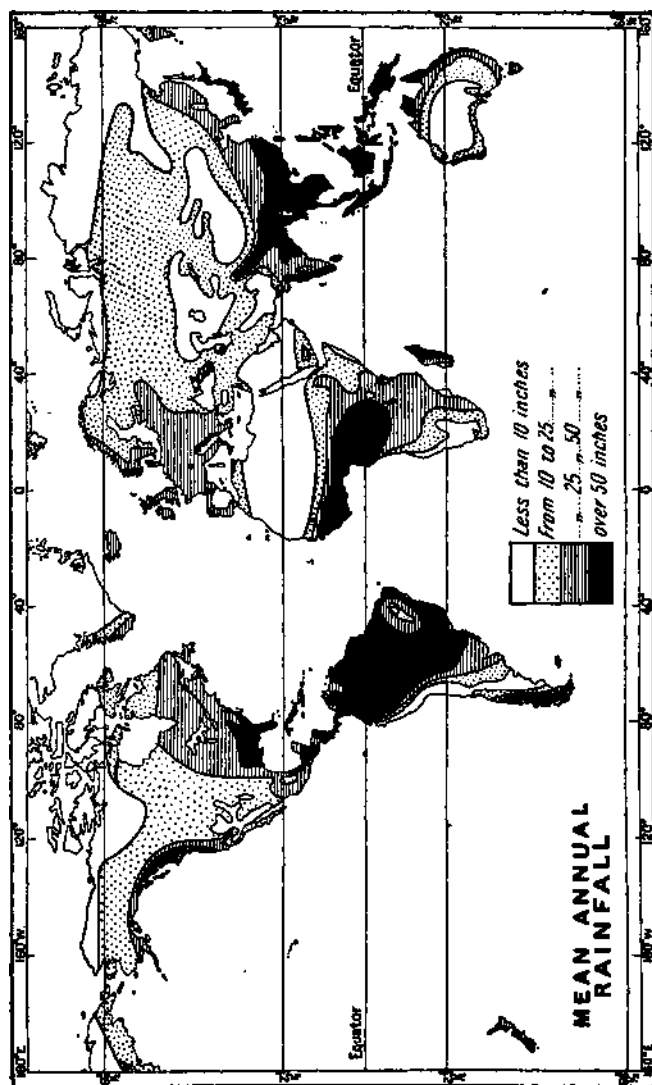


FIG. 21.—The mean annual distribution of rainfall.

tribution of pressure and the direction of the prevailing winds are kept in mind, Ex. 2 at the end of this chapter will serve as a test as to whether the principles which have been explained have been grasped or not.

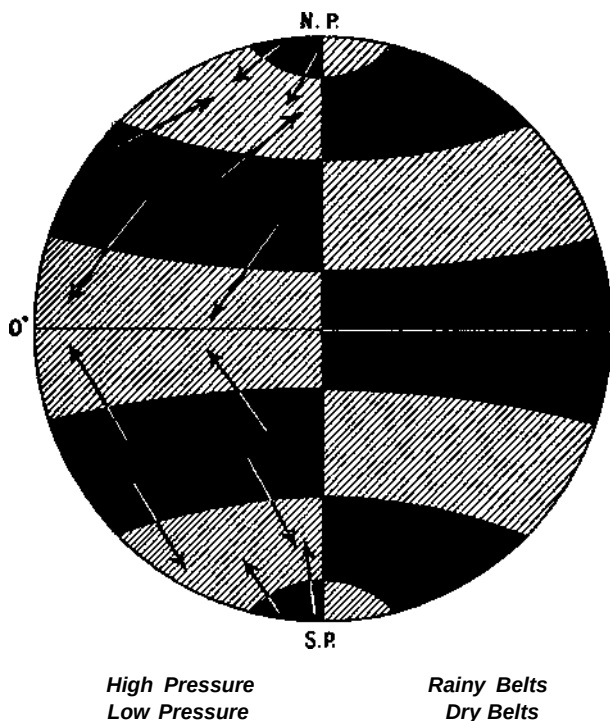


FIG. 22.—The relations between pressure and rainfall

DISTRIBUTION OF RAINFALL IN JANUARY AND JULY.

In January, the typical summer month of the southern hemisphere, the belt of greatest heat is south of the equator (Fig. 10). It is in January that the pressure

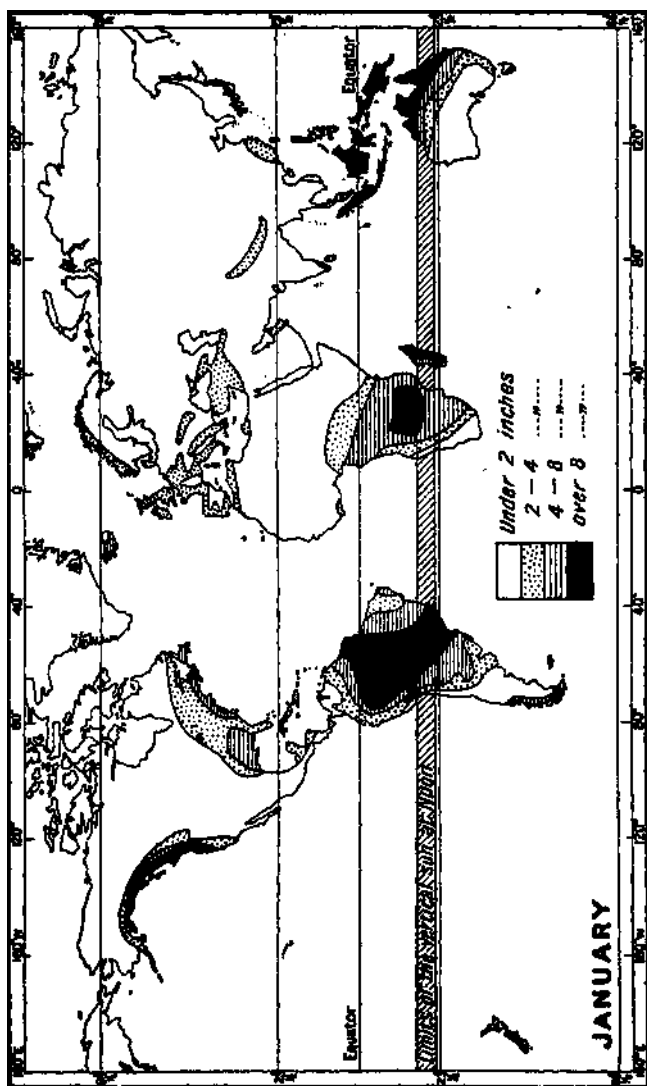
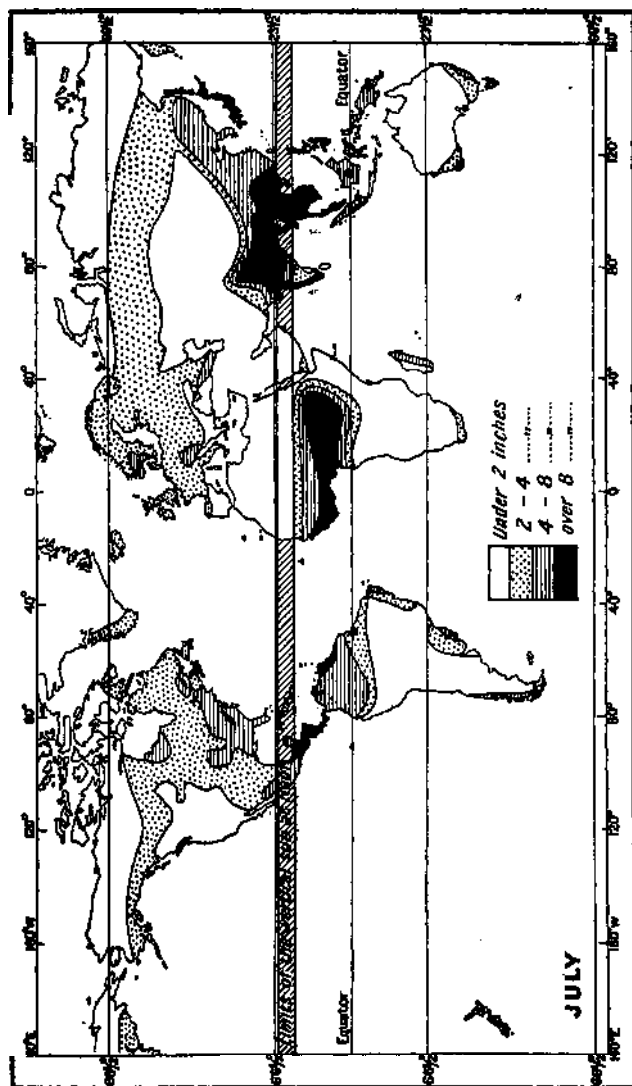


FIG. 23.—Mean rainfall for January. (After Herbertson.)

belts reach the southern limits of their migration. For these reasons, the regions of heaviest rainfall are all south of the equator in this month (Fig. 23). In July, the areas of heaviest rainfall are north of the equator, and this is due to the northerly migration of the temperature and pressure belts, a movement caused by the apparent migration of the sun (Fig. 24). These seasonal changes produce interesting results, as will be seen from an examination of Fig. 25. In the first column the approximate position of the high and low pressure belts is given for July, the month in which they are at their northern limit of migration. The second column gives the position of the various belts in the southern summer. It is at once clear that in the equatorial regions is an area which has low pressure all the year round. North and south of these are belts having low pressure in summer and high pressure in winter; these are succeeded by belts which have high pressure at all seasons. North and south of the latter are belts of low pressure at all seasons. Since areas of high pressure have little rainfall, it follows that certain of these belts will be wet at one season and dry at another, but it must be carefully observed that Fig. 25 only applies to the western margins of continents, for a wind which is there on-shore, *i.e.* blows from the sea to the land, will be an off-shore wind on the eastern lands in similar latitudes.

Let us apply Fig. 25 to the western coasts of Europe and Africa. From the north of Norway to the north of Spain is an area of rain all the year round, for the Westerlies are at all seasons the prevailing winds. From the Cantabrian Mountains to the Atlas Mountains is an area of winter rainfall and dry summers. This is succeeded by a belt of very little rainfall, and it is here that the Sahara Desert reaches the west coast of Africa. South of this is an area of summer rainfall, the Gambia and Senegal rivers having their mouths in this belt. The Guinea Coast and the Congo Basin receive rain at all seasons. South of the equator, the belts are repeated in reverse order, although there is



no counterpart of the West European type, for Africa

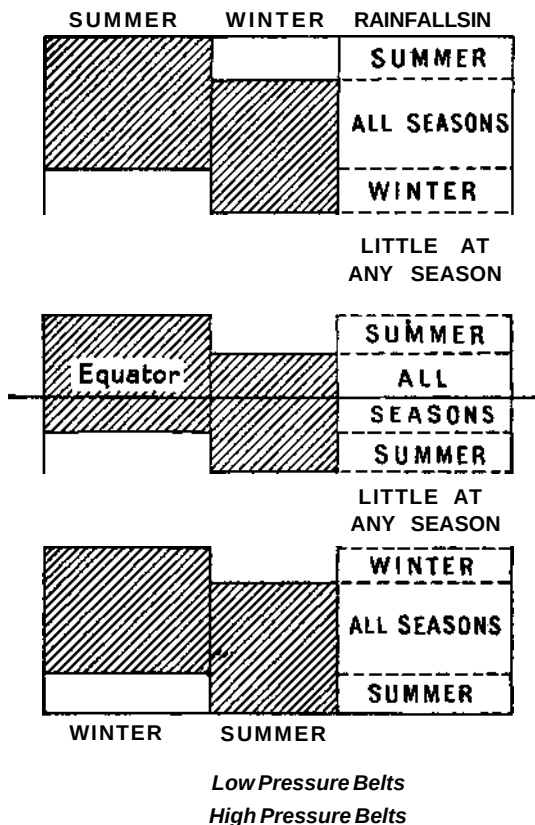


FIG. 25.—The influence of the migration of the pressure belts on the distribution of rain on the western margins on continents.

does not extend far enough south to have a belt in the prevailing north-westerly winds all the year round.

If we consider Figs. 23 and 24 together, it will be evident that some regions receive rain in winter and are dry in summer. They are on the west of continents and in the same latitudes as the two African winter rain areas which we have just considered. They are the lands bordering the Mediterranean Sea, the Valley of California, Central Chile, the south-west corner of Africa, the two southern protuberances of Australia and the north island of New Zealand. The winter rains and dry summers of all these lands are due to the migration of the pressure belts.

If we turn to Asia, we see a very striking contrast between the rainfall for January and that for July. In January, owing to this continent being under the influence of a huge high-pressure system (see Fig. 15), there are outflowing winds, and since these are dry, very little rain falls in this month except on the north-east coastlands, western Japan, in the Mediterranean lands to the east of the Mediterranean Sea, and on the Himalayas. In July, when a low-pressure system holds sway (see Fig. 16), there are inflowing winds, and since these have come over vast expanses of ocean, very great precipitation takes place, most of the continent, excepting the centre and the south-west, having a considerable amount of rain. The same causes in Australia give heavy rainfall in the southern summer to the northern margins. The winds which bring the heavy summer rain in south-east Asia and northern Australia are, as we have already learned, called monsoons.

Other lands of summer rainfall we should expect to find in the same positions as the African belts of summer rain, to which reference has already been made. In America we find that the north of South America, Central America, Mexico and the West Indies receive their rain mainly in summer; south of the Amazonian region of rain at all seasons is the Brazilian highland region of summer rain.

Owing to their great distance from the sea, we also

find that the interior lands of the great continents receive rain in summer, when they are under the influence of low pressure; but as they are far from the sea, such places have only a moderate rainfall.

EXERCISES.

1. Why is it that—

- (a) Sweden is drier than Norway?
- (b) The east of the South Island of New Zealand is drier than the west?
- (c) The northern Andes have heavy rainfall on their eastern slopes and an almost rainless area on their western slopes, and that these conditions are reversed in the southern Andes?

2. Write a short account of the mean annual distribution of rainfall as shown in Fig. 21. Give reasons for heavy rainfall in equatorial latitudes, the presence of rainless areas in the trade-wind regions, the heavy rainfall of the western margins in temperate latitudes, and the slight rainfall in the interior of the great land masses.

3. What is meant by saying that the mean annual rainfall of London is 25 inches? How has this figure been obtained?

4. Explain clearly why it is that the rain belts migrate northwards in our summer and southwards in the southern summer. What are the principal results of this migration?

5. On p. 50 figures are given showing the amount of water vapour which air at different temperatures can hold. Represent these figures graphically and write a summary of the important facts illustrated by the graph.

6. Describe a coastal region of deficient rainfall. Account for its aridity.

CHAPTER VII.

THE DISTRIBUTION OF NATURAL VEGETATION.

THE land surface of the earth is covered naturally with plants, except in those regions where it is either too high, too cold or too dry for any vegetation to exist. Generally speaking, regions of heavy nunjfallare forested, regions of light-rainfall are grasslands, and~those which lack moisture are deserts. The type of forest, grassland or desert will depend largely upon the temperature, so that there are tropical and temperate forests and grasslands, and tropical, temperate and cold deserts.

., Soil has an important influence upon-vegetetion,for some plants thrive best upon particular soils, as, for example, the beech thrives on a soil rich in lime. For most plants the presence of salt is fatal, but the mangrove and the coconut palm appear to like its presence. Different soils vary very much in their capacity for holding moisture, whilst plants differ in their capacities for extracting moisture from different soils. Some soils, again, are naturally very in fertile owing to the character of the rocks from which they havel been formed.

Fig. 26 shows the general distribution of natural vegetation, but it must not be supposed that the boundaries between the various types can be defined very clearly, for there is a gradual merging of one type into another. Deserts gradually become grasslands through an intermediate scrubland which is notable for its scattered grass patches and low, dry bushes. Grasslands merge into forests very gradually, for between areas which are typical forests and those which are typical grasslands, the scenery first resembles natural parkland—

a mixture of grasslands and woodlands—and very gradually becomes more wooded as the true forests are approached.

In studying Fig. 26 it is very important that constant reference should be made to the temperature and rainfall maps in Chapters III and VI, so that the connections between temperature, rainfall and natural vegetation may be clearly understood.

HOT WET FORESTS.

Forests of this type are found in (i) the hot wet equatorial belt; (ii) in lands having so much rain in their wet season that the soil holds a considerable amount of moisture all the year round. The former are sometimes called equatorial forests, and the latter monsoon rain forests. Equatorial forests are found chiefly in the Amazon basin and on the wet east coastlands in South America; on the Guinea coast, and in the Congo basin in Africa; and in the Malay Peninsula and the East Indies. In these forests the vegetation is exceedingly dense, even the undergrowth attaining forest dimensions, whilst the giant trees are linked together by a mass of creepers and parasitic vegetation. The floor of the forest is gloomy in the extreme, and its inhabitants are amongst the most backward races in the world. So solid are these forests that the rivers, which at the rainy seasons resemble long, narrow lakes, are the only easy ways of communication. The various trees which yield rubber are the most important trees, although there are valuable cabinet and dye woods, such as mahogany, ebony, logwood, etc., but the present difficulty of access is so great that these sources of wealth are practically untouched. Guttapercha trees are of great importance in the East Indies, and oil palms in the equatorial forests of Africa.

The forests of S.E. Asia and North Australia are not so dense, as here there is a well-marked dry season.

THE HOT GRASSLANDS OR SAVANNAHS.

Savannahs, or parklands, are grasslands interrupted by isolated patches of trees. They are found in tropical latitudes, in regions which have warm, dry winters and hot summers, with a small rainfall in summer. Fig. 26 shows that their distribution is closely related to the summer rainfall belts north and south of the equatorial belt of rain at all seasons. As the summer rainfall is not heavy, trees cannot grow excepting in places where there is a constant supply of water, *e.g.* near rivers, for the rainfall is not sufficient to keep the soil moist at all seasons. The climatic conditions are suitable for the growth of grass which springs up, produces flowers and seeds, and dies in a short time. As we should expect, one of the chief occupations on the savannahs is cattle rearing. The temperature is unsuitable for sheep.

In South America there are extensive savannahs north of the equator in the Guinea highlands and the llanos of the Orinoco Valley, and south of the equator in the Brazilian highlands. In Africa they are found north, east and south of the equatorial forests, and in a very similar position in Australia. Asiatic regions in these latitudes receive so much summer rain that, as we have already seen, they are forested.

THE HOT DESERTS.

The savannahs gradually merge, through intermediate scrublands, into deserts. The hot deserts lie chiefly on the west of continents in the latitudes of the Trade Winds. In North Africa there is the enormous Sahara desert stretching from the Atlantic Ocean to the Red Sea, and continued eastwards in Asia by the deserts of Arabia and Thar. South Africa has the Kalahari desert. In similar latitudes in South America are the long, narrow, west coast deserts of northern Chile and Peru. They lie to the lee of the Andes. In North America we have the Colorado desert, and in Australia the great western desert. There are also the extensive desert lands on

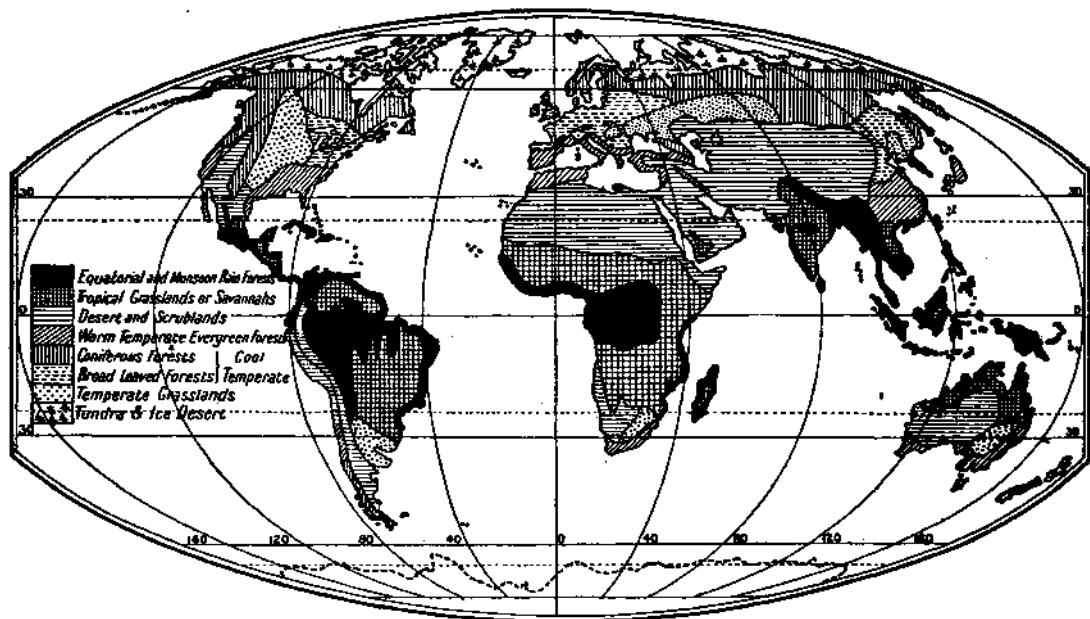


FIG. 26.—The distribution of natural vegetation.

high plateaux and in the interior of the great Asiatic land mass. Examples of these plateaux and interior desert and semi-desert lands are found in the western cordillera of North America, in the plateau of Iran, and in the deserts of Turan and Gobi.

Except where there are underground supplies of water, there are very few plants on deserts. Desert plants must either have very long roots, so that they can reach this underground water, or thick, fleshy leaves to store up water. The leaves, which are designed to resist the evaporation of moisture from the plant, are often very small and protected by means of thorns. On the scrub edges of the desert, trees which exude gum in the dry season are often met with. The acacia is a good example.

Even in the desert, wherever there is a permanent supply of water from wells or from rivers which flow across deserts but rise in wet lands, cultivation can take place, while by means of irrigation, many arid lands have been reclaimed, especially in North Africa, North America and Australia.

TEMPERATE FORESTS.

These are of two varieties: (1) *warm temperate*, which are found roughly from latitude 30° to latitude 45° , and (2) *cool temperate*, from latitude 45° to latitude 60° .

(1) WARM TEMPERATE FORESTS.—Fig. 26 shows that these are found on both east and west sides of continents. The rainfall maps show that whilst the western regions receive most of their rain in winter, the eastern regions have summer rainfall. This will naturally have its influence upon the vegetation. Whether on the east or the west, these forests are evergreen; but in the eastern forests the leaves are usually very large and thick, as, for example, the leaves of camellias and magnolias, whilst the trees in the various "Mediterranean" regions of winter rainfall

have usually either small, dry leaves, as, for example, the olive, or leathery leaves like those of the laurel.

Forests of the western or Mediterranean type are found in the lands of winter rains bordering the Mediterranean Sea; in California, Central Chile, south-west Africa, south-west and south-east Australia, and in the north island of New Zealand. The chief trees are evergreen oaks, including the cork oak, walnut, chestnut, and some species of pine. In most of these regions, vines, olives and mulberries are cultivated. In Australia the chief trees are the acacia and the eucalyptus, each of which has its leaves hanging edgewise, so that little shade from the sun's heat is given.

(2) COOL TEMPERATE FORESTS.—As in the case of the warm temperate forests, the cool temperate forests may be divided into two groups: the coniferous and deciduous forests. The former are found where the winters are severe, the summers short and the rainfall inclined to be deficient, whilst the deciduous or broad-leaved forests are found in regions where the temperature conditions are more genial and the rainfall is fairly abundant.

(a) *Coniferous Forests*.—The chief conifers are pines, hemlocks, firs and larches, but the hardy birch, which is deciduous, is a common tree in coniferous forests. The leaves of most of these trees are needle-like in structure, and thus transpiration is checked, for little surface is exposed. As a general rule, these trees retain their leaves during the long winter, which is not with all species a resting season, for the summer is so short that the comparatively warm periods at the beginning and end of winter are taken advantage of.

The most extensive coniferous forests are found in northern Europe, Asia and America. They give shelter to large numbers of fur-bearing animals, and thus trapping is usually the first occupation carried on. Later come the lumber-men, who cut down the trees, which are used for many different purposes, such as doors, window-frames, flooring, etc., whilst they also

yield turpentine, pitch, resin and wood pulp. In deforested areas where the climatic conditions are suitable, agriculture is carried on. Some regions have undergone all these stages of development, whilst some, as, for example, the forests of eastern and northern Siberia, are still in the trapping and hunting stage.

Coniferous forests are sometimes found in regions of more genial climates than those of the ordinary forests of this type. Under these conditions, the trees often attain gigantic dimensions, as on the west coast of North America, where the famous Douglas firs and giant pines are found.

(b) *The Broad-leaved Forests.*—The chief trees in these forests are the oak, beech, elm and maple. In autumn the leaves fall, and thus transpiration is checked. The flowers are not very prominent, and most of them are wind fertilized. In this respect these forests offer a marked contrast to those of hot lands, where the trees have brilliantly coloured flowers. The distribution of broad-leaved forests is shown in Fig. 26, and their positions as compared with those of the coniferous forests should be noticed. From the greater part of Western Europe and eastern North America the natural deciduous forests have disappeared, and in their place we find agricultural and industrial regions.

TEMPERATE GRASSLANDS.

These, known in particular places as prairies, pampas or steppes, are found in regions having very warm summers and cold winters, with a moderate to slight rainfall in summer. Fig. 26 shows that these regions are usually in the interior of great land masses, for it is there that these climatic conditions are met with. The rainfall is not sufficient to keep the soil moist at all seasons, so that trees are found only near rivers. It should be noted, however, that in some places there are other reasons, *e.g.* strong winds or porous soil, why trees do not grow. The prevailing vegetation everywhere is grass, so that these

NATURAL VEGETATION

regions are noted pasture lands, whilst in those parts where the rainfall is sufficient, large tracts are used for the growth of cereals. Most of the wheat of the world is now grown in areas which were once natural grasslands.

The seasonal changes, the green of late spring and early summer, the brown of late summer and autumn, the snowy mantle of winter, and the carpet of bulbous flowers in early spring, form a most enchanting cycle of changes.

THE TUNDRA AND ICE-DESERTS.

The poleward limit of coniferous forests is approximately the July isotherm of 50° F., for unless that temperature is attained during at least one month, trees cannot thrive. North of that line is the tundra, which is really a cold desert whose total precipitation is less than 10" per year. In the long winter the ground is snow-covered, but during the short, warm summers the lowlands often assume a meadow-like appearance, bright with numerous flowers. They are not merely lands where only stunted berry-bearing bushes, mosses and lichens grow. There are no tundra lands in the southern hemisphere.

Towards the poles are wildernesses of ice and snow which are practically devoid of life. Such lands are found in Greenland, in many of the islands to the north of Canada and Asia, and in the Antarctic continent.

THE INFLUENCE OF ALTITUDE UPON VEGETATION.

We have seen that latitude has a great influence upon vegetation; the equatorial forests are very different from the temperate forests and the hot deserts from the tundra. Altitude, too, has a great influence. Many mountains in equatorial latitudes are snow-capped all the year round. The dense equatorial forests at the bases of these high mountains, e.g. Ruwenzori in Central Africa, give way very gradually to evergreen, warm temperate, broad-leaved coniferous forests. Above

these levels the trees become scattered and dwarfed, and there are parts which are snow-covered in winter, but the melting of the snow in spring provides moisture for the growth of grass and many kinds of beautifully coloured flowering plants. Still higher than these meadow-like lands are areas resembling the tundra, whilst beyond that the snow lies on the ground all the year round. Thus, in ascending a high mountain situated close to the equator, somewhat the same changes in vegetation are experienced as in a journey from the equator to the polar regions, such is the great effect of altitude upon vegetation (see Fig. 41).

On the high dry plateaux, *e.g.* Tibet and Bolivia, there are extensive areas with a semi-desert type of vegetation, consisting chiefly of coarse grasses and scattered patches of bush.

EXERCISES.

1. Explain why it is that the vegetation belts on the west of continents differ from those on the east.
2. State and account for the distribution of Equatorial forests.
3. Examine the different types of natural vegetation found in your home district.
4. What are the climatic reasons for the distribution of the great deserts of the world?
5. What are the chief types of natural vegetation that would be encountered in a journey (*a*) from the White Sea to the Caspian Sea, (*b*) from the mouth of the Nile to Lake Victoria, (*c*) across Canada by the Canadian Pacific Railway? Account for the differences you mention.
6. Give examples of the connections between the natural vegetation and the chief occupations of a region.
7. Obtain pictures of each type of vegetation and fix them in your note-book, along with your notes.

CHAPTER VIII.

ASIA: PHYSICAL FEATURES.

IN previous chapters we have been considering the outlines of the world distribution of temperature, pressure, winds, ocean currents, rainfall, and natural vegetation, and we have shown the relations which exist between these various factors. We shall now turn our attention to the continent of Asia; and, whilst studying it, we shall pay particular attention to the principles which we have learned and apply them in more detail, although, of course, it is necessary that our study should have a wider outlook than merely the study of questions involving climate and natural vegetation.

THE POSITION AND SIZE OF ASIA.

If we examined a globe, we should see that Asia lies to the east of Europe and North Africa, and that the whole of the mainland is north of the equator. Its most northerly point, Cape Chelyuskin, is within 13° of the North Pole, and its most southerly, Cape Romania, is only 1° north of the equator. The distance "Between these capes is over 5,000 miles, whilst in an east and west direction the continent extends for an even greater distance. Asia is thus an enormous land mass. It is the greatest of all the continents, being four and a half times the size of Europe, and containing within its frontiers about one-third of the total land surfaces of the world. In shape, Asia is a rough quadrilateral, with three very large southern peninsulas, Arabia,

PHYSICAL FEATURES AND STRUCTURE 73

India, and Indo-China. On the east coast are the smaller peninsulas of Kamchatka and Korea, and on the west the plateau peninsula of Asia Minor.

PHYSICAL FEATURES AND STRUCTURE.¹

A physical map of Asia shows a great belt of highlands stretching across the continent from west to east. In Asia Minor this belt is fairly wide. It widens out in the plateau of Iran, but in the Pamir Plateau, to the north-west of India, it is very narrow. From this point it rapidly widens, until in the east it occupies an area stretching through almost the whole breadth of the continent. North of this high belt are vast plains stretching to the Arctic Ocean, into which they are drained, except in the west, where the lowest parts of the plains are occupied by the salt Caspian and Aral seas. In the south of Asia there is the deeply trenched plateau of South India, the Deccan, which is an old block so tilted that it presents in the west a steep face to the Arabian Sea, and gradually slopes eastwards to the Bay of Bengal. The Deccan is separated from the central belt of highlands by the plains of the Ganges and the Indus. In the south-west there is the Arabian plateau, tilted in the same manner as the Deccan, and separated from the central highlands by the Persian Gulf and the plains of the Tigris and Euphrates. In the east are many broad plains, drained by great rivers. The chief are those of the Amur, Hwang-ho, Yangtse-kiang, and Si-kiang. Lastly, we have the archipelago of the East Indies, and the eastern festoon of mountainous islands stretching from the peninsula of Kamchatka, through the Kurile Islands, Japan, and Formosa to the Philippines.

From this brief account, it will be seen that Asia may be divided into four physical units—

¹ See Book I of this series for an account of the formation of plateaux, plains, folded mountains, etc.

- I. The north-western lowlands.
- II. The central highlands and plateaux.
- III. The southern plateaux.
- IV. The eastern margins and island ranges.

Reference to the map will at once show that the great north-western lowlands, the central highlands east of the Pamirs, and the Indian plateau are all triangular.

I. THE NORTH-WESTERN LOWLANDS.

The only important break in the continuity of the great plain which stretches from the North Sea to the central highlands of Asia is formed by the Ural Mountains. But these mountains are not high enough to form a really serious barrier, either as regards climate, vegetation or communications, so that we must regard the whole of this vast plain—the greatest in the world—as one, although in this book we shall only consider its eastern or Asiatic portion. Fig. 27 shows the structural divisions of Asia. It will be seen that these vast plains consist, for the most part, of sedimentary rocks, which lie in horizontal layers, unfolded and undisturbed. One addition to this statement must be made. The greater part of the West Siberian portion of the 'plain' is shown as being covered with recent deposits. This region is very flat and low, so that the rivers have not sufficient speed to carry along the load of silt which they bring from the mountains. They are compelled to spread this over the land in times of flood, and in this way this portion of the plain has been largely covered by alluvium. The eastern lowlands, drained by the Yenisei and the Lena, are narrower, but higher, and therefore less swampy.

Whilst the great north-west lowlands are drained mainly to the Arctic Ocean by the three long rivers, Obi, Yenisei and Lena, the south-western Turan plains contain the large Aral Sea, which is the centre of an area of continental or inland drainage, for the rivers flowing into it never reach the sea.

THE CENTRAL HIGHLANDS

IL THE CENTRAL HIGHLANDS.

These highlands are continuous with those of Europe, and form the highest and greatest mass of mountains in

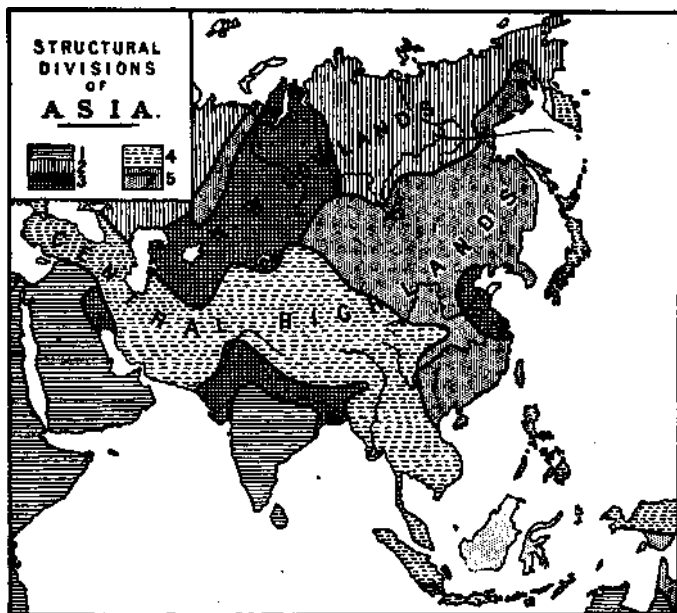


FIG. 27.—The structural divisions of Asia,

- x. Plateaux of unfolded rocks.
- 9. Unfolded lowlands.
- 3. Unfolded lowlands of recent deposits.
- 4. Folded mountains and enclosed plateaux.
- 5. Highlands of rocks folded in ancient times, now greatly denuded and fractured.

the world. They consist of mountain chains, generally running in an east and west direction, between which are lofty plateaux, which are wider in the east than in the west. Fig. 27 shows that the central highlands may be divided into two structural groups, a series of parallel folded ranges enclosing plateaux and deed

valleys, and a much older eastern mass which originally consisted of folded ranges, but has been very much worn down. In the first group three distinct chains can be traced by the aid of a physical map. The three chains' come very close together in the Pamirs, and on that account we find there the highest region in the world. It is often called the "roof of the world." The first chain is represented by the Caucasus and Tien Shan mountains: the second, or central chain, by the Pontic, Elburz, Hindu Kush, and Kwen Lun mountains. Between these chains lie the great basins of the Black Sea, the Caspian Sea, and the Tarim basin. The third, or southern range, is a series of great loops, and includes the Taurus, Zagros, Sulaiman, and Himalaya mountains, whilst between the central and southern ranges are the plateaux of Asia Minor, Iran, and Tibet. To the east of Tibet, where the older highlands formed a great centre of resistance and turned the folded ranges southwards, is a series of north and south chains, traversing Indo-China. Between these ranges are densely forested valleys, drained by such large streams as the Irawadi, Salwin, and Mekong. The ranges of western Burmah are continued through the Andaman and Nicobar Islands, Sumatra, Java, and the Lesser Sundas, where they once more become east and west in direction. Fig. 48 shows that the islands west of a line passing between Bali and Lombok (east of Java), and between Borneo and Celebes, stand on a shallow submerged platform. At one time they were joined to Asia, as were the Philippines, although the latter appear to have been separated from the mainland at a much earlier time than the others. We shall find further evidence of the former connection of these islands with Asia when we speak of their plants and animals.

The older, eastern highlands are not so lofty as the younger mountains we have just traced. They consist of:—(i) the mountainous area surrounding Lake Baikal and extending from the Altai Mountains to the south-west of the lake, to the Yablonoi Mountains to the east;

(ii) the plateau of Mongolia, which ends abruptly in the Khingan Mountains in the east and stretches as far southwards as the North China Highlands. The Khingan Mountains have a steep slope to the Manchurian Plains and a gradual one to the Desert of Gobi. They owe their origin to the faulting and tilting of a huge block of the earth's crust. The east and west ranges of South China, known as the South China Highlands, the mountains to the east of the plain of Manchuria, the highlands of Korea, and the island of Borneo also belong to the older eastern highlands.

III. THE SOUTHERN PLATEAUX.

These are the plateaux of Arabia and the Deccan in Southern India. Arabia is very similar to the African plateau, from which it has been separated by the subsidences which made the Red Sea. It is composed of sedimentary rocks of great age and is tilted, so that it has a long, gradual, eastern slope and a steep slope to the west and south-west. The map shows that the Deccan is tilted in the same way as the Arabian plateau, so that its longest rivers run eastwards to the Bay of Bengal, and it presents a steep face, the Western Ghats, to the Arabian Sea. South of the Deccan is the island of Ceylon, and between the two are the island stepping stones known as Adam's bridge. Ceylon is a detached portion of the Deccan, to which it was formerly joined.

These two plateaux at one time formed part of an ancient continent which stretched thousands! of miles in an east and west direction. Extensive faultings and subsidences caused the breaking up of this old land mass, and formed the present oceans which now separate the remaining portions from each other. The remnants of this old continent are shown in Fig. 28.

Between Arabia and the plateau of Iran, and between the Deccan and the folded mountains to the north of India are extensive lowlands drained by very long rivers. The Persian Gulf at one time extended much

farther to the north-west, but it has been filled up by the sediment brought from the surrounding mountains by the Tigris and Euphrates and their tributaries, and in this way the alluvial plain of Mesopotamia has been made. In the same way, the rivers of the Indus and

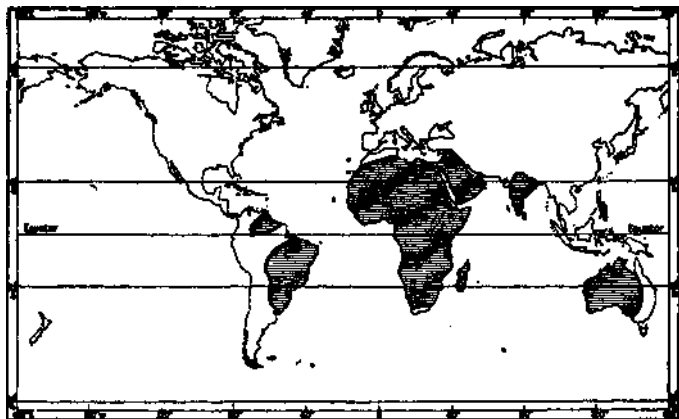


FIG. 28.—The great southern plateaux of unfolded strata. It is thought that they were once part of an ancient continent which geologists call Gondwanaland.

the Ganges systems have built the extensive alluvial plains which now separate the Deccan from the northern mountains of India. All these rivers have deltas which are being pushed out farther and farther every year.

IV. THE EASTERN MARGINS AND ISLAND RANGES.

The true eastern limits of Asia are to be found in the festoons of islands south of the peninsula of Kamchatka. This peninsula is continued southwards through the Kurile Islands, the Japanese Islands, the Lu-chu Islands and the Philippines. The ranges of these islands are largely volcanic.

Of the volcanoes, Fuji-San, Japan's sacred moun-

tain, has the most perfect cone. Fig. 66 shows that this volcanic belt extends all round the margins of the Pacific Ocean; it is sometimes called "The Fiery Ring of the Pacific." Between the mainland and the inland chain are the seas of Okhotsk, Japan, Yellow, East and South China. Of these, the Yellow and East China seas are the shallowest. They all occupy basins made by the subsidence of blocks of the earth's crust.

The chief rivers draining the eastern margin are the Amur, the Hwang-ho or Yellow River, and the Yangtse-kiang. The map shows that they rise far away in the central highlands and have extensive lowlands in their lower courses.

In this short account of the physical features and structure of Asia we have seen that the continent is of enormous size. It stretches through about 76 degrees of latitude, it has extensive plateaux, it has the highest mountain ranges in the world as well as vast plains, whilst tracts along the shores of the Caspian Sea are below sea-level. We shall, therefore, expect to find strong climatic and vegetation contrasts, ranging from the cold deserts of the north to the equatorial forests of the south, from the bleak, sparsely peopled plateau of Tibet to the densely peopled lowlands of China and north India. Asia is a continent of great contrasts.

EXERCISES.

1. On an outline map of Asia mark all the chief rivers and shade the map so as to show the land drained:—(a) to the Arctic Ocean, (b) to the Pacific Ocean, (c) to the Indian Ocean, (d) to the Mediterranean, (e) area of inland or continental drainage. Write a brief description of this map.

2. Draw a map of Eastern Asia, and the eastern volcanic chain of islands. Shade boldly the sea deeper than 100 fathoms, and the land above 600 feet. Mark the chief rivers.

3. Using the relief map in your atlas, draw a section from the Ganges plains to the north coast of Asia.

4. Give reasons why you would expect many political frontiers to meet in the Armenian Highlands and in the Pamirs.

5. Explain the terms:—alluvial plain; folded mountain; inland basin; escarpment. Give Asiatic examples of each.

CHAPTER IX,

ASIA: CLIMATE AND NATURAL VEGETATION.

IN earlier chapters we have considered temperature, pressure and winds, and rainfall as applied to the whole world. We must now summarize the chief facts as they concern the continent of Asia. From what we have learned in the last chapter it is not difficult to see that two outstanding factors will have a very considerable influence upon the climate of Asia. The first is its great extent in latitude, and the second its very varied relief. As regards the latter, it must constantly be borne in mind that the temperature and pressure maps have been corrected to sea-level readings.

TEMPERATURE.

Fig. 10 shows that a large proportion of the land has a temperature below freezing point in January.-The isotherm of 32° F. is a very important one, for it means that those plants which cannot flourish where there are severe winter frosts, will not grow in parts where the temperature falls below the freezing point for a whole month or more. It will be seen that the only parts which are free from frosts in winter are in the south and south-east. Now turn to Fig. 11, which shows that in July the greater part of the continent has a temperature exceeding 68° F., whilst the areas in which little rain falls (Iran and Arabia) have a very high temperature indeed, as there is little or no covering of cloud to lessen the heat. Notice the position of the isotherm of 48° F. This is important, because it marks

the northern limit of trees which must have at least that temperature during the warmest month. The influence of the Indian and Pacific oceans is seen in the lower temperature of the coastlands compared with those of the dry areas just mentioned, and in the northerly bends of the isotherms on the east coasts. The great facts to keep in mind are the contrasts between the cold of winter and the heat of summer experienced by the interior lands. Now let us consider a few actual figures—

Place.	Lat.	Long.	Height in feet.	Mean temperature in coldest month.	Mean tempera- ture in hottest month.
Verkhoyansk .	67° N.	133° E.	330	- 60° F.	60° F.
Yakutsk .	62	129	330	- 47	66
Tomsk .	56	85	395	- 3	66
Tobolsk .	58	68	345	— 2	64
Tashkent	41	68	300	30	81
Trebizond	41	40	100	41	75
Smyrna .	38	27	33	47	80
Aden	12	13	0	76	84
Bombay	19	73	35	75	85
Calcutta	22	88	20	65	86
Rangoon	16	96	40	75	85
Singapore	1	103	10	78	82
Hankow	3°	114	140	38	83
Shanghai	31	121	35	38	81
Peking .	40	116	130	23	80
Tokyo	35	140	65	37	78

The first group is taken from the great north-west low-lands. All have an extreme climate which is more extreme in the north-east than in the south-west, although the south-west portion of the plains has a much **hotter**

summer, as is illustrated by the summer temperature at Tashkent. Verkhoyansk has the lowest recorded temperature in the whole world, and has the exceedingly large range of 120° F. In places like this, where the winters are long and severe, most of the year's work has to be accomplished during the summer months, when work is carried on at high pressure in order that enough of the necessities of life may be obtained to last through the winter.

Trebizond and Smyrna are on the Black Sea and Mediterranean Sea respectively, and have cool winters and hot summers. The towns in the third group have only a small range of temperature, and are hot at all seasons, although Calcutta's coldest month may be described as very warm. They are all within the tropics. The last group illustrates the hot summers and relatively cold winters of the south-eastern margins. These places have colder winters than have western margins in the same latitude, this being due to the cold, dry winds which blow from the high-pressure system centred towards the middle of the cold land mass. If figures were given for towns on the great central—plateaux of Tibet, the Tarim basin and Mongolia, they would show cold winters below freezing point, *and* very hot summers.

PRESSURES AND WINDS.

Owing to the land becoming very hot in summer, a low-pressure area is created towards which winds flow from the oceans, where the pressure is higher. -Since this inflowing air is cooler and denser than the heated air, the latter is forced to ascend: Thus the greater part of Asia receives inflowing winds in July (see Fig. 16). In January the conditions are reversed (see Fig. 15). The land masses in the heart of the continent are extremely cold, and this produces a great high-pressure system which hangs over Central Asia like a heavy cap. From this system winds flow outwards towards the

oceans, where the pressure is less, so that the greater part of Asia has cold outflowing in winter.

RAINFALL.

Fig. 21 shows the mean annual rainfall of Asia. About two-thirds of the continent receives very little rain. It will be seen that these areas are found, (i) in the south-western part of the great northern lowlands, (ii) on the central plateaux. (iii) on the plateaux of Arabia and Iran, (iv) in the extreme north. The little rainfall is due in the first region to the great distance from the ocean, in the second to the fact that these plateaux are to the lee of the highlands of northern India and China, which have already received most of the moisture brought by the wet summer winds, and in the third region (the south-western plateaux) to the dryness of the prevailing N.E. Trades, for the monsoon rain-bearing winds of summer do not affect this part of Asia. The north coastlands lack rain, as the low temperature causes very little evaporation to take place, and therefore limits the rainfall.

A comparison of Figs. 23 and 24 will show that most rain falls in summer when there are the inflowing winds. If Fig. 24 is studied in connection with a relief map, it will be seen that these summer winds deposit most of their moisture on the mountains with which they first come into contact, and pass on as dry winds. South of a line from the mouth of the Indus to Korea is a region over the greater part of which there is a heavy summer rainfall. Summer rainfall, though small in amount, is also experienced in a broad band stretching across the north of the *the lands bordering the eastern Mediterranean* have the dry summers and wet winters typical of the Mediterranean shorelands. Ceylon, the Malay Peninsula, the coastlands of China, the islands in the eastern volcanic Chain and the East Indies all have rain at all seasons. Fig. 29 shows the season at which most rain falls in the different parts of Asia.

VEGETATION AND ANIMALS.

Fig. 26 shows the world distribution of vegetation. It will be seen that the tundra, the cool temperate forests and the steppe of Europe are all continued eastwards

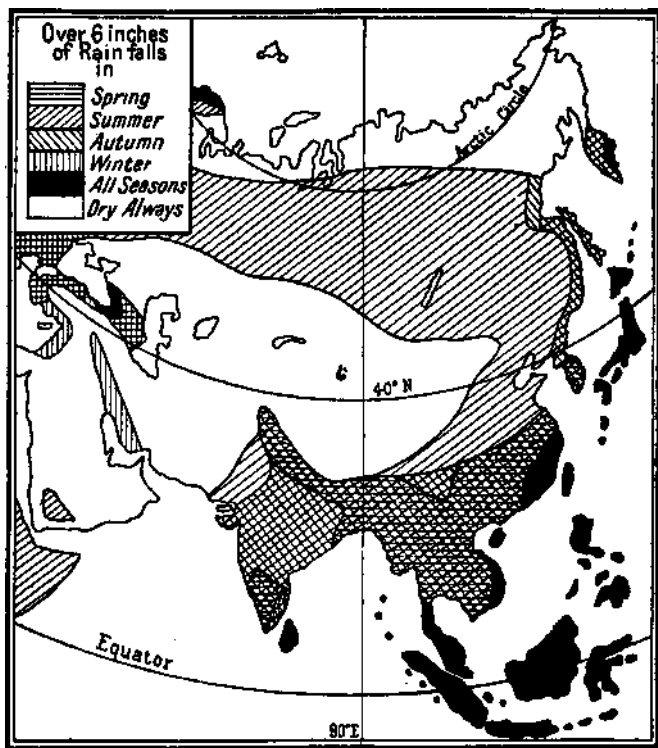


FIG. 29.—The Seasonal distribution of rain in Asia.
(After Herbertson and Supan.)

into Asia. The chief animal of the tundra is the reindeer. The coniferous forests of Siberia are very dense, and give shelter to many kinds of fur-bearing animals, of which the chief are the sable, fox, mink and ermine. These forests gradually give place to the grassy steppes,

the richer parts of which are rapidly becoming important wheat-producing lands.

Towards the Sea of Aral, the steppes merge into semi-desert or scrublands in which are extensive areas of true desert. Deserts are also found in the rainless parts of Arabia, Iran, Tibet, and Mongolia. In the higher parts of Arabia, and over considerable areas of the central plateaux, are tracts of slight rainfall having a very poor type of pasture, not unlike the drier steppes. Yet even this is sufficient to support wandering tribes of herdsmen, who follow their sheep and goats from pasture to pasture. Fleet-footed grazing animals, such as gazelles and asses, run wild. In Arabia, the chief animal is the camel, whilst the famous Arab horses are reared on the poor pastures. In Tibet, the yak, the native ox, is the chief beast of burden and also provides food and clothing.

In the Mediterranean region of winter rainfall the plants adapted to summer drought are found. The chief are the vine, fig, mulberry and olive.

The monsoon lands of the south-east have rain mainly in summer, and, since this is generally considerable in quantity, the natural covering is usually forests. In North China, Korea and Japan, these are of the warm, temperate type, and in Southern China, Indo-China and India, of the hot, wet variety, although there are parts having a smaller rainfall, in which savannah, or mixed grass and woodlands are found. The Deccan is an example of this type. In the forests and jungles are many species of wild animals, amongst which may be mentioned the elephant, which can be domesticated and taught to do useful work, the dreaded tiger of Bengal and the Malay Peninsula, the leopard, the tapir (found in Asia only in the Malay Peninsula and in Sumatra), as well as many varieties of monkeys, apes and snakes, of which the cobra is perhaps the most dreaded. Mention should also be made of the buffaloes and humped cattle of India, for they are very important for draught purposes.

In the hot, wet equatorial forests of the South Malay

Peninsula and the East Indies the heat and rainfall are constant, so that dense tropical vegetation is met with, except in the higher parts of Borneo. The chief trees are sago-palms, bananas, coconut palms, gutta-perchas, bread-fruits, and trees and shrubs from which spices are obtained. From these the natives can obtain most of the necessities of life. The great naturalist, Wallace, fixed the line separating the Asiatic animals from those distinctly Australian in type, as running between the islands of Bali and Lombok, east of Java, and between Borneo and Celebes (see Fig. 48). Others have fixed the line so as to include Celebes as having an Asiatic type of fauna. As a matter of fact, the fauna along the boundary line drawn by Wallace is of a mixed type, and this is what we should expect to find. We have already learned that the islands west of Wallace's line stand on a submarine platform less than 100 fathoms below sea-level, whilst those to the east have surrounding seas which are very much deeper. Wallace thought this indicated that Australia was separated from other land masses very early indeed, so that it had been able to develop a typical flora and fauna. The typical Australian tree is the eucalyptus, whilst the characteristic animals are marsupials—that is, they are pouched, as, for example, the kangaroo.

EXERCISES.

1. Why is it that (a) Asia Minor receives its rain chiefly in winter, (6) the East Indies at all seasons, (c) south-east Asia chiefly in summer, (d) the central plateaux are deficient in rainfall?

2. Describe the climatic conditions which produce (a) tundra, (b) steppe. What animals are best suited for each?

3. What zones of vegetation would be passed through in a journey from the south of India to the arctic coast of Asia? Account for the changes you notice.

4. On an outline map of Asia shade all regions receiving a mean annual rainfall of less than 10 inches. On the same map mark the desert lands of the continent. What connections do you notice between the two sets of factors?

5. What are monsoon winds? Draw sketch map to illustrate **their** causes, and, in writing, briefly describe the maps.

CHAPTER X.

THE MAJOR NATURAL REGIONS OF ASIA.

ASIA may be divided into several large units or major natural regions. In so dividing the continent, the physical features, climate, vegetation and leading occupations must be taken into account. One of these factors alone is not sufficient, for a physical unit may be so large that the climate and vegetation in different parts vary very much. It will thus be seen that natural regions are not simply physical units. Ideal natural regions would be those which were physical, climatic and vegetative units—that is, regions of the same physical type throughout (plains, plateaux or highlands) in which the same set of climatic conditions obtained in all parts of the unit, and produced the same general result as seen in the natural vegetation and occupations. To carry out this thoroughly we should have to divide the continent into a great many units. For our present purpose, it is sufficient to take very large divisions, in each of which are certain outstanding characteristics, which allow of the region being considered as a unit. In selecting the major natural regions the chief factor which has been considered is natural vegetation, for in the distribution of vegetation we also have the influence of relief and of climate playing important parts. That is, if a region has the same type of natural vegetation in all parts, it is obvious that the climate is approximately the same throughout the region, and that there will be a similarity in the natural occupations. Much of this chapter will therefore resemble Chapter VII, although here we shall confine our attention to Asia.

It will be seen that a division of Asia into large natural regions takes no account of the political boundaries but as the importance of these is not inconsiderable, we must not neglect them. We must also notice that it is often impossible to draw an exact boundary line between natural regions, for one type merges into another very gradually.

(A) THE TUNDRA.

This region occupies most of the land lying within the Arctic Circle. The physical map will show that the tundra consists mainly of lowlands. Short summers and long, cold winters, a total precipitation of less than 10 inches, and a natural vegetation consisting chiefly of berry-bearing bushes, mosses and lichens, and numerous flowering plants, are the outstanding characteristics of this region. Life here is very hard indeed, and the hard work necessary to keep alive is not rewarded by the comforts of more fortunate climates.

(B) THE NORTHERN TEMPERATE FORESTS.

This region is a great belt stretching across northern Asia, south of the tundra. In the west it covers lowlands, and in the east, highlands. The chief trees are conifers, although towards the south broad-leaved trees appear. Little lumbering is done in these forests, for the means of export are at present very difficult indeed. The trapping of fur-bearing animals is the chief occupation. Throughout the area the climate is one of extremes, although the summers are much warmer than those of the tundra, and the rainfall is greater. This, of course, accounts for this region being forested, whilst the tundra is a gold desert.

(C) THE GRASSY STEPPE.

This is a great grassy plain with a rich soil. Owing to distance from the sea the climate is one of extremes,

The rainfall is not very heavy—in parts it is deficient in quantity—and falls in summer. The natural occupation is stock-rearing, although a great change is taking place in the richer parts immediately south of the forest belt. Here every year sees an increase in the area of



FIG. 30.—The major natural regions of Asia.

A. Tundra.	B. The northern temperate forests.
C. The steppes.	D. The Mediterranean lands.
E. The deserts and semi-deserts.	F. The monsoon lands.
G. The South-Eastern Archipelago.	

land devoted to the growing of cereals, especially wheat

Towards the south-east the steppe becomes arid and desert-like, so that we shall include this southern portion of the north-west lowlands in the Great Desert Belt.

(D) THE MEDITERRANEAN LANDS.

This region stretches from the Mediterranean Sea to the plateau of Iran. Politically it includes Turkey, Syria, Palestine, Iraq, the Republics of Armenia, Georgia and Azerbaijan, and the western districts of Persia. Only the coaslnds have the typical Mediterranean type of climate of very warm, dry summers, mild winters and winter rains, for the rainfall diminishes and the summer heat and winter cold increase as we go southwards and eastwards away from the sea. The plateaux have an extreme climate, whilst towards the south and south-east it is difficult to draw a boundary between the Mediterranean region and the Desert.

Evergreen trees and shrubs are the characteristic vegetation of the coastlands, whose chief cereals and cultivated plants are wheat, maize, barley, the vine, mulberry and olive. Farther inland pomegranates and apricots are more important, while the drier plateau interior is at best a poor grassland.

(E) THE DESERT BELT.

This belt of dry deserts stretches north-eastwards across Asia from the Red Sea to the Khingan mountains, including within its limits the plateaux of Arabia, Iran, Tibet, the Tarim basin and Mongolia. It also includes the deserts of Western Turkestan and the lower Indus valley. All these regions receive very little rainfall, for the high central plateaux and Turkestan are shut off from rain-bearing winds, whilst Arabia and the Lower Indus Valley are off the track of the summer monsoons.

As regards temperature, the various parts of this belt differ very considerably owing to differences of latitude and altitude. In Arabia and the Lower Indus Valley the winters are warm and the summers very hot; but in the other parts of this desert belt the winters are very

THE MONSOON LANDS

cold indeed, and the summers, as a rule, not quite so hot. In all parts of the region settled life is only possible where there are permanent supplies of water.

(F) THE MONSOON LANDS.

These are lands of hot, wet summers and dry winters. The winter temperatures differ according to elevation, distance from the sea, and distance from the equator. Indeed, there is such a great difference between the temperatures of the northern and southern parts of this region that we must divide it into (i) a temperate region, (2) a sub-tropical region, and (3) a tropical region. The first region, which has cold winters, includes Korea, the plains of Manchuria and northern China, and the islands of Sakhalin and Yezo. The uplands are clothed with mixed coniferous and broad-leaved forests. The second region has warmer winters than those of the lands farther north; it also has a heavier and more evenly distributed rainfall. It includes Japan and Central China. The vegetation is of the warm temperate type. The third or tropical region includes India, Indo-China, and southern China, and it is distinguished from the others by its warm to very warm winters. The coastal lands, especially those nearest the equator, have very little difference between summer and winter temperatures.

The climatic characteristics common to the whole monsoon region are the comparatively dry winters and the wet summers. Where the summer rains are sufficient to keep the soil moist all the year round, forests are found, and these vary according to the temperature. In those parts where the rainfall is deficient, for example, on the Deccan to the leeside of the western Ghats, the vegetation is of a poorer type, such as mixed scrubland or savannah.

The chief products of this monsoon region are such as require considerable heat and moisture at the same time. They are:—rice, sugar-cane, cotton, opium, indigo,

tea, and coffee. In the drier parts where a sufficient temperature is reached, wheat is grown as a winter crop. The forests provide such useful timber as teak and bamboo, whilst in China and Japan, the mulberry is cultivated in order to feed silkworms. The fertile lowlands of the monsoon region are amongst the most thickly populated regions in the world, and this is rendered possible by the ease with which the necessities of life—here chiefly rice—can be obtained.

(G) THE SOUTH-EASTERN ARCHIPELAGO.

This region includes Ceylon, the East Indies, the Philippines, and the southern portion of the Malay Peninsula. A high temperature and abundant rainfall at all seasons are its chief characteristics.

In consequence of these climatic conditions, the lowlands are densely forested with vegetation of the equatorial forest type, whilst on the highlands are considerable areas of grasslands. In these hot regions we find a very backward type of man, for nature plenteously supplies him with all his needs. In return for the minimum of exertion on his part. The cultivation of tropical products such as sago-palms, coconuts, bananas, rubber, and spices is extending, but there are still considerable areas which remain in a natural condition, and even cannibalism is not unknown.

EXERCISES.

1. Name the chief parts of Asia in which each of the following is a very important product—rice, tea, cotton, wheat. Give full reasons for your answer.
2. Contrast, as vividly as you can, the differences between Northern Siberia and Java.
3. A, B, C, etc., are towns in Asia. From an examination of the climatic statistics quoted can you identify each? If you cannot mention a town try to state a region. Give reasons for your selections.

Place.	Height in feet.	Jan. temp.	July temp.	Mean annual rainfall in inches.
A	90	75° F.	85° F.	3
B	SL.	75° F.	78° F.	101 (mainly in summer)
C	250	-4° F.	68° F.	15 (two-thirds in summer)
D	20	80° F.	81° F.	94 (at all seasons)
E	26	47° F.	80° F.	27 (mainly in winter)

4. In what other parts of the world would you expect to find similar regions to the Asiatic tundra, the steppes, and the northern temperate forests? (see Chapter VII).

5. What is a major natural region? Give examples from Asia.

CHAPTER XL

THE RUSSIAN LANDS.¹

Natural Regions.—The Russian lands of Asia include (i) the tundra, (ii) the coniferous forest belt, (iii) the steppes, (iv) the semi-desert and desert lands of Turan, (v) portions of marginal lands of the central highlands, (vi) northern portions of the temperate monsoon region.

The total area of these lands is about one-third of the whole continent, but the total population numbers only about one-fortieth of the people of Asia.

The map shows that the greater part of Russian Asia consists of the great north-western plain, and that to the east and south of this plain are high mountain uplifts.

THE NORTH-WESTERN LOWLANDS.

Physical Conditions.—Let us first realize the size of this plain. From south-west to north-east it stretches through more than 4,000 miles—as far as from London to Chicago; at its greatest width it exceeds 1,200 miles, whilst by far the greater part is below an elevation of 600 ft. above sea-level. And this plain, great as it is, is only a part of a very much larger lowland which extends beyond the Urals to the North and Baltic Seas.

This vast triangle-shaped plain is drained to the

¹As the result of the Russian Revolution of 1917, the political geography of the Asiatic lands of the Old Russian Empire is very complicated. Many socialist soviet republics have been formed, but these, together with the republics of European Russia, are federated or allied to form the Russian Socialist Federal Soviet Republic (R.S.F.S.R.). We shall, therefore, think of them all under the general title—"The Russian Lands." See Exercise 8 on page 109.

Arctic Ocean by many large rivers, of which the Ob, the Yenisei and the Lena are the most important. These mighty streams—the Ob is 3,230 miles in length—and their network of east and west flowing streams are the chief means of communication, but, unfortunately, they suffer from the great disadvantage of flowing into an ocean which is frozen for at least eight months every year. Besides this, their lower courses are frozen for many months, whilst the thaws of spring turn the country bordering their banks into enormous lakes. For these reasons the main streams have been little used for commerce, although their east and west flowing tributaries have had a great deal to do with Russian expansion eastwards. The western movement of Mongol horsemen from Eastern Asia to Europe was*along the great grassy plains of the steppes, for here pasture and firm ground were found. The Russian eastward expansion was not confined to the grasslands and the use of horses, for the rivers and boats offered an excellent method of progress, especially through the forests. To-day, the vigorous Russian Government is working hard successfully to develop lines of export along the rivers to the Arctic Ocean. This is only possible for a limited period in summer, but most promising experience has been gained.

Turning to the climate, the severity of the winters rapidly increases as we go from west to east. Siberia is everywhere colder than Russia in the same latitude. It is also drier. These conditions are what we should expect to find as we approach the centre of the great Eurasian land mass. In the Turan lowlands of the south-west the winters are cold, and as we go towards the north-east they become colder and colder, until at Verkhoyansk we reach the exceedingly low mean January temperature of -60° F. or 92° F. below freezing point. In summer the south-west lowlands are very hot, and the temperature decreases, although not so rapidly as it falls in winter, as we go towards the north-east. As regards rainfall, the extreme north and the Turan lowlands have a very slight rainfall, less than 10 inches, and

between these there is a broad, belt where the mean annual rainfall is from 10 to 20 inches.

It is on account of the vast size of the north-west lowlands and the consequent different climatic conditions that we find it contains several natural regions, which we will now discuss in more detail.

(1) THE TUNDRA AND ITS INHABITANTS.

As will be seen from Fig. 31, the tundra occupies the most northerly part of the area. We have already learned that in this region the summers are short and warm, the winters long and cold, the rainfall is slight, and that as a result of these conditions instead of trees we find mosses, lichens, small bushes and berry-bearing plants, and, in summer, a great variety of flowers.

The rivers which cross the tundra flow from south to north, so that in spring, when the thaw comes, their upper courses are supplied with water from the melting of ice and snow, whilst their lower courses are still frozen. This is the cause of large tracts being under water in summer. Millions of mosquitoes make life in these swampy lowlands almost unbearable, so that the inhabitants have to keep as far as possible to the higher portion of the tundra.

The inhabitants of the tundra belong to various races, and are known by different names. In northern Norway and Russia are the Lapps and Finns, and in northern Asia the Ostyaks, Samoyads, Yakuts and other similar tribes. Mention has just been made of the fact that several races are represented. This is very interesting, for we find that men of the same races as some of those inhabiting the tundra, are much taller in more southerly lands, whilst in these cold, barren wastes all the inhabitants, whatever their origin, are small and undersized. This is undoubtedly an example of the influence of climate upon man. The climatic conditions not only influence stature, but the whole mode of life, for all tundra dwellers appear to have been compelled to adopt similar ways and means of existence.

The tundra has very little to offer to its inhabitants as a reward for their labour. The ground is permanently frozen below a depth of one or two feet, so that, apart from the climatic conditions, agriculture is impossible. The sparse vegetation is, fortunately, able to support herds of reindeer, but provides nothing for the support of human life except certain berries. The dwellers in

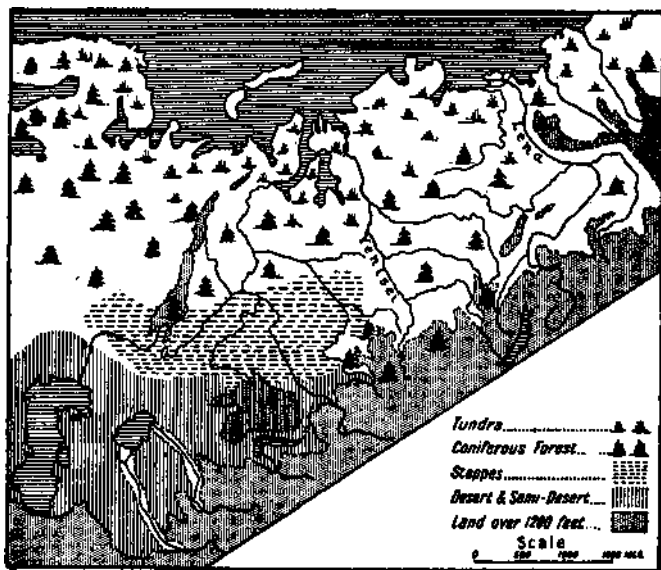


FIG. 31.—The north-western lowlands of Asia. Relief and vegetation.

the tundra are therefore compelled to depend for their food upon the reindeer, the fish which they catch in the rivers and sea, and the wild animals which they can hunt. Reindeer are indispensable to the people of the tundra. They roam about in a semi-domesticated condition in search of reindeer moss, in discovering which they show extraordinary sagacity, their owners meanwhile following them from place to place. The possession of a few reindeer means that a man and his family have most of their

needs supplied. To own a large number is to be quite a rich man. Alive, the reindeer is used as a beast of burden, and provides milk. When killed, every part of its body supplies something useful—the skin for clothing and tent covers, the flesh for food, the horns and bones for tools and implements, and the sinews for thread, etc. Fishing is carried on chiefly in the late spring and summer, when the rivers thaw and fish are abundant. The men catch the fish, and to the women falls the task of drying enough for use in the long winter when fishing is impossible. The families dependent upon fishing alone have a far more insecure existence than those supported partly by fishing and partly by the reindeer. A certain amount of hunting is possible, especially in winter, when it is the custom to migrate as far southwards as the northern edges of the great forest belt.

From what has been already stated it will be evident that tundra dwellers live nomadic or wandering lives, and that the summer will be the season of most changes. For this reason a fixed house is impossible, but the winter dwelling is of a more permanent type than the summer one, indeed, in many cases, one dwelling is used throughout the whole of that season. The summer houses are tents which are easily carried, erected, or pulled down. They are made of a framework of poles covered with skins or bark. The winter houses are generally made of a framework of wood covered with turf or earth.

We have seen that for food and clothing tundra dwellers depend very largely upon the reindeer. Some tea and tobacco are obtained from traders, and are greatly prized. Important articles of winter clothing are the hood, the thick, skin gloves which are attached to the sleeves, and the warm, fur boots. A mother carries her baby in her hood. She covers it with furs, and laces it into a skin cradle which she carries on her back. Travellers tell us that children are generally kindly treated, although tundra boys and girls can never enjoy real home life when the home comforts are

so few, and the place of habitation is constantly being changed. The position of the aged, the sick, and those who are not strong enough to take their part in the hard struggle for existence is often very hard indeed. They are sometimes neglected and left to perish.

(2) THE BELT OF NORTHERN TEMPERATE FORESTS.

As shown in Fig. 31, this is a broad belt of forests south of the tundra. The trees are mainly conifers, although many broad-leaved trees appear towards the southern margins. This enormous area is almost entirely virgin forest. It is the greatest hunting ground for fur-bearing animals in the whole world, although, except on its margins, it is almost uninhabited. The trapping is done chiefly by Ostyak and Samoyad hunters who live on the northern fringes, and whose settlements are regularly visited by traders who transact their business by means of barter.

Better means of communication are already making lumbering an important occupation; but even at present comparatively little is done in this direction. Towards the south the forests gradually thin out, and, owing chiefly to the drier conditions, the prevailing vegetation is grass.

(3) THE STEPPE.

As regards the climate and vegetation of the steppe, it is not necessary to add to what has been learned in previous chapters. We shall only recall that the rain-fall is small and falls chiefly in summer, and that the range of temperature is *very considerable*. But, as in the tundra, we shall go into more detail in connection with the way in which the primitive steppe dwellers live, so that we may see how geographical conditions affect modes of life. The majority of the inhabitants of these great areas of grass-covered lowlands are shepherds who rear large herds of sheep, camels, horses, goats and cattle, and since the grass in a particular place is soon exhausted, it follows that the animals have to be constantly moved from place to place. Thus the steppe shepherd, like

the tundra hunter, leads a nomadic life. It is necessary, therefore, that the house, furniture and household utensils should be of as simple and light a character as possible, so as to be moved with as much ease and comfort as circumstances permit. The people, therefore, live in tents which are usually round in shape and are most comfortable. The framework is made of willow sticks which are obtained from the banks of rivers. The sticks are made into a lattice-work which can be expanded or contracted according to the size desired. This lattice-work is then covered with skins or felt, and the whole held together by cords or bands. The only furniture consists of carpets, cushions and rugs, whilst most of the household utensils are made of leather or wood, because articles so made are not easily broken. The work of erecting or taking down the tent falls, as is customary with most nomadic peoples, to the women, who can easily accomplish **the** task in about half an hour.

The winter houses are more durable, and are sometimes built of stone. Since the winters are usually severe and often snowy, stables have to be erected for the animals, which are fed upon hay that has been stored for winter use. The site of the winter dwelling is very important, for it must be near to a reliable water supply and in as sheltered a place as possible. Therefore a river valley is often chosen. We have said that steppe dwellers are nomads, but one point must be noted. In however many places the summer tent is pitched, it is very seldom that **the** shepherd does not return to the same winter quarters. Although the chief work is looking after the animals and keeping them from any harm, some hunting is usually possible in winter, as at this season the hungry animals of the forest venture farther south in search of food.

As a rule, primitive steppe dwellers despise a settled life, and glory in their nomadic existence. Their flocks and herds provide them with all they require, and therefore they are content. The felt for the tent covering is made from wool. The hair of the camel is woven into camel's-hair cloth. Wool and hair are also used

in the making of the cushions, rugs and carpets which are noted all over the world for their beauty of design, and the excellence of the work. Leather and skins can be obtained very easily, and are made into bottles and clothing. Milk and flesh form by far the most important food, although other things can be obtained from the trading caravans which carry on commerce with the steppe dwellers. The favourite drink, koomiss, is made from the fermentation of milk, whilst large quantities of milk are also used in the making of cheese and butter. When we consider that the people are constantly moving in summer, we see that the camel and horse are very important indeed as beasts of burden. Steppe dwellers are noted horsemen. The Kirghiz give themselves the name of Kazak, which means "horsemen." Without the help of horses it would be impossible to keep the flocks in order whilst moving from place to place, or to prevent them from straying during a temporary halt. Even the children are expert in horsemanship, and they are placed on horseback when about four or five years of age.

In most other occupations, the introduction of machinery has made great changes, but the shepherding of animals is still carried on in much the same way as in the days of the Bible patriarchs. Indeed, some of the best accounts of steppe life are found in the Old Testament. Since there is little or no change, steppe dwellers are opposed to everything new, and are very much attached to tradition. The unit is the family, and as the wealth of the family is reckoned by the number of animals possessed, we find that the families are very large. Indeed, it is the practice for the wealthy steppe dwellers to have more than one wife. The head of the family is an autocrat who is a law unto himself, and is obeyed by all. Again, since wealth consists of livestock, drought or severe winters, storms or disease may reduce the richest of men to poverty in a short time. Such a disaster has always to be reckoned with, and it has the effect of making steppe dwellers fatalists, for no action of theirs can avert these unforeseen disasters.

The hardy horsemen of the steppe make splendid fighting men. Many times they have passed across southern Russia, and even reached as far as the Alps. The Magyars of Hungary are descended from such twelfth-century invaders. The once famous Russian cavalry, the Cossacks, were steppe dwellers. Cossack is an altered form of the word Kazak (see page 101).

The northern portion of the steppe is arable land—that is, it may be cultivated. It is in this region that great changes have been made in recent years. Settlers from places where a higher civilization than a pastoral type has been reached, have settled and brought with them the knowledge of the use of machinery, of irrigation, of the digging of deeper wells. In short, the modern settler in this part of the steppe knows how to live a settled life. Russian colonists are now raising large quantities of wheat, oats, rye and root crops, for the soil is very fertile and the rainfall generally sufficient, although dangers such as long droughts and early frosts are by no means unknown. Cattle are also reared in large numbers, and the manufacture of butter, introduced by the Danes, is to-day one of the chief industries in Siberia. As more and more areas are developed and used for stock-keeping, dairy farming, and the growing of cereals, the nomadic Kirghiz, who cling to their mode of life, are being pressed farther south towards the less fertile parts of the steppe. The development of this portion of Siberia may be compared with that of the North American prairie. As in the latter region, the construction of railways has led to rapid progress. Fig. 32 shows the great *Trans-Siberian Railway*. From Moscow the main line goes to Perm and across the Urals to Omsk. An alternative route is via Samara. The Urals do not present a serious obstacle, for their gradients are not difficult, and convenient gaps can be used. By means of easy descents, the main line reaches the steppe of south-west Siberia, and crosses the Irtish, an important tributary of the Ob, at Omsk. This town lies in a rich, black earth region in which wheat growing, dairy

farming, and stock-keeping are important occupations. It is the most important town in the agricultural area of Siberia. North-west of Omsk, at the confluence of the Irtysh and the Tobol, is *Tobolsk*, which, although not on the railway line, commands routes via the Tobol to the Kirghiz steppe, along the Irtysh to the Zungarian Gate, between the Altai and the Tien Shan mountains (see Fig. 32), and beyond that to the Far East. The latter advantage has also helped the growth of Omsk, which is more

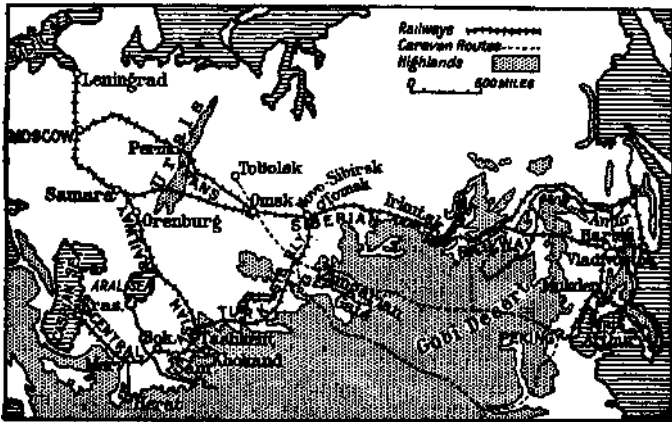


FIG. 32.—The Trans-Siberian, Central Asian and Turk-Sib. railways.

important to-day than Tobolsk. From Omsk, the railway continues eastwards to *Novo-Sibirsk*, the capital of Western Siberia, which has a fine position where the Trans-Siberian Railway crosses the Ob and is joined by the "Turk-Sib." Railway from Turkestan. Continuing eastwards, a branch line goes to *Tomsk*, a rising Siberian city noted as the centre of a gold-mining district, and crosses the Yenisei at Krasnoyarsk. For some 300 miles before reaching this town, which, like Tomsk, is a mining centre, the railway passes through coniferous forests. Beyond Krasnoyarsk, open country is again reached, and the

line continues to Irkutsk, to the west of Lake Baikal. After skirting the southern shores of this lake, the line forks, one branch following the general direction of the Amur, but some 40 or 50 miles north of that river, the other continuing across Manchuria via Harbin to Vladivostok, and via Mukden to Port Arthur, which the Russians lost in the war with Japan in 1905. The Amur valley line was developed with a view to giving a route to Vladivostok entirely through Russian territory. From Khabarovsk, on the Amur, the line utilizes the valley of the important north-flowing Usuri river, which offers a good route southwards to Vladivostok.

Let us return to that portion of the railway which is on the central plains. North of Lat. 56° N., and between the Urals and the Yenisei, is a great swamp region, whilst to the south lie the dry steppes. It was along this firmer ground that many Mongol invaders passed into Europe, and it was naturally here that the Trans-Siberian railway was built, passing through Omsk instead of Tobolsk, which is in the swamp region.

4. TURAN OR RUSSIAN CENTRAL ASIA.

This fourth region of the north-west lowlands occupies the semi-desert and desert lands lying between the central highlands in the east and the Caspian Sea on the west, and stretches southwards to the Iran plateau. The map shows that, except in the north, it is shut in by high mountains, which shut it off from rain-bearing winds. But since the mountains themselves receive rain and are often snow-capped, the Turan rivers rising in them are supplied with water. Of these, the Syr and the Amu flow into the Sea of Aral, and are the most important, but there are many which lose themselves in the sand.

The only fertile parts are those which are irrigated. About one-tenth is fit for settlement, and much of this is of a very poor type of pasture, and can be used for a short time only. The chief occupation on these poorer

pastures is stock-keeping, which is carried on in **the** same way as in the better-watered steppe lands already considered. It has been said that these Turan shepherds are half shepherds and half robbers, and this is hardly to be wondered at. In the river valleys a settled life, based on irrigation, is possible, and wheat, maize, wine, cotton and tobacco are produced, whilst the mulberry is grown in order to feed the silkworm.

The Russians have built railways, by means of which the chief towns in Turan can be reached with much greater speed and safety than is possible by caravan. Fig. 32 shows that the *Central Asian Railway* leaves the old Trans-Siberian line at Samara, and crosses the Ural river at *Orenburg*. After skirting the western margins of the Kirghiz steppe, which separates Siberia from Turan, the line reaches the valley of the Syr, one of the rivers draining into the Aral Sea, and continues to *Tashkent*. In common with other Turan rivers from the central highlands, the Syr carries little water except in early summer, when the melting of the snow fills the river channels. So fast do these rivers flow in their upper courses at this time of the year, that they bring down quantities of silt and rock waste, which is spread out like a fan where the current receives a check, and this, of course, takes place when the lowlands are reached. These fertile land deltas can be made very productive by means of irrigation. *Tashkent*, the political and commercial centre of Turan, is situated in the best part of the Syr valley. *Kokand*, reached by a branch line, is also irrigated by the waters of the Syr.

Leaving Tashkent, the railway proceeds to *Samarkand* and *Bokhara*. These ancient cities are in the valley of the Zarafshan, a river which loses itself in the sand. Bokhara is at the end of the river. Conquered by the Arabs in the eighth century, these oasis cities became Mohammedan centres of learning, but many of the famous buildings were destroyed during Mongol invasions of the thirteenth century. The greatest of all the Mongols, Tamerlane, made Samarkand his capital, and erected

splendid buildings, the ruins of which may be seen to-day. The thirteenth-century traveller, Marco Polo, visited Turan, and has left on record excellent accounts of its cities and their inhabitants. From Bokhara, the railway turns south-westwards, and runs to *Merv*, a very old route centre from which a branch line runs southwards as far as the frontier of Afghanistan. Leaving *Merv* the main line winds across the desert, and has its terminus at *Kfasnovodsk*, on the Caspian Sea.

The new Turkestan-Siberian (Turk-Sib.) railway links the Trans-Siberian and Central Asian railways. It was built as part of the famous *Five Years Plan* and will do much to develop the areas through which it passes, especially the rich mines of copper, silver and other metals in the region south of Omsk and at Semipalatinsk.

We have so far considered that part of the Russian Lands which lie within the great north-western lowland. We will now turn to Eastern Siberia.

EASTERN SIBERIA.

Eastern Siberia, as will be seen from the map, is higher than Western Siberia. South of the tundra, it is mainly an elevated region bordered on the east by the Stanovoi mountains, and extending south-westwards to the forested highlands surrounding *Lake Baikal*. It is drained by the Amur, Lena, and the eastern tributaries of the Yenisei, and lies wholly within the tundra and forest zones.

Between the Yenisei and the Lena is a low plateau, above which rise table-shaped mountains. It is here that the world's greatest extremes of temperature are met with. The river Lena, whose source is close to Lake Baikal, is the least useful of the great Siberian rivers. Notice on the map (a) its very circuitous course, (b) the highlands which border its right bank, thus giving a continuous wall, and (c) the large delta which it is building at its mouth. The whole of its course is through forests or tundra. The only town of any importance on its banks is *Yakutsk*, situated on the great eastern bend of the river. It is the chief centre of the Siberian fur trade, and was

formerly a penal settlement for convicts. The east and west flowing tributaries of the Yenisei have already been mentioned in connection with the help that they gave to Russian expansion eastwards (see p. 95). Its Angara tributary drains *Lake Baikal*, the deepest known fresh-water lake in the world—its depth in places reaching nearly one mile. Its area is almost twice that of Wales. The lake, which is shut in by steep mountain walls, occupies two long parallel troughs separated by a ridge, above which the water is at places less than twenty-five fathoms deep. In winter it is frozen over for four or five months, so that the summer steamship service is replaced by sledges. *Irkutsk*, the largest town in Siberia and the seat of government for Eastern Siberia, stands on the Angara, forty miles from Lake Baikal. In the mountainous region for which it is the centre, gold-mining is an important occupation. The town has gained very considerably in importance since the construction of the Trans-Siberian railway, which passes through it. It is also reached by a camel caravan route, which crosses the Gobi desert on its way from Peking.

The river Amur can hardly be considered a Siberian river. Its lower valley and mouth are in Russian territory, but for the greater part of its course it forms the boundary between Eastern Siberia and Manchuria. It drains a little-developed pine-forested area, whose climate is very severe. Gold-mining and trapping are the most important occupations, whilst in many of the fertile valleys cereals are now cultivated. *Vladivostok*, on an arm of Peter the Great Bay, is a terminus of the Trans-Siberian railway, and is the chief port. It is unfortunate that its fine harbour is closed for about three months every year, owing to being ice-blocked.

Modern Siberia.—It is strange what wrong ideas many people have about Siberia. It is often imagined that the whole country is a land of snow and ice—a great lone land—for which the old Russian Empire had no use except as a place of punishment for criminals and political prisoners. In one sense it may be said that the Russians

themselves only discovered Siberia with the making of the great railway. The old government granted help to people who emigrated to the arable lands of the steppe, and took part in the great agricultural development which took place there in the years before the Great War. It is true that great tracts will always be unable to support many people, *e.g.* the tundra. But Siberia is a large country—half as large again as the whole of Europe—and contains vast forests, the fringe of whose wealth has been scarcely touched, as well as agricultural and pastoral lands with vast possibilities, not to mention the enormous mineral wealth of Eastern Siberia.

The Soviet government is actively exploiting the agricultural and mineral wealth of both Western and Eastern Siberia. Eastern Siberia already grows more wheat than she requires, while the great new metal works of the Kuznetsk Basin depend upon the rich deposits of coal and iron found locally. The successful attempts to export Siberian products via the rivers and the Arctic Ocean are important, and may be compared with similar Canadian efforts through Churchill on Hudson Bay.

Since 1932 very many ships have fully navigated the north-east passage in the summer. *The Northern Sea Route Administration* has established a large number of scientific stations (wireless, meteorological, biological, etc.) along the northern coast-line and on many of the islands, and sea routes are supplemented by air routes. Ports have been constructed on the Ob, Yenisei and Lena. *Port Ingara* on the Yenisei is the largest. It is built entirely of timber, and its population of about 15,000 men, women and children have all left Russia to settle there. Work goes on all the year round, even in winter when the temperature falls much below freezing-point, when there is little daylight, and the town is floodlit by electricity! The principal occupation is the preparation for export of the timber floated down the river during the summer months. *Ingara* exports the timber the following summer, for the river is frozen over in winter and the port is 400 miles from the mouth.

This astonishing achievement is typical of changes that are going on in Asiatic Russia. Perhaps the most astonishing thing is the way the new forms of organization in Russia in Europe, *e.g.* collective and state farms, state ownership of all mines, means of transport, etc., have penetrated to every part of Russia in Asia—tundra, forest, steppes and desert.

EXERCISES.

1. Describe the climatic changes that you would notice in a journey from the Siberian Arctic coast to the Sea of Aral. What other changes would be observed?

2. Write an account of the connection between the physical conditions and the life of the peoples of the tundra and the steppe.

3. What factors have led to the growth and importance of: Omsk, Irkutsk, Samarkand and Vladivostok?

Draw sketch maps to illustrate your answers.

4. What are the leading natural resources of Siberia? State their location, and describe their present state of development.

5. Describe a railway journey from Leningrad to Vladivostok. Describe the character of the country passed through at different stages of the journey, and draw a sketch map in illustration.

6. The Russian Lands occupy about one-third of Asia, but their population is only about one-fortieth of that of the continent.

Explain fully the reasons for this.

7. Which part of the north-west lowlands may be described as a "Land of hunger and privation"? Which part is a "Land of wandering"? How have Russians in recent years shown that settled life can be supported in both regions?

8. Consult the *Statesman's Year Book* and find out the political changes which have taken place since the Great War in the Asiatic part of the former Russian Empire. Do the new subdivisions appear to you to show much relation to the geographical conditions of this area?

CHAPTER XII.

SOUTH-WEST ASIA.

Natural Regions.—(i) The lands having a Mediterranean type of climate. (2) The deserts of Iran and Arabia.

Physical Features.—South-west Asia is composed chiefly of plateaux. In the north-west there is the plateau of Asia Minor, which rises eastwards into the still higher plateau of Armenia, above which tower such lofty peaks as the extinct volcano of Mount Ararat. To the north are the great ranges of the Caucasus, whilst to the south-east the plateau of Iran, comparable in elevation with Asia Minor, stretches as far as the mountain wall to the north-west of India. All these mountains and plateaux are part of the great belt of the central highlands (see p. 74). In the south-west there is the old tilted block of Arabia separated from the Iran plateau by the lowlands drained by the Tigris and the Euphrates. Six seas wash the shores of these lands. They are the Caspian, Black, Mediterranean, Red and Arabian seas, and the Persian Gulf.

THE GREAT ROUTES.

From the very dawn of history south-western Asia has been of great importance. It was in Mesopotamia, the land between the rivers, *i.e.*, the Tigris and Euphrates, that the early civilizations of Babylon and Assyria appeared, whilst the still earlier Egyptian civilization developed along the lower valley of the Nile, which, although not in Asia, is intimately con*

nected with the region we are considering, for the earliest commerce of which we have any knowledge was between Mesopotamia and Egypt.

It was not very difficult for travellers from Babylon to follow the Euphrates north-westwards, and then to strike westwards, via the oasis of Palmyra to Damascus. Turning south-west, this ancient route reached the coastal plains of Palestine, and after passing the fertile land of the Philistines, continued to its destination across the narrow strip of desert to the north of the Sinai peninsula (see Fig. 33). It may appear to be easier to strike due westwards from Babylon across the country separating it from Palestine; but this intervening land is arid desert, and therefore the longer, but safer, route was followed. It will be seen that if this route is continued along the Euphrates, it reaches the coast at Antioch, a point upon which the routes coming from the plateau of Asia Minor also converge. Fig. 33 also shows that Antioch is in the great gateway between the highlands of Asia Minor and those of Syria.

In connection with these routes notice the position of the ancient cities of *Tyre* and *Sidon*. These were the chief cities of the Phoenicians, who thus held a very important position between Mesopotamia and Egypt. When in the course of time the Phoenicians went on the sea and became seamen, they grew to be the greatest sailors of their day, visiting and trading with lands not only on the shores of the Mediterranean, but even daring to pass through the Straits of Gibraltar, the Pillars of Hercules. It is generally believed that the tin-producing islands with which they traded were our own islands, for we know that tin is mined in Cornwall. But since Phoenicia itself is not a very rich country, the decay of the great civilizations between which it lay, resulted, in the end, in the decay of Phoenicia itself.

Let us now return to Antioch, where the route following the Euphrates reached the coast. To-day,

Aleppo is the most important town in that important gap between the plateaux of Asia Minor and Syria. It stands midway between the Euphrates and the Mediterranean, and, through its modern port of Alexandretta, reaps all the advantages formerly enjoyed by -Antioch. From Aleppo, the caravan routes from Syria and Palestine on the one hand, and from the

FIG. 33.—S.W. Asia. Relief and routes.

Euphrates on the other, strike northwards across the plateau of Asia Minor, reaching the coast at Trebizond, Scutari and Smyrna. Another route follows the Tigris from Baghdad, and, passing through Mosul, proceeds west of Lake Van via Erzerum to Trebizond. Thus we see how routes via the Persian Gulf and the great rivers Tigris and Euphrates reach the Mediterranean, the iEgean and the Black seas.

The map shows the importance of the Red Sea as a great highway of trade passing to and from the Mediterranean and the Indian Ocean. In modern times the cutting of the Suez Canal has given a through water passage, but it must not be supposed that the making of this canal discovered the route. It has been known and used for centuries, although it was formerly not so important as the route following the Euphrates.

Mecca, the great centre of Mohammedanism, has been the objective of pilgrims ever since the days of the prophet. Fig. 33 shows the routes by which many of them reach the holy city. Notice that the route which goes from Mecca to Baghdad, via Medina and the comparatively well-watered Nejd plateau, is continued to Teheran, the capital of Persia. The map shows a small river entering the Tigris from the east. It is the valley of this river which makes the crossing of the Zagros mountains comparatively easy.

Other ancient routes are those which traverse the plateau of Iran, avoiding the barren depressions of the centre and keeping to the bases of the better-watered mountains, *e.g.* that from Meshed, via Teheran and Tabriz to Erzerum, or one from Teheran, via Kashan and Kerman to Quetta and the Indus.

In modern times, the great importance of the routes across south-western Asia has led to the construction of railways, of which the most important is the *Baghdad Railway*. When completed, this line will offer a land route to the east in rivalry to the sea route via the Red Sea and the Suez Canal. If a bridge were built across the straits between Constantinople and Scutari—or a tunnel were made under them—the completed railway would give communication from the North Sea to the Persian Gulf, whilst in the future it is certain to be extended to meet the Indian railways at Karachi (see Fig. 33). In Asia Minor, branch lines reach Angora and Smyrna, taking to the latter port the produce of the plateau. The map shows that in the south-east of Asia

Minor, the Taurus mountains bend away from the coast and become a barrier to the line. Here there is the famous pass, the *Cilician Gates*, through which the traffic of many centuries has passed, but the passes are too difficult to be traversed by railways so that tunnels have been constructed. During the Great War the line was constructed as far as Nisibin. From the Basra end the railway now extends beyond Baghdad and Samarra to a point some 50 miles south of Mosul, thus leaving a short middle section to be completed.

Ten miles north of Aleppo the Baghdad railway makes a junction with the French line which runs southwards and passes through Damascus to Medina, with branch lines reaching the coast at Beirut and Haifa. On account of the large number of Mecca pilgrims carried on this railway, it is known as the *Pilgrims' Railway*. The other important railway of S.W. Asia runs from Baku, on the Caspian Sea, to Batum on the Black Sea. This line is linked to the main Russian system by a line which runs round the eastern end of the Caucasus.

Thus we see that one of the most important things in the geography of S.W. Asia—perhaps the most important—is that, owing to the fact that it sits astride the great highways of trade between Europe and the Far East and Australia, and to the presence of the long Red Sea and Persian Gulf arms of sea, routes of great importance will pass across it. Of all the routes, two stand out as of first-class importance—the "through" water route, and the land route from Constantinople to the Persian Gulf. Fig. 33 also shows part of the air route from Britain to India, Malaya and Australia. This quick route is rapidly increasing in importance, especially for mails and passengers. The oil pipe lines mentioned on pages 124 and 126 are also of importance.

Now let us return to our regional study of south-west Asia. For climatic reasons we shall consider the area under the following headings: (1) The Lands of the Five Seas. (2) The Arabian and Iran Deserts.

(i) THE LANDS OF THE FIVE SEAS.

This picturesque name is given to the land bordered by the Caspian, Black, Mediterranean and Red seas, and the Persian Gulf, and, as Fig. 34 shows, it is very suitably named. The Mediterranean and Black Sea coastlands have the dry summer and winter rainfall peculiar to lands having a Mediterranean type of climate (see p. 90). The plateaux lack moisture, and are very

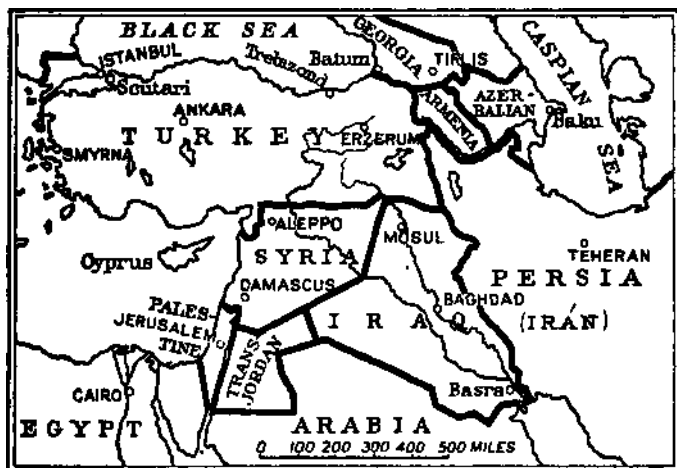


FIG. 34~The Land of the Five Seas.

hot in summer and cold in winter. The rainfall everywhere decreases with distance from the sea, so that the typical Mediterranean trees, the mulberry, olive and vine, give place to pomegranates and dates.

ASIA MINOR.

The plateau of Asia Minor or Anatolia is lowest on the west and highest on the east, where it rises to the high Armenian plateau. It is also crossed by mountain ranges which run from west to east, and the influence of these factors is seen in the drainage and routes of

the country, for both largely follow the same direction. In the north, the plateau descends so steeply to the Black Sea that there are no good harbours; in the south, the Taurus mountains rise very steeply from the sea coast, except in the east, where they bend away from the coast, leaving the very fertile plain of Cilicia. In the west the coast is much indented and there are numerous islands, which are the remnants of the mountain chains which once were continuous with those of Greece. Many rivers flowing between the east and west ranges drain the broad valleys which give easy access to the plateau.

Asia Minor forms the greater part of the Republic of Turkey, for the European possessions of that country are now very small and even Constantinople has ceased to be capital in favour of the centrally placed Ankara.

The coastal lands, including the mountains bordering the plateau, are forested with evergreen trees, with an undergrowth of shrubs, such as the rhododendron. The valleys opening westwards are also well wooded. In both valleys and plains the inhabitants follow settled occupations, and produce, in addition to the Mediterranean fruits (mulberries, olives, grapes, oranges, figs), tobacco, cotton, wheat and barley, whilst along the west coast sponge fishing is important. A considerable amount of silk manufacturing is carried on, especially at *Brussa*, at the foot of Mount Olympus, and other manufactures are of cotton and wool, the latter being used in making fine Turkey carpets and rugs. *Smyrna*, situated on a splendid harbour between two fertile valleys opening out to the *Ægean Sea*, is the chief port, its exports being representative of all the products of the country. Formerly *Smyrna* and the coastlands generally were largely inhabited by Greeks. To-day not only in Asia Minor but also in European Turkey, except in Constantinople, there are extremely few Greeks.

The plateau lacks moisture and has very cold winters, so that there is little vegetation beyond grass, and parts are even deserts in which are oases where the date palm,

as in the Saharan oases, is of the greatest importance. The plateau dwellers are, therefore, largely nomads, who move about from place to place attending to the wants of herds of camels, horses, goats and sheep. In the east the plateaux are more rugged. They are crossed by high ranges which here come close together and sometimes enclose fertile valleys. Erzerum, the largest town in this part of the country, lies over a mile above sea level and is so exposed that it is sometimes called the "Siberia of Turkey." Trebizond, on the Black Sea, is the port for this area.

Ankara, on the lower western plateau, is noted for fine goats' hair, greatly prized in the manufacture of mohair cloths. The city has fine modern buildings and is centrally placed for its function as capital of modern, progressive Turkey.

TRANS-CAUCASIA.

Trans-Caucasia is largely drained by the Kura river. The Caucasus mountains consist of rugged parallel ranges, in which are numerous glaciers. Their southern slopes are densely forested and contain valleys in which Mediterranean fruits and cereals are produced. The lower valley of the Kura is an extensive fertile plain opening to the Caspian Sea. Tobacco, cotton, and maize, as well as the vine, are produced here. South of the Kura are the plateaux of the Lower Caucasus. Here lies the Republic of Armenia, whose capital is Erivan. Note the large lake, Sevan, which is 6,300 ft. above sea-level. Agricultural occupations, especially the growing of cotton on irrigated fields, occupy most of the inhabitants.

Baku, an important port on the Caspian Sea, stands at the north of the plain, and is the centre of a very important petroleum area. It is not a very inviting town, for even the air is pervaded by the smell of oil, whilst the numerous refineries and pumping

stations are not buildings which can enhance its appearance. Since it is on an enclosed sea, the oil is sent by pipeline to *Batum*, on the Black Sea. Here it is pumped into oil-steamers and shipped to all parts of Europe. Between Baku and Batum the line passes through *Tiflis*, the capital of Georgia. The city is beautifully situated on the precipitous cliffs of the ravines of the upper Kura. In addition to its position on this important railway, it also commands the easiest north and south route across the Caucasus via the Georgian Highway. This route is very important, and has been followed by a splendid road, built primarily for military purposes. Eventually it will be followed by a railway line. The Georgian Highway is, of course, snow-bound in winter.

SYRIA AND PALESTINE.

Syria and Palestine, lands full of interest on account of their Scriptural connections, lie along the eastern shores of the Mediterranean Sea. The former is a high plateau, whilst in Palestine, north of Mount Carmel, the highlands are farther away from the coast, leaving a fertile coastal plain everywhere less than 600 ft. above sea-level. Rising abruptly from the plains is the plateau of Judea and Samaria, which is not so high as that of Syria, farther north. The plateaux of Syria and Palestine slope gradually towards the east, and form the Syrian desert. Notice the north and south direction of the Jordan and the Gulf of Akabah, which is the more easterly of the two gulfs at the northern end of the Red Sea. The greater part of the Jordan valley is below sea-level, the surfaces of the Sea of Galilee and the Dead Sea being 682 ft. and 1,291 ft. below sea-level respectively. These lakes occupy part of the floor of what is known as a *rift valley*, a type of valley which we will now proceed to explain.

Rift Valleys.—During the formation of a fold in the crust of the earth the pressure is generally so steadily

exerted that even rocks are gradually forced into folds. But in some cases the beds of rock cannot withstand the strain of the bending required, and they accordingly fracture. This causes blocks of the earth's crust to be raised and others to be depressed relatively to each other. Such crustal blocks are bounded by faults (see

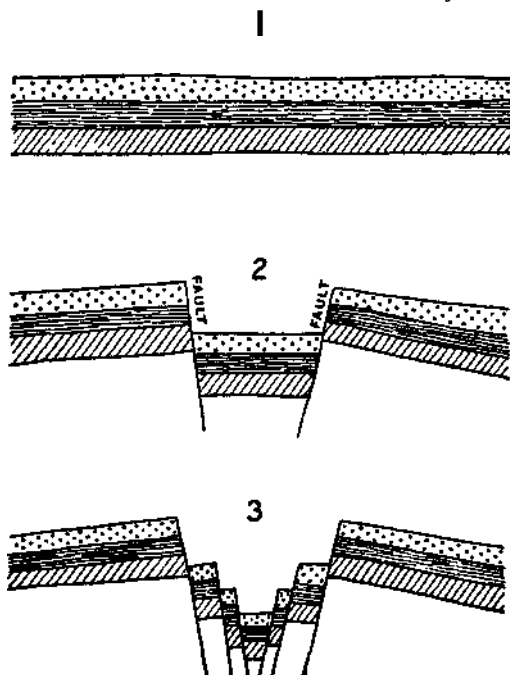


FIG. 35.—Sections illustrating the formation of a rift valley.

Fig- 35). Very often the land between two parallel faults is let down, and a comparatively narrow depression is formed. This is known as a rift valley. The Red Sea, as is indicated by its length and width and its steep, straight sides, occupies such a valley, which is a continuation of that of Palestine. Turning south-westwards at the southern end of the Red Sea, this

great rift is met by another which contains the Gulf of Aden, and is then continued across Africa as far as the south of Lake Nyassa. The connection between the Asiatic and African rift valleys is shown in Fig. 36.

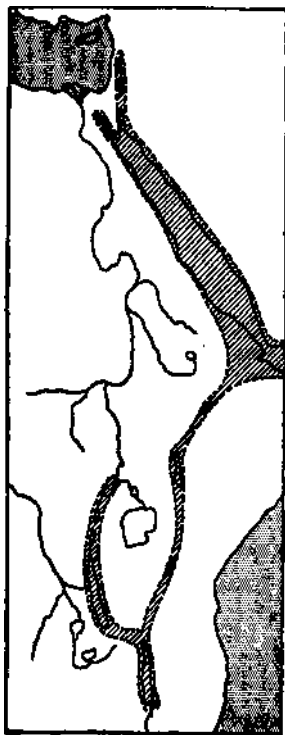


FIG. 36.—The Great Rift Valley.

In Palestine all the Mediterranean plants can be cultivated, and great quantities of wheat and barley used to be grown on the coastal plains. The hill sides were terraced for the culture of the vine, and irrigation works were carefully constructed, whilst the hill country was inhabited by prosperous shepherds. The Turks sadly neglected these lands, and in the place of fertility they left behind them poverty and waste. At the present time, however, great schemes for barraging the Jordan below Lake Tiberias are in progress. These will provide water for the fields and power for industries and are expected to do much to bring back prosperity to this ancient land. Already the population of Palestine has doubled since the Great War, and this is chiefly due to Jewish immigration.

In modern times the most important port is *Beirut*, which is surrounded by a very fertile tract of land, and is connected by rail with *Damascus*, the capital of Syria. *Damascus* is an oasis made by the waters of a small river at the base of the Anti-Lebanon mountains. It owes its importance to its control of routes—eastward to Mesopotamia,

and southward, via the Pilgrims' Railway, to Mecca.

The ancient city of *Jerusalem*, the capital of Palestine, has a central position, and one that could be easily defended, for it is protected on three sides by deep ravines. It is a walled city, and is visited every year by thousands of pilgrims and tourists, who are attracted by its sacred associations. From Jerusalem a railway runs to its port, *Jaffa*, but at present it has no connection with the Mecca railway owing to the difficulty presented by the Jordan rift valley. There is also a frequent service of motor omnibuses between the two towns. The journey takes about two hours. *Jaffa* has a very important export of oranges. Its near neighbour, *Tel Aviv*, has been built by Jewish enterprise. *Haifa* has increased in importance with the coming of the Jewish settlers, and has a modern harbour opened in 1933.

MESOPOTAMIA OR IRAQ.

As we have seen, the word Mesopotamia means "between the rivers," that is, the Tigris and Euphrates. We shall here use it to include all the lowlands shut in between the Arabian plateau and the Zagros mountains. Upper Mesopotamia, which was roughly the ancient land of Assyria, has a much more varied relief than the lowlands of southern Mesopotamia, which was occupied by Babylon. The latter lowlands consist mainly of alluvial deposits so low lying that many parts are swamps. The Euphrates and Tigris rise amidst the snows of the Armenian mountains, and their upper courses are very wild. Before reaching the Persian Gulf they join and flow through a region rendered swampy by the uncontrolled flood waters. The combined river is busily engaged in filling up the Persian Gulf, and is pushing its delta onwards at the rate of about 70 ft. per year. Close to the rivers, where irrigation is rendered easy, fields of cotton, wheat, tobacco and maize are found, whilst sugar and date palms are important in the lower valley. The rainfall, however,

is so small that without irrigation agriculture cannot be carried on, and since the same story of Turkish neglect has to be told of this land as of Syria and Palestine, the present condition of the greater part of the country is little better than a poor steppe land in which nomadic Arabs and Kurds pasture their flocks. There is no doubt that, given wise government, Mesopotamia would once again become one of the gardens of the world. As in Egypt, great barriers could be put across the rivers in order that water may be held up for use when the rivers are low. Large irrigation schemes are already in hand.

Even to-day the most important towns stand on the rivers. *Mosul* stands at the navigation limit of the Tigris, and is built mainly upon rising ground so as to be above the level of the river floods. Its name means "Central Gates," and was bestowed upon the city because it is situated at the intersection of routes from the Black Sea to the Persian Gulf, and from the Mediterranean Sea to the Caspian. On account of its site at the intersection of these routes, and at the navigation limit of the Tigris, it has been said that whatever military power holds Mosul must eventually become the possessor, sooner or later, of the whole of the Tigris valley, and even of the whole plain as far as the Persian Gulf. The ruins of the ancient Assyrian capital, Nineveh, stand on the opposite bank of the river. In ancient times, as now, in a country which has little stone for building purposes, the chief substance used in house making was sun-dried brick, made of clay. One point about the site of Mosul must be mentioned. Nineveh fell into decay, but Mosul arose near its ruins. Should Mosul disappear, another city will arise somewhere near by, for here is one of those places where the geographical conditions make it inevitable that there should be a town.

At *Kirkuk*, nearly 100 miles south-east of Mosul, **are** rich oil wells belonging to the Anglo-Iranian Oil Co. (see p. 126). The oil is pumped along a pipe to Haditha

on the Euphrates. From this point the pipe line bifurcates, one branch going to Tripoli, the other to Haifa. At these ports the oil is pumped directly into tankers. The construction of these pipe lines was a magnificent achievement (see Ex. 4 on p. 128).

Baghdad, famous in the *Arabian Nights*, is a walled city, standing on both banks of the Tigris, at the point at which that river comes very close to the Euphrates. The latter fact is of importance, as it may be possible to unite the rivers by canals, used for navigation as well as irrigation. A tributary from the Zagros mountains enters the Tigris at Baghdad and adds to its importance, for a route to Teheran, the capital of Iran, follows the valley of this river, and gains a fairly easy crossing of the Zagros mountains. South of Baghdad, but on the Euphrates, stood Babylon, now in ruins.

Basra stands near the Shat-el-Arab, the combined Tigris and Euphrates, and is the port for the delta lands. It is built about a mile from the river; but the district is so cut up by canals that all communication takes place by water. The surrounding country is dreary, owing to the extent of the marshes which are a source of malaria, but near Basra itself there are extensive plantations of date palms. The town is reached by ocean vessels. *Abadan* is the port for the Iranian oil-fields (see p. 126).

(2) ARABIA AND IRAN.

These arid lands are both plateaux, Arabia an old fractured and tilted block, and Iran a plateau whose uplift accompanied the growth of the young folded ranges which border and cross it.

ARABIA.____)

The Arabian plateau, very little of which is less than 1,500 ft. above sea-level, is highest along the Red Sea shores, from which it slopes eastwards to Mesopotamia and the Persian gulf. The map shows that the south-west, the south, the centre, and the land bordering the

Gulf of Oman are all high. The central highland is the large plateau of Nejd.

Arabia is one of the driest lands in the world. The higher districts, especially those of the south-west and the centre, receive slight rains, and on that account pastoral occupations can be carried on there; but elsewhere the land is practically rainless. Except in the south-west, there are no permanent streams, only wadis, or channels which are supplied with water after the occasional rains, but even then the streams never reach the sea. There are, however, oases where underground sources of water can be reached, or where springs occur, and in these date palms and cereals can be cultivated. Such oases are found in the valleys of the Nejd plateau, where rain falls during spring and autumn in sufficient quantity to give a covering of grass for a short time. It is on account of this that the Nejd region is famous for its breeds of horses, camels, donkeys, and sheep.

In Yemen, in the south-west, there are permanent streams flowing to the Red Sea, and, owing to the elevation, the high parts enjoy a warm, temperate climate. Fields of wheat and fruit-trees are numerous, and coffee is an important product. Coffee is grown on the lower south-west slopes, where the climate is hot and moist, and mists from the sea are very common. *Mocha*, whose name is usually associated with the coffee from this region, is not now so important for this article as *Hodeida*, the chief port.

The remainder of the west coastlands, and those in the south, are hot and dry, and almost uninhabited. In the region of the Oman highlands, in the south-east, some rain falls, and there are parts which are suitable for pasture. Notice the Bahrein Islands, in the Persian Gulf. They are British, and have important pearl fisheries. Another British Arabian possession of very great importance is *Aden* in the south-west, more than one hundred miles from the narrow straits of Bab-el-Mandeb, by which the Red Sea is entered, but sufficiently near to that entrance to be of great value as a naval

and commercial depot. In the straits themselves is the small island of Perim, which is also British, and is attached politically to Aden. The latter town is built in the crater of an extinct volcano. Rain falls very irregularly, often at intervals of more than a year, so that fresh water has to be obtained by means of the evaporation of sea water. In addition to this, large tanks have been cut in the rock, in order to receive and store the storm-brought rains. Aden's chief importance lies in its strategic position, and therefore it is strongly fortified, whilst it is on the great ocean trade route to India, the Far East and Australia.

The most interesting town in all Arabia is Mecca, famous as the birthplace of Mohammed. Every year it is visited by thousands of pilgrims, who make long journeys to the tomb of the prophet. Except the great mosque, there are few handsome buildings, for it is desired that no other building should rival the sacred edifice. The port of Mecca is Jiddah. Medina, north of Mecca, contains the tomb of Mohammed, and is also much visited by pilgrims. It can now be reached by railway from Aleppo and Damascus. Apart from this line, the chief means of communication in Arabia are naturally by means of caravans.

IRAN.

The Iran plateau, the greater part of which is about a mile above sea-level, is really a depression, bounded on the north by mountains stretching from the Elburz to the Hindu Kush (=Slayer of the Hindu, *i.e.* by means of avalanches); on the east by the Sulaiman and Hala mountains, and on the south and west by the coastal highlands and the Zagros Mountains. Communication in a region like this is naturally very difficult, and depends chiefly on the use of camels and mules, for, excepting the roads leading from Teheran, the Persian capital, to the Black Sea, there are no roads upon which wheeled conveyances can be used with ease. The two great caravan routes avoid the central depressions, of

which the two largest are the Great Salt Desert in the north-west, and the Seistan depression in the east. The sandy soil of the former is impregnated with salt, whilst the few rivers which traverse the latter, lose themselves in extensive salt marshes. In the latter connection, notice the Halmand river.

With regard to the climate of Iran, there are marked contrasts between (a) the Persian Gulf coastlands, where the climate is unhealthy, owing to a damp heat, with a low rainfall; (b) the greater part of the plateau, where there are extremes of winter cold and summer heat, together with a small rainfall; and (c) the lands bordering the Caspian Sea, where the climate is of the warm, temperate type. In the latter region there is ample rainfall, and the slopes of the mountains are forested.

The products of Iran closely correspond to the climates. On the plateau the poor pasture supports goats, sheep, and camels, and pastoral products are of chief importance, and have been the means of making Persian carpets and cloths famed the world over. On leaving the mountains, the rivers in many cases disappear underground, owing to the porous nature of the limestone, of which much of the plateau is composed. An elaborate system of underground canals, or *kanats*, partly natural, partly artificial, is often found in the vicinity of the larger plateau towns. By means of these less water is evaporated by the heat of the sun, and water can be obtained for irrigation in order that otherwise desert areas may become oases, and rice, tobacco, etc., be cultivated. Along the south coast the date palm is the typical product, whilst in the lowlands bordering the Caspian Sea, silk, cotton, and sugar are produced.

The mineral wealth of Iran is considerable, but is not worked, except for the valuable petroleum deposits which have been found along a zone extending in the west of Persia from Kurdistan to the Persian Gulf. The chief Persian wells are some 150 miles north-east of *Abadan*, the port of Iraq, to which the oil is brought by pipe line. This oil-field, and the newer one in Iraq (see

p. 122), are worked by the Anglo-Iranian Oil Company.

The chief Towns of Iran.—*Teheran*, the capital of Iran, the new name for Persia, lies at the southern base of the Elburz in sight of Mount Demavend, a snow-capped volcano of majestic appearance. It is the converging point of routes (see Fig. 33). One of the most important of these passes through *Ispahan* and *Shiraz*, both oasis towns, to its termination at *Bushire*, the chief port. Another route goes westwards to *Tabriz*, next to the capital the largest city in the country, and eastwards to *Meshed*, famed for its shawls and carpets. A Trans-Iranian railway runs from *Bandar Shapour* on the Persian Gulf via *Hamadan* to *Teheran* and *Bandar Shah* on the Caspian.

The capital of Afghanistan is *Kabul*, a town of great strategic importance, since it controls the Khaibar Pass, a narrow defile some thirty-three miles long. This pass, which does not follow the *Kabul* river, leads to the plains of north-west India, and can be held by a few good marksmen against a large number of attackers, for in places it is very narrow indeed. *Kandahar* and *Quetta*, the former in Afghanistan and the latter in Baluchistan, are on another route, which also leads to the plains of the Indus, via the *Bolan* Pass.

THE POLITICAL UNITS OF SOUTH-WEST ASIA.

Changes as a result of the Great War are indicated on Fig. 34. At first the collapse of the central Russian government and the difficulty of communication across the Caucasus led to the secession of the Trans-Caucasian peoples and their formation into semi-independent states. Round *Erivan* an *Armenian Republic* has been formed which also includes some former Turkish territory. The area round *Tiflis* and *Batum* has become the *Republic of Georgia*, whilst in the lower valley of the *Kura* and along the shores of the *Caspian* we have the *Republic of Azerbaijan*, with *Baku* as capital. These three republics belong to the Union of Soviet Socialist Republics. Their capitals are connected by railway with each other and also with *Erzerum* (Turkey) and *Tabriz* (Iran).

The peace treaty with Turkey, itself now a republic, demanded that she recognized the independence of *Armenia, Iraq, Syria, Palestine* and the *Hejaz* (Arabia). Greece held the city and district of Smyrna for a time, but they have now been returned to Turkey. Thus all that is left to Turkey of her former vast Asiatic possessions is Asia Minor. Under mandates from the League of Nations, Britain guides the affairs of Palestine, and France those of Syria. In 1929 *Trans-Jordan* was given a government, independent of Palestine, under its Arab prince. It is still part of the territory mandated to Britain, and the High Commissioner of Palestine is also High Commissioner of Trans-Jordan. Iraq, which was ruled under mandate by Britain until 1927, is now independent. It has a native government with an Arab king. In Palestine an effort is being made to create a national home for the Jewish people. Some success has already been achieved in this direction, for the total population in the new settlements is about 50,000. The settlers have come from many countries in order to make homes in the ancient Jewish homeland. Unfortunately, Jews and Arabs have so far failed to agree to live peaceably together.

The political units of the Iran plateau remain unchanged. *Iran* (Persia) and *Afghanistan* are independent, and *Baluchistan*, a stony desert with a few oases, forms part of the British Indian Empire. All three occupy positions of great political and strategic importance, especially was this so in the days when they were "buffer states" between powerful Russian and British interests.

EXERCISES.

1. Of what importance is Aden? What is its annual rainfall? How is the town provided with fresh water?

a. What special features are there in the physical geography of the Jordan valley? Are these features to be found in Britain?

3. Why are the following cities important to-day, and why were they important in ancient times: Baghdad, Jerusalem, Damascus, Aleppo?

4. Find out how the construction of the oil pipe lines (pp. 123, 126) has affected the life, distribution and education of the people. Make a map of these pipe lines and, in writing, give an account of the difficulties overcome during their construction.

CHAPTER XIII.

INDIA AND CEYLON.

PHYSICAL FEATURES, CLIMATE AND VEGETATION.

OUR Indian empire, as defined by Act of Parliament, includes not only the great peninsula south of the Himalaya mountains, but Baluchistan, of which we learned in the last chapter, in the west, and Assam and Burma in the east. It covers an area of about a million and a half square miles, and can be regarded as a small continent in itself, rather than as a country. Its population numbers about 353 millions, who belong to many races and religions, and speak many languages. Some of its cities are among the finest in the world, whilst many of its inhabitants are extremely backward. It is a land of great contrasts.

PHYSICAL FEATURES.

An examination of the physical map will at once show—

1. The great mountain barrier in the north-west, the north and the north-east.
2. The extensive plains of the Indus and the Ganges.
3. The triangular plateau of the Deccan, bordered by much wider plains on the east than on the west. Ceylon is a detached portion of this plateau.

I. THE NORTHERN RANGES.

To the north of India is the high plateau of Tibet, to the south of which rise the Himalaya mountains.

As seen from the plains of the Ganges, these mountains rise very suddenly from land which is almost dead level. The Himalayas are a series of parallel earth folds which rise, ridge behind ridge, until the highest central crest is reached. This central ridge, known as

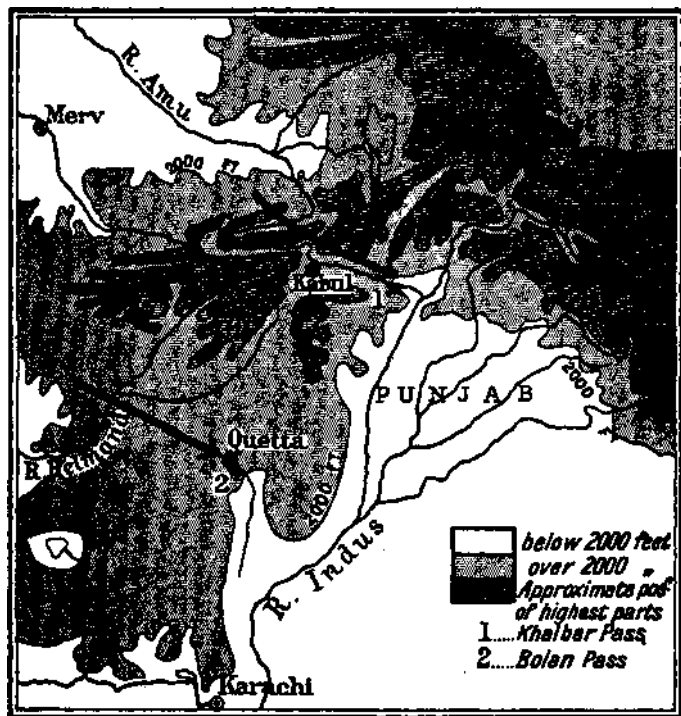


FIG. 37.—The north-west gates to India.

the snowy Himalayas, contains all the highest peaks, including Mount Everest, the highest mountain in the world. This giant has a summit over 29,000 ft. above sea level. The crests of the Himalayan ranges are snow-covered, and glaciers are numerous. Owing to the great width and height of this system (no pass is

THE INDO-GANGETIC PLAIN

lower than 17,000 ft.), they have always been a great obstruction to communications between the bleak plateau of Tibet and India. North of the western Himalayas, and separated from them by the upper Indus, are the Karakoram mountains, an eastern continuation of the Hindu Kush.

In the north-west of India, the Iran plateau, bordered by the Sulaiman and Hala mountains, rises above the plain of the Indus. The mountain barrier here is not so continuous as in the Himalaya region, and there are two passes which give fairly easy access to India from the north-west. They are the Khaibar and Bolan passes (see Fig. 37). These are the great gateways leading into India from Iran and the Turan lowlands, and have been followed by many conquerors and invaders.

In the north-east, the Himalayan ranges bend south and traverse Indo-China. The mountains here are much more of an obstacle to invaders than those of the north-west, but not so great as the Himalayas. Many Mongols have entered India from the north-east, but their numbers have been few compared with those invaders who came through the north-west gates. The Andaman and Nicobar islands mark the tops of continuations of one of these north and south-eastern chains.

2. THE INDO-GANGETIC PLAIN.

This extensive lowland lies between the northern ranges and the Deccan. It has been very slowly built up by the sediment brought from the mountains by rivers. So fine is this alluvium that it is very rare to find stones or pebbles. The map shows that the Ganges is nearer to the northern edge of the Deccan than to the Himalayas, and this is partly due to the fact that the Himalayan rivers have higher sources and greater volumes than those from the Deccan, and consequently push the river southwards, and partly to the raising of the land on the north of the plain due

to the deposition of sediment. In this connection it is interesting to notice the lower course of the Indus, where the river flows comparatively close to the mountains, as it receives no tributaries in this section. It is worthy of note that the three great rivers of India, the Indus, Ganges and Brahmaputra, have headstreams (in the case of the Ganges one of its tributaries) which have their sources north of the Himalayas, about the centre of the system (see Fig. 51). The rivers reach the Indo-Gangetic plain by means of difficult and often inaccessible gorges. It is very probable that the rivers existed before the mountain ranges, and that the latter were uplifted so slowly that the rivers were able to maintain their north and south direction by cutting gorges of constantly increasing depth. At their mouths they are building up great deltas, thus extending the area of the plain. The low-lying region at the mouth of the Ganges-Brahmaputra is known as the *Sundarbans* (= forests), a swampy region across which the deltaic streams meander, and in which they often change their courses, so that there are many towns which have become derelict owing to their being no longer on navigable waterways. The map shows that the watershed between the Indus and the Ganges is a very low swell of ground which extends from the Aravalli hills to the Himalayas.

3. THE DECCAN.

We have already learned that the Deccan is a fragment of the ancient southern continent, and that it is a plateau so tilted that it presents a steep face to the Arabian Sea, and has a long slope to the Bay of Bengal, along which are coastal lowlands much wider and more extensive than on the west. The western edge of the Deccan forms the Western Ghats (— steps) and its eastern margins the lower and much more broken Eastern Ghats. The Vindhya mountains form the water parting between the Deccan rivers and those

which **flow** to the Ganges. The longer Deccan rivers as, for example, the Godaveri, Kristna, and Cauvery, **flow** eastwards, their valleys having very considerably dissected the plateau. Their upper valleys are steep, contain many waterfalls and are often inaccessible.' The rivers flowing westwards are much shorter, except for the Narbada and the Tapti, between which are the Satpura mountains. On a first glance at the map it would appear as though those river valleys offered good routes from the Gulf of Cambay to the Ganges basin, but we shall learn later that this is not the case in their lower courses, on account of the dense forests which are found there. The easiest natural route across the western Ghats is south of the Nilgiri hills (see Fig. 43), where the Palghat Gap, about 1,000 ft. above sea level, forms a natural means of communication between the Malabar and Coromandel coasts.

In the north-west of the Deccan there are large areas covered with a very rich black soil, made by the decomposition of the basalt rock which is found in that region. This soil can hold moisture long after the rains have ceased, and as it is much used for the production of cotton, is often called "the black cotton soil of the Deccan."

CLIMATE.

The greater part of India has what is known as a monsoon type of climate—that is, the rain falls mainly in summer. We have seen that this is due to the position of India on the fringe of a great land mass which is greatly heated in summer and cooled in winter, so that, at the former season, winds blow from the oceans towards the low pressure areas on the land, and during the latter season from the high pressure areas situated over the land towards the ocean, where the pressure is less. We must now go into more detail. The great mountain barrier to the north of India is a climatic as well as a physical barrier. The winter, or cool season, winds of India blow from the north-east,

and those of summer from the south-west, but it does not appear that the former have come from the heart of the continent, or that the latter are making for the large low pressure system north of India. Fig. 38 gives temperature maps for January, May, July, and

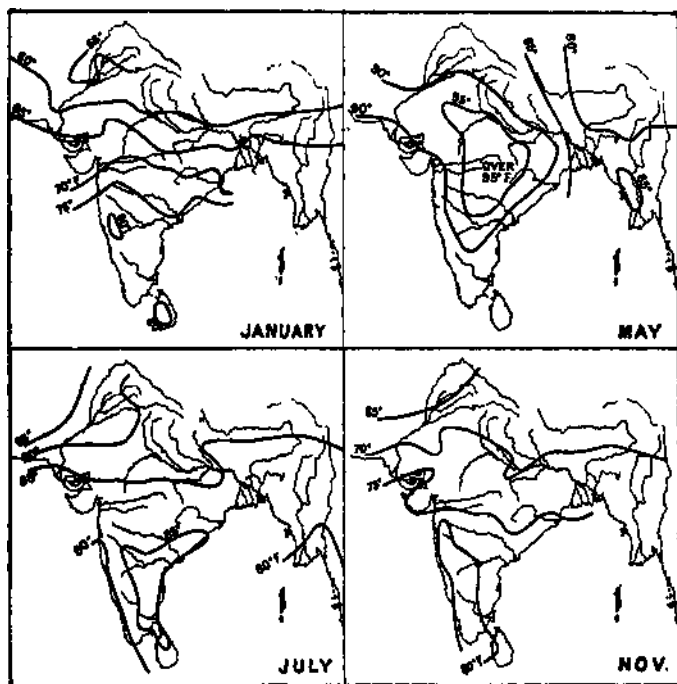


FIG. 38.—India. Temperature maps.

November. It will be seen that the coldest part of India in January is in the north-west, *ie.* the lower Indus basin and the Thar desert. Between January and May the heat is gradually increasing, until at the end of May the region of greatest heat is the centre of the peninsula. At this time of the year the sun is seen overhead at noon in the northern hemisphere nearer

and nearer the Tropic of Cancer every day, so that, in July, the region having the highest temperature is the same area which was coldest in January. This, of course, means that this region is a centre of high pressure in January, and of low pressure in July (see Fig. 39). Now it is from this local area of high pressure that India's winds blow in the cool season, and towards this area of low pressure that they blow during the wet season.

During January and February India has its *cool*

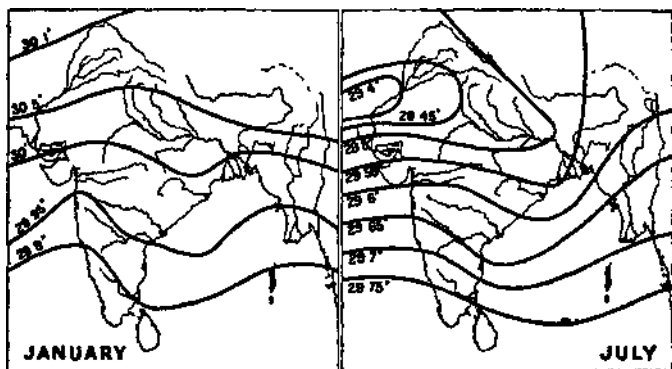


FIG. 39.—Pressure maps for January and July.

wather season, and in this month there is a movement of air from the north-west along the valleys of the Indus and the Ganges. Over the ocean these winds, obeying Ferrers Law, are deflected to the right and become N.E. winds—in fact, the N.E. Trades. Lying between the two great air currents, the Deccan, at this time of the year, receives few winds and is dry and dusty. March, April and May are the months of the *hot weather season*. The northerly migration of the sun causes India to be slowly heated, until at the end of May the heat, especially on the Deccan, is almost unbearable. The whole country is baked, the grass is

withered, even man languishes, and everything is ready for the coming of the monsoon. Some rain falls in the south and on the mountains, but in insufficient quantities to relieve the general state of depression. The region of greatest heat moves to the north-west, the winds of the earlier part of the year cease to blow, and, early in June, the monsoon winds reach Bombay. From June to October is the *Season of the South-west Monsoon*.

The coming of the monsoon is heralded by cyclonic storms of great violence, but they are soon over and calm reigns again, only to be broken by other storms, which usually occur about every fortnight. The periods of calm between the great storms are very important, for immediately following one of them the farmers put their plants in the ground (especially rice and indigo), so that they may be firmly rooted before the next storm arrives. What has really happened is, that the Doldrums low pressure area has moved as far north as northern India, so that the south-east Trades¹ cross the equator (see Fig. 40). Having done this, they are under the influence of deflection to the right, for they are now in the northern hemisphere. This great mass of air meets the wedge-shaped Deccan and we thus have one current proceeding into the Arabian Sea, the other into the Bay of Bengal. Under the influence of deflection the former current reaches the western Ghats, and is suddenly forced to ascend, and, since these winds have come over thousands of miles of water, the rainfall is tremendous. Indeed, so much is liberated that the winds continue eastwards across the Deccan as dry "Chinook" winds. • It is owing to this fact that the Deccan is indifferently watered, and is often troubled by famine. This danger has been somewhat mitigated by the construction of tanks of reservoirs for the storage of water. It must also be noted that the full force of the south-west winds is not felt north of the Gulf of Cutch, so that even at this season little rain is brought to the lower Indus basin, whilst, owing to the low elevation of this region,

there is less precipitation from those sea winds which it does receive.

The air currents passing up the Bay of Bengal water the greater area. Some of the winds blow towards the hills of Assam, and enormous quantities of rain fall there, Cherrapunji having a world's record—a mean annual rainfall of 460 in., or nearly 39 ft. Other currents, making for the low pressure area in the north-west, pass along the Ganges valley, dropping rain all the way. Very gradually these conditions change, and November and December may be named the *Season of*

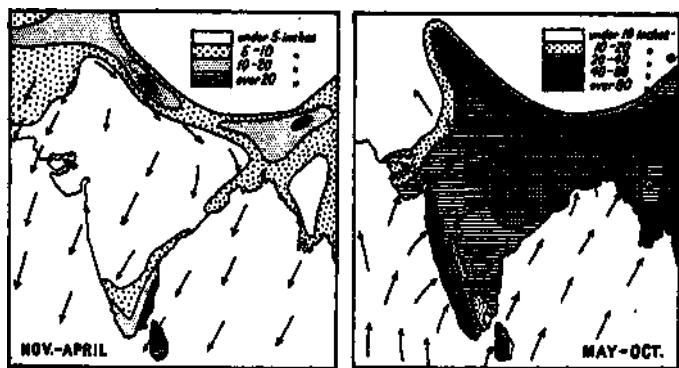


FIG. 40.—India. Winds and rainfall.

the Retreating Monsoon. The north-east winds begin to gain control in the north, and the south-west winds retreat farther and farther south; but before they finally disappear they bring rainfall to the south-eastern margin and to Ceylon.

Dividing the year into two periods, it will be seen that the drier six months are from November to April, and the wetter from May to October (see Fig. 40). All the rain which falls in the latter period is brought by the summer monsoon. From November to April, the greater part of India receives little rain because (except for the rain which is brought by the receding

monsoon) the only parts receiving winds from the ocean are the south-east and Ceylon.

NATURAL VEGETATION AND CULTIVATED PLANTS.

NATURAL VEGETATION.—The kind of vegetation a country has depends chiefly upon two factors—temperature and rainfall. As regards the former, we have seen that India may be said to have a hot climate. As regards rainfall, that of the Western Ghats, the Himalayas and the mountains of Assam and Burma is very heavy, resulting in dense forests on their lower slopes. Teak is one of the most valuable of the forest trees, and elephants are cleverly trained to move the heavy logs from place to place.

Of course elevation has a very important effect on natural vegetation. This may be illustrated from the vegetation of the Himalayas (see Fig. 41). The foothills are bordered by the swampy, malarial region known as the Terai, which in parts, especially in the wetter east, is wild jungle. Up to about 3,000 ft. the vegetation is tropical, and tall ferns, bamboo, teak and sal are found. From this elevation to about 7,000 ft. magnolias, oaks and chestnuts abound, and all are festooned by long convolvuluses. Forests of this type give way to gigantic conifers such as pines, firs and cedars, which are found up to an elevation of about 12,000 ft. Beyond this the trees disappear, and pasture lands, the Alp of the Himalayas, are met with, as well as fields of beautiful flowers. The pastures become poorer and poorer, and gradually merge into vegetation of the tundra type before the snow line (about 16,000 ft. on the southern slopes) is reached.

The monsoon winds also blow up the valleys of the Narbada and Tapti, and the heavy rains which fall account for the dense forests in the valleys of these rivers. The delta of the Ganges-Brahmaputra, the Sundarbans, is also a densely forested swamp, inhabited

by tigers, deer, wild boars, enormous crocodiles and reptiles. Much of Ceylon is forested.

On the borders of the desert of Thar there are considerable areas where, owing to the light rainfall, agriculture cannot be carried on, although it is possible to rear cattle, as the prevailing vegetation is that of poor grassland. Much of the Deccan is savannah, due

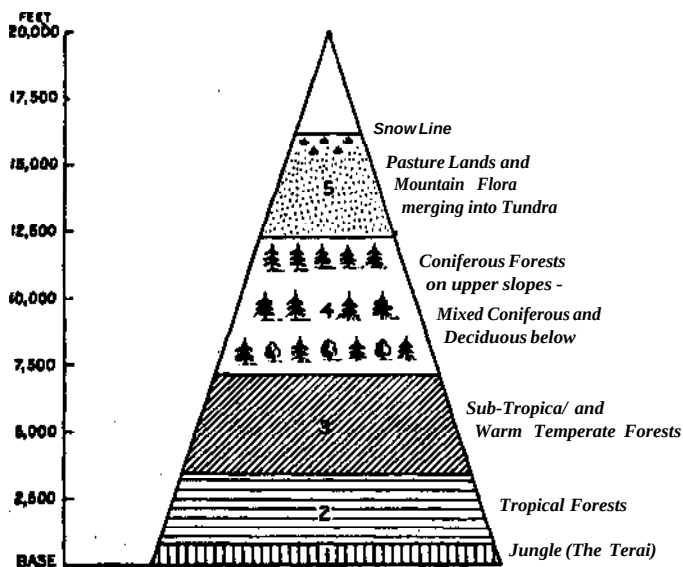


FIG. 41. -The vegetation belts on the southern slopes of the Himalaya Mountains.

to the lack of water, for it must be clearly understood that, as the greater part of India receives rain in summer only, forests will not be found in those places where the summer rain is not sufficient to keep the soil moist at all seasons.

CULTIVATION AND WATER SUPPLY.—Agriculture is by far the most important occupation in India, and since the type of climate to which that of this country belongs is

suitable for a great variety of plants, we have in India a very varied list of cultivated products. The great drawback is the occasional failure of the summer monsoons to bring an adequate supply of rains. When this occurs very serious famines are the result, and thousands of people die. In the areas which are indifferently watered it is absolutely necessary to practise irrigation if agriculture is to be successfully carried on.

In the Ganges valley, the low-lying lands of the delta and of the lower valleys of the two great rivers are so near sea-level that the land cannot be drained, and is actually too wet and swampy for full use to be made of it. Farther up the Ganges valley the land is a little higher, the rainfall is sufficient, and it is here that we have land most suitable for the production of India's chief product—rice. Proceeding towards the upper Ganges basin we come to an area where the rainfall is not sufficient for the needs of agriculture, and it is necessary to resort to irrigation, which has been carried on to such an extent that the whole region has been covered with a network of canals and pitted by thousands of wells. Continuing to the mouth of the Indus we cross the poorer grasslands, already referred to, and the arid lands of the lower Indus. But even here a great barrage has been built across the Indus just below Sukkur, where the river is a mile wide. The water held back by the barrage irrigates an area as large as the six northern counties of England.

In recent years many irrigation canals have been constructed in the Punjab, which is situated in the upper valley of the Indus, and is drained, as its name implies, by five great rivers, the Indus and four important tributaries. Some of these canals carry more water than the Thames at London, and all have enormously increased the area which can be used for production, although it must be borne in mind that irrigation has long been practised in this part of India.

In many parts of the Deccan it is also necessary to store water for use in the dry season, and this is done

in great tanks and reservoirs. At Bhatyar, about 30 miles south of Poona, the famous *Lloyd Dam*, one of the largest in the world, holds back a lake 17 miles long and supplies irrigation canals with water for an area of over 1,300 square miles.

CULTIVATED PLANTS.—Fig. 42 shows the distribution of the leading vegetable products of India. It will be seen that *rice* is grown chiefly in the well-watered lowlands of the Ganges basin and along the coastal plains bordering the Deccan and eastern Burma. Rice requires a high temperature, and must be planted in fields that can be easily flooded to a depth of several inches at certain stages of its growth. On deltas and the banks of rivers flowing over plains this is not difficult. In other places the fields must be flooded by means of irrigation canals or wells. Some kinds of rice can be cultivated on uplands, and require less moisture, but the hill rice produced in India is very small in comparison with the swamp variety. Rice is very exhausting to soil, so that it is of necessity most cultivated where the summer floods cause rivers to spread fertilizing silt over their low-lying lands. One other point must be noted. Rice is exceedingly prolific and a great amount can be produced on one field, especially as more than one crop can be obtained from the same ground during one summer. Now rice forms the chief article of food in south-east Asia, and it is partly owing to the great quantity which can be produced that the plains of this part of Asia are densely peopled. In India the best rice is grown in the area for which Patna, on the Ganges, is the centre. *Millet*, extensively grown as a food grain, is generally confined to those regions which, on account of lack of moisture or too poor soil, are not suitable for rice or wheat. Its distribution is shown on Fig. 42. *Tea*, like rice, requires considerable heat and a heavy rainfall, but, unlike rice, its roots must not be water-logged and the soil must be well-drained. It is, therefore, grown on hill slopes and on well-drained plains. It is a very hardy plant, and is able to withstand even winter frosts. Most of the tea

INDIA AND CEYLON

imported into the British Isles is produced on the hills of Assam and Ceylon. Darkling, situated on the slopes of the Himalayas, between the independent states of Nepal and Bhutan, is the centre of an important tea-producing region. *Coffee* cannot thrive in places where the winters are severe, and is, therefore, chiefly grown in southern India and in Ceylon, although in the latter island it has made way for other products in recent years. We have left wheat until last of the food crops because it is grown in India as a winter crop. Now India receives little rain in winter, so it is evident that much of the water required must be obtained by irrigation methods, although it is the rule to plant the seed just before the summer rains cease. The sunny cool season brings the crop to fruition, and it is generally harvested in February or March. The chief wheat producing areas are the Punjab and the well region of the upper Ganges.

Cotton is also a very important product. As will be seen from Fig. 42, its cultivation is confined chiefly to those parts of the Deccan which are covered by the fertile black soil (see p.133). This soil is especially suitable, for it can hold moisture even after the monsoon rains have ceased. The climatic conditions suitable for cotton are long, very warm, moist summers. Indian cotton is exported from Bombay, which is also a rising cotton manufacturing centre. Jute is one of India's most valuable exports. It requires a hot, damp climate, but the rainfall must not be too heavy, and, like rice, it exhausts soil very rapidly. For these reasons its cultivation is confined to the lower valleys of the Ganges and the Prahmaputra, and to the Sundarbans, for these areas are fertilized naturally by the river floods. One result of the production of jute in this part of India has been to make Calutta a very important jute manufacturing city. *Flax* is very largely grown, and oil seeds form one of the chief exports of the country. In hot countries like India, the fibre does not develop sufficiently well to be used for manufacture, but the seed (linseed) is more abundant than in temperate countries, in which the fibre is of more

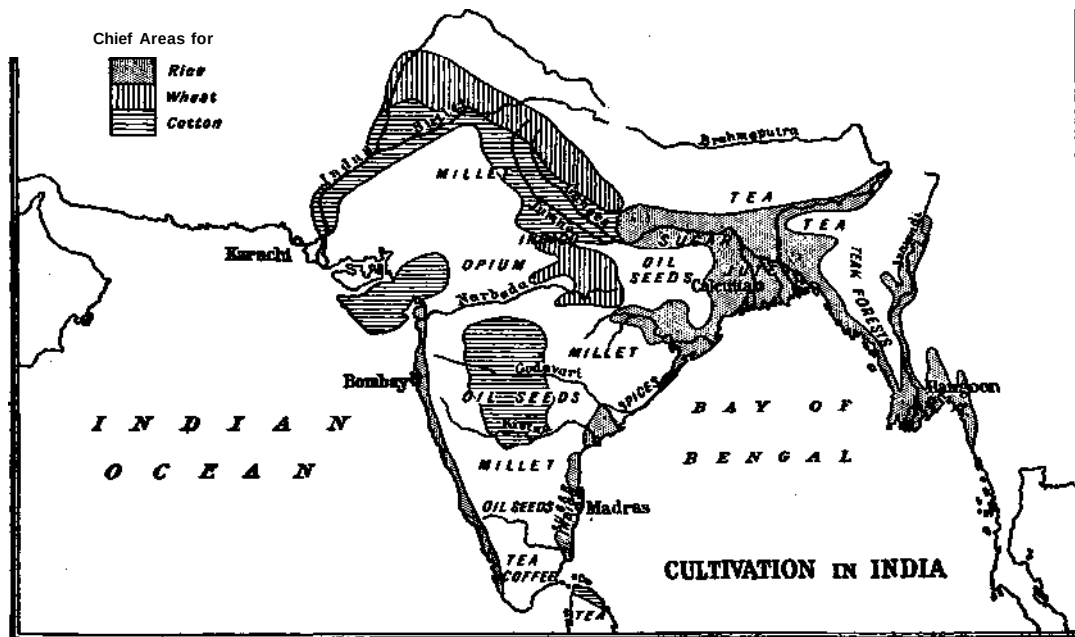


FIG 42. Cultivation in India.

INDIA AND CEYLON

value than the seed. The seeds are exported and used in the manufacture of linseed oil.

Indigo and *opium* are also produced, but not to the same extent as in former years. From the indigo plant a blue dye can be obtained, but since the discovery and manufacture of chemical dyes the demand for indigo has fallen off considerably. Opium, made from poppy seed-pods, is largely exported to China, but during the last few years the Chinese Government has taken commendable steps to stamp out the evil habit of opium smoking, and a large decrease in imports from India has been achieved.

CEYLON.

Ceylon produces *rubber* and *cinchona*, which have been introduced from South America with conspicuous success. Rubber is cultivated on the lowlands, and cinchona, from which quinine is obtained, on the hill slopes. Other products of Ceylon are coconuts, cacao and cinnamon, but tea, already mentioned, is its chief export. As will be seen, Ceylon's products are those of a more equatorial type of climate than those of India, and it is on this ground that it is included with the South-Eastern Archipelago in the classification of natural regions (see Fig- 30).

.MINERAL WEALTH.

Mining occupations are relatively unimportant in India. The chief minerals obtained are coal, iron ore, manganese ore, gold, silver and petroleum. In the Chota Nagpur plateau, west of Calcutta, 90 per cent, of the coal mined in India (normally from 20 to 25 million tons per annum) is found. Coal from this area is used in the Calcutta jute factories, in local industries and on the railways; but much has to be imported. India is rich in iron ore, but very little is found near the coalfields. Ninety-five per cent, of the gold output comes from the Kdar gold-field, situated some 40 miles north-east of "Bangalore. India is one of the world's chief producers of manganese ores, which are mined in the Central Provinces and ex-

ported unsmelted from both Calcutta and Bombay. Manganese ores are used in the manufacture of steel.

THE TRADE OF INDIA AND CEYLON.

As most of India's products are of an agricultural nature, we are in a position to discuss the trade of India at once. In order of value the most important exports are cotton, jute, rice, tea, oil-seeds, and wheat and flour. The chief customers are Great Britain, Japan, the United States, Germany, Italy and France.

The chief imports are manufactured cotton goods; metals and ores; machinery, railway plant and hardware; and sugar. Great Britain, Japan, the Dutch East Indies, Germany, and the United States are the chief places traded with.

Ceylon is governed separately from India. The island's chief exports are tea, rubber, fresh and dried coconuts and coconut oil, and copra. The leading imports are rice, cotton goods, coal and coke, sugar, and fertilizers. As in the case of India, Ceylon buys from and sells to Britain more goods than she buys from or sells to any other country.

EXERCISES.

1. Describe the belts of vegetation on the southern slopes of the Himalayas. Why is the snow line on the Himalayas (a) lower on their southern than on their northern slopes; (b) higher than in the Alps? Draw diagrams to illustrate your answer.

2. Divide India into physical units, and write a short descriptive account of each.

3. Explain clearly, using diagrams or sketch maps in illustration, why India has most of its rain in summer.

4. Obtain copies of the monthly charts of the Indian Ocean (Meteorological Office) and on outline maps of India, mark the winds shown on the January and July charts. Account for the leading differences between **the** two maps.

MEAN MONTHLY TEMPERATURE IN DEGREES FAHRENHEIT.

Stations	Height in ft above sea-level,	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
Bombay .	35	74.5	75	78	82	84.5	82.5	79.5	79	79	80.5	79.5	76.5	79
Calcutta .	18	65	70.5	79.5	85	85.5	84.5	83	82.5	82.5	80	72.5	65.5	78
Madras .	10	75.5	76.5	79.5	84.5	88.5	88	84.5	84.5	82.5 84	8x	77.5	75.5	82

MEAN MONTHLY RAINFALL IN INCHES.

	Jan.	Feb.	March	April	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec	Total for Year.
Bombay	.1	0	0	0	.5	20.5	24.6	15.0	11.0	1.8	.3	0	74.0
Calcutta	3	1.0	1.1	1.5	9.5	11.0	12.3	12.7	10.4	V9	.6	.3	64.6
Madras .	7	.3	.4	7	2.0	2.0	3.8	4.6	4.8	11.0	13.3	5.2	48.9
Cherrapunji .	7	2.2	11.1	32.3	52.0	106.0	110.0	77.0	53.5	14.0	15	.2	460.5

5. Represent the above statistics graphically, and in writing point out and account for their leading characteristics.

6. Write a short account of the physical features and climate of Ceylon.

7. Why is it that Lancashire textile manufacturers are far more interested in Indian trade than their Yorkshire neighbours? Why has Lancashire's export trade to India greatly declined in recent years?

8. "India's chief imports are manufactured goods and the chief exports agricultural products." Verify this statement by **reference** to **the Statesman's rear Book**.

9. From what country does India import sugar? What does India buy from Japan? Why are these articles not bought from Britain? Why is rice the chief import of Ceylon?

10. How does the government of India differ from that of Ceylon?

CHAPTER XIV.

INDIA AND CEYLON.

1. COMMUNICATIONS, CITIES-AND PEOPLE.

DURING recent years India's commerce with the outside world has developed very greatly, and this is in no small degree due to the construction of railways. Formerly, rivers had been the chief means of communication, but these were not of great value, except in the rivers in the Ganges system. Neither were there good roads, as in the Indo-Gangetic plain there is a great absence of road-making materials, and in other parts the irregularity of relief, and the fact that many roads become impassable during the rainy season, also prevented much intercourse. The chief beasts of burden are elephants and humped cattle, and they offer a very slow and expensive means of transport. Thus it was that the making of railways made many changes and especially gave a help to trade. The railways, however, were not built solely from the commercial standpoint, but in case of serious trouble to give the means of carrying soldiers from one part of India to another in as short a time as possible, and also to render it much easier to relieve distress in times of famine. Before they were made it was not uncommon for large numbers of people to die of starvation before help could arrive. Fig. 43 gives the chief railways of India marked on a map which shows relief. There are many railways besides these, but unfortunately the gauges upon which they have

be constructed differ very considerably, and as this prevents through running, it is a serious disadvantage.

As most of the chief cities of India are on these

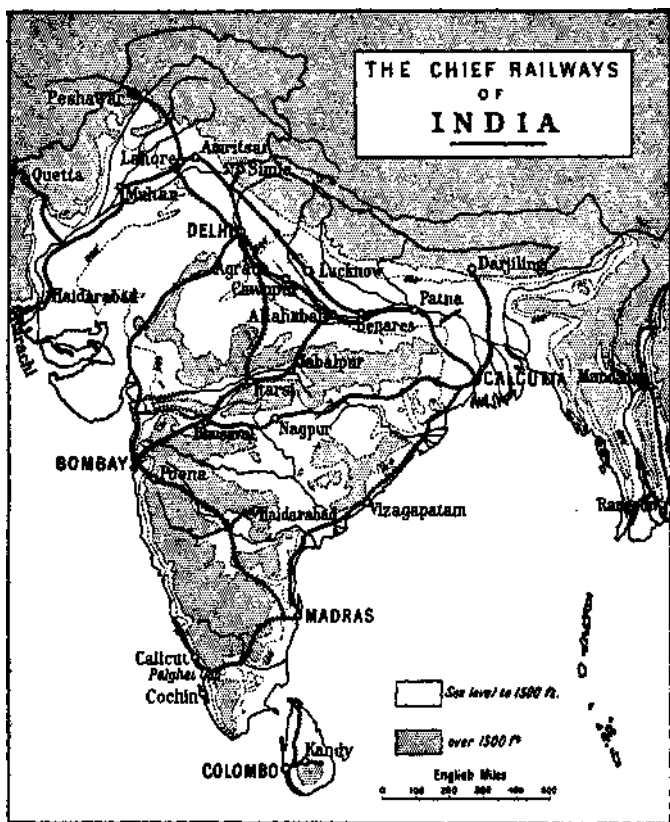


FIG. 43.—India. Relief and chief railways.

railway routes, we can learn about them whilst following the railways. There is one very important caution to be given here. The railways of India are comparatively

recent constructions, but all of the cities we shall mention were in existence long before the railways. It is, therefore, clear that the latter had nothing to do with the fixing of the sites of these places, and that we must look for other explanations of the question, "Why is this large city here?" Of course, many of them have greatly increased in importance owing to the making of railways, especially those situated at junctions, and the ports which have been brought into closer connection with their hinterlands.

Let us begin at *Calcutta*. It is built on the Hugh, a distributary of the Ganges, is eighty miles from the sea, and is the outlet of the rich Ganges lowlands. There is a great contrast between the European part of the city with its splendid buildings and wide streets, and the native town with its narrow streets and dirty brick houses. Within the last few years *Calcutta* has become the centre of a very important jute manufacturing industry. This, of course, is based on the large amount of jute grown in this part of India (see Fig. 42).

Leaving Howrah, on the opposite side of the river, the East Indian Railway traverses the plains of the Ganges, passing through Patna, Benares, Allahabad, Cawnpore, Tundla and Delhi. *Patna* is the centre of a rich rice-growing region, and also manufactures opium. *Benares* is the most sacred city of the Hindus, and is dependent chiefly on the large number of pilgrims who visit it. It is built high above the river, to which the descent is made by a series of wide, well-built steps. The chief objects of making a pilgrimage to Benares are to worship in the temples and to bathe in the sacred waters of the Ganges. The steps leading to the river from the temples and the palatial buildings for the reception of priests and pilgrims are never empty. From early morning until night there is a continuous throng of bathers, who come from all parts of the country. *Allahabad* stands at the junction of the Ganges and its chief tributary the Jumna,, a position which made it important before the construction of railways. It is now a great railway

centre, for it is at the junction of the railways from Calcutta, Bombay and Peshawar. It manufactures cotton goods. Cawnpore, on the Ganges, has become a modern manufacturing town, making cotton and leather goods. It will always be remembered as the scene of the horrible massacre which took place there during the Indian Mutiny.

We do not pass through the important cities of Lucknow and Agra, but this is the most convenient point to notice them. Lucknow, on the Gumti, is also remembered in connection with the prominent part it took during the Mutiny. It was the ancient capital of Oudh, and was formerly famous for its native manufactures, particularly of chased gold and silver, Agra, on the Jumna, is situated in a very rich agricultural district. It was formerly one of the chief cities of the Mogul Empire, and possesses some splendid monuments of the Mogul rule, the most beautiful being the famous Tai Mahal, which is esteemed the finest work of art in India, This magnificent building was erected in 1719 by Shah Jehan in memory of his wife, and, as its name implies, is a mausoleum and a palace.

Farther up the Jumna from Agra is Delhi, since 1912 the capital of India. The map will show that it stands at the eastern edge of the higher land (known as the Delhi ridge), which forms the watershed between the Indus and Ganges tributaries. It is also in the comparatively narrow gap between the Thar desert and the Aravalli Hills on the one side, and the Himalayas on the other. For these reasons, Delhi is well situated for control over both great river basins of northern India, and was the capital of several earlier empires than the British.

The reasons which prompted Britain to make an inland city the capital, instead of Calcutta which had been established by British sea-power, may be briefly stated as follows—

(1) For the reasons already given, Delhi is held in great reverence by Hindus.

(2) Its central situation between the populated Punjab and the Ganges plain, and the ease with which railway

communication can now be established with all parts of India, have made it a good centre for the seat of Government.

(3) During the hot season, the Viceroy moves his residence to Simla, a Himalayan hill station, north of

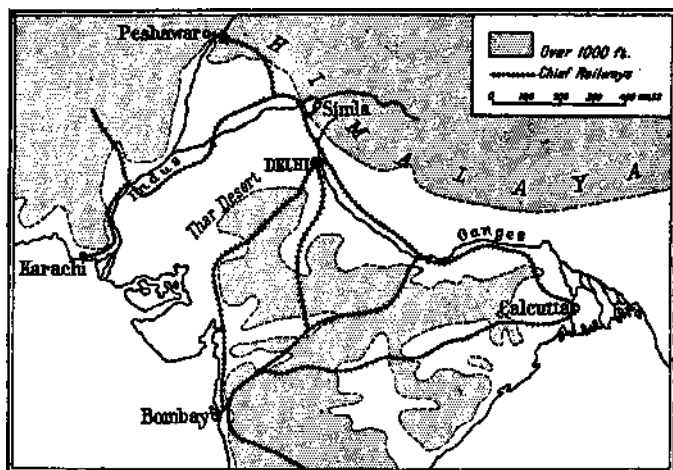


FIG. 44.—The position of Delhi.

Delhi. Now Calcutta is not so healthy as Delhi, and consequently it will not be necessary for the Viceroy, and, of course, a large number of officials, etc., to be absent from Delhi for so long a period as from Calcutta. Another evident advantage is the proximity of Simla to Delhi (see Fig. 44).

Delhi contains many reminders of the great part it has played in Indian history, from its ancient mosque and fort to its walls, which show the effects of the bombardments endured during the Mutiny. In modern days it has become an important cotton manufacturing town, and factory chimneys now darken the sky.

Continuing our journey to *Peshawar*, the next important town we should pass through is *Amritsar*. We are now in the basin of the Indus. *Amritsar*, a sacred city of the Sikhs, is one of a line of cities situated on or near the Indus tributaries in the wetter belt near to the base of the Himalayas. *Lahore*, about a mile from the left bank of the Ravi, is another of these towns. Fig. 43 shows that it is an important railway centre, for besides being on the great Calcutta—Peshawar trunk route, it is on a line which runs south-west to Karachi, near the mouth of the Indus. It is the largest city in the Punjab, and is the centre of a region producing great quantities of wheat. From Lahore we continue our journey to *Peshawar*, which is not far from where the Indus leaves the mountains for the lowlands, but the most important factor in its situation is, that it is on the Kabul river, near the entrance to the famous Khaibar Pass, which leads to Kabul, the capital of Afghanistan, and beyond Kabul to the plains of Turan. It is on account of this that it is strongly fortified.

Let us now return to Lahore, and from that city trace the North-Western Railway (by which the journey between Peshawar and Lahore is made) as it follows the Ravi towards *Multan*, a city so placed as to be near the confluence of the Punjab rivers. It is also on the margin of the desert of Thar. These factors have made it a good collecting centre for the wheat grown in the Punjab, as well as a meeting-place of important routes. Leaving Multan, the railway follows the Indus, which receives no large tributaries in its lower course, and runs to *Karachi*, the chief port for the produce of the Indus delta, and for the Punjab wheat. Note its situation to the west of the delta. This line has an important branch which goes a little beyond *Quetta*, a fortress city guarding the western entry to India, by way of the Bolan Pass.

Now let us consider the routes which radiate from *Bombay*, now the largest city in India. The city is built on an island, and the passage between the island and the mainland gives a splendid natural harbour.

Although England has owned Bombay since the days of Charles II, it was the opening of the Suez Canal which made it of first-class importance, for it is in a very favourable position for trade with Europe. We have learned that the Western Ghats present a very steep face to the Arabian Sea, and it will at once be seen that the construction of railways from Bombay to the Deccan was no light task. But the growth of Bombay depended upon means of quick communication with Calcutta and the Ganges basin, and a railway, which climbs the Ghats by a very difficult zigzag course, reaches both Delhi and Calcutta, whilst another follows the coastal plains northwards via Surat, and continues its journey between the Aravalli hills and the south-eastern edge of the Thar desert to Delhi, the capital (see Fig. 43). Now let us learn something of the commercial importance of Bombay. It is the largest jrgiton-manufacturing town in India, and this is owing to its proximity to the Deccan cotton-producing region. It also exports most of the raw cotton which is sent to other countries. Cotton manufacturing is quite an ancient industry in many parts of India, some of the cloths produced being noted for their very good quality. But in Bombay, huge modern mills, such as are found in south-east Lancashire, have been erected, and give employment to large numbers of people, although if the numbers employed in the three hundred and two cotton mills which India possessed in 1934 be compared with the number of cotton spinners and weavers exclusive of those working in the factories, it would be seen that less than one-tenth of the cotton workers in India are found in the big mills.

Leaving Bombay by the Great Indian Peninsular Railway, the train climbs the zigzag line on its way to the Deccan plateau. Passing through *Bhusaval*, the junction for Calcutta via Nagpur, and *Itarsi*, where the main line proceeds to Delhi via Agra, the more northern route to Calcutta follows the Narbada to *Jubbulpore*, an agricultural centre in which several cotton mills have been

recently established. From Jubbulpore the East Indian Railway system continues the route to Allahabad, and beyond to Calcutta. *Nagpur*, on the shorter route between Bombay and Calcutta, is another town owing its modern cotton mills to the cotton-producing region in which it is situated. The importance of these two lines between Bombay and Calcutta is very great indeed, for by means of them passengers and mails can reach Calcutta much sooner than if the journey had to be made entirely by water.

Another section of the G.I.P. Railway runs south-eastwards via Poona, traverses the Deccan, and after making a junction with the Madras railway, runs into *Madras*. Poona, in modern times, is to Bombay what Simla and Darjeeling are to Delhi and Calcutta. It is a hill station where Europeans may find the summer climatic conditions less oppressive than in Bombay. *Hyderabad* is reached by a branch line (see Fig. 43). It is the capital of a native state of the same name, and is ruled by the Nizam. Hyderabad state has more people than any other native state, and its capital is the fourth largest city in India, having a population of rather less than half a million. *Golconda*, near by, is noted for its diamond mines.

Madras, the third city in India, was one of the earliest British settlements, and it was from there that British influence spread westwards to the Deccan. It is the port for the rich plains of eastern India which produce great quantities of rice. As a port it is greatly hampered by not having a natural harbour, for it stands on a surf-beaten coast. Madras is connected with Calcutta by a line which follows the coast plains, and with the west coast by the Madras Railway, which utilizes the Palghat Gap, the only break in the Western Ghats between the mouth of the Tapti and the extreme south of India. The small port of *Calicut*, once a Portuguese trading settlement, controls the gap.

The large and important native state of Kashmir is not served by railways. It lies up in the western

Himalayas, and owing to its elevation, has a climate entirely different from that of other parts of India, as it is free from the great summer heat of the Deccan and the northern plains, whilst it is not so cold and bleak as the plateaux of Pamir and Tibet. It is crossed by lofty mountains, and contains many deep valleys, the most important of which is the vale of Kashmir, the upper valley of the Jehlam, one of the Punjab streams. The capital is *Srinagar*, which produces the famous Kashmir shawls, made from goats' hair. From this city, caravans start for Leh, and from there cross the Karakoram Pass on their way to Chinese Turkestan.

In Ceylon a railway has been built from Colombo to the north of the island, whilst a branch climbs to Kandy, the old capital. The journey from Colombo to Kandy takes about four hours, and the traveller is treated to a delightful series of everchanging views, for in that short space of time he is transported from the tropical heat of Colombo to the cooler temperature of the mountains. *Qglambo*, the capital and chiefport of Ceylon, is situated on a splendid artificial harbour, protected from the south-west monsoon by breakwaters. It is on the west coast, and is not only important as the port for the valuable products of Ceylon, but is a Port of call on the great routes from Europe, via the Suez Canal to Calcutta, Singapore, and the Far East on the one hand, and to Australia on the other. It has also a considerable trade with East and South African ports (see Fig. 45).

In Burma two railways leave Rangoon, one following the Irawadi, and the other striking northwards and reaching the same river at Mandalay (see Fig. 43). The latter is the more important. Notice that these railways follow the general north and south direction of the mountain ranges and rivers of Burma. In Upper Burma, where the river valleys are narrow, the chief source of wealth lies in the extensive forests of teak. Rice is easily the most important product of Lower Burma, and it is from this part of India that most rice

is exported. *Rangoon*, on the Irawadi delta, is the great port for rice and teak. Perhaps the most wonderful sight in Rangoon is the immense Glden pagoda which contains many temples and a number of gigantic and richly jewelled images. Temples are very common in Burma, where the prevailing religion is Buddhism. *Mandalay*, the chief city of Upper Burma, is the centre of the interior lowlands. It is the old capital and

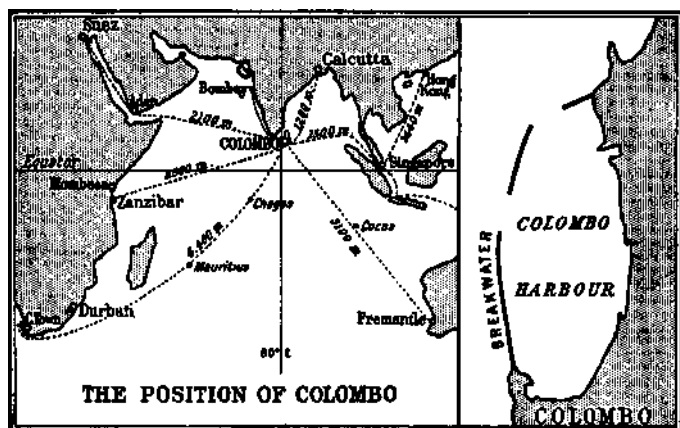


FIG. 45.—Colombo.

contains splendid pagodas and shrines dedicated to the worship of Buddha. Upper Burma produces the finest rubies in the world, the chief mining centres being in the mountains to the north-west of Mandalay.

2. THE PEOPLE OF INDIA.

India is essentially an agricultural country, and this has important influences upon the distribution of the population. In 1931, India had a population of 353 millions, that is, seven times as great as that of the United Kingdom in the same year or nearly three times

as great as that of all the British Empire without India. In the same year, the population of Ceylon was nearly five and a half millions. Despite this enormous number of people, there are only thirteen cities in India and one in Ceylon which have a population of more than 250,000. The vast majority of the people live in villages. Bombay (1,161,383) and Calcutta, with Howrah (1,485,582), are the only cities with more than a million inhabitants.

India includes not only districts subject to English law, but also native states. The latter are ruled by native princes, but in all cases the Indian Government is represented by an agent or resident. Over four-fifths of the people live in those parts directly ruled by the Indian Government. British India, as the result of administrative changes in 1912, is now divided into fifteen provinces, particulars of which are given below—

	Province.	Area in square miles.	Population at 1931 census.
1	Madras	144,000	47i millions
2	Bombay	152,000	26½
3	Bengal	83,000	51
4	United Provinces of Agra and Oudh	112,000	50
5	The Punjab	105,000	24
6	Burma	234,000	14¾ „
7	Bihar and Orissa .	112,000	42¼ „
8	Central Provinces and Berar .	131,000	18
9	Assam	67,000	9¼ „
10	North-west Frontier Province	36,000	4¾ „
11	Aj mer-Merwara	2,700	½ million
12	Coorg	1,580	164,000
13	Baluchistan	135,000	869,000
14	Delhi	593	636,000
15	Andaman and Nicobar Islands	3,140	29,000

Fig. 46 shows the parts of India which are directly under British rule, the numbers referring to those given in the table above. Fig. 47 gives the distribution of the

population. By comparing the two maps, it is obvious that the majority of the people are directly ruled by the Government of India.

One other point must be noted from Fig. 47. The

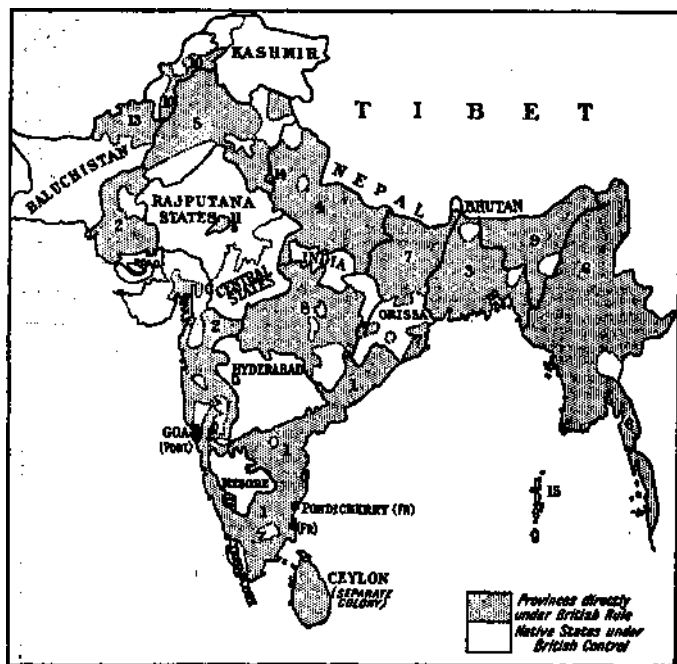


FIG. 46.—Map showing the Government of India.

bulk of the people are found in just those places we should have expected after our consideration of the relief, climate and vegetation of India. The greatest concentration is in the valley of the Ganges, the Punjab, and the east coast plain. The less productive parts, such as large areas of the Deccan and the Thar desert, support fewer people.

One interesting fact may be mentioned here. At the

census of 1931, English was the language of 319,000 people, of whom about one-third were of British birth. We have already pointed out that the climate of India is unsuitable for British immigrants, so that the English in India are chiefly traders, soldiers or officials who

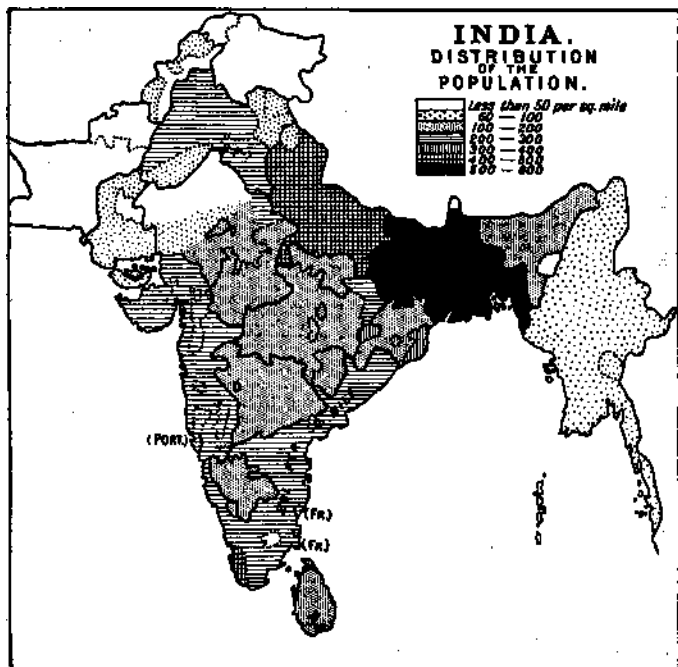


FIG. 47.—India. The distribution of the population.

are in the country for a term of years only. There is a constant change of officials and civil servants owing to retirement, etc., and it is largely owing to this that English rule in India has been so successful, for men never stay long enough to get stale, and new ideas, freshness, and greater energy are being constantly brought to the work of government.

Now let us learn more of the people themselves. India is so vast—nearly fifteen times as large as the British Isles—and has been entered by so many different peoples, some of whom settled in the land, that it is not surprising that many races and many religions are to be found. The descendants of the earliest inhabitants are found in the least accessible parts of the Deccan, in the swampy Ganges-Brahmaputra delta, and in Ceylon. They are darker skinned and smaller in stature than the people of northern India, whilst they speak languages which belong to quite a different group. They are called Dravidians, and it is thought that at one time they occupied the whole of India, but were pushed southwards and eastwards by more virile invaders, who probably entered India about 2000 B.C., by the great north-west gateways. These intruders were a taller, fairer race, quite different in appearance from the Dravidians, and akin to the people of Mediterranean Europe. They are known as the Indo-Aryans, and are best seen to-day in the Sikhs of the Punjab. The descendants of these early invaders are found in the north-west, nearest to the gateways by which they entered. In the upper basin of the Ganges, the prevailing type seems to be a mixed Indo-Aryan and Dravidian race, whilst in the lowlands, near the mouths of the Ganges and Brahmaputra, we find peoples of Dravidian blood.

Later, by the same north-western gateways, there came other conquerors, Darius of Persia and Alexander the Great, but their conquests were only temporary, and had little influence upon the people themselves.

During the first five or six centuries of the Christian era, continual inroads by steppe dwellers—Huns, Tartars and Scythians—occurred. Their plunderings were confined mainly to the north-west, for they met with opposition in the Ganges valley, but they appear to have settled in considerable numbers on the black earth lands of the Deccan, where they found a fertile land. In this area, even to-day, the predominant types appear to be

of mixed Mongol and Dravidian descent. Later, conquests by the Mohammedans took place. They, too, entered by the north-west gateways. They became very powerful, and established great empires, but they affected race very little, and except in the Punjab, they had also little effect upon the religion.

We learned in the last chapter that the approaches to India from the north-east are not so easy as those from the north-west. Many invaders have come, however, though in relatively small numbers, along the passes where the Brahmaputra enters India. These people were yellow-skinned, black-haired Mongols, whose descendants are still found in eastern India and in Burma, where the people are essentially Mongolian, and quite different from the inhabitants of India. In the lowlands of the Ganges-Brahmaputra, the Mongol immigrants mixed with the Dravidians, driven eastwards by the approach of the Indo-Aryans from the west.

The Himalayas form a great barrier, effectively preventing race migration into India from the north, except in small numbers. It is interesting, however, to notice that the people of Nepal and the Gurkhas appear to have crossed the Himalayas from Tibet. They are small, hardy people, and very fond of fighting.

This account of the people of India is, of course, not by any means complete, but it does show how the disposition of the chief races has been influenced by geographical conditions. All the invaders of whom we have learned entered India by the land routes, but we must not forget that India to-day is held by a nation whose approach was from the sea. In the seventeenth century, England, Portugal and France had coastal trading settlements, but it does not appear as though they thought of conquest at that time. At a later date the English made conquests from Madras and the French from Pondicherri. These places are on the east coast, where communication along the coastal lowlands and westward expansion to the Deccan are comparatively easy. Struggles between the English and **the French**

resulted in the victory going to the former. Living on the Deccan, east of Bombay, were the warlike Mahrattas, who extended their power northwards, and a struggle between them and the British for the possession of the Ganges plain was decided by the battle of Plassey (1757), in which the British were successful. Early in the nineteenth century, Delhi was captured, and this led to British power being established in the Indus valley, and to its final extension to practically the whole of the peninsula.

The Portuguese and the French still have trading stations, the most important being the west coast settlement of Goa (Portuguese), and the east coast settlement of Pondicherri (French).

Of the religions of India, little need be said here. Two-thirds of the people profess Hinduism, which is a most complicated religion. It appears to have as its basis the religious beliefs of the earliest inhabitants. The Aryan invaders adopted it, and largely added to it, but so complicated has it become that it differs considerably in various parts of the country, and is very often a strange mixture of superstition, elaborate worship of many gods, and the performance of innumerable duties and rites. Its distinguishing feature is the caste system. In the main there are four castes or groups, the Brahmans belonging to the highest, or priestly caste. All Brahmans are not priests, but may become so. All the leading professions are filled by Brahmans, who belong to their particular caste on account of birth alone. The other castes are the warriors, the farmers, and lastly, those who are neither Brahmans, warriors nor farmers. Those belonging to the lowest caste are regarded with great contempt by the others. The castes have many sub-divisions, so that to-day they number between three and four thousand. Each caste is commonly associated with some occupation, and since a man must follow the occupation of his father, the system exercises a very powerful influence over the people. At death, however, the soul

takes a higher or lower caste, according to the life the person has lived.

Rather more than one-fifth of the people are Mohammedans, who are found in all parts of the country, but in greatest numbers in the Indus basin, west of the Thar desert. They are the descendants of the Mohammedans who entered India by the great gateways of the north-west, between the sixth and the sixteenth centuries. The Mohammedan religion was founded in the sixth century by Mohammed, who was born in Mecca (see p. 125). It was called Islam by its founder, who wrote the sacred book, the Koran, in which he unifies the Arab worship of several gods, and taught, "There is one God, Allah, and Mohammed is His prophet."

In order of numbers the Buddhists come next, and they are found almost entirely in Burma, where the population is chiefly of Mongol extraction, and in Ceylon. This religion was founded by a man of the warrior caste who lived near the Ganges about six centuries before the birth of Christ. He was not satisfied with the state of Hinduism, and wished for a simpler religion. He taught that Nirvana, the final end of life, is to be reached by a life of self-denial and indifference to pleasure and pain. Such a belief has the effect of making its followers live quiet and peaceful lives, but is not helpful to national advancement. It is strange that to-day his religion is not followed in the land of its birth, but has its greatest number of followers in China.

These three religions, the Hindu, the Mohammedan and the Buddhist, are followed, more or less devoutly, by the great bulk of the people; but there are many others, such as those followed by the Parsis and the Sikhs, whilst there are about six million Christians.

We have seen that India is a large country, with a large population composed of many different races, and belonging to many different creeds. It is governed by a nation, the British, who are non-Indian in race and religion, who have entered the land by way of the sea, but

do not make it a permanent home. They have established law and justice, and have brought a considerable amount of prosperity, and there can be no doubt whatever that their rule has been of enormous value to India itself. As to the natives, although education is rapidly making headway, and large numbers have been advanced to administrative posts, the great bulk of the people are still unable to rule themselves. Experiments in self-government are being tried and are meeting with some success, but it will be a long time before the country as a whole is ready to guide its own destinies. The future holds many interesting questions for settlement, and among them, not the least important is, "Will India, like Australia and Canada, remain within the British Empire as a great self-governing dominion, or will she seek out her own salvation as an independent state?"

EXERCISES.

1. What geographical factors have given importance to the sites of each of the following Indian cities: Calcutta, Peshawar, Bombay, Madras, Allahabad, Delhi? Draw maps to illustrate your answer.
2. Draw a sketch-map to show the line of Punjab towns near the base of the Himalayas. Shade the high ground.
3. What factors affect the distribution of the population of India? Briefly describe the distribution.
4. How far are the routes of the chief Indian railways controlled by the relief of the land? Illustrate your answer by a sketch-map.
5. Draw a map to show the various sea-ways, land-ways, and air-ways from Britain to India.
6. "The great differences in surface and climate—much greater than those of Europe—with their consequent differences in racial habits and productivity of the soil, cause greater differences between a Pathan of the North-West Frontier and a Burman of Moulmein than between a Norwegian of Bergen and an Italian of Brindisi." Comment on this statement

CHAPTER XV.

INDO-CHINA AND THE EAST INDIES.

Natural Regions.—(i) Indo-China, with the exception of the southern Malay Peninsula, forms part of the Monsoon region. (2) The tropical islands of the East Indies.

INDO-CHINA.

Physical Features.—The name Indo-China is given to the large south-eastern peninsula which lies between India and China. A physical map will show that the mountain chains which traverse the peninsula from north to south are continuations of those of Eastern Tibet. The rivers Mekong, Menam, Salwin and Irawadi flow along little known gorges in their upper courses where the ranges come close together, but their lower courses occupy broad valleys. Three main series of chains can be traced in Indo-China. The eastern chain traverses Annam, the central chain lies between the Menam and the Salwin, whilst to the west of the latter river are the western ridges. A prolongation of the central chains forms the Malay peninsula. The rivers of Indo-China are swift flowing, and are loaded with sediment by means of which they have built up great deltas.

Climate and Products.—The climate of Indo-China resembles that of India, although there are naturally differences between the highlands and the lowlands; Most rain falls in summer, at which season the rivers

are often in flood, but Annam also receives rain from the north-east winds which blow in winter.

The vegetable products, too, resemble those of India. Rice, grown on the lowlands where water can easily be obtained for flooding the fields, is the most important crop, and forms the chief article of food. So much is grown that there is a large surplus for export. Coffee is grown on the hills of Annam, sugar in Annam and Cambodia, and in the hotter, wetter south, whilst rubber trees have been successfully planted in Cochin-China, which also produces pepper. In addition to these, the highlands, owing to the heavy rainfall, are densely forested, and teak forms an important export, especially from Siam.

Political Divisions.—The physical structure of Indo-China greatly influenced the formation of many independent native states, centred round the river lowlands, between which there was little communication on account of the mountain barriers which separate them from each other. Tongking occupies the delta of the Song-ka or Red River, Cambodia and Cochin-China are in the lowlands of the Mekong, Siam is largely the valley and delta of the Menam, Burma is the land of the Irawadi, whilst Annam is the narrow coastal plain between the eastern ridges and the South China Sea. In the upper courses of the great rivers are the Shan States, which, although owing nominal allegiance to England, China and Siam, are practically independent owing to difficulty of access. To-day France rules Tongking, Annam, Cochin-China and Cambodia in the east, Britain holds sway in the west, whilst between the possessions of these Powers there is the independent buffer kingdom of Siam.

The capital of Tongking, and since 1902, the capital of French Indo-China, is *Hanoi*, situated on the Red River about sixty miles from the sea. It is really a collection of many native villages and formerly was on the sea coast. Its present position so many miles inland illustrates the rapid growth of the river delta.

A railway has been constructed from Hanoi to Yunnan in south-western China, and has been the means of increasing the trade of Hanoi. One writer speaks of the natives of Hanoi as being very small, narrow-chested and thin-legged, and says their mouths are always stained, owing to their habit of chewing the areca-nut. He also declares that they are stupid beyond the power of words to tell. Hue, the capital of Annam, is a very poor port, and is situated on a coast which is dangerous for ships, owing to strong winds and storms. The government of Annam is administered by natives under the direction of the French Government. *Saigon* is the capital of Cochin-China. It has a good harbour and is connected by a waterway and railway—the first railway to be built in French Indo-China—to the Mekong. There is no very important town in Cambodia, but this country was once very powerful. The old kingdom had the large Lake Tonle Sap, which regulates the supply of water to the Mekong, at its centre, and its former importance is indicated by the extensive ruins which are to be seen there.

In passing it may be noted that the various governments of French Indo-China are unified under the control of a governor-general. Cochin-China is a French Colony (the other states are Protectorates) and is represented in the parliament at Paris by one deputy. There is a common budget for the whole of French Indo-China, and also a separate one for each state. The common budget deals with matters which concern the whole—customs, ports, telegraphs, defences, etc.

Bangkok, built nearly forty miles up the Menam, is the capital of Siam. Unfortunately the presence of a bar at the mouth of the river makes it impossible for large vessels to reach the city, which stands on the river, from which branch innumerable creeks or klongs. Bangkok has been called "the Venice of the East." The comparison fails in all points else except in the amount of traffic by water. One traveller says that there is no medium in Siam. One sees either gorge-

ously gilded palaces and fantastically adorned temples or filthy-looking huts. Bangkok offers no contradiction to this. The klongs, which are lined with shops and houses, have been compared with open sewers, full of garbage. The most famous building is the king's palace, in which there is a temple containing fabulous wealth in the form of a floor of silver, golden ornaments, statues of Buddha—the Siamese, like the Burmese, are Buddhists—altars glittering with precious stones, etc.

The people of Siam very much resemble the Chinese. It is probable that their ancestors came from China, and by gradual stages followed the Menam, eventually reaching its mouth, where they built Bangkok, their final capital.

West of Siam is Burma, which includes the basins of the Salwin and the Irawadi (see pp. 155-6).

MALAYA AND THE EAST INDIES.

PHYSICAL FEATURES.—The East Indies lie between Asia and Australia. We have learned in an earlier chapter (see p. 86) that Wallace's line separates those islands which are Australian in flora and fauna from those which are Asiatic. In this chapter we are concerned mainly with the Asiatic islands, although for structural reasons we shall take the boundary as lying east of the Moluccas and Timur Archipelago.

The archipelago is bounded on the west by the volcanic chains which traverse Sumatra, Java, and the smaller Sunda Islands (see Fig. 48). These are continued through the Moluccas or Spice Islands, and join the eastern volcanic chain (see p. 78) which passes through the Philippines. A continuation of the Malay Peninsula may be seen in the small islands of Banka and Billiton, east of Sumatra. Between this volcanic girdle and the mainland of Asia, Borneo stands on a continental shelf, and is separated from Celebes by a deep strait. Notice the peculiar shape of the latter island. It is evident that its lowlands have been drowned by

sinking. A physical map shows that Borneo would present a somewhat similar outline if it were to be submerged about 100 fathoms. Observe also the deep South China Sea between the Philippines and the mainland of Asia. This would suggest that the sinking which separated these islands from Asia took place long before that which detached Borneo. Owing to the western chains



FIG. 48.—The East Indies.

of islands forming a barrier, vessels from the Suez Canal and India proceeding to China and Japan must take one of two passages, either the Malacca Strait between Sumatra and the Malay Peninsula, or the Sunda Strait between Sumatra and Java (see Fig. 48). This has aided the growth of Singapore and Batavia.

CLIMATE AND VEGETATION.—NO part of this region is outside the Tropics. Since this means that every place will have the sun overhead on two occasions each year,

and that the sun will never be low in the sky, it follows that, except at high altitudes, the temperature will always be high. We have learned that these islands have rain at all seasons, and we have also seen that the rain belts follow the sun. Consequently we find that the equinoxes are the periods of heaviest rainfall in the parts of the region nearest to the equator, and that islands towards the northern margins, *e.g.* the Philippines, have most rain in our summer months, and those towards the southern margins, *e.g.* Java and Lesser Sundas, have their heaviest rainfall in the months of the southern summer.

One result of the climatic conditions is seen in the natural vegetation, which is of the equatorial type. The lowlands are often dense jungles, infested with snakes and wild animals. The vegetation of the volcanic islands, especially Java, is exceedingly luxuriant, partly due to the fertility of the volcanic soils.

THE INHABITANTS OF THE EAST INDIES.—Because the lowlands open to the sea, and the straits between the islands are not very wide, and are not as a rule visited by severe storms, the natives of the East Indies have readily taken to the sea, and there has been a great intermixture of races. It is clear that in such a region sea power is all important. On the other hand the lowlands, especially in Borneo, are separated from each other by mountain ridges, and there is often a lack of intercourse between the natives of the same island. One result of this has been the formation of several independent native states in the same island, the best example being seen in Borneo. On the whole the natives are very backward, and many of those who live in the little known interior regions and hill country are cannibals even to this day. The Malays, who are straight-haired Mongolians, resembling the Chinese in their oblique eyes, round heads and wide cheeks, are more numerous than peoples of other races. In religion the Malays are Mohammedans, and in temperament very much inclined to be morose and revengeful. There are also wavy-haired peoples of the

same race as the Dravidians of India as well as many very dark-skinned, woolly, or peppercorn-haired peoples of negro origin. Both of the latter types are small in stature, and are often so short as to be called pigmies. That descendants of diverse races should be found in these islands is probably due to the fact that the islands are on the "bridge" between continents, and the various races who have passed this connecting link have done something, however slight, to influence race.

POLITICAL PARTITION.—The Portuguese were the first Europeans to reach the East Indies, and they did so in the 15th century. They were closely followed by the Spaniards, who reached the islands by sailing westwards from Spam. The Philippines formed part of the Spanish possessions until 1898, when they were ceded to the United States. In the 16th century the Dutch established many trading settlements, and to-day their possessions are more extensive than those of any other Power. The British possessions are the Straits Settlements, the Federated Malay States and the British parts of Borneo, whilst all that remains to Portugal is the eastern portion of the island of Timor.

THE BRITISH POSSESSIONS.—These are in the Malay Peninsula and Borneo. In the Malay Peninsula there are the *Straits Settlements* and the *Federated Malay States*.

The Straits Settlements form a Crown Colony comprising Singapore, Penang (including Wellesley Province and the Dindings) and Malacca. The colony now includes the island of Lebuau, whilst the settlement of Singapore has been given the control of Christmas Island and the Cocos Islands. The most valuable of the Straits Settlements is *Singapore*, which owes its importance to its commanding position (see Fig. 48). It is an island about twenty-seven miles long by fourteen wide, and is separated from the Malay Peninsula by a strait about three-quarters of a mile in width. A causeway carrying railway lines has been built across the strait so that Singapore is now connected with the railways of the peninsula. The map shows that Singapore is situated at the

converging point of great ocean routes to and from India and the Suez Canal, China and Japan, and Australia. The port of Singapore has thus developed an enormous *entrepot* trade, and produce from all parts of the world may be found in its warehouses. The town is very cosmopolitan, having quite distinct European, Chinese, Javanese and Malay quarters. The Chinese are in greatest number, and carry on a large part of the port's trade. Besides being a great trading centre, Singapore is a strongly fortified coaling station, and possesses extensive dockyards. *Penang* is an island in the Straits of Malacca; *Wellesley Province*, the strip of mainland opposite; *the Bindings* comprise a small island and a strip of mainland, and *Malacca* another strip about forty miles in length and from eight to twenty-four in breadth.

Most of the trade of these settlements is done at Singapore, the chief articles exported being tin, sugar, pepper, nutmegs and other spices, sago, gutta-percha and rubber. Of these, rubber and tin far outweigh the others in importance and value. More than half the world's supplies of rubber and tin are produced in the plantations and mines of the Malay Peninsula. Of course during times of depression in the rubber and tin market the disadvantages of undue specialisation are severely felt in Malaya. To counter this every effort is being made to encourage the other industries.

Christmas Island and the *Cocos or Keeling Islands* are in the Indian Ocean, south-west of Java. The latter are coral islands covered by coconut palms, and the former possesses very valuable deposits of phosphate of lime. *Labuan* lies six miles from the north-west coast of Borneo, and is important on account of its coal mines, which supply the British warships on the China station as well as trading ships.

The Federated Malay States.—These are a number of native states which chiefly occupy the eastern portion of the southern Malay Peninsula. They are under British protection, the native rulers being advised or controlled by British representatives. *Perak* and *Selangor* are the

most important of these small states. As in Singapore, a large proportion of the inhabitants are Chinese who have emigrated to the peninsula in order to work in the tin and gold mines, and to supply labour in the fields. The agriculture is tropical, the chief cultivations being coconuts, rice, rubber, sugar, tapioca and pepper.

British Borneo,—The British possessions in this large island are *British North Borneo*, a territory under the jurisdiction of the British North Borneo Company; *Brunei*, a native state under British protection, and *Sarawak*. Sarawak is a native state whose head, Rajah Brooke, is an Englishman who rules under the protection of Britain. All have a very luxuriant natural vegetation, which differs with elevation, the coastal lowlands being covered with dense jungle, and the less known interior highlands with forests or savannahs. The chief cultivations are very similar to those of the Malay Peninsula. In addition, British North Borneo exports large quantities of tobacco, and Sarawak has rich deposits of coal and oil as well as some gold.

DUTCH POSSESSIONS.—These are more numerous and more extensive than those of any other nation. Although not the largest, Java, the "Garden of the East," is the most important, for by means of garden cultivation, the Dutch have made it the most productive and most densely peopled island in the archipelago. The total population of the Dutch East Indies is over sixty millions, and of these forty-two millions are in *Java*. This development has been helped by the great fertility of the volcanic soil and the abundant rainfall, as well as by the construction of railways and good roads. The range of products is very wide, but those for export are chiefly rubber, coffee, sugar, cinchona and tobacco, whilst the staple articles of food are rice and sago. The capital of Java is *Batavia*, which controls the Sunda Strait, between Sumatra and Java. In the chain of mountains which traverses Java from end to end, there are more than fifty volcanoes. The remainder of the Dutch East Indies have been little developed. Sumatra

and Dutch Borneo export pepper, coffee and tobacco; Celebes and the Moluccas are noted for spices. The Moluccas are the famous Spice Islands.

In the Sunda Strait is the volcanic island of *Krakatoa*, which was shattered in 1883 by the most terrible volcanic eruption of which we have any knowledge.¹ So tremendous was the outburst that a large part of the cone was blown into the air, and the site of the destroyed portion was occupied by water 1,000 ft. deep, whilst every vestige of life on the island was obliterated. A great water wave was caused, which spread all over the Pacific and Indian Oceans, and a great air wave passed three times round the earth. Prior to that catastrophe the volcano had been inactive for a century.

The Philippine Islands.—Discovered by the Spaniards, and named after King Philip II, these islands have belonged to the United States since the war with Spain in 1898. The group includes several thousand islands, the largest being Luzon and Mindanao. We have already learned that the Philippines form part of the great volcanic girdle of the Pacific. Throughout the islands destructive earthquakes are frequent, whilst they are often visited by terrific cyclonic storms called *typhoons*. These are accompanied by very heavy downpours of rain and by winds so strong that trees are uprooted and cities destroyed. The chief articles exported are tobacco, which is made into cigars (the only manufacture of importance); a fibre (Manilla hemp) obtained from a wild plantain very closely resembling the banana; copra and coconut oil; sugar and rubber. Rice is extensively grown for home consumption. The capital and chief town is *Manila*, which has the great advantage of being the point at which routes from Hongkong, Singapore, Australia and the west of the Americas meet. The map also shows that it is almost equidistant from all the chief ports of the mainland between Saigon and Foochow. It is the centre of the cigar manufacturing industry.

¹ See Book I of this series for the physical history of volcanoes.

EXERCISES.

1. What geographical conditions have aided the growth of Singapore, Manila and Batavia? Compare the relative importance of these ports. Illustrate your answer by sketch-maps.

2. "Both in Indo-China and in Borneo the configuration of the land helped to foster a large number of small independent native states." Explain this statement.

3. How far are the East Indies "Australasian," and how far "Asiatic"? Give reasons for your answer, and draw a map in illustration.

4. Give full reasons why Java is the most densely peopled island in the whole of the East Indies.

5. What difference would you expect to find between the seasonal distribution of temperature and rainfall at Manila, Singapore and Batavia?

6. Find out how many subjects the Queen of Holland has in (a) the motherland, (b) the Dutch East Indies? Comment on these figures. Of what value are the Dutch East Indies to the motherland?

7. Find out how the first rubber trees came to be planted in Malaya. Where did they come from? Why is the rubber grown in Malaya called Para rubber? Where is Para?

8. Describe three ways of travelling from Singapore to Bangkok.

CHAPTER XVI.

THE CHINESE LANDS.

THE Chinese Lands¹ cover a very large area, as they include Mongolia, Manchuria, Eastern Turkestan, and Tibet, as well as China Proper. The area of this portion of Asia exceeds four million square miles—larger than Europe—and has a population, probably, exceeding four hundred millions, although some authorities think that this is considerably overstated. At any rate 95 per cent, of the people are in China Proper, which includes less than half the area.

It is very evident that physical and climatic conditions will vary over such a large land mass, and although Fig. 30 shows that the area includes both desert lands and monsoon lands, we must recollect that the different parts of both the deserts and the summer rain lands vary considerably in elevation and latitude, and therefore in temperature.

We shall consider the Chinese Lands under two headings: (1) China Proper; (2) the outlying portions.

CHINA PROPER.

PHYSICAL FEATURES AND CLIMATE.—As the map will show, China is a country of high mountains opening to lowlands along the Pacific coast. The most extensive of these lowlands are in the lower valleys of the Hwang-ho and the Yangtse-kiang. China Proper is a very compact area, almost shut off from the rest of Asia by natural barriers in the form of (1) high, parallel, north and south ranges between China and

¹ The Japanese invaded China in 1937 and have occupied large areas. In this book temporary changes are disregarded.

India, (2) the high, inaccessible, desert-like plateaux of Tibet and Mongolia; yet easy of entry by land from the plains of Manchuria in the north, but most of all from the sea and along the great rivers. South of the Yangtse, China has a smaller extent of lowland than north of that river, but the land is not generally too high for settlement, although it naturally supports a smaller number of people, except in the plains bordering the rivers. Of the Chinese rivers, a glance at the map is sufficient to show that there are three rivers of outstanding importance, the Hwang-ho or Yellow River in the north, the Yangtse-kiang or Blue River in the centre, and the Si-kiang or West River in the south. (See Fig. 49.)

Turning to the climate, we are already familiar with the fact that China has a monsoon type of climate but important differences must be noted. In Chapter X (page 91) we have learned that owing to the differences of temperature, northern, central and southern China have temperate, sub-tropical, and tropical types of monsoon climate respectively. There are also differences in rainfall, as will be seen from a consideration of the following figures—

Place.	Lat. N.	Temperatures.		Rainfall in inches.				
		Coldest month.	Warmest month.	March- May.	June- Aug.	Sept- Nov.	Dec- Feb.	Total.
Peking	40°	23° F.	79	2'4	18'2	3'5	0'4	24'5
Hankow	30	38	83	17'6	19'9	8'9	4'3	50'7
Canton	23	55	83	17'6	29'2	14'8	3'9	65'5

These figures may be taken as typical of the three monsoon types. They show (1) that in all most rain falls in summer, although in Peking the early summer is drier than farther south, (2) that Southern China has a heavier rainfall than Northern China, (3) that for their latitudes all three towns have low winter tempera-

tures. The latter fact is accounted for by the cold winds which blow at that season.

Taking the three towns as typical of Northern, Central and Southern China, we may see from the figures that

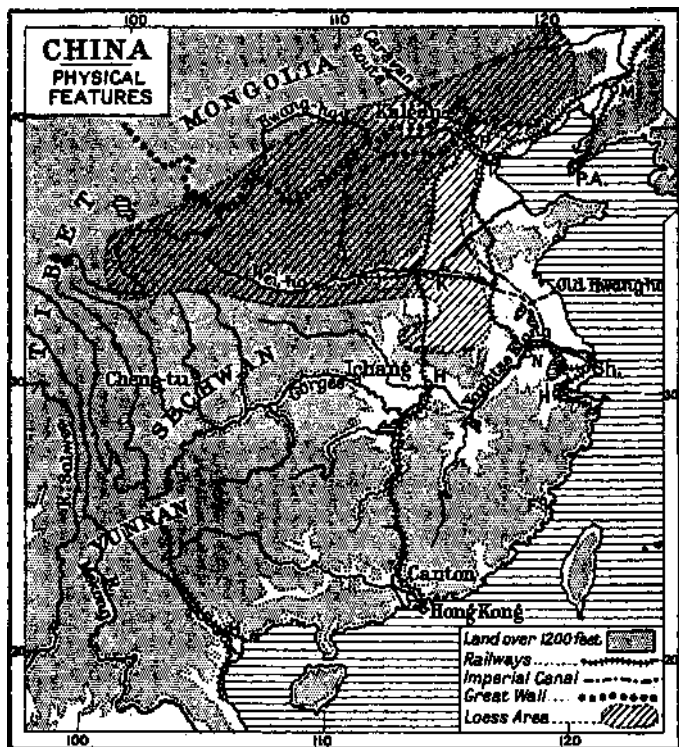


FIG. 49~Physical map of China.

Northern China has cold winters and hot summers, Central China cool winters and hot summers, and Southern China warm winters and hot summers. China falls so naturally into these three regions that we shall consider each in turn.

NORTHERN CHINA

NORTHERN CHINA.

Northern China is mountainous in the west and low in the east. Part of its southern boundary is clearly marked by the Tsingling-shan, which forms a mountainous boundary between the Wei-ho and the Yangtse-kiang. The boundary on the plains cannot be so clearly defined. A large part of Northern China is covered by a deposit called *loess* (see Fig. 49). We have seen that in winter time dry winds blow outwards from the heart of Asia. These winds carry with them very fine dust from the arid plateau regions over which they have passed. This dust has accumulated on the margin of the plateau, and in the course of time has completely buried not only the plain, but the mountains and hills with a mantle of loess often 1000 ft. thick. Looked at from above, a loess area presents a very smooth and monotonous outline, and usually consists of a number of basins, the raised rims bordering the basins representing the mountain ranges. It is typical of the region that each of these basins formed a little unit, having a centrally placed fortified city. The great disadvantage of loess is that it is porous, and so easily cut through that rivers and roads often cross it by intricate passages, on each side of which are very steep, often quite vertical, walls. It has, however, the great advantage of being fertile, although in this connection its porous nature is a drawback, and makes irrigation a necessity in most parts. In colour it is yellow, or brownish-yellow, hence the names of the Yellow river and the Yellow sea.

The chief rivers of Northern China are the Hwang-ho and Pei-ho or North River. The Hwang-ho is in some respects one of the most remarkable rivers in the world. It rises in Tibet, and its upper courses are fed by melting glaciers, which, together with the heavy summer rains of the mountainous region across which the upper stream and its tributaries flow, causes disastrous floods when the swollen river leaves its narrower

mountain bed for the low plains of its lower valley. In this part of its course it does not permanently follow a particular channel, as, owing to the deposition of sediment along the bed, the latter is constantly being raised, so that the river really runs on a self-created ridge that is increasing every year in height. This, of course, necessitates the construction of dykes or embankments in order to confine the river to its channel, and since the bed rises, so the height of the dykes must increase. There is thus the ever present danger that the river may burst the dykes and find a new course. This has happened several times in the past with terrible results, for when the last serious change took place in 1851, owing to the dykes near Kaifeng giving way, the river, which is here very wide and swift flowing, turned northwards and found a new mouth north of the Shan-tung peninsula. Kaifeng is now about twenty miles south of the river, and 20 ft. below its level. (Examine Fig. 49, and in order to realize what this change in the course of the river meant, work Ex. 1 at the end of this chapter.) In 1887 and again in 1898, the bursting of the dykes caused widespread devastation, the toll of those who lost their lives being measured in millions. It is no wonder that the Hwang-ho is called "China's Sorrow." As it flows fast, is not very deep and is liable to floods, it is not of very great commercial value, and in its lower course there are no large towns on its banks. But the fertile yellow silt which it brings down, and by means of which it is busily engaged in extending the lowlands into the Gulf of Pechili, is of great value to agriculture, the predominant Chinese occupation.

The important Wei-ho tributary of the Hwang-ho must be noticed. It is important not only because it was probably in its valley that the Chinese civilization had its birth, but also on account of the routes which continue the line of the Hwang-ho, and pass through Langchow, where they reach the Hwang-ho once more, and then strike across the central plateaux to the

Zurtgarian Gate, and beyond to the towns of Siberia, (seep. 103).

In the mountainous west of Northern China, agriculture is not so easily carried on as in the lowlands, and is in most cases dependent upon irrigation, which is often impossible in a loess-covered region. The plains, however, support a dense population engaged in the growing of wheat, barley, beans, millet maize, and, to a smaller extent, tobacco and cotton. Cultivation is carried on with the careful attention which we give to our gardens. The spade is the chief implement used. The Shan-tung peninsula, an isolated highland region, has areas of oak forests, and these are important owing to the use of the leaves for the feeding of silkworms. The naval and military importance of the peninsula is shown in the occupation of Wei-hai-wei by the British, and the former occupation of Kiaochow by the Germans. In the early part of the great European war, the latter was captured by combined Japanese and British forces.

The most famous town in Northern China is Peking until recently the capital of the whole country. At first sight it seems strange that a city right in the north-east corner of the country should be capital for many hundreds of years. Let us see why. China is easily entered by land routes from the plains of Manchuria, and it was the great importance of this gateway that led to the selection of Peking as capital, although the city itself was finally captured in the seventeenth century by Manchu invaders, who also made it their capital, from which the Manchu dynasty exercised its authority until the last Manchu emperor abdicated, so recently as February 1912. The danger of invasion from the north is also seen in the position of the Great Wall of China. This wonder of the world was completed two centuries before the birth of Christ, and runs westward from the Gulf of Chihli for some sixteen hundred miles (see Fig. 49). It climbs up to the steepest mountain sides, and descends into deep river valleys and even gorges. Peking not

only controls the route to Manrhuria, now followed by a railway which connects it with the Trans-Siberian line, but also the route to Mongolia, via the Pei-ho and Kalgan- Kalgan and Peking are now connected by a railway which is continued to Tientsin. In the future this line will be linked to the Trans-Siberian. Peking has also railway connections via Kaifeng with Hankow. Now let us learn a little of the city itself. The Manchu city occupies a square facing the cardinal points, and is enclosed by four gigantic walls each three miles long. The walls are so wide that four carriages can be driven abreast along the top. Each wall has two gates built a mile from the corners, and therefore a mile from each other. The gateways on opposite walls are connected by means of four roads which thus divide the city into nine parts, each having an area of one square mile. In the centre of the city is the Forbidden City, enclosed in high walls and containing the Imperial Palace. Outside the Forbidden City, which no foreigner is allowed to enter, no building is permitted to exceed a height of one storey, excepting the temples and pagodas. The Chinese city attached to the south wall of the Tartar or Manchu city, is rectangular in shape, and is also surrounded by high walls. After sundown communication between the two cities is cut off by the closing of the gates. Europeans live within the Tartar city, and their quarter is very western in appearance.

Tientsin, the port of Peking, has a larger population than the capital, from which it is distant about eighty miles by land and one hundred and forty miles by river. Unfortunately it cannot be reached by large steamers, whilst the river freezes in winter for about three months. Tientsin is the northern terminus of the Grand or Imperial Canal, which is nearly one thousand miles in length, and was begun about the sixth century B.C. and not completed until 1283 A.D. It gave a water connection between Tientsin and Hangchow, but of late years has been so neglected that many

parts, especially in the north, have fallen out of repair. A North China town of great historical interest is *Si-ngan* on the Wei-ho. For two thousand two hundred and fifty years this city was the capital of China.

Before leaving Northern China, reference must be made to the great wealth of coal and iron this part of the country possesses. The Shansi highlands are especially rich in both, and mining also takes place in Shan-tung and other parts. The railway from Peking to Hankow passes along the eastern margins of the SHahsi region, and will do much to develop iron and other manufacturing industries. The plains of North China are practically treeless, and coal will supply a needed cheap fuel, as well as lead to a development of manufacturing.

CENTRAL CHINA.

This comprises the basin of the Yangtse-kiang. The map shows that the upper basin is a highland region, and that the lowlands are either along the river, or near its mouth, where they are continuous with those of Northern China. The higher temperature at all seasons, and the heavier rainfall make life easier than in Northern China, and have an important influence upon vegetation and the nature of the chief cultivated products, which are those of a distinctly warmer type of climate. Rice, tea, sugar, cotton, as well as the cereals of the north, are all important cultivations. As in Northern China, agriculture is by far the most important occupation. Notice on a physical map the basin of Sechwan situated in the upper valley of the Yangtse-kiang. It is an elevated region, but is not so high as the surrounding land. Sometimes it is called the Red Basin, on account of its fertile red soil, which has come from the red sandstone of which the area is composed. This basin is nearly as large as France, and is very densely peopled

Most of the vegetable products already mentioned are grown easily, although irrigation is usually necessary, especially for rice. The chief town is *Chengtu*, the centre of a densely peopled area of extraordinary fertility, famous for its garden cultivation. The hill sides have been carefully terraced, so that cultivation is carried on at a height of many thousand feet above sea-level, the type of product varying with the elevation. Although Sechwan is noted for its agriculture, it has also very extensive coal and iron deposits, whilst the more precious metals and copper are known to exist in considerable quantities along the margin of the Tibet plateau. Sechwan is somewhat difficult of access owing to its build. It is unfortunate that the Tsingling-shan form a difficult barrier between the Wei-ho and the Yangtse tributaries draining Sechwan. The easiest entry is by way of the Yangtse, and it is on its banks that the port is situated. This is *Chungking*, which suffers from the disadvantage that great gorges and rapids of the Yangtse, which interrupt the navigation of the river for some four hundred miles, are between it and Ichang. Below Ichang the river is navigable for river boats and small ocean vessels to Hankow, and from that city to the mouth for larger ocean vessels. From Ichang to the mouth is nearly a thousand miles.

Between Ichang and Hankow is a lake-studded lowland region, which is known as the Plain of the *the Middle Yangtse*. The most important tributary is the Han, whose valley gives an easy route to the north-west. At its confluence with the main river stands the triple city of Hankow-Wunchang-Hanyang, some six hundred miles from the mouth. Of these, Hankow, the second forgest city in China, is of greatest importance. It is a great commercial centre, and was the scene of many stirring events during the recent revolutionary war, which led to the downfall of the last Manchu emperor. It is a centre for rice and tea, whilst in recent years a Chinese

company has built extensive ironworks at Hanyang, across the Han from Hankow. There are also other ironworks in the neighbourhood, and considerable quantities of pig-iron are now exported to Japan, and even to the United States. Note the position of Hankow, between the points at which the rivers draining the large lakes of Tungting and Poyang enter the Yangtse. The great Chinese railway, which will eventually join Peking to Canton, has been built along Lake Tungting and will use the valley of the river which passes through the lake, as a route southwards. These lakes have a very important function to perform. As the Yangtse is fed mainly by melting snow and summer rains, like other great Chinese rivers, it is much higher in summer than in winter. Even a rise of 70 ft. is not in some parts regarded as exceptional. In summer these lakes act as great reservoirs, and thus help to check disastrous floods, whilst in the dry season, when the river is low, they help to increase the volume. {cf. Tonle Sap Lake and the Mekong.)

In its lower course, the Yangtse flows through a densely peopled region in which cotton, silk, rice and tea are of special importance (see Fig 50). The outlet for this rich region—the richest in China—is the port of *Shanghai*, situated south of the Yangtse delta. Unfortunately, the harbour is in constant danger of silting up, owing to the great quantities of sediment brought down by the river, and dredging operations have to be resorted to continuously. Shanghai was one of the first ports in China to be opened to foreign trade, and owes its importance as the chief port of China to its position near the mouth of the Yangtse, and to the great richness of the middle and lower portions of the Yangtse valley.

Two other large cities in the lower Yangtse valley are *Nanking* and *Hangchow*. Each has been the capital of China in times past, and in 1927 Nanking once more became capital of the whole country. Its central position, almost equidistant from Peking and Canton, the great cities

of the north and south respectively, is largely responsible for the change. The city is connected by rail with Shanghai and Tientsin, and when a projected railway which will link it to Hankow is completed, it is bound to increase in importance. Hangchow, at the southern

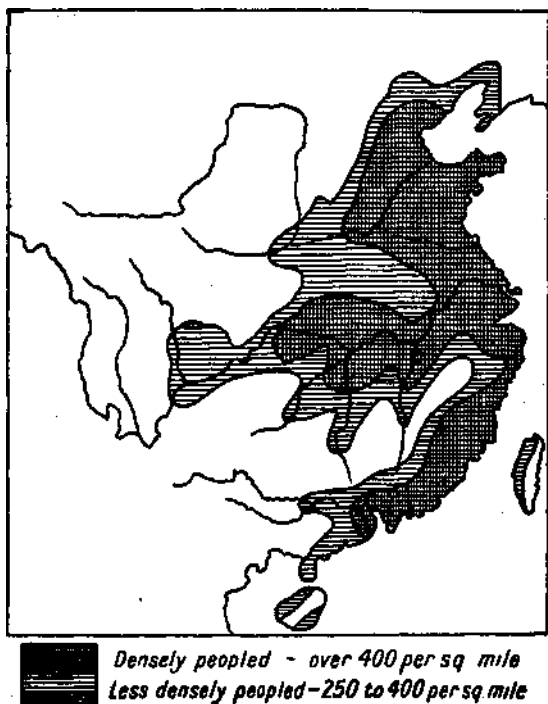


FIG. 50.—Map showing the most densely peopled parts of China.

terminus of the imperial canal, is the Kinsay so wonderfully described by Marco Polo, the great Venetian thirteenth century traveller. When he visited the city, it was the capital, and his detailed descriptions of the manners and customs of its inhabitants, their methods of government, and their institutions, are very interesting. A rail-

way line from Shanghai passes through Hangchow, and will eventually continue through Ningpo, to Foochow.

SOUTHERN CHINA.

Except in the valleys of the rivers, chief of which is the Si-kiang, or West River, there are few lowlands in this part of China. Most of the country is mountainous, the east and west direction of the chief ranges being an obstacle to communication between the valleys of the Yangtse and the Si, so that the valleys of the rivers passing through Tungting and Poyang Lakes are of great importance as routes. The highlands of South China are densely forested, on account of the fact that the rainfall, though mainly occurring in summer, is sufficient for the growth of forests. Considerable areas have been cut down, and agricultural pursuits are now followed in the clearings, but there are still extensive forests which supply valuable products such as bamboo, camphor, and cinnamQn. Thejbanjboo is of very great importance, and is used in the making of many household utensils, as well as for building and other purposes. Camphor and cinnamon are obtained from trees of the laurel type, the former by distillation of the wood of the tree, whilst the latter is the inner bark. In the lowlands of the Si-kiang and in the coastal provinces, the chief cultivated products are rice, tea, sugar, oil-seeds, and indigo, products which remind us of those of India.

The high plateau province of Yunnan, in the west, is the least known and most backward part of South China. It is known to be very rich in all kinds of minerals. A large part of Yunnan is used for the pasturing of cattle and sheep, an occupation of no very great importance elsewhere in China, a country in which the products of pastoral pursuits (milk, cheese, butter, wool, etc.) are somewhat scarce. We have already noted the outlet of Yunnan, via the French port of Hanoi (see Fig. 49).

The largest city in all China is *Canton*, the port for the rich Si-kiang valley. It stands at the head of

the extensive and wonderfully fertile delta made by three rivers, all of which are navigable and of importance, not only because they flow through fertile lowlands, but also because of the routes which follow their valleys. From the north there is the Pei-kiang (North River), from the west the Si-kiang (West River), and from the east the Tung-kiang (East River). As in many other Chinese cities, a large number of people—over three hundred thousand—live in boats, which cover the river for many miles. Near the mouth of the Canton river, the estuary formed by the three rivers above mentioned, is Hong Kong, an island which, together with the adjacent peninsula of Kowloon, has been British since 1841. Victoria, or Hong Kong, is the chief town and port. It has a splendid harbour, and is the headquarters of the British China squadron, as well as a great commercial port. Like Singapore and Shanghai, it has a large *entrepot* trade, and goods from Europe, India, China, Japan, and Australia may be found in its warehouses. Other ports in Southern China are *Macao*, a Portuguese station, at the mouth of the Si-kiang; and *Amoy* and *Foochow*, both of which are situated in a province from which there is considerable emigration, owing to the population being more than can be supported, even by intensive methods of cultivation.

THE CHINESE AND THEIR HISTORY.

There are few English people who are not familiar with the physical appearance of the Chinese, who are members of the great Mongolian race. Originally, the word Mongolian was restricted to the inhabitants of the plateau of Mongolia, but it is now used of all Asiatic people who have the same general characteristic features. The typical Chinese has a yellowish-brown skin, straight Black hair, a rather broad, flat face with prominent cheek-bones, and narrow eyes. The people of North China are usually very tall, but those in the south are below the average in stature. Travellers who

know China and its people intimately, always speak of the Chinese unvarying cheerfulness, even under depressing conditions. As a general rule he is thrifty; a splendid organizer, with phenomenal capacity for adapting himself to circumstances; exceedingly polite, and very trustworthy. He is particularly open to reason, and is capable of putting forth very considerable staying power, even on occasion enduring hunger, thirst, or exposure to a greater degree than most races. The ignorant Chinese is, however, very superstitious, and believes in all kinds of spirits, mostly evil, who are about him with the intention of doing harm to him unless they are appeased by gifts or driven away by noises. To describe all the means which he takes to keep from their influence would take too great a space. Although the ignorance of large masses of the people is almost incredible, the Chinese have a great reverence for knowledge, and often show exaggerated respect for worthless scraps of written paper, whilst teachers are held in high esteem.

When the immense size of China is taken into consideration, it is remarkable that there is such a similarity of type throughout the country. Naturally, the Cantonese, noted for the ardour with which he pursues commerce, his alertness and his anxiety to have a finger in every pie, the real Chinese of the north, famed for his simplicity and reserve, and the Manchu, differ very considerably, but their differences are small compared with those found in India. There are many different languages in China, and yet Mandarin, the official language, is spoken and understood in most parts of the country. Indeed, the differences in race and language will probably be overcome when better means of communication are introduced, and people from all parts are brought into intimate relation with each other. Centuries of isolation from other countries have made the Chinese very conservative and antagonistic to all reform, so that the foreigner, who has introduced new things into the country, is often regarded with

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suspicion and distrust. This, of course, is only natural.

It is commonly stated that there are three religions in China—Buddhism, Confucianism, and Taoism—but this is misleading, since there are many Chinese who profess all three. We have already noted the outstanding characteristics of Buddhism (see p. 163), whose stronghold is China. Confucius was a great teacher of the sixth century B.C., and he was the teacher of doctrines which existed long before his own time. Taoism is a teaching of high moral precepts, which has adopted much ceremonialism from Buddhism. The outstanding feature of the beliefs held by the great mass of people is ancestral worship. The Chinese idolize their ancestors, whose burying places are sacred, whilst each house possesses its shrine, at which their memory is worshipped. The effect of this has been to make the family the unit, and thus to give China that lack of the sense of nationality she so much needs at the present time.

There are signs that the Chinese are awakening. Large numbers of their young men now take courses of study in European and American universities, and as a result of this, western knowledge is spreading; the mineral resources are being worked, and large quantities of machinery are being imported. Even the pig-tail has been discarded since the fall of the Manchu dynasty. But there are many difficulties to overcome before China becomes one of the great powers of the world. Leaders will be needed, and since China has no natural ruling class, it seems as though these will have to be found among those who have been educated abroad. New systems of government will have to be introduced, whilst problems relating to currency—in which much confusion at present exists—and taxation will require careful attention. But the most potent factor of all will be the creation in the Chinese of a sense of nationality.

What a splendid opportunity other countries have of helping China to find her way to national greatness along the best lines! China in the past has been marked

for its backward look, its pronounced conservatism; to-day she has the forward look, and modernism is the new passion of millions of her people. Where rush lights were used twenty years ago, we now find the electric light, junks are giving way to steamships, straggling footpaths to railways and motor roads.

We have learned that Chinese civilization grew up in the valley of the Wei. From there it was easy to spread to the great plains of the north, which for two or three thousand years remained the great home of the Chinese people. About two centuries before the birth of Christ, the people appeared to have begun the great movement of spreading over the southern part of China, a movement which took some four hundred years to complete. Hitherto the dense forest and jungle character of the land had prevented this. But the Chinese have not had the undisturbed possession of this great area. There have been constant invasions from the less favoured steppes and the plateau deserts to the north and north-west, and these necessitated, as we have seen, the building of the Great Wall more than two hundred years B.C. In the thirteenth century A.D., the great Mongol conquest, begun by Jenghiz Khan and completed by his son and grandson—the famous Kublai Khan—was accomplished. The last conquest of China was that by the Manchus, who entered from the north by the easy route from Manchuria, but both Mongols and Manchus were absorbed, owing to the size of the land and the numbers of its people. Some years ago it was the danger of Russian threats along the same route which led to the Russo-Japanese War. On Feb. 12, 1912, China became a republic, having for its first president Yuan Shih-K'ai, who did not long survive an attempt to attain the greater dignity of Emperor.

Since 1912 there has been great unrest and much fighting and war among rival factions. It is still doubtful whether the central government established at Nanking will be able to enforce its authority over the whole country. If this difficult task is successfully accomplished the new China

will rapidly progress, and in time will take her place as one of the most important countries in the modern world. But it can be accomplished only if other people help the Chinese and if she is able to keep free from war and international conflict. Unfortunately her Japanese neighbours look enviously upon China's broad territories.

EXERCISES.

1. On an outline map of the British Isles let a small circle, to represent Kaifeng, be marked about the centre of Ireland. On the same scale as the outline map, draw the present and old courses of the Hwang-ho as well as the coastline between the old and the present mouth. This map will give you some idea of what the great change in the Hwang-ho's course meant.

2. What grounds are there for believing that the Chinese people have a great future before them?

3. What geographical or other conditions have aided the growth of each of the following Chinese cities: Peking, Shanghai, Hankow, Canton? Illustrate your answer by sketch maps.

4. Give reasons for the density of the population in the valleys of the Ganges, Yangtse, and Hwang-ho rivers.

5. Why it is that (a) the Hwang-ho is often called "China's Sorrow"? (b) A large area of Southern China is covered by trees? (c) The level of the Yangtse is much higher in summer than in winter? (d) China remained until the last few years a country closed to foreigners?

6. *Trade of Hong Kong in 1937.*

	Value in ;
Exports to Great Britain .	935,000
Imports from Great Britain	3,392,000
Exports to rest of British Empire .	4,368,000
Imports from rest of British Empire	3,266,000
Exports to foreign countries .	23,168,000
Imports from foreign countries	31,934,000

Comment upon these statistics. Which will be the chief foreign country?

CHAPTER XVII.

THE CHINESE LANDS.

THE OUTLYING PROVINCES.

IN the last chapter we considered China Proper, the most important part of the Chinese Lands. In the present chapter we shall learn something about the other Asiatic lands over which the Chinese exercise a more or less effective overlordship. We shall consider them in the following order: Manchuria, Mongolia, Sin-Kiang and Tibet. Although these dependencies and frontier provinces contain more than half the area of the Chinese Lands, their total population is only about five per cent.

MANCHURIA.¹

Area, 400,000 sq. miles.

Population (in 1930), 29,606,000.

This dependency, lying between the province of Chihli and the Amur river, has an area over four times that of Great Britain, and a population which numbers nearly thirty millions, of whom the majority are Chinese, for there is no longer a large Manchu population in the country. A physical map shows that western Manchuria consists of lowlands, whilst in the east are highlands. The country extends from the latitude of Madrid to that of Liverpool, but its climate is totally different from that of lands in similar latitudes of western Europe. It is marked by exceedingly cold winters and hot summers, with rain in summer, the fall

¹ Helped by the Japanese, Manchuria has declared its independence and has been organized as the Kingdom of *Manchukuo*, with the ex-Emperor of China as ruler and Hsinking as capital. Most countries, including the United Kingdom, have not recognized the new kingdom, so that for the present we retain it among the Chinese Lands.

on the western plains being less than on the eastern highlands. It is because of this that the west is a steppe land, whilst the eastern mountains have extensive forests of coniferous and broad-leaved trees.

Owing to the development of railway facilities and the immigration of Chinese from Northern China, Manchuria has seen a greater development in recent years than any other part of the empire. The Chinese immigrants are engaged in agriculture—millet, beans, wheat and rice being the principal crops. The best agricultural lands are in the valleys of the Sungari, a tributary of the Amur, and the Liao, which flows to the Gulf of Pechili. Manchuria is rich in minerals, especially in the mountains of the east and west, but little mining takes place at present.

In the south there is the Liaotung peninsula, whose southern extremity is now leased to Japan. The leased land includes the important town of Port Arthur, the southern terminus of the Trans-Siberian railway, and an important commercial and naval base. It was leased to Russia until 1905, when it was lost owing to the success of Japan in the great war with that country. In 1900 there occurred the serious Chinese "Boxer" uprising, and as a consequence Russia occupied Manchuria, refusing to withdraw when peace was restored. It was on this account that Japan went to war with her in 1904. The loss of Port Arthur and the control of the railway were great blows to Russia, especially as Port Arthur was her only ice-free port.

Other important Manchurian towns are Mukden and Harbin. The former stands at the point where the Manchurian section of the Trans-Siberian railway branches into three lines, one going to Peking, another to Port Arthur, and the third to Korea. It is the chief city of Manchuria, and is the centre for the southern agricultural region. Harbin stands where the great railway line crosses the Sungari on its way to Vladivostock, **and** the line **for** Manchuria leaves the main line.

MONGOLIA.

Area, 1,875,000 sq. miles.
Population, 850,000 (estimated).

This enormous country, with its ill-defined boundaries, lies to the north and north-west of China Proper. It is an arid plateau in the heart of which is the desert of Gobi, or Shamo, as the Chinese call it. The north and east, the highest parts of the plateau, are crossed by high mountains. The marginal lands are steppe lands whose rainfall is sufficient for the rearing of cattle, horses and camels, the last named being the chief beasts of burden. It was from the north Mongolian steppes that Jenghiz Khan and his followers and successors spread eastwards to China and westwards via the Zungarian Gate, between the Tien Shan and the Altai Mountains, across Siberia, Russia, and even to Hungary. Their conquests were in no small measure helped by the hardy horses they possessed.

The chief trade route of the country has already been referred to. From Peking it follows the Pei-ho to Kalgan, and from there it crosses the Gobi desert to Uraa, the most important town in Mongolia. Leaving Urga, the route proceeds northwards to the Siberian towns of Kiakhta, on the frontier, and Irkutsk. This caravan route is sometimes called the "Great Tea Route," on account of the quantities of brick tea carried from China to Mongolia and Siberia.

Mongolia may be divided into Outer and Inner Mongolia, the latter being that part of the country adjacent to China. Shortly after the outbreak of the great Chinese revolution in 1911, Outer Mongolia declared its independence, a procedure which was recognised by Russia. In 1913, however, an agreement was entered into between China and Russia, by which Outer Mongolia was recognized as Chinese territory, but was to have self-government. Both countries agreed not to colonize the territory. We have seen that the Chinese have colonized Manchuria.

They have also spread into Inner Mongolia, and even to the margins of the Gobi desert, where by means of careful irrigation they have made agricultural pursuits possible. The natives of Mongolia are nomadic Mongols and Kalmucks, who are little given to agriculture, even in the more fertile parts, and are employed mainly in looking after their animals.

SIN-KIANG.

Area, 550,000 sq. miles.

Population, 1,200,000 (estimated).

Sin-Kiang, or Eastern Turkestan, comprises all the Chinese dependencies lying between Mongolia to the north and Tibet to the south, and is divided by the Tien Shan into two parts, a large southern area drained by the Tarim, and the smaller northern region of Zungaria. The whole region, which is nearly five times as large as the British Isles, has a very extreme climate, and is very deficient in rainfall, so that it is a land of dry steppes and deserts.

The Tarim basin¹ is a plateau bounded by the Tien Shan mountains on the north and the Kwen Lun on the south. The physical map shows that it is much lower than surrounding plateaux, and on this account may be considered as a great depression, most of which forms the basin of the river Tarim. This river and its tributaries are supplied with water from the encircling mountains, for there the rainfall is heavier, and the higher valleys contain great glaciers whose melting provides water. When the rivers reach the plateau, their waters can be used for irrigation, and tracts which would otherwise be desert are green oases. As Fig. 51 shows, there are many rivers which never reach the Tarim, but lose themselves in the sand. Even the Tarim finally loses itself amidst the reedy swamps of Lob Nor. Although a centre of inland drainage,

¹ This is a convenient title, but it should be noticed that the Tarim does not drain the whole area.

THE OUTLYING PROVINCES

Lob Nor is not very salt, probably due to the fact that it is of recent origin. Since there is plenty of water for irrigation purposes at the foot of the mountains, the trade routes pass either along a line of oasis towns south of the Tien Shan, or along a similar line north of the Kwen Lun, for except along the water-

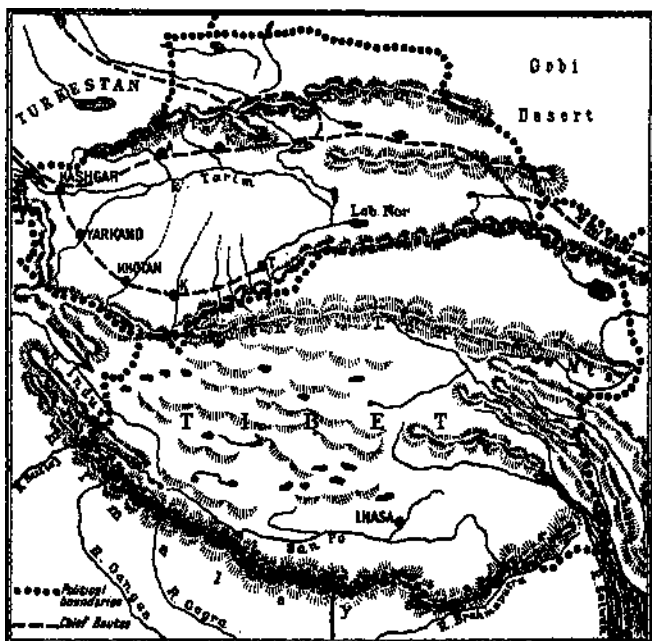


FIG. 51.—The Chinese provinces of Sin-Kiang and Tibet,

courses the rest of the Tarim basin is a desert. These trade routes meet at *Kashgar*, which is also reached by caravans which have crossed the mountain passes on their way from Russian Turkestan. *Yarkand* and *Khotan* are on the southern route. All three are **walled** oasis cities intersected by irrigation canals, and consisting of low flat-topped houses surrounded by gardens

and fields producing cereals and cotton. North of the Tien Shan, and between those mountains and the Altai Mountains is the steppe land of Zungaria, across which the great route from Siberia to Northern China passes.

It is interesting to notice that, as in Manchuria and Mongolia, there has of recent years been a very considerable Chinese immigration into Sin-Kiang. Every year the whole territory is increasing in population and prosperity.

TIBET.

Area, 463,000 sq. miles.

Population, 2,000,000 (estimated).

Tibet is a high bleak plateau, so cut off from surrounding lands by high mountains as to be difficult of access, and therefore it is often known as "Mysterious Tibet." Shutting it off from India are the Himalayas and Karakoram, ranges on the south and west, on the north the Kwen Lun mountains separate it from eastern Turkestan, and in the east the north and south ranges of Western China form a barrier, making it very difficult for the Chinese to enter their dependency. Across these barriers there are few good routes. From Darjeeling difficult routes lead over the Himalayas, others enter on the west by means of Karakoram passes. From China the best routes either follow the Wei-ho, or cross the ranges separating south-eastern Tibet from Sechwan (see Fig. 51). The chief Tibetan import, tea, is brought along the latter routes.

Not only do these mountain barriers make it very difficult to enter Tibet, but they also shut out rain-bearing winds, whilst the great elevation of the plateau—over three miles—has such an influence on the temperature, that despite its nearness to the Tropics, the country is swept by icy winds, and snowstorms are common. Permanent settlement is not possible never-
the greater part scattered in-

habitants obtaining a livelihood by pasturing yaka, goats and sheep, and in some parts camels, The yak is to the Tibetan what the remdeesus. to the man of the Tundra It supplies Bin with food and clothing, and is the beast of burden. The great majority of the people live in the valleys of southern Tibet, especially in that of the the Tibetan name of the Upper Brahmaputra. Here it is possible, owing to the presence of alluvial soil, to grow fruits such as apricots and peaches, as well as wheat, barley and geas; but, in order to do this, it is "necessary to resort to irrigation. pastoral occupations are also very important.

The capital is Lhasa, the Forbidden City. It is situated in the valley of a tributary of the San-po, and is famous for its imposing monasteries, the world-famed palace of the Dalai Lama, the head of the Buddhist faith, being the most renowned. In 1904, Lhasa was entered by a British mission, accompanied by an armed escort. The Tibetans had not fulfilled a treaty made between Britain and China regarding the removal of hindrances to Indian trade, so the mission entered the country and reached the capital by force of arms, concluding agreements relating to the preservation of passes, the demolition of Tibetan forts, the fixing of customs and tariffs, etc. All the arrangements made were afterwards ratified by China. What seems to have made most impression on the members of the mission were the filthy state of most Tibetans and their villages and the extraordinary religious beliefs of the people. The prevailing religion is Lamaism, a degraded form of Buddhism, in most parts of the country little better than devil-worship. Every dark spot—a cave, a hole in a wall, a crack in a rock—is filled with evil spirits who must be kept off, and in order to do. this strings of flags, prayer poles, and many other devices are used. There is a very great difference between the lives of the people and those of the priests, of whom there are a tremendous number—twenty-five thousand in Lhasa alone.

EXERCISES.

1. Contrast life in the Tibetan plateau with life in the plains of Northern India. Give reasons for your statements.

2. Why is the Tarim basin called an area of inland or continental drainage? Give other Asiatic examples.

3. Which of the Chinese outlying provinces do you think is of the greatest economic importance? Give reasons for your answer.

4. Draw a section from Calcutta to Lake Balkash. Explain its leading features.

5. Compare the value of the reindeer to the dweller in the Tundra with the value of the yak to the Tibetan.

6. Look at the physical map of South America in your atlas. Can you find a plateau which may be compared with Tibet? How does it differ in size and elevation from Tibet? What country is it in?

7. Find out all you can about Manchukuo. Why is Japan the only country to give it recognition? Who is its ruler? Why does Japan take a great interest in the affairs of China? In what other parts of China, besides Manchukuo, are the Japanese interested?

CHAPTER XVIII.

THE JAPANESE EMPIRE.¹

THE island Empire of Japan, the Land of the Rising Sun, consists mainly of a long chain of islands off Eastern Asia, stretching from Formosa, which is bisected by the Tropic of Cancer, to the Kurile Islands and the southern portion of Sakhalin, which are in the latitude of Southern England. Of these, the largest and most important island is Honshiu, or Mainland, whose area is greater than all the rest put together. Japan is often called the "Britain of the East," although the similarities between our own islands and Japan are not so prominent as the points in which they differ. Both countries are composed of islands lying off the opposite shores of the great Eurasian land mass, and within easy reach of mainland countries which have large populations. Each country has splendid harbours, and is endowed with considerable mineral wealth; but the chief point to notice is that, owing to these similarities, each country is a great maritime power. When we examine their structure, their positions with regard to the Equator, the climatic contrasts caused by the location of one on the west and the other on the east of a great land mass, and the influence of these factors upon vegetation and occupations, we see that there are wide contrasts between the two countries.

¹ The Peace of Versailles, 1919, gave Japan the mandate (on behalf of the League of Nations) to administer the Marianne, Caroline and Marshall Islands, which formerly belonged to Germany. She also succeeded to the German rights at Kiaochow (see p. 181).

THE JAPANESE EMPIRE

PHYSICAL FEATURES.

We have already learned (see pp. 78, 79) that the Japanese Islands are part of the great belt of volcanic mountains surrounding the Pacific Ocean. Evidence of volcanic activity is seen in the frequent earthquakes and the presence of hot springs, whilst there are several active volcanoes. The most terrible earthquakes known in Japanese history occurred in 1923. Great loss of life and property was caused in Tokyo, Yokohama and the surrounding country.

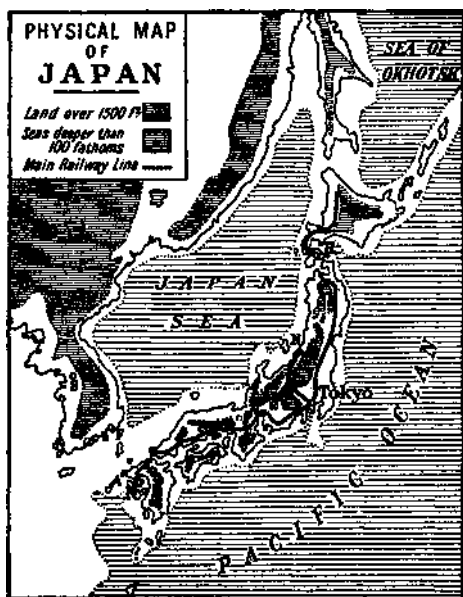


FIG. 52—Japan. Relief and chief railways.

The beautiful Fuji-san (12,500 ft.), the most famous of Japanese volcanoes, has not been active for about two hundred years. Two distinct chains, separated by a

CLIMATE AND PRODUCTS

rift valley traverse Northern Honshiu from north to south. In Southern Honshiu a change of direction is evident, and we can distinguish two ranges running from south-west to north-west, the northern one forming the long, narrow continuation of Western Honshiu, the other, the islands of Shikoku and Kiushiu. Between them is the depression occupied by the Inland Sea. From Hokkaido, or Yezo, one range is continued by the Kurile Islands, and another by the mountains of Sakhalin. South of Honshiu the volcanic chain is continued through the Lu Chu Islands to Formosa, and beyond to the Philippines.

So much of Japan is mountainous (see Fig. 52) that the height of the mountains and their nearness to the coast makes the rivers so short and swift-flowing as to be of little value for commerce. They are also loaded with sediment, and consequently fill up harbours and bring about the decline of ports, *e.g.* Tokyo and Osaka.

The few lowlands of Japan are separated from each other by mountains, so that until the building of railways communication between them had to be by sea. The largest extent of lowland is north of Tokyo, and it is here that the population is densest. The narrow coastal plains around the Inland Sea are also densely peopled.

One other point must be noticed. East of Japan the Pacific Ocean rapidly descends to enormous depths. Quite close to the east coast is a basin more than 4,000 fathoms deep. On the west the Sea of Okhotsk and the Japan Sea are much shallower, although they, too, must be considered as deep in comparison with the shallower Yellow and East China Seas, or the continental shelf surrounding Britain.

CLIMATE AND PRODUCTS.

Climate.—The climate of Japan is monsoon in type its distinctive features being due to its position off the shores of the great land mass of Asia. In winter it receives cold winds from the continent, and in summer the monsoon winds blowing from the ocean towards the

THE JAPANESE EMPIRE

low pressure areas in Central Asia. Thus it is that the country receives most of its rain in summer, although the west coast has rain and snow in winter also, this being due to the winds picking up some moisture in crossing the Sea of Japan. In amount the rainfall is generally heavy in all parts, but is less in the-west than in the-east

As regards temperature, the great stretch in latitude is a very important factor. Speaking generally, Japan has an extreme climate despite its insular position, for the winters are much--colder-than would appear from the latitudes, whilst the summers are hot. In chapter V we have learned that the warm Kuro Siwo, or Black Stream, sweeps past the eastern shores of Japan. In winter this current has little effect on the climate, because the winds at that season blow from Japan to the Pacific, *i.e.* off shore, whilst in summer there is not a very great difference between the land and sea temperature, so that the modification of the land temperatures by the cooler winds from the sea is not very marked. There is also the cold Kurile current which flows from the Arctic Ocean through Bering Strait and along the eastern margins of the Kurile Islands and the Island of Yezo. Off the shores of the latter island the meeting of air currents whose temperatures have been affected by the warm Kuro Siwo or the cold Kurile current, as the case may be, causes fogs such as are common on the banks of Newfoundland.

The following figures illustrate the chief differences in climate in various parts of the Japanese Empire—

Place.	Latitude.	Longi- tude.	Height in Feet.	Coldest Month.	Warmest Month.	Mean Annual Rainfall.
Hakodate.	41°	141°	16	27° F.	70°F.	45-4 ins.
Tokyo	35°	140°	69	37°	78°	62 "
Nagasaki .	32°	130°	190	32°	80°	80 "
Niigata						
(west coast)	38°	139°	32	34°	77°	68 "
N. Formosa	25°	122°	16	62°	84°	125 "

Vegetation.—Owing to the heavy rainfall the mountains of Japan are forest clad. In the cooler north, coniferous and broad-leaved trees are found, whilst the warmer southern regions produce bamboos, gigantic cedars, maples, mulberries, camphor and lacquer trees. The bamboo is of enormous value, for the uses to which the different parts of the tree can be put are almost innumerable. Lacquer, used in the decoration of many Japanese articles, is the gum exuded by a large shrub. The northern forests supply wood-pulp for paper-making and wood for the match-making industry. The pastoral areas are not very extensive, and the effect of this is seen in the comparative scarcity of cattle, horses and sheep, and hence of such products as leather, dairy produce and wool. The scarcity of sheep is also due to the growth of a kind of grass which is quite unsuitable for them to eat. The lack of pasture lands was one of the reasons which prompted Japan to annex Korea, as that country possesses many areas suitable for pastoral occupations.

As regards the cultivated plants, rice, as in the other lands of monsoon south-eastern Asia, comes easily first. Wheat barley and oats are grown in the cooler parts, and as winter crops in the rice fields after the rice has been harvested. Tea is also very important, and is grown largely on the terraced slopes of the central and southern highlands. Mulberries are extensively cultivated, and as the climate is very suitable for the silk worm ("the Honourable Mr. Baby"), Japan not only produces enough silk for her own needs, but has a large surplus export. Other minor products are cotton (not nearly in sufficient quantities for the Japanese cotton trade), indigo, tobacco and sugar. The method of agriculture resembles that of China in that it is almost entirely done by laborious Spade cultivation. Although this careful method increases the yield, the land available for cultivation is so limited that even rice, the chief article of food, has to be imported in large quantities to supply the needs of the people.

The Japanese enjoy a world-wide reputation as horticulturists, and this is largely owing to their skill in dwarfing trees and in acclimatizing plants and flowers native to other countries. They are great admirers of the chrysanthemum.

The *mineral wealth* of Japan is very valuable and varied, and since the Japanese began to copy Western nations their output has increased enormously. The characteristic minerals are sulphur, kaolin and copper. Sulphur, of course, is obtained from the volcanic regions, and, together with the timber from the forests, has led to match-making. The presence of kaolin accounts for the fine porcelain for which the Japanese are justly noted. It is obtained chiefly in the Nagoya area of Honshiu. More copper is mined in Japan than any other mineral, the region north of Tokyo being the greatest copper-producing region of Asia. The artistic bronze work, for which Japan is famous, is due to the great supplies of copper. Silver, lead, petroleum, as well as coal and are also found. The largest coal deposits are in Yezo, Northern Honshiu and Kiushiu (see Fig. 53). The Kiushiu coal-fields supply about 75 per cent, of the total output. It is unfortunate that coal and iron are not found together, but still more so that large quantities of iron have to be imported to meet the needs of the manufacturing industries (see page 185).

Fishing is one of the leading occupations in Japan. Fish forms a very important part of the food of the people, not only because from religious motives meat is avoided, but also on account of the presence of rich fishing grounds within Japanese waters. Mention has already been made of the cold and warm currents of ocean waters which sweep past Japan, and it is largely because of the food for fish brought by those currents, and on account of their varying temperatures, that fish are not only abundant, but also, of great variety. Then, again, the indented nature of the coast-line helps the industry. There are said to be nearly one million people in Japan who have fishing as their *sole* occupation. The

chief fishing grounds are in the shallow waters bordering the coast of Yezo, but the occupation is widespread along most of the coasts. Herring, mackerel, sardines and tunny are the chief species caught. In addition to their value for food purposes, fish are commonly used as manure in order to enrich the agricultural lands

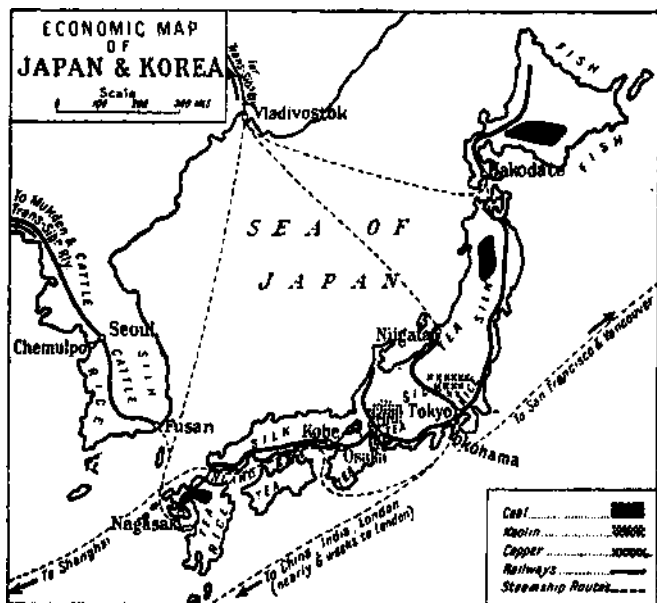


FIG. 53.—Japan and Korea. Economic map.

The fishing ability of the people has helped to make Japan one of the world's great naval powers, but even before the days of modern navies they were able to defeat with ease those who tried to invade their land.

CENTRES OF POPULATION AND COMMUNICATION.

The most thickly peopled parts of Japan are the fertile lowlands bordering the coasts, especially those

along the margins of the inland sea and north of Tokyo, and it is in these places that the largest cities are to be found.

Tokyo, the capital, with six million inhabitants, is one of the largest cities in the world. It stands, within sight of Fuji-San, at the head of Tokyo Bay, on the banks of a river which has silted up its harbour, so that it is no longer a port. In the heart of the city there stands an ancient castle surrounded by moats and wooded grounds, and these form a pleasant relief to the otherwise somewhat monotonous aspect of vast numbers of the low wooden houses of which Tokyo is largely composed. Most parts of Japan are so subject to earthquakes, that the buildings are made of light materials. Very often of bamboo, and sometimes even of paper. The oldest inhabitants of the capital, which was formerly called Yedo, have seen a great change in recent years. Modern buildings, after the style of those of Western Europe, electric lighting and electric tramcars, motor-cars, railway stations from which run lines to many parts of Honshiu, Japanese in Western clothes, and the presence of a considerable number of foreigners are all surprises for the man from the country when on a visit to Tokyo. Many industries are followed in the city, the chief being the modern manufacture of clothing, matches chemicals, as well as the ancient industries in ivory, bronze, and lacquer-ware.

The port for Tokyo is *Yokohama*, on the western shores of Tokyo Bay. It is the great port for trade with the mainland of Asia and with Australia, Western America and Europe. It carries on the foreign trade of the largest and most densely peopled lowland in Japan.

Osaka, the second city, also owes its position to the lowlands in its hinterland. It stands at the mouth of the river which drains Lake Biwa to the Inland Sea, and is the chief seat of the Japanese textile industry, especially cotton. The Great War gave Japan a chance to extend her markets to India, China and other parts of the world, [^]*tidt* to-day she is Lancashire's most serious rival in every

CENTRES OF POPULATION

part of the world. *Kobe*, a neighbouring port, has risen to prominence during recent years. Its import trade (mainly raw materials such as cotton from India and wool from Australia) is the largest in the country, but the export trade takes second place to that of *Yokohama*. *Kobe*, like *Osaka*, engages in the manufacture of textiles and in shipbuilding. *Kyoto*, the fourth largest city in Japan, is situated amidst beautiful surroundings, near to Lake Biwa. Until 1868 it was the capital, and has declined in importance since the removal of the seat of government to *Tokyo*. It is in the centre of the best silk, and tea producing districts, and is also noted for its artistic productions. In many respects *Kyoto* is the most interesting city in Japan, and is quite different from the modernized *Tokyo*. On account of its ancient monuments and buildings it has been ambitiously called the "Rome of the Far East," although it is a city, not of seven hills, but of thirty-six peaks.

Nagasaki, on the west coast of *Kiushiu*, has the finest harbour in Japan. It has important naval and shipbuilding dockyards, and exports coal, but it is not so important, either as a port of call for liners or as an exporter of coal, as *Moji*, in the north of the island. The chief town and port of *Yezo*, the northern island, is *Hakodate*, which has also a splendid harbour, and large supplies of coal near by. Its chief trade is in coal and fish. *Vladivostok* can be reached from *Hakodate* in two days.

The chief railway in Japan follows the whole length of the east coast of *Honshiu*, giving connections between all the largest towns. (See Fig. 52.) Continuations of the system are found in *Kiushiu* (to *Nagasaki*), and from *Hakodate* to the interior of *Yezo*. The west coast of *Honshiu* is reached by two railways, the more important being that to *Niigata*, from which *Vladivostok* is a two-days' steamship journey distant. In addition to these lines there are many others which act as links between the various systems.

For short distances and for use in towns the

jinrickshaw, a two-wheeled conveyance resembling a bath-chair fitted with shafts, is still in common use.

The Japanese Empire also includes Korea, Formosa, and the leased territory containing the great port of Port Arthur, the southern terminus of the Trans-Siberian Railway.

KOREA.

Korea, called by its inhabitants Chosen,¹ has an area of 86,000 sq. miles, and a population of over twenty millions, and was annexed in 1910 by the Japanese, who had previously acquired a great amount of control in Korean affairs by the treaty which concluded the war with Russia. It is a mountainous peninsula, whose eastern coast rises steeply from a very narrow coastal plain, bordering the Sea of Japan. As we proceed towards the west coast, the elevation becomes less and less, until the coastal plains bordering the Yellow Sea are reached. On account of the configuration, the majority of the inhabitants are found in the west, where the lowlands are suitable for cultivation, especially of rice which, as in the other monsoon lands, forms the chief food of the people. Other products are millet soya beans, cotton. and. hemp. Gold is mined in the north in considerable quantities, and the country is also rich in coal and iron, but their development is very backward. Pastoral occupations are of much greater importance in Korea than in Japan, and hides form one of the chief exports.

The capital of Korea is Seoul situated some sixty miles from the mouth of the Han, the most important river It is connected by rail to its port. Chemulpo. Built at the mouth of the Han, and is on the chief railway of the country. This line runs from Fusan. in the south-east, and traverses the whole length of the peninsula, keeping nearer the west than the east

¹ The title adopted by the Japanese.

coast, and effecting a junction with the Trans-Siberian line at Mukden. Chemulpo and Fusan are the chief ports.

Since Japan acquired Korea there has been a large influx of Japanese, while a considerable number of Koreans have emigrated to the neighbouring countries of China and Manchuria. The Japanese have already made great changes in means of communication and transport, in methods of agriculture and in local government, changes which it is very unlikely the Koreans, who show little energy either in commercial or political matters, would have made if left to themselves,

FORMOSA.

Formosa, or Taiwan, was ceded to Japan in 1895. It has an area of about 14,000 sq. miles, and supports a population of four and a half millions. Its structure resembles Korea for it is traversed from north to south by a range of mountains nearer the east coast than the west, giving a steep slope towards the Pacific, and a gradual slope to the west. Its climate is tropical (notice that it is bisected by the Tropic of Cancer), and its vegetation is of the hot, wet forest variety, camphor trees being of great economic value. Owing to the reckless cutting down of these trees, they are now found only in the mountainous districts, where young saplings are constantly being planted to keep up the supply. Tea is cultivated on the slopes of the mountains, whilst on the alluvial western lowlands, rice and sugar are produced.

The inhabitants of eastern Formosa are of Malay stock, and are very backward indeed. Modern improvements have been chiefly confined to the west, which is inhabited by natives of Chinese descent. The western lowlands are now served by a railway which runs from the northern port of *Kelung*, the best harbour in the country, through *Tainan*, the largest town, to *Tokau*, a port in the south-west.

THE JAPANESE EMPIRE

THE JAPANESE AND THEIR HISTORY.

The Japanese, like the Chinese, are of Mongolian stock. In physique, they very much resemble the Chinese, but are rather shorter in stature. They are not the original inhabitants of their island kingdom, but came from the mainland, probably via Korea, very many centuries ago. Earlier inhabitants are to-day found in the north, especially in Yezo and the Kurile Islands, whence they retired before the stronger invaders. These people, who are called *Ainus*, differ from the Japanese. They have wavy hair and long, thick beards, and do not possess the Mongolian eye. There is little doubt that the ready manner in which the Japanese have adapted themselves to Western ideas is largely due to the fact that, unlike the Chinese, they have come into contact with other peoples (Koreans, Ainus, and perhaps even Polynesians), and the infusion of other races has led to a broader and wider adaptability.

In matters of religion the greatest freedom is allowed in Japan. The chief religions are Shintoism (which regards the Mikado as a god descended from the sun-goddess, and is chiefly a worship of ancestors and nature, and a cultivation of intense patriotism) and Buddhism.

The Japanese claim that the present Mikado, a title which, by the way, is used by foreigners only, can trace his descent far away back to the great year 660 B.C., when their empire was founded. But the Mikado has not possessed unbroken the power he exercises to-day. In the eleventh century the chief power was wrested from the emperor by military leaders who went by the name of Shoguns, and held the ruling power in successive families. The capital of the Shogun was Tokyo, then called Yedo, and the Mikado was virtually a prisoner in Kyoto. The first Europeans to reach Japan were the Portuguese, who for a time were allowed to carry on trade, At a later period the Dutch were allowed to trade at Nagasaki only. But the Shoguns

never liked foreigners, and **at** different times **rebellions arose**, and foreign teachers, chiefly Jesuits, **and their** converts suffered many hardships, even massacres.

In 1854 the United States sent a fleet to Yedo **and** forced a commercial treaty upon Japan. Other Powers did the same, and treaty ports were opened to foreign trade. Troubles between the Japanese and the foreigners led to revolution and civil war, and it was in this crisis that the power of the Shogun, the military dictator, was overthrown, and the Mikado resumed his authority. This was in 1868, and from that year Japan entered into full relations with the outside world. Reference has already been made to changes which have occurred and to the ability of the Japanese in carrying out these changes. It only remains to add that Japan to-day is one of the Great Powers of the world. She has learned one lesson from one nation, another from another, always selecting the nation in which that which it was desired to copy was best managed. Not only **in** her army and navy, which had been so perfected as to surprise Europe by the defeat of Russia in 1905, but in the peaceful field of art, education, commerce and manufacture, Japan has forged ahead. The beginnings of this great step forward were guided by Europeans, but Japan is already able to take complete control, for many of her young men have been trained in the schools and workshops of all the most important countries in the world, whilst at home primary education is compulsory for all, and schools, colleges, universities and technical institutions are provided for higher education.

The extraordinary progress made by Japan since 1868 augurs well for the future of the country. But the rapid increase in the population, which still continues, causes great difficulty in times of diminishing world trade, and Japanese trade can only increase at the expense of other countries. Thus modern industrial development **brings** her into conflict with other countries, and raises **many** difficult problems for solution.

EXERCISES.

1. Discuss the statement, "Japan is the Britain of the East* To what extent is it appropriate?

2. Describe the great changes which Japan has undergone during the last 60 years.

3. Illustrate from Japan the relations between relief, climate, vegetation, and the distribution of the population.

4. Give the position and importance of Tokyo, Nagasaki and Kobe. Draw maps to illustrate the points you make.

5. Using the most suitable physical map in your Atlas, draw a section from Mukden in Manchuria to about two hundred miles of east of Tokyo. Describe the leading features illustrated by this section.

6. "It is remarkable that Japan can support a larger population than that of the British Isles." Why is this remarkable? How is it that a large population can be supported in Japan?

7. Japan's chief exports are raw silk and manufactured cotton and silk goods, and her chief imports raw cotton, iron and timber. Account for this.

8. Find out (a) the size of the Japanese population 70 years ago and at intervals of ten years since; (b) the present annual increase in the population; (c) the estimated population in 25 years from now.

Comment upon these statistics with special reference to problems of employment.

9. Find out all you can about the organization of Japanese cotton mills.

CHAPTER XIX.

AUSTRALIA.

PHYSICAL CONDITIONS.

IN previous chapters we have been considering the geography of Asia. We shall now turn to Australasia, the name given to Australia and the numerous islands north and east of that island continent. The largest of these islands, not including Australia, are New Guinea and the two large islands of New Zealand, but there are thousands of others, some of which are of considerable size, whilst others are small coral atolls. The map shows that the Australasian islands lie mainly south of the Equator, and since this means that January will usually be the typical summer month, and July the typical winter month, we shall be able to draw many climatic contrasts between Asia and Australasia. We shall begin our study of Australasia by a consideration of the physical conditions of the island continent of Australia.

POSITION AND SIZE.

Australia lies south of the Equator, between the parallels of 10° S. and 40^0 S., being therefore almost bisected by the Tropic of Capricorn. It is the smallest of all the continents, its area being nearly three million square miles, or about three-quarters of the size of Europe. Its coast-line has very few large inlets, so that in comparison with the size of the continent the coast-line is not very long, and in this respect Australia may be compared with Africa and contrasted with Europe. To the north

the East Indies form a series of stepping-stones between Australia and Asia; to the east is the island-studded Pacific; in the south the wide belt of the Southern Ocean separates the continent from the Antarctic region, whilst the Indian Ocean washes its western shores. Its isolated position, away from the great highways of trade and discovery during the fifteenth and sixteenth centuries, accounts for its late discovery and development.

RELIEF AND STRUCTURE.

The relief of Australia is very simple, as an examination of a physical map will show. The continent consists of three main divisions—

1. The eastern highlands.
2. The east-central lowlands.
3. The low western plateau.

The eastern highlands, which run at no great distance from the east coast, are not folded ranges like the Himalayas of Asia, but consist of an ancient highland mass which was worn down and then uplifted. The rains and streams have cut into the raised mass and have deeply dissected it. Towards the Pacific the south-eastern highlands present a steep face or escarpment, their slopes to the west being more gradual. The name "Great Dividing Range" is given to the whole, but the system is so long that it is known by different names in different parts. The highest portions are in the south-east, where we have the Australian Alps, partly in Victoria and partly in New South Wales • the Blue Mountains, and the Liverpool and New England ranges in New South Wales. The highest mountain in Australia, Mount Kosciusko, attains an elevation of 7,300 ft., which is rather less than one and a half miles. Since these highlands have been formed by the uplift of older mountains, which had been worn down to rough plains, they are often flat-topped and

resemble plateaux. The island of Tasmania is a detached portion of the eastern highlands.

The great depression of the central plains stretches from the Gulf of Carpentaria to the south coast, and, except for a belt in the north, is entirely below 600 ft. in elevation, whilst in the region of Lake Eyre, it is actually below sea-level. Long ago these plains were the bed of a great inland sea. At that time the eastern highlands were much higher and wetter than they are now, and the rivers which flowed from them to the inland sea carried along rock waste, clay and sands, which were spread on the sea floor. Gradually the highlands were lowered by denudation, thus causing the rainfall and the volumes of the rivers to decrease. In time evaporation exceeded the amount of water brought by the rivers, and finally the bed of the sea became dry land. It is also believed that the land itself was raised.

Note the Flinders Range which separates the basin of the Murray-Darling from Spencer Gulf and the Gulf of St. Vincent. It overlooks a rift valley which contains Lake Torrens and the two gulfs just mentioned.

West of the central lowlands is the enormous low plateau of Western Australia. It consists of an ancient block of the earth's crust which has remained undisturbed for ages. It may be compared with the Arabian and Deccan plateaux of Asia, and to the great African and South American table-lands (Brazilian and Guiana highlands). Geologists tell us that long ago these ancient plateaux were united to form a vast continent, which stretched across the southern hemisphere (see Fig. 28). Seen from the sea the edges of the Australian plateau, especially in the south-west, look like steep mountain ranges, and in this respect may be compared with the broken edges of the Deccan and Arabian table-lands.

One very interesting feature of Australia is the Great Barrier Reef. This reef is composed of coral, and follows roughly the direction of the coast of Queensland

for about one thousand two hundred miles. It is built along an ancient coast-line, now represented by the margins of a submarine plateau (see also pp. 273-5).

CLIMATE.

Although Australia is an island, we shall not expect the influence of the sea to be felt much beyond the coastal margins. The reasons for this are not difficult to understand. In the first place, the size and compact shape of the continent must be taken into consideration. Secondly, the highest mountains are along the coasts, this being especially noticeable on the east coast, a fact which is very important, since the prevailing winds of the greater part of the continent are the south-east Trades. Thus, the effect of the relief is to shut off a large part of the continent from rain-bearing winds and to give the interior a climate over which the sea has no moderating influence whatever.

Temperature.—Figs. 10 and 11 show sea-level isotherms for January and July. In January, the summer month, only the extreme south-west and south-east coasts have a temperature below 70 ° F.; the greater part of the continent is above 80° F., whilst there is a large area where the temperature is over 90° F. In July, the winter month, the lower elevation of the sun naturally gives a lower temperature, so that only the northern margins have a temperature higher than 70 ° F.; the greater part of the continent is between 50° F. and 70° F. and the coolest region is in the south-east.

Winds and Rainfall.—We learned that the south-eastern marginal countries of Asia have what we called a monsoon climate, on account of the summer heating and winter cooling of the great land mass of Asia causing a system of low pressure in summer, towards which winds from the oceans flow, and a system of high pressure in winter, from which winds flow towards the oceans. We find the same phenomenon in Australia. It is produced by similar capses, but because Australia is

in the southern hemisphere, the seasons **are** different. Figs. 15, 16, 23 and 24 show the winds and rainfall for January and July. In the latter month there is a high pressure area over the land mass, and from this winds blow northwards and southwards, being deflected to the left by the earth's rotation. Thus the northern part of the continent receives south-east Trade Winds, which bring no rain, except a small amount to the north-east coast. In the south, the prevailing winds are the north-westerlies, which bring rain to the south-west and south-east regions, as well as to Tasmania. In January there is a well-developed system of low pressure over the north centre caused by the great heating of the interior due to the southerly migration of the sun.

In moving towards this low pressure system, the south-east Trades are turned from their course, and bring a considerable rainfall to the north-east coastlands, whilst the north and north-west coasts receive moisture from the north-east Trade Winds, which flow towards Australia as north-west monsoon winds, on account of their being deflected to the left on crossing the Equator. As in July, Tasmania has westerly winds, but south-west and south-east Australia are in the high pressure belt, and receive little rain during this month.

If we consider the January and July maps together, we shall see that, as in Asia, the rain-bearing winds penetrate farther into the continent in summer than in winter. Fig. 54, which shows the seasonal distribution of rainfall, has been built up from maps showing the mean rainfall for each month of the year.

DRAINAGE.

Australia has very few important rivers, a fact which is due partly to the relief and partly to the distribution of rainfall. The east coast is the best watered part of the continent, but the mountains **lie** so **close** to the coast that most of the rivers flowing eastwards are short and swift, and many waterfalls are often found

in their courses. They are all actively engaged in dissecting the eastern highlands, and some of them have cut deep gaps, which are followed by lines of communication. The most important of the east flowing rivers are the Hunter and the Fitzroy.

In the north, the central lowlands are drained to the Gulf of Carpentaria by the Flinders and other rivers. In the south, the rivers gather to make the great

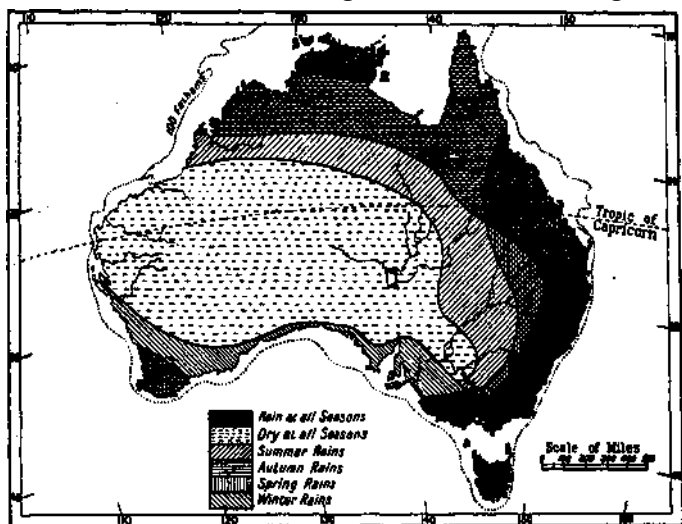


FIG. 54.—The seasonal distribution of rain in Australia,
(After Herbertson and Supan.)

Murray-Darling system, whose waters are drained to the Southern Ocean. The upper and middle courses of the Murray-Darling streams and of those of other rivers rising in the eastern highlands and flowing eastwards have certain drawbacks in common. When they reach the great plains, not only is their velocity checked, so that their load of sediment is deposited, but they flow over an area of very little rainfall. The deposition of sediment has caused them to raise their beds higher than the level of the surrounding plains, so that heavy rains in the high-

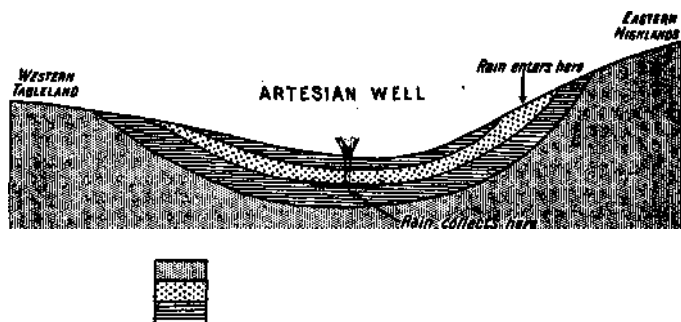
lands produce destructive floods in the plains. Another drawback of the rivers of this system is, that the enormous evaporation occurring during the hot weather causes the amount of water they carry to be very small during summer and autumn. Now the Murray rises in the highest part of the Australian Alps, and the melting of the snow helps to keep the supply of water in that river more constant than that of the Darling. It will readily be seen that it is in winter, and in the case of the Murray in spring also, that the Murray-Darling is of greatest utility for navigation; but even in this respect, so much water is taken from the rivers for irrigation purposes, owing to the slight rainfall on the plains that there is sometimes an insufficient depth for navigation even in winter and spring. This has led to considerable friction between South Australia, Victoria and New South Wales, for the first is primarily interested in the *navigation* of the Murray, and the other provinces in its value for *irrigation*. Another disadvantage is the very poor mouth. The river flows into Lake Alexandrina, a large lagoon whose outlet to the open sea is not only shallow, but is made of little value owing to the presence of banks of shifting sand.

Between the rivers draining into the Gulf of Carpentaria and the Murray-Darling system, there is a great area of inland or continental drainage, in which the rivers flow towards Lake Eyre, which is below sea-level. As may be expected, these rivers, such as Cooper's Creek, seldom contain water in their lower courses. Indeed, Lake Eyre is not a lake in the ordinary sense of the word. It is a wide expanse of swamp, in which are found small salt lakes, and it is very seldom that the rivers bring down sufficient water to give the whole the appearance of a great lake. The same applies to Lakes Gairdner and Torrens.

Between the Gulf of Carpentaria and the Murrumbidgee tributary of the Murray, and including the Lake Eyre basin, is a region known as the *artesian area*. It is composed of permeable layers of rock,

i.e. layers through which water easily passes, lying on the top of impermeable layers of clays. The basin-shaped structure of the strata causes underground water to collect above the clays. This water can be reached by very deep borings, sometimes nearly a mile in depth, from which it usually gushes without the aid of pumping machinery (see Fig. 55). The importance of such wells in a region of little rainfall is apparent. Fig. 56 shows the chief artesian basins of the continent.

In the dry western plateau there are no perennial streams, and what watercourses there are drain into inland lakes, such as Lake Amadeus; but in the mon-



soon region in the north, perennial streams are found, although there is a great difference between their volumes in summer and in winter. Naturally they contain most water in summer, and are either very low or nearly dry in winter. In the south-west the Swan River is the most important. This corner of Australia has most rain in winter, and it is therefore at that season that its rivers have their greatest volumes.

The map of Australia shows that the west, north, and eastern margins, as well as the Murray-Darling basin, are drained to the sea; whilst the dry centre and south are areas of inland drainage. (See Ex. 2 at the end of this chapter.)

PLANTS AND ANIMALS

PLANTS AND ANIMALS

We can now go into more detail than was possible in Chap. VII. The influence of the long separation of Australia from other land masses is seen in its typical plants and animals. Much of Australia is so dry that

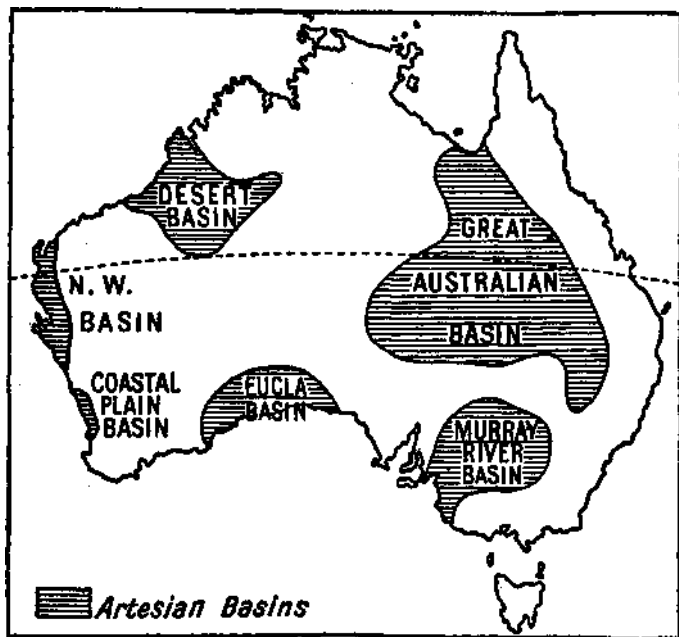


FIG. 56.—The artesian basins of Australia.

The map shows the parts of the Commonwealth which are or might be irrigated by water from artesian bores.

the prevailing forms of vegetation are such as can resist long, dry periods. The eucalyptus, or gum, is the commonest tree. Instead of shedding its leaves, it loses its bark, whilst it gives little shelter from the rays of

the sun, as its small, tough leaves stand edgewise. There are many kinds of eucalyptus, ranging from the mallee scrub, which covers a large area of South Australia and New South Wales, to the enormous karri and jarrah species of South-west Australia. The wood of the latter is of great importance in the construction of railways, etc., in hot, wet countries, as it is so hard that white ants and lice cannot destroy it. It is widely used for street paving, and in the construction of docks and harbour works.

As Fig. 26 shows, forested areas are found only in the better watered coastal lands and highlands. Along the north and north-eastern margins are forests of the hot, wet variety. Bananas, bread-fruit trees, palms, wild vines, spices and valuable timber trees, such as sandalwood, are all found. In the cooler south-east we find a highland region of woodland and grassland. In the former gum trees are commonest, but there are also magnificent tree-ferns as well as European trees such as beeches, pines and walnuts. Those parts receiving heavy rainfall, *e.g.* western Tasmania and the Australian Alps, are naturally the most densely forested. In the south-west and in south-eastern South Australia and western Victoria (regions receiving rain mainly in winter), the chief trees are the karri and jarrah gums already referred to.

The grasslands of Australia may be divided into two kinds, the savannahs or tropical grasslands, and the steppe or temperate grasslands. The former are to be found in the drier belt south of the hot, wet forests, and the latter in the basin of the Murray-Darling. The native grasses, which are very deep-rooted, and tend to be spiny, have been improved by the introduction of European grasses, as well as by the grazing of animals. Many areas marked on the vegetation map as grasslands, are covered with salt bush and brigalow scrub, or dwarf acacia. The latter is exceedingly difficult to penetrate, but the salt bush is very good for sheep. It can be found green long after the heat has withered

the other grasses and shrubs, as it is well adapted to withstand drought.

The dry interior and western areas are either scrublands or deserts. Rain falls only in very small amounts and at uncertain intervals, so that the only vegetation consists of thorny scrub bushes and spiny grasses. The best known of the latter is the spinifex, a tall grass which grows in clumps, and has leaves not unlike a bayonet. So sharp are the leaves that, if one is not very careful, they will cause very dangerous wounds. Travellers who know these dry Australian lands, say that it is really wonderful how their appearance can be changed by one shower of rain. The dreary, barren, brown desert quickly becomes carpeted with many coloured flowers and a thin covering of grass, only to be as quickly burned brown again by the relentless heat of the sun.

Perhaps the effect of long separation from other land masses is more clearly shown in the animals than in the plants. The native Australian animals are of a type long since extinct in other continents. Although the common, domesticated animals of Europe were lacking when the continent was discovered, horses, cattle, pigs and sheep have all been introduced, and thrive very well indeed, increasing in numbers at the expense of the native animals. Rabbits have also been introduced, and owing to the great rate at which they have multiplied, largely due to the absence of such enemies as the fox and the weasel, are now a very serious menace, and have to be kept off the sheep runs or prevented from spreading by means of wire fences. West Australia has endeavoured to keep them out of that state by means of a wire fence, which runs right across the continent from north to south. Frozen rabbits are now exported, whilst the fur is also valuable for making imitations of the furs of the animals of Siberian and Canadian forests. The distinctive Australian animals are the marsupials, or pouched animals, the best known being the kangaroo, the largest native grass-eating animal. The young marsupials **are** born

in such a helpless state that they are carried about in a pouch until they are able to take care of themselves. There are many other marsupials, such as the wallaby, the opossum, and the native rabbits, cats, and wolves. A very strange animal is the platypus, or duck-billed mole, which lays eggs, and after having hatched the young, proceeds to suckle them. In the forested regions are many animals adapted for life in trees. Among these we may name flying squirrels, tree kangaroos, and tree snakes, whilst gaily plumed parrots, parrakeets, and the beautiful lyre birds are also found.

On the grasslands, besides the kangaroo, we find the emu and the cassowary, large running birds resembling the ostrich. Few of the Australian animals are of value, either for their skins or their flesh, and that accounts for their being gradually driven towards the scrub and desert lands, as man extends farther into the continent. This will lead eventually to their disappearance.

THE NATIVES OF AUSTRALIA.

The fate of the animals appears likely to be also that of the natives, for there are now only about 60,000 aborigines left, probably about half as many as there were when Europeans first reached the continent. In appearance the aborigines, who belong to a very primitive type of man, are short in stature, their skin is dark brown in colour, their hair is black and wavy, and they usually have a profusion of beard. In advancement they appear to have reached only the Stone Age, for when they were first discovered they were using stone axes. Probably their advancement had been retarded by lack of domestic animals, as the dingo, or native dog, was all they had; but the inhospitable nature of the climate of much of the continent, and the consequent hard struggle for existence, must also have had an important influence. The latter cause certainly made a large increase in their numbers impossible. Their occupation is chiefly hunting, a calling in

which they have developed marked skill, as is shown by their invention of the boomerang, a curved wooden weapon so shaped that it returns to the thrower if the object aimed at is missed, and the throwing-stick, by means of which a spear can be thrown with great force. To-day the aborigines are to be found mainly on the scrublands, on the margins of the deserts, and in government reservations.

In Tasmania, the aborigines, who were not of the same race as those of Australia, have now no representatives.

EXERCISES.

1. Describe the relief of Australia, and illustrate your answer by a map on which the physical units are clearly brought out and marked.

2. Draw a map of Australia, shaded so as to show the land drained (i) to the sea, (ii) to centres of inland drainage. Briefly describe the map.

3.

Town.	Elevation in Feet.	Mean Jan. Temperature	Mean July Temperature.	Mean Annual Rainfall in inches.
A	15	76°F.	55° F.	33 (chiefly in winter)
B	20	84	75	63 (chiefly summer)
C	700	85	68	28 (chiefly summer)
D	587	86	• 52	11 (chiefly summer)
E	45	71	49	48 (at all seasons, most March-July)
F	37	61	47	23 (all seasons)

The above figures illustrate' the climatic conditions which obtain at six Australian towns. Identify each town, or state the region, and give full reasons for your choice.

4. "As the interior of Australia is approached, the rainfall decreases and the temperature increases." Illustrate and explain this statement.

5. Giving Australian examples, illustrate the connections **between** relief, climate, and vegetation.

6. Draw a sketch map of Australia to show the distribution of deserts, grass lands, and forests.

CHAPTER XX.

AUSTRALIA: REGIONAL AND ECONOMIC.

MAJOR NATURAL REGIONS.

HAVING considered the physical conditions of the continent, we are now in a position to divide Australia into its major natural regions. Fig. 57 shows these units.

The Tropical Monsoon Region.—This includes the north and north-eastern coastal belts. The climatic conditions are: a high temperature with little range between winter and summer, and abundant summer rainfall. The vegetation is of the hot, wet variety. Most of the region is suitable for cultivating the products of the Asiatic monsoon lands, *e.g.* rice, maize, cotton, sugar, indigo, etc., but the great drawback is that the climate is not suitable for white labourers. The Australian Government has decided upon a policy of a "white" Australia, that is, the exclusion of all Asiatic or coloured races from the continent. This means that the agricultural development of the monsoon areas of Queensland and the Northern Territory is bound to be retarded.

The Savannahs or Tropical Grasslands. These form a transition stage between the north coast belt and the desert-like interior, and may be compared with the smaller Indian region between the Deccan and the Desert of Thar. The range of temperature is greater than in the hot monsoon lands; and the rain, although falling in summer, is less in quantity. The natural vegetation is grass, although large areas of scrub are to be found. Pastoral occupations predominate; whether cattle or

NATURAL REGIONS

sheep predominate, depending upon the rainfall. In the north of Queensland and in the north-west of this region cattle are in the majority, but in southern Queensland, where drier conditions prevail, sheep exceed cattle in numbers.

The Deserts and Semi-Deserts— Here the changes of temperature, both annual and diurnal, are considerable, whilst the rainfall is very small and irregular. The areas of really arid desert are not very extensive, for no part

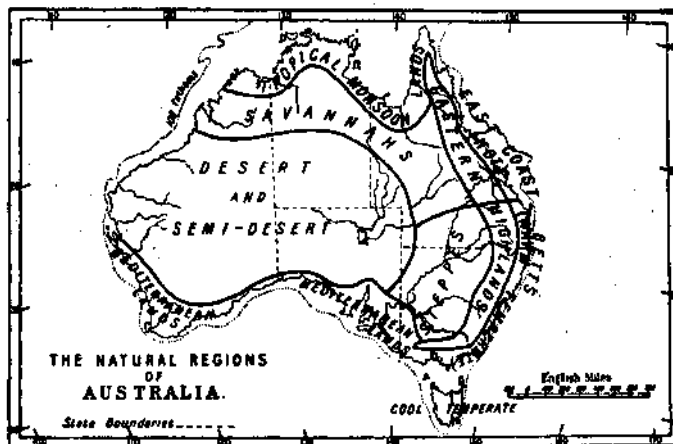


FIG. 57.—The major natural regions of Australia.

is quite without rainfall. The region is of slight value for its vegetable productions, but there are areas, as at Kal-gorlie and Coolgardie, where valuable mineral deposits, especially of gold, exist. Naturally, the development of gold-mining is largely dependent upon the supply of water. The Australian deserts may be compared with Arabia.

The Mediterranean Lands.—The Asiatic counterparts of these lands of warm, temperate climates with winter rainfall, are found in the Lands of the Five Seas. These regions receive most of their rain from the prevailing

westerly winds blowing in winter. In the Australian region the parts getting heavy rainfall are forested, but along the dry coasts of the great Australian Bight the rainfall is only sufficient for scrub and clump grasses, so that pastoral occupations only can be carried on. In the Victorian part of the region there are rich grasslands suitable either for pasture or for agriculture. The typical Mediterranean products—vines, olives, mulberries, etc.—have been introduced in suitable parts of Mediterranean Australia, and even outside that area, with considerable success, but taking the Australian Mediterranean lands as a whole, they are not so true to type as the Mediterranean lands of the Old World, the Americas and South Africa.

The Steppes or Temperate Grasslands,—This region, which may be compared with the Siberian steppes, is chiefly the basin of the Murray-Darling, and is noted for its pastoral occupations, especially sheep-rearing. The rainfall decreases from east to west, so that the number of sheep per 1000 acres in the east is over four times as many as in the west. Another important point to notice is that the west has very few places suitable for agricultural occupations, whilst rapid progress in this direction has been made in the wetter east, where wheat-growing is now very important. The development of the pastoral and agricultural pursuits of the region has been greatly helped by the boring of artesian wells (see p. 222).

The Eastern Highlands,—The climate of these highlands varies with latitude and elevation. In the wetter parts, such as the Australian Alps, the forests are more extensive than elsewhere. Generally speaking the vegetation is of the mixed forest and grassland type, so that agricultural and pastoral occupations are carried on as well as lumbering. Rich mineral deposits make the eastern highlands of great economic value.

The Warm Temperate South-Eastern Margins.—In latitude this region may be compared with Central and Northern China. The latter have the greater part of their rain in summer, whilst the Australian region has rain at all seasons, but most in summer. The tempera

ture conditions in the two regions are very different. The Chinese type of region is continental in character, having very cold winters and hot summers. The explanation of these differences must be sought for in the relief and size of the land masses behind the regions. In the north of the Australian region the temperature is high enough for sugar, whilst maize is more important than wheat, even in the south.

Cool Temperate Tasmania.—The Tasmanian climate, which has no counterpart in Asia, may be compared with that of Britain. The range of temperature is not very great, and the general climatic conditions are distinctly those associated with Western Europe. The prevailing winds at all seasons are the westerlies; the heaviest rains are on the west coast, and the island generally is well-watered. As a natural consequence a large part of the island is forested by trees of a similar kind to those of Western Europe, the forests being densest on the west coast, whilst the drier, less exposed parts are grass covered.

HISTORY AND POLITICAL DIVISIONS.

HISTORY.—The history of the discovery of Australia forms a most interesting story, but only the barest outlines can be given here. If a large atlas map of Australia is examined, the number of Dutch names appearing on the west of the continent is at once noticed.

Some of these are:—Cape Van Diemen, Houtman's Abrolhos, Dirk Hartog Island, Cape Leeuwin (lioness). Tasmania was formerly known as Van Diemen's Land. Indeed, until the middle of the last century, Australia was commonly called New Holland, and it is very probable that* if the Dutch sailors who first explored its coasts had seen the east coast, instead of the north coast with its mangrove swamps, or the desert west coast, the continent would still have borne that name. It appears as though the earliest Portuguese, Dutch and Spanish explorers, whose objective was the Spice Islands, missed

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EDITOR'S INTRODUCTION

THE time has gone by when it was thought possible that a textbook of geography should be equally suitable for pupils at different stages of advancement, so that a series of books suited to different stages is necessary for use in schools. Regions may be studied in different orders suited to different circumstances and aims, and, to be entirely satisfying, each scheme of study should have a special series of books. The series, of which this book forms one, is designed to fit a particular scheme—i.e. that in a secondary school in the years at the end of which is one of the First Public Examinations of the type of the London General School Examination, a scheme which has for many years been found in practice to be extremely satisfactory at the William Ellis School.

Three of the volumes cover the world regionally in three years; the fourth contains much of the preceding matter in a condensed form, together with a few additions on subjects which are more profitably studied after other work has been done. Account is taken of the fact that the pupils are advancing in ability, so that, while there is a certain uniformity in that each book provides a north and south section of the world, yet the arrangement is such that the matter increase in difficulty. The series supplies textbooks for a complete school course in geography which includes physical as well as regional geography, and the order in which regions are taken depends to some extent on the desirability of studying particular sections of physical geography in a suitable order.

After the Americas in Book I, Asia and Australasia are selected for treatment in Book II. Here the geography of man is much more complicated, and the related physical geography, including, as it does, such phenomena as monsoons, necessitates the study of more climatic material than is found in Book I. At the same time the fact that the volume treats of a north and south section of the world allows of revision of previous work by comparison and contrast.

JAMES FAIRGRIEVE.

PREFACE

THIS book is the second of a series of four intended to cover the geography course for the four years leading up to and including the year in which an examination of matriculation standard is taken. From the very earliest years of teaching reference is constantly being made to matters pertaining to climate. The writer has found from experience that pupils who have arrived at this age are particularly interested in the meteorological side of geography, and are old enough and sufficiently advanced to draw together and organize, as well as to add to, previous teaching. Therefore the first seven chapters are designed to accomplish this, and to show in a clear and simple manner the broad connections existing between temperature, pressure and winds, rainfall, etc., and to carry these connections one step farther by showing the influence of all upon the distribution of natural vegetation. More difficult matters, such as the study of the Daily Weather Report and the division of the world into its major natural regions, are left for full consideration at a later stage. Chapters VIII to XVIII deal with the regional geography of Asia, and whilst the work covered in the earlier chapters is illustrated and emphasized in a concrete manner, the treatment is not unduly biased, and the method follows broad lines. The remaining chapters are devoted to Australasia, in studying which it is possible, not only to test whether the principles already learned have been understood, but also to note the differences that occur through its position in the southern hemisphere as contrasted with the situation of Asia north of the equator.

At the end of each chapter there will be found a number of questions and exercises. They are designed to test the pupil's powers of assimilation and originality; and of course it is not intended that answers should be *written* to all, nor are they by any means the only suitable exercises which may be set.

Teachers will find Book II, the *New Regional Map Books*, by V. C. Spary, B.Sc., published by the University of London Press Ltd. (price *is.*) of considerable value for use with this book.

As the author is a Divisional Inspector of Schools under the London County Council, the rules of that Authority make it necessary for him to state that the Council is in no way responsible for the book or for any of the statements in it.

L. B.

**44 Wildwood Road,
Hampstead Garden Suburb, N W. 11.
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BOOK II

ASIA AND AUSTRALASIA

CHAPTER I.

THE EARTH AS A GLOBE.

LONG before the birth of Christ men believed that the earth was a sphere, and in support of their views put forward some of the arguments with which we are now so familiar. But during the Middle Ages, and right up to the time of Columbus, the most absurd views of the earth's shape were held. Sailors believed that the earth was like a shield, and that if they arrived at the edge, their vessels would fall off into space. It was the voyage of Columbus which compelled men to pay more attention to the older and truer notions of the earth's shape.

Over three hundred years before the Christian Era, it was noticed that when the earth came between the sun and the moon, thus causing the shadow of the earth to be cast on the moon, the edge of the shadow was always part of a circle. Cones, cylinders and bodies shaped like a penny can be made to cast circular shadows in some positions, but the only body which casts a circular shadow *in all positions* is a sphere.

Early in the first century, sailors had already noticed that as they approached land, the latter was first visible from the top of the mast. We now generally state this

from the standpoint of an observer looking out to sea, from which point of view the mast becomes visible first, and later, the hull. Again, the horizon, as seen from the deck of a ship, is circular in shape, and if you climb high up the mast, the horizon still remains circular, but its distance from the ship has increased. The same would be noticed on land, but it is not so easy to see the circular horizon, owing to the hills, trees and buildings. Many other reasons for believing that the earth is spherical, or nearly so, could be given, but since they are mainly the result of somewhat complicated observations by astronomers and mathematicians, it will not be necessary to discuss them here. One very simple fact, which proves that the earth cannot be flat, should be mentioned. A ship can leave Liverpool, sail westwards across the Atlantic Ocean, pass through the Panama Canal, and continue its journey across the Pacific Ocean. It can return to Liverpool *via* the Red Sea, the Sue/ Canal and the Mediterranean, after having sailed round the world. If there were no land masses to interfere, it would be possible for our ship to sail round the world on any parallel of latitude.

Scientific men have determined for us not only the shape, but the size of the earth. We know that it is not quite spherical, and that it is very slightly flattened at the poles. This flattening is so slight that an observer would not be able to detect it on the largest of artificial globes made to scale, for the polar diameter is only 26 miles less than the equatorial diameter. The circumference of the earth is rather less than 25,000 miles, and the diameter nearly 8,000 miles.

So far as we know, the first attempt at measuring the size of the earth was made by a Greek named Eratosthenes, who lived about 200 years before the birth of Christ. At Syene, now Assuan, there was a very deep well, and noticing that the image of the sun could be seen on midsummer day at the bottom of the well, he came to the conclusion that on that day the sun was overhead, and therefore the place was on the Northern

Tropic. Eratosthenes lived at Alexandria, and he set himself the task of finding out what was the angular difference between the height of the sun on midsummer day at Syene and at Alexandria. By observations at Alexandria he found that this difference was $7^{\circ} 12'$. The next thing he required was the linear distance between

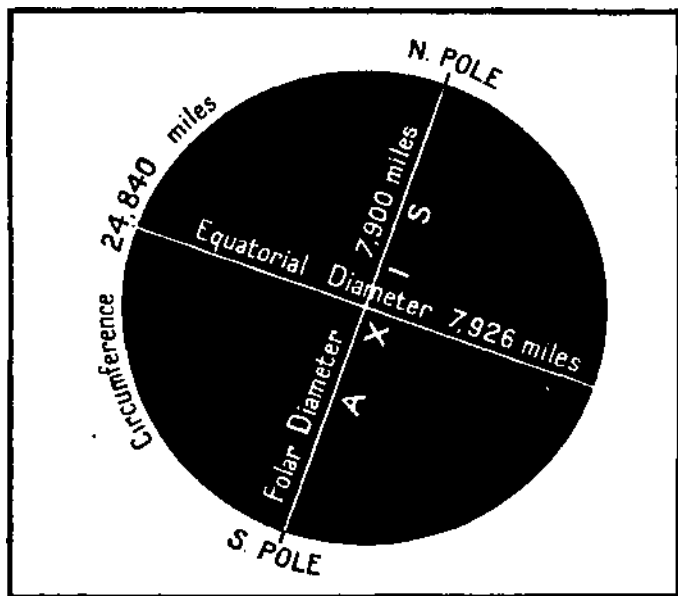


FIG. I.—Diagram illustrating some earth measurements.

Alexandria and Syene, and since even in those early days there was a good system of land survey in the Nile Valley owing to the annual floods, he had no great difficulty in obtaining this. He found the distance required was 5,000 stadia, which is 500 miles. Then he reasoned that, since a distance of 5,000 stadia subtended an angle of $7^{\circ} 12'$, the circumference of the world must

THE EARTH AS A GLOBE

be as many times 5,000 stadia as $7^{\circ} 12'$ are contained in 360° . Thus he calculated:—

$$\begin{aligned}\text{The world's circumference} &= \frac{360}{7^{\circ} 12'} 12' \cdot \times 5,000 \text{ stadia} \\ &= 250,000 \text{ stadia,} \\ &= 25,000 \text{ miles (10 stadia = 1 mile).}\end{aligned}$$

Many faults can be found in this calculation. For example, a map will show that the two towns are not on the same meridian; Syene is not quite on the Tropic of Cancer, whilst the distance from Syene to Alexandria is not exactly 5,000 stadia. Despite these drawbacks, this first measurement is very interesting.

GLOBES AND MAPS.—Since the earth is a spheroid, *i.e.*, a sphere slightly flattened at the poles, you will readily understand that the only correct representation of any part of its surface is that which we have on an artificial globe. You must have noticed how the shape of any large country or continent differs on different maps. The only correct map must be on a curved surface, for it represents a part of the curved surface of the earth, and therefore all flat maps are wrong in some respect. It is very necessary that constant reference should be made to a globe in order that wrong impressions derived from flat maps may be corrected.

CHAPTER II

THE MOVEMENTS OF THE EARTH AND THEIR RESULTS.

THE APPARENT MOVEMENTS OF THE SUN.

ALTHOUGH in this chapter we shall discuss the movements of the earth, we shall first of all learn something of the apparent movements of the sun as seen in our own country from our standpoint as spectators. If the height of the sun is measured each day at noon (see Ex. 1),¹ it will be found that its height above the horizon changes a little from day to day. If the path which the sun appears to take in its journey across the heavens is noted, it will be discovered that every day the sun gets higher and higher between sunrise and noon, at the same time appearing to move from the east towards the south. When it is due south, about noon, it is also highest in the sky. During the afternoon the sun sinks lower and lower, at the same time moving westwards. If these observations are made throughout the year, it will be seen that the sun is lowest in the sky at noon about December 21, and highest about June 21, but that it is always seen in the south about twelve o'clock. If we note the point of the compass at which the sun appears to rise, we shall find that in winter it is south-east, on March 21 due east, in summer north-east, and on September 21 due east. In winter the sun appears to set south-west, on March 21 due west, in summer north-

¹ The observations suggested are best carried out in the lower forms, but in case this has not been done, it is advisable to take them at this stage.

6 THE MOVEMENTS OF THE EARTH

west, and on September 21 due west once more. If we could see the sun at midnight it would be in the north, but since it is below the horizon we cannot see it.

THE CAUSE OF NIGHT AND DAY.

We must now explain why it is that the sun appears to make these movements. This is very simple when we realize that it is not the sun which moves, but the earth. We imagine that the earth rotates on its axis, a line passing through the earth from pole to pole. It takes the earth one day to make a complete rotation on its axis. This turning of the earth on its axis is, of course, the cause of day and night, for only half the globe can receive the sun's rays at once. The earth rotates from west to east, so that as each place comes into the light the sun appears to rise in the east. Further turning causes the sun to appear higher and higher, and to reach its greatest height about noon. After noon the continued rotation causes the sun to become lower and lower, and finally to set in the west.

THE CAUSE OF THE SEASONS.

But the earth has another motion: it makes a yearly revolution round the sun. This is illustrated in Fig. 2, which represents a tub filled with water. The water surface represents the *plane of the ecliptic*, that is, the plane in which the earth moves during its revolution round the sun. Two balls are placed on the water, one to represent the earth and the other the sun. The former is moved round the sun-ball, and its path represents the orbit of the earth.

Fig. 2 shows that needles have been passed through the earth-ball to represent the axis, and it will be seen that these are not vertical; they have been inserted so as to make an angle of $66\frac{1}{2}^{\circ}$ with the surface of the water, for the earth's axis is inclined to the plane of its orbit at that angle. We must also observe that the axis

points in the same direction during the whole period of the earth's yearly revolution round the sun. Fig. 3

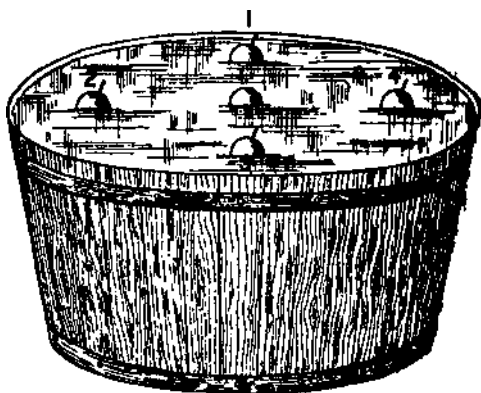


FIG. 2.—This diagram illustrates the revolution of the earth. illustrates the position of the earth with regard to the sun on certain days of the year, the unshaded area

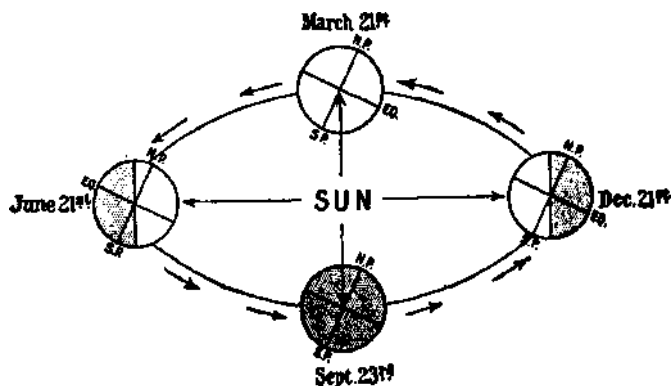


FIG. 3.—Diagram showing the position of the earth with regard to the sun at the equinoxes and solstices.

representing that part of the earth reached by the rays of the sun. It will be seen that on June 21 the northern

8 THE MOVEMENTS OF THE EARTH

end of the earth's axis, *i.e.*, the North Pole, is tilted *towards the sun* and *away from it* on December 21, so that on June 21 the sun's rays pass $23\frac{1}{2}^{\circ}$ beyond the North Pole, and fall short of the South Pole by the same angle. These conditions are reversed on December 21. On March 21 and September 23, the earth is illuminated from North to South Poles, so that the sun's rays reach the poles, but do not pass beyond them.

Now this yearly revolution of the earth round the sun is the cause of the seasons. In the next chapter we shall learn that the more overhead the rays of the sun strike the earth's surface, the warmer is the temperature*. The revolution of the earth round the sun causes the sun's rays to strike the same place at different angles at different times, and thus we have the seasons.

THE APPARENT MOVEMENT OF THE SUN IN DIFFERENT LATITUDES.

(1) AT THE EQUATOR.—Fig. 4 is a diagram which shows the apparent path of the sun at different times of the year. The point *x* represents the position of the observer, his horizon being shown by the ellipse. On March 21 the sun rises due east at six o'clock in the morning, and gradually gets higher and higher, until at noon the observer at *x* would see the sun immediately overhead. At six o'clock in the evening it sets due west. From March 21 to June 21 the sun appears to rise every day a little farther north of east, and to set a little farther north of west, whilst at the same time the elevation at noon decreases. On June 21 this northward movement ends, and on each successive day the sun rises nearer east, sets nearer west, and has a higher noon elevation. On September 23 the conditions observed on March 21 are repeated, the sun rising due east, setting due west, and being overhead at noon. Between September 23 and December 21, the sun rises each day farther south of east, and sets farther south of west, the farthest southern limits being

APPARENT MOVEMENT OF THE SUN 9

reached on December 21, when it is $66\frac{1}{2}^{\circ}$ above the horizon, which is the same elevation as on June 21, when the northern limit was reached. Between December 21 and March 21 every day sees the sun rising nearer east and setting nearer west, so that by the time the latter date is reached the sun once more rises due

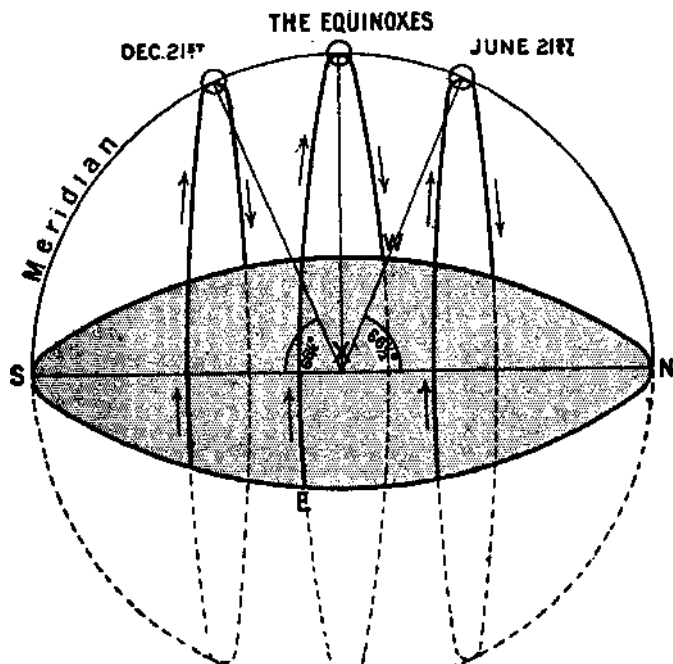


FIG. 4.—The apparent path of the sun at the equator at the solstices and equinoxes.

east, sets due west, and has an elevation above the horizon of 90° . One point must be noted, and that is, that on every day of the year at the equator, the sun rises and sets at the same time, i.e. 6 a.m. and 6 p.m. respectively.

10 THE MOVEMENTS OF THE EARTH

(2) AT LONDON.—The symbols used in Fig. 5 are the same as in Fig. 4, and since reference was made at the beginning of the chapter to the apparent movements of the sun in our own country, there is no necessity to go into detail again. The important points

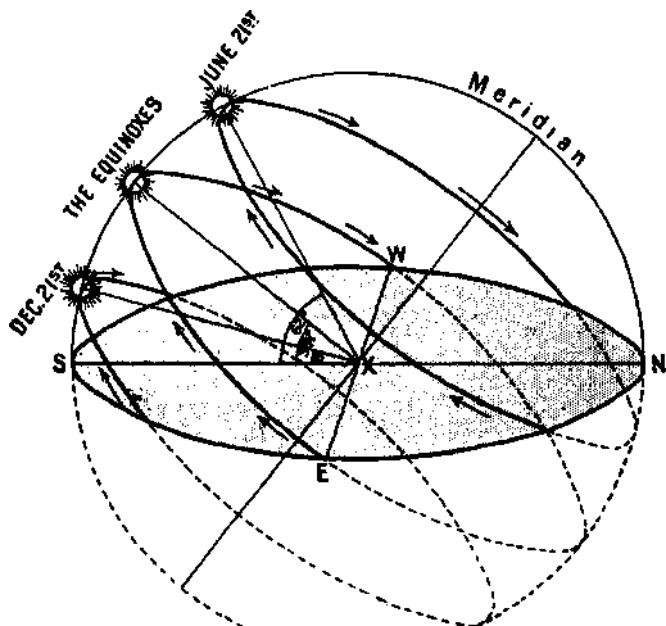


Fig. 5—The apparent path of the sun at London at the solstices and equinoxes.

to notice are (a) the long summer day, (6) the short winter day, (c) the similar conditions on March 21 and September 23.

(3) AT THE NORTH POLE.—Fig. 6 shows that on March 21 an observer at the poles would see the sun circle round the sky on the horizon. Between March 21 and June 21 it appears to circle round in the heavens,

APPARENT MOVEMENT OF THE SUN ii

gradually increasing in height, until on the latter day it reaches an elevation of $23\frac{1}{2}^{\circ}$. On each succeeding day the sun continues to circle the sky but is getting lower and lower, until, on September 23, it is once more on the horizon. But between September 23 and March 21 the sun cannot be seen at the North Pole, for it is below the horizon, reaching its lowest point on December 21. Thus we see that at the North Pole

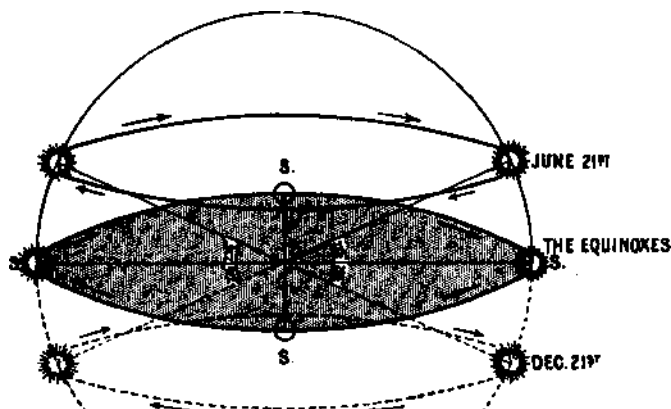


FIG. 6.—The apparent path of the sun at the North Pole at the solstices and equinoxes.

the sun never sets for six months, and never rises above the horizon for the same period. This is true at the South Pole, too, but the seasons are reversed. It must not be supposed that this means that the poles have six months light and six months darkness, for we must note that there is twilight until the sun reaches a certain distance below the horizon, and since the sun at the poles increases and decreases in height very slowly, twilight lasts for a whole month.

12 THE MOVEMENTS OF THE EARTH

HOW THE TROPICS, THE ARCTIC AND ANTARCTIC CIRCLES ARE FIXED.

We have learned that on June 21 the North Pole is tilted towards the sun, whilst on December 21 it is pointed away from the sun. It is this tilting of the earth's axis which causes the sun to be overhead at noon on June 21 as far north of the equator as $23\frac{1}{2}^{\circ}$ N. This is, naturally, what may be expected, for the earth's axis is inclined at that angle from the vertical. Similarly, on December 21, the sun is seen overhead at noon $23\frac{1}{2}^{\circ}$ S. of the equator (see Fig. 7). If, as

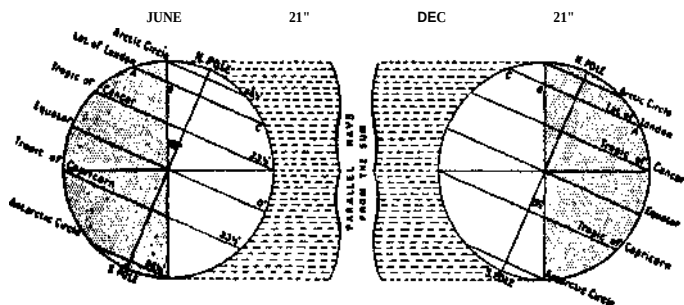


FIG. 7.—The position of the earth with regard to the sun at the solstices.

the earth rotates on its axis on these days, the sun were to trace on the earth a line along which it is seen overhead, we should have two circles which mark the northern and southern limits of the belt within which the sun can be seen overhead on certain days of the year. Thus we have the Tropics of Capricorn and Cancer fixed. The word "tropic" means a "turning point." Fig. 7 also shows that the rays of the sun fall $23\frac{1}{2}^{\circ}$ beyond the North Pole at the northern mid-summer and fall short of the South Pole by the same angle; whilst at the northern midwinter, the rays pass beyond the South Pole and fall short of the North Pole. In this way, the Arctic and Antarctic Circles are fixed.

THE EQUINOXES AND SOLSTICES.

On March 21 and September 21, when the rays reach both poles, the sun can be seen overhead at the equator, and every place has equal day and night, the sun rising at 6 a.m. and setting at 6 p.m. Therefore these days are called respectively, the *Vernal or Spring and Autumnal Equinoxes*. We have also seen that on June 21 the sun reaches the northern limit of its apparent migration into the northern hemisphere. This day is said to be the *Solstice*, which means, that the sun, as it were, stands still before its migration southwards, and since it is this apparent movement of the sun which causes summer, June 21 is called the *Summer Solstice*. Similarly, December 21 is known as the *Winter Solstice*.

EXERCISES.

1. (a) Keep a record of the noon height of the sun, if you have not done so in a lower form or class. Any sufficiently accurate instrument may be used. (b) Push a knitting-needle into a drawing-board and place the board where the sun's rays will fall upon it during school hours. Draw a line along the shadow every half-hour. From the lines so drawn, what can you learn about the height of the sun during the day? (c) By means of drawing-pins, fasten a piece of white cardboard to a drawing-board. Draw a circle of about four or five inches radius. Draw a diameter. Divide half of the circle into angles of 15° , and erect a knitting-needle at the point where each radius touches the circumference. By means of a cork-borer, obtain several pieces of cork about a quarter of an inch long and push these on the knitting-needles. The drawing-board must then be placed in a spot (best of all a window facing south) upon which the sun shines during school hours. At nine o'clock in the morning, turn the board so that the left knitting-needle and the centre of the circle are in a line with the sun. Push the cork down the needle until its shadow falls upon the centre of the circle. Repeat the process every hour, and at the end the small corks will give a representation of the path of the sun during the day. This may be repeated at other times, using different corks.

2. Draw diagrams similar to Figs. 4, 5 and 6 to show the apparent path of the sun at the solstices and equinoxes as seen by an observer at (a) the Arctic Circle, (b) the Tropic of Capricorn.

14 THE MOVEMENTS OF THE EARTH

3. Give in tabular form the height of the sun at noon on the days of the equinoxes and solstices at the poles, the Arctic and Antarctic Circles, London and the Equator. Arrange the table so as to give the dates on the left column and the places at the heads of columns.

4. Explain points of geographical interest in each of the following quotations-

- (a) The sun above the mast
Had fixed her to the Ocean.
- (b) The days grew longer and longer
Till they became as one.

5. What would be the effect (a) if the earth's axis were not tilted? (6) If the South Pole were always tilted towards the sun?

6. What are (a) the Tropics of Cancer and Capricorn, (b) the Arctic and Antarctic Circles?

CHAPTER III.

THE DISTRIBUTION OF TEMPERATURE.

TEMPERATURE is measured by means of the thermometer, and in English-speaking countries, except for scientific purposes, the Fahrenheit thermometer is in most general use, although continental countries use the Centigrade thermometer. On the former, freezing-point is 32° and boiling-point 212° , whilst on the latter these are 0° and 100° respectively. On the maps used in illustrating this chapter both scales are given.

The envelope of air which surrounds the earth can be heated in two ways; either from the earth itself, and we know that the interior of the earth has a very high temperature indeed, or from the sun. The amount of heat which the air derives from the heated interior of the earth is very small indeed, and this is illustrated by the fact that polar regions must have the same amount of heat from this source as equatorial regions, but we know that there are enormous differences between the temperature conditions in these areas. For all practical purposes we must confine our attention to the sun as the source of heat.

THE DISTRIBUTION OF INSOLATION.

Fig. 8 represents the earth, and A, B and C are bundles of sun's rays of equal width. It is clear that the nearer the rays fall to the equator, the greater is the angle at which they strike the earth, and the less the area which they have to heat. This is one reason why equatorial regions are warmer than polar regions. It is very

16 THE DISTRIBUTION OF TEMPERATURE

useful to use a term which expresses the amount of heat energy we receive from the sun. The term is *insolation*. The insolation for any day is the total amount of radiant energy received from the sun during that particular day. It is very important to notice that figures which give the amount of insolation at different latitudes

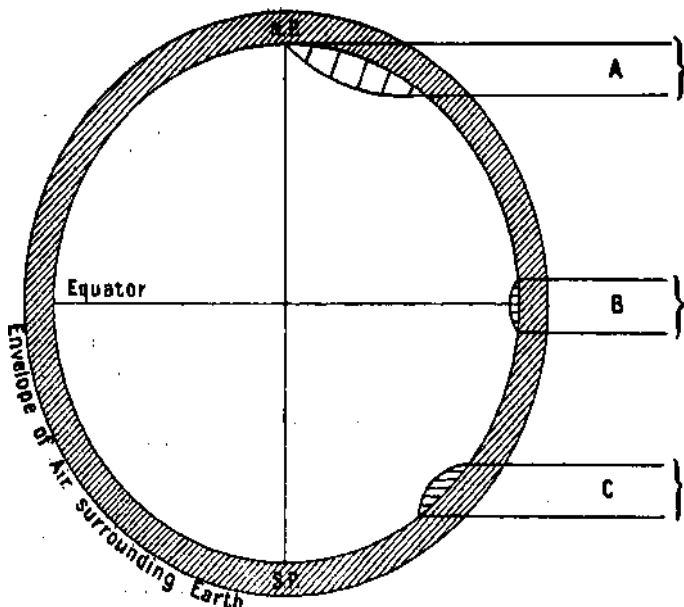


FIG. 8.—Diagram showing bundles of the sun's rays striking the earth's surface at different angles.

at certain times of the year, do not take into account the important facts that the earth is surrounded by an atmosphere, and that the land and sea surfaces of the globe differ very greatly in their power of heating and cooling. They do, however, take into account the length of time the sun is above the horizon.

It might be supposed that on June 21, when the sun is overhead at the northern tropic, insolation will be

greatest there. This is not so, for we must not forget that on that day, day and night are not of equal length as at the equinoxes, when the amount of heat received from the sun is greatest at the Equator, and decreases towards the poles. At the summer solstice, there is still equal day and night at the Equator, but as we go towards the North Pole the length of day increases, being 13 hrs. 56 min. in lat. 30° , and $18\frac{1}{2}$ hrs. in lat. 60° ; whilst regions within the Arctic Circle have a longest day varying from 24 hours to 6 months, according to their positions. Thus it is evident, that although the sun will be hotter at the Tropic of Cancer, it is longer in the sky in latitudes farther north, so that the total amount of radiant energy or insolation received is not very easy to calculate. If we let the insolation at the equator for the vernal equinox be represented by the number 1,000, that at different latitudes on June 21 is given in the following table :—

Latitude N.			
0°	881	50°	1105
10°	975	60°	1093
20°	1045	70°	1130
30°	1088	80°	1184
40°	1107	90°	1202

From these figures it will be seen that the insolation on June 21 is greater at the North Pole than at the Equator. But there are certain facts which must be pointed out, or a wrong impression might be gained. Firstly, the figures represent the total amount of insolation received during the whole day, and do not show the temperature *reached* during the day. We know that the polar regions do not attain the same temperatures as equatorial regions. Secondly, since the table imagines the earth to have no atmosphere, it does not take into account the loss of heat owing to absorption by the atmosphere. Thirdly, the figures do not allow for the fact that the earth has both land and

18 THE DISTRIBUTION OF TEMPERATURE

water surfaces, and that these affect the distribution of temperature very considerably. Let us first consider the influence of the atmosphere upon insolation.

THE INFLUENCE OF THE ATMOSPHERE ON INSOLATION.

Before they can reach the earth, the sun's rays have to pass through the air envelope which surrounds the earth to a height of some 200 miles. In passing through the atmosphere, the sun's rays must lose some heat even if the air were quite free from all impurities. But there are dust particles and water vapour in the air, and these absorb the sun's rays to such an extent that a large proportion of heat does not reach the earth. It will readily be seen that more heat will be absorbed by the atmosphere, the denser and thicker the envelope of air and the more dust and water particles that air contains. Fig. 8 shows that ray B has to pass through less air than those which fall obliquely (A and C), and therefore will not lose so much heat to the atmosphere. Therefore, since the sun's rays reach equatorial regions in a far less slanting direction than polar regions we have here another reason why the latter regions are colder. We shall now learn of the influence of land and water upon temperature.

THE INFLUENCE OF LAND AND WATER UPON TEMPERATURE.

Land and water do not take in heat at the same rates. If we heat a cubic foot of sand and the same quantity of water, we should find that the latter requires about twice as much heat to raise the temperature 1° as is required to raise the temperature of the sand by the same amount. On cooling, water gives out more heat than land. Again, the water in the ocean is in constant motion, so that the heat received from the sun is distributed, whereas rays falling on land heat only the

ALTITUDE AND TEMPERATURE

area on which they fall. Water is heated to a greater depth than land, and this is another reason why water takes longer to heat. In brief, we may say that the water surfaces of the earth take longer to heat in summer than the land surfaces, and cool at a slower rate in winter—that is, the oceans will be cooler than the continents in the same latitudes in summer, and warmer in winter (see Ex. 4 at the end of chapter). Lastly, let us turn to the influence of altitude upon temperature.

THE EFFECT OF ALTITUDE ON TEMPERATURE.

It has been seen that the atmosphere receives some heat from the rays of the sun as they pass through it. But only a small proportion of the heat received is acquired in this way. The sun's rays heat the surface of the earth, and by the process of radiation some of this heat is absorbed by the air. But the air is probably affected most by actually coming in contact with the earth, for it is easily heated by contact with something warmer than itself and cooled by something colder than itself. Thus the layers of air in contact with the earth are heated, and becoming lighter than the surrounding air, are displaced by the latter and forced to rise. The air which now comes in contact with the earth is warmed, and in its turn is compelled to rise. The ascending particles of air lose some of their heat to the air with which they come into contact. In this way the whole of the lower layers of the atmosphere are gradually warmed. Since the air is largely heated by contact with the earth, it is natural that the temperature falls as altitude increases. But this does not fully explain why it is colder on the top of a mountain than at its base, for the air at the summit is as near the ground as the air at the base. The question of pressure comes in here, and although we shall speak of atmospheric pressure in the next chapter we can now mention that air pressure decreases as sea-level is left behind.

20 THE DISTRIBUTION OF TEMPERATURE

As the air at high altitudes is not so dense as near sea-level, and is freer from water vapour and dust, it follows that the amount of insolation reaching the surface is greater than at sea-level. But for the same reasons the heat is very quickly radiated to the atmosphere, and the ground cannot retain its temperature for long. The total effect is to lower the temperature on mountains or plateaux.

The rate at which the temperature falls varies very much according to the place and season, but it may be taken as about 1° F. for 300 feet of ascent (see Ex. 3 at the end of this chapter). We have now covered all the points which will help us to understand the temperature maps of the world. Before studying them, however, let us just put together, from what we have learned, the causes which make summer warmer than winter.

WHY IT IS WARMER IN SUMMER THAN IN WINTER.

Fig. 7 shows that the North Pole is tilted towards the sun in June, and away from the sun in December. This not only gives us longer days in summer, but causes the sun to be higher in the sky in summer than in winter. Thus it is warmer in summer than in winter, for these reasons—

(1) The amount of insolation is greater, partly on account of the greater angle at which the sun's rays are received, and partly because the days are longer. (2) Less heat is absorbed as the sun's rays pass through the air. The lines A, B, C, in Fig. 7, represent the latitude of London, and the thickened rays are those which reach this latitude at June 21 and December 21. It will be seen that the summer ray reaches the latitude of London in a less slanting direction and passes through less air in June than in December. Notice the parts of the lines A, B, C, which are in the unshaded portion of the diagrams. These represent the relative length of days in June and December. It is at once

evident that the tilting of the earth's axis gives to London a longer day in summer and therefore more heat.

Temperature distributions are shown by means of *isotherms*, which may be defined as lines along which the temperature is everywhere the same. The method of drawing isotherms is illustrated in Ex. 1 at the end of this chapter. It is very important to notice that most isothermal maps are reduced to sea-level. Temperature varies with elevation, and therefore it is necessary to correct the thermometer readings at each station to what they would be at sea-level, if we wish to learn from the map the effects upon temperature of causes other than elevation.

TEMPERATURE MAPS OF THE WORLD.

Figs. 9, 10 and 11 show the mean sea-level temperatures for April, January and July. April (or October) is the best month for showing the temperature conditions when the maximum temperature is near the equator. January and July maps give the distribution of temperature in the winter and summer months of temperate latitudes. Theoretically, Figs. 9, 10 and 11 should be made for the days of the vernal or spring equinox and the solstices, but there is what may be described as a "lagging of the seasons," which must be taken into account.

Some isotherms are of greater importance than others; for example, the summer isotherm of 50° F. approximately marks the poleward limit of trees, for the latter cannot thrive unless this temperature is reached during at least one month. On Figs. 9, 10 and 11 the isotherms of 32° , 50° , 68° and 86° F. have been inserted. In order to bring out more clearly the great winter cold of the Eurasian land mass, other isotherms have been added to the January map.

APRIL TEMPERATURES.—Fig. 9 shows the **April** temperatures reduced to sea-level. It will be seen that

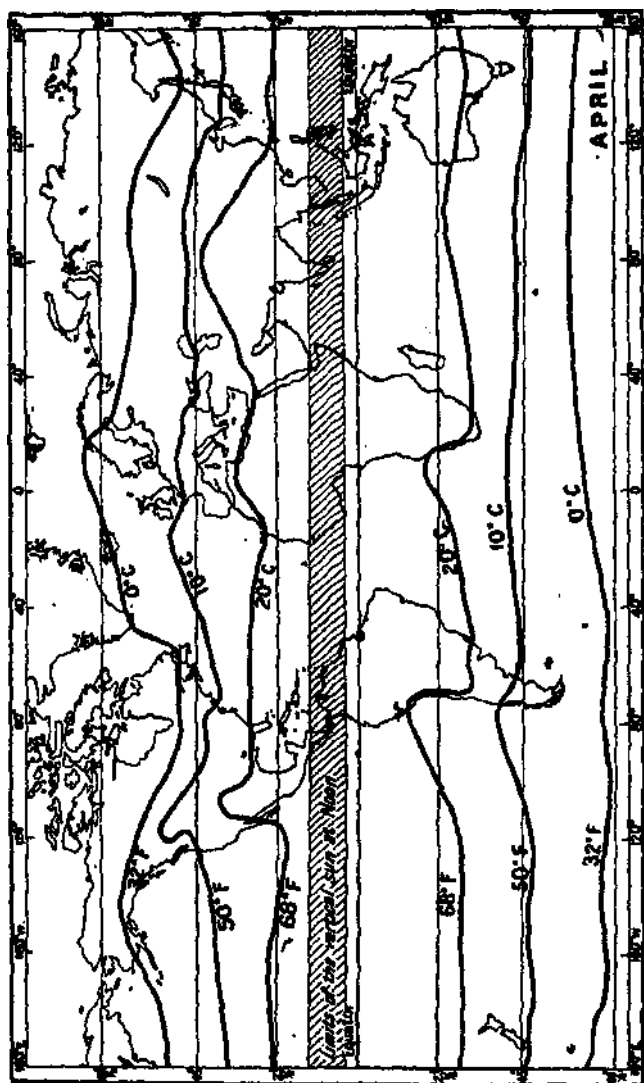


FIG. 9.—Mean sea-level temperatures for April.

TEMPERATURE MAPS OF THE WORLD 23

the region of greatest heat lies in equatorial regions, and that the temperature decreases gradually as the poles are approached. The isotherm of 50° follows very roughly the parallels of latitude 45° N. and S. The explanation of this general distribution of temperature is found in the fact that this map is made for a month immediately following the spring equinox, so that we should expect temperatures to decrease gradually from the equator to the poles.

JANUARY TEMPERATURES.—This map shows that the heat belt has migrated southwards with the sun, for the latter is overhead at noon on December 21 at the Tropic of Capricorn. The hottest belt is distinctly south of the equator, for it is in the summer season in the southern hemisphere. The highest temperatures (over 86°) are to be found over the land masses, on account of the fact that the temperature of land rises more quickly than that of water. The isotherm for 50° almost keeps parallel to the lines of latitude, and the reason for this should be apparent, as it is almost entirely over water. As a contrast, the isotherms for the northern hemisphere show a most marked bend southwards on the west of continents, and northwards on the east of continents, whilst over the land masses themselves they bend southwards. The isotherm for 32° F. gives the best illustration of this. This irregularity is accounted for partly by the unequal heating of land and water, and partly by ocean currents. With regard to the effect of the latter, we shall make fuller reference in Chapter V, but one other example of their influence on temperature may be pointed out now. In both January and July, the isotherms of the southern hemisphere bend northwards off the west coasts of land masses and southwards off their eastern shores. The reason for this is, that cold currents flow northwards along their western shores, and warm currents flow southwards along their eastern margins.

The coldest region is in Northern Siberia, where there is an area which has been called the "cold pole,"

24 THE DISTRIBUTION OF TEMPERATURE

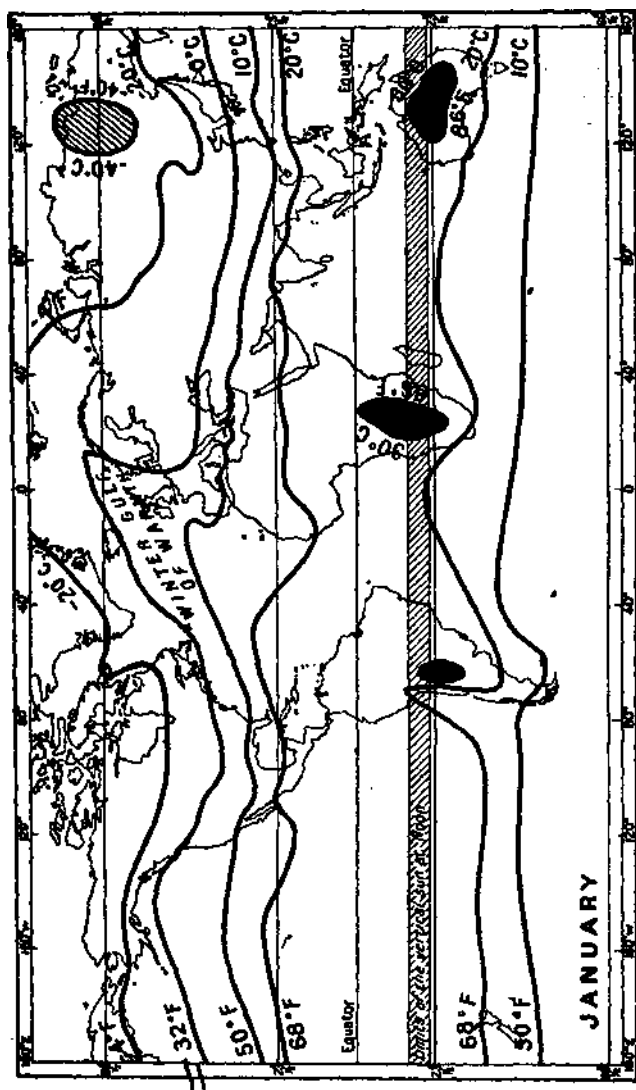


FIG. 10.—Mean sea-level temperatures for January.

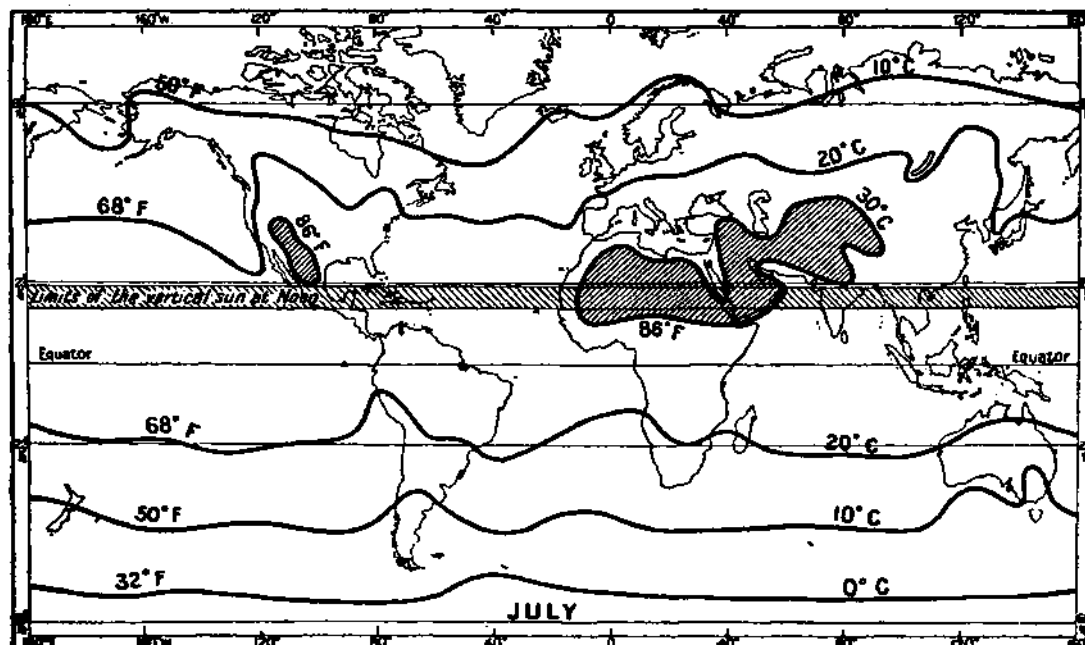


FIG. II.—Mean sea-level temperatures for July.

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whose temperature is below -48° F. A vast area of Eurasia has a temperature below freezing-point. So great is the land mass that this temperature is experienced within 3° of the Tropic of Cancer. The interior lands of North America are also very cold, but since the land area is not so great as in the old world, the temperatures are relatively not so low.

JULY TEMPERATURES.—Fig. 11 shows the temperature for July, when it is evident that the heat belt has migrated into the northern hemisphere, where the highest temperatures are seen to be over the land masses. Since the latter are warmer than the oceans in the same latitudes, the isotherms of the northern hemisphere bend northwards over the land. Over Asia, the isotherm of 68° F. reaches within 7° of the Arctic Circle. The southern hemisphere shows a more equable distribution of temperature south of the equator, due to the great extent of ocean.

EXERCISES.

1. On two outline maps of the British Isles plot the positions of the stations used (or the reports of the Meteorological Office. On one map print by the side of each station the mean temperature for January, as given in Appendix 1 of the D.W.R. On the other do the same for July. Then draw the isotherms for every even number of degrees (*i.e.* 38° , 40° , 42° F., etc., for January, and 56° , 58° , 60° F., etc., for July).

2. Draw a map of the coast-lines of the North Atlantic Ocean, and on it mark the January isotherm of 32° F. Shade the area which has a temperature of over 32° F. The great gulf-like tongue of warmer water off the West of Europe is sometimes called "The Winter Gulf of Warmth."

3.

Place.	Height in feet above sea.	Jan. temp.	July temp.
Fort William . Ben Nevis summit .	S.L. 4,400	$38^{\circ}7'$ F. $23^{\circ}4'$ F.	$57^{\circ}1'$ F. $41^{\circ}7'$ F.

Find these places on the map. Account fully for their differences in temperature.

EXERCISES

4.

Place.	Jan. temp.	July temp.	Range of temp.
Cambridge .	37-6° F.	61'5° F.	23'9 ⁰ F.
Berlin .	31'3° F.	64'5° F.	33'2' F.
Warsaw • •	23'9 ⁸ F.	65'5° F.	41'6° F.
Saratof. • •	13'5° F.	71'0° F.	57'5 ⁰ F.

These places are in approximately the same latitude. Account for the different temperature conditions shown by the figures.

5. On outline maps of the Old World north of the equator mark the isotherms for January and for July. Shade the maps so as to emphasize cold in winter and heat in summer. Write short accounts bringing out the leading features shown by the maps.

6. On outline maps of the southern hemisphere draw the isotherms for January and for July. Shade the map as suggested in Exercise 5. State the chief differences between the distribution of temperature in Eurasia and North Africa and in the southern hemisphere.

7. Why is it warmer in equatorial regions than in polar regions? Draw diagrams to illustrate your answer.

CHAPTER IV.

THE PRESSURE OF THE ATMOSPHERE AND ITS INFLUENCE ON WINDS.

IN previous chapters we have learned that the earth is surrounded by an air envelope. It is known that this extends to a height of about 200 miles from the earth's surface, and that the higher we go the lighter the air becomes. Since we know that air has weight, it follows that it exerts a pressure upon the surface of the earth, and that this pressure will be greater at sea-level than on the top of a high mountain, for there is not so much air above the latter as there is above a place at sea-level. Air pressure is measured by means of the barometer. A barometer consists of a glass tube which is closed at one end. This tube is filled with mercury, inverted, and the open end placed into a cup of mercury. The mercury column then falls a little, and some of the mercury runs back into the cup, leaving in the tube a column about thirty inches high.

When the air pressure upon the surface of the mercury in the cup is increased, the column is pushed higher up the tube; but if the air pressure decreases mercury flows from the tube to the cup, and the height of the column is decreased. Thus it is seen that when the column stands at a height of 30 inches the pressure of the atmosphere is equal to that of a layer of mercury 30 inches deep. It is usual to express the pressure of the atmosphere in inches or millimetres of mercury, and the normal pressure at sea-level is about 29.9 inches or 760 millimetres. It is more scientific, however, to use a pressure unit, hence the increasing use of the terms *bar*

and *millibar* (see Exercise 7 at the end of this chapter). When the pressure is more than 29.9 inches **or 1012.5** millibars we speak of it as being "high," and when it is below this we speak of it as being "low." Since we know the density of mercury it is easy to calculate that this pressure is equal to one of 147 pounds per square inch.

PRESSURE AND ALTITUDE.

We have seen that the air extends to a height of about 200 miles, but at that height it is extremely rare. Since the upper layers of air press upon the lower layers, the latter are denser and therefore heavier, for the particles of air are closer together. If a barometer were carried up the sides of a high mountain it would be found that the reading would continually fall, and that at an elevation of 900 feet from sea-level the reading would be one inch less than at sea-level. To cause a fall of another inch, however, we should have to make an ascent of more than 900 feet, because, as we are now increasing our elevation, the air is less dense than it was at lower levels. At an elevation of 3½ miles the pressure is only about half what it is at sea-level, so that half of the atmosphere would be below that elevation; whilst at a height of seven miles we should have three-fourths of the atmosphere below us.

So rarefied is the atmosphere at great elevations that it is very difficult to breathe sufficient air for the wants of the body. Some men and animals have become accustomed to living at great elevations; but it is a well-known fact that travellers *unaccustomed* to living in high altitudes find great difficulty in breathing, and even at lower levels, suffer from headaches, dizziness and sickness. It will readily be seen that barometer readings can be used for determining roughly the heights of mountains.

PRESSURE AND WINDS.

If the pressure at any place is high, and that of the surrounding area low, air flows outwards from the higher

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pressure towards the lower. Air always flows from places of high pressure towards places of low pressure. But this statement requires some modification, for the rotation of the earth causes winds to be deflected to the right in the northern hemisphere, and to the left in the southern hemisphere. Pressures are represented by means of *isobars*, or lines along which the pressure is everywhere the same (see Ex. I on p. 40). Fig. 12 A shows an area of high pressure surrounded by lower

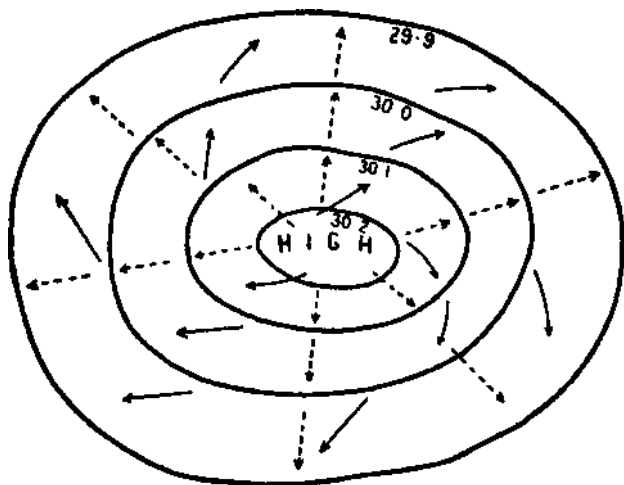


FIG. 12 A.—The relation between pressure and winds.

pressure, and if the earth stood still winds would flow outwards as indicated by the dotted arrows. If this represents a pressure system in the northern hemisphere the actual winds will be as shown by the straight-lined arrows. This law of the deflection of winds to the right in the northern hemisphere, and to the left in the southern hemisphere, due to the earth's rotation, is known as *Ferrers Law*. It must be noted that rivers are also influenced, but not nearly to the same extent as the lighter, easily influenced air currents.

PRESSURE AND WINDS

A full explanation of this deflection cannot be entered into here, but it may be illustrated in several ways.

Push a knitting-needle through the centre of a cardboard disc, and rotate the disc from right to left. From the centre of the disc allow an inked marble to run towards the edges, and then notice its track. The marble does not reach the point originally aimed at, but is deflected to the right. This illustrates the deflection of a northern hemisphere air current moving equatorwards, for the edge of the disc represents the equator, and the centre the North Pole. If the disc be rotated from left to right the deflection is then to the left, and this illustrates the deflection of air currents

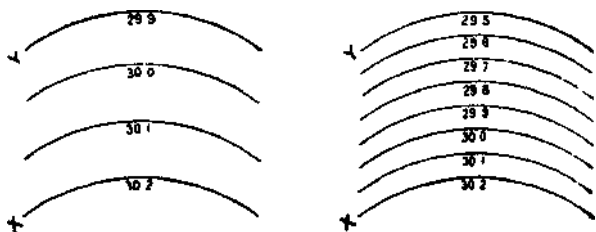


FIG. 12 B.—Steep and less steep gradients.

moving from the South Pole towards the equator from the standpoint of a person looking down upon the South Pole. The deflection of currents moving equatorwards can also be shown as follows: Rotate a globe in the same direction as the earth's rotation, *Le.* from west to east. Whilst the globe is turning round, by means of a piece of chalk, try to draw due north and south lines. Draw several for each hemisphere, taking care that each line is drawn towards, and not away from, the equator. Stop the globe, and it will be seen that the lines show deflection, as stated in Ferrel's Law. Currents moving polewards are also deflected to the right in the northern hemisphere, and **to the left in the southern hemisphere.**

There is one more point to which **reference** must be

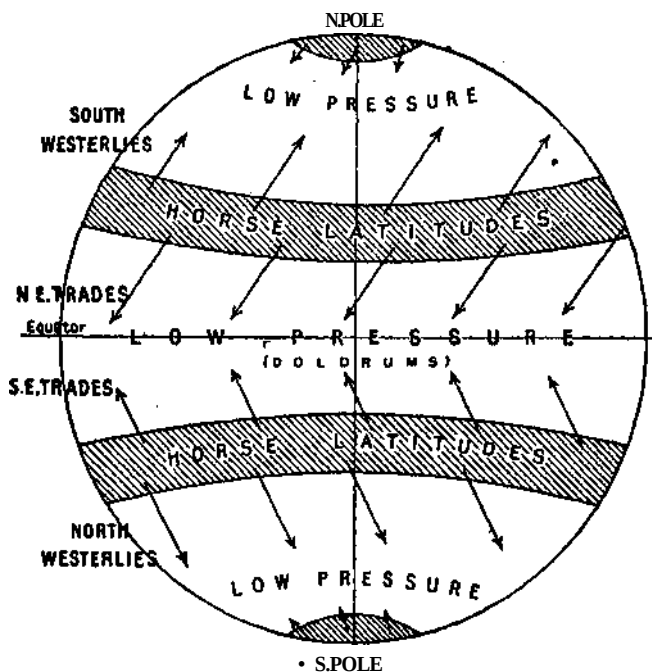
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made. At the beginning of this section we learned that winds are due to differences of pressure. From this it follows that the greater the difference in pressure between two places the stronger will be the resulting wind. In the isobars on the left of Fig. 12 B the difference between the readings at x and y is three-tenths of an inch. In those on the right x and y are the same number of miles apart, but the pressure difference is seven-tenths of an inch. In the latter case, the winds experienced will be much stronger than in the former, for the air will be pushed outwards with much greater force. In each case the isobars are drawn to show differences of pressure at one-tenth of an inch intervals, but it is evident that they are closer together in one than in the other. Thus we reach a statement which is sufficient for present purposes: winds are generally stronger where the isobars are closer together than where they are farther apart.

GENERAL DESCRIPTION OF THE DISTRIBUTION OF PRESSURE AND THE PLANETARY WINDS.

We are now in a position to consider the distribution of pressure over the surface of the globe. In the last chapter we learned that the equatorial belt has great heat. Now this causes the development of an area of low pressure known as the Doldrums, towards which there are inflowing winds at the surface and above which there is a drift of air forced upwards by the meeting of the inflowing air currents. About 30° to 35° north and south of the equator are two belts of high pressure. These are known as the Horse Latitudes. Small areas of high pressure are also found at the poles, whilst in sub-arctic regions there are low-pressure areas. All these will be found on Fig. 13. Now if the world stood still, we should have winds blowing from high-pressure belts to low-pressure belts; but, as the rotation of the earth causes the winds to be deflected, we have air currents moving equatorwards and polewards from

the Horse Latitudes, and being deflected to the right in the northern hemisphere and to the left in the southern hemisphere. Those blowing towards the equator are the steady *Trade Winds*, and those blowing pole-



high Pressure Areas.

FIG. 13.—A diagrammatic representation of the prevailing winds of the world.

wards are the *Westerlies*. In addition to these, there are the winds which blow from the polar high-pressure areas. All these winds will be found marked in Fig. 13. The *Westerlies* are stronger than the *Trades*, but do not blow with such regularity, and on this account are best referred to as the "Prevailing *Westerlies*." The pic-

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turesque name " Brave West Winds " has been given to the Westerlies of the southern hemisphere, whilst the latitudes in which they are most reliable and are very strong, have been named " The Roaring Forties." These names help to indicate the strength of the southern hemisphere Westerlies.

One other point must be made clearer. The Horse Latitudes and the Doldrums are " calms "—that is, little movement of air is felt. Very often sailing ships are becalmed in these latitudes for many days together. This is due mainly to the fact that the chief movement of air in these places is a vertical one. Air rises at the Doldrums and, in the upper layers of the atmosphere, flows out towards the poles. By the time the Horse Latitudes are reached, the air has sufficiently increased in density, due to cooling, that it falls to the surface, and flows either to the equator or towards the poles as a surface wind. Thus it is seen that since the movement of air at the Horse Latitudes and Doldrums is not a horizontal movement, these regions will be calms. This explains, too, why there are high-pressure belts from 30° to 35° north and south of the equator. The air which descends to the surface in these latitudes increases very rapidly in density as it falls, so that the pressure is bound to be high.

WORLD DISTRIBUTION OF PRESSURE.

In explaining Fig. 13, we have not taken into consideration the fact that the earth's surface consists of land and water, and that these, owing to their different capacities for heating and cooling, will affect pressure. Nor have we taken into account seasonal changes in pressure distribution. We shall now consider these points.

Figs. 14, 15 and 16 show the distribution of pressure in October, January and July. For the purposes of comparison, all the readings from which pressure maps are constructed have certain corrections applied to them,

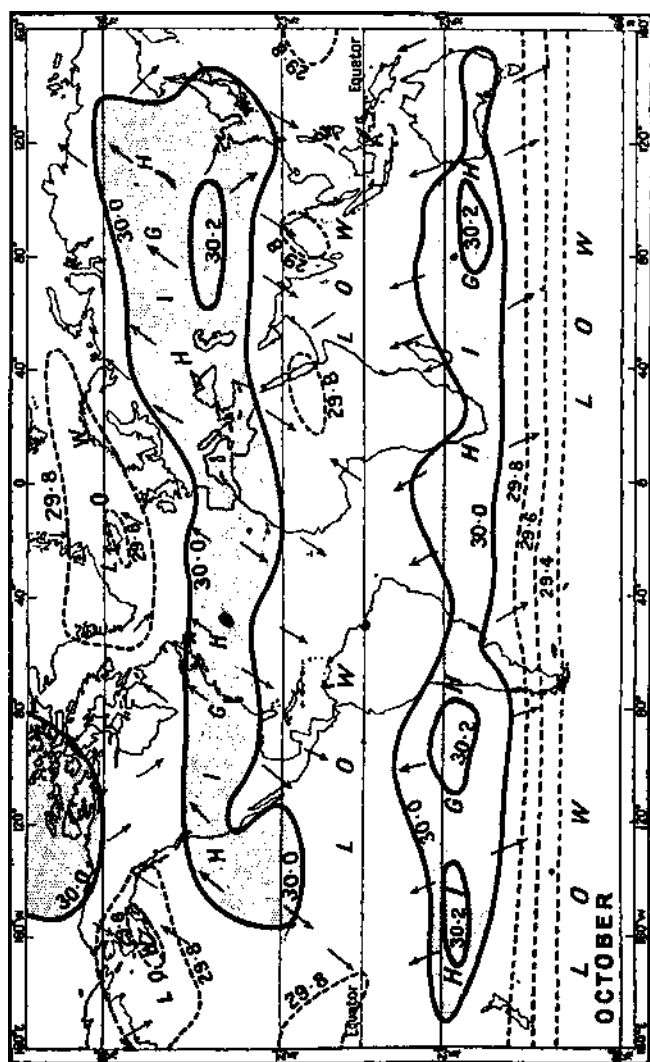


FIG. 14.—Isobars and winds for October. (After Buchan.)

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the chief being for altitude and temperature. As all readings have been corrected to sea-level readings, it follows that the actual pressure over such a high plateau as Tibet is much less than these maps show. Temperature, too, has an important influence upon pressure, so that pressure maps are corrected to a standard reading at 32° F., but this correction is not nearly so large as that for altitude.

PRESSURE DISTRIBUTION IN OCTOBER.—Fig. 14 shows that at this month there is a marked low-pressure belt corresponding to the equatorial heat belt. The pressure increases until the latitudes 30° — 40° N. and S. are reached, and here we have belts of high pressure. In higher latitudes still, the pressure again diminishes. This distribution more nearly corresponds with that shown in the diagram Fig. 13, and this is due to the fact that October is very near to the equinox, when the sun is seen overhead at noon at the equator.

PRESSURE AND WINDS IN JANUARY.—We can see very clearly from Fig. 15 that in this month the equatorial low-pressure area has moved southwards. This is in accordance with the migration of the temperature belts. We can also see that the southern high-pressure belt, the Horse Latitudes, is not so continuous as in October, for there are distinct low-pressure areas over the land masses of South America, Africa and Australia. Remembering that January is the southern summer, this is easily accounted for by the unequal heating of land and water. In the northern hemisphere, the high-pressure belt is a very marked feature, especially over the land masses, where the pressure is the highest. This is best shown over Asia, where the area of high pressure is very large indeed. Over the North Atlantic and Pacific Oceans are well-defined low-pressure areas. The influence of land and water upon the pressure distribution just outlined should be obvious.

The arrows show the winds which will be found to blow from high to low pressure, and to be deflected according to Ferret's Law. Notice the continuous belt

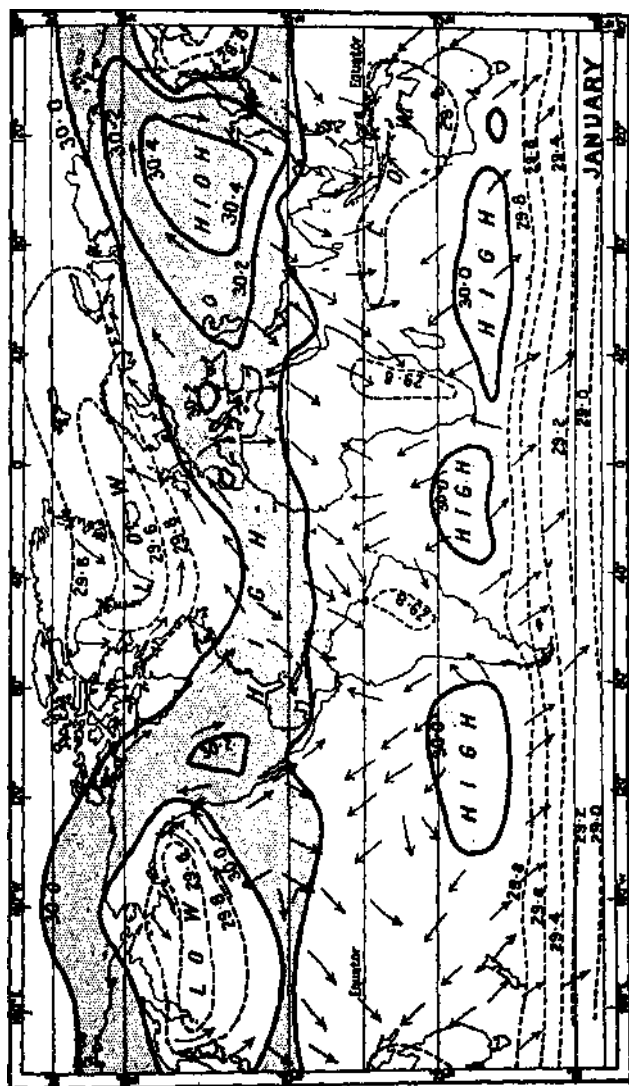


FIG. 15.—Isobars and winds for January. (After Buchan.)

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of north-westerlies compared with the south-westerlies of the northern hemisphere. The latter tend to get into great swirls of air blowing spirally round the ocean centres of low pressure. One more point should be observed. In North-western Australia the ordinary S.E. Trades are not experienced at this season (southern summer). Owing to heat, a low-pressure system is formed, towards which air flows, thus giving a north-west monsoon.

PRESSURE AND WINDS IN JULY.—This is the winter month of the southern hemisphere, where we find the actual distribution of pressure closely corresponding to Fig. 13. The reason is, that in this hemisphere the disturbing factor of the temperature differences between land and sea is not so important as in the other hemisphere, because the land masses are not nearly so large. The Doldrums belt of low pressure and the southern Horse Latitudes high-pressure belt are clearly shown, but when we turn to the northern hemisphere Horse Latitudes, it is apparent that there is no continuous belt of high pressure at this season. Over the oceans are areas of high pressure, and over the continents areas of low pressure, that over Asia being very well marked. It will thus be seen that the distribution of pressure shown in Fig. 13 has to be modified in the case of Asia, owing to the enormous area of the land mass. In January, Asia has a system of high pressure, with out-flowing winds; in July, it is under the influence of a low-pressure system with inflowing winds. It is this great change in the distribution of pressure that gives to Asia, south-east of a line drawn from Karachi to Korea, a distinctive type of climate of alternating dry and wet seasons. The full consideration of this is reserved for another chapter, but one point must be mentioned. Fig. 16 shows that the S.W. wind which blows over India in July is simply the S.E. Trade Wind, which, having crossed the equator, is deflected to the right by the rotation of the earth, and proceeds towards India as a south-west wind. The term " Mon-

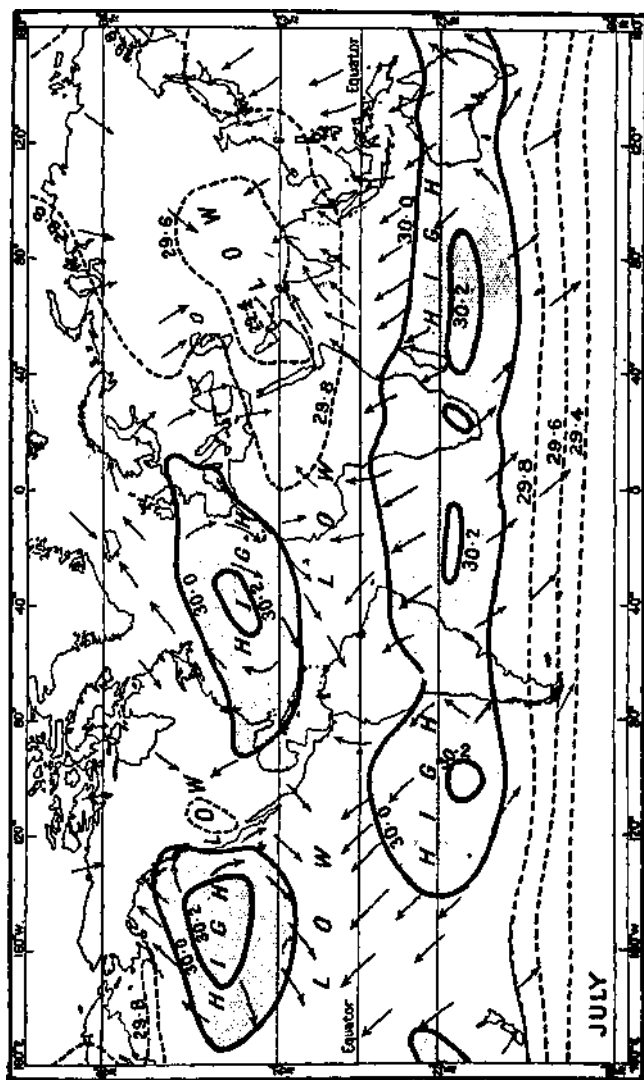


Fig. 16.—Isobars and winds for July. (After Buchan.)

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soon" (= a seasonal wind) is given to the summer winds of S.E. Asia.

We have learned that in January there is a distinct southerly migration of the pressure belts, and if the pressure maps for October and July be compared, it will be apparent that in the latter month there is a similar migration northwards. This is exceedingly important, for there are certain latitudes which will be transition areas, *i.e.* will be in high-pressure belts at one season, and in low-pressure belts at another. In order to prevent exaggerated ideas concerning the amount of the migration you will do well to consult a set of monthly charts of the North Atlantic Ocean.

EXERCISES.

1. Draw an outline map of Western Europe. Mark the positions of the places shown in the first column of the Daily Weather Report. Beside each, mark neatly the reading of the barometer at 7 a.m. and draw the isobars at intervals of one-tenth of an inch. Compare your results with those on p. 3 of the Weather Report.

2. Make maps showing the distribution of pressure in the southern hemisphere for January and July. Show winds by arrows. Write an account of the distribution of pressure as shown in the map.

3. Make maps showing the distribution of pressure in the northern hemisphere for January and July. Show winds by arrows. Describe the distribution in writing, accounting for the differences noted between these maps and those for the southern hemisphere.

4. On an outline map of the world plot the probable course of a sailing vessel from London to Melbourne and home again. (The direction of the prevailing winds must be kept in mind in order to accomplish this exercise successfully.)

5. Explain very carefully:—high pressure, Roaring Forties, Horse Latitudes, Doldrums, Ferrers Law.

6. Draw a circle of $2\frac{1}{2}$ " radius. Mark the equator and the tropics. Shade or mark the polar high-pressure regions and the Horse Latitudes. By means of arrows, show the prevailing winds of the world.

7. What is a millibar? Why is air pressure now recorded in millibars in the Daily Weather Report?

8. What special precautions had to be taken by the Mt. Everest climbing parties in order to carry on their work at high altitudes? Why **were these** necessary?

CHAPTER V.

OCEAN CURRENTS.

FIG. 17 shows a small tank containing water. At one end a strainer containing ice is fixed, and at the other the lid of a small tin box is held in position by a piece of wire. A bunsen burner is fixed or held so that the flame heats the lid. The water in contact with the heated lid is raised in temperature and thus expands, whilst that in contact with the ice is chilled and contracts. This causes the cooled water to sink and the heated water to flow towards the ice. In this way a circulation of water is set up as indicated in Fig. 17 by the arrows.

Now let us apply this simple experiment to the waters of the ocean. The heated end of the tank may be compared with the surface waters of the ocean at the equator, and the cool end with polar waters. In polar regions water sinks to the bottom of the ocean on account of increasing density due to cold, whilst at the equator, where the heat of the sun warms the surface water, expansion takes place and water is set in motion polewards.

There is no doubt that there is a general equatorwards creep of cold water along the ocean bed, and a surface flow towards the poles; but this is not sufficient to account for the extensive movements which take place in the surface waters of the oceans. The chief cause of these must be looked for in another direction.

If, by means of a pair of bellows, air is blown upon the surface of a tank filled with water, the force of the air is quite sufficient to set up surface currents of water.

There can be little doubt that the prevailing winds are the chief factors in the production of ocean currents, for in regions where winds change with the seasons, the change of wind is accompanied by a change in the direction of the currents. This is very clearly shown in the North Indian Ocean. We have learned that at one time of the year (Nov.-April) the wind is from the north-east; at the other time (May-Oct.) it blows from the south-west. Fig. 18 shows the currents of the Indian Ocean, from which it will be seen that a change of wind

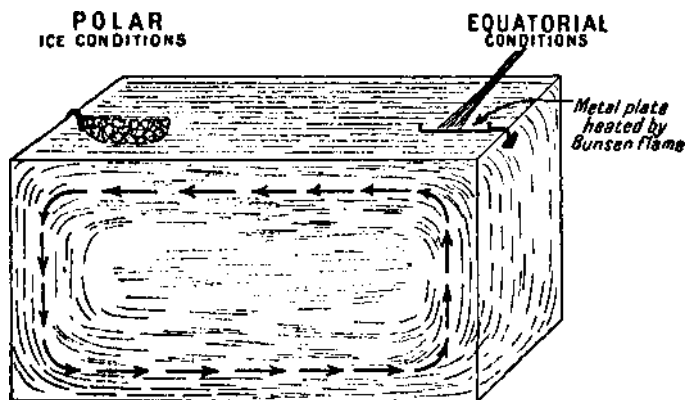


FIG. 17.—Diagrams showing currents caused by unequal temperatures.

is accompanied by a change in the direction of the ocean currents.

Let us at the outset notice two ways in which ocean currents may be classified. In the first place, we can distinguish between *relatively warm* and *relatively cold* currents, as is done in Fig. 18. A current will be relatively warm when it is flowing towards regions which are colder than those from which it has come, and, on the other hand, a current will be relatively cold when it is flowing towards warmer regions.

Ocean currents may also be classified as *stream* or *drift* currents. The former may be likened to broad

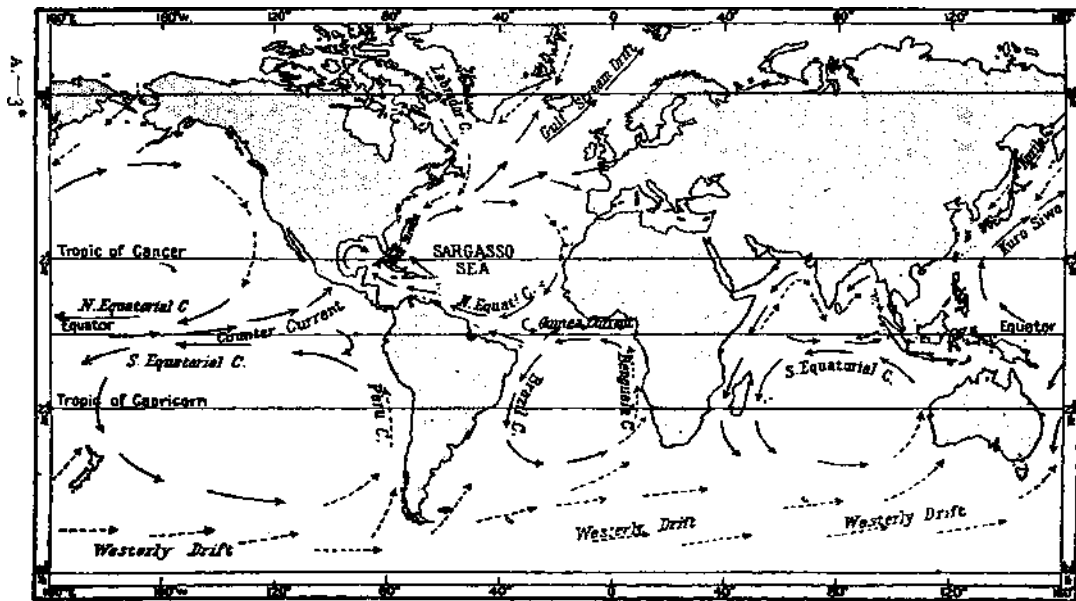


FIG. 18.—Ocean currents. The dotted arrows in the N. Indian Ocean show the currents during the S.W. Monsoon, the other arrows those during the season of the N.E. Trades. Elsewhere on the map the dotted arrows show relatively cold currents, the others relatively warm currents.

ocean rivers flowing between comparatively still waters. They flow faster than drift currents, and are caused by water which has been heaped up, seeking to find its own level. Drift currents move more slowly, and are simply a general drift of the surface water due to the force of the prevailing winds.

Keeping clearly in mind the prevailing winds, there should be no difficulty in understanding the direction of the chief ocean currents as given in Fig. 18. Let us consider the currents in the Atlantic Ocean. Off the north-west coast of Africa, in the region of the N.E. Trades, the surface waters are compelled by the winds to drift westwards until they are turned, partly by the shape of the mainland of North America, and partly, as in the case of winds, by the influence of deflection. A similar drift of waters is set up by the influence of the S.E. Trades, and the result is the South Equatorial Current, which is split into two by the wedge-shaped corner of South America, part of the waters flowing northwards to join those of the North Equatorial Current, and part passing along the shores of Brazil, from which country the branch is named the Brazilian Current. As all this water is blown across the Atlantic, it will be seen that the level of the sea off the American coast in these latitudes tends to be rather higher than on the corresponding African shores, and so it is.

But water cannot continue to be piled up, however steady and strong the winds may be. Some of it is bound to return, and it does so in the region of Doldrum Calms, which is between the North and South Equatorial Currents. This return, or counter-stream current, is known as the Guinea Current.

Now let us return to the North Equatorial Current, which is reinforced by a portion of its southern counterpart. Some of its waters pass through the Caribbean Sea and the Gulf of Mexico, and cause such a piling up of waters that a strong and steady stream current of water flows from the Gulf of Mexico between Cuba and Florida. This is the much misunderstood Gulf Stream.

This stream of warm water, which can be quite plainly distinguished from the surrounding waters, then flows along the south-eastern coast of the United States, although it is impossible that all the water in the stream has come from the Gulf of Mexico; some must have come from the current which did not enter the Caribbean Sea, but kept outside the West Indies. Soon after Cape Hatteras has been passed, the Gulf Stream spreads out its waters like an enormous fan, and it is no longer a stream flowing between comparatively still water, but a general drift of the warm surface waters of the ocean, blown by the westerlies towards the shores of Europe. The various branches of the Gulf Stream Drift, or North Atlantic Drift, are shown on Fig. 18, and it will be noticed that one branch returns to the north-west coast of Africa, thus completing a great clockwise motion of water, in the centre of which is the Sargasso Sea, where huge masses of floating seaweed, called sargassum, are sometimes very troublesome to ships. Fig. 18 shows that a great quantity of water from the North Atlantic is forced into the Arctic Ocean, where, as in the Gulf of Mexico, we have a piling up of waters. This cannot proceed indefinitely, and so we have return cold-stream currents re-entering the North Atlantic on either side of Greenland. These surface currents are in addition to the "cold creep" of water referred to in the beginning of this chapter. The Labrador current flows from amongst the islands of North America, past the coasts of Labrador, Newfoundland, Nova Scotia and New England, and finally sinks in the vicinity of Cape Hatteras, owing to its density being high in comparison with that of the warmer waters of those latitudes. The meeting of currents of air warmed by the Gulf Stream or its great drift, with air which has been cooled by the Labrador current, is the cause of the dense fogs which make Nova Scotia and Newfoundland the foggiest area in the world. These fogs are a source of great trouble to sailors.

Returning to the South Atlantic Ocean we find that, partly under the influence of deflection and partly **due**

to having reached the area of the westerly winds, the Brazilian Current passes across the ocean and proceeds equator wards up the coast of south-west Africa, where it is joined by the cold Antarctic Drift, a great drift of cold water blown by the westerly winds. As in the North Atlantic, there is in this part of the ocean a great circulation of water, moving in this case in a counter-clockwise direction, and having at its centre another Sargasso Sea.

The currents of the Pacific Ocean should now present no difficulty. There are equatorial drifts beginning in trade wind areas off the American coasts. Between them is the Counter Equatorial Current, which can be compared with the Guinea Current. The Kuro Siwo, or Black Stream of Japan, is the counterpart of the Gulf Stream; the north-western American coasts receive warm southern waters which may be compared with the North Atlantic Drift, whilst the counterpart of the Labrador Current is seen in the Kurile Current, which enters the North Pacific Ocean through the Bering Strait. Similarly, the currents of the South Pacific are comparable with those of the South Atlantic.

Reference has been made to the seasonal changes which occur in the North Indian Ocean, so that it is only necessary to add that in the southern portion of that ocean are currents in every essential respect similar to those of the South Atlantic and Pacific Ocean. Since the currents of the northern part of the ocean are not constant, the Counter Equatorial Current is uncertain and irregular, as may be expected.

OCEAN CURRENTS AND CLIMATE.

Finally, ocean currents have a very important influence upon climate. In Chapter III, we have seen how the warm water that is drifted past the western shores of Europe influences the climate of the western margin of that continent. This is very clearly shown in Fig. 19, for the direction taken by the January

isotherm of 32° F. is very considerably influenced by this factor. There is a striking difference between the winter temperature of the coast lands on opposite temperate shores of the North Atlantic.

Fig. 19 represents a land mass stretching from north to south temperate latitudes. The vast amount of water carried eastwards by the westerly winds causes a piling up of warm surface water on the western shores of temperate latitudes, whilst these waters tend to be blown away from eastern shores in the same latitudes,

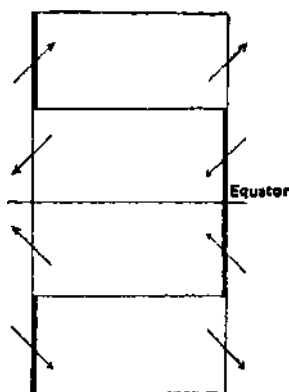


FIG. 19.—This diagram illustrates the piling up of waters by on-shore winds

and much lower temperatures are experienced. In trade-wind latitudes the conditions are reversed and the warm surface waters are piled up on the east coast and carried away from the west. A map showing the distribution of coral will show coral reefs, etc., on the eastern shores of tropical countries, but not on the west, for the tiny coral polyp cannot live unless the temperature of the water is always over 70° F. These warm conditions are not found on the western margins, where the colder water takes the place of the surface water drifted away from the coast by the prevailing winds.

EXERCISES.

1. Describe the courses which might be taken by a sealed bottle cast into the sea from a boat passing the Canary Islands.

2. How far is it true to say that the circulation of the surface waters of the North Atlantic Ocean is as if the water had been stirred in the direction of the hands of a clock, and in the South Atlantic in a direction opposite to those of the hands of a clock?

3. What effect have ocean currents upon the directions taken by the southern hemisphere isotherms of 68° F. (January and July)? See Figs. 10 and 11.

4. Explain what is meant by warm and cold currents, stream and drift currents. Give examples.

5. Draw a diagram to show the ocean currents of the North Atlantic Ocean. Show their connection with the prevailing winds.

CHAPTER VI.

RAINFALL: ITS CAUSES AND DISTRIBUTION.

EVAPORATION AND CONDENSATION.

AFTER rains a considerable quantity of water remains on the surface of the ground in small pools, but quickly disappears. Wet clothes are hung out and are taken down quite dry. In both of these instances the water has disappeared into the atmosphere in the form of water vapour which we cannot see—that is, it has evaporated. On the surface of the earth are oceans, lakes, rivers, etc., exposed to the atmosphere, and from all these water is constantly being evaporated and received into the atmosphere. If a mass of air which contains water vapour is cooled, some of the vapour may condense into very tiny drops of water which are not too heavy to be held in the air. It is in this way that mists, fogs and clouds are produced. Should the condensation proceed further, the tiny drops of water run together and form a raindrop that is too heavy for the air to carry in suspension, and rain results. Of course, only a portion of the rain which falls on the land is directly evaporated into the air; much finds its way into rivers, and is carried off to the oceans, whilst some remains in the soil and is used by plants and animals. It is interesting to think of the great oceans as the chief places where evaporation is taking place; that this water-laden air is carried by means of winds towards the lands, where it is forced to rise—perhaps on meeting mountains—and is therefore cooled, and a fall of rain occurs. The rainwater is carried off to the oceans

largely by rivers, and thus the cycle is going on throughout the centuries.

It is very important to notice that warm air can hold much more water vapour than cold air, as the following figures show—

Temperature.	Maximum amount of water vapour which can be held by a cubic metre of air.
— 10° C	2.28 grammes
0°	487 „
+ 10°	936 »
20°	17.1 „
30°	3008 „
40°	50.67 „

This table shows that the maximum amount of water vapour which can be held by a cubic metre of air at a temperature of — 10° C. is 2.28 grammes, whilst the same volume at 10° C. can hold 9.36 grammes. It will be observed that the amount of water vapour held at different temperatures increases very considerably with increase of temperature. Saturated air, or air at a certain temperature, containing the maximum amount of water vapour for that temperature, can be made to hold more by being warmed, but if it be cooled, some of the vapour will condense. The temperature to which air must be cooled in order that some water vapour may be condensed, is called its *dew-point*. Another glance at the table will show that if saturated masses of air at different temperatures, say 10° C. and 30° C, are cooled, there will be much greater precipitation in the case of the warm air than in the case of the cooler air. This has a great deal to do with the heavy rainfall in equatorial latitudes.

There are innumerable particles of dust in the atmosphere, and these appear to play a very important part in assisting condensation, for when water vapour is condensed, it is upon a nucleus of a dust particle that the tiny water drops grow.

How RAINFALL IS MEASURED.

Rainfall is measured by means of a rain-gauge. In essence, this consists of a funnel which catches the rain and leads it into some kind of vessel. If the vessel is cylindrical and the area of its opening is the same as that of the opening of the funnel, the depth of water in it represents the amount of rain which has fallen in that area. In order to measure accurately small amounts of rainfall, it is necessary to have a specially graduated measuring glass whose diameter is less than that of the funnel. If the area of the mouth of the funnel is 15 square inches, it is obvious that 15 cubic inches of water will be necessary to cover that area to a depth of one inch. Therefore, if 15 cubic inches of water are carefully measured and poured into a measuring glass, the height of the column of water will represent a fall of one inch upon the area of the funnel's opening. The measuring glass can then be graduated so as to read such small amounts of rainfall as one-hundredth of an inch.

To get correct results, it is very necessary to place the rain-gauge in a suitable position, in order that all the rain which falls may be registered. It should be placed about twice as far from the nearest building as the latter is high, and raised from the ground about one foot. The latter precaution prevents water splashing upwards from entering the funnel.

Of course, all condensed water vapour does not fall in the form of rain. Falls of snow and hail are common. The former requires very careful measuring, for the funnel of the gauge may be filled before the snow ceases to fall. Snow has to be melted before the amount can be read in rainfall equivalents. About ten inches of untouched snow yields one inch of rainfall.

THE CAUSES OF RAINFALL.

Rain is the result of the cooling of air containing water vapour. The cooling may be accomplished in several ways:—

(i) Air moving from warm to cooler latitudes will not be able to hold as great a quantity of water vapour, and there will be a tendency to precipitation. The best examples are the Westerlies, which blow towards colder latitudes.

(2) The cooling of air due to a forced ascent on meeting a mountain barrier. Rains caused by this means are spoken of as *relief* rains. Fig. 20 shows a moisture-laden wind approaching a mountain chain. It is compelled to rise and this causes the air to expand. Expansion causes a lowering in temperature and this produces rain. When the temperature falls to freezing point, snow will fall instead of rain. On reaching the leeward side of the mountains, the air begins to descend and consequently to increase in density and in temperature, and therefore

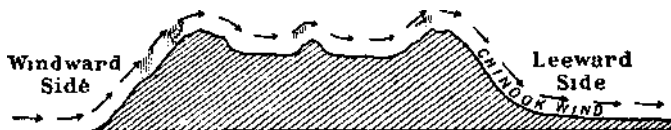


FIG. 20.—Chinook or Fohn wind.

in its capacity for holding water vapour. The increase in temperature is greater than that which was lost in ascending the windward slopes, so that the wind reaches the foot of the mountains on the leeward side a warm, dry wind. The names *Chinook* and *Fohn* have been given to such a wind. The former name applies particularly to the winds descending the leeward slopes of the Canadian Rockies, and the latter to the warm winds experienced in Swiss valleys, but the principle holds good in all particular cases, and therefore we may think of all such winds as Chinook or Fohn winds (see Ex. 1, at the end of the chapter).

There is a very close connection between the relief and rainfall maps of most countries, especially of those

in temperate latitudes. An examination of the two maps for the British Isles will show how close these relationships are in our own islands.

(3) The movement of air in cyclones causes expansion and therefore cooling and condensation. A cyclone is a pressure system in which the lowest pressure is in the centre from which the pressure rises towards the edges. In such a system the winds blow towards the centre and are deflected according to Ferrel's Law, so that, in the northern hemisphere, the whole system is rotating about its centre in a direction opposite to that of the hands of the clock. The centre of the cyclone remains an area of low pressure because the air which flows towards it is constantly rising and expanding. It is on account of this rising of air that cyclones are accompanied by falling rain. Cyclones are commonly experienced in the area of the westerly winds, and it is by their means that much of the rain that falls in these latitudes is brought.

(4) The meeting of air currents causes air to rise and expand, and therefore causes rainfall. This cause of rainfall is very similar to that which has just been considered. In the Doldrums belt, the N.E. and S.E. Trades meet, and air being forced upwards on a very large scale causes this region to be one of very heavy rainfall.

THE CAUSES OF DROUGHT.

Since any cause which can force large masses of air to be cooled will produce rainfall, any cause whereby air is warmed will tend to produce drought. It will not be necessary to go into these causes at length, for they are the opposite of those which produce rain. They are—

(1) Air flowing steadily from warm latitudes towards regions warmer still will increase its capacity for holding water vapour and condensation will not usually occur, unless by some means the air is suddenly cooled. The best examples of such air currents are the Trade Winds, and it is very striking that all the great deserts of the world are in trade-wind latitudes.

(2) There will be dry areas on the leeward side of most high mountain ranges.

(3) Anticyclones, usually masses of almost inert air, are systems of pressure, having the highest pressure in the centre and the lowest pressure towards the edges, and are fed by air descending from the upper atmosphere. They bring little or no rainfall.

(4) The Horse Latitudes are areas in which there is a descending of air, and they, too, are marked by drought.

THE DISTRIBUTION OF RAINFALL.

Figs. 21, 23 and 24 show respectively the annual, January and July distribution of rainfall over the surface of the globe. In studying these maps, constant reference must be made to the pressure and wind maps, and to the physical maps in an atlas.

MEAN ANNUAL RAINFALL.

A very general connection between Figs. 14 and 21 is evident. The belts of low pressure are areas of considerable rainfall, whilst the high-pressure belts are deficient in rain. This is illustrated in Fig. 22. The equatorial low-pressure area, the Doldrums, is one of heavy rainfall; the trade-wind areas contain most of the great deserts of the world, and in the low-pressure belts between the Horse Latitudes and the polar high-pressure areas there are other regions of considerable rainfall. Naturally, this requires to be considerably modified, for the actual distribution of pressure, as we saw in the last chapter, is not so regular as is shown in a diagrammatic manner in Fig. 22. Nevertheless, it is important to notice that there is a very close relationship between pressure and rainfall.

Fig. 21 is shaded to show areas which may be described as being well watered (over 25 ins.), moderately watered, or as having a deficient supply of rain. If this map is studied in connection with a relief map, and the dis-

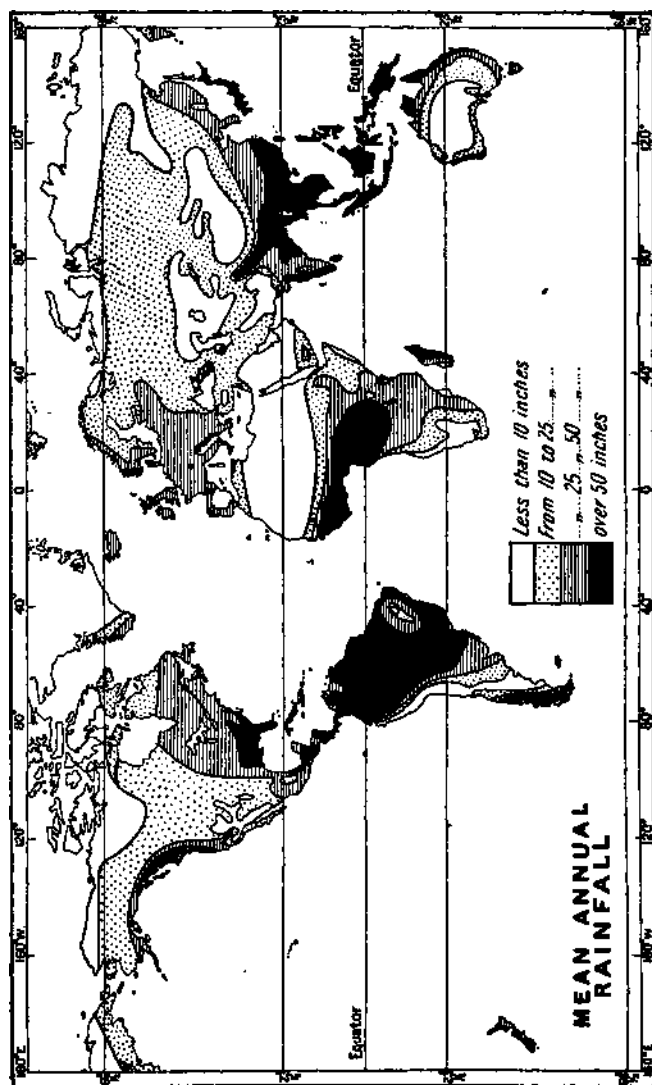


FIG. 21.—The mean annual distribution of rainfall.

tribution of pressure and the direction of the prevailing winds are kept in mind, Ex. 2 at the end of this chapter will serve as a test as to whether the principles which have been explained have been grasped or not.

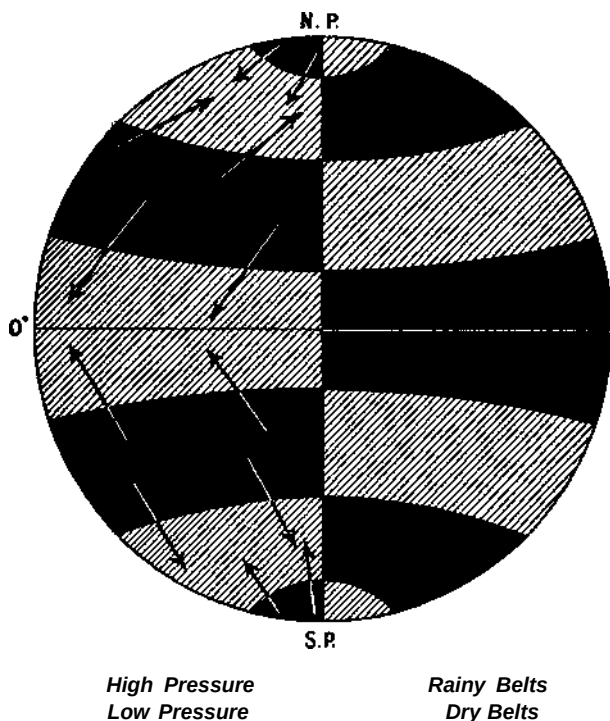


FIG. 22.—The relations between pressure and rainfall

DISTRIBUTION OF RAINFALL IN JANUARY AND JULY.

In January, the typical summer month of the southern hemisphere, the belt of greatest heat is south of the equator (Fig. 10). It is in January that the pressure

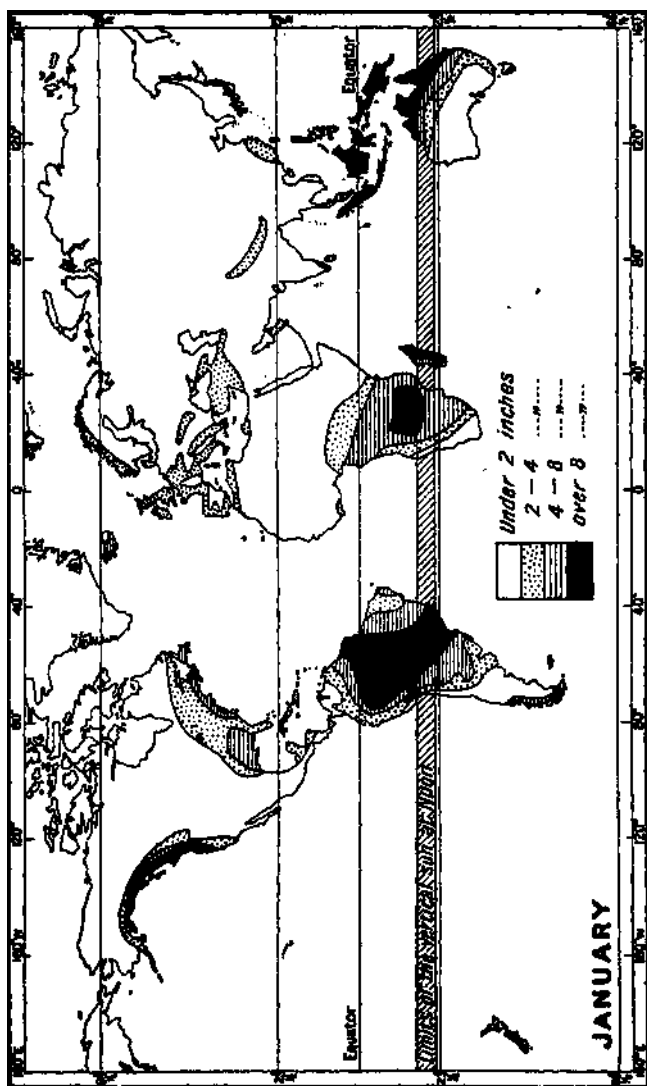
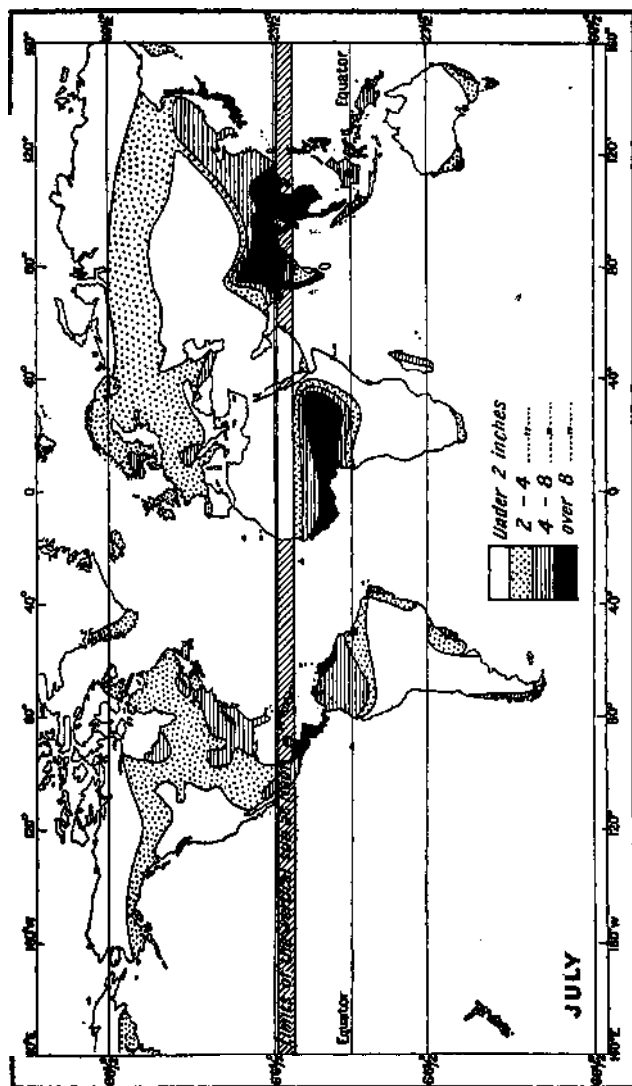


FIG. 23.—Mean rainfall for January. (After Herbertson.)

belts reach the southern limits of their migration. For these reasons, the regions of heaviest rainfall are all south of the equator in this month (Fig. 23). In July, the areas of heaviest rainfall are north of the equator, and this is due to the northerly migration of the temperature and pressure belts, a movement caused by the apparent migration of the sun (Fig. 24). These seasonal changes produce interesting results, as will be seen from an examination of Fig. 25. In the first column the approximate position of the high and low pressure belts is given for July, the month in which they are at their northern limit of migration. The second column gives the position of the various belts in the southern summer. It is at once clear that in the equatorial regions is an area which has low pressure all the year round. North and south of these are belts having low pressure in summer and high pressure in winter; these are succeeded by belts which have high pressure at all seasons. North and south of the latter are belts of low pressure at all seasons. Since areas of high pressure have little rainfall, it follows that certain of these belts will be wet at one season and dry at another, but it must be carefully observed that Fig. 25 only applies to the western margins of continents, for a wind which is there on-shore, *i.e.* blows from the sea to the land, will be an off-shore wind on the eastern lands in similar latitudes.

Let us apply Fig. 25 to the western coasts of Europe and Africa. From the north of Norway to the north of Spain is an area of rain all the year round, for the Westerlies are at all seasons the prevailing winds. From the Cantabrian Mountains to the Atlas Mountains is an area of winter rainfall and dry summers. This is succeeded by a belt of very little rainfall, and it is here that the Sahara Desert reaches the west coast of Africa. South of this is an area of summer rainfall, the Gambia and Senegal rivers having their mouths in this belt. The Guinea Coast and the Congo Basin receive rain at all seasons. South of the equator, the belts are repeated in reverse order, although there is



no counterpart of the West European type, for Africa

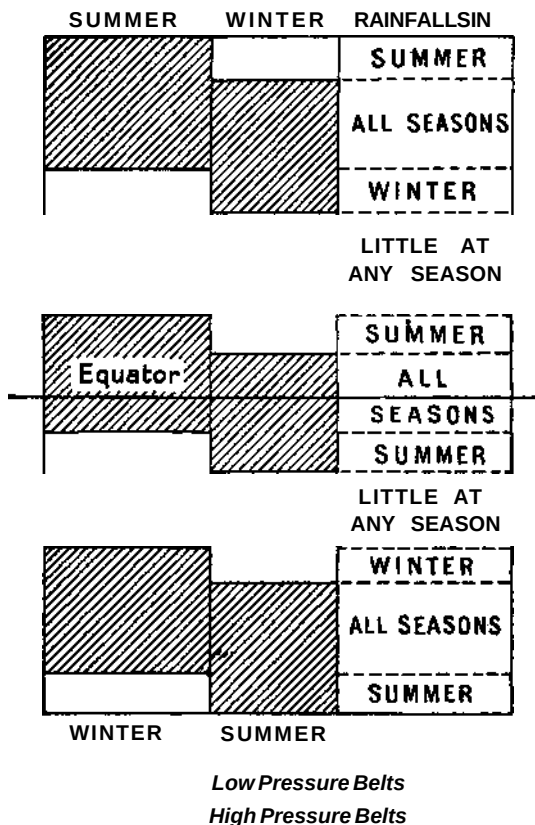


FIG. 25.—The influence of the migration of the pressure belts on the distribution of rain on the western margins on continents.

does not extend far enough south to have a belt in the prevailing north-westerly winds all the year round.

If we consider Figs. 23 and 24 together, it will be evident that some regions receive rain in winter and are dry in summer. They are on the west of continents and in the same latitudes as the two African winter rain areas which we have just considered. They are the lands bordering the Mediterranean Sea, the Valley of California, Central Chile, the south-west corner of Africa, the two southern protuberances of Australia and the north island of New Zealand. The winter rains and dry summers of all these lands are due to the migration of the pressure belts.

If we turn to Asia, we see a very striking contrast between the rainfall for January and that for July. In January, owing to this continent being under the influence of a huge high-pressure system (see Fig. 15), there are outflowing winds, and since these are dry, very little rain falls in this month except on the north-east coastlands, western Japan, in the Mediterranean lands to the east of the Mediterranean Sea, and on the Himalayas. In July, when a low-pressure system holds sway (see Fig. 16), there are inflowing winds, and since these have come over vast expanses of ocean, very great precipitation takes place, most of the continent, excepting the centre and the south-west, having a considerable amount of rain. The same causes in Australia give heavy rainfall in the southern summer to the northern margins. The winds which bring the heavy summer rain in south-east Asia and northern Australia are, as we have already learned, called monsoons.

Other lands of summer rainfall we should expect to find in the same positions as the African belts of summer rain, to which reference has already been made. In America we find that the north of South America, Central America, Mexico and the West Indies receive their rain mainly in summer; south of the Amazonian region of rain at all seasons is the Brazilian highland region of summer rain.

Owing to their great distance from the sea, we also

find that the interior lands of the great continents receive rain in summer, when they are under the influence of low pressure; but as they are far from the sea, such places have only a moderate rainfall.

EXERCISES.

1. Why is it that—

- (a) Sweden is drier than Norway?
- (b) The east of the South Island of New Zealand is drier than the west?
- (c) The northern Andes have heavy rainfall on their eastern slopes and an almost rainless area on their western slopes, and that these conditions are reversed in the southern Andes?

2. Write a short account of the mean annual distribution of rainfall as shown in Fig. 21. Give reasons for heavy rainfall in equatorial latitudes, the presence of rainless areas in the trade-wind regions, the heavy rainfall of the western margins in temperate latitudes, and the slight rainfall in the interior of the great land masses.

3. What is meant by saying that the mean annual rainfall of London is 25 inches? How has this figure been obtained?

4. Explain clearly why it is that the rain belts migrate northwards in our summer and southwards in the southern summer. What are the principal results of this migration?

5. On p. 50 figures are given showing the amount of water vapour which air at different temperatures can hold. Represent these figures graphically and write a summary of the important facts illustrated by the graph.

6. Describe a coastal region of deficient rainfall. Account for its aridity.

CHAPTER VII.

THE DISTRIBUTION OF NATURAL VEGETATION.

THE land surface of the earth is covered naturally with plants, except in those regions where it is either too high, too cold or too dry for any vegetation to exist. Generally speaking, regions of heavy nunjfallare forested, regions of light-rainfall are grasslands, and~those which lack moisture are deserts. The type of forest, grassland or desert will depend largely upon the temperature, so that there are tropical and temperate forests and grasslands, and tropical, temperate and cold deserts.

., Soil has an important influence upon-vegetetion,for some plants thrive best upon particular soils, as, for example, the beech thrives on a soil rich in lime. For most plants the presence of salt is fatal, but the mangrove and the coconut palm appear to like its presence. Different soils vary very much in their capacity for holding moisture, whilst plants differ in their capacities for extracting moisture from different soils. Some soils, again, are naturally very in fertile owing to the character of the rocks from which they havel been formed.

Fig. 26 shows the general distribution of natural vegetation, but it must not be supposed that the boundaries between the various types can be defined very clearly, for there is a gradual merging of one type into another. Deserts gradually become grasslands through an intermediate scrubland which is notable for its scattered grass patches and low, dry bushes. Grasslands merge into forests very gradually, for between areas which are typical forests and those which are typical grasslands, the scenery first resembles natural parkland—

a mixture of grasslands and woodlands—and very gradually becomes more wooded as the true forests are approached.

In studying Fig. 26 it is very important that constant reference should be made to the temperature and rainfall maps in Chapters III and VI, so that the connections between temperature, rainfall and natural vegetation may be clearly understood.

HOT WET FORESTS.

Forests of this type are found in (i) the hot wet equatorial belt; (ii) in lands having so much rain in their wet season that the soil holds a considerable amount of moisture all the year round. The former are sometimes called equatorial forests, and the latter monsoon rain forests. Equatorial forests are found chiefly in the Amazon basin and on the wet east coastlands in South America; on the Guinea coast, and in the Congo basin in Africa; and in the Malay Peninsula and the East Indies. In these forests the vegetation is exceedingly dense, even the undergrowth attaining forest dimensions, whilst the giant trees are linked together by a mass of creepers and parasitic vegetation. The floor of the forest is gloomy in the extreme, and its inhabitants are amongst the most backward races in the world. So solid are these forests that the rivers, which at the rainy seasons resemble long, narrow lakes, are the only easy ways of communication. The various trees which yield rubber are the most important trees, although there are valuable cabinet and dye woods, such as mahogany, ebony, logwood, etc., but the present difficulty of access is so great that these sources of wealth are practically untouched. Guttapercha trees are of great importance in the East Indies, and oil palms in the equatorial forests of Africa.

The forests of S.E. Asia and North Australia are not so dense, as here there is a well-marked dry season.

THE HOT GRASSLANDS OR SAVANNAHS.

Savannahs, or parklands, are grasslands interrupted by isolated patches of trees. They are found in tropical latitudes, in regions which have warm, dry winters and hot summers, with a small rainfall in summer. Fig. 26 shows that their distribution is closely related to the summer rainfall belts north and south of the equatorial belt of rain at all seasons. As the summer rainfall is not heavy, trees cannot grow excepting in places where there is a constant supply of water, *e.g.* near rivers, for the rainfall is not sufficient to keep the soil moist at all seasons. The climatic conditions are suitable for the growth of grass which springs up, produces flowers and seeds, and dies in a short time. As we should expect, one of the chief occupations on the savannahs is cattle rearing. The temperature is unsuitable for sheep.

In South America there are extensive savannahs north of the equator in the Guinea highlands and the llanos of the Orinoco Valley, and south of the equator in the Brazilian highlands. In Africa they are found north, east and south of the equatorial forests, and in a very similar position in Australia. Asiatic regions in these latitudes receive so much summer rain that, as we have already seen, they are forested.

THE HOT DESERTS.

The savannahs gradually merge, through intermediate scrublands, into deserts. The hot deserts lie chiefly on the west of continents in the latitudes of the Trade Winds. In North Africa there is the enormous Sahara desert stretching from the Atlantic Ocean to the Red Sea, and continued eastwards in Asia by the deserts of Arabia and Thar. South Africa has the Kalahari desert. In similar latitudes in South America are the long, narrow, west coast deserts of northern Chile and Peru. They lie to the lee of the Andes. In North America we have the Colorado desert, and in Australia the great western desert. There are also the extensive desert lands on

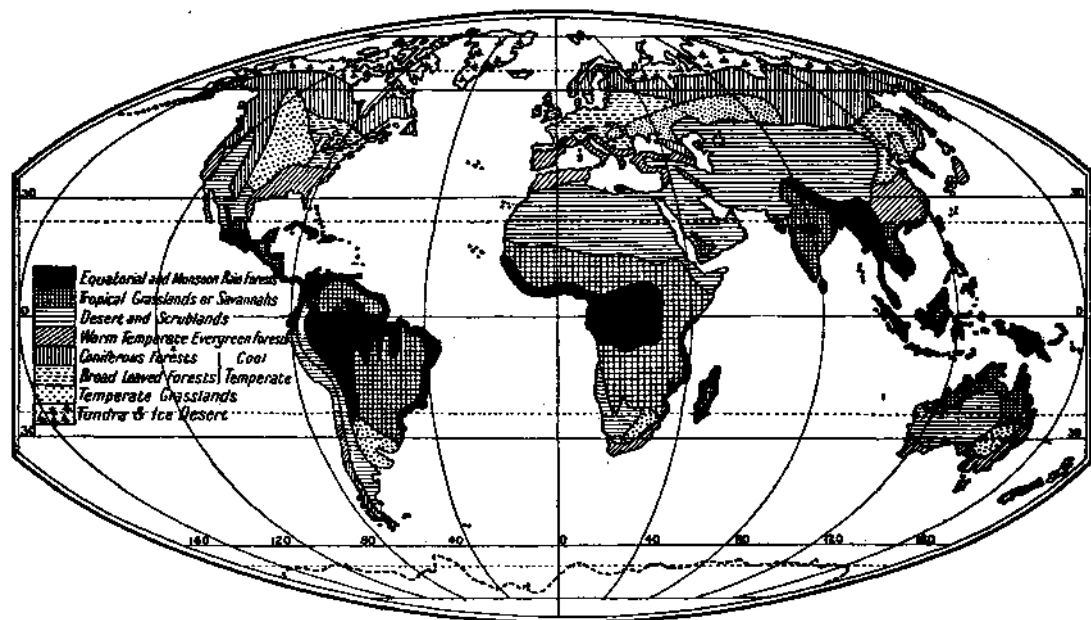


FIG. 26.—The distribution of natural vegetation.

high plateaux and in the interior of the great Asiatic land mass. Examples of these plateaux and interior desert and semi-desert lands are found in the western cordillera of North America, in the plateau of Iran, and in the deserts of Turan and Gobi.

Except where there are underground supplies of water, there are very few plants on deserts. Desert plants must either have very long roots, so that they can reach this underground water, or thick, fleshy leaves to store up water. The leaves, which are designed to resist the evaporation of moisture from the plant, are often very small and protected by means of thorns. On the scrub edges of the desert, trees which exude gum in the dry season are often met with. The acacia is a good example.

Even in the desert, wherever there is a permanent supply of water from wells or from rivers which flow across deserts but rise in wet lands, cultivation can take place, while by means of irrigation, many arid lands have been reclaimed, especially in North Africa, North America and Australia.

TEMPERATE FORESTS.

These are of two varieties: (1) *warm temperate*, which are found roughly from latitude 30° to latitude 45° , and (2) *cool temperate*, from latitude 45° to latitude 60° .

(1) WARM TEMPERATE FORESTS.—Fig. 26 shows that these are found on both east and west sides of continents. The rainfall maps show that whilst the western regions receive most of their rain in winter, the eastern regions have summer rainfall. This will naturally have its influence upon the vegetation. Whether on the east or the west, these forests are evergreen; but in the eastern forests the leaves are usually very large and thick, as, for example, the leaves of camellias and magnolias, whilst the trees in the various "Mediterranean" regions of winter rainfall

have usually either small, dry leaves, as, for example, the olive, or leathery leaves like those of the laurel.

Forests of the western or Mediterranean type are found in the lands of winter rains bordering the Mediterranean Sea; in California, Central Chile, south-west Africa, south-west and south-east Australia, and in the north island of New Zealand. The chief trees are evergreen oaks, including the cork oak, walnut, chestnut, and some species of pine. In most of these regions, vines, olives and mulberries are cultivated. In Australia the chief trees are the acacia and the eucalyptus, each of which has its leaves hanging edgewise, so that little shade from the sun's heat is given.

(2) COOL TEMPERATE FORESTS.—As in the case of the warm temperate forests, the cool temperate forests may be divided into two groups: the coniferous and deciduous forests. The former are found where the winters are severe, the summers short and the rainfall inclined to be deficient, whilst the deciduous or broad-leaved forests are found in regions where the temperature conditions are more genial and the rainfall is fairly abundant.

(a) *Coniferous Forests*.—The chief conifers are pines, hemlocks, firs and larches, but the hardy birch, which is deciduous, is a common tree in coniferous forests. The leaves of most of these trees are needle-like in structure, and thus transpiration is checked, for little surface is exposed. As a general rule, these trees retain their leaves during the long winter, which is not with all species a resting season, for the summer is so short that the comparatively warm periods at the beginning and end of winter are taken advantage of.

The most extensive coniferous forests are found in northern Europe, Asia and America. They give shelter to large numbers of fur-bearing animals, and thus trapping is usually the first occupation carried on. Later come the lumber-men, who cut down the trees, which are used for many different purposes, such as doors, window-frames, flooring, etc., whilst they also

yield turpentine, pitch, resin and wood pulp. In deforested areas where the climatic conditions are suitable, agriculture is carried on. Some regions have undergone all these stages of development, whilst some, as, for example, the forests of eastern and northern Siberia, are still in the trapping and hunting stage.

Coniferous forests are sometimes found in regions of more genial climates than those of the ordinary forests of this type. Under these conditions, the trees often attain gigantic dimensions, as on the west coast of North America, where the famous Douglas firs and giant pines are found.

(b) *The Broad-leaved Forests.*—The chief trees in these forests are the oak, beech, elm and maple. In autumn the leaves fall, and thus transpiration is checked. The flowers are not very prominent, and most of them are wind fertilized. In this respect these forests offer a marked contrast to those of hot lands, where the trees have brilliantly coloured flowers. The distribution of broad-leaved forests is shown in Fig. 26, and their positions as compared with those of the coniferous forests should be noticed. From the greater part of Western Europe and eastern North America the natural deciduous forests have disappeared, and in their place we find agricultural and industrial regions.

TEMPERATE GRASSLANDS.

These, known in particular places as prairies, pampas or steppes, are found in regions having very warm summers and cold winters, with a moderate to slight rainfall in summer. Fig. 26 shows that these regions are usually in the interior of great land masses, for it is there that these climatic conditions are met with. The rainfall is not sufficient to keep the soil moist at all seasons, so that trees are found only near rivers. It should be noted, however, that in some places there are other reasons, *e.g.* strong winds or porous soil, why trees do not grow. The prevailing vegetation everywhere is grass, so that these

NATURAL VEGETATION

regions are noted pasture lands, whilst in those parts where the rainfall is sufficient, large tracts are used for the growth of cereals. Most of the wheat of the world is now grown in areas which were once natural grasslands.

The seasonal changes, the green of late spring and early summer, the brown of late summer and autumn, the snowy mantle of winter, and the carpet of bulbous flowers in early spring, form a most enchanting cycle of changes.

THE TUNDRA AND ICE-DESERTS.

The poleward limit of coniferous forests is approximately the July isotherm of 50° F., for unless that temperature is attained during at least one month, trees cannot thrive. North of that line is the tundra, which is really a cold desert whose total precipitation is less than 10" per year. In the long winter the ground is snow-covered, but during the short, warm summers the lowlands often assume a meadow-like appearance, bright with numerous flowers. They are not merely lands where only stunted berry-bearing bushes, mosses and lichens grow. There are no tundra lands in the southern hemisphere.

Towards the poles are wildernesses of ice and snow which are practically devoid of life. Such lands are found in Greenland, in many of the islands to the north of Canada and Asia, and in the Antarctic continent.

THE INFLUENCE OF ALTITUDE UPON VEGETATION.

We have seen that latitude has a great influence upon vegetation; the equatorial forests are very different from the temperate forests and the hot deserts from the tundra. Altitude, too, has a great influence. Many mountains in equatorial latitudes are snow-capped all the year round. The dense equatorial forests at the bases of these high mountains, e.g. Ruwenzori in Central Africa, give way very gradually to evergreen, warm temperate, broad-leaved coniferous forests. Above

these levels the trees become scattered and dwarfed, and there are parts which are snow-covered in winter, but the melting of the snow in spring provides moisture for the growth of grass and many kinds of beautifully coloured flowering plants. Still higher than these meadow-like lands are areas resembling the tundra, whilst beyond that the snow lies on the ground all the year round. Thus, in ascending a high mountain situated close to the equator, somewhat the same changes in vegetation are experienced as in a journey from the equator to the polar regions, such is the great effect of altitude upon vegetation (see Fig. 41).

On the high dry plateaux, *e.g.* Tibet and Bolivia, there are extensive areas with a semi-desert type of vegetation, consisting chiefly of coarse grasses and scattered patches of bush.

EXERCISES.

1. Explain why it is that the vegetation belts on the west of continents differ from those on the east.
2. State and account for the distribution of Equatorial forests.
3. Examine the different types of natural vegetation found in your home district.
4. What are the climatic reasons for the distribution of the great deserts of the world?
5. What are the chief types of natural vegetation that would be encountered in a journey (*a*) from the White Sea to the Caspian Sea, (*b*) from the mouth of the Nile to Lake Victoria, (*c*) across Canada by the Canadian Pacific Railway? Account for the differences you mention.
6. Give examples of the connections between the natural vegetation and the chief occupations of a region.
7. Obtain pictures of each type of vegetation and fix them in your note-book, along with your notes.

CHAPTER VIII.

ASIA: PHYSICAL FEATURES.

IN previous chapters we have been considering the outlines of the world distribution of temperature, pressure, winds, ocean currents, rainfall, and natural vegetation, and we have shown the relations which exist between these various factors. We shall now turn our attention to the continent of Asia; and, whilst studying it, we shall pay particular attention to the principles which we have learned and apply them in more detail, although, of course, it is necessary that our study should have a wider outlook than merely the study of questions involving climate and natural vegetation.

THE POSITION AND SIZE OF ASIA.

If we examined a globe, we should see that Asia lies to the east of Europe and North Africa, and that the whole of the mainland is north of the equator. Its most northerly point, Cape Chelyuskin, is within 13° of the North Pole, and its most southerly, Cape Romania, is only 1° north of the equator. The distance "Between these capes is over 5,000 miles, whilst in an east and west direction the continent extends for an even greater distance. Asia is thus an enormous land mass. It is the greatest of all the continents, being four and a half times the size of Europe, and containing within its frontiers about one-third of the total land surfaces of the world. In shape, Asia is a rough quadrilateral, with three very large southern peninsulas, Arabia,

PHYSICAL FEATURES AND STRUCTURE 73

India, and Indo-China. On the east coast are the smaller peninsulas of Kamchatka and Korea, and on the west the plateau peninsula of Asia Minor.

PHYSICAL FEATURES AND STRUCTURE.¹

A physical map of Asia shows a great belt of highlands stretching across the continent from west to east. In Asia Minor this belt is fairly wide. It widens out in the plateau of Iran, but in the Pamir Plateau, to the north-west of India, it is very narrow. From this point it rapidly widens, until in the east it occupies an area stretching through almost the whole breadth of the continent. North of this high belt are vast plains stretching to the Arctic Ocean, into which they are drained, except in the west, where the lowest parts of the plains are occupied by the salt Caspian and Aral seas. In the south of Asia there is the deeply trenched plateau of South India, the Deccan, which is an old block so tilted that it presents in the west a steep face to the Arabian Sea, and gradually slopes eastwards to the Bay of Bengal. The Deccan is separated from the central belt of highlands by the plains of the Ganges and the Indus. In the south-west there is the Arabian plateau, tilted in the same manner as the Deccan, and separated from the central highlands by the Persian Gulf and the plains of the Tigris and Euphrates. In the east are many broad plains, drained by great rivers. The chief are those of the Amur, Hwang-ho, Yangtse-kiang, and Si-kiang. Lastly, we have the archipelago of the East Indies, and the eastern festoon of mountainous islands stretching from the peninsula of Kamchatka, through the Kurile Islands, Japan, and Formosa to the Philippines.

From this brief account, it will be seen that Asia may be divided into four physical units—

¹ See Book I of this series for an account of the formation of plateaux, plains, folded mountains, etc.

- I. The north-western lowlands.
- II. The central highlands and plateaux.
- III. The southern plateaux.
- IV. The eastern margins and island ranges.

Reference to the map will at once show that the great north-western lowlands, the central highlands east of the Pamirs, and the Indian plateau are all triangular.

I. THE NORTH-WESTERN LOWLANDS.

The only important break in the continuity of the great plain which stretches from the North Sea to the central highlands of Asia is formed by the Ural Mountains. But these mountains are not high enough to form a really serious barrier, either as regards climate, vegetation or communications, so that we must regard the whole of this vast plain—the greatest in the world—as one, although in this book we shall only consider its eastern or Asiatic portion. Fig. 27 shows the structural divisions of Asia. It will be seen that these vast plains consist, for the most part, of sedimentary rocks, which lie in horizontal layers, unfolded and undisturbed. One addition to this statement must be made. The greater part of the West Siberian portion of the 'plain' is shown as being covered with recent deposits. This region is very flat and low, so that the rivers have not sufficient speed to carry along the load of silt which they bring from the mountains. They are compelled to spread this over the land in times of flood, and in this way this portion of the plain has been largely covered by alluvium. The eastern lowlands, drained by the Yenisei and the Lena, are narrower, but higher, and therefore less swampy.

Whilst the great north-west lowlands are drained mainly to the Arctic Ocean by the three long rivers, Obi, Yenisei and Lena, the south-western Turan plains contain the large Aral Sea, which is the centre of an area of continental or inland drainage, for the rivers flowing into it never reach the sea.

THE CENTRAL HIGHLANDS

IL THE CENTRAL HIGHLANDS.

These highlands are continuous with those of Europe, and form the highest and greatest mass of mountains in

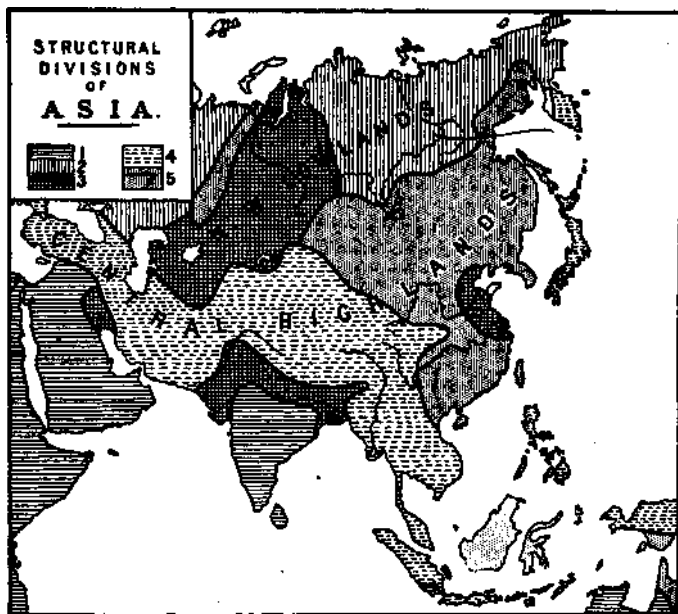


FIG. 27.—The structural divisions of Asia,

- x. Plateaux of unfolded rocks.
- 9. Unfolded lowlands.
- 3. Unfolded lowlands of recent deposits.
- 4. Folded mountains and enclosed plateaux.
- 5. Highlands of rocks folded in ancient times, now greatly denuded and fractured.

the world. They consist of mountain chains, generally running in an east and west direction, between which are lofty plateaux, which are wider in the east than in the west. Fig. 27 shows that the central highlands may be divided into two structural groups, a series of parallel folded ranges enclosing plateaux and deed

valleys, and a much older eastern mass which originally consisted of folded ranges, but has been very much worn down. In the first group three distinct chains can be traced by the aid of a physical map. The three chains' come very close together in the Pamirs, and on that account we find there the highest region in the world. It is often called the "roof of the world." The first chain is represented by the Caucasus and Tien Shan mountains: the second, or central chain, by the Pontic, Elburz, Hindu Kush, and Kwen Lun mountains. Between these chains lie the great basins of the Black Sea, the Caspian Sea, and the Tarim basin. The third, or southern range, is a series of great loops, and includes the Taurus, Zagros, Sulaiman, and Himalaya mountains, whilst between the central and southern ranges are the plateaux of Asia Minor, Iran, and Tibet. To the east of Tibet, where the older highlands formed a great centre of resistance and turned the folded ranges southwards, is a series of north and south chains, traversing Indo-China. Between these ranges are densely forested valleys, drained by such large streams as the Irawadi, Salwin, and Mekong. The ranges of western Burmah are continued through the Andaman and Nicobar Islands, Sumatra, Java, and the Lesser Sundas, where they once more become east and west in direction. Fig. 48 shows that the islands west of a line passing between Bali and Lombok (east of Java), and between Borneo and Celebes, stand on a shallow submerged platform. At one time they were joined to Asia, as were the Philippines, although the latter appear to have been separated from the mainland at a much earlier time than the others. We shall find further evidence of the former connection of these islands with Asia when we speak of their plants and animals.

The older, eastern highlands are not so lofty as the younger mountains we have just traced. They consist of:—(i) the mountainous area surrounding Lake Baikal and extending from the Altai Mountains to the south-west of the lake, to the Yablonoi Mountains to the east;

(ii) the plateau of Mongolia, which ends abruptly in the Khingan Mountains in the east and stretches as far southwards as the North China Highlands. The Khingan Mountains have a steep slope to the Manchurian Plains and a gradual one to the Desert of Gobi. They owe their origin to the faulting and tilting of a huge block of the earth's crust. The east and west ranges of South China, known as the South China Highlands, the mountains to the east of the plain of Manchuria, the highlands of Korea, and the island of Borneo also belong to the older eastern highlands.

III. THE SOUTHERN PLATEAUX.

These are the plateaux of Arabia and the Deccan in Southern India. Arabia is very similar to the African plateau, from which it has been separated by the subsidences which made the Red Sea. It is composed of sedimentary rocks of great age and is tilted, so that it has a long, gradual, eastern slope and a steep slope to the west and south-west. The map shows that the Deccan is tilted in the same way as the Arabian plateau, so that its longest rivers run eastwards to the Bay of Bengal, and it presents a steep face, the Western Ghats, to the Arabian Sea. South of the Deccan is the island of Ceylon, and between the two are the island stepping stones known as Adam's bridge. Ceylon is a detached portion of the Deccan, to which it was formerly joined.

These two plateaux at one time formed part of an ancient continent which stretched thousands! of miles in an east and west direction. Extensive faultings and subsidences caused the breaking up of this old land mass, and formed the present oceans which now separate the remaining portions from each other. The remnants of this old continent are shown in Fig. 28.

Between Arabia and the plateau of Iran, and between the Deccan and the folded mountains to the north of India are extensive lowlands drained by very long rivers. The Persian Gulf at one time extended much

farther to the north-west, but it has been filled up by the sediment brought from the surrounding mountains by the Tigris and Euphrates and their tributaries, and in this way the alluvial plain of Mesopotamia has been made. In the same way, the rivers of the Indus and

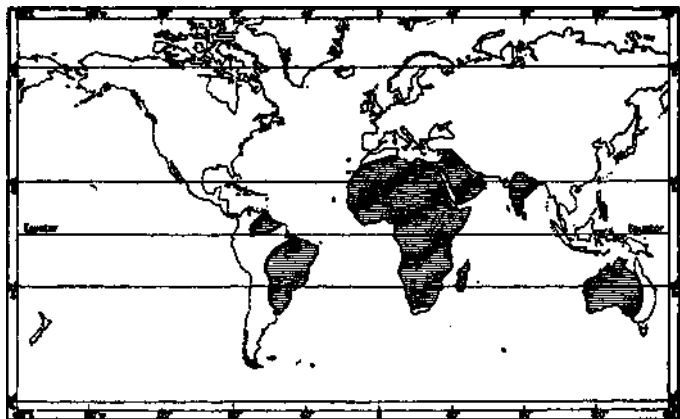


FIG. 28.—The great southern plateaux of unfolded strata. It is thought that they were once part of an ancient continent which geologists call Gondwanaland.

the Ganges systems have built the extensive alluvial plains which now separate the Deccan from the northern mountains of India. All these rivers have deltas which are being pushed out farther and farther every year.

IV. THE EASTERN MARGINS AND ISLAND RANGES.

The true eastern limits of Asia are to be found in the festoons of islands south of the peninsula of Kamchatka. This peninsula is continued southwards through the Kurile Islands, the Japanese Islands, the Lu-chu Islands and the Philippines. The ranges of these islands are largely volcanic.

Of the volcanoes, Fuji-San, Japan's sacred moun-

tain, has the most perfect cone. Fig. 66 shows that this volcanic belt extends all round the margins of the Pacific Ocean; it is sometimes called "The Fiery Ring of the Pacific." Between the mainland and the inland chain are the seas of Okhotsk, Japan, Yellow, East and South China. Of these, the Yellow and East China seas are the shallowest. They all occupy basins made by the subsidence of blocks of the earth's crust.

The chief rivers draining the eastern margin are the Amur, the Hwang-ho or Yellow River, and the Yangtse-kiang. The map shows that they rise far away in the central highlands and have extensive lowlands in their lower courses.

In this short account of the physical features and structure of Asia we have seen that the continent is of enormous size. It stretches through about 76 degrees of latitude, it has extensive plateaux, it has the highest mountain ranges in the world as well as vast plains, whilst tracts along the shores of the Caspian Sea are below sea-level. We shall, therefore, expect to find strong climatic and vegetation contrasts, ranging from the cold deserts of the north to the equatorial forests of the south, from the bleak, sparsely peopled plateau of Tibet to the densely peopled lowlands of China and north India. Asia is a continent of great contrasts.

EXERCISES.

1. On an outline map of Asia mark all the chief rivers and shade the map so as to show the land drained:—(a) to the Arctic Ocean, (b) to the Pacific Ocean, (c) to the Indian Ocean, (d) to the Mediterranean, (e) area of inland or continental drainage. Write a brief description of this map.

2. Draw a map of Eastern Asia, and the eastern volcanic chain of islands. Shade boldly the sea deeper than 100 fathoms, and the land above 600 feet. Mark the chief rivers.

3. Using the relief map in your atlas, draw a section from the Ganges plains to the north coast of Asia.

4. Give reasons why you would expect many political frontiers to meet in the Armenian Highlands and in the Pamirs.

5. Explain the terms:—alluvial plain; folded mountain; inland basin; escarpment. Give Asiatic examples of each.

CHAPTER IX,

ASIA: CLIMATE AND NATURAL VEGETATION.

IN earlier chapters we have considered temperature, pressure and winds, and rainfall as applied to the whole world. We must now summarize the chief facts as they concern the continent of Asia. From what we have learned in the last chapter it is not difficult to see that two outstanding factors will have a very considerable influence upon the climate of Asia. The first is its great extent in latitude, and the second its very varied relief. As regards the latter, it must constantly be borne in mind that the temperature and pressure maps have been corrected to sea-level readings.

TEMPERATURE.

Fig. 10 shows that a large proportion of the land has a temperature below freezing point in January.-The isotherm of 32° F. is a very important one, for it means that those plants which cannot flourish where there are severe winter frosts, will not grow in parts where the temperature falls below the freezing point for a whole month or more. It will be seen that the only parts which are free from frosts in winter are in the south and south-east. Now turn to Fig. 11, which shows that in July the greater part of the continent has a temperature exceeding 68° F., whilst the areas in which little rain falls (Iran and Arabia) have a very high temperature indeed, as there is little or no covering of cloud to lessen the heat. Notice the position of the isotherm of 48° F. This is important, because it marks

the northern limit of trees which must have at least that temperature during the warmest month. The influence of the Indian and Pacific oceans is seen in the lower temperature of the coastlands compared with those of the dry areas just mentioned, and in the northerly bends of the isotherms on the east coasts. The great facts to keep in mind are the contrasts between the cold of winter and the heat of summer experienced by the interior lands. Now let us consider a few actual figures—

Place.	Lat.	Long.	Height in feet.	Mean temperature in coldest month.	Mean tempera- ture in hottest month.
Verkhoyansk .	67° N.	133° E.	330	- 60° F.	60° F.
Yakutsk .	62	129	330	- 47	66
Tomsk .	56	85	395	- 3	66
Tobolsk .	58	68	345	— 2	64
Tashkent	41	68	300	30	81
Trebizond	41	40	100	41	75
Smyrna .	38	27	33	47	80
Aden	12	13	0	76	84
Bombay	19	73	35	75	85
Calcutta	22	88	20	65	86
Rangoon	16	96	40	75	85
Singapore	1	103	10	78	82
Hankow	3°	114	140	38	83
Shanghai	31	121	35	38	81
Peking .	40	116	130	23	80
Tokyo	35	140	65	37	78

The first group is taken from the great north-west low-lands. All have an extreme climate which is more extreme in the north-east than in the south-west, although the south-west portion of the plains has a much **hotter**

summer, as is illustrated by the summer temperature at Tashkent. Verkhoyansk has the lowest recorded temperature in the whole world, and has the exceedingly large range of 120° F. In places like this, where the winters are long and severe, most of the year's work has to be accomplished during the summer months, when work is carried on at high pressure in order that enough of the necessities of life may be obtained to last through the winter.

Trebizond and Smyrna are on the Black Sea and Mediterranean Sea respectively, and have cool winters and hot summers. The towns in the third group have only a small range of temperature, and are hot at all seasons, although Calcutta's coldest month may be described as very warm. They are all within the tropics. The last group illustrates the hot summers and relatively cold winters of the south-eastern margins. These places have colder winters than have western margins in the same latitude, this being due to the cold, dry winds which blow from the high-pressure system centred towards the middle of the cold land mass. If figures were given for towns on the great central—plateaux of Tibet, the Tarim basin and Mongolia, they would show cold winters below freezing point, *and* very hot summers.

PRESSURES AND WINDS.

Owing to the land becoming very hot in summer, a low-pressure area is created towards which winds flow from the oceans, where the pressure is higher. -Since this inflowing air is cooler and denser than the heated air, the latter is forced to ascend: Thus the greater part of Asia receives inflowing winds in July (see Fig. 16). In January the conditions are reversed (see Fig. 15). The land masses in the heart of the continent are extremely cold, and this produces a great high-pressure system which hangs over Central Asia like a heavy cap. From this system winds flow outwards towards the

oceans, where the pressure is less, so that the greater part of Asia has cold outflowing in winter.

RAINFALL.

Fig. 21 shows the mean annual rainfall of Asia. About two-thirds of the continent receives very little rain. It will be seen that these areas are found, (i) in the south-western part of the great northern lowlands, (ii) on the central plateaux. (iii) on the plateaux of Arabia and Iran, (iv) in the extreme north. The little rainfall is due in the first region to the great distance from the ocean, in the second to the fact that these plateaux are to the lee of the highlands of northern India and China, which have already received most of the moisture brought by the wet summer winds, and in the third region (the south-western plateaux) to the dryness of the prevailing N.E. Trades, for the monsoon rain-bearing winds of summer do not affect this part of Asia. The north coastlands lack rain, as the low temperature causes very little evaporation to take place, and therefore limits the rainfall.

A comparison of Figs. 23 and 24 will show that most rain falls in summer when there are the inflowing winds. If Fig. 24 is studied in connection with a relief map, it will be seen that these summer winds deposit most of their moisture on the mountains with which they first come into contact, and pass on as dry winds. South of a line from the mouth of the Indus to Korea is a region over the greater part of which there is a heavy summer rainfall. Summer rainfall, though small in amount, is also experienced in a broad band stretching across the north of the *the lands bordering the eastern Mediterranean* have the dry summers and wet winters typical of the Mediterranean shorelands. Ceylon, the Malay Peninsula, the coastlands of China, the islands in the eastern volcanic Chain and the East Indies all have rain at all seasons. Fig. 29 shows the season at which most rain falls in the different parts of Asia.

VEGETATION AND ANIMALS.

Fig. 26 shows the world distribution of vegetation. It will be seen that the tundra, the cool temperate forests and the steppe of Europe are all continued eastwards

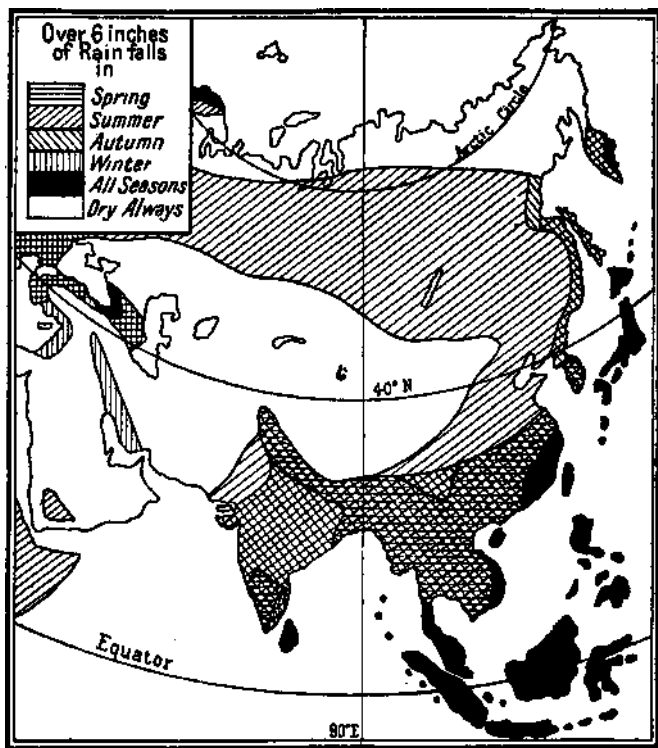


FIG. 29.—The Seasonal distribution of rain in Asia.
(After Herbertson and Supan.)

into Asia. The chief animal of the tundra is the reindeer. The coniferous forests of Siberia are very dense, and give shelter to many kinds of fur-bearing animals, of which the chief are the sable, fox, mink and ermine. These forests gradually give place to the grassy steppes,

the richer parts of which are rapidly becoming important wheat-producing lands.

Towards the Sea of Aral, the steppes merge into semi-desert or scrublands in which are extensive areas of true desert. Deserts are also found in the rainless parts of Arabia, Iran, Tibet, and Mongolia. In the higher parts of Arabia, and over considerable areas of the central plateaux, are tracts of slight rainfall having a very poor type of pasture, not unlike the drier steppes. Yet even this is sufficient to support wandering tribes of herdsmen, who follow their sheep and goats from pasture to pasture. Fleet-footed grazing animals, such as gazelles and asses, run wild. In Arabia, the chief animal is the camel, whilst the famous Arab horses are reared on the poor pastures. In Tibet, the yak, the native ox, is the chief beast of burden and also provides food and clothing.

In the Mediterranean region of winter rainfall the plants adapted to summer drought are found. The chief are the vine, fig, mulberry and olive.

The monsoon lands of the south-east have rain mainly in summer, and, since this is generally considerable in quantity, the natural covering is usually forests. In North China, Korea and Japan, these are of the warm, temperate type, and in Southern China, Indo-China and India, of the hot, wet variety, although there are parts having a smaller rainfall, in which savannah, or mixed grass and woodlands are found. The Deccan is an example of this type. In the forests and jungles are many species of wild animals, amongst which may be mentioned the elephant, which can be domesticated and taught to do useful work, the dreaded tiger of Bengal and the Malay Peninsula, the leopard, the tapir (found in Asia only in the Malay Peninsula and in Sumatra), as well as many varieties of monkeys, apes and snakes, of which the cobra is perhaps the most dreaded. Mention should also be made of the buffaloes and humped cattle of India, for they are very important for draught purposes.

In the hot, wet equatorial forests of the South Malay

Peninsula and the East Indies the heat and rainfall are constant, so that dense tropical vegetation is met with, except in the higher parts of Borneo. The chief trees are sago-palms, bananas, coconut palms, gutta-perchas, bread-fruits, and trees and shrubs from which spices are obtained. From these the natives can obtain most of the necessities of life. The great naturalist, Wallace, fixed the line separating the Asiatic animals from those distinctly Australian in type, as running between the islands of Bali and Lombok, east of Java, and between Borneo and Celebes (see Fig. 48). Others have fixed the line so as to include Celebes as having an Asiatic type of fauna. As a matter of fact, the fauna along the boundary line drawn by Wallace is of a mixed type, and this is what we should expect to find. We have already learned that the islands west of Wallace's line stand on a submarine platform less than 100 fathoms below sea-level, whilst those to the east have surrounding seas which are very much deeper. Wallace thought this indicated that Australia was separated from other land masses very early indeed, so that it had been able to develop a typical flora and fauna. The typical Australian tree is the eucalyptus, whilst the characteristic animals are marsupials—that is, they are pouched, as, for example, the kangaroo.

EXERCISES.

1. Why is it that (a) Asia Minor receives its rain chiefly in winter, (6) the East Indies at all seasons, (c) south-east Asia chiefly in summer, (d) the central plateaux are deficient in rainfall?

2. Describe the climatic conditions which produce (a) tundra, (b) steppe. What animals are best suited for each?

3. What zones of vegetation would be passed through in a journey from the south of India to the arctic coast of Asia? Account for the changes you notice.

4. On an outline map of Asia shade all regions receiving a mean annual rainfall of less than 10 inches. On the same map mark the desert lands of the continent. What connections do you notice between the two sets of factors?

5. What are monsoon winds? Draw sketch map to illustrate **their** causes, and, in writing, briefly describe the maps.

CHAPTER X.

THE MAJOR NATURAL REGIONS OF ASIA.

ASIA may be divided into several large units or major natural regions. In so dividing the continent, the physical features, climate, vegetation and leading occupations must be taken into account. One of these factors alone is not sufficient, for a physical unit may be so large that the climate and vegetation in different parts vary very much. It will thus be seen that natural regions are not simply physical units. Ideal natural regions would be those which were physical, climatic and vegetative units—that is, regions of the same physical type throughout (plains, plateaux or highlands) in which the same set of climatic conditions obtained in all parts of the unit, and produced the same general result as seen in the natural vegetation and occupations. To carry out this thoroughly we should have to divide the continent into a great many units. For our present purpose, it is sufficient to take very large divisions, in each of which are certain outstanding characteristics, which allow of the region being considered as a unit. In selecting the major natural regions the chief factor which has been considered is natural vegetation, for in the distribution of vegetation we also have the influence of relief and of climate playing important parts. That is, if a region has the same type of natural vegetation in all parts, it is obvious that the climate is approximately the same throughout the region, and that there will be a similarity in the natural occupations. Much of this chapter will therefore resemble Chapter VII, although here we shall confine our attention to Asia.

It will be seen that a division of Asia into large natural regions takes no account of the political boundaries but as the importance of these is not inconsiderable, we must not neglect them. We must also notice that it is often impossible to draw an exact boundary line between natural regions, for one type merges into another very gradually.

(A) THE TUNDRA.

This region occupies most of the land lying within the Arctic Circle. The physical map will show that the tundra consists mainly of lowlands. Short summers and long, cold winters, a total precipitation of less than 10 inches, and a natural vegetation consisting chiefly of berry-bearing bushes, mosses and lichens, and numerous flowering plants, are the outstanding characteristics of this region. Life here is very hard indeed, and the hard work necessary to keep alive is not rewarded by the comforts of more fortunate climates.

(B) THE NORTHERN TEMPERATE FORESTS.

This region is a great belt stretching across northern Asia, south of the tundra. In the west it covers lowlands, and in the east, highlands. The chief trees are conifers, although towards the south broad-leaved trees appear. Little lumbering is done in these forests, for the means of export are at present very difficult indeed. The trapping of fur-bearing animals is the chief occupation. Throughout the area the climate is one of extremes, although the summers are much warmer than those of the tundra, and the rainfall is greater. This, of course, accounts for this region being forested, whilst the tundra is a gold desert.

(C) THE GRASSY STEPPE.

This is a great grassy plain with a rich soil. Owing to distance from the sea the climate is one of extremes,

The rainfall is not very heavy—in parts it is deficient in quantity—and falls in summer. The natural occupation is stock-rearing, although a great change is taking place in the richer parts immediately south of the forest belt. Here every year sees an increase in the area of



FIG. 30.—The major natural regions of Asia.

A. Tundra.	B. The northern temperate forests.
C. The steppes.	D. The Mediterranean lands.
E. The deserts and semi-deserts.	F. The monsoon lands.
G. The South-Eastern Archipelago.	

land devoted to the growing of cereals, especially wheat

Towards the south-east the steppe becomes arid and desert-like, so that we shall include this southern portion of the north-west lowlands in the Great Desert Belt.

(D) THE MEDITERRANEAN LANDS.

This region stretches from the Mediterranean Sea to the plateau of Iran. Politically it includes Turkey, Syria, Palestine, Iraq, the Republics of Armenia, Georgia and Azerbaijan, and the western districts of Persia. Only the coaslnds have the typical Mediterranean type of climate of very warm, dry summers, mild winters and winter rains, for the rainfall diminishes and the summer heat and winter cold increase as we go southwards and eastwards away from the sea. The plateaux have an extreme climate, whilst towards the south and south-east it is difficult to draw a boundary between the Mediterranean region and the Desert.

Evergreen trees and shrubs are the characteristic vegetation of the coastlands, whose chief cereals and cultivated plants are wheat, maize, barley, the vine, mulberry and olive. Farther inland pomegranates and apricots are more important, while the drier plateau interior is at best a poor grassland.

(E) THE DESERT BELT.

This belt of dry deserts stretches north-eastwards across Asia from the Red Sea to the Khingan mountains, including within its limits the plateaux of Arabia, Iran, Tibet, the Tarim basin and Mongolia. It also includes the deserts of Western Turkestan and the lower Indus valley. All these regions receive very little rainfall, for the high central plateaux and Turkestan are shut off from rain-bearing winds, whilst Arabia and the Lower Indus Valley are off the track of the summer monsoons.

As regards temperature, the various parts of this belt differ very considerably owing to differences of latitude and altitude. In Arabia and the Lower Indus Valley the winters are warm and the summers very hot; but in the other parts of this desert belt the winters are very

THE MONSOON LANDS

cold indeed, and the summers, as a rule, not quite so hot. In all parts of the region settled life is only possible where there are permanent supplies of water.

(F) THE MONSOON LANDS.

These are lands of hot, wet summers and dry winters. The winter temperatures differ according to elevation, distance from the sea, and distance from the equator. Indeed, there is such a great difference between the temperatures of the northern and southern parts of this region that we must divide it into (i) a temperate region, (2) a sub-tropical region, and (3) a tropical region. The first region, which has cold winters, includes Korea, the plains of Manchuria and northern China, and the islands of Sakhalin and Yezo. The uplands are clothed with mixed coniferous and broad-leaved forests. The second region has warmer winters than those of the lands farther north; it also has a heavier and more evenly distributed rainfall. It includes Japan and Central China. The vegetation is of the warm temperate type. The third or tropical region includes India, Indo-China, and southern China, and it is distinguished from the others by its warm to very warm winters. The coastal lands, especially those nearest the equator, have very little difference between summer and winter temperatures.

The climatic characteristics common to the whole monsoon region are the comparatively dry winters and the wet summers. Where the summer rains are sufficient to keep the soil moist all the year round, forests are found, and these vary according to the temperature. In those parts where the rainfall is deficient, for example, on the Deccan to the leeside of the western Ghats, the vegetation is of a poorer type, such as mixed scrubland or savannah.

The chief products of this monsoon region are such as require considerable heat and moisture at the same time. They are:—rice, sugar-cane, cotton, opium, indigo,

tea, and coffee. In the drier parts where a sufficient temperature is reached, wheat is grown as a winter crop. The forests provide such useful timber as teak and bamboo, whilst in China and Japan, the mulberry is cultivated in order to feed silkworms. The fertile lowlands of the monsoon region are amongst the most thickly populated regions in the world, and this is rendered possible by the ease with which the necessities of life—here chiefly rice—can be obtained.

(G) THE SOUTH-EASTERN ARCHIPELAGO.

This region includes Ceylon, the East Indies, the Philippines, and the southern portion of the Malay Peninsula. A high temperature and abundant rainfall at all seasons are its chief characteristics.

In consequence of these climatic conditions, the lowlands are densely forested with vegetation of the equatorial forest type, whilst on the highlands are considerable areas of grasslands. In these hot regions we find a very backward type of man, for nature plenteously supplies him with all his needs. In return for the minimum of exertion on his part. The cultivation of tropical products such as sago-palms, coconuts, bananas, rubber, and spices is extending, but there are still considerable areas which remain in a natural condition, and even cannibalism is not unknown.

EXERCISES.

1. Name the chief parts of Asia in which each of the following is a very important product—rice, tea, cotton, wheat. Give full reasons for your answer.
2. Contrast, as vividly as you can, the differences between Northern Siberia and Java.
3. A, B, C, etc., are towns in Asia. From an examination of the climatic statistics quoted can you identify each? If you cannot mention a town try to state a region. Give reasons for your selections.

Place.	Height in feet.	Jan. temp.	July temp.	Mean annual rainfall in inches.
A	90	75° F.	85° F.	3
B	SL.	75° F.	78° F.	101 (mainly in summer)
C	250	-4° F.	68° F.	15 (two-thirds in summer)
D	20	80° F.	81° F.	94 (at all seasons)
E	26	47° F.	80° F.	27 (mainly in winter)

4. In what other parts of the world would you expect to find similar regions to the Asiatic tundra, the steppes, and the northern temperate forests? (see Chapter VII).

5. What is a major natural region? Give examples from Asia.

CHAPTER XL

THE RUSSIAN LANDS.¹

Natural Regions.—The Russian lands of Asia include (i) the tundra, (ii) the coniferous forest belt, (iii) the steppes, (iv) the semi-desert and desert lands of Turan, (v) portions of marginal lands of the central highlands, (vi) northern portions of the temperate monsoon region.

The total area of these lands is about one-third of the whole continent, but the total population numbers only about one-fortieth of the people of Asia.

The map shows that the greater part of Russian Asia consists of the great north-western plain, and that to the east and south of this plain are high mountain uplifts.

THE NORTH-WESTERN LOWLANDS.

Physical Conditions.—Let us first realize the size of this plain. From south-west to north-east it stretches through more than 4,000 miles—as far as from London to Chicago; at its greatest width it exceeds 1,200 miles, whilst by far the greater part is below an elevation of 600 ft. above sea-level. And this plain, great as it is, is only a part of a very much larger lowland which extends beyond the Urals to the North and Baltic Seas.

This vast triangle-shaped plain is drained to the

¹As the result of the Russian Revolution of 1917, the political geography of the Asiatic lands of the Old Russian Empire is very complicated. Many socialist soviet republics have been formed, but these, together with the republics of European Russia, are federated or allied to form the Russian Socialist Federal Soviet Republic (R.S.F.S.R.). We shall, therefore, think of them all under the general title—"The Russian Lands." See Exercise 8 on page 109.

Arctic Ocean by many large rivers, of which the Ob, the Yenisei and the Lena are the most important. These mighty streams—the Ob is 3,230 miles in length—and their network of east and west flowing streams are the chief means of communication, but, unfortunately, they suffer from the great disadvantage of flowing into an ocean which is frozen for at least eight months every year. Besides this, their lower courses are frozen for many months, whilst the thaws of spring turn the country bordering their banks into enormous lakes. For these reasons the main streams have been little used for commerce, although their east and west flowing tributaries have had a great deal to do with Russian expansion eastwards. The western movement of Mongol horsemen from Eastern Asia to Europe was*along the great grassy plains of the steppes, for here pasture and firm ground were found. The Russian eastward expansion was not confined to the grasslands and the use of horses, for the rivers and boats offered an excellent method of progress, especially through the forests. To-day, the vigorous Russian Government is working hard successfully to develop lines of export along the rivers to the Arctic Ocean. This is only possible for a limited period in summer, but most promising experience has been gained.

Turning to the climate, the severity of the winters rapidly increases as we go from west to east. Siberia is everywhere colder than Russia in the same latitude. It is also drier. These conditions are what we should expect to find as we approach the centre of the great Eurasian land mass. In the Turan lowlands of the south-west the winters are cold, and as we go towards the north-east they become colder and colder, until at Verkhoyansk we reach the exceedingly low mean January temperature of -60° F. or 92° F. below freezing point. In summer the south-west lowlands are very hot, and the temperature decreases, although not so rapidly as it falls in winter, as we go towards the north-east. As regards rainfall, the extreme north and the Turan lowlands have a very slight rainfall, less than 10 inches, and

between these there is a broad, belt where the mean annual rainfall is from 10 to 20 inches.

It is on account of the vast size of the north-west lowlands and the consequent different climatic conditions that we find it contains several natural regions, which we will now discuss in more detail.

(1) THE TUNDRA AND ITS INHABITANTS.

As will be seen from Fig. 31, the tundra occupies the most northerly part of the area. We have already learned that in this region the summers are short and warm, the winters long and cold, the rainfall is slight, and that as a result of these conditions instead of trees we find mosses, lichens, small bushes and berry-bearing plants, and, in summer, a great variety of flowers.

The rivers which cross the tundra flow from south to north, so that in spring, when the thaw comes, their upper courses are supplied with water from the melting of ice and snow, whilst their lower courses are still frozen. This is the cause of large tracts being under water in summer. Millions of mosquitoes make life in these swampy lowlands almost unbearable, so that the inhabitants have to keep as far as possible to the higher portion of the tundra.

The inhabitants of the tundra belong to various races, and are known by different names. In northern Norway and Russia are the Lapps and Finns, and in northern Asia the Ostyaks, Samoyads, Yakuts and other similar tribes. Mention has just been made of the fact that several races are represented. This is very interesting, for we find that men of the same races as some of those inhabiting the tundra, are much taller in more southerly lands, whilst in these cold, barren wastes all the inhabitants, whatever their origin, are small and undersized. This is undoubtedly an example of the influence of climate upon man. The climatic conditions not only influence stature, but the whole mode of life, for all tundra dwellers appear to have been compelled to adopt similar ways and means of existence.

The tundra has very little to offer to its inhabitants as a reward for their labour. The ground is permanently frozen below a depth of one or two feet, so that, apart from the climatic conditions, agriculture is impossible. The sparse vegetation is, fortunately, able to support herds of reindeer, but provides nothing for the support of human life except certain berries. The dwellers in

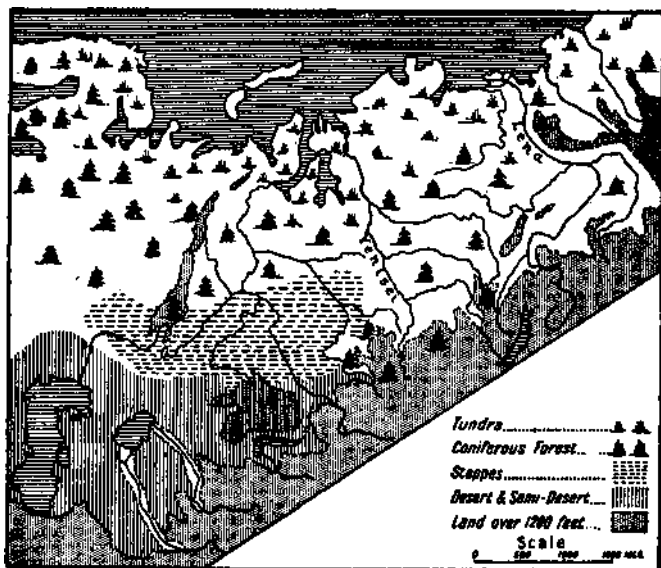


FIG. 31.—The north-western lowlands of Asia. Relief and vegetation.

the tundra are therefore compelled to depend for their food upon the reindeer, the fish which they catch in the rivers and sea, and the wild animals which they can hunt. Reindeer are indispensable to the people of the tundra. They roam about in a semi-domesticated condition in search of reindeer moss, in discovering which they show extraordinary sagacity, their owners meanwhile following them from place to place. The possession of a few reindeer means that a man and his family have most of their

needs supplied. To own a large number is to be quite a rich man. Alive, the reindeer is used as a beast of burden, and provides milk. When killed, every part of its body supplies something useful—the skin for clothing and tent covers, the flesh for food, the horns and bones for tools and implements, and the sinews for thread, etc. Fishing is carried on chiefly in the late spring and summer, when the rivers thaw and fish are abundant. The men catch the fish, and to the women falls the task of drying enough for use in the long winter when fishing is impossible. The families dependent upon fishing alone have a far more insecure existence than those supported partly by fishing and partly by the reindeer. A certain amount of hunting is possible, especially in winter, when it is the custom to migrate as far southwards as the northern edges of the great forest belt.

From what has been already stated it will be evident that tundra dwellers live nomadic or wandering lives, and that the summer will be the season of most changes. For this reason a fixed house is impossible, but the winter dwelling is of a more permanent type than the summer one, indeed, in many cases, one dwelling is used throughout the whole of that season. The summer houses are tents which are easily carried, erected, or pulled down. They are made of a framework of poles covered with skins or bark. The winter houses are generally made of a framework of wood covered with turf or earth.

We have seen that for food and clothing tundra dwellers depend very largely upon the reindeer. Some tea and tobacco are obtained from traders, and are greatly prized. Important articles of winter clothing are the hood, the thick, skin gloves which are attached to the sleeves, and the warm, fur boots. A mother carries her baby in her hood. She covers it with furs, and laces it into a skin cradle which she carries on her back. Travellers tell us that children are generally kindly treated, although tundra boys and girls can never enjoy real home life when the home comforts are

so few, and the place of habitation is constantly being changed. The position of the aged, the sick, and those who are not strong enough to take their part in the hard struggle for existence is often very hard indeed. They are sometimes neglected and left to perish.

(2) THE BELT OF NORTHERN TEMPERATE FORESTS.

As shown in Fig. 31, this is a broad belt of forests south of the tundra. The trees are mainly conifers, although many broad-leaved trees appear towards the southern margins. This enormous area is almost entirely virgin forest. It is the greatest hunting ground for fur-bearing animals in the whole world, although, except on its margins, it is almost uninhabited. The trapping is done chiefly by Ostyak and Samoyad hunters who live on the northern fringes, and whose settlements are regularly visited by traders who transact their business by means of barter.

Better means of communication are already making lumbering an important occupation; but even at present comparatively little is done in this direction. Towards the south the forests gradually thin out, and, owing chiefly to the drier conditions, the prevailing vegetation is grass.

(3) THE STEPPE.

As regards the climate and vegetation of the steppe, it is not necessary to add to what has been learned in previous chapters. We shall only recall that the rain-fall is small and falls chiefly in summer, and that the range of temperature is *very considerable*. But, as in the tundra, we shall go into more detail in connection with the way in which the primitive steppe dwellers live, so that we may see how geographical conditions affect modes of life. The majority of the inhabitants of these great areas of grass-covered lowlands are shepherds who rear large herds of sheep, camels, horses, goats and cattle, and since the grass in a particular place is soon exhausted, it follows that the animals have to be constantly moved from place to place. Thus the steppe shepherd, like

the tundra hunter, leads a nomadic life. It is necessary, therefore, that the house, furniture and household utensils should be of as simple and light a character as possible, so as to be moved with as much ease and comfort as circumstances permit. The people, therefore, live in tents which are usually round in shape and are most comfortable. The framework is made of willow sticks which are obtained from the banks of rivers. The sticks are made into a lattice-work which can be expanded or contracted according to the size desired. This lattice-work is then covered with skins or felt, and the whole held together by cords or bands. The only furniture consists of carpets, cushions and rugs, whilst most of the household utensils are made of leather or wood, because articles so made are not easily broken. The work of erecting or taking down the tent falls, as is customary with most nomadic peoples, to the women, who can easily accomplish **the** task in about half an hour.

The winter houses are more durable, and are sometimes built of stone. Since the winters are usually severe and often snowy, stables have to be erected for the animals, which are fed upon hay that has been stored for winter use. The site of the winter dwelling is very important, for it must be near to a reliable water supply and in as sheltered a place as possible. Therefore a river valley is often chosen. We have said that steppe dwellers are nomads, but one point must be noted. In however many places the summer tent is pitched, it is very seldom that **the** shepherd does not return to the same winter quarters. Although the chief work is looking after the animals and keeping them from any harm, some hunting is usually possible in winter, as at this season the hungry animals of the forest venture farther south in search of food.

As a rule, primitive steppe dwellers despise a settled life, and glory in their nomadic existence. Their flocks and herds provide them with all they require, and therefore they are content. The felt for the tent covering is made from wool. The hair of the camel is woven into camel's-hair cloth. Wool and hair are also used

in the making of the cushions, rugs and carpets which are noted all over the world for their beauty of design, and the excellence of the work. Leather and skins can be obtained very easily, and are made into bottles and clothing. Milk and flesh form by far the most important food, although other things can be obtained from the trading caravans which carry on commerce with the steppe dwellers. The favourite drink, koomiss, is made from the fermentation of milk, whilst large quantities of milk are also used in the making of cheese and butter. When we consider that the people are constantly moving in summer, we see that the camel and horse are very important indeed as beasts of burden. Steppe dwellers are noted horsemen. The Kirghiz give themselves the name of Kazak, which means "horsemen." Without the help of horses it would be impossible to keep the flocks in order whilst moving from place to place, or to prevent them from straying during a temporary halt. Even the children are expert in horsemanship, and they are placed on horseback when about four or five years of age.

In most other occupations, the introduction of machinery has made great changes, but the shepherding of animals is still carried on in much the same way as in the days of the Bible patriarchs. Indeed, some of the best accounts of steppe life are found in the Old Testament. Since there is little or no change, steppe dwellers are opposed to everything new, and are very much attached to tradition. The unit is the family, and as the wealth of the family is reckoned by the number of animals possessed, we find that the families are very large. Indeed, it is the practice for the wealthy steppe dwellers to have more than one wife. The head of the family is an autocrat who is a law unto himself, and is obeyed by all. Again, since wealth consists of livestock, drought or severe winters, storms or disease may reduce the richest of men to poverty in a short time. Such a disaster has always to be reckoned with, and it has the effect of making steppe dwellers fatalists, for no action of theirs can avert these unforeseen disasters.

The hardy horsemen of the steppe make splendid fighting men. Many times they have passed across southern Russia, and even reached as far as the Alps. The Magyars of Hungary are descended from such twelfth-century invaders. The once famous Russian cavalry, the Cossacks, were steppe dwellers. Cossack is an altered form of the word Kazak (see page 101).

The northern portion of the steppe is arable land—that is, it may be cultivated. It is in this region that great changes have been made in recent years. Settlers from places where a higher civilization than a pastoral type has been reached, have settled and brought with them the knowledge of the use of machinery, of irrigation, of the digging of deeper wells. In short, the modern settler in this part of the steppe knows how to live a settled life. Russian colonists are now raising large quantities of wheat, oats, rye and root crops, for the soil is very fertile and the rainfall generally sufficient, although dangers such as long droughts and early frosts are by no means unknown. Cattle are also reared in large numbers, and the manufacture of butter, introduced by the Danes, is to-day one of the chief industries in Siberia. As more and more areas are developed and used for stock-keeping, dairy farming, and the growing of cereals, the nomadic Kirghiz, who cling to their mode of life, are being pressed farther south towards the less fertile parts of the steppe. The development of this portion of Siberia may be compared with that of the North American prairie. As in the latter region, the construction of railways has led to rapid progress. Fig. 32 shows the great *Trans-Siberian Railway*. From Moscow the main line goes to Perm and across the Urals to Omsk. An alternative route is via Samara. The Urals do not present a serious obstacle, for their gradients are not difficult, and convenient gaps can be used. By means of easy descents, the main line reaches the steppe of south-west Siberia, and crosses the Irtish, an important tributary of the Ob, at Omsk. This town lies in a rich, black earth region in which wheat growing, dairy

farming, and stock-keeping are important occupations. It is the most important town in the agricultural area of Siberia. North-west of Omsk, at the confluence of the Irtysh and the Tobol, is *Tobolsk*, which, although not on the railway line, commands routes via the Tobol to the Kirghiz steppe, along the Irtysh to the Zungarian Gate, between the Altai and the Tien Shan mountains (see Fig. 32), and beyond that to the Far East. The latter advantage has also helped the growth of Omsk, which is more

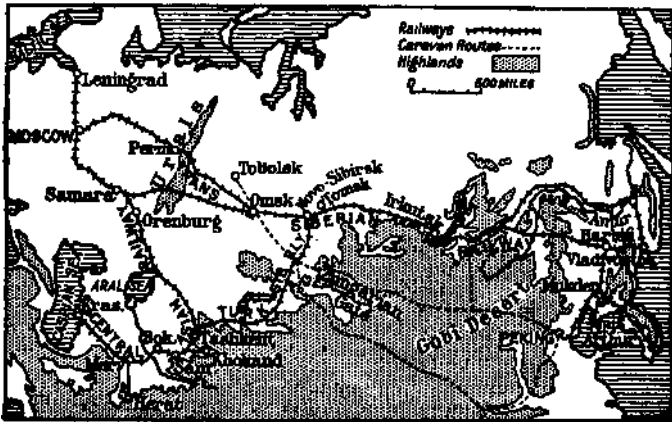


FIG. 32.—The Trans-Siberian, Central Asian and Turk-Sib. railways.

important to-day than Tobolsk. From Omsk, the railway continues eastwards to *Novo-Sibirsk*, the capital of Western Siberia, which has a fine position where the Trans-Siberian Railway crosses the Ob and is joined by the "Turk-Sib." Railway from Turkestan. Continuing eastwards, a branch line goes to *Tomsk*, a rising Siberian city noted as the centre of a gold-mining district, and crosses the Yenisei at Krasnoyarsk. For some 300 miles before reaching this town, which, like Tomsk, is a mining centre, the railway passes through coniferous forests. Beyond Krasnoyarsk, open country is again reached, and the

line continues to Irkutsk, to the west of Lake Baikal. After skirting the southern shores of this lake, the line forks, one branch following the general direction of the Amur, but some 40 or 50 miles north of that river, the other continuing across Manchuria via Harbin to Vladivostok, and via Mukden to Port Arthur, which the Russians lost in the war with Japan in 1905. The Amur valley line was developed with a view to giving a route to Vladivostok entirely through Russian territory. From Khabarovsk, on the Amur, the line utilizes the valley of the important north-flowing Usuri river, which offers a good route southwards to Vladivostok.

Let us return to that portion of the railway which is on the central plains. North of Lat. 56° N., and between the Urals and the Yenisei, is a great swamp region, whilst to the south lie the dry steppes. It was along this firmer ground that many Mongol invaders passed into Europe, and it was naturally here that the Trans-Siberian railway was built, passing through Omsk instead of Tobolsk, which is in the swamp region.

4. TURAN OR RUSSIAN CENTRAL ASIA.

This fourth region of the north-west lowlands occupies the semi-desert and desert lands lying between the central highlands in the east and the Caspian Sea on the west, and stretches southwards to the Iran plateau. The map shows that, except in the north, it is shut in by high mountains, which shut it off from rain-bearing winds. But since the mountains themselves receive rain and are often snow-capped, the Turan rivers rising in them are supplied with water. Of these, the Syr and the Amu flow into the Sea of Aral, and are the most important, but there are many which lose themselves in the sand.

The only fertile parts are those which are irrigated. About one-tenth is fit for settlement, and much of this is of a very poor type of pasture, and can be used for a short time only. The chief occupation on these poorer

pastures is stock-keeping, which is carried on in **the** same way as in the better-watered steppe lands already considered. It has been said that these Turan shepherds are half shepherds and half robbers, and this is hardly to be wondered at. In the river valleys a settled life, based on irrigation, is possible, and wheat, maize, wine, cotton and tobacco are produced, whilst the mulberry is grown in order to feed the silkworm.

The Russians have built railways, by means of which the chief towns in Turan can be reached with much greater speed and safety than is possible by caravan. Fig. 32 shows that the *Central Asian Railway* leaves the old Trans-Siberian line at Samara, and crosses the Ural river at *Orenburg*. After skirting the western margins of the Kirghiz steppe, which separates Siberia from Turan, the line reaches the valley of the Syr, one of the rivers draining into the Aral Sea, and continues to *Tashkent*. In common with other Turan rivers from the central highlands, the Syr carries little water except in early summer, when the melting of the snow fills the river channels. So fast do these rivers flow in their upper courses at this time of the year, that they bring down quantities of silt and rock waste, which is spread out like a fan where the current receives a check, and this, of course, takes place when the lowlands are reached. These fertile land deltas can be made very productive by means of irrigation. *Tashkent*, the political and commercial centre of Turan, is situated in the best part of the Syr valley. *Kokand*, reached by a branch line, is also irrigated by the waters of the Syr.

Leaving Tashkent, the railway proceeds to *Samarkand* and *Bokhara*. These ancient cities are in the valley of the Zarafshan, a river which loses itself in the sand. Bokhara is at the end of the river. Conquered by the Arabs in the eighth century, these oasis cities became Mohammedan centres of learning, but many of the famous buildings were destroyed during Mongol invasions of the thirteenth century. The greatest of all the Mongols, Tamerlane, made Samarkand his capital, and erected

splendid buildings, the ruins of which may be seen to-day. The thirteenth-century traveller, Marco Polo, visited Turan, and has left on record excellent accounts of its cities and their inhabitants. From Bokhara, the railway turns south-westwards, and runs to *Merv*, a very old route centre from which a branch line runs southwards as far as the frontier of Afghanistan. Leaving *Merv* the main line winds across the desert, and has its terminus at *Kfasnovodsk*, on the Caspian Sea.

The new Turkestan-Siberian (Turk-Sib.) railway links the Trans-Siberian and Central Asian railways. It was built as part of the famous *Five Years Plan* and will do much to develop the areas through which it passes, especially the rich mines of copper, silver and other metals in the region south of Omsk and at Semipalatinsk.

We have so far considered that part of the Russian Lands which lie within the great north-western lowland. We will now turn to Eastern Siberia.

EASTERN SIBERIA.

Eastern Siberia, as will be seen from the map, is higher than Western Siberia. South of the tundra, it is mainly an elevated region bordered on the east by the Stanovoi mountains, and extending south-westwards to the forested highlands surrounding *Lake Baikal*. It is drained by the Amur, Lena, and the eastern tributaries of the Yenisei, and lies wholly within the tundra and forest zones.

Between the Yenisei and the Lena is a low plateau, above which rise table-shaped mountains. It is here that the world's greatest extremes of temperature are met with. The river Lena, whose source is close to Lake Baikal, is the least useful of the great Siberian rivers. Notice on the map (a) its very circuitous course, (b) the highlands which border its right bank, thus giving a continuous wall, and (c) the large delta which it is building at its mouth. The whole of its course is through forests or tundra. The only town of any importance on its banks is *Yakutsk*, situated on the great eastern bend of the river. It is the chief centre of the Siberian fur trade, and was

formerly a penal settlement for convicts. The east and west flowing tributaries of the Yenisei have already been mentioned in connection with the help that they gave to Russian expansion eastwards (see p. 95). Its Angara tributary drains *Lake Baikal*, the deepest known fresh-water lake in the world—its depth in places reaching nearly one mile. Its area is almost twice that of Wales. The lake, which is shut in by steep mountain walls, occupies two long parallel troughs separated by a ridge, above which the water is at places less than twenty-five fathoms deep. In winter it is frozen over for four or five months, so that the summer steamship service is replaced by sledges. *Irkutsk*, the largest town in Siberia and the seat of government for Eastern Siberia, stands on the Angara, forty miles from Lake Baikal. In the mountainous region for which it is the centre, gold-mining is an important occupation. The town has gained very considerably in importance since the construction of the Trans-Siberian railway, which passes through it. It is also reached by a camel caravan route, which crosses the Gobi desert on its way from Peking.

The river Amur can hardly be considered a Siberian river. Its lower valley and mouth are in Russian territory, but for the greater part of its course it forms the boundary between Eastern Siberia and Manchuria. It drains a little-developed pine-forested area, whose climate is very severe. Gold-mining and trapping are the most important occupations, whilst in many of the fertile valleys cereals are now cultivated. *Vladivostok*, on an arm of Peter the Great Bay, is a terminus of the Trans-Siberian railway, and is the chief port. It is unfortunate that its fine harbour is closed for about three months every year, owing to being ice-blocked.

Modern Siberia.—It is strange what wrong ideas many people have about Siberia. It is often imagined that the whole country is a land of snow and ice—a great lone land—for which the old Russian Empire had no use except as a place of punishment for criminals and political prisoners. In one sense it may be said that the Russians

themselves only discovered Siberia with the making of the great railway. The old government granted help to people who emigrated to the arable lands of the steppe, and took part in the great agricultural development which took place there in the years before the Great War. It is true that great tracts will always be unable to support many people, *e.g.* the tundra. But Siberia is a large country—half as large again as the whole of Europe—and contains vast forests, the fringe of whose wealth has been scarcely touched, as well as agricultural and pastoral lands with vast possibilities, not to mention the enormous mineral wealth of Eastern Siberia.

The Soviet government is actively exploiting the agricultural and mineral wealth of both Western and Eastern Siberia. Eastern Siberia already grows more wheat than she requires, while the great new metal works of the Kuznetsk Basin depend upon the rich deposits of coal and iron found locally. The successful attempts to export Siberian products via the rivers and the Arctic Ocean are important, and may be compared with similar Canadian efforts through Churchill on Hudson Bay.

Since 1932 very many ships have fully navigated the north-east passage in the summer. *The Northern Sea Route Administration* has established a large number of scientific stations (wireless, meteorological, biological, etc.) along the northern coast-line and on many of the islands, and sea routes are supplemented by air routes. Ports have been constructed on the Ob, Yenisei and Lena. *Port Ingara* on the Yenisei is the largest. It is built entirely of timber, and its population of about 15,000 men, women and children have all left Russia to settle there. Work goes on all the year round, even in winter when the temperature falls much below freezing-point, when there is little daylight, and the town is floodlit by electricity! The principal occupation is the preparation for export of the timber floated down the river during the summer months. *Ingara* exports the timber the following summer, for the river is frozen over in winter and the port is 400 miles from the mouth.

This astonishing achievement is typical of changes that are going on in Asiatic Russia. Perhaps the most astonishing thing is the way the new forms of organization in Russia in Europe, *e.g.* collective and state farms, state ownership of all mines, means of transport, etc., have penetrated to every part of Russia in Asia—tundra, forest, steppes and desert.

EXERCISES.

1. Describe the climatic changes that you would notice in a journey from the Siberian Arctic coast to the Sea of Aral. What other changes would be observed?

2. Write an account of the connection between the physical conditions and the life of the peoples of the tundra and the steppe.

3. What factors have led to the growth and importance of: Omsk, Irkutsk, Samarkand and Vladivostok?

Draw sketch maps to illustrate your answers.

4. What are the leading natural resources of Siberia? State their location, and describe their present state of development.

5. Describe a railway journey from Leningrad to Vladivostok. Describe the character of the country passed through at different stages of the journey, and draw a sketch map in illustration.

6. The Russian Lands occupy about one-third of Asia, but their population is only about one-fortieth of that of the continent.

Explain fully the reasons for this.

7. Which part of the north-west lowlands may be described as a "Land of hunger and privation"? Which part is a "Land of wandering"? How have Russians in recent years shown that settled life can be supported in both regions?

8. Consult the *Statesman's Year Book* and find out the political changes which have taken place since the Great War in the Asiatic part of the former Russian Empire. Do the new subdivisions appear to you to show much relation to the geographical conditions of this area?

CHAPTER XII.

SOUTH-WEST ASIA.

Natural Regions.—(i) The lands having a Mediterranean type of climate. (2) The deserts of Iran and Arabia.

Physical Features.—South-west Asia is composed chiefly of plateaux. In the north-west there is the plateau of Asia Minor, which rises eastwards into the still higher plateau of Armenia, above which tower such lofty peaks as the extinct volcano of Mount Ararat. To the north are the great ranges of the Caucasus, whilst to the south-east the plateau of Iran, comparable in elevation with Asia Minor, stretches as far as the mountain wall to the north-west of India. All these mountains and plateaux are part of the great belt of the central highlands (see p. 74). In the south-west there is the old tilted block of Arabia separated from the Iran plateau by the lowlands drained by the Tigris and the Euphrates. Six seas wash the shores of these lands. They are the Caspian, Black, Mediterranean, Red and Arabian seas, and the Persian Gulf.

THE GREAT ROUTES.

From the very dawn of history south-western Asia has been of great importance. It was in Mesopotamia, the land between the rivers, *i.e.*, the Tigris and Euphrates, that the early civilizations of Babylon and Assyria appeared, whilst the still earlier Egyptian civilization developed along the lower valley of the Nile, which, although not in Asia, is intimately con*

nected with the region we are considering, for the earliest commerce of which we have any knowledge was between Mesopotamia and Egypt.

It was not very difficult for travellers from Babylon to follow the Euphrates north-westwards, and then to strike westwards, via the oasis of Palmyra to Damascus. Turning south-west, this ancient route reached the coastal plains of Palestine, and after passing the fertile land of the Philistines, continued to its destination across the narrow strip of desert to the north of the Sinai peninsula (see Fig. 33). It may appear to be easier to strike due westwards from Babylon across the country separating it from Palestine; but this intervening land is arid desert, and therefore the longer, but safer, route was followed. It will be seen that if this route is continued along the Euphrates, it reaches the coast at Antioch, a point upon which the routes coming from the plateau of Asia Minor also converge. Fig. 33 also shows that Antioch is in the great gateway between the highlands of Asia Minor and those of Syria.

In connection with these routes notice the position of the ancient cities of *Tyre* and *Sidon*. These were the chief cities of the Phoenicians, who thus held a very important position between Mesopotamia and Egypt. When in the course of time the Phoenicians went on the sea and became seamen, they grew to be the greatest sailors of their day, visiting and trading with lands not only on the shores of the Mediterranean, but even daring to pass through the Straits of Gibraltar, the Pillars of Hercules. It is generally believed that the tin-producing islands with which they traded were our own islands, for we know that tin is mined in Cornwall. But since Phoenicia itself is not a very rich country, the decay of the great civilizations between which it lay, resulted, in the end, in the decay of Phoenicia itself.

Let us now return to Antioch, where the route following the Euphrates reached the coast. To-day,

Aleppo is the most important town in that important gap between the plateaux of Asia Minor and Syria. It stands midway between the Euphrates and the Mediterranean, and, through its modern port of Alexandretta, reaps all the advantages formerly enjoyed by -Antioch. From Aleppo, the caravan routes from Syria and Palestine on the one hand, and from the

FIG. 33.—S.W. Asia. Relief and routes.

Euphrates on the other, strike northwards across the plateau of Asia Minor, reaching the coast at Trebizond, Scutari and Smyrna. Another route follows the Tigris from Baghdad, and, passing through Mosul, proceeds west of Lake Van via Erzerum to Trebizond. Thus we see how routes via the Persian Gulf and the great rivers Tigris and Euphrates reach the Mediterranean, the iEgean and the Black seas.

The map shows the importance of the Red Sea as a great highway of trade passing to and from the Mediterranean and the Indian Ocean. In modern times the cutting of the Suez Canal has given a through water passage, but it must not be supposed that the making of this canal discovered the route. It has been known and used for centuries, although it was formerly not so important as the route following the Euphrates.

Mecca, the great centre of Mohammedanism, has been the objective of pilgrims ever since the days of the prophet. Fig. 33 shows the routes by which many of them reach the holy city. Notice that the route which goes from Mecca to Baghdad, via Medina and the comparatively well-watered Nejd plateau, is continued to Teheran, the capital of Persia. The map shows a small river entering the Tigris from the east. It is the valley of this river which makes the crossing of the Zagros mountains comparatively easy.

Other ancient routes are those which traverse the plateau of Iran, avoiding the barren depressions of the centre and keeping to the bases of the better-watered mountains, *e.g.* that from Meshed, via Teheran and Tabriz to Erzerum, or one from Teheran, via Kashan and Kerman to Quetta and the Indus.

In modern times, the great importance of the routes across south-western Asia has led to the construction of railways, of which the most important is the *Baghdad Railway*. When completed, this line will offer a land route to the east in rivalry to the sea route via the Red Sea and the Suez Canal. If a bridge were built across the straits between Constantinople and Scutari—or a tunnel were made under them—the completed railway would give communication from the North Sea to the Persian Gulf, whilst in the future it is certain to be extended to meet the Indian railways at Karachi (see Fig. 33). In Asia Minor, branch lines reach Angora and Smyrna, taking to the latter port the produce of the plateau. The map shows that in the south-east of Asia

Minor, the Taurus mountains bend away from the coast and become a barrier to the line. Here there is the famous pass, the *Cilician Gates*, through which the traffic of many centuries has passed, but the passes are too difficult to be traversed by railways so that tunnels have been constructed. During the Great War the line was constructed as far as Nisibin. From the Basra end the railway now extends beyond Baghdad and Samarra to a point some 50 miles south of Mosul, thus leaving a short middle section to be completed.

Ten miles north of Aleppo the Baghdad railway makes a junction with the French line which runs southwards and passes through Damascus to Medina, with branch lines reaching the coast at Beirut and Haifa. On account of the large number of Mecca pilgrims carried on this railway, it is known as the *Pilgrims' Railway*. The other important railway of S.W. Asia runs from Baku, on the Caspian Sea, to Batum on the Black Sea. This line is linked to the main Russian system by a line which runs round the eastern end of the Caucasus.

Thus we see that one of the most important things in the geography of S.W. Asia—perhaps the most important—is that, owing to the fact that it sits astride the great highways of trade between Europe and the Far East and Australia, and to the presence of the long Red Sea and Persian Gulf arms of sea, routes of great importance will pass across it. Of all the routes, two stand out as of first-class importance—the "through" water route, and the land route from Constantinople to the Persian Gulf. Fig. 33 also shows part of the air route from Britain to India, Malaya and Australia. This quick route is rapidly increasing in importance, especially for mails and passengers. The oil pipe lines mentioned on pages 124 and 126 are also of importance.

Now let us return to our regional study of south-west Asia. For climatic reasons we shall consider the area under the following headings: (1) The Lands of the Five Seas. (2) The Arabian and Iran Deserts.

(i) THE LANDS OF THE FIVE SEAS.

This picturesque name is given to the land bordered by the Caspian, Black, Mediterranean and Red seas, and the Persian Gulf, and, as Fig. 34 shows, it is very suitably named. The Mediterranean and Black Sea coastlands have the dry summer and winter rainfall peculiar to lands having a Mediterranean type of climate (see p. 90). The plateaux lack moisture, and are very

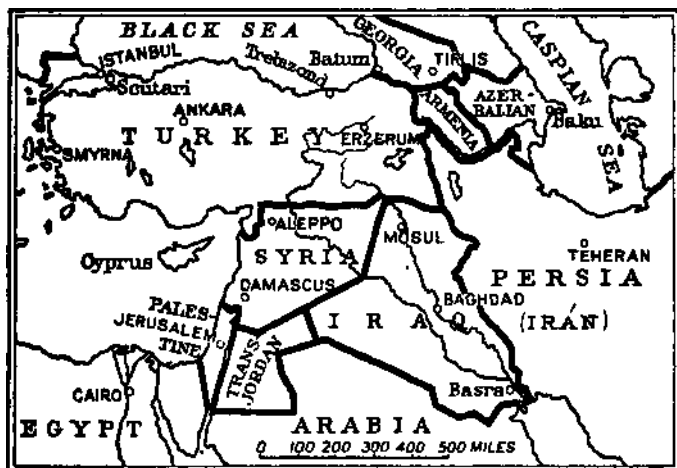


FIG. 34~The Land of the Five Seas.

hot in summer and cold in winter. The rainfall everywhere decreases with distance from the sea, so that the typical Mediterranean trees, the mulberry, olive and vine, give place to pomegranates and dates.

ASIA MINOR.

The plateau of Asia Minor or Anatolia is lowest on the west and highest on the east, where it rises to the high Armenian plateau. It is also crossed by mountain ranges which run from west to east, and the influence of these factors is seen in the drainage and routes of

the country, for both largely follow the same direction. In the north, the plateau descends so steeply to the Black Sea that there are no good harbours; in the south, the Taurus mountains rise very steeply from the sea coast, except in the east, where they bend away from the coast, leaving the very fertile plain of Cilicia. In the west the coast is much indented and there are numerous islands, which are the remnants of the mountain chains which once were continuous with those of Greece. Many rivers flowing between the east and west ranges drain the broad valleys which give easy access to the plateau.

Asia Minor forms the greater part of the Republic of Turkey, for the European possessions of that country are now very small and even Constantinople has ceased to be capital in favour of the centrally placed Ankara.

The coastal lands, including the mountains bordering the plateau, are forested with evergreen trees, with an undergrowth of shrubs, such as the rhododendron. The valleys opening westwards are also well wooded. In both valleys and plains the inhabitants follow settled occupations, and produce, in addition to the Mediterranean fruits (mulberries, olives, grapes, oranges, figs), tobacco, cotton, wheat and barley, whilst along the west coast sponge fishing is important. A considerable amount of silk manufacturing is carried on, especially at *Brussa*, at the foot of Mount Olympus, and other manufactures are of cotton and wool, the latter being used in making fine Turkey carpets and rugs. *Smyrna*, situated on a splendid harbour between two fertile valleys opening out to the *Ægean Sea*, is the chief port, its exports being representative of all the products of the country. Formerly *Smyrna* and the coastlands generally were largely inhabited by Greeks. To-day not only in Asia Minor but also in European Turkey, except in Constantinople, there are extremely few Greeks.

The plateau lacks moisture and has very cold winters, so that there is little vegetation beyond grass, and parts are even deserts in which are oases where the date palm,

as in the Saharan oases, is of the greatest importance. The plateau dwellers are, therefore, largely nomads, who move about from place to place attending to the wants of herds of camels, horses, goats and sheep. In the east the plateaux are more rugged. They are crossed by high ranges which here come close together and sometimes enclose fertile valleys. Erzerum, the largest town in this part of the country, lies over a mile above sea level and is so exposed that it is sometimes called the "Siberia of Turkey." Trebizond, on the Black Sea, is the port for this area.

Ankara, on the lower western plateau, is noted for fine goats' hair, greatly prized in the manufacture of mohair cloths. The city has fine modern buildings and is centrally placed for its function as capital of modern, progressive Turkey.

TRANS-CAUCASIA.

Trans-Caucasia is largely drained by the Kura river. The Caucasus mountains consist of rugged parallel ranges, in which are numerous glaciers. Their southern slopes are densely forested and contain valleys in which Mediterranean fruits and cereals are produced. The lower valley of the Kura is an extensive fertile plain opening to the Caspian Sea. Tobacco, cotton, and maize, as well as the vine, are produced here. South of the Kura are the plateaux of the Lower Caucasus. Here lies the Republic of Armenia, whose capital is Erivan. Note the large lake, Sevan, which is 6,300 ft. above sea-level. Agricultural occupations, especially the growing of cotton on irrigated fields, occupy most of the inhabitants.

Baku, an important port on the Caspian Sea, stands at the north of the plain, and is the centre of a very important petroleum area. It is not a very inviting town, for even the air is pervaded by the smell of oil, whilst the numerous refineries and pumping

stations are not buildings which can enhance its appearance. Since it is on an enclosed sea, the oil is sent by pipeline to *Batum*, on the Black Sea. Here it is pumped into oil-steamers and shipped to all parts of Europe. Between *Baku* and *Batum* the line passes through *Tiflis*, the capital of Georgia. The city is beautifully situated on the precipitous cliffs of the ravines of the upper Kura. In addition to its position on this important railway, it also commands the easiest north and south route across the Caucasus via the Georgian Highway. This route is very important, and has been followed by a splendid road, built primarily for military purposes. Eventually it will be followed by a railway line. The Georgian Highway is, of course, snow-bound in winter.

SYRIA AND PALESTINE.

Syria and Palestine, lands full of interest on account of their Scriptural connections, lie along the eastern shores of the Mediterranean Sea. The former is a high plateau, whilst in Palestine, north of Mount Carmel, the highlands are farther away from the coast, leaving a fertile coastal plain everywhere less than 600 ft. above sea-level. Rising abruptly from the plains is the plateau of Judea and Samaria, which is not so high as that of Syria, farther north. The plateaux of Syria and Palestine slope gradually towards the east, and form the Syrian desert. Notice the north and south direction of the Jordan and the Gulf of Akabah, which is the more easterly of the two gulfs at the northern end of the Red Sea. The greater part of the Jordan valley is below sea-level, the surfaces of the Sea of Galilee and the Dead Sea being 682 ft. and 1,291 ft. below sea-level respectively. These lakes occupy part of the floor of what is known as a *rift valley*, a type of valley which we will now proceed to explain.

Rift Valleys.—During the formation of a fold in the crust of the earth the pressure is generally so steadily

exerted that even rocks are gradually forced into folds. But in some cases the beds of rock cannot withstand the strain of the bending required, and they accordingly fracture. This causes blocks of the earth's crust to be raised and others to be depressed relatively to each other. Such crustal blocks are bounded by faults (see

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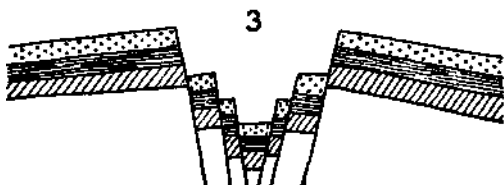
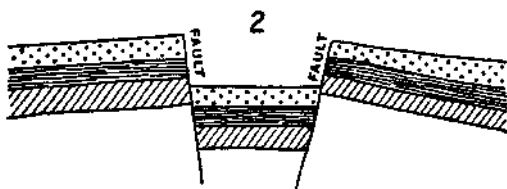


FIG. 35.—Sections illustrating the formation of a rift valley.

Fig- 35). Very often the land between two parallel faults is let down, and a comparatively narrow depression is formed. This is known as a rift valley. The Red Sea, as is indicated by its length and width and its steep, straight sides, occupies such a valley, which is a continuation of that of Palestine. Turning south-westwards at the southern end of the Red Sea, this

great rift is met by another which contains the Gulf of Aden, and is then continued across Africa as far as the south of Lake Nyassa. The connection between the Asiatic and African rift valleys is shown in Fig. 36.

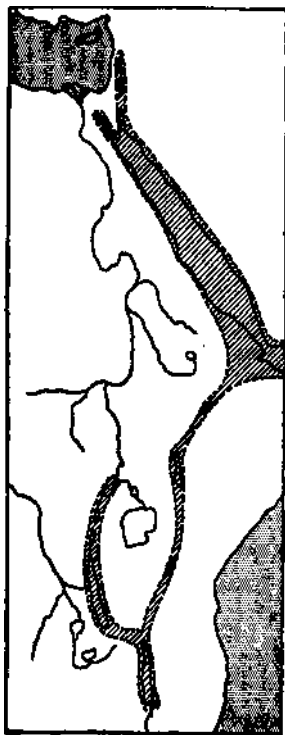


FIG. 36.—The Great Rift Valley.

In Palestine all the Mediterranean plants can be cultivated, and great quantities of wheat and barley used to be grown on the coastal plains. The hill sides were terraced for the culture of the vine, and irrigation works were carefully constructed, whilst the hill country was inhabited by prosperous shepherds. The Turks sadly neglected these lands, and in the place of fertility they left behind them poverty and waste. At the present time, however, great schemes for barraging the Jordan below Lake Tiberias are in progress. These will provide water for the fields and power for industries and are expected to do much to bring back prosperity to this ancient land. Already the population of Palestine has doubled since the Great War, and this is chiefly due to Jewish immigration.

In modern times the most important port is *Beirut*, which is surrounded by a very fertile tract of land, and is connected by rail with *Damascus*, the capital of Syria. *Damascus* is an oasis made by the waters of a small river at the base of the Anti-Lebanon mountains. It owes its importance to its control of routes—eastward to Mesopotamia,

and southward, via the Pilgrims' Railway, to Mecca.

The ancient city of *Jerusalem*, the capital of Palestine, has a central position, and one that could be easily defended, for it is protected on three sides by deep ravines. It is a walled city, and is visited every year by thousands of pilgrims and tourists, who are attracted by its sacred associations. From Jerusalem a railway runs to its port, *Jaffa*, but at present it has no connection with the Mecca railway owing to the difficulty presented by the Jordan rift valley. There is also a frequent service of motor omnibuses between the two towns. The journey takes about two hours. *Jaffa* has a very important export of oranges. Its near neighbour, *Tel Aviv*, has been built by Jewish enterprise. *Haifa* has increased in importance with the coming of the Jewish settlers, and has a modern harbour opened in 1933.

MESOPOTAMIA OR IRAQ.

As we have seen, the word Mesopotamia means "between the rivers," that is, the Tigris and Euphrates. We shall here use it to include all the lowlands shut in between the Arabian plateau and the Zagros mountains. Upper Mesopotamia, which was roughly the ancient land of Assyria, has a much more varied relief than the lowlands of southern Mesopotamia, which was occupied by Babylon. The latter lowlands consist mainly of alluvial deposits so low lying that many parts are swamps. The Euphrates and Tigris rise amidst the snows of the Armenian mountains, and their upper courses are very wild. Before reaching the Persian Gulf they join and flow through a region rendered swampy by the uncontrolled flood waters. The combined river is busily engaged in filling up the Persian Gulf, and is pushing its delta onwards at the rate of about 70 ft. per year. Close to the rivers, where irrigation is rendered easy, fields of cotton, wheat, tobacco and maize are found, whilst sugar and date palms are important in the lower valley. The rainfall, however,

is so small that without irrigation agriculture cannot be carried on, and since the same story of Turkish neglect has to be told of this land as of Syria and Palestine, the present condition of the greater part of the country is little better than a poor steppe land in which nomadic Arabs and Kurds pasture their flocks. There is no doubt that, given wise government, Mesopotamia would once again become one of the gardens of the world. As in Egypt, great barriers could be put across the rivers in order that water may be held up for use when the rivers are low. Large irrigation schemes are already in hand.

Even to-day the most important towns stand on the rivers. *Mosul* stands at the navigation limit of the Tigris, and is built mainly upon rising ground so as to be above the level of the river floods. Its name means "Central Gates," and was bestowed upon the city because it is situated at the intersection of routes from the Black Sea to the Persian Gulf, and from the Mediterranean Sea to the Caspian. On account of its site at the intersection of these routes, and at the navigation limit of the Tigris, it has been said that whatever military power holds Mosul must eventually become the possessor, sooner or later, of the whole of the Tigris valley, and even of the whole plain as far as the Persian Gulf. The ruins of the ancient Assyrian capital, Nineveh, stand on the opposite bank of the river. In ancient times, as now, in a country which has little stone for building purposes, the chief substance used in house making was sun-dried brick, made of clay. One point about the site of Mosul must be mentioned. Nineveh fell into decay, but Mosul arose near its ruins. Should Mosul disappear, another city will arise somewhere near by, for here is one of those places where the geographical conditions make it inevitable that there should be a town.

At *Kirkuk*, nearly 100 miles south-east of Mosul, **are** rich oil wells belonging to the Anglo-Iranian Oil Co. (see p. 126). The oil is pumped along a pipe to Haditha

on the Euphrates. From this point the pipe line bifurcates, one branch going to Tripoli, the other to Haifa. At these ports the oil is pumped directly into tankers. The construction of these pipe lines was a magnificent achievement (see Ex. 4 on p. 128).

Baghdad, famous in the *Arabian Nights*, is a walled city, standing on both banks of the Tigris, at the point at which that river comes very close to the Euphrates. The latter fact is of importance, as it may be possible to unite the rivers by canals, used for navigation as well as irrigation. A tributary from the Zagros mountains enters the Tigris at Baghdad and adds to its importance, for a route to Teheran, the capital of Iran, follows the valley of this river, and gains a fairly easy crossing of the Zagros mountains. South of Baghdad, but on the Euphrates, stood Babylon, now in ruins.

Basra stands near the Shat-el-Arab, the combined Tigris and Euphrates, and is the port for the delta lands. It is built about a mile from the river; but the district is so cut up by canals that all communication takes place by water. The surrounding country is dreary, owing to the extent of the marshes which are a source of malaria, but near Basra itself there are extensive plantations of date palms. The town is reached by ocean vessels. *Abadan* is the port for the Iranian oil-fields (see p. 126).

(2) ARABIA AND IRAN.

These arid lands are both plateaux, Arabia an old fractured and tilted block, and Iran a plateau whose uplift accompanied the growth of the young folded ranges which border and cross it.

ARABIA.____)

The Arabian plateau, very little of which is less than 1,500 ft. above sea-level, is highest along the Red Sea shores, from which it slopes eastwards to Mesopotamia and the Persian gulf. The map shows that the south-west, the south, the centre, and the land bordering the

Gulf of Oman are all high. The central highland is the large plateau of Nejd.

Arabia is one of the driest lands in the world. The higher districts, especially those of the south-west and the centre, receive slight rains, and on that account pastoral occupations can be carried on there; but elsewhere the land is practically rainless. Except in the south-west, there are no permanent streams, only wadis, or channels which are supplied with water after the occasional rains, but even then the streams never reach the sea. There are, however, oases where underground sources of water can be reached, or where springs occur, and in these date palms and cereals can be cultivated. Such oases are found in the valleys of the Nejd plateau, where rain falls during spring and autumn in sufficient quantity to give a covering of grass for a short time. It is on account of this that the Nejd region is famous for its breeds of horses, camels, donkeys, and sheep.

In Yemen, in the south-west, there are permanent streams flowing to the Red Sea, and, owing to the elevation, the high parts enjoy a warm, temperate climate. Fields of wheat and fruit-trees are numerous, and coffee is an important product. Coffee is grown on the lower south-west slopes, where the climate is hot and moist, and mists from the sea are very common. *Mocha*, whose name is usually associated with the coffee from this region, is not now so important for this article as *Hodeida*, the chief port.

The remainder of the west coastlands, and those in the south, are hot and dry, and almost uninhabited. In the region of the Oman highlands, in the south-east, some rain falls, and there are parts which are suitable for pasture. Notice the Bahrein Islands, in the Persian Gulf. They are British, and have important pearl fisheries. Another British Arabian possession of very great importance is *Aden* in the south-west, more than one hundred miles from the narrow straits of Bab-el-Mandeb, by which the Red Sea is entered, but sufficiently near to that entrance to be of great value as a naval

and commercial depot. In the straits themselves is the small island of Perim, which is also British, and is attached politically to Aden. The latter town is built in the crater of an extinct volcano. Rain falls very irregularly, often at intervals of more than a year, so that fresh water has to be obtained by means of the evaporation of sea water. In addition to this, large tanks have been cut in the rock, in order to receive and store the storm-brought rains. Aden's chief importance lies in its strategic position, and therefore it is strongly fortified, whilst it is on the great ocean trade route to India, the Far East and Australia.

The most interesting town in all Arabia is Mecca, famous as the birthplace of Mohammed. Every year it is visited by thousands of pilgrims, who make long journeys to the tomb of the prophet. Except the great mosque, there are few handsome buildings, for it is desired that no other building should rival the sacred edifice. The port of Mecca is Jiddah. Medina, north of Mecca, contains the tomb of Mohammed, and is also much visited by pilgrims. It can now be reached by railway from Aleppo and Damascus. Apart from this line, the chief means of communication in Arabia are naturally by means of caravans.

IRAN.

The Iran plateau, the greater part of which is about a mile above sea-level, is really a depression, bounded on the north by mountains stretching from the Elburz to the Hindu Kush (=Slayer of the Hindu, *i.e.* by means of avalanches); on the east by the Sulaiman and Hala mountains, and on the south and west by the coastal highlands and the Zagros Mountains. Communication in a region like this is naturally very difficult, and depends chiefly on the use of camels and mules, for, excepting the roads leading from Teheran, the Persian capital, to the Black Sea, there are no roads upon which wheeled conveyances can be used with ease. The two great caravan routes avoid the central depressions, of

which the two largest are the Great Salt Desert in the north-west, and the Seistan depression in the east. The sandy soil of the former is impregnated with salt, whilst the few rivers which traverse the latter, lose themselves in extensive salt marshes. In the latter connection, notice the Halmand river.

With regard to the climate of Iran, there are marked contrasts between (a) the Persian Gulf coastlands, where the climate is unhealthy, owing to a damp heat, with a low rainfall; (b) the greater part of the plateau, where there are extremes of winter cold and summer heat, together with a small rainfall; and (c) the lands bordering the Caspian Sea, where the climate is of the warm, temperate type. In the latter region there is ample rainfall, and the slopes of the mountains are forested.

The products of Iran closely correspond to the climates. On the plateau the poor pasture supports goats, sheep, and camels, and pastoral products are of chief importance, and have been the means of making Persian carpets and cloths famed the world over. On leaving the mountains, the rivers in many cases disappear underground, owing to the porous nature of the limestone, of which much of the plateau is composed. An elaborate system of underground canals, or *kanats*, partly natural, partly artificial, is often found in the vicinity of the larger plateau towns. By means of these less water is evaporated by the heat of the sun, and water can be obtained for irrigation in order that otherwise desert areas may become oases, and rice, tobacco, etc., be cultivated. Along the south coast the date palm is the typical product, whilst in the lowlands bordering the Caspian Sea, silk, cotton, and sugar are produced.

The mineral wealth of Iran is considerable, but is not worked, except for the valuable petroleum deposits which have been found along a zone extending in the west of Persia from Kurdistan to the Persian Gulf. The chief Persian wells are some 150 miles north-east of *Abadan*, the port of Iraq, to which the oil is brought by pipe line. This oil-field, and the newer one in Iraq (see

p. 122), are worked by the Anglo-Iranian Oil Company.

The chief Towns of Iran.—*Teheran*, the capital of Iran, the new name for Persia, lies at the southern base of the Elburz in sight of Mount Demavend, a snow-capped volcano of majestic appearance. It is the converging point of routes (see Fig. 33). One of the most important of these passes through *Ispahan* and *Shiraz*, both oasis towns, to its termination at *Bushire*, the chief port. Another route goes westwards to *Tabriz*, next to the capital the largest city in the country, and eastwards to *Meshed*, famed for its shawls and carpets. A Trans-Iranian railway runs from *Bandar Shapour* on the Persian Gulf via *Hamadan* to *Teheran* and *Bandar Shah* on the Caspian.

The capital of Afghanistan is *Kabul*, a town of great strategic importance, since it controls the Khaibar Pass, a narrow defile some thirty-three miles long. This pass, which does not follow the *Kabul* river, leads to the plains of north-west India, and can be held by a few good marksmen against a large number of attackers, for in places it is very narrow indeed. *Kandahar* and *Quetta*, the former in Afghanistan and the latter in Baluchistan, are on another route, which also leads to the plains of the Indus, via the *Bolan* Pass.

THE POLITICAL UNITS OF SOUTH-WEST ASIA.

Changes as a result of the Great War are indicated on Fig. 34. At first the collapse of the central Russian government and the difficulty of communication across the Caucasus led to the secession of the Trans-Caucasian peoples and their formation into semi-independent states. Round *Erivan* an *Armenian Republic* has been formed which also includes some former Turkish territory. The area round *Tiflis* and *Batum* has become the *Republic of Georgia*, whilst in the lower valley of the *Kura* and along the shores of the *Caspian* we have the *Republic of Azerbaijan*, with *Baku* as capital. These three republics belong to the Union of Soviet Socialist Republics. Their capitals are connected by railway with each other and also with *Erzerum* (Turkey) and *Tabriz* (Iran).

The peace treaty with Turkey, itself now a republic, demanded that she recognized the independence of *Armenia, Iraq, Syria, Palestine* and the *Hejaz* (Arabia). Greece held the city and district of Smyrna for a time, but they have now been returned to Turkey. Thus all that is left to Turkey of her former vast Asiatic possessions is Asia Minor. Under mandates from the League of Nations, Britain guides the affairs of Palestine, and France those of Syria. In 1929 *Trans-Jordan* was given a government, independent of Palestine, under its Arab prince. It is still part of the territory mandated to Britain, and the High Commissioner of Palestine is also High Commissioner of Trans-Jordan. Iraq, which was ruled under mandate by Britain until 1927, is now independent. It has a native government with an Arab king. In Palestine an effort is being made to create a national home for the Jewish people. Some success has already been achieved in this direction, for the total population in the new settlements is about 50,000. The settlers have come from many countries in order to make homes in the ancient Jewish homeland. Unfortunately, Jews and Arabs have so far failed to agree to live peaceably together.

The political units of the Iran plateau remain unchanged. *Iran* (Persia) and *Afghanistan* are independent, and *Baluchistan*, a stony desert with a few oases, forms part of the British Indian Empire. All three occupy positions of great political and strategic importance, especially was this so in the days when they were "buffer states" between powerful Russian and British interests.

EXERCISES.

1. Of what importance is Aden? What is its annual rainfall? How is the town provided with fresh water?

a. What special features are there in the physical geography of the Jordan valley? Are these features to be found in Britain?

3. Why are the following cities important to-day, and why were they important in ancient times: Baghdad, Jerusalem, Damascus, Aleppo?

4. Find out how the construction of the oil pipe lines (pp. 123, 126) has affected the life, distribution and education of the people. Make a map of these pipe lines and, in writing, give an account of the difficulties overcome during their construction.

CHAPTER XIII.

INDIA AND CEYLON.

PHYSICAL FEATURES, CLIMATE AND VEGETATION.

OUR Indian empire, as defined by Act of Parliament, includes not only the great peninsula south of the Himalaya mountains, but Baluchistan, of which we learned in the last chapter, in the west, and Assam and Burma in the east. It covers an area of about a million and a half square miles, and can be regarded as a small continent in itself, rather than as a country. Its population numbers about 353 millions, who belong to many races and religions, and speak many languages. Some of its cities are among the finest in the world, whilst many of its inhabitants are extremely backward. It is a land of great contrasts.

PHYSICAL FEATURES.

An examination of the physical map will at once show—

1. The great mountain barrier in the north-west, the north and the north-east.
2. The extensive plains of the Indus and the Ganges.
3. The triangular plateau of the Deccan, bordered by much wider plains on the east than on the west. Ceylon is a detached portion of this plateau.

I. THE NORTHERN RANGES.

To the north of India is the high plateau of Tibet, to the south of which rise the Himalaya mountains.

As seen from the plains of the Ganges, these mountains rise very suddenly from land which is almost dead level. The Himalayas are a series of parallel earth folds which rise, ridge behind ridge, until the highest central crest is reached. This central ridge, known as

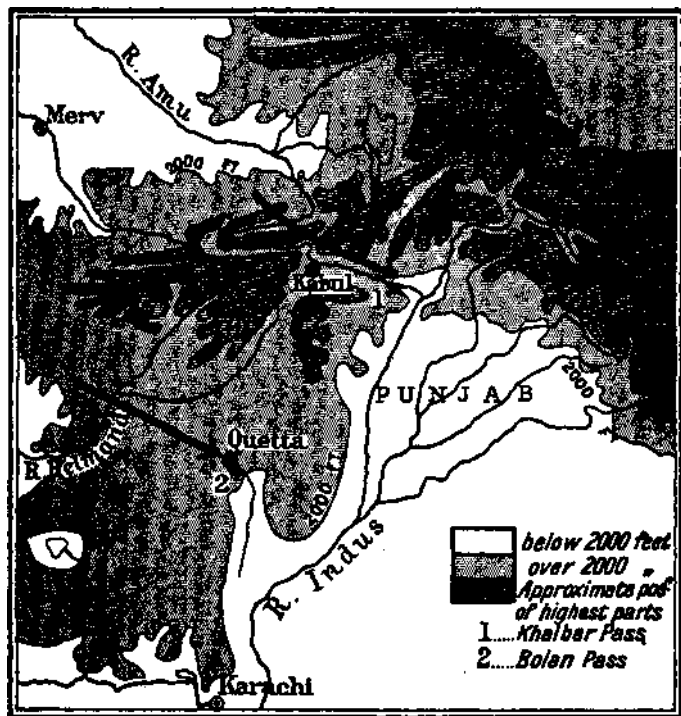


FIG. 37.—The north-west gates to India.

the snowy Himalayas, contains all the highest peaks, including Mount Everest, the highest mountain in the world. This giant has a summit over 29,000 ft. above sea level. The crests of the Himalayan ranges are snow-covered, and glaciers are numerous. Owing to the great width and height of this system (no pass is

THE INDO-GANGETIC PLAIN

lower than 17,000 ft.), they have always been a great obstruction to communications between the bleak plateau of Tibet and India. North of the western Himalayas, and separated from them by the upper Indus, are the Karakoram mountains, an eastern continuation of the Hindu Kush.

In the north-west of India, the Iran plateau, bordered by the Sulaiman and Hala mountains, rises above the plain of the Indus. The mountain barrier here is not so continuous as in the Himalaya region, and there are two passes which give fairly easy access to India from the north-west. They are the Khaibar and Bolan passes (see Fig. 37). These are the great gateways leading into India from Iran and the Turan lowlands, and have been followed by many conquerors and invaders.

In the north-east, the Himalayan ranges bend south and traverse Indo-China. The mountains here are much more of an obstacle to invaders than those of the north-west, but not so great as the Himalayas. Many Mongols have entered India from the north-east, but their numbers have been few compared with those invaders who came through the north-west gates. The Andaman and Nicobar islands mark the tops of continuations of one of these north and south-eastern chains.

2. THE INDO-GANGETIC PLAIN.

This extensive lowland lies between the northern ranges and the Deccan. It has been very slowly built up by the sediment brought from the mountains by rivers. So fine is this alluvium that it is very rare to find stones or pebbles. The map shows that the Ganges is nearer to the northern edge of the Deccan than to the Himalayas, and this is partly due to the fact that the Himalayan rivers have higher sources and greater volumes than those from the Deccan, and consequently push the river southwards, and partly to the raising of the land on the north of the plain due

to the deposition of sediment. In this connection it is interesting to notice the lower course of the Indus, where the river flows comparatively close to the mountains, as it receives no tributaries in this section. It is worthy of note that the three great rivers of India, the Indus, Ganges and Brahmaputra, have headstreams (in the case of the Ganges one of its tributaries) which have their sources north of the Himalayas, about the centre of the system (see Fig. 51). The rivers reach the Indo-Gangetic plain by means of difficult and often inaccessible gorges. It is very probable that the rivers existed before the mountain ranges, and that the latter were uplifted so slowly that the rivers were able to maintain their north and south direction by cutting gorges of constantly increasing depth. At their mouths they are building up great deltas, thus extending the area of the plain. The low-lying region at the mouth of the Ganges-Brahmaputra is known as the *Sundarbans* (= forests), a swampy region across which the deltaic streams meander, and in which they often change their courses, so that there are many towns which have become derelict owing to their being no longer on navigable waterways. The map shows that the watershed between the Indus and the Ganges is a very low swell of ground which extends from the Aravalli hills to the Himalayas.

3. THE DECCAN.

We have already learned that the Deccan is a fragment of the ancient southern continent, and that it is a plateau so tilted that it presents a steep face to the Arabian Sea, and has a long slope to the Bay of Bengal, along which are coastal lowlands much wider and more extensive than on the west. The western edge of the Deccan forms the Western Ghats (— steps) and its eastern margins the lower and much more broken Eastern Ghats. The Vindhya mountains form the water parting between the Deccan rivers and those

which **flow** to the Ganges. The longer Deccan rivers as, for example, the Godaveri, Kristna, and Cauvery, **flow** eastwards, their valleys having very considerably dissected the plateau. Their upper valleys are steep, contain many waterfalls and are often inaccessible.' The rivers flowing westwards are much shorter, except for the Narbada and the Tapti, between which are the Satpura mountains. On a first glance at the map it would appear as though those river valleys offered good routes from the Gulf of Cambay to the Ganges basin, but we shall learn later that this is not the case in their lower courses, on account of the dense forests which are found there. The easiest natural route across the western Ghats is south of the Nilgiri hills (see Fig. 43), where the Palghat Gap, about 1,000 ft. above sea level, forms a natural means of communication between the Malabar and Coromandel coasts.

In the north-west of the Deccan there are large areas covered with a very rich black soil, made by the decomposition of the basalt rock which is found in that region. This soil can hold moisture long after the rains have ceased, and as it is much used for the production of cotton, is often called "the black cotton soil of the Deccan."

CLIMATE.

The greater part of India has what is known as a monsoon type of climate—that is, the rain falls mainly in summer. We have seen that this is due to the position of India on the fringe of a great land mass which is greatly heated in summer and cooled in winter, so that, at the former season, winds blow from the oceans towards the low pressure areas on the land, and during the latter season from the high pressure areas situated over the land towards the ocean, where the pressure is less. We must now go into more detail. The great mountain barrier to the north of India is a climatic as well as a physical barrier. The winter, or cool season, winds of India blow from the north-east,

and those of summer from the south-west, but it does not appear that the former have come from the heart of the continent, or that the latter are making for the large low pressure system north of India. Fig. 38 gives temperature maps for January, May, July, and

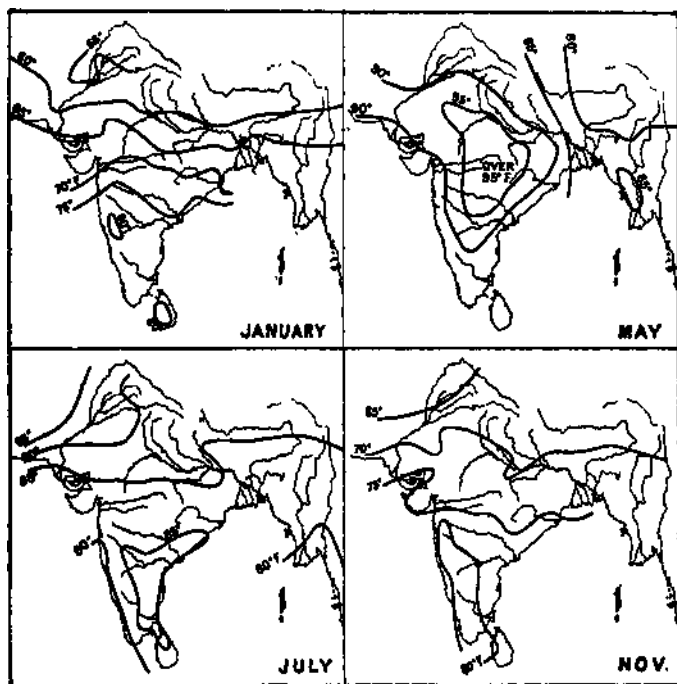


FIG. 38.—India. Temperature maps.

November. It will be seen that the coldest part of India in January is in the north-west, *ie.* the lower Indus basin and the Thar desert. Between January and May the heat is gradually increasing, until at the end of May the region of greatest heat is the centre of the peninsula. At this time of the year the sun is seen overhead at noon in the northern hemisphere nearer

and nearer the Tropic of Cancer every day, so that, in July, the region having the highest temperature is the same area which was coldest in January. This, of course, means that this region is a centre of high pressure in January, and of low pressure in July (see Fig. 39). Now it is from this local area of high pressure that India's winds blow in the cool season, and towards this area of low pressure that they blow during the wet season.

During January and February India has its *cool*

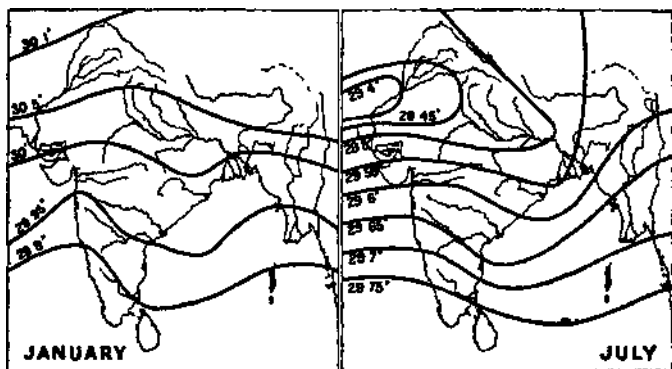


FIG. 39.—Pressure maps for January and July.

wather season, and in this month there is a movement of air from the north-west along the valleys of the Indus and the Ganges. Over the ocean these winds, obeying Ferrers Law, are deflected to the right and become N.E. winds—in fact, the N.E. Trades. Lying between the two great air currents, the Deccan, at this time of the year, receives few winds and is dry and dusty. March, April and May are the months of the *hot weather season*. The northerly migration of the sun causes India to be slowly heated, until at the end of May the heat, especially on the Deccan, is almost unbearable. The whole country is baked, the grass is

withered, even man languishes, and everything is ready for the coming of the monsoon. Some rain falls in the south and on the mountains, but in insufficient quantities to relieve the general state of depression. The region of greatest heat moves to the north-west, the winds of the earlier part of the year cease to blow, and, early in June, the monsoon winds reach Bombay. From June to October is the *Season of the South-west Monsoon*.

The coming of the monsoon is heralded by cyclonic storms of great violence, but they are soon over and calm reigns again, only to be broken by other storms, which usually occur about every fortnight. The periods of calm between the great storms are very important, for immediately following one of them the farmers put their plants in the ground (especially rice and indigo), so that they may be firmly rooted before the next storm arrives. What has really happened is, that the Doldrums low pressure area has moved as far north as northern India, so that the south-east Trades¹ cross the equator (see Fig. 40). Having done this, they are under the influence of deflection to the right, for they are now in the northern hemisphere. This great mass of air meets the wedge-shaped Deccan and we thus have one current proceeding into the Arabian Sea, the other into the Bay of Bengal. Under the influence of deflection the former current reaches the western Ghats, and is suddenly forced to ascend, and, since these winds have come over thousands of miles of water, the rainfall is tremendous. Indeed, so much is liberated that the winds continue eastwards across the Deccan as dry "Chinook" winds. • It is owing to this fact that the Deccan is indifferently watered, and is often troubled by famine. This danger has been somewhat mitigated by the construction of tanks of reservoirs for the storage of water. It must also be noted that the full force of the south-west winds is not felt north of the Gulf of Cutch, so that even at this season little rain is brought to the lower Indus basin, whilst, owing to the low elevation of this region,

there is less precipitation from those sea winds which it does receive.

The air currents passing up the Bay of Bengal water the greater area. Some of the winds blow towards the hills of Assam, and enormous quantities of rain fall there, Cherrapunji having a world's record—a mean annual rainfall of 460 in., or nearly 39 ft. Other currents, making for the low pressure area in the north-west, pass along the Ganges valley, dropping rain all the way. Very gradually these conditions change, and November and December may be named the *Season of*

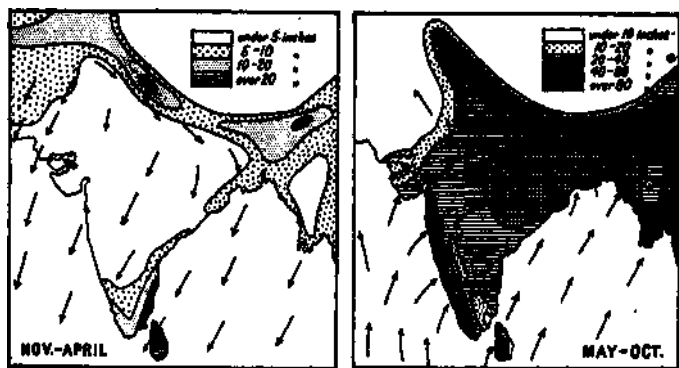


FIG. 40.—India. Winds and rainfall.

the Retreating Monsoon. The north-east winds begin to gain control in the north, and the south-west winds retreat farther and farther south; but before they finally disappear they bring rainfall to the south-eastern margin and to Ceylon.

Dividing the year into two periods, it will be seen that the drier six months are from November to April, and the wetter from May to October (see Fig. 40). All the rain which falls in the latter period is brought by the summer monsoon. From November to April, the greater part of India receives little rain because (except for the rain which is brought by the receding

monsoon) the only parts receiving winds from the ocean are the south-east and Ceylon.

NATURAL VEGETATION AND CULTIVATED PLANTS.

NATURAL VEGETATION.—The kind of vegetation a country has depends chiefly upon two factors—temperature and rainfall. As regards the former, we have seen that India may be said to have a hot climate. As regards rainfall, that of the Western Ghats, the Himalayas and the mountains of Assam and Burma is very heavy, resulting in dense forests on their lower slopes. Teak is one of the most valuable of the forest trees, and elephants are cleverly trained to move the heavy logs from place to place.

Of course elevation has a very important effect on natural vegetation. This may be illustrated from the vegetation of the Himalayas (see Fig. 41). The foothills are bordered by the swampy, malarial region known as the Terai, which in parts, especially in the wetter east, is wild jungle. Up to about 3,000 ft. the vegetation is tropical, and tall ferns, bamboo, teak and sal are found. From this elevation to about 7,000 ft. magnolias, oaks and chestnuts abound, and all are festooned by long convolvuluses. Forests of this type give way to gigantic conifers such as pines, firs and cedars, which are found up to an elevation of about 12,000 ft. Beyond this the trees disappear, and pasture lands, the Alp of the Himalayas, are met with, as well as fields of beautiful flowers. The pastures become poorer and poorer, and gradually merge into vegetation of the tundra type before the snow line (about 16,000 ft. on the southern slopes) is reached.

The monsoon winds also blow up the valleys of the Narbada and Tapti, and the heavy rains which fall account for the dense forests in the valleys of these rivers. The delta of the Ganges-Brahmaputra, the Sundarbans, is also a densely forested swamp, inhabited

by tigers, deer, wild boars, enormous crocodiles and reptiles. Much of Ceylon is forested.

On the borders of the desert of Thar there are considerable areas where, owing to the light rainfall, agriculture cannot be carried on, although it is possible to rear cattle, as the prevailing vegetation is that of poor grassland. Much of the Deccan is savannah, due

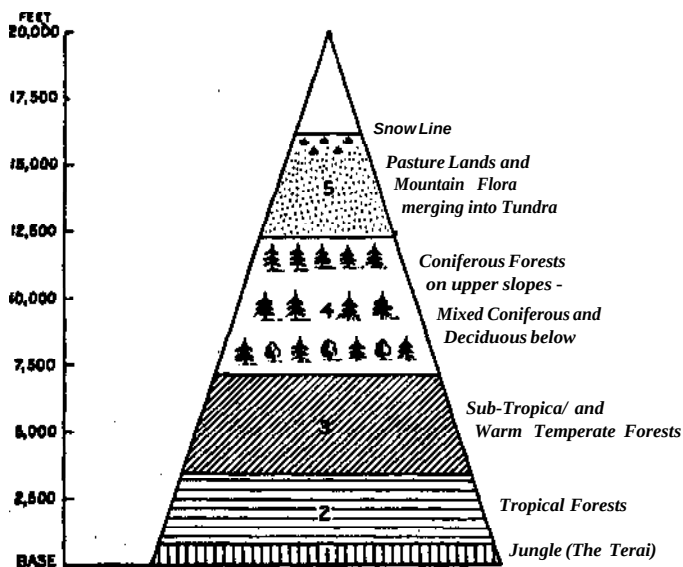


FIG. 41. -The vegetation belts on the southern slopes of the Himalaya Mountains.

to the lack of water, for it must be clearly understood that, as the greater part of India receives rain in summer only, forests will not be found in those places where the summer rain is not sufficient to keep the soil moist at all seasons.

CULTIVATION AND WATER SUPPLY.—Agriculture is by far the most important occupation in India, and since the type of climate to which that of this country belongs is

suitable for a great variety of plants, we have in India a very varied list of cultivated products. The great drawback is the occasional failure of the summer monsoons to bring an adequate supply of rains. When this occurs very serious famines are the result, and thousands of people die. In the areas which are indifferently watered it is absolutely necessary to practise irrigation if agriculture is to be successfully carried on.

In the Ganges valley, the low-lying lands of the delta and of the lower valleys of the two great rivers are so near sea-level that the land cannot be drained, and is actually too wet and swampy for full use to be made of it. Farther up the Ganges valley the land is a little higher, the rainfall is sufficient, and it is here that we have land most suitable for the production of India's chief product—rice. Proceeding towards the upper Ganges basin we come to an area where the rainfall is not sufficient for the needs of agriculture, and it is necessary to resort to irrigation, which has been carried on to such an extent that the whole region has been covered with a network of canals and pitted by thousands of wells. Continuing to the mouth of the Indus we cross the poorer grasslands, already referred to, and the arid lands of the lower Indus. But even here a great barrage has been built across the Indus just below Sukkur, where the river is a mile wide. The water held back by the barrage irrigates an area as large as the six northern counties of England.

In recent years many irrigation canals have been constructed in the Punjab, which is situated in the upper valley of the Indus, and is drained, as its name implies, by five great rivers, the Indus and four important tributaries. Some of these canals carry more water than the Thames at London, and all have enormously increased the area which can be used for production, although it must be borne in mind that irrigation has long been practised in this part of India.

In many parts of the Deccan it is also necessary to store water for use in the dry season, and this is done

in great tanks and reservoirs. At Bhatyar, about 30 miles south of Poona, the famous *Lloyd Dam*, one of the largest in the world, holds back a lake 17 miles long and supplies irrigation canals with water for an area of over 1,300 square miles.

CULTIVATED PLANTS.—Fig. 42 shows the distribution of the leading vegetable products of India. It will be seen that *rice* is grown chiefly in the well-watered lowlands of the Ganges basin and along the coastal plains bordering the Deccan and eastern Burma. Rice requires a high temperature, and must be planted in fields that can be easily flooded to a depth of several inches at certain stages of its growth. On deltas and the banks of rivers flowing over plains this is not difficult. In other places the fields must be flooded by means of irrigation canals or wells. Some kinds of rice can be cultivated on uplands, and require less moisture, but the hill rice produced in India is very small in comparison with the swamp variety. Rice is very exhausting to soil, so that it is of necessity most cultivated where the summer floods cause rivers to spread fertilizing silt over their low-lying lands. One other point must be noted. Rice is exceedingly prolific and a great amount can be produced on one field, especially as more than one crop can be obtained from the same ground during one summer. Now rice forms the chief article of food in south-east Asia, and it is partly owing to the great quantity which can be produced that the plains of this part of Asia are densely peopled. In India the best rice is grown in the area for which Patna, on the Ganges, is the centre. *Millet*, extensively grown as a food grain, is generally confined to those regions which, on account of lack of moisture or too poor soil, are not suitable for rice or wheat. Its distribution is shown on Fig. 42. *Tea*, like rice, requires considerable heat and a heavy rainfall, but, unlike rice, its roots must not be water-logged and the soil must be well-drained. It is, therefore, grown on hill slopes and on well-drained plains. It is a very hardy plant, and is able to withstand even winter frosts. Most of the tea

INDIA AND CEYLON

imported into the British Isles is produced on the hills of Assam and Ceylon. Darkling, situated on the slopes of the Himalayas, between the independent states of Nepal and Bhutan, is the centre of an important tea-producing region. *Coffee* cannot thrive in places where the winters are severe, and is, therefore, chiefly grown in southern India and in Ceylon, although in the latter island it has made way for other products in recent years. We have left wheat until last of the food crops because it is grown in India as a winter crop. Now India receives little rain in winter, so it is evident that much of the water required must be obtained by irrigation methods, although it is the rule to plant the seed just before the summer rains cease. The sunny cool season brings the crop to fruition, and it is generally harvested in February or March. The chief wheat producing areas are the Punjab and the well region of the upper Ganges.

Cotton is also a very important product. As will be seen from Fig. 42, its cultivation is confined chiefly to those parts of the Deccan which are covered by the fertile black soil (see p.133). This soil is especially suitable, for it can hold moisture even after the monsoon rains have ceased. The climatic conditions suitable for cotton are long, very warm, moist summers. Indian cotton is exported from Bombay, which is also a rising cotton manufacturing centre. Jute is one of India's most valuable exports. It requires a hot, damp climate, but the rainfall must not be too heavy, and, like rice, it exhausts soil very rapidly. For these reasons its cultivation is confined to the lower valleys of the Ganges and the Prahmaputra, and to the Sundarbans, for these areas are fertilized naturally by the river floods. One result of the production of jute in this part of India has been to make Calutta a very important jute manufacturing city. *Flax* is very largely grown, and oil seeds form one of the chief exports of the country. In hot countries like India, the fibre does not develop sufficiently well to be used for manufacture, but the seed (linseed) is more abundant than in temperate countries, in which the fibre is of more

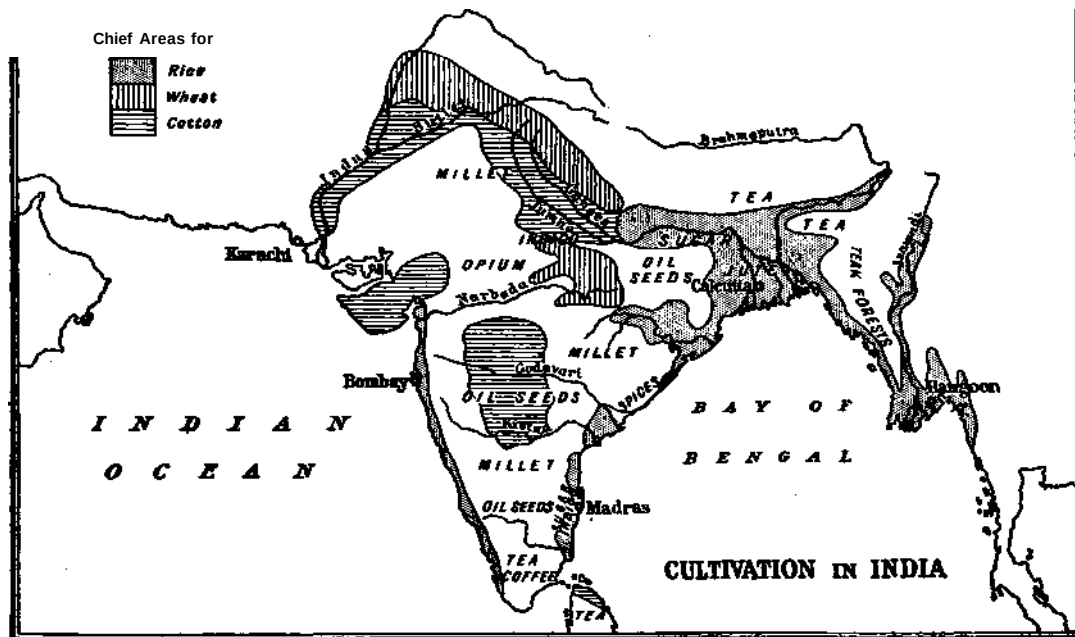


FIG 42. Cultivation in India.

INDIA AND CEYLON

value than the seed. The seeds are exported and used in the manufacture of linseed oil.

Indigo and *opium* are also produced, but not to the same extent as in former years. From the indigo plant a blue dye can be obtained, but since the discovery and manufacture of chemical dyes the demand for indigo has fallen off considerably. Opium, made from poppy seed-pods, is largely exported to China, but during the last few years the Chinese Government has taken commendable steps to stamp out the evil habit of opium smoking, and a large decrease in imports from India has been achieved.

CEYLON.

Ceylon produces rubber and cinchona, which have been introduced from South America with conspicuous success. Rubber is cultivated on the lowlands, and cinchona, from which quinine is obtained, on the hill slopes. Other products of Ceylon are coconuts, cacao and cinnamon, but tea, already mentioned, is its chief export. As will be seen, Ceylon's products are those of a more equatorial type of climate than those of India, and it is on this ground that it is included with the South-Eastern Archipelago in the classification of natural regions (see Fig- 30).

.MINERAL WEALTH.

Mining occupations are relatively unimportant in India. The chief minerals obtained are coal, iron ore, manganese ore, gold, silver and petroleum. In the Chota Nagpur plateau, west of Calcutta, 90 per cent, of the coal mined in India (normally from 20 to 25 million tons per annum) is found. Coal from this area is used in the Calcutta jute factories, in local industries and on the railways; but much has to be imported. India is rich in iron ore, but very little is found near the coalfields. Ninety-five per cent, of the gold output comes from the Kdar gold-field, situated some 40 miles north-east of "Bangalore. India is one of the world's chief producers of manganese ores, which are mined in the Central Provinces and ex-

ported unsmelted from both Calcutta and Bombay. Manganese ores are used in the manufacture of steel.

THE TRADE OF INDIA AND CEYLON.

As most of India's products are of an agricultural nature, we are in a position to discuss the trade of India at once. In order of value the most important exports are cotton, jute, rice, tea, oil-seeds, and wheat and flour. The chief customers are Great Britain, Japan, the United States, Germany, Italy and France.

The chief imports are manufactured cotton goods; metals and ores; machinery, railway plant and hardware; and sugar. Great Britain, Japan, the Dutch East Indies, Germany, and the United States are the chief places traded with.

Ceylon is governed separately from India. The island's chief exports are tea, rubber, fresh and dried coconuts and coconut oil, and copra. The leading imports are rice, cotton goods, coal and coke, sugar, and fertilizers. As in the case of India, Ceylon buys from and sells to Britain more goods than she buys from or sells to any other country.

EXERCISES.

1. Describe the belts of vegetation on the southern slopes of the Himalayas. Why is the snow line on the Himalayas (a) lower on their southern than on their northern slopes; (b) higher than in the Alps? Draw diagrams to illustrate your answer.

2. Divide India into physical units, and write a short descriptive account of each.

3. Explain clearly, using diagrams or sketch maps in illustration, why India has most of its rain in summer.

4. Obtain copies of the monthly charts of the Indian Ocean (Meteorological Office) and on outline maps of India, mark the winds shown on the January and July charts. Account for the leading differences between **the** two maps.

MEAN MONTHLY TEMPERATURE IN DEGREES FAHRENHEIT.

Stations	Height in ft above sea-level,	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average.
Bombay .	35	74.5	75	78	82	84.5	82.5	79.5	79	79	80.5	79.5	76.5	79
Calcutta .	18	65	70.5	79.5	85	85.5	84.5	83	82.5	82.5	80	72.5	65.5	78
Madras .	10	75.5	76.5	79.5	84.5	88.5	88	84.5	84.5	82.5 84	8x	77.5	75.5	82

MEAN MONTHLY RAINFALL IN INCHES.

	Jan.	Feb.	March	April	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec	Total for Year.
Bombay	.1	0	0	0	.5	20.5	24.6	15.0	11.0	1.8	.3	0	74.0
Calcutta	3	1.0	1.1	1.5	9.5	11.0	12.3	12.7	10.4	V9	.6	.3	64.6
Madras .	3	.3	.4	7	2.0	2.0	3.8	4.6	4.8	11.0	13.3	5.2	48.9
Cherrapunji .	7	2.2	11.1	32.3	52.0	106.0	110.0	77.0	53.5	14.0	15	.2	460.5

5. Represent the above statistics graphically, and in writing point out and account for their leading characteristics.

6. Write a short account of the physical features and climate of Ceylon.

7. Why is it that Lancashire textile manufacturers are far more interested in Indian trade than their Yorkshire neighbours? Why has Lancashire's export trade to India greatly declined in recent years?

8. "India's chief imports are manufactured goods and the chief exports agricultural products." Verify this statement by **reference** to **the Statesman's rear Book**.

9. From what country does India import sugar? What does India buy from Japan? Why are these articles not bought from Britain? Why is rice the chief import of Ceylon?

10. How does the government of India differ from that of Ceylon?

CHAPTER XIV.

INDIA AND CEYLON.

1. COMMUNICATIONS, CITIES-AND PEOPLE.

DURING recent years India's commerce with the outside world has developed very greatly, and this is in no small degree due to the construction of railways. Formerly, rivers had been the chief means of communication, but these were not of great value, except in the rivers in the Ganges system. Neither were there good roads, as in the Indo-Gangetic plain there is a great absence of road-making materials, and in other parts the irregularity of relief, and the fact that many roads become impassable during the rainy season, also prevented much intercourse. The chief beasts of burden are elephants and humped cattle, and they offer a very slow and expensive means of transport. Thus it was that the making of railways made many changes and especially gave a help to trade. The railways, however, were not built solely from the commercial standpoint, but in case of serious trouble to give the means of carrying soldiers from one part of India to another in as short a time as possible, and also to render it much easier to relieve distress in times of famine. Before they were made it was not uncommon for large numbers of people to die of starvation before help could arrive. Fig. 43 gives the chief railways of India marked on a map which shows relief. There are many railways besides these, but unfortunately the gauges upon which they have

be constructed differ very considerably, and as this prevents through running, it is a serious disadvantage.

As most of the chief cities of India are on these

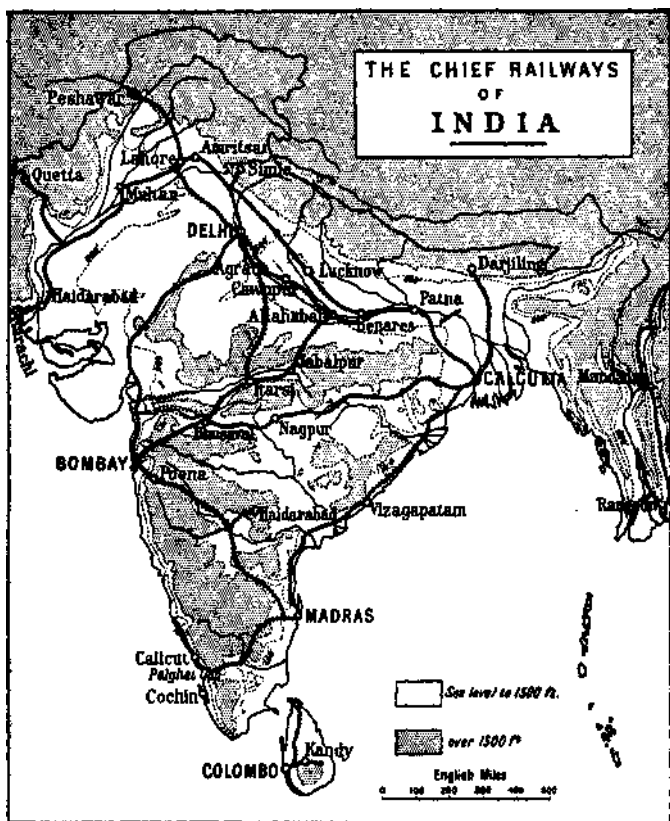


FIG. 43.—India. Relief and chief railways.

railway routes, we can learn about them whilst following the railways. There is one very important caution to be given here. The railways of India are comparatively

recent constructions, but all of the cities we shall mention were in existence long before the railways. It is, therefore, clear that the latter had nothing to do with the fixing of the sites of these places, and that we must look for other explanations of the question, "Why is this large city here?" Of course, many of them have greatly increased in importance owing to the making of railways, especially those situated at junctions, and the ports which have been brought into closer connection with their hinterlands.

Let us begin at *Calcutta*. It is built on the Hugh, a distributary of the Ganges, is eighty miles from the sea, and is the outlet of the rich Ganges lowlands. There is a great contrast between the European part of the city with its splendid buildings and wide streets, and the native town with its narrow streets and dirty brick houses. Within the last few years *Calcutta* has become the centre of a very important jute manufacturing industry. This, of course, is based on the large amount of jute grown in this part of India (see Fig. 42).

Leaving Howrah, on the opposite side of the river, the East Indian Railway traverses the plains of the Ganges, passing through Patna, Benares, Allahabad, Cawnpore, Tundla and Delhi. *Patna* is the centre of a rich rice-growing region, and also manufactures opium. *Benares* is the most sacred city of the Hindus, and is dependent chiefly on the large number of pilgrims who visit it. It is built high above the river, to which the descent is made by a series of wide, well-built steps. The chief objects of making a pilgrimage to Benares are to worship in the temples and to bathe in the sacred waters of the Ganges. The steps leading to the river from the temples and the palatial buildings for the reception of priests and pilgrims are never empty. From early morning until night there is a continuous throng of bathers, who come from all parts of the country. *Allahabad* stands at the junction of the Ganges and its chief tributary the Jumna,, a position which made it important before the construction of railways. It is now a great railway

centre, for it is at the junction of the railways from Calcutta, Bombay and Peshawar. It manufactures cotton goods. Cawnpore, on the Ganges, has become a modern manufacturing town, making cotton and leather goods. It will always be remembered as the scene of the horrible massacre which took place there during the Indian Mutiny.

We do not pass through the important cities of Lucknow and Agra, but this is the most convenient point to notice them. Lucknow, on the Gumti, is also remembered in connection with the prominent part it took during the Mutiny. It was the ancient capital of Oudh, and was formerly famous for its native manufactures, particularly of chased gold and silver, Agra, on the Jumna, is situated in a very rich agricultural district. It was formerly one of the chief cities of the Mogul Empire, and possesses some splendid monuments of the Mogul rule, the most beautiful being the famous Tai Mahal, which is esteemed the finest work of art in India, This magnificent building was erected in 1719 by Shah Jehan in memory of his wife, and, as its name implies, is a mausoleum and a palace.

Farther up the Jumna from Agra is Delhi, since 1912 the capital of India. The map will show that it stands at the eastern edge of the higher land (known as the Delhi ridge), which forms the watershed between the Indus and Ganges tributaries. It is also in the comparatively narrow gap between the Thar desert and the Aravalli Hills on the one side, and the Himalayas on the other. For these reasons, Delhi is well situated for control over both great river basins of northern India, and was the capital of several earlier empires than the British.

The reasons which prompted Britain to make an inland city the capital, instead of Calcutta which had been established by British sea-power, may be briefly stated as follows—

(1) For the reasons already given, Delhi is held in great reverence by Hindus.

(2) Its central situation between the populated Punjab and the Ganges plain, and the ease with which railway

communication can now be established with all parts of India, have made it a good centre for the seat of Government.

(3) During the hot season, the Viceroy moves his residence to Simla, a Himalayan hill station, north of

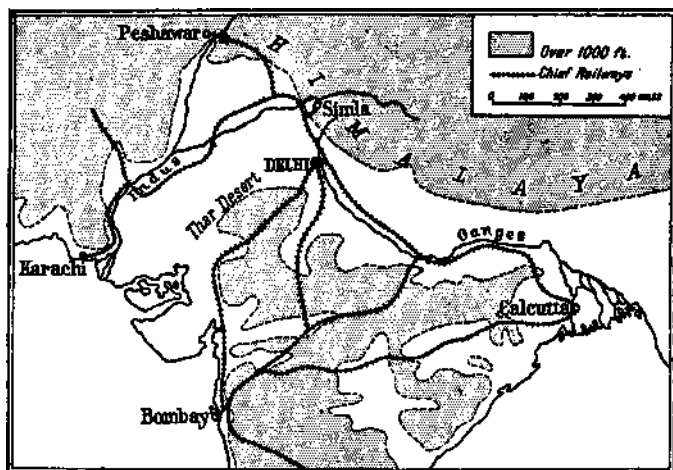


FIG. 44.—The position of Delhi.

Delhi. Now Calcutta is not so healthy as Delhi, and consequently it will not be necessary for the Viceroy, and, of course, a large number of officials, etc., to be absent from Delhi for so long a period as from Calcutta. Another evident advantage is the proximity of Simla to Delhi (see Fig. 44).

Delhi contains many reminders of the great part it has played in Indian history, from its ancient mosque and fort to its walls, which show the effects of the bombardments endured during the Mutiny. In modern days it has become an important cotton manufacturing town, and factory chimneys now darken the sky.

Continuing our journey to *Peshawar*, the next important town we should pass through is *Amritsar*. We are now in the basin of the Indus. *Amritsar*, a sacred city of the Sikhs, is one of a line of cities situated on or near the Indus tributaries in the wetter belt near to the base of the Himalayas. *Lahore*, about a mile from the left bank of the Ravi, is another of these towns. Fig. 43 shows that it is an important railway centre, for besides being on the great Calcutta—Peshawar trunk route, it is on a line which runs south-west to Karachi, near the mouth of the Indus. It is the largest city in the Punjab, and is the centre of a region producing great quantities of wheat. From Lahore we continue our journey to *Peshawar*, which is not far from where the Indus leaves the mountains for the lowlands, but the most important factor in its situation is, that it is on the Kabul river, near the entrance to the famous Khaibar Pass, which leads to Kabul, the capital of Afghanistan, and beyond Kabul to the plains of Turan. It is on account of this that it is strongly fortified.

Let us now return to Lahore, and from that city trace the North-Western Railway (by which the journey between Peshawar and Lahore is made) as it follows the Ravi towards *Multan*, a city so placed as to be near the confluence of the Punjab rivers. It is also on the margin of the desert of Thar. These factors have made it a good collecting centre for the wheat grown in the Punjab, as well as a meeting-place of important routes. Leaving Multan, the railway follows the Indus, which receives no large tributaries in its lower course, and runs to *Karachi*, the chief port for the produce of the Indus delta, and for the Punjab wheat. Note its situation to the west of the delta. This line has an important branch which goes a little beyond *Quetta*, a fortress city guarding the western entry to India, by way of the Bolan Pass.

Now let us consider the routes which radiate from *Bombay*, now the largest city in India. The city is built on an island, and the passage between the island and the mainland gives a splendid natural harbour.

Although England has owned Bombay since the days of Charles II, it was the opening of the Suez Canal which made it of first-class importance, for it is in a very favourable position for trade with Europe. We have learned that the Western Ghats present a very steep face to the Arabian Sea, and it will at once be seen that the construction of railways from Bombay to the Deccan was no light task. But the growth of Bombay depended upon means of quick communication with Calcutta and the Ganges basin, and a railway, which climbs the Ghats by a very difficult zigzag course, reaches both Delhi and Calcutta, whilst another follows the coastal plains northwards via Surat, and continues its journey between the Aravalli hills and the south-eastern edge of the Thar desert to Delhi, the capital (see Fig. 43). Now let us learn something of the commercial importance of Bombay. It is the largest jrgiton-manufacturing town in India, and this is owing to its proximity to the Deccan cotton-producing region. It also exports most of the raw cotton which is sent to other countries. Cotton manufacturing is quite an ancient industry in many parts of India, some of the cloths produced being noted for their very good quality. But in Bombay, huge modern mills, such as are found in south-east Lancashire, have been erected, and give employment to large numbers of people, although if the numbers employed in the three hundred and two cotton mills which India possessed in 1934 be compared with the number of cotton spinners and weavers exclusive of those working in the factories, it would be seen that less than one-tenth of the cotton workers in India are found in the big mills.

Leaving Bombay by the Great Indian Peninsular Railway, the train climbs the zigzag line on its way to the Deccan plateau. Passing through *Bhusaval*, the junction for Calcutta via Nagpur, and *Itarsi*, where the main line proceeds to Delhi via Agra, the more northern route to Calcutta follows the Narbada to *Jubbulpore*, an agricultural centre in which several cotton mills have been

recently established. From Jubbulpore the East Indian Railway system continues the route to Allahabad, and beyond to Calcutta. *Nagpur*, on the shorter route between Bombay and Calcutta, is another town owing its modern cotton mills to the cotton-producing region in which it is situated. The importance of these two lines between Bombay and Calcutta is very great indeed, for by means of them passengers and mails can reach Calcutta much sooner than if the journey had to be made entirely by water.

Another section of the G.I.P. Railway runs south-eastwards via Poona, traverses the Deccan, and after making a junction with the Madras railway, runs into *Madras*. Poona, in modern times, is to Bombay what Simla and Darjeeling are to Delhi and Calcutta. It is a hill station where Europeans may find the summer climatic conditions less oppressive than in Bombay. *Hyderabad* is reached by a branch line (see Fig. 43). It is the capital of a native state of the same name, and is ruled by the Nizam. Hyderabad state has more people than any other native state, and its capital is the fourth largest city in India, having a population of rather less than half a million. *Golconda*, near by, is noted for its diamond mines.

Madras, the third city in India, was one of the earliest British settlements, and it was from there that British influence spread westwards to the Deccan. It is the port for the rich plains of eastern India which produce great quantities of rice. As a port it is greatly hampered by not having a natural harbour, for it stands on a surf-beaten coast. Madras is connected with Calcutta by a line which follows the coast plains, and with the west coast by the Madras Railway, which utilizes the Palghat Gap, the only break in the Western Ghats between the mouth of the Tapti and the extreme south of India. The small port of *Calicut*, once a Portuguese trading settlement, controls the gap.

The large and important native state of Kashmir is not served by railways. It lies up in the western

Himalayas, and owing to its elevation, has a climate entirely different from that of other parts of India, as it is free from the great summer heat of the Deccan and the northern plains, whilst it is not so cold and bleak as the plateaux of Pamir and Tibet. It is crossed by lofty mountains, and contains many deep valleys, the most important of which is the vale of Kashmir, the upper valley of the Jehlam, one of the Punjab streams. The capital is *Srinagar*, which produces the famous Kashmir shawls, made from goats' hair. From this city, caravans start for Leh, and from there cross the Karakoram Pass on their way to Chinese Turkestan.

In Ceylon a railway has been built from Colombo to the north of the island, whilst a branch climbs to Kandy, the old capital. The journey from Colombo to Kandy takes about four hours, and the traveller is treated to a delightful series of everchanging views, for in that short space of time he is transported from the tropical heat of Colombo to the cooler temperature of the mountains. *Qglambo*, the capital and chiefport of Ceylon, is situated on a splendid artificial harbour, protected from the south-west monsoon by breakwaters. It is on the west coast, and is not only important as the port for the valuable products of Ceylon, but is a Port of call on the great routes from Europe, via the Suez Canal to Calcutta, Singapore, and the Far East on the one hand, and to Australia on the other. It has also a considerable trade with East and South African ports (see Fig. 45).

In Burma two railways leave Rangoon, one following the Irawadi, and the other striking northwards and reaching the same river at Mandalay (see Fig. 43). The latter is the more important. Notice that these railways follow the general north and south direction of the mountain ranges and rivers of Burma. In Upper Burma, where the river valleys are narrow, the chief source of wealth lies in the extensive forests of teak. Rice is easily the most important product of Lower Burma, and it is from this part of India that most rice

is exported. *Rangoon*, on the Irawadi delta, is the great port for rice and teak. Perhaps the most wonderful sight in Rangoon is the immense Glden pagoda which contains many temples and a number of gigantic and richly jewelled images. Temples are very common in Burma, where the prevailing religion is Buddhism. *Mandalay*, the chief city of Upper Burma, is the centre of the interior lowlands. It is the old capital and

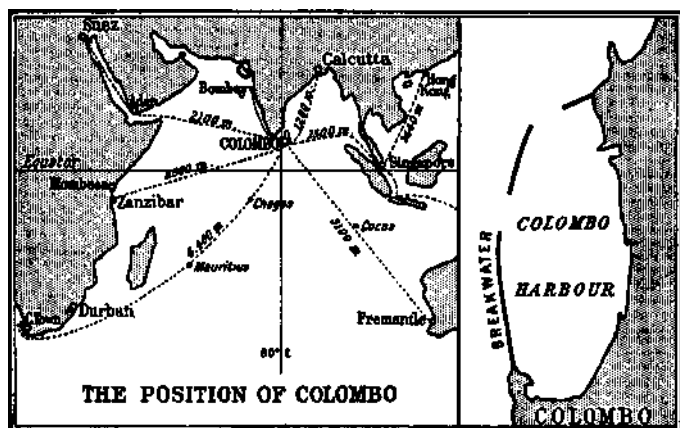


FIG. 45.—Colombo.

contains splendid pagodas and shrines dedicated to the worship of Buddha. Upper Burma produces the finest rubies in the world, the chief mining centres being in the mountains to the north-west of Mandalay.

2. THE PEOPLE OF INDIA.

India is essentially an agricultural country, and this has important influences upon the distribution of the population. In 1931, India had a population of 353 millions, that is, seven times as great as that of the United Kingdom in the same year or nearly three times

as great as that of all the British Empire without India. In the same year, the population of Ceylon was nearly five and a half millions. Despite this enormous number of people, there are only thirteen cities in India and one in Ceylon which have a population of more than 250,000. The vast majority of the people live in villages. Bombay (1,161,383) and Calcutta, with Howrah (1,485,582), are the only cities with more than a million inhabitants.

India includes not only districts subject to English law, but also native states. The latter are ruled by native princes, but in all cases the Indian Government is represented by an agent or resident. Over four-fifths of the people live in those parts directly ruled by the Indian Government. British India, as the result of administrative changes in 1912, is now divided into fifteen provinces, particulars of which are given below—

	Province.	Area in square miles.	Population at 1931 census.
1	Madras	144,000	47i millions
2	Bombay	152,000	26½
3	Bengal	83,000	51
4	United Provinces of Agra and Oudh	112,000	50
5	The Punjab	105,000	24
6	Burma	234,000	14¾ „
7	Bihar and Orissa .	112,000	42¼ „
8	Central Provinces and Berar .	131,000	18
9	Assam	67,000	9¼ „
10	North-west Frontier Province	36,000	4¾ „
11	Aj mer-Merwara	2,700	½ million
12	Coorg	1,580	164,000
13	Baluchistan	135,000	869,000
14	Delhi	593	636,000
15	Andaman and Nicobar Islands	3,140	29,000

Fig. 46 shows the parts of India which are directly under British rule, the numbers referring to those given in the table above. Fig. 47 gives the distribution of the

population. By comparing the two maps, it is obvious that the majority of the people are directly ruled by the Government of India.

One other point must be noted from Fig. 47. The

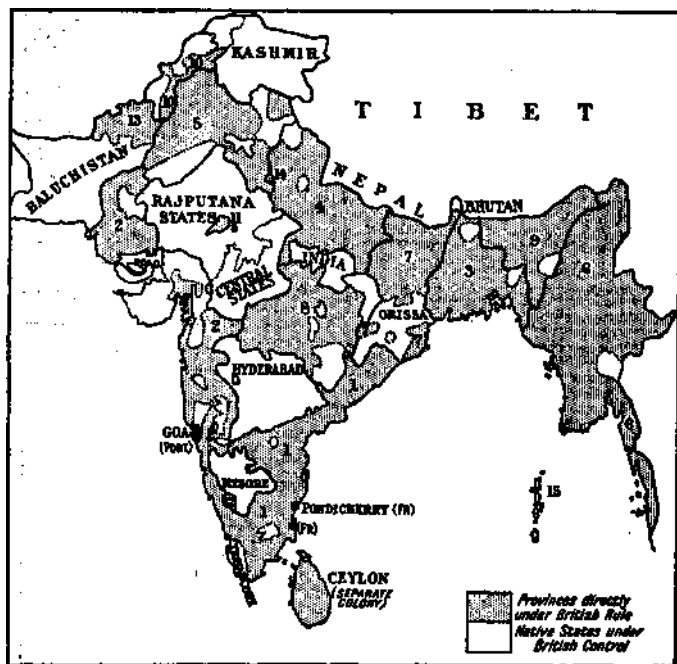


FIG. 46.—Map showing the Government of India.

bulk of the people are found in just those places we should have expected after our consideration of the relief, climate and vegetation of India. The greatest concentration is in the valley of the Ganges, the Punjab, and the east coast plain. The less productive parts, such as large areas of the Deccan and the Thar desert, support fewer people.

One interesting fact may be mentioned here. At the

census of 1931, English was the language of 319,000 people, of whom about one-third were of British birth. We have already pointed out that the climate of India is unsuitable for British immigrants, so that the English in India are chiefly traders, soldiers or officials who

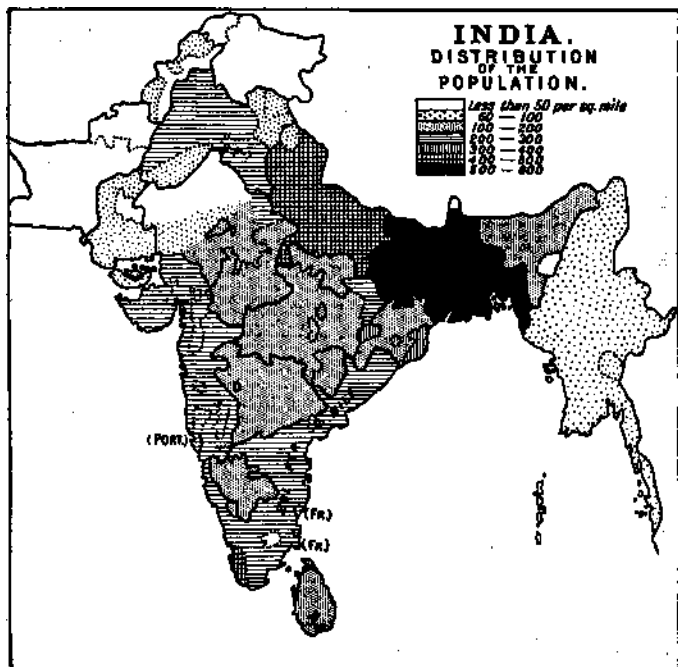


FIG. 47.—India. The distribution of the population.

are in the country for a term of years only. There is a constant change of officials and civil servants owing to retirement, etc., and it is largely owing to this that English rule in India has been so successful, for men never stay long enough to get stale, and new ideas, freshness, and greater energy are being constantly brought to the work of government.

Now let us learn more of the people themselves. India is so vast—nearly fifteen times as large as the British Isles—and has been entered by so many different peoples, some of whom settled in the land, that it is not surprising that many races and many religions are to be found. The descendants of the earliest inhabitants are found in the least accessible parts of the Deccan, in the swampy Ganges-Brahmaputra delta, and in Ceylon. They are darker skinned and smaller in stature than the people of northern India, whilst they speak languages which belong to quite a different group. They are called Dravidians, and it is thought that at one time they occupied the whole of India, but were pushed southwards and eastwards by more virile invaders, who probably entered India about 2000 B.C., by the great north-west gateways. These intruders were a taller, fairer race, quite different in appearance from the Dravidians, and akin to the people of Mediterranean Europe. They are known as the Indo-Aryans, and are best seen to-day in the Sikhs of the Punjab. The descendants of these early invaders are found in the north-west, nearest to the gateways by which they entered. In the upper basin of the Ganges, the prevailing type seems to be a mixed Indo-Aryan and Dravidian race, whilst in the lowlands, near the mouths of the Ganges and Brahmaputra, we find peoples of Dravidian blood.

Later, by the same north-western gateways, there came other conquerors, Darius of Persia and Alexander the Great, but their conquests were only temporary, and had little influence upon the people themselves.

During the first five or six centuries of the Christian era, continual inroads by steppe dwellers—Huns, Tartars and Scythians—occurred. Their plunderings were confined mainly to the north-west, for they met with opposition in the Ganges valley, but they appear to have settled in considerable numbers on the black earth lands of the Deccan, where they found a fertile land. In this area, even to-day, the predominant types appear to be

of mixed Mongol and Dravidian descent. Later, conquests by the Mohammedans took place. They, too, entered by the north-west gateways. They became very powerful, and established great empires, but they affected race very little, and except in the Punjab, they had also little effect upon the religion.

We learned in the last chapter that the approaches to India from the north-east are not so easy as those from the north-west. Many invaders have come, however, though in relatively small numbers, along the passes where the Brahmaputra enters India. These people were yellow-skinned, black-haired Mongols, whose descendants are still found in eastern India and in Burma, where the people are essentially Mongolian, and quite different from the inhabitants of India. In the lowlands of the Ganges-Brahmaputra, the Mongol immigrants mixed with the Dravidians, driven eastwards by the approach of the Indo-Aryans from the west.

The Himalayas form a great barrier, effectively preventing race migration into India from the north, except in small numbers. It is interesting, however, to notice that the people of Nepal and the Gurkhas appear to have crossed the Himalayas from Tibet. They are small, hardy people, and very fond of fighting.

This account of the people of India is, of course, not by any means complete, but it does show how the disposition of the chief races has been influenced by geographical conditions. All the invaders of whom we have learned entered India by the land routes, but we must not forget that India to-day is held by a nation whose approach was from the sea. In the seventeenth century, England, Portugal and France had coastal trading settlements, but it does not appear as though they thought of conquest at that time. At a later date the English made conquests from Madras and the French from Pondicherri. These places are on the east coast, where communication along the coastal lowlands and westward expansion to the Deccan are comparatively easy. Struggles between the English and **the French**

resulted in the victory going to the former. Living on the Deccan, east of Bombay, were the warlike Mahrattas, who extended their power northwards, and a struggle between them and the British for the possession of the Ganges plain was decided by the battle of Plassey (1757), in which the British were successful. Early in the nineteenth century, Delhi was captured, and this led to British power being established in the Indus valley, and to its final extension to practically the whole of the peninsula.

The Portuguese and the French still have trading stations, the most important being the west coast settlement of Goa (Portuguese), and the east coast settlement of Pondicherri (French).

Of the religions of India, little need be said here. Two-thirds of the people profess Hinduism, which is a most complicated religion. It appears to have as its basis the religious beliefs of the earliest inhabitants. The Aryan invaders adopted it, and largely added to it, but so complicated has it become that it differs considerably in various parts of the country, and is very often a strange mixture of superstition, elaborate worship of many gods, and the performance of innumerable duties and rites. Its distinguishing feature is the caste system. In the main there are four castes or groups, the Brahmans belonging to the highest, or priestly caste. All Brahmans are not priests, but may become so. All the leading professions are filled by Brahmans, who belong to their particular caste on account of birth alone. The other castes are the warriors, the farmers, and lastly, those who are neither Brahmans, warriors nor farmers. Those belonging to the lowest caste are regarded with great contempt by the others. The castes have many sub-divisions, so that to-day they number between three and four thousand. Each caste is commonly associated with some occupation, and since a man must follow the occupation of his father, the system exercises a very powerful influence over the people. At death, however, the soul

takes a higher or lower caste, according to the life the person has lived.

Rather more than one-fifth of the people are Mohammedans, who are found in all parts of the country, but in greatest numbers in the Indus basin, west of the Thar desert. They are the descendants of the Mohammedans who entered India by the great gateways of the north-west, between the sixth and the sixteenth centuries. The Mohammedan religion was founded in the sixth century by Mohammed, who was born in Mecca (see p. 125). It was called Islam by its founder, who wrote the sacred book, the Koran, in which he unifies the Arab worship of several gods, and taught, "There is one God, Allah, and Mohammed is His prophet."

In order of numbers the Buddhists come next, and they are found almost entirely in Burma, where the population is chiefly of Mongol extraction, and in Ceylon. This religion was founded by a man of the warrior caste who lived near the Ganges about six centuries before the birth of Christ. He was not satisfied with the state of Hinduism, and wished for a simpler religion. He taught that Nirvana, the final end of life, is to be reached by a life of self-denial and indifference to pleasure and pain. Such a belief has the effect of making its followers live quiet and peaceful lives, but is not helpful to national advancement. It is strange that to-day his religion is not followed in the land of its birth, but has its greatest number of followers in China.

These three religions, the Hindu, the Mohammedan and the Buddhist, are followed, more or less devoutly, by the great bulk of the people; but there are many others, such as those followed by the Parsis and the Sikhs, whilst there are about six million Christians.

We have seen that India is a large country, with a large population composed of many different races, and belonging to many different creeds. It is governed by a nation, the British, who are non-Indian in race and religion, who have entered the land by way of the sea, but

do not make it a permanent home. They have established law and justice, and have brought a considerable amount of prosperity, and there can be no doubt whatever that their rule has been of enormous value to India itself. As to the natives, although education is rapidly making headway, and large numbers have been advanced to administrative posts, the great bulk of the people are still unable to rule themselves. Experiments in self-government are being tried and are meeting with some success, but it will be a long time before the country as a whole is ready to guide its own destinies. The future holds many interesting questions for settlement, and among them, not the least important is, "Will India, like Australia and Canada, remain within the British Empire as a great self-governing dominion, or will she seek out her own salvation as an independent state?"

EXERCISES.

1. What geographical factors have given importance to the sites of each of the following Indian cities: Calcutta, Peshawar, Bombay, Madras, Allahabad, Delhi? Draw maps to illustrate your answer.
2. Draw a sketch-map to show the line of Punjab towns near the base of the Himalayas. Shade the high ground.
3. What factors affect the distribution of the population of India? Briefly describe the distribution.
4. How far are the routes of the chief Indian railways controlled by the relief of the land? Illustrate your answer by a sketch-map.
5. Draw a map to show the various sea-ways, land-ways, and air-ways from Britain to India.
6. "The great differences in surface and climate—much greater than those of Europe—with their consequent differences in racial habits and productivity of the soil, cause greater differences between a Pathan of the North-West Frontier and a Burman of Moulmein than between a Norwegian of Bergen and an Italian of Brindisi." Comment on this statement

CHAPTER XV.

INDO-CHINA AND THE EAST INDIES.

Natural Regions.—(i) Indo-China, with the exception of the southern Malay Peninsula, forms part of the Monsoon region. (2) The tropical islands of the East Indies.

INDO-CHINA.

Physical Features.—The name Indo-China is given to the large south-eastern peninsula which lies between India and China. A physical map will show that the mountain chains which traverse the peninsula from north to south are continuations of those of Eastern Tibet. The rivers Mekong, Menam, Salwin and Irawadi flow along little known gorges in their upper courses where the ranges come close together, but their lower courses occupy broad valleys. Three main series of chains can be traced in Indo-China. The eastern chain traverses Annam, the central chain lies between the Menam and the Salwin, whilst to the west of the latter river are the western ridges. A prolongation of the central chains forms the Malay peninsula. The rivers of Indo-China are swift flowing, and are loaded with sediment by means of which they have built up great deltas.

Climate and Products.—The climate of Indo-China resembles that of India, although there are naturally differences between the highlands and the lowlands; Most rain falls in summer, at which season the rivers

are often in flood, but Annam also receives rain from the north-east winds which blow in winter.

The vegetable products, too, resemble those of India. Rice, grown on the lowlands where water can easily be obtained for flooding the fields, is the most important crop, and forms the chief article of food. So much is grown that there is a large surplus for export. Coffee is grown on the hills of Annam, sugar in Annam and Cambodia, and in the hotter, wetter south, whilst rubber trees have been successfully planted in Cochin-China, which also produces pepper. In addition to these, the highlands, owing to the heavy rainfall, are densely forested, and teak forms an important export, especially from Siam.

Political Divisions.—The physical structure of Indo-China greatly influenced the formation of many independent native states, centred round the river lowlands, between which there was little communication on account of the mountain barriers which separate them from each other. Tongking occupies the delta of the Song-ka or Red River, Cambodia and Cochin-China are in the lowlands of the Mekong, Siam is largely the valley and delta of the Menam, Burma is the land of the Irawadi, whilst Annam is the narrow coastal plain between the eastern ridges and the South China Sea. In the upper courses of the great rivers are the Shan States, which, although owing nominal allegiance to England, China and Siam, are practically independent owing to difficulty of access. To-day France rules Tongking, Annam, Cochin-China and Cambodia in the east, Britain holds sway in the west, whilst between the possessions of these Powers there is the independent buffer kingdom of Siam.

The capital of Tongking, and since 1902, the capital of French Indo-China, is *Hanoi*, situated on the Red River about sixty miles from the sea. It is really a collection of many native villages and formerly was on the sea coast. Its present position so many miles inland illustrates the rapid growth of the river delta.

A railway has been constructed from Hanoi to Yunnan in south-western China, and has been the means of increasing the trade of Hanoi. One writer speaks of the natives of Hanoi as being very small, narrow-chested and thin-legged, and says their mouths are always stained, owing to their habit of chewing the areca-nut. He also declares that they are stupid beyond the power of words to tell. Hue, the capital of Annam, is a very poor port, and is situated on a coast which is dangerous for ships, owing to strong winds and storms. The government of Annam is administered by natives under the direction of the French Government. *Saigon* is the capital of Cochin-China. It has a good harbour and is connected by a waterway and railway—the first railway to be built in French Indo-China—to the Mekong. There is no very important town in Cambodia, but this country was once very powerful. The old kingdom had the large Lake Tonle Sap, which regulates the supply of water to the Mekong, at its centre, and its former importance is indicated by the extensive ruins which are to be seen there.

In passing it may be noted that the various governments of French Indo-China are unified under the control of a governor-general. Cochin-China is a French Colony (the other states are Protectorates) and is represented in the parliament at Paris by one deputy. There is a common budget for the whole of French Indo-China, and also a separate one for each state. The common budget deals with matters which concern the whole—customs, ports, telegraphs, defences, etc.

Bangkok, built nearly forty miles up the Menam, is the capital of Siam. Unfortunately the presence of a bar at the mouth of the river makes it impossible for large vessels to reach the city, which stands on the river, from which branch innumerable creeks or klongs. Bangkok has been called "the Venice of the East." The comparison fails in all points else except in the amount of traffic by water. One traveller says that there is no medium in Siam. One sees either gorge-

ously gilded palaces and fantastically adorned temples or filthy-looking huts. Bangkok offers no contradiction to this. The klongs, which are lined with shops and houses, have been compared with open sewers, full of garbage. The most famous building is the king's palace, in which there is a temple containing fabulous wealth in the form of a floor of silver, golden ornaments, statues of Buddha—the Siamese, like the Burmese, are Buddhists—altars glittering with precious stones, etc.

The people of Siam very much resemble the Chinese. It is probable that their ancestors came from China, and by gradual stages followed the Menam, eventually reaching its mouth, where they built Bangkok, their final capital.

West of Siam is Burma, which includes the basins of the Salwin and the Irawadi (see pp. 155-6).

MALAYA AND THE EAST INDIES.

PHYSICAL FEATURES.—The East Indies lie between Asia and Australia. We have learned in an earlier chapter (see p. 86) that Wallace's line separates those islands which are Australian in flora and fauna from those which are Asiatic. In this chapter we are concerned mainly with the Asiatic islands, although for structural reasons we shall take the boundary as lying east of the Moluccas and Timur Archipelago.

The archipelago is bounded on the west by the volcanic chains which traverse Sumatra, Java, and the smaller Sunda Islands (see Fig. 48). These are continued through the Moluccas or Spice Islands, and join the eastern volcanic chain (see p. 78) which passes through the Philippines. A continuation of the Malay Peninsula may be seen in the small islands of Banka and Billiton, east of Sumatra. Between this volcanic girdle and the mainland of Asia, Borneo stands on a continental shelf, and is separated from Celebes by a deep strait. Notice the peculiar shape of the latter island. It is evident that its lowlands have been drowned by

sinking. A physical map shows that Borneo would present a somewhat similar outline if it were to be submerged about 100 fathoms. Observe also the deep South China Sea between the Philippines and the mainland of Asia. This would suggest that the sinking which separated these islands from Asia took place long before that which detached Borneo. Owing to the western chains



FIG. 48.—The East Indies.

of islands forming a barrier, vessels from the Suez Canal and India proceeding to China and Japan must take one of two passages, either the Malacca Strait between Sumatra and the Malay Peninsula, or the Sunda Strait between Sumatra and Java (see Fig. 48). This has aided the growth of Singapore and Batavia.

CLIMATE AND VEGETATION.—NO part of this region is outside the Tropics. Since this means that every place will have the sun overhead on two occasions each year,

and that the sun will never be low in the sky, it follows **that, except at** high altitudes, the temperature will always be high. We have learned that these islands have rain **at** all seasons, and we have also seen that the rain belts follow the sun. Consequently we find that the equinoxes are the periods of heaviest rainfall in the parts of the region nearest to the equator, and that islands towards the northern margins, *e.g.* the Philippines, have most rain in our summer months, and those towards the southern margins, *e.g.* Java and Lesser Sundas, have their heaviest rainfall in the months of the southern summer.

One result of the climatic conditions is seen in the natural vegetation, which is of the equatorial type. The lowlands are often dense jungles, infested with snakes and wild animals. The vegetation of the volcanic islands, especially Java, is exceedingly luxuriant, partly due to the fertility of the volcanic soils.

THE INHABITANTS OF THE EAST INDIES.—Because the lowlands open to the sea, and the straits between the islands are not very wide, and are not as a rule visited by severe storms, the natives of the East Indies have readily taken to the sea, and there has been a great intermixture of races. It is clear that in such a region sea power is all important. On the other hand the lowlands, especially in Borneo, are separated from each other by mountain ridges, and there is often a lack of intercourse between the natives of the same island. One result of this has been the formation of several independent native states in the same island, the best example being seen in Borneo. On the whole the natives are very backward, and many of those who live in the little known interior regions and hill country are cannibals even to this day. The Malays, who are straight-haired Mongolians, resembling the Chinese in their oblique eyes, round heads and wide cheeks, are more numerous than peoples of other races. In religion the Malays are Mohammedans, and in temperament very much inclined to be morose and revengeful. There are also wavy-haired peoples of the

same race as the Dravidians of India as well as many very dark-skinned, woolly, or peppercorn-haired peoples of negro origin. Both of the latter types are small in stature, and are often so short as to be called pigmies. That descendants of diverse races should be found in these islands is probably due to the fact that the islands are on the "bridge" between continents, and the various races who have passed this connecting link have done something, however slight, to influence race.

POLITICAL PARTITION.—The Portuguese were the first Europeans to reach the East Indies, and they did so in the 15th century. They were closely followed by the Spaniards, who reached the islands by sailing westwards from Spam. The Philippines formed part of the Spanish possessions until 1898, when they were ceded to the United States. In the 16th century the Dutch established many trading settlements, and to-day their possessions are more extensive than those of any other Power. The British possessions are the Straits Settlements, the Federated Malay States and the British parts of Borneo, whilst all that remains to Portugal is the eastern portion of the island of Timor.

THE BRITISH POSSESSIONS.—These are in the Malay Peninsula and Borneo. In the Malay Peninsula there are the *Straits Settlements* and the *Federated Malay States*.

The Straits Settlements form a Crown Colony comprising Singapore, Penang (including Wellesley Province and the Dindings) and Malacca. The colony now includes the island of Lebuau, whilst the settlement of Singapore has been given the control of Christmas Island and the Cocos Islands. The most valuable of the Straits Settlements is *Singapore*, which owes its importance to its commanding position (see Fig. 48). It is an island about twenty-seven miles long by fourteen wide, and is separated from the Malay Peninsula by a strait about three-quarters of a mile in width. A causeway carrying railway lines has been built across the strait so that Singapore is now connected with the railways of the peninsula. The map shows that Singapore is situated at the

converging point of great ocean routes to and from India and the Suez Canal, China and Japan, and Australia. The port of Singapore has thus developed an enormous *entrepot* trade, and produce from all parts of the world may be found in its warehouses. The town is very cosmopolitan, having quite distinct European, Chinese, Javanese and Malay quarters. The Chinese are in greatest number, and carry on a large part of the port's trade. Besides being a great trading centre, Singapore is a strongly fortified coaling station, and possesses extensive dockyards. *Penang* is an island in the Straits of Malacca; *Wellesley Province*, the strip of mainland opposite; *the Bindings* comprise a small island and a strip of mainland, and *Malacca* another strip about forty miles in length and from eight to twenty-four in breadth.

Most of the trade of these settlements is done at Singapore, the chief articles exported being tin, sugar, pepper, nutmegs and other spices, sago, gutta-percha and rubber. Of these, rubber and tin far outweigh the others in importance and value. More than half the world's supplies of rubber and tin are produced in the plantations and mines of the Malay Peninsula. Of course during times of depression in the rubber and tin market the disadvantages of undue specialisation are severely felt in Malaya. To counter this every effort is being made to encourage the other industries.

Christmas Island and the *Cocos or Keeling Islands* are in the Indian Ocean, south-west of Java. The latter are coral islands covered by coconut palms, and the former possesses very valuable deposits of phosphate of lime. *Labuan* lies six miles from the north-west coast of Borneo, and is important on account of its coal mines, which supply the British warships on the China station as well as trading ships.

The Federated Malay States.—These are a number of native states which chiefly occupy the eastern portion of the southern Malay Peninsula. They are under British protection, the native rulers being advised or controlled by British representatives. *Perak* and *Selangor* are the

most important of these small states. As in Singapore, a large proportion of the inhabitants are Chinese who have emigrated to the peninsula in order to work in the tin and gold mines, and to supply labour in the fields. The agriculture is tropical, the chief cultivations being coconuts, rice, rubber, sugar, tapioca and pepper.

British Borneo,—The British possessions in this large island are *British North Borneo*, a territory under the jurisdiction of the British North Borneo Company; *Brunei*, a native state under British protection, and *Sarawak*. Sarawak is a native state whose head, Rajah Brooke, is an Englishman who rules under the protection of Britain. All have a very luxuriant natural vegetation, which differs with elevation, the coastal lowlands being covered with dense jungle, and the less known interior highlands with forests or savannahs. The chief cultivations are very similar to those of the Malay Peninsula. In addition, British North Borneo exports large quantities of tobacco, and Sarawak has rich deposits of coal and oil as well as some gold.

DUTCH POSSESSIONS.—These are more numerous and more extensive than those of any other nation. Although not the largest, Java, the "Garden of the East," is the most important, for by means of garden cultivation, the Dutch have made it the most productive and most densely peopled island in the archipelago. The total population of the Dutch East Indies is over sixty millions, and of these forty-two millions are in *Java*. This development has been helped by the great fertility of the volcanic soil and the abundant rainfall, as well as by the construction of railways and good roads. The range of products is very wide, but those for export are chiefly rubber, coffee, sugar, cinchona and tobacco, whilst the staple articles of food are rice and sago. The capital of Java is *Batavia*, which controls the Sunda Strait, between Sumatra and Java. In the chain of mountains which traverses Java from end to end, there are more than fifty volcanoes. The remainder of the Dutch East Indies have been little developed. Sumatra

and Dutch Borneo export pepper, coffee and tobacco; Celebes and the Moluccas are noted for spices. The Moluccas are the famous Spice Islands.

In the Sunda Strait is the volcanic island of *Krakatoa*, which was shattered in 1883 by the most terrible volcanic eruption of which we have any knowledge.¹ So tremendous was the outburst that a large part of the cone was blown into the air, and the site of the destroyed portion was occupied by water 1,000 ft. deep, whilst every vestige of life on the island was obliterated. A great water wave was caused, which spread all over the Pacific and Indian Oceans, and a great air wave passed three times round the earth. Prior to that catastrophe the volcano had been inactive for a century.

The Philippine Islands.—Discovered by the Spaniards, and named after King Philip II, these islands have belonged to the United States since the war with Spain in 1898. The group includes several thousand islands, the largest being Luzon and Mindanao. We have already learned that the Philippines form part of the great volcanic girdle of the Pacific. Throughout the islands destructive earthquakes are frequent, whilst they are often visited by terrific cyclonic storms called *typhoons*. These are accompanied by very heavy downpours of rain and by winds so strong that trees are uprooted and cities destroyed. The chief articles exported are tobacco, which is made into cigars (the only manufacture of importance); a fibre (Manilla hemp) obtained from a wild plantain very closely resembling the banana; copra and coconut oil; sugar and rubber. Rice is extensively grown for home consumption. The capital and chief town is *Manila*, which has the great advantage of being the point at which routes from Hongkong, Singapore, Australia and the west of the Americas meet. The map also shows that it is almost equidistant from all the chief ports of the mainland between Saigon and Foochow. It is the centre of the cigar manufacturing industry.

¹ See Book I of this series for the physical history of volcanoes.

EXERCISES.

1. What geographical conditions have aided the growth of Singapore, Manila and Batavia? Compare the relative importance of these ports. Illustrate your answer by sketch-maps.

2. "Both in Indo-China and in Borneo the configuration of the land helped to foster a large number of small independent native states." Explain this statement.

3. How far are the East Indies "Australasian," and how far "Asiatic"? Give reasons for your answer, and draw a map in illustration.

4. Give full reasons why Java is the most densely peopled island in the whole of the East Indies.

5. What difference would you expect to find between the seasonal distribution of temperature and rainfall at Manila, Singapore and Batavia?

6. Find out how many subjects the Queen of Holland has in (a) the motherland, (b) the Dutch East Indies? Comment on these figures. Of what value are the Dutch East Indies to the motherland?

7. Find out how the first rubber trees came to be planted in Malaya. Where did they come from? Why is the rubber grown in Malaya called Para rubber? Where is Para?

8. Describe three ways of travelling from Singapore to Bangkok.

CHAPTER XVI.

THE CHINESE LANDS.

THE Chinese Lands¹ cover a very large area, as they include Mongolia, Manchuria, Eastern Turkestan, and Tibet, as well as China Proper. The area of this portion of Asia exceeds four million square miles—larger than Europe—and has a population, probably, exceeding four hundred millions, although some authorities think that this is considerably overstated. At any rate 95 per cent, of the people are in China Proper, which includes less than half the area.

It is very evident that physical and climatic conditions will vary over such a large land mass, and although Fig. 30 shows that the area includes both desert lands and monsoon lands, we must recollect that the different parts of both the deserts and the summer rain lands vary considerably in elevation and latitude, and therefore in temperature.

We shall consider the Chinese Lands under two headings: (1) China Proper; (2) the outlying portions.

CHINA PROPER.

PHYSICAL FEATURES AND CLIMATE.—As the map will show, China is a country of high mountains opening to lowlands along the Pacific coast. The most extensive of these lowlands are in the lower valleys of the Hwang-ho and the Yangtse-kiang. China Proper is a very compact area, almost shut off from the rest of Asia by natural barriers in the form of (1) high, parallel, north and south ranges between China and

¹ The Japanese invaded China in 1937 and have occupied large areas. In this book temporary changes are disregarded.

India, (2) the high, inaccessible, desert-like plateaux of Tibet and Mongolia; yet easy of entry by land from the plains of Manchuria in the north, but most of all from the sea and along the great rivers. South of the Yangtse, China has a smaller extent of lowland than north of that river, but the land is not generally too high for settlement, although it naturally supports a smaller number of people, except in the plains bordering the rivers. Of the Chinese rivers, a glance at the map is sufficient to show that there are three rivers of outstanding importance, the Hwang-ho or Yellow River in the north, the Yangtse-kiang or Blue River in the centre, and the Si-kiang or West River in the south. (See Fig. 49.)

Turning to the climate, we are already familiar with the fact that China has a monsoon type of climate but important differences must be noted. In Chapter X (page 91) we have learned that owing to the differences of temperature, northern, central and southern China have temperate, sub-tropical, and tropical types of monsoon climate respectively. There are also differences in rainfall, as will be seen from a consideration of the following figures—

Place.	Lat. N.	Temperatures.		Rainfall in inches.				
		Coldest month.	Warmest month.	March- May.	June- Aug.	Sept- Nov.	Dec- Feb.	Total.
Peking	40°	23° F.	79	2'4	18'2	3'5	0'4	24'5
Hankow	30	38	83	17'6	19'9	8'9	4'3	50'7
Canton	23	55	83	17'6	29'2	14'8	3'9	65'5

These figures may be taken as typical of the three monsoon types. They show (1) that in all most rain falls in summer, although in Peking the early summer is drier than farther south, (2) that Southern China has a heavier rainfall than Northern China, (3) that for their latitudes all three towns have low winter tempera-

tures. The latter fact is accounted for by the cold winds which blow at that season.

Taking the three towns as typical of Northern, Central and Southern China, we may see from the figures that

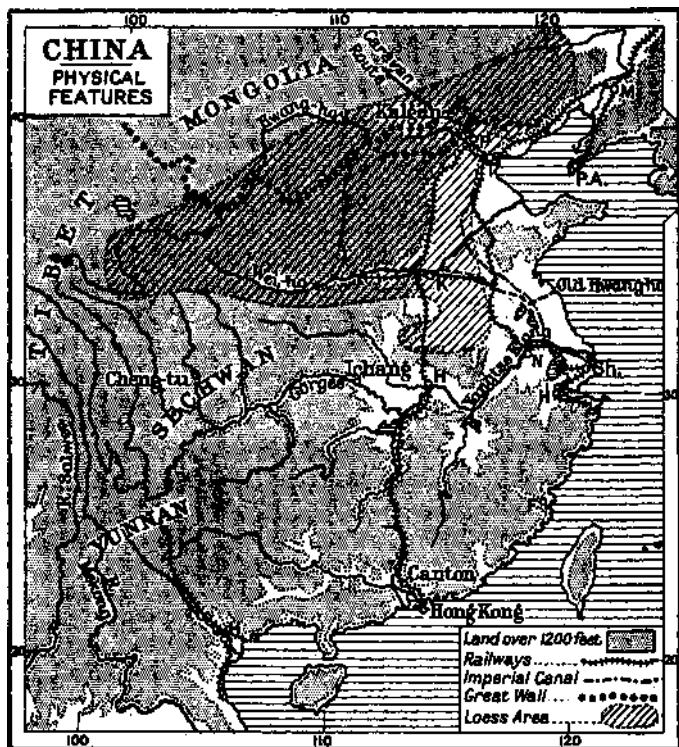


FIG. 49~Physical map of China.

Northern China has cold winters and hot summers, Central China cool winters and hot summers, and Southern China warm winters and hot summers. China falls so naturally into these three regions that we shall consider each in turn.

NORTHERN CHINA

NORTHERN CHINA.

Northern China is mountainous in the west and low in the east. Part of its southern boundary is clearly marked by the Tsingling-shan, which forms a mountainous boundary between the Wei-ho and the Yangtse-kiang. The boundary on the plains cannot be so clearly defined. A large part of Northern China is covered by a deposit called *loess* (see Fig. 49). We have seen that in winter time dry winds blow outwards from the heart of Asia. These winds carry with them very fine dust from the arid plateau regions over which they have passed. This dust has accumulated on the margin of the plateau, and in the course of time has completely buried not only the plain, but the mountains and hills with a mantle of loess often 1000 ft. thick. Looked at from above, a loess area presents a very smooth and monotonous outline, and usually consists of a number of basins, the raised rims bordering the basins representing the mountain ranges. It is typical of the region that each of these basins formed a little unit, having a centrally placed fortified city. The great disadvantage of loess is that it is porous, and so easily cut through that rivers and roads often cross it by intricate passages, on each side of which are very steep, often quite vertical, walls. It has, however, the great advantage of being fertile, although in this connection its porous nature is a drawback, and makes irrigation a necessity in most parts. In colour it is yellow, or brownish-yellow, hence the names of the Yellow river and the Yellow sea.

The chief rivers of Northern China are the Hwang-ho and Pei-ho or North River. The Hwang-ho is in some respects one of the most remarkable rivers in the world. It rises in Tibet, and its upper courses are fed by melting glaciers, which, together with the heavy summer rains of the mountainous region across which the upper stream and its tributaries flow, causes disastrous floods when the swollen river leaves its narrower

mountain bed for the low plains of its lower valley. In this part of its course it does not permanently follow a particular channel, as, owing to the deposition of sediment along the bed, the latter is constantly being raised, so that the river really runs on a self-created ridge that is increasing every year in height. This, of course, necessitates the construction of dykes or embankments in order to confine the river to its channel, and since the bed rises, so the height of the dykes must increase. There is thus the ever present danger that the river may burst the dykes and find a new course. This has happened several times in the past with terrible results, for when the last serious change took place in 1851, owing to the dykes near Kaifeng giving way, the river, which is here very wide and swift flowing, turned northwards and found a new mouth north of the Shan-tung peninsula. Kaifeng is now about twenty miles south of the river, and 20 ft. below its level. (Examine Fig. 49, and in order to realize what this change in the course of the river meant, work Ex. 1 at the end of this chapter.) In 1887 and again in 1898, the bursting of the dykes caused widespread devastation, the toll of those who lost their lives being measured in millions. It is no wonder that the Hwang-ho is called "China's Sorrow." As it flows fast, is not very deep and is liable to floods, it is not of very great commercial value, and in its lower course there are no large towns on its banks. But the fertile yellow silt which it brings down, and by means of which it is busily engaged in extending the lowlands into the Gulf of Pechili, is of great value to agriculture, the predominant Chinese occupation.

The important Wei-ho tributary of the Hwang-ho must be noticed. It is important not only because it was probably in its valley that the Chinese civilization had its birth, but also on account of the routes which continue the line of the Hwang-ho, and pass through Langchow, where they reach the Hwang-ho once more, and then strike across the central plateaux to the

Zurtgarian Gate, and beyond to the towns of Siberia, (seep. 103).

In the mountainous west of Northern China, agriculture is not so easily carried on as in the lowlands, and is in most cases dependent upon irrigation, which is often impossible in a loess-covered region. The plains, however, support a dense population engaged in the growing of wheat, barley, beans, millet maize, and, to a smaller extent, tobacco and cotton. Cultivation is carried on with the careful attention which we give to our gardens. The spade is the chief implement used. The Shan-tung peninsula, an isolated highland region, has areas of oak forests, and these are important owing to the use of the leaves for the feeding of silkworms. The naval and military importance of the peninsula is shown in the occupation of Wei-hai-wei by the British, and the former occupation of Kiaochow by the Germans. In the early part of the great European war, the latter was captured by combined Japanese and British forces.

The most famous town in Northern China is Peking until recently the capital of the whole country. At first sight it seems strange that a city right in the north-east corner of the country should be capital for many hundreds of years. Let us see why. China is easily entered by land routes from the plains of Manchuria, and it was the great importance of this gateway that led to the selection of Peking as capital, although the city itself was finally captured in the seventeenth century by Manchu invaders, who also made it their capital, from which the Manchu dynasty exercised its authority until the last Manchu emperor abdicated, so recently as February 1912. The danger of invasion from the north is also seen in the position of the Great Wall of China. This wonder of the world was completed two centuries before the birth of Christ, and runs westward from the Gulf of Chihli for some sixteen hundred miles (see Fig. 49). It climbs up to the steepest mountain sides, and descends into deep river valleys and even gorges. Peking not

only controls the route to Manrhuria, now followed by a railway which connects it with the Trans-Siberian line, but also the route to Mongolia, via the Pei-ho and Kalgan- Kalgan and Peking are now connected by a railway which is continued to Tientsin. In the future this line will be linked to the Trans-Siberian. Peking has also railway connections via Kaifeng with Hankow. Now let us learn a little of the city itself. The Manchu city occupies a square facing the cardinal points, and is enclosed by four gigantic walls each three miles long. The walls are so wide that four carriages can be driven abreast along the top. Each wall has two gates built a mile from the corners, and therefore a mile from each other. The gateways on opposite walls are connected by means of four roads which thus divide the city into nine parts, each having an area of one square mile. In the centre of the city is the Forbidden City, enclosed in high walls and containing the Imperial Palace. Outside the Forbidden City, which no foreigner is allowed to enter, no building is permitted to exceed a height of one storey, excepting the temples and pagodas. The Chinese city attached to the south wall of the Tartar or Manchu city, is rectangular in shape, and is also surrounded by high walls. After sundown communication between the two cities is cut off by the closing of the gates. Europeans live within the Tartar city, and their quarter is very western in appearance.

Tientsin, the port of Peking, has a larger population than the capital, from which it is distant about eighty miles by land and one hundred and forty miles by river. Unfortunately it cannot be reached by large steamers, whilst the river freezes in winter for about three months. Tientsin is the northern terminus of the Grand or Imperial Canal, which is nearly one thousand miles in length, and was begun about the sixth century B.C. and not completed until 1283 A.D. It gave a water connection between Tientsin and Hangchow, but of late years has been so neglected that many

parts, especially in the north, have fallen out of repair. A North China town of great historical interest is *Si-ngan* on the Wei-ho. For two thousand two hundred and fifty years this city was the capital of China.

Before leaving Northern China, reference must be made to the great wealth of coal and iron this part of the country possesses. The Shansi highlands are especially rich in both, and mining also takes place in Shan-tung and other parts. The railway from Peking to Hankow passes along the eastern margins of the SHahsi region, and will do much to develop iron and other manufacturing industries. The plains of North China are practically treeless, and coal will supply a needed cheap fuel, as well as lead to a development of manufacturing.

CENTRAL CHINA.

This comprises the basin of the Yangtse-kiang. The map shows that the upper basin is a highland region, and that the lowlands are either along the river, or near its mouth, where they are continuous with those of Northern China. The higher temperature at all seasons, and the heavier rainfall make life easier than in Northern China, and have an important influence upon vegetation and the nature of the chief cultivated products, which are those of a distinctly warmer type of climate. Rice, tea, sugar, cotton, as well as the cereals of the north, are all important cultivations. As in Northern China, agriculture is by far the most important occupation. Notice on a physical map the basin of Sechwan situated in the upper valley of the Yangtse-kiang. It is an elevated region, but is not so high as the surrounding land. Sometimes it is called the Red Basin, on account of its fertile red soil, which has come from the red sandstone of which the area is composed. This basin is nearly as large as France, and is very densely peopled

Most of the vegetable products already mentioned are grown easily, although irrigation is usually necessary, especially for rice. The chief town is *Chengtu*, the centre of a densely peopled area of extraordinary fertility, famous for its garden cultivation. The hill sides have been carefully terraced, so that cultivation is carried on at a height of many thousand feet above sea-level, the type of product varying with the elevation. Although Sechwan is noted for its agriculture, it has also very extensive coal and iron deposits, whilst the more precious metals and copper are known to exist in considerable quantities along the margin of the Tibet plateau. Sechwan is somewhat difficult of access owing to its build. It is unfortunate that the Tsingling-shan form a difficult barrier between the Wei-ho and the Yangtse tributaries draining Sechwan. The easiest entry is by way of the Yangtse, and it is on its banks that the port is situated. This is *Chungking*, which suffers from the disadvantage that great gorges and rapids of the Yangtse, which interrupt the navigation of the river for some four hundred miles, are between it and Ichang. Below Ichang the river is navigable for river boats and small ocean vessels to Hankow, and from that city to the mouth for larger ocean vessels. From Ichang to the mouth is nearly a thousand miles.

Between Ichang and Hankow is a lake-studded lowland region, which is known as the Plain of the *the Middle Yangtse*. The most important tributary is the Han, whose valley gives an easy route to the north-west. At its confluence with the main river stands the triple city of Hankow-Wunchang-Hanyang, some six hundred miles from the mouth. Of these, Hankow, the second forgest city in China, is of greatest importance. It is a great commercial centre, and was the scene of many stirring events during the recent revolutionary war, which led to the downfall of the last Manchu emperor. It is a centre for rice and tea, whilst in recent years a Chinese

company has built extensive ironworks at Hanyang, across the Han from Hankow. There are also other ironworks in the neighbourhood, and considerable quantities of pig-iron are now exported to Japan, and even to the United States. Note the position of Hankow, between the points at which the rivers draining the large lakes of Tungting and Poyang enter the Yangtse. The great Chinese railway, which will eventually join Peking to Canton, has been built along Lake Tungting and will use the valley of the river which passes through the lake, as a route southwards. These lakes have a very important function to perform. As the Yangtse is fed mainly by melting snow and summer rains, like other great Chinese rivers, it is much higher in summer than in winter. Even a rise of 70 ft. is not in some parts regarded as exceptional. In summer these lakes act as great reservoirs, and thus help to check disastrous floods, whilst in the dry season, when the river is low, they help to increase the volume. {cf. Tonle Sap Lake and the Mekong.)

In its lower course, the Yangtse flows through a densely peopled region in which cotton, silk, rice and tea are of special importance (see Fig 50). The outlet for this rich region—the richest in China—is the port of *Shanghai*, situated south of the Yangtse delta. Unfortunately, the harbour is in constant danger of silting up, owing to the great quantities of sediment brought down by the river, and dredging operations have to be resorted to continuously. Shanghai was one of the first ports in China to be opened to foreign trade, and owes its importance as the chief port of China to its position near the mouth of the Yangtse, and to the great richness of the middle and lower portions of the Yangtse valley.

Two other large cities in the lower Yangtse valley are *Nanking* and *Hangchow*. Each has been the capital of China in times past, and in 1927 Nanking once more became capital of the whole country. Its central position, almost equidistant from Peking and Canton, the great cities

of the north and south respectively, is largely responsible for the change. The city is connected by rail with Shanghai and Tientsin, and when a projected railway which will link it to Hankow is completed, it is bound to increase in importance. Hangchow, at the southern

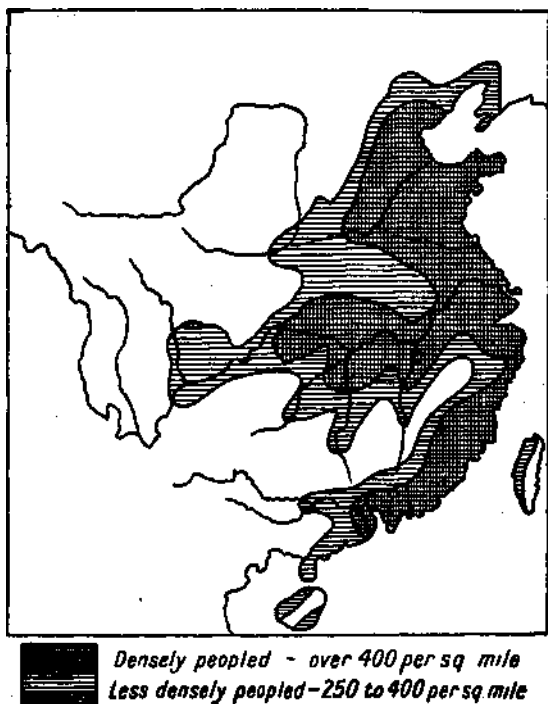


FIG. 50.—Map showing the most densely peopled parts of China.

terminus of the imperial canal, is the Kinsay so wonderfully described by Marco Polo, the great Venetian thirteenth century traveller. When he visited the city, it was the capital, and his detailed descriptions of the manners and customs of its inhabitants, their methods of government, and their institutions, are very interesting. A rail-

way line from Shanghai passes through Hangchow, and will eventually continue through Ningpo, to Foochow.

SOUTHERN CHINA.

Except in the valleys of the rivers, chief of which is the Si-kiang, or West River, there are few lowlands in this part of China. Most of the country is mountainous, the east and west direction of the chief ranges being an obstacle to communication between the valleys of the Yangtse and the Si, so that the valleys of the rivers passing through Tungting and Poyang Lakes are of great importance as routes. The highlands of South China are densely forested, on account of the fact that the rainfall, though mainly occurring in summer, is sufficient for the growth of forests. Considerable areas have been cut down, and agricultural pursuits are now followed in the clearings, but there are still extensive forests which supply valuable products such as bamboo, camphor, and cinnamQn. Thejbanjboo is of very great importance, and is used in the making of many household utensils, as well as for building and other purposes. Camphor and cinnamon are obtained from trees of the laurel type, the former by distillation of the wood of the tree, whilst the latter is the inner bark. In the lowlands of the Si-kiang and in the coastal provinces, the chief cultivated products are rice, tea, sugar, oil-seeds, and indigo, products which remind us of those of India.

The high plateau province of Yunnan, in the west, is the least known and most backward part of South China. It is known to be very rich in all kinds of minerals. A large part of Yunnan is used for the pasturing of cattle and sheep, an occupation of no very great importance elsewhere in China, a country in which the products of pastoral pursuits (milk, cheese, butter, wool, etc.) are somewhat scarce. We have already noted the outlet of Yunnan, via the French port of Hanoi (see Fig. 49).

The largest city in all China is *Canton*, the port for the rich Si-kiang valley. It stands at the head of

the extensive and wonderfully fertile delta made by three rivers, all of which are navigable and of importance, not only because they flow through fertile lowlands, but also because of the routes which follow their valleys. From the north there is the Pei-kiang (North River), from the west the Si-kiang (West River), and from the east the Tung-kiang (East River). As in many other Chinese cities, a large number of people—over three hundred thousand—live in boats, which cover the river for many miles. Near the mouth of the Canton river, the estuary formed by the three rivers above mentioned, is Hong Kong, an island which, together with the adjacent peninsula of Kowloon, has been British since 1841. Victoria, or Hong Kong, is the chief town and port. It has a splendid harbour, and is the headquarters of the British China squadron, as well as a great commercial port. Like Singapore and Shanghai, it has a large *entrepot* trade, and goods from Europe, India, China, Japan, and Australia may be found in its warehouses. Other ports in Southern China are *Macao*, a Portuguese station, at the mouth of the Si-kiang; and *Amoy* and *Foochow*, both of which are situated in a province from which there is considerable emigration, owing to the population being more than can be supported, even by intensive methods of cultivation.

THE CHINESE AND THEIR HISTORY.

There are few English people who are not familiar with the physical appearance of the Chinese, who are members of the great Mongolian race. Originally, the word Mongolian was restricted to the inhabitants of the plateau of Mongolia, but it is now used of all Asiatic people who have the same general characteristic features. The typical Chinese has a yellowish-brown skin, straight Black hair, a rather broad, flat face with prominent cheek-bones, and narrow eyes. The people of North China are usually very tall, but those in the south are below the average in stature. Travellers who

know China and its people intimately, always speak of the Chinese unvarying cheerfulness, even under depressing conditions. As a general rule he is thrifty; a splendid organizer, with phenomenal capacity for adapting himself to circumstances; exceedingly polite, and very trustworthy. He is particularly open to reason, and is capable of putting forth very considerable staying power, even on occasion enduring hunger, thirst, or exposure to a greater degree than most races. The ignorant Chinese is, however, very superstitious, and believes in all kinds of spirits, mostly evil, who are about him with the intention of doing harm to him unless they are appeased by gifts or driven away by noises. To describe all the means which he takes to keep from their influence would take too great a space. Although the ignorance of large masses of the people is almost incredible, the Chinese have a great reverence for knowledge, and often show exaggerated respect for worthless scraps of written paper, whilst teachers are held in high esteem.

When the immense size of China is taken into consideration, it is remarkable that there is such a similarity of type throughout the country. Naturally, the Cantonese, noted for the ardour with which he pursues commerce, his alertness and his anxiety to have a finger in every pie, the real Chinese of the north, famed for his simplicity and reserve, and the Manchu, differ very considerably, but their differences are small compared with those found in India. There are many different languages in China, and yet Mandarin, the official language, is spoken and understood in most parts of the country. Indeed, the differences in race and language will probably be overcome when better means of communication are introduced, and people from all parts are brought into intimate relation with each other. Centuries of isolation from other countries have made the Chinese very conservative and antagonistic to all reform, so that the foreigner, who has introduced new things into the country, is often regarded with

THE CHINESE LANDS

suspicion and distrust. This, of course, is only natural.

It is commonly stated that there are three religions in China—Buddhism, Confucianism, and Taoism—but this is misleading, since there are many Chinese who profess all three. We have already noted the outstanding characteristics of Buddhism (see p. 163), whose stronghold is China. Confucius was a great teacher of the sixth century B.C., and he was the teacher of doctrines which existed long before his own time. Taoism is a teaching of high moral precepts, which has adopted much ceremonialism from Buddhism. The outstanding feature of the beliefs held by the great mass of people is ancestral worship. The Chinese idolize their ancestors, whose burying places are sacred, whilst each house possesses its shrine, at which their memory is worshipped. The effect of this has been to make the family the unit, and thus to give China that lack of the sense of nationality she so much needs at the present time.

There are signs that the Chinese are awakening. Large numbers of their young men now take courses of study in European and American universities, and as a result of this, western knowledge is spreading; the mineral resources are being worked, and large quantities of machinery are being imported. Even the pig-tail has been discarded since the fall of the Manchu dynasty. But there are many difficulties to overcome before China becomes one of the great powers of the world. Leaders will be needed, and since China has no natural ruling class, it seems as though these will have to be found among those who have been educated abroad. New systems of government will have to be introduced, whilst problems relating to currency—in which much confusion at present exists—and taxation will require careful attention. But the most potent factor of all will be the creation in the Chinese of a sense of nationality.

What a splendid opportunity other countries have of helping China to find her way to national greatness along the best lines! China in the past has been marked

for its backward look, its pronounced conservatism; to-day she has the forward look, and modernism is the new passion of millions of her people. Where rush lights were used twenty years ago, we now find the electric light, junks are giving way to steamships, straggling footpaths to railways and motor roads.

We have learned that Chinese civilization grew up in the valley of the Wei. From there it was easy to spread to the great plains of the north, which for two or three thousand years remained the great home of the Chinese people. About two centuries before the birth of Christ, the people appeared to have begun the great movement of spreading over the southern part of China, a movement which took some four hundred years to complete. Hitherto the dense forest and jungle character of the land had prevented this. But the Chinese have not had the undisturbed possession of this great area. There have been constant invasions from the less favoured steppes and the plateau deserts to the north and north-west, and these necessitated, as we have seen, the building of the Great Wall more than two hundred years B.C. In the thirteenth century A.D., the great Mongol conquest, begun by Jenghiz Khan and completed by his son and grandson—the famous Kublai Khan—was accomplished. The last conquest of China was that by the Manchus, who entered from the north by the easy route from Manchuria, but both Mongols and Manchus were absorbed, owing to the size of the land and the numbers of its people. Some years ago it was the danger of Russian threats along the same route which led to the Russo-Japanese War. On Feb. 12, 1912, China became a republic, having for its first president Yuan Shih-K'ai, who did not long survive an attempt to attain the greater dignity of Emperor.

Since 1912 there has been great unrest and much fighting and war among rival factions. It is still doubtful whether the central government established at Nanking will be able to enforce its authority over the whole country. If this difficult task is successfully accomplished the new China

will rapidly progress, and in time will take her place as one of the most important countries in the modern world. But it can be accomplished only if other people help the Chinese and if she is able to keep free from war and international conflict. Unfortunately her Japanese neighbours look enviously upon China's broad territories.

EXERCISES.

1. On an outline map of the British Isles let a small circle, to represent Kaifeng, be marked about the centre of Ireland. On the same scale as the outline map, draw the present and old courses of the Hwang-ho as well as the coastline between the old and the present mouth. This map will give you some idea of what the great change in the Hwang-ho's course meant.

2. What grounds are there for believing that the Chinese people have a great future before them?

3. What geographical or other conditions have aided the growth of each of the following Chinese cities: Peking, Shanghai, Hankow, Canton? Illustrate your answer by sketch maps.

4. Give reasons for the density of the population in the valleys of the Ganges, Yangtse, and Hwang-ho rivers.

5. Why it is that (a) the Hwang-ho is often called "China's Sorrow"? (b) A large area of Southern China is covered by trees? (c) The level of the Yangtse is much higher in summer than in winter? (d) China remained until the last few years a country closed to foreigners?

6. *Trade of Hong Kong in 1937.*

	Value in ;
Exports to Great Britain .	935,000
Imports from Great Britain	3,392,000
Exports to rest of British Empire .	4,368,000
Imports from rest of British Empire	3,266,000
Exports to foreign countries .	23,168,000
Imports from foreign countries	31,934,000

Comment upon these statistics. Which will be the chief foreign country?

CHAPTER XVII.

THE CHINESE LANDS.

THE OUTLYING PROVINCES.

IN the last chapter we considered China Proper, the most important part of the Chinese Lands. In the present chapter we shall learn something about the other Asiatic lands over which the Chinese exercise a more or less effective overlordship. We shall consider them in the following order: Manchuria, Mongolia, Sin-Kiang and Tibet. Although these dependencies and frontier provinces contain more than half the area of the Chinese Lands, their total population is only about five per cent.

MANCHURIA.¹

Area, 400,000 sq. miles.

Population (in 1930), 29,606,000.

This dependency, lying between the province of Chihli and the Amur river, has an area over four times that of Great Britain, and a population which numbers nearly thirty millions, of whom the majority are Chinese, for there is no longer a large Manchu population in the country. A physical map shows that western Manchuria consists of lowlands, whilst in the east are highlands. The country extends from the latitude of Madrid to that of Liverpool, but its climate is totally different from that of lands in similar latitudes of western Europe. It is marked by exceedingly cold winters and hot summers, with rain in summer, the fall

¹ Helped by the Japanese, Manchuria has declared its independence and has been organized as the Kingdom of *Manchukuo*, with the ex-Emperor of China as ruler and Hsinking as capital. Most countries, including the United Kingdom, have not recognized the new kingdom, so that for the present we retain it among the Chinese Lands.

on the western plains being less than on the eastern highlands. It is because of this that the west is a steppe land, whilst the eastern mountains have extensive forests of coniferous and broad-leaved trees.

Owing to the development of railway facilities and the immigration of Chinese from Northern China, Manchuria has seen a greater development in recent years than any other part of the empire. The Chinese immigrants are engaged in agriculture—millet, beans, wheat and rice being the principal crops. The best agricultural lands are in the valleys of the Sungari, a tributary of the Amur, and the Liao, which flows to the Gulf of Pechili. Manchuria is rich in minerals, especially in the mountains of the east and west, but little mining takes place at present.

In the south there is the Liaotung peninsula, whose southern extremity is now leased to Japan. The leased land includes the important town of Port Arthur, the southern terminus of the Trans-Siberian railway, and an important commercial and naval base. It was leased to Russia until 1905, when it was lost owing to the success of Japan in the great war with that country. In 1900 there occurred the serious Chinese "Boxer" uprising, and as a consequence Russia occupied Manchuria, refusing to withdraw when peace was restored. It was on this account that Japan went to war with her in 1904. The loss of Port Arthur and the control of the railway were great blows to Russia, especially as Port Arthur was her only ice-free port.

Other important Manchurian towns are Mukden and Harbin. The former stands at the point where the Manchurian section of the Trans-Siberian railway branches into three lines, one going to Peking, another to Port Arthur, and the third to Korea. It is the chief city of Manchuria, and is the centre for the southern agricultural region. Harbin stands where the great railway line crosses the Sungari on its way to Vladivostock, **and** the line **for** Manchuria leaves the main line.

MONGOLIA.

Area, 1,875,000 sq. miles.
Population, 850,000 (estimated).

This enormous country, with its ill-defined boundaries, lies to the north and north-west of China Proper. It is an arid plateau in the heart of which is the desert of Gobi, or Shamo, as the Chinese call it. The north and east, the highest parts of the plateau, are crossed by high mountains. The marginal lands are steppe lands whose rainfall is sufficient for the rearing of cattle, horses and camels, the last named being the chief beasts of burden. It was from the north Mongolian steppes that Jenghiz Khan and his followers and successors spread eastwards to China and westwards via the Zungarian Gate, between the Tien Shan and the Altai Mountains, across Siberia, Russia, and even to Hungary. Their conquests were in no small measure helped by the hardy horses they possessed.

The chief trade route of the country has already been referred to. From Peking it follows the Pei-ho to Kalgan, and from there it crosses the Gobi desert to Uraa, the most important town in Mongolia. Leaving Urga, the route proceeds northwards to the Siberian towns of Kiakhta, on the frontier, and Irkutsk. This caravan route is sometimes called the "Great Tea Route," on account of the quantities of brick tea carried from China to Mongolia and Siberia.

Mongolia may be divided into Outer and Inner Mongolia, the latter being that part of the country adjacent to China. Shortly after the outbreak of the great Chinese revolution in 1911, Outer Mongolia declared its independence, a procedure which was recognised by Russia. In 1913, however, an agreement was entered into between China and Russia, by which Outer Mongolia was recognized as Chinese territory, but was to have self-government. Both countries agreed not to colonize the territory. We have seen that the Chinese have colonized Manchuria.

They have also spread into Inner Mongolia, and even to the margins of the Gobi desert, where by means of careful irrigation they have made agricultural pursuits possible. The natives of Mongolia are nomadic Mongols and Kalmucks, who are little given to agriculture, even in the more fertile parts, and are employed mainly in looking after their animals.

SIN-KIANG.

Area, 550,000 sq. miles.

Population, 1,200,000 (estimated).

Sin-Kiang, or Eastern Turkestan, comprises all the Chinese dependencies lying between Mongolia to the north and Tibet to the south, and is divided by the Tien Shan into two parts, a large southern area drained by the Tarim, and the smaller northern region of Zungaria. The whole region, which is nearly five times as large as the British Isles, has a very extreme climate, and is very deficient in rainfall, so that it is a land of dry steppes and deserts.

The Tarim basin¹ is a plateau bounded by the Tien Shan mountains on the north and the Kwen Lun on the south. The physical map shows that it is much lower than surrounding plateaux, and on this account may be considered as a great depression, most of which forms the basin of the river Tarim. This river and its tributaries are supplied with water from the encircling mountains, for there the rainfall is heavier, and the higher valleys contain great glaciers whose melting provides water. When the rivers reach the plateau, their waters can be used for irrigation, and tracts which would otherwise be desert are green oases. As Fig. 51 shows, there are many rivers which never reach the Tarim, but lose themselves in the sand. Even the Tarim finally loses itself amidst the reedy swamps of Lob Nor. Although a centre of inland drainage,

¹ This is a convenient title, but it should be noticed that the Tarim does not drain the whole area.

THE OUTLYING PROVINCES

Lob Nor is not very salt, probably due to the fact that it is of recent origin. Since there is plenty of water for irrigation purposes at the foot of the mountains, the trade routes pass either along a line of oasis towns south of the Tien Shan, or along a similar line north of the Kwen Lun, for except along the water-

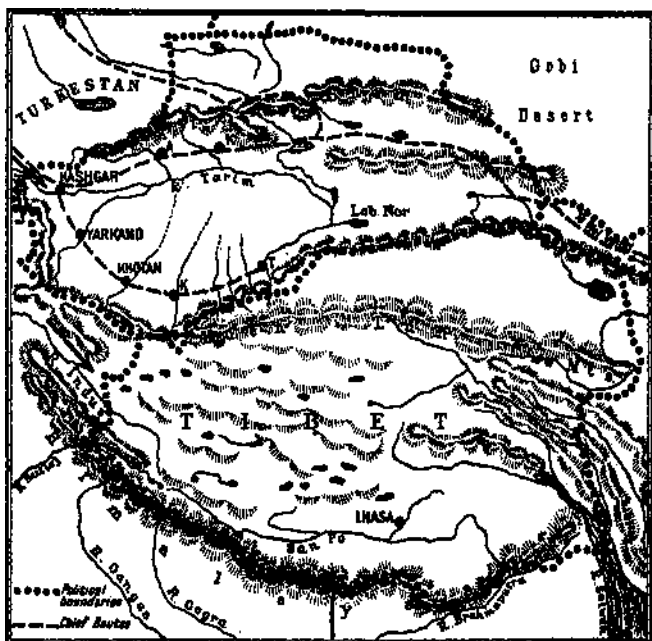


FIG. 51.—The Chinese provinces of Sin-Kiang and Tibet,

courses the rest of the Tarim basin is a desert. These trade routes meet at *Kashgar*, which is also reached by caravans which have crossed the mountain passes on their way from Russian Turkestan. *Yarkand* and *Khotan* are on the southern route. All three are **walled** oasis cities intersected by irrigation canals, and consisting of low flat-topped houses surrounded by gardens

and fields producing cereals and cotton. North of the Tien Shan, and between those mountains and the Altai Mountains is the steppe land of Zungaria, across which the great route from Siberia to Northern China passes.

It is interesting to notice that, as in Manchuria and Mongolia, there has of recent years been a very considerable Chinese immigration into Sin-Kiang. Every year the whole territory is increasing in population and prosperity.

TIBET.

Area, 463,000 sq. miles.

Population, 2,000,000 (estimated).

Tibet is a high bleak plateau, so cut off from surrounding lands by high mountains as to be difficult of access, and therefore it is often known as "Mysterious Tibet." Shutting it off from India are the Himalayas and Karakoram, ranges on the south and west, on the north the Kwen Lun mountains separate it from eastern Turkestan, and in the east the north and south ranges of Western China form a barrier, making it very difficult for the Chinese to enter their dependency. Across these barriers there are few good routes. From Darjeeling difficult routes lead over the Himalayas, others enter on the west by means of Karakoram passes. From China the best routes either follow the Wei-ho, or cross the ranges separating south-eastern Tibet from Sechwan (see Fig. 51). The chief Tibetan import, tea, is brought along the latter routes.

Not only do these mountain barriers make it very difficult to enter Tibet, but they also shut out rain-bearing winds, whilst the great elevation of the plateau—over three miles—has such an influence on the temperature, that despite its nearness to the Tropics, the country is swept by icy winds, and snowstorms are common. Permanent settlement is not possible never-
the greater part scattered in-

habitants obtaining a livelihood by pasturing yaka, goats and sheep, and in some parts camels, The yak is to the Tibetan what the remdeesus. to the man of the Tundra It supplies Bin with food and clothing, and is the beast of burden. The great majority of the people live in the valleys of southern Tibet, especially in that of the the Tibetan name of the Upper Brahmaputra. Here it is possible, owing to the presence of alluvial soil, to grow fruits such as apricots and peaches, as well as wheat, barley and geas; but, in order to do this, it is "necessary to resort to irrigation. pastoral occupations are also very important.

The capital is Lhasa, the Forbidden City. It is situated in the valley of a tributary of the San-po, and is famous for its imposing monasteries, the world-famed palace of the Dalai Lama, the head of the Buddhist faith, being the most renowned. In 1904, Lhasa was entered by a British mission, accompanied by an armed escort. The Tibetans had not fulfilled a treaty made between Britain and China regarding the removal of hindrances to Indian trade, so the mission entered the country and reached the capital by force of arms, concluding agreements relating to the preservation of passes, the demolition of Tibetan forts, the fixing of customs and tariffs, etc. All the arrangements made were afterwards ratified by China. What seems to have made most impression on the members of the mission were the filthy state of most Tibetans and their villages and the extraordinary religious beliefs of the people. The prevailing religion is Lamaism, a degraded form of Buddhism, in most parts of the country little better than devil-worship. Every dark spot—a cave, a hole in a wall, a crack in a rock—is filled with evil spirits who must be kept off, and in order to do. this strings of flags, prayer poles, and many other devices are used. There is a very great difference between the lives of the people and those of the priests, of whom there are a tremendous number—twenty-five thousand in Lhasa alone.

EXERCISES.

1. Contrast life in the Tibetan plateau with life in the plains of Northern India. Give reasons for your statements.
2. Why is the Tarim basin called an area of inland or continental drainage? Give other Asiatic examples.
3. Which of the Chinese outlying provinces do you think is of the greatest economic importance? Give reasons for your answer.
4. Draw a section from Calcutta to Lake Balkash. Explain its leading features.
5. Compare the value of the reindeer to the dweller in the Tundra with the value of the yak to the Tibetan.
6. Look at the physical map of South America in your atlas. Can you find a plateau which may be compared with Tibet? How does it differ in size and elevation from Tibet? What country is it in?
7. Find out all you can about Manchukuo. Why is Japan the only country to give it recognition? Who is its ruler? Why does Japan take a great interest in the affairs of China? In what other parts of China, besides Manchukuo, are the Japanese interested?

CHAPTER XVIII.

THE JAPANESE EMPIRE.¹

THE island Empire of Japan, the Land of the Rising Sun, consists mainly of a long chain of islands off Eastern Asia, stretching from Formosa, which is bisected by the Tropic of Cancer, to the Kurile Islands and the southern portion of Sakhalin, which are in the latitude of Southern England. Of these, the largest and most important island is Honshiu, or Mainland, whose area is greater than all the rest put together. Japan is often called the "Britain of the East," although the similarities between our own islands and Japan are not so prominent as the points in which they differ. Both countries are composed of islands lying off the opposite shores of the great Eurasian land mass, and within easy reach of mainland countries which have large populations. Each country has splendid harbours, and is endowed with considerable mineral wealth; but the chief point to notice is that, owing to these similarities, each country is a great maritime power. When we examine their structure, their positions with regard to the Equator, the climatic contrasts caused by the location of one on the west and the other on the east of a great land mass, and the influence of these factors upon vegetation and occupations, we see that there are wide contrasts between the two countries.

¹ The Peace of Versailles, 1919, gave Japan the mandate (on behalf of the League of Nations) to administer the Marianne, Caroline and Marshall Islands, which formerly belonged to Germany. She also succeeded to the German rights at Kiaochow (see p. 181).

THE JAPANESE EMPIRE

PHYSICAL FEATURES.

We have already learned (see pp. 78, 79) that the Japanese Islands are part of the great belt of volcanic mountains surrounding the Pacific Ocean. Evidence of volcanic activity is seen in the frequent earthquakes and the presence of hot springs, whilst there are several active volcanoes. The most terrible earthquakes known in Japanese history occurred in 1923. Great loss of life and property was caused in Tokyo, Yokohama and the surrounding country.

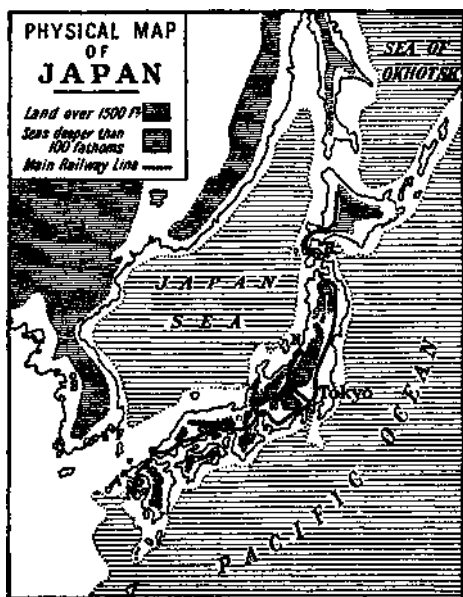


FIG. 52—Japan. Relief and chief railways.

The beautiful Fuji-san (12,500 ft.), the most famous of Japanese volcanoes, has not been active for about two hundred years. Two distinct chains, separated by a

CLIMATE AND PRODUCTS

rift valley traverse Northern Honshiu from north to south. In Southern Honshiu a change of direction is evident, and we can distinguish two ranges running from south-west to north-west, the northern one forming the long, narrow continuation of Western Honshiu, the other, the islands of Shikoku and Kiushiu. Between them is the depression occupied by the Inland Sea. From Hokkaido, or Yezo, one range is continued by the Kurile Islands, and another by the mountains of Sakhalin. South of Honshiu the volcanic chain is continued through the Lu Chu Islands to Formosa, and beyond to the Philippines.

So much of Japan is mountainous (see Fig. 52) that the height of the mountains and their nearness to the coast makes the rivers so short and swift-flowing as to be of little value for commerce. They are also loaded with sediment, and consequently fill up harbours and bring about the decline of ports, *e.g.* Tokyo and Osaka.

The few lowlands of Japan are separated from each other by mountains, so that until the building of railways communication between them had to be by sea. The largest extent of lowland is north of Tokyo, and it is here that the population is densest. The narrow coastal plains around the Inland Sea are also densely peopled.

One other point must be noticed. East of Japan the Pacific Ocean rapidly descends to enormous depths. Quite close to the east coast is a basin more than 4,000 fathoms deep. On the west the Sea of Okhotsk and the Japan Sea are much shallower, although they, too, must be considered as deep in comparison with the shallower Yellow and East China Seas, or the continental shelf surrounding Britain.

CLIMATE AND PRODUCTS.

Climate.—The climate of Japan is monsoon in type its distinctive features being due to its position off the shores of the great land mass of Asia. In winter it receives cold winds from the continent, and in summer the monsoon winds blowing from the ocean towards the

THE JAPANESE EMPIRE

low pressure areas in Central Asia. Thus it is that the country receives most of its rain in summer, although the west coast has rain and snow in winter also, this being due to the winds picking up some moisture in crossing the Sea of Japan. In amount the rainfall is generally heavy in all parts, but is less in the-west than in the-east

As regards temperature, the great stretch in latitude is a very important factor. Speaking generally, Japan has an extreme climate despite its insular position, for the winters are much--colder-than would appear from the latitudes, whilst the summers are hot. In chapter V we have learned that the warm Kuro Siwo, or Black Stream, sweeps past the eastern shores of Japan. In winter this current has little effect on the climate, because the winds at that season blow from Japan to the Pacific, *i.e.* off shore, whilst in summer there is not a very great difference between the land and sea temperature, so that the modification of the land temperatures by the cooler winds from the sea is not very marked. There is also the cold Kurile current which flows from the Arctic Ocean through Bering Strait and along the eastern margins of the Kurile Islands and the Island of Yezo. Off the shores of the latter island the meeting of air currents whose temperatures have been affected by the warm Kuro Siwo or the cold Kurile current, as the case may be, causes fogs such as are common on the banks of Newfoundland.

The following figures illustrate the chief differences in climate in various parts of the Japanese Empire—

Place.	Latitude.	Longi- tude.	Height in Feet.	Coldest Month.	Warmest Month.	Mean Annual Rainfall.
Hakodate.	41°	141°	16	27° F.	70°F.	45-4 ins.
Tokyo	35°	140°	69		78°	62
Nagasaki .	32°	130°	190	37°	80°	80 „
Niigata				42°		
(west coast)	38°	139°	32	34°	77°	68 „
N. Formosa	25°	122°	16	62°	84°	125 „

Vegetation.—Owing to the heavy rainfall the mountains of Japan are forest clad. In the cooler north, coniferous and broad-leaved trees are found, whilst the warmer southern regions produce bamboos, gigantic cedars, maples, mulberries, camphor and lacquer trees. The bamboo is of enormous value, for the uses to which the different parts of the tree can be put are almost innumerable. Lacquer, used in the decoration of many Japanese articles, is the gum exuded by a large shrub. The northern forests supply wood-pulp for paper-making and wood for the match-making industry. The pastoral areas are not very extensive, and the effect of this is seen in the comparative scarcity of cattle, horses and sheep, and hence of such products as leather, dairy produce and wool. The scarcity of sheep is also due to the growth of a kind of grass which is quite unsuitable for them to eat. The lack of pasture lands was one of the reasons which prompted Japan to annex Korea, as that country possesses many areas suitable for pastoral occupations.

As regards the cultivated plants, rice, as in the other lands of monsoon south-eastern Asia, comes easily first. Wheat barley and oats are grown in the cooler parts, and as winter crops in the rice fields after the rice has been harvested. Tea is also very important, and is grown largely on the terraced slopes of the central and southern highlands. Mulberries are extensively cultivated, and as the climate is very suitable for the silk worm ("the Honourable Mr. Baby"), Japan not only produces enough silk for her own needs, but has a large surplus export. Other minor products are cotton (not nearly in sufficient quantities for the Japanese cotton trade), indigo, tobacco and sugar. The method of agriculture resembles that of China in that it is almost entirely done by laborious Spade cultivation. Although this careful method increases the yield, the land available for cultivation is so limited that even rice, the chief article of food, has to be imported in large quantities to supply the needs of the people.

The Japanese enjoy a world-wide reputation as horticulturists, and this is largely owing to their skill in dwarfing trees and in acclimatizing plants and flowers native to other countries. They are great admirers of the chrysanthemum.

The *mineral wealth* of Japan is very valuable and varied, and since the Japanese began to copy Western nations their output has increased enormously. The characteristic minerals are sulphur, kaolin and copper. Sulphur, of course, is obtained from the volcanic regions, and, together with the timber from the forests, has led to match-making. The presence of kaolin accounts for the fine porcelain for which the Japanese are justly noted. It is obtained chiefly in the Nagoya area of Honshiu. More copper is mined in Japan than any other mineral, the region north of Tokyo being the greatest copper-producing region of Asia. The artistic bronze work, for which Japan is famous, is due to the great supplies of copper. Silver, lead, petroleum, as well as coal and are also found. The largest coal deposits are in Yezo, Northern Honshiu and Kiushiu (see Fig. 53). The Kiushiu coal-fields supply about 75 per cent, of the total output. It is unfortunate that coal and iron are not found together, but still more so that large quantities of iron have to be imported to meet the needs of the manufacturing industries (see page 185).

Fishing is one of the leading occupations in Japan. Fish forms a very important part of the food of the people, not only because from religious motives meat is avoided, but also on account of the presence of rich fishing grounds within Japanese waters. Mention has already been made of the cold and warm currents of ocean waters which sweep past Japan, and it is largely because of the food for fish brought by those currents, and on account of their varying temperatures, that fish are not only abundant, but also, of great variety. Then, again, the indented nature of the coast-line helps the industry. There are said to be nearly one million people in Japan who have fishing as their *sole* occupation. The

chief fishing grounds are in the shallow waters bordering the coast of Yezo, but the occupation is widespread along most of the coasts. Herring, mackerel, sardines and tunny are the chief species caught. In addition to their value for food purposes, fish are commonly used as manure in order to enrich the agricultural lands

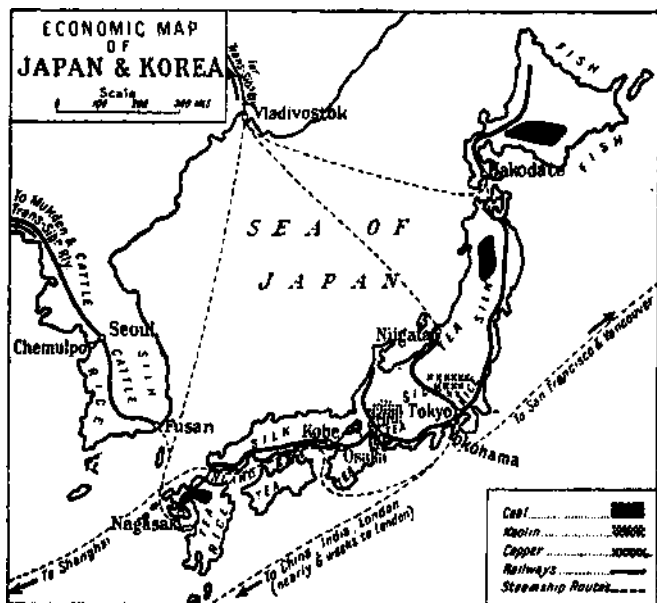


FIG. 53.—Japan and Korea. Economic map.

The fishing ability of the people has helped to make Japan one of the world's great naval powers, but even before the days of modern navies they were able to defeat with ease those who tried to invade their land.

CENTRES OF POPULATION AND COMMUNICATION.

The most thickly peopled parts of Japan are the fertile lowlands bordering the coasts, especially those

along the margins of the inland sea and north of Tokyo, and it is in these places that the largest cities are to be found.

Tokyo, the capital, with six million inhabitants, is one of the largest cities in the world. It stands, within sight of Fuji-San, at the head of Tokyo Bay, on the banks of a river which has silted up its harbour, so that it is no longer a port. In the heart of the city there stands an ancient castle surrounded by moats and wooded grounds, and these form a pleasant relief to the otherwise somewhat monotonous aspect of vast numbers of the low wooden houses of which Tokyo is largely composed. Most parts of Japan are so subject to earthquakes, that the buildings are made of light materials. Very often of bamboo, and sometimes even of paper. The oldest inhabitants of the capital, which was formerly called Yedo, have seen a great change in recent years. Modern buildings, after the style of those of Western Europe, electric lighting and electric tramcars, motor-cars, railway stations from which run lines to many parts of Honshiu, Japanese in Western clothes, and the presence of a considerable number of foreigners are all surprises for the man from the country when on a visit to Tokyo. Many industries are followed in the city, the chief being the modern manufacture of clothing, matches chemicals, as well as the ancient industries in ivory, bronze, and lacquer-ware.

The port for Tokyo is *Yokohama*, on the western shores of Tokyo Bay. It is the great port for trade with the mainland of Asia and with Australia, Western America and Europe. It carries on the foreign trade of the largest and most densely peopled lowland in Japan.

Osaka, the second city, also owes its position to the lowlands in its hinterland. It stands at the mouth of the river which drains Lake Biwa to the Inland Sea, and is the chief seat of the Japanese textile industry, especially cotton. The Great War gave Japan a chance to extend her markets to India, China and other parts of the world, [^]*tidt* to-day she is Lancashire's most serious rival in every

CENTRES OF POPULATION

part of the world. *Kobe*, a neighbouring port, has risen to prominence during recent years. Its import trade (mainly raw materials such as cotton from India and wool from Australia) is the largest in the country, but the export trade takes second place to that of *Yokohama*. *Kobe*, like *Osaka*, engages in the manufacture of textiles and in shipbuilding. *Kyoto*, the fourth largest city in Japan, is situated amidst beautiful surroundings, near to Lake Biwa. Until 1868 it was the capital, and has declined in importance since the removal of the seat of government to *Tokyo*. It is in the centre of the best silk, and tea producing districts, and is also noted for its artistic productions. In many respects *Kyoto* is the most interesting city in Japan, and is quite different from the modernized *Tokyo*. On account of its ancient monuments and buildings it has been ambitiously called the "Rome of the Far East," although it is a city, not of seven hills, but of thirty-six peaks.

Nagasaki, on the west coast of *Kiushiu*, has the finest harbour in Japan. It has important naval and shipbuilding dockyards, and exports coal, but it is not so important, either as a port of call for liners or as an exporter of coal, as *Moji*, in the north of the island. The chief town and port of *Yezo*, the northern island, is *Hakodate*, which has also a splendid harbour, and large supplies of coal near by. Its chief trade is in coal and fish. *Vladivostok* can be reached from *Hakodate* in two days.

The chief railway in Japan follows the whole length of the east coast of *Honshiu*, giving connections between all the largest towns. (See Fig. 52.) Continuations of the system are found in *Kiushiu* (to *Nagasaki*), and from *Hakodate* to the interior of *Yezo*. The west coast of *Honshiu* is reached by two railways, the more important being that to *Niigata*, from which *Vladivostok* is a two-days' steamship journey distant. In addition to these lines there are many others which act as links between the various systems.

For short distances and for use in towns the

jinrickshaw, a two-wheeled conveyance resembling a bath-chair fitted with shafts, is still in common use.

The Japanese Empire also includes Korea, Formosa, and the leased territory containing the great port of Port Arthur, the southern terminus of the Trans-Siberian Railway.

KOREA.

Korea, called by its inhabitants Chosen,¹ has an area of 86,000 sq. miles, and a population of over twenty millions, and was annexed in 1910 by the Japanese, who had previously acquired a great amount of control in Korean affairs by the treaty which concluded the war with Russia. It is a mountainous peninsula, whose eastern coast rises steeply from a very narrow coastal plain, bordering the Sea of Japan. As we proceed towards the west coast, the elevation becomes less and less, until the coastal plains bordering the Yellow Sea are reached. On account of the configuration, the majority of the inhabitants are found in the west, where the lowlands are suitable for cultivation, especially of rice which, as in the other monsoon lands, forms the chief food of the people. Other products are millet soya beans, cotton. and. hemp. Gold is mined in the north in considerable quantities, and the country is also rich in coal and iron, but their development is very backward. Pastoral occupations are of much greater importance in Korea than in Japan, and hides form one of the chief exports.

The capital of Korea is Seoul situated some sixty miles from the mouth of the Han, the most important river It is connected by rail to its port. Chemulpo. Built at the mouth of the Han, and is on the chief railway of the country. This line runs from Fusan. in the south-east, and traverses the whole length of the peninsula, keeping nearer the west than the east

¹ The title adopted by the Japanese.

coast, and effecting a junction with the Trans-Siberian line at Mukden. Chemulpo and Fusan are the chief ports.

Since Japan acquired Korea there has been a large influx of Japanese, while a considerable number of Koreans have emigrated to the neighbouring countries of China and Manchuria. The Japanese have already made great changes in means of communication and transport, in methods of agriculture and in local government, changes which it is very unlikely the Koreans, who show little energy either in commercial or political matters, would have made if left to themselves,

FORMOSA.

Formosa, or Taiwan, was ceded to Japan in 1895. It has an area of about 14,000 sq. miles, and supports a population of four and a half millions. Its structure resembles Korea for it is traversed from north to south by a range of mountains nearer the east coast than the west, giving a steep slope towards the Pacific, and a gradual slope to the west. Its climate is tropical (notice that it is bisected by the Tropic of Cancer), and its vegetation is of the hot, wet forest variety, camphor trees being of great economic value. Owing to the reckless cutting down of these trees, they are now found only in the mountainous districts, where young saplings are constantly being planted to keep up the supply. Tea is cultivated on the slopes of the mountains, whilst on the alluvial western lowlands, rice and sugar are produced.

The inhabitants of eastern Formosa are of Malay stock, and are very backward indeed. Modern improvements have been chiefly confined to the west, which is inhabited by natives of Chinese descent. The western lowlands are now served by a railway which runs from the northern port of *Kelung*, the best harbour in the country, through *Tainan*, the largest town, to *Tokau*, a port in the south-west.

THE JAPANESE EMPIRE

THE JAPANESE AND THEIR HISTORY.

The Japanese, like the Chinese, are of Mongolian stock. In physique, they very much resemble the Chinese, but are rather shorter in stature. They are not the original inhabitants of their island kingdom, but came from the mainland, probably via Korea, very many centuries ago. Earlier inhabitants are to-day found in the north, especially in Yezo and the Kurile Islands, whence they retired before the stronger invaders. These people, who are called *Ainus*, differ from the Japanese. They have wavy hair and long, thick beards, and do not possess the Mongolian eye. There is little doubt that the ready manner in which the Japanese have adapted themselves to Western ideas is largely due to the fact that, unlike the Chinese, they have come into contact with other peoples (Koreans, Ainus, and perhaps even Polynesians), and the infusion of other races has led to a broader and wider adaptability.

In matters of religion the greatest freedom is allowed in Japan. The chief religions are Shintoism (which regards the Mikado as a god descended from the sun-goddess, and is chiefly a worship of ancestors and nature, and a cultivation of intense patriotism) and Buddhism.

The Japanese claim that the present Mikado, a title which, by the way, is used by foreigners only, can trace his descent far away back to the great year 660 B.C., when their empire was founded. But the Mikado has not possessed unbroken the power he exercises to-day. In the eleventh century the chief power was wrested from the emperor by military leaders who went by the name of Shoguns, and held the ruling power in successive families. The capital of the Shogun was Tokyo, then called Yedo, and the Mikado was virtually a prisoner in Kyoto. The first Europeans to reach Japan were the Portuguese, who for a time were allowed to carry on trade, At a later period the Dutch were allowed to trade at Nagasaki only. But the Shoguns

never liked foreigners, and **at** different times **rebellions arose**, and foreign teachers, chiefly Jesuits, **and their** converts suffered many hardships, even massacres.

In 1854 the United States sent a fleet to Yedo **and** forced a commercial treaty upon Japan. Other Powers did the same, and treaty ports were opened to foreign trade. Troubles between the Japanese and the foreigners led to revolution and civil war, and it was in this crisis that the power of the Shogun, the military dictator, was overthrown, and the Mikado resumed his authority. This was in 1868, and from that year Japan entered into full relations with the outside world. Reference has already been made to changes which have occurred and to the ability of the Japanese in carrying out these changes. It only remains to add that Japan to-day is one of the Great Powers of the world. She has learned one lesson from one nation, another from another, always selecting the nation in which that which it was desired to copy was best managed. Not only **in** her army and navy, which had been so perfected as to surprise Europe by the defeat of Russia in 1905, but in the peaceful field of art, education, commerce and manufacture, Japan has forged ahead. The beginnings of this great step forward were guided by Europeans, but Japan is already able to take complete control, for many of her young men have been trained in the schools and workshops of all the most important countries in the world, whilst at home primary education is compulsory for all, and schools, colleges, universities and technical institutions are provided for higher education.

The extraordinary progress made by Japan since 1868 augurs well for the future of the country. But the rapid increase in the population, which still continues, causes great difficulty in times of diminishing world trade, and Japanese trade can only increase at the expense of other countries. Thus modern industrial development **brings** her into conflict with other countries, and raises **many** difficult problems for solution.

EXERCISES.

1. Discuss the statement, "Japan is the Britain of the East." To what extent is it appropriate?

2. Describe the great changes which Japan has undergone during the last 60 years.

3. Illustrate from Japan the relations between relief, climate, vegetation, and the distribution of the population.

4. Give the position and importance of Tokyo, Nagasaki and Kobe. Draw maps to illustrate the points you make.

5. Using the most suitable physical map in your Atlas, draw a section from Mukden in Manchuria to about two hundred miles of east of Tokyo. Describe the leading features illustrated by this section.

6. "It is remarkable that Japan can support a larger population than that of the British Isles." Why is this remarkable? How is it that a large population can be supported in Japan?

7. Japan's chief exports are raw silk and manufactured cotton and silk goods, and her chief imports raw cotton, iron and timber. Account for this.

8. Find out (a) the size of the Japanese population 70 years ago and at intervals of ten years since; (b) the present annual increase in the population; (c) the estimated population in 25 years from now.

Comment upon these statistics with special reference to problems of employment.

9. Find out all you can about the organization of Japanese cotton mills.

CHAPTER XIX.

AUSTRALIA.

PHYSICAL CONDITIONS.

IN previous chapters we have been considering the geography of Asia. We shall now turn to Australasia, the name given to Australia and the numerous islands north and east of that island continent. The largest of these islands, not including Australia, are New Guinea and the two large islands of New Zealand, but there are thousands of others, some of which are of considerable size, whilst others are small coral atolls. The map shows that the Australasian islands lie mainly south of the Equator, and since this means that January will usually be the typical summer month, and July the typical winter month, we shall be able to draw many climatic contrasts between Asia and Australasia. We shall begin our study of Australasia by a consideration of the physical conditions of the island continent of Australia.

POSITION AND SIZE.

Australia lies south of the Equator, between the parallels of 10° S. and 40^0 S., being therefore almost bisected by the Tropic of Capricorn. It is the smallest of all the continents, its area being nearly three million square miles, or about three-quarters of the size of Europe. Its coast-line has very few large inlets, so that in comparison with the size of the continent the coast-line is not very long, and in this respect Australia may be compared with Africa and contrasted with Europe. To the north

the East Indies form a series of stepping-stones between Australia and Asia; to the east is the island-studded Pacific; in the south the wide belt of the Southern Ocean separates the continent from the Antarctic region, whilst the Indian Ocean washes its western shores. Its isolated position, away from the great highways of trade and discovery during the fifteenth and sixteenth centuries, accounts for its late discovery and development.

RELIEF AND STRUCTURE.

The relief of Australia is very simple, as an examination of a physical map will show. The continent consists of three main divisions—

1. The eastern highlands.
2. The east-central lowlands.
3. The low western plateau.

The eastern highlands, which run at no great distance from the east coast, are not folded ranges like the Himalayas of Asia, but consist of an ancient highland mass which was worn down and then uplifted. The rains and streams have cut into the raised mass and have deeply dissected it. Towards the Pacific the south-eastern highlands present a steep face or escarpment, their slopes to the west being more gradual. The name "Great Dividing Range" is given to the whole, but the system is so long that it is known by different names in different parts. The highest portions are in the south-east, where we have the Australian Alps, partly in Victoria and partly in New South Wales • the Blue Mountains, and the Liverpool and New England ranges in New South Wales. The highest mountain in Australia, Mount Kosciusko, attains an elevation of 7,300 ft., which is rather less than one and a half miles. Since these highlands have been formed by the uplift of older mountains, which had been worn down to rough plains, they are often flat-topped and

resemble plateaux. The island of Tasmania is a detached portion of the eastern highlands.

The great depression of the central plains stretches from the Gulf of Carpentaria to the south coast, and, except for a belt in the north, is entirely below 600 ft. in elevation, whilst in the region of Lake Eyre, it is actually below sea-level. Long ago these plains were the bed of a great inland sea. At that time the eastern highlands were much higher and wetter than they are now, and the rivers which flowed from them to the inland sea carried along rock waste, clay and sands, which were spread on the sea floor. Gradually the highlands were lowered by denudation, thus causing the rainfall and the volumes of the rivers to decrease. In time evaporation exceeded the amount of water brought by the rivers, and finally the bed of the sea became dry land. It is also believed that the land itself was raised.

Note the Flinders Range which separates the basin of the Murray-Darling from Spencer Gulf and the Gulf of St. Vincent. It overlooks a rift valley which contains Lake Torrens and the two gulfs just mentioned.

West of the central lowlands is the enormous low plateau of Western Australia. It consists of an ancient block of the earth's crust which has remained undisturbed for ages. It may be compared with the Arabian and Deccan plateaux of Asia, and to the great African and South American table-lands (Brazilian and Guiana highlands). Geologists tell us that long ago these ancient plateaux were united to form a vast continent, which stretched across the southern hemisphere (see Fig. 28). Seen from the sea the edges of the Australian plateau, especially in the south-west, look like steep mountain ranges, and in this respect may be compared with the broken edges of the Deccan and Arabian table-lands.

One very interesting feature of Australia is the Great Barrier Reef. This reef is composed of coral, and follows roughly the direction of the coast of Queensland

for about one thousand two hundred miles. It is built along an ancient coast-line, now represented by the margins of a submarine plateau (see also pp. 273-5).

CLIMATE.

Although Australia is an island, we shall not expect the influence of the sea to be felt much beyond the coastal margins. The reasons for this are not difficult to understand. In the first place, the size and compact shape of the continent must be taken into consideration. Secondly, the highest mountains are along the coasts, this being especially noticeable on the east coast, a fact which is very important, since the prevailing winds of the greater part of the continent are the south-east Trades. Thus, the effect of the relief is to shut off a large part of the continent from rain-bearing winds and to give the interior a climate over which the sea has no moderating influence whatever.

Temperature.—Figs. 10 and 11 show sea-level isotherms for January and July. In January, the summer month, only the extreme south-west and south-east coasts have a temperature below 70 ° F.; the greater part of the continent is above 80° F., whilst there is a large area where the temperature is over 90° F. In July, the winter month, the lower elevation of the sun naturally gives a lower temperature, so that only the northern margins have a temperature higher than 70 ° F.; the greater part of the continent is between 50° F. and 70° F. and the coolest region is in the south-east.

Winds and Rainfall.—We learned that the south-eastern marginal countries of Asia have what we called a monsoon climate, on account of the summer heating and winter cooling of the great land mass of Asia causing a system of low pressure in summer, towards which winds from the oceans flow, and a system of high pressure in winter, from which winds flow towards the oceans. We find the same phenomenon in Australia. It is produced by similar capses, but because Australia is

in the southern hemisphere, the seasons **are** different. Figs. 15, 16, 23 and 24 show the winds and rainfall for January and July. In the latter month there is a high pressure area over the land mass, and from this winds blow northwards and southwards, being deflected to the left by the earth's rotation. Thus the northern part of the continent receives south-east Trade Winds, which bring no rain, except a small amount to the north-east coast. In the south, the prevailing winds are the north-westerlies, which bring rain to the south-west and south-east regions, as well as to Tasmania. In January there is a well-developed system of low pressure over the north centre caused by the great heating of the interior due to the southerly migration of the sun.

In moving towards this low pressure system, the south-east Trades are turned from their course, and bring a considerable rainfall to the north-east coastlands, whilst the north and north-west coasts receive moisture from the north-east Trade Winds, which flow towards Australia as north-west monsoon winds, on account of their being deflected to the left on crossing the Equator. As in July, Tasmania has westerly winds, but south-west and south-east Australia are in the high pressure belt, and receive little rain during this month.

If we consider the January and July maps together, we shall see that, as in Asia, the rain-bearing winds penetrate farther into the continent in summer than in winter. Fig. 54, which shows the seasonal distribution of rainfall, has been built up from maps showing the mean rainfall for each month of the year.

DRAINAGE.

Australia has very few important rivers, a fact which is due partly to the relief and partly to the distribution of rainfall. The east coast is the best watered part of the continent, but the mountains **lie** so **close** to the coast that most of the rivers flowing eastwards are short and swift, and many waterfalls are often found

in their courses. They are all actively engaged in dissecting the eastern highlands, and some of them have cut deep gaps, which are followed by lines of communication. The most important of the east flowing rivers are the Hunter and the Fitzroy.

In the north, the central lowlands are drained to the Gulf of Carpentaria by the Flinders and other rivers. In the south, the rivers gather to make the great

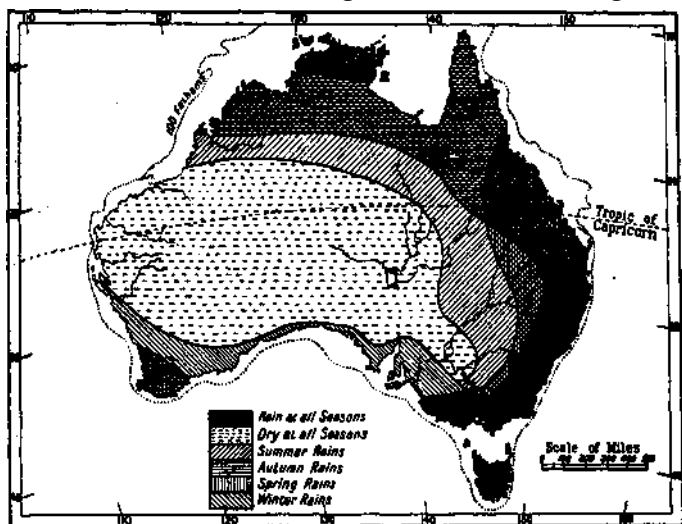


FIG. 54.—The seasonal distribution of rain in Australia,
(After Herbertson and Supan.)

Murray-Darling system, whose waters are drained to the Southern Ocean. The upper and middle courses of the Murray-Darling streams and of those of other rivers rising in the eastern highlands and flowing eastwards have certain drawbacks in common. When they reach the great plains, not only is their velocity checked, so that their load of sediment is deposited, but they flow over an area of very little rainfall. The deposition of sediment has caused them to raise their beds higher than the level of the surrounding plains, so that heavy rains in the high-

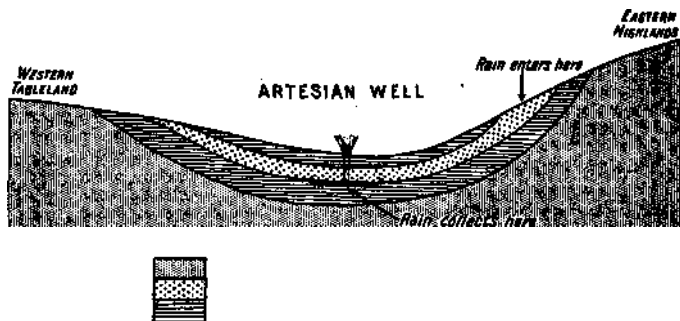
lands produce destructive floods in the plains. Another drawback of the rivers of this system is, that the enormous evaporation occurring during the hot weather causes the amount of water they carry to be very small during summer and autumn. Now the Murray rises in the highest part of the Australian Alps, and the melting of the snow helps to keep the supply of water in that river more constant than that of the Darling. It will readily be seen that it is in winter, and in the case of the Murray in spring also, that the Murray-Darling is of greatest utility for navigation; but even in this respect, so much water is taken from the rivers for irrigation purposes, owing to the slight rainfall on the plains that there is sometimes an insufficient depth for navigation even in winter and spring. This has led to considerable friction between South Australia, Victoria and New South Wales, for the first is primarily interested in the *navigation* of the Murray, and the other provinces in its value for *irrigation*. Another disadvantage is the very poor mouth. The river flows into Lake Alexandrina, a large lagoon whose outlet to the open sea is not only shallow, but is made of little value owing to the presence of banks of shifting sand.

Between the rivers draining into the Gulf of Carpentaria and the Murray-Darling system, there is a great area of inland or continental drainage, in which the rivers flow towards Lake Eyre, which is below sea-level. As may be expected, these rivers, such as Cooper's Creek, seldom contain water in their lower courses. Indeed, Lake Eyre is not a lake in the ordinary sense of the word. It is a wide expanse of swamp, in which are found small salt lakes, and it is very seldom that the rivers bring down sufficient water to give the whole the appearance of a great lake. The same applies to Lakes Gairdner and Torrens.

Between the Gulf of Carpentaria and the Murrumbidgee tributary of the Murray, and including the Lake Eyre basin, is a region known as the *artesian area*. It is composed of permeable layers of rock,

i.e. layers through which water easily passes, lying on the top of impermeable layers of clays. The basin-shaped structure of the strata causes underground water to collect above the clays. This water can be reached by very deep borings, sometimes nearly a mile in depth, from which it usually gushes without the aid of pumping machinery (see Fig. 55). The importance of such wells in a region of little rainfall is apparent. Fig. 56 shows the chief artesian basins of the continent.

In the dry western plateau there are no perennial streams, and what watercourses there are drain into inland lakes, such as Lake Amadeus; but in the mon-



soon region in the north, perennial streams are found, although there is a great difference between their volumes in summer and in winter. Naturally they contain most water in summer, and are either very low or nearly dry in winter. In the south-west the Swan River is the most important. This corner of Australia has most rain in winter, and it is therefore at that season that its rivers have their greatest volumes.

The map of Australia shows that the west, north, and eastern margins, as well as the Murray-Darling basin, are drained to the sea; whilst the dry centre and south are areas of inland drainage. (See Ex. 2 at the end of this chapter.)

PLANTS AND ANIMALS

PLANTS AND ANIMALS

We can now go into more detail than was possible in Chap. VII. The influence of the long separation of Australia from other land masses is seen in its typical plants and animals. Much of Australia is so dry that

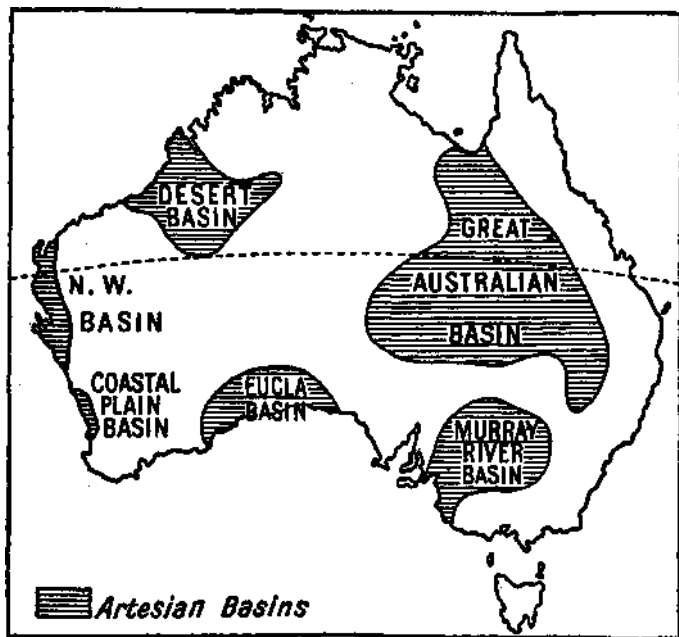


FIG. 56.—The artesian basins of Australia.

The map shows the parts of the Commonwealth which are or might be irrigated by water from artesian bores.

the prevailing forms of vegetation are such as can resist long, dry periods. The eucalyptus, or gum, is the commonest tree. Instead of shedding its leaves, it loses its bark, whilst it gives little shelter from the rays of

the sun, as its small, tough leaves stand edgewise. There are many kinds of eucalyptus, ranging from the mallee scrub, which covers a large area of South Australia and New South Wales, to the enormous karri and jarrah species of South-west Australia. The wood of the latter is of great importance in the construction of railways, etc., in hot, wet countries, as it is so hard that white ants and lice cannot destroy it. It is widely used for street paving, and in the construction of docks and harbour works.

As Fig. 26 shows, forested areas are found only in the better watered coastal lands and highlands. Along the north and north-eastern margins are forests of the hot, wet variety. Bananas, bread-fruit trees, palms, wild vines, spices and valuable timber trees, such as sandalwood, are all found. In the cooler south-east we find a highland region of woodland and grassland. In the former gum trees are commonest, but there are also magnificent tree-ferns as well as European trees such as beeches, pines and walnuts. Those parts receiving heavy rainfall, *e.g.* western Tasmania and the Australian Alps, are naturally the most densely forested. In the south-west and in south-eastern South Australia and western Victoria (regions receiving rain mainly in winter), the chief trees are the karri and jarrah gums already referred to.

The grasslands of Australia may be divided into two kinds, the savannahs or tropical grasslands, and the steppe or temperate grasslands. The former are to be found in the drier belt south of the hot, wet forests, and the latter in the basin of the Murray-Darling. The native grasses, which are very deep-rooted, and tend to be spiny, have been improved by the introduction of European grasses, as well as by the grazing of animals. Many areas marked on the vegetation map as grasslands, are covered with salt bush and brigalow scrub, or dwarf acacia. The latter is exceedingly difficult to penetrate, but the salt bush is very good for sheep. It can be found green long after the heat has withered

the other grasses and shrubs, as it is well adapted to withstand drought.

The dry interior and western areas are either scrublands or deserts. Rain falls only in very small amounts and at uncertain intervals, so that the only vegetation consists of thorny scrub bushes and spiny grasses. The best known of the latter is the spinifex, a tall grass which grows in clumps, and has leaves not unlike a bayonet. So sharp are the leaves that, if one is not very careful, they will cause very dangerous wounds. Travellers who know these dry Australian lands, say that it is really wonderful how their appearance can be changed by one shower of rain. The dreary, barren, brown desert quickly becomes carpeted with many coloured flowers and a thin covering of grass, only to be as quickly burned brown again by the relentless heat of the sun.

Perhaps the effect of long separation from other land masses is more clearly shown in the animals than in the plants. The native Australian animals are of a type long since extinct in other continents. Although the common, domesticated animals of Europe were lacking when the continent was discovered, horses, cattle, pigs and sheep have all been introduced, and thrive very well indeed, increasing in numbers at the expense of the native animals. Rabbits have also been introduced, and owing to the great rate at which they have multiplied, largely due to the absence of such enemies as the fox and the weasel, are now a very serious menace, and have to be kept off the sheep runs or prevented from spreading by means of wire fences. West Australia has endeavoured to keep them out of that state by means of a wire fence, which runs right across the continent from north to south. Frozen rabbits are now exported, whilst the fur is also valuable for making imitations of the furs of the animals of Siberian and Canadian forests. The distinctive Australian animals are the marsupials, or pouched animals, the best known being the kangaroo, the largest native grass-eating animal. The young marsupials **are** born

in such a helpless state that they are carried about in a pouch until they are able to take care of themselves. There are many other marsupials, such as the wallaby, the opossum, and the native rabbits, cats, and wolves. A very strange animal is the platypus, or duck-billed mole, which lays eggs, and after having hatched the young, proceeds to suckle them. In the forested regions are many animals adapted for life in trees. Among these we may name flying squirrels, tree kangaroos, and tree snakes, whilst gaily plumed parrots, parrakeets, and the beautiful lyre birds are also found.

On the grasslands, besides the kangaroo, we find the emu and the cassowary, large running birds resembling the ostrich. Few of the Australian animals are of value, either for their skins or their flesh, and that accounts for their being gradually driven towards the scrub and desert lands, as man extends farther into the continent. This will lead eventually to their disappearance.

THE NATIVES OF AUSTRALIA.

The fate of the animals appears likely to be also that of the natives, for there are now only about 60,000 aborigines left, probably about half as many as there were when Europeans first reached the continent. In appearance the aborigines, who belong to a very primitive type of man, are short in stature, their skin is dark brown in colour, their hair is black and wavy, and they usually have a profusion of beard. In advancement they appear to have reached only the Stone Age, for when they were first discovered they were using stone axes. Probably their advancement had been retarded by lack of domestic animals, as the dingo, or native dog, was all they had; but the inhospitable nature of the climate of much of the continent, and the consequent hard struggle for existence, must also have had an important influence. The latter cause certainly made a large increase in their numbers impossible. Their occupation is chiefly hunting, a calling in

which they have developed marked skill, as is shown by their invention of the boomerang, a curved wooden weapon so shaped that it returns to the thrower if the object aimed at is missed, and the throwing-stick, by means of which a spear can be thrown with great force. To-day the aborigines are to be found mainly on the scrublands, on the margins of the deserts, and in government reservations.

In Tasmania, the aborigines, who were not of the same race as those of Australia, have now no representatives.

EXERCISES.

1. Describe the relief of Australia, and illustrate your answer by a map on which the physical units are clearly brought out and marked.

2. Draw a map of Australia, shaded so as to show the land drained (i) to the sea, (ii) to centres of inland drainage. Briefly describe the map.

3.

Town.	Elevation in Feet.	Mean Jan. Temperature	Mean July Temperature.	Mean Annual Rainfall in inches.
A	15	76°F.	55° F.	33 (chiefly in winter)
B	20	84	75	63 (chiefly summer)
C	700	85	68	28 (chiefly summer)
D	587	86	• 52	11 (chiefly summer)
E	45	71	49	48 (at all seasons, most March-July)
F	37	61	47	23 (all seasons)

The above figures illustrate' the climatic conditions which obtain at six Australian towns. Identify each town, or state the region, and give full reasons for your choice.

4. "As the interior of Australia is approached, the rainfall decreases and the temperature increases." Illustrate and explain this statement.

5. Giving Australian examples, illustrate the connections **between** relief, climate, and vegetation.

6. Draw a sketch map of Australia to show the distribution of deserts, grass lands, and forests.

CHAPTER XX.

AUSTRALIA: REGIONAL AND ECONOMIC.

MAJOR NATURAL REGIONS.

HAVING considered the physical conditions of the continent, we are now in a position to divide Australia into its major natural regions. Fig. 57 shows these units.

The Tropical Monsoon Region.—This includes the north and north-eastern coastal belts. The climatic conditions are: a high temperature with little range between winter and summer, and abundant summer rainfall. The vegetation is of the hot, wet variety. Most of the region is suitable for cultivating the products of the Asiatic monsoon lands, *e.g.* rice, maize, cotton, sugar, indigo, etc., but the great drawback is that the climate is not suitable for white labourers. The Australian Government has decided upon a policy of a "white" Australia, that is, the exclusion of all Asiatic or coloured races from the continent. This means that the agricultural development of the monsoon areas of Queensland and the Northern Territory is bound to be retarded.

The Savannahs or Tropical Grasslands. These form a transition stage between the north coast belt and the desert-like interior, and may be compared with the smaller Indian region between the Deccan and the Desert of Thar. The range of temperature is greater than in the hot monsoon lands; and the rain, although falling in summer, is less in quantity. The natural vegetation is grass, although large areas of scrub are to be found. Pastoral occupations predominate; whether cattle or

NATURAL REGIONS

sheep predominate, depending upon the rainfall. In the north of Queensland and in the north-west of this region cattle are in the majority, but in southern Queensland, where drier conditions prevail, sheep exceed cattle in numbers.

The Deserts and Semi-Deserts— Here the changes of temperature, both annual and diurnal, are considerable, whilst the rainfall is very small and irregular. The areas of really arid desert are not very extensive, for no part

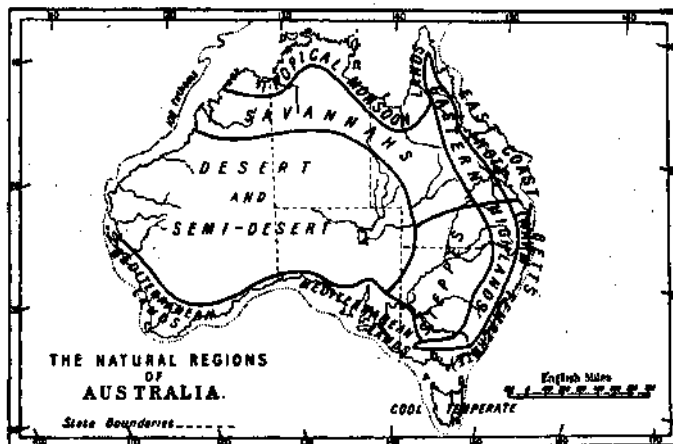


FIG. 57.—The major natural regions of Australia.

is quite without rainfall. The region is of slight value for its vegetable productions, but there are areas, as at Kalbarrie and Coolgardie, where valuable mineral deposits, especially of gold, exist. Naturally, the development of gold-mining is largely dependent upon the supply of water. The Australian deserts may be compared with Arabia.

The Mediterranean Lands.—The Asiatic counterparts of these lands of warm, temperate climates with winter rainfall, are found in the Lands of the Five Seas. These regions receive most of their rain from the prevailing

westerly winds blowing in winter. In the Australian region the parts getting heavy rainfall are forested, but along the dry coasts of the great Australian Bight the rainfall is only sufficient for scrub and clump grasses, so that pastoral occupations only can be carried on. In the Victorian part of the region there are rich grasslands suitable either for pasture or for agriculture. The typical Mediterranean products—vines, olives, mulberries, etc.—have been introduced in suitable parts of Mediterranean Australia, and even outside that area, with considerable success, but taking the Australian Mediterranean lands as a whole, they are not so true to type as the Mediterranean lands of the Old World, the Americas and South Africa.

The Steppes or Temperate Grasslands,—This region, which may be compared with the Siberian steppes, is chiefly the basin of the Murray-Darling, and is noted for its pastoral occupations, especially sheep-rearing. The rainfall decreases from east to west, so that the number of sheep per 1000 acres in the east is over four times as many as in the west. Another important point to notice is that the west has very few places suitable for agricultural occupations, whilst rapid progress in this direction has been made in the wetter east, where wheat-growing is now very important. The development of the pastoral and agricultural pursuits of the region has been greatly helped by the boring of artesian wells (see p. 222).

The Eastern Highlands,—The climate of these highlands varies with latitude and elevation. In the wetter parts, such as the Australian Alps, the forests are more extensive than elsewhere. Generally speaking the vegetation is of the mixed forest and grassland type, so that agricultural and pastoral occupations are carried on as well as lumbering. Rich mineral deposits make the eastern highlands of great economic value.

The Warm Temperate South-Eastern Margins.—In latitude this region may be compared with Central and Northern China. The latter have the greater part of their rain in summer, whilst the Australian region has rain at all seasons, but most in summer. The tempera

ture conditions in the two regions are very different. The Chinese type of region is continental in character, having very cold winters and hot summers. The explanation of these differences must be sought for in the relief and size of the land masses behind the regions. In the north of the Australian region the temperature is high enough for sugar, whilst maize is more important than wheat, even in the south.

Cool Temperate Tasmania.—The Tasmanian climate, which has no counterpart in Asia, may be compared with that of Britain. The range of temperature is not very great, and the general climatic conditions are distinctly those associated with Western Europe. The prevailing winds at all seasons are the westerlies; the heaviest rains are on the west coast, and the island generally is well-watered. As a natural consequence a large part of the island is forested by trees of a similar kind to those of Western Europe, the forests being densest on the west coast, whilst the drier, less exposed parts are grass covered.

HISTORY AND POLITICAL DIVISIONS.

HISTORY.—The history of the discovery of Australia forms a most interesting story, but only the barest outlines can be given here. If a large atlas map of Australia is examined, the number of Dutch names appearing on the west of the continent is at once noticed.

Some of these are:—Cape Van Diemen, Houtman's Abrolhos, Dirk Hartog Island, Cape Leeuwin (lioness). Tasmania was formerly known as Van Diemen's Land. Indeed, until the middle of the last century, Australia was commonly called New Holland, and it is very probable that* if the Dutch sailors who first explored its coasts had seen the east coast, instead of the north coast with its mangrove swamps, or the desert west coast, the continent would still have borne that name. It appears as though the earliest Portuguese, Dutch and Spanish explorers, whose objective was the Spice Islands, missed

the southern continent. In 1606, Torres, a Spaniard, discovered the straits which bear his name, but of greater importance were the discoveries of Tasman, who, in 1642, reached Tasmania, which he believed to be part of the mainland. It was not until over a century later, however, that the great Englishman, Captain Cook, discovered the fertile east coast. He had been engaged upon astronomical work in one of the Pacific Islands, and when that was completed he sailed westwards, and hitting upon New Zealand, whose west coast had been seen earlier by Tasman, circumnavigated both large islands, and continued his voyage westwards. He reached the Australian coast at Botany Bay, so called on account of its profuse vegetation. After sailing northwards along the coast of a land which he named New South Wales, he passed through Endeavour Strait (called after his boat), and returned to England. The first use to which the new land was put was as a convict settlement, which was formed at Botany Bay, but afterwards removed to the much superior inlet of Port Jackson. Here Sydney was built. By degrees the whole of the continent was unveiled. It is interesting to notice that it was not until about ten years after the first settlement was made at Sydney that Dr. Bass, a surgeon in the Navy, discovered that Tasmania was separated from the mainland.

Other penal settlements were made at Hobart, in Tasmania, ;and at Brisbane, in Queensland. Settlements on the Swan River in West Australia, at Adelaide and at Melbourne soon followed, although these were by legitimate settlers who engaged in pastoral and farming occupations. Very gradually these six settlements and the regions around them attracted more and more people, so that finally they formed separate colonies. The discovery of gold at Bathurst in 1851, and later at Ballarat and Bendigo, led to a large increase in the population. In the end it was seen that if the continent was to attract the right kind af settlers the penal settlements must be broken up.

In 1901 the six states (five Australian and Tasmania) united to form the Commonwealth of Australia, although they still retained a large amount of local self-government. The difficulty of selecting a capital was got over by conferring the honour upon *Canberra*, a small township some 150 miles south-west of Sydney. Here splendid parliament buildings have been erected.

The population of Australia in 1937 was 6,867,000,

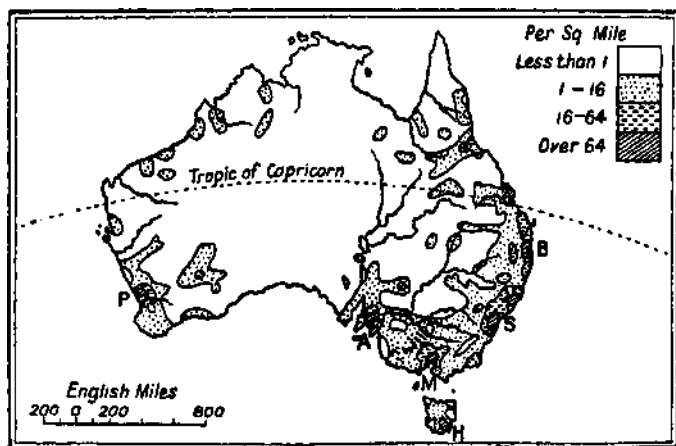


FIG. 58.—Australia. The distribution of the population.

Even when we take into consideration the tropical nature of the northern coastal belt and the arid character of large areas in the west, it is obvious that there are great opportunities for a large increase of the population (see Fig. 58), especially when it is recalled that nearly half of the people live in the six state capitals. We will now consider each of the Commonwealth States in turn.

QUEENSLAND.

As will be seen from the Australian statistics given at the end of this chapter, Queensland is the second

largest of the Commonwealth States, but for many reasons its development is not in an advanced state, and its population is small, little more than one per square mile. It may be divided into the following natural regions (see Fig. 57)—

1. The hot coastal margins.
2. The eastern highlands.
3. The western plains, a savannah region to the lee of the eastern highlands, but gradually becoming more and more arid as the interior is approached.

1. Having already considered the natural regions, we are in a position to see along what main lines the economic development of each region will proceed. On account of its position and climate the "White Australia" policy retards the development of Queensland more than any other state, especially in the first region—the coastal margins. After very careful consideration, the Australian Government has decided that a very determined attempt must be made to keep the continent for whites; and their reasons are partly on the grounds of defence. The natural cultivation in the coastal lands of Queensland would be of sugar, cotton, rice, tropical fruits and other products of the Indian type. Now it is generally held that the climate of regions producing these commodities is not suitable for white labour, but in recent years medical opinion on the subject has undergone a considerable change, and it is now believed that many of those parts of the world popularly thought to be white men's graves, or to be unsuitable for white labourers, will be made safe owing to the great advance which has been made in the study of tropical diseases and medicines. If the development of the Australian tropical lands by whites is, after trial, proved to be a failure, there is no doubt that the whole question will be reconsidered. At present the area certainly does not produce up to anything like its capacity. Should the

experiment prove a success it will be the first successful example of its kind in the world.

At present the alluvial plains of the first region in Queensland (see above) produce such tropical crops as bananas, sugar, and pineapples; on the lower slopes of the hills a little tobacco, cotton and coffee are grown, whilst the chief crop, maize, is found at higher elevations still.

2. In the second region, the eastern highlands, mining is the leading occupation, although on the Darling Downs, on the borders of New South Wales, there are arable and pasture lands on which wheat is grown, and large numbers of sheep and cattle are reared. The mineral wealth includes gold, copper, tin, lead and coal. Gold is mined at *Charter's Towers*, some eighty miles west of Townsville, and *Mount Morgan*, about thirty miles south-west of Rockhampton. Copper is also mined at Mount Morgan. Large deposits of coal are known to exist, but, except at Ipswich, twenty-five miles south-west of Brisbane, are little mined owing to distance from the coast.

3. In the third natural region of Queensland, the savannahs, pastoral occupations are of greatest importance. Cattle and sheep are reared in large numbers, the former in the wetter, the latter in the drier parts. Queensland has more cattle than any other state in Australia. The whole of this region lies in the artesian well area, and over three thousand wells, yielding more than three hundred millions of gallons per day, are in operation. By far the greater part of this water so obtained is used for watering cattle and sheep. From this region wool, mutton, hides, butter, and dairy produce are sent eastwards for export.

The chief port and capital of Queensland, *Brisbane*, is situated about twenty miles from the mouth of the Brisbane river, and has about one-third of the population of the state. It has not quite the same dominating part in the trade of its state as is possessed by the other capitals, partly on account of its position in the south-

east corner but also owing to the competition of other rising ports, which have good facilities for railway communication with their hinterlands. As Fig. 59 shows, Brisbane is connected by rail with Sydney to the south and Rockhampton to the north, whilst another line runs westwards to the stock-lands. *Ipswich*, the chief coal centre, is on the latter line, and has cotton and woollen manufacturing industries. *Rockhampton* and *Townsville* are important ports from which railways run westwards, crossing all three of the natural regions, and bringing their products to the coast for export. All the ports of north-eastern Queensland benefit from the sheltering effect of the Great Barrier Reef.

NEW SOUTH WALES.

The physical features of the natural regions of this state are somewhat similar to those of Queensland. Owing to the latitude, however, the climatic and vegetation conditions belong to cooler types. The natural regions are—

1. The coastal belt.
2. The eastern highlands.
3. The western plains.

1. The coastal belt is in a much more advanced state of development than that of Queensland, and supports a large population. The reasons for this are:—the fertility of the soil and the more favourable climatic conditions, the great wealth of coal, the richer hinterland, and the better means of communication. Sugar is grown in the north, but the output is declining. Maize is largely grown, especially in the south; and it is worthy of note that although New South Wales is the chief maize producing state, much has to be brought from Queensland to supply the demand for this valuable stock food. The coastal belt is more suitable for cattle than sheep, and it is on this account that dairy farming has become a very important industry. The coal-fields are near the coast, so that the coal can be exported very easily. The most import-

ant is the Hunter River coal-field, with the appropriately named town of *Newcastle* as its centre. More coal is got from this district than from any other in the southern hemisphere. Manufactures are increasing in importance. South of Sydney there is another coal-field in the vicinity of Wollongong.

2. We have learned that the tops of the eastern

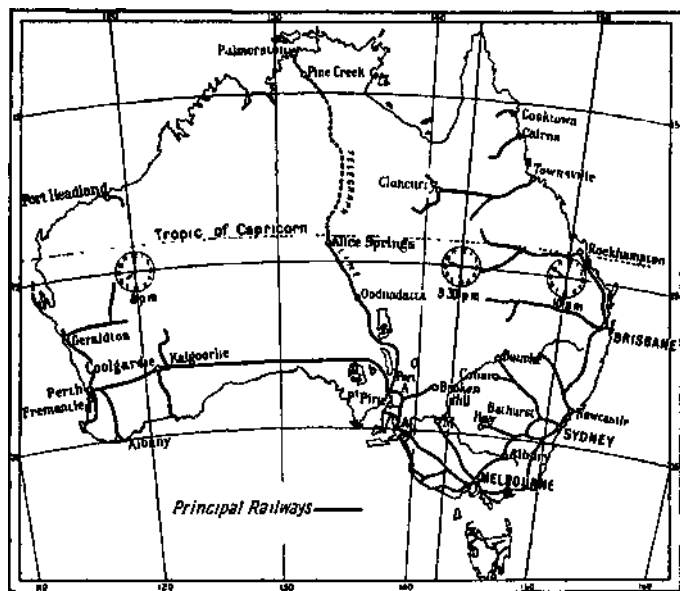


FIG. 59.—The chief railways of Australia. The "clocks" show Australian standard time.

highlands resemble plateaux, that the eastern slopes are short and steep, and the slopes to the west are longer and more gradual. These physical conditions have a marked influence upon agriculture, for large areas of the western slopes produce wheat and barley, while the plateau has a much smaller area of cultivated land, and oats and potatoes are quite as important as wheat. There are splendid pastures in the highlands,

and over one-half of the cattle and nearly one-half of the sheep of the state are grazed there, whilst the number of sheep per square mile is much greater than in the drier lands of the steppe.

As regards mining, the same minerals are found as in Queensland. Gold, copper, and tin are mined in many places. *Bathurst*, formerly one of the chief gold-mining towns in Australia, is now more important as an agricultural and stock-rearing centre.

3. The third region, the western plains, is part of the basin of the Murray-Darling, and is a great stock region. We have already learned that the western part of this region is poorer than the east, on account of the more arid conditions, and that the number of sheep decreases as we go westwards. It is also owing to the more favourable climatic conditions that the east is more important for wheat than the west. Great progress in agriculture has been made in the *Riverina*, the land between the Murray and the Murrumbidgee, although even here the rainfall must frequently be supplemented by water from artesian wells. The *Riverina* is now the chief wheat growing area in Australia.

The western plains are not without mineral wealth. Copper is mined at Cobar and silver at Broken Hill, near the borders of South Australia. Broken Hill exports its silver from Port Pirie, a South Australian port on Spencer Gulf.

Sydney, the capital and chief port of New South Wales, is the oldest and largest town in Australia. It has a magnificent position on Port Jackson (see Fig. 60), an almost landlocked deep inlet with a narrow entrance. Since it has become the centre of the state's railway system it has greatly increased in importance, as will readily be seen from a list of its chief exports. They are wool, frozen and preserved meats, butter, hides and skins, leather, wheat and flour, gold, etc. It will be seen that these are representative of all the natural regions of the state. The great barriers to the

making of railways were the steep slopes and difficult valleys of the eastern scarps of the Blue Mountains. A winding road and a zigzag railway, and later a tunnel overcame these difficulties and Sydney was connected by rail with Bathurst. Soon after leaving the latter town the railway branches, one line serving the rich lands on the western slopes of the highlands and eventually reaching Melbourne via Albury; the other reaching *Bourke*, a great stock-rearing centre at the head of the navigation of the Darling, with a branch to Cobar, the copper-mining

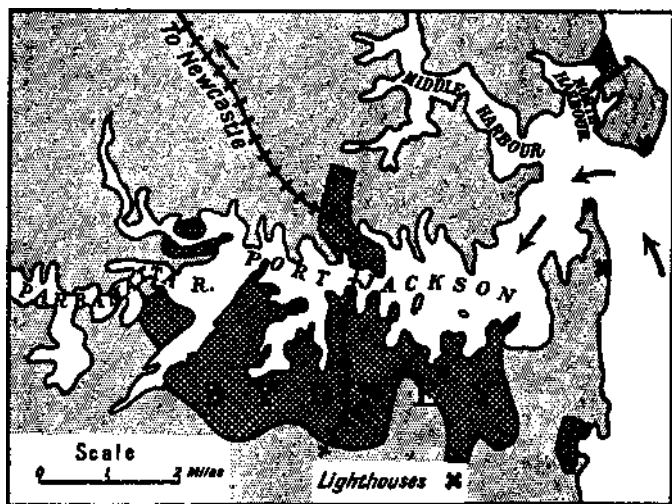


FIG. 60.—The position of Sydney.

town. Other lines take the coastal routes north and south of Sydney, and reach the two coalfields already mentioned. A more important southern route crosses the plateau and after passing *Goulburn*, a rising agricultural centre, makes a junction with the western line to Victoria.

VICTORIA.

Victoria, separated from New South Wales by the

Murray River, is the smallest state in the Commonwealth, and has the largest number of inhabitants per square mile, although this only amounts to nearly twenty. The state may be divided into the following natural regions—

1. A north-western steppe region.
2. An eastern highlands region.
3. A Mediterranean region.
4. An eastern warm temperate belt.

1. The first region has already been sufficiently described in connection with New South Wales. It is devoted to sheep-rearing, except in those parts which have been cleared of mallee scrub (see p. 223) and are now devoted to wheat growing. Large sums have been spent upon this clearing work, and upon the construction of dams across the rivers in order to hold up water for use on the fields. This is necessary because Victoria is outside the artesian well area. Despite the dry conditions which obtain in the north-western plains, about nine-tenths of the wheat output of Victoria comes from there.

The irrigated *Wimmera* district, one of the areas formerly covered with mallee scrub, now grows great quantities of wheat. North of the *Wimmera*, the dry climate and the possibility of getting water from the *Murray* has led to the growth of a fruit industry with its centre at *Mildura*. All the Mediterranean products, such as the vine, olive, apricot, peach, orange, etc., do very well indeed. Raisins and canned fruits are largely exported (see p. 230).

2. In the second region, the highland belt, gold-mining is of prime importance, although pastoral occupations are important in the valleys. The chief mining centres are *Ballarat* and *Bendigo*, but in recent years the output has declined, and many of the miners have left for mines in other parts of the continent. The wetter, southern slopes of the highlands are densely forested, and provide a source of wealth which has been very little exploited.

The third and fourth Victorian regions occupy the coast belt. To the north the highlands rise very abruptly, whilst in the south are the moderately high mountains to the east and west of Port Phillip, the harbour of Melbourne (see Fig. 61). Between the two systems lies a rift valley, the *Great Valley of Victoria*. Evidences of former volcanic activity are seen in the numerous extinct cones scattered about the surface of the western portions of the Great Valley, and the results of this are seen in the rich volcanic soils, and consequent greater productivity of the west compared with the east. The Valley is largely devoted to stock-

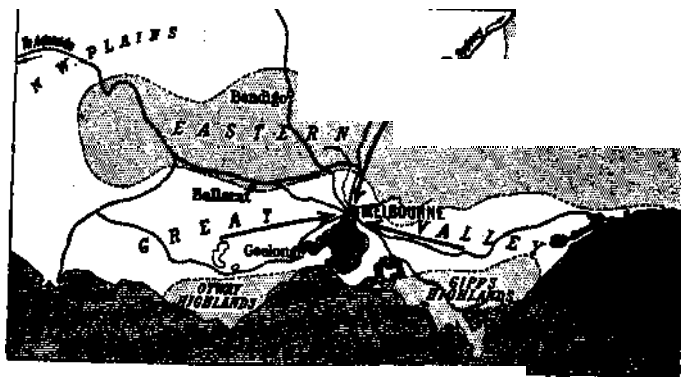


FIG. 61.—The position of Melbourne

rearing and dairy-farming. It has half the sheep and cattle of Victoria, and exports the world's finest merino wool. Fruit-growing is spreading in the western half of the valley, and here, the climate, which approximates to that of typical "Mediterranean" areas, is suitable for the industry. The eastern half is almost entirely pastoral

the Gippsland and Otway highland areas, are still largely covered by forests—due of course, to their heavier rainfall. Great progress in felling the trees is taking place, and on the cleared lands dairy-farming is meeting with much success. Grasses from Europe have been planted, and are much better than the very

dry native grasses. Most of the farmers belong to the co-operative dairies which collect the milk, eggs, etc., manufacture the former into butter and cheese, and arrange for their export.

The capital of Victoria is *Melbourne*, which, as Fig. 61 shows, occupies a magnificent position at the head of Port Phillip Bay. The latter almost cuts the Great Valley in two, so that all east and west routes must pass through Melbourne. Besides this, behind the city the highlands are narrowest and lowest, so that railways will cross there. Owing to these great advantages, Melbourne has a population of over one million, over half of the population of Victoria, whilst it exports the greater part of the state's products. *Geelong*, also on Port Phillip, is the second port, and is primarily engaged in the exportation of wool and wheat. The great production of wool has led to the establishment of woollen manufacturing in the town.

SOUTH AUSTRALIA AND NORTHERN TERRITORY.

Fig. 56 shows that these divisions of Australia extend from north to south of the continent, and that their land boundaries are entirely artificial. Except in the south-east of South Australia, they contain very few people indeed. The reasons for this sparse population are evident when we consider the natural regions which make up South Australia and the Northern Territory. From north to south they are—

1. A tropical monsoon coastal belt,
2. A belt of savannahs.
3. A large area of desert and semi-desert.
4. A Mediterranean coastal belt in the south.

Northern Territory.—This vast undeveloped area includes the first two regions and part of the third. At the present time the leading occupations of the settlers are cattle-rearing and mining. In the wet coastal belt, where the difficulties are those of the similar region in Queensland,* i.e. lack of labour, some

SOUTH AUSTRALIA

rice and hemp are grown. In 1937 the population was estimated at nearly 23,000, of whom 17,000 **were** aborigines and 700 were Chinese.

After being administered first by New South Wales and then by South Australia, Northern Territory passed under Commonwealth control in 1911. In 1927 it was divided into two territories, *North Australia* and *Central Australia*, the dividing line being the twentieth parallel of south latitude. This was repealed in 1931 and the whole of Northern Territory was placed under the control of an Administrator. It is hoped that these changes will speed up the development of the area. Port Darwin and Alice Springs are the chief settlements.

South Australia.—The north of South Australia consists of dry lands of limited value, although it is believed that rich deposits of gold exist. As the south coast is approached the land becomes less arid, and there are scrub-covered tracts, in parts of which sheep are reared.

Farther south the Mediterranean regions comprise the narrow coastal margins in the west, and the land round Spencer and St. Vincent Gulfs in the east. The former are the eastern parts of the Nullarbor plain. Strictly speaking they are hardly "Mediterranean" at all for they are so dry as to be only suitable for sheep. Most of the inhabitants of South Australia live in the lands surrounding the Spencer and St. Vincent Gulfs, openings of very great value, for they give easy access to the best lands of the state. We have already seen (see p. 217) that they are drowned parts of a rift valley extending northwards and including Lake Torrens. The climate is suitable for fruits, and many vineyards and fruit gardens have been planted on the sunny northern slopes of the hills, whilst much wheat is grown on the coastal plains surrounding the two great gulfs. Copper is mined and smelted at Moonta and Wallaroo in the York Peninsula, and silver from Broken Hill (New South Wales) is smelted at, and exported from Port Pirie. East of the

South Australian highlands, the land is chiefly given over to pastoral occupations, although in the south, owing to a heavier rainfall, dairy-farming is of greater importance.

Adelaide, the capital of South Australia, and a city of some 320,000 inhabitants, is splendidly situated between the South Australian highlands and St. Vincent Gulf, about six miles from the latter. Its port is Port Adelaide. The city has not made such marked progress as the other Australian capitals, largely owing to the uncertain character of the rainfall affecting the agricultural activities of the state, and to the comparatively inferior value of the mining industry. It is in direct communication by rail with Melbourne, and through that city with Sydney and Brisbane, as well as with Perth (West Australia). Fig. 59 shows the overland telegraph line which crosses Central Australia from Port Darwin to Adelaide. A projected transcontinental railway has been built from Adelaide through Oodnadatta, which is north-west of Lake Eyre, to Alice Springs. The last 750 miles of this railway does not cross a single running stream.

Port Augusta, a small port at the head of Spencer Gulf, has a good position on the railways from Perth, Oodnadatta and Adelaide, but its trade is very small.

The chief exports of South Australia are wheat, wheat-flour, wool, copper and other minerals, wine and fruits. The bulk of the trade is done through Port Adelaide.

WEST AUSTRALIA

West Australia, often called Westralia, has one-third of the total area, but a population of less than four hundred thousand. This exceedingly small population is not accounted for simply by the fact that Australia is a new country, but is due to the types of regions of which the state largely consists. As Fig. 57 shows, its natural regions are—

- I. A small area of hot, tropical monsoon lands.

2. A savannah region.
3. A huge tract of desert **and semi-desert.**
4. A Mediterranean region.

From what we have already learned, it will **be evident** that the bulk of the people live in the fourth region. White settlers are very few in the first region. The second region, although unsuitable for sheep, is the chief cattle-rearing part of the state. The valley of the Fitzroy is especially noted for this industry. The desert, which reaches the coast on the west, is of economic importance, owing to the rich gold-mines in the south-west and west. The most important of **these are** in the district of *Kalgoorlie* and *Coolgardie*. The former is the chief centre, and produces one-half of the total output of the state. It is noted for its "Golden Mile" of mines. The difficulty of **getting** water to these mining towns was overcome in the following way:—A small river near Perth, the **Helena**, has been dammed, and the water thus held up is pumped into reservoirs on the Darling Range, which are higher above sea-level than the mining towns. From the reservoirs it is conducted by water-pipes which run alongside the railway for a distance of several hundred miles.

There are also many other gold-fields, such as **the** Murchison, which is reached by rail from Geraldton. Australia ranks third in the world as a producer of gold, her production being exceeded by that of **the** Transvaal and the United States. Of Australian gold, **rather** more than half is mined in Westralia. It is worth noting, however, that the supplies from this state appear **to have** reached the maximum, and to be declining, unless, **of course**, this is made up for by the discovery of **further deposits.**

The Mediterranean region contains the most **valuable** forests **and** agricultural lands. The former supply **the** famous karri and jarrah woods (see p. 223). **Wheat** is the most important **cereal, and although Mediter-**
anean fruits have not been introduced very extensively
there is no reason why they should not be grown, as

the climate is quite favourable. The coastal margins of the great Australian Bight, like the similar lands of South Australia, are only important for sheep-grazing. The small port of Eucla serves this region.

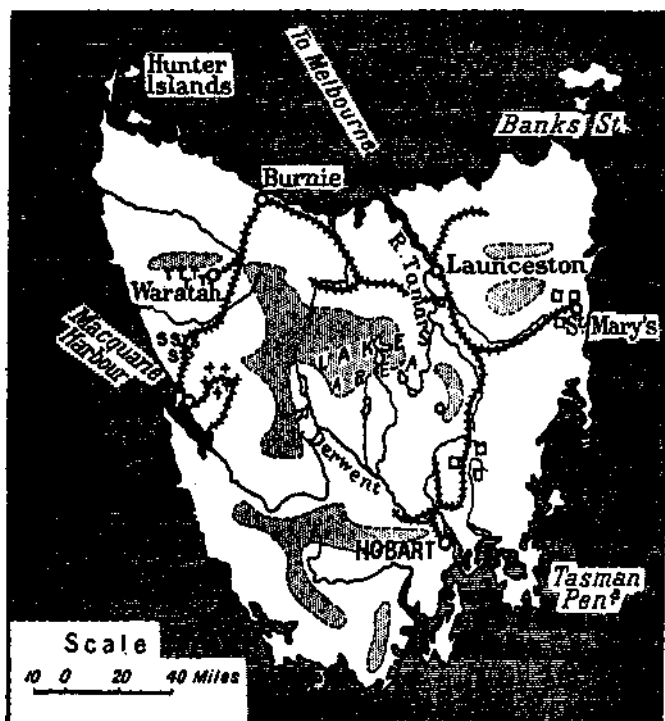
The capital of Westralia is *Perth*, situated some twelve miles from the mouth of the Swan River. Its prosperity has been due largely to the discovery of gold in the Kalgoorlie area. It has a very agreeable climate, although in summer the heat is often very great, and would sometimes be unbearable were it not for a cool, west sea-breeze, locally called the "Fremantle Doctor," which sets in in the early afternoon. *Fremantle*, whose harbour is artificial, is its port, and is the first Australian calling station for steamers for Australia via the Suez Canal and Colombo. From *Perth* railways run northward to *Geraldton*, the port for the Murchison gold-fields; southwards to *Bunbury*, a rising port with supplies of coal near at hand, and *Albany*, the chief south coast port and an important naval station; and eastwards to *Adelaide* and the east.

The Australian Railways.—If we consider the Australian railway system as a whole, we see that it shows the partial development of the Commonwealth, and the effect of the desert interior. The state capitals are to a remarkable extent the centres of the railways of their respective states. There is one trans-continental line, and another is projected (see Fig. 59). Many lines, notably in the east, run from the coast through the productive belts, and bring their produce to the coast. The linking up of the various systems has been of considerable difficulty, especially as there is no common gauge, a drawback of considerable importance. For example, in going from Melbourne to Sydney a change of trains has to take place when the boundary between New South Wales and Victoria is reached.

TASMANIA.

The island state of Tasmania is the smallest in the Commonwealth. We have learned that it is a dissected

outlying portion of the eastern highlands, and that it lies at all seasons in the track of the prevailing wester-



Railways

Land over 3000 ft

Chief Copper Mines ++ Mt Lyell Mines

.....Silrer & Lead S S Mt Zeehan Mines

.....Coal Mines.....a a

.....Tin.....T T Mt Bischoff Mines

FIG. 62.—Tasmania.

lies, so that it is well-watered, especially in the west. The leading occupations are agriculture, pastoral farm-

ing, and mining. Fruit-growing is extensively carried on in the drier south and south-east, and large quantities of fruit, especially apples, are exported. The drier parts of the island are also noted for sheep-rearing", whilst cattle are reared in most of the settled areas. Tasmania is rich in minerals, and copper, tin and lead are mined in considerable quantities, whilst small quantities of gold and coal are also obtained (see Fig. 62).

The capital, *Hobart*, stands about twelve miles from the mouth of the Derwent, and has a climate very similar to that of the watering-places of south-western England. It is connected by rail with Launceston, the commercial centre, built on the estuary of the Tamar. Launceston owes its commercial importance to its nearness to Australian ports, especially Melbourne.

PAPUA.

The large island of Papua or New Guinea (two and a half times the size of the British Isles) is a detached portion of the continent of Australia, from which it is separated by very shallow seas. Its great length is due to lofty ranges of mountains, which traverse the north and centre of the island from east to west. One range, the Owen Stanley, forms the narrow south-eastern peninsula. In the south there are extensive plains drained by the navigable Fly and other rivers. The interior of the island has been little explored, and much is quite unknown.

The position of Papua between the Equator and 10° S. latitude ensures that the temperature is equable and in most parts very high. The rainfall is heavy in all parts. In the north the wettest season is during the southern summer, when monsoons are experienced.[#] In the south most rain falls in the northern winter when the south-east Trades cross the Equator to become the monsoon winds of South-east Asia. In each season the central mountains act as a barrier. The effects of heat, rainfall, and altitude are seen in the vegetation, which is of the

equatorial type in the lowlands and lower mountain slopes, with open woodlands of the savannah type at higher altitudes. The native animals are marsupials like those of Australia, but the commonest domesticated animal is the pig. The inhabitants, called Papuans, are akin to the negro, for their hair is black and woolly, often like a great mop, and their skins are very dark in colour. Many of them cultivate yams, taro, and sweet potatoes in forest clearings close to the villages, whilst those who live near the sea are often venturesome sailors and fishers. White settlers own extensive plantations in which coconuts, bananas, sugar and rubber are cultivated. The mineral wealth, which includes gold, is said to be abundant, but at present is little exploited.

Before the Great European War, Papua was divided among the British, Dutch and Germans, but the German portion, Kaiser Wilhelm's Land, as well as the Bismarck Archipelago and other adjacent islands, has been handed over to Australia to administer on behalf of the League of Nations. Australia has thus a considerable daughter colony to look after. *Port Moresby* is the chief town and does most of the trade.

SOME AUSTRALIAN STATISTICS.

State.	Area in sq. miles.	Population at last census (1933).	No. of People persq. mile.	No of Sheep (in millions) in 1937.	No. of Cattle (in millions) in 1937.
New South Wales.	309,432	2,600,428	84	53'2	3'3
Victoria	87,884	1,818,080	20'7	18'9	1'9
Queensland .	670,500	945,565	1'4	22'2	6'0
South Australia .	380,070	580,849	1'6	8'9	0'3
West Australia	975,920	438,113	0'4	8'7	0'7
Tasmania .	26,214	227,473	87	2'2	0'3
Northern Territory	523,620	4,848	0'009	0'011	0'8
Federal Territory (Canberra district)	940	8,946	95		

250 AUSTRALIA: REGIONAL, ECONOMIC

TRADE FIGURES FOR YEAR ENDING JUNE 30th, 1938.

IMPORTS.		EXPORTS.	
Articles.	Value in million £	Articles.	Value in million £.
L Machinery, iron, steel and electrical goods	10'0	Wool .	47'0
Motor-cars (including parts) .	8'4	Flour and wheat	27'0
Cotton and linen goods	5'7	Gold .	13'9
Petroleum spirit	5'5	Butter, milk, cheese, cream, and eggs .	12'7
Paper, books, and stationery .	4'4	Beef, mutton, and tinned meat	12'2
Drugs and chemicals.	4'1	Skins, hides and leather, and tallow .	7'4
Silk goods	3'4	Fruits (dried, fresh, and preserved)	5'0
Tea	2'4	Lead	4'9
Timber .	2'4	Sugar .	4'0
Tobacco .	2'0	Concentrates and ores .	2'9
Carpets, linoleums, etc.	1'9	Timber .	1'2
Rubber and manufactures	1'9	Silver .	1'0
Bags and sacks	1'6	Other Articles	18'4
Other Articles	60'3		
Total	114'0	Total	157'61

CHIEF COUNTRIES TRADED WITH

Country.	IMPORTS.	EXPORTS.
	Value in million £.	Value in million £.
Great Britain	46'2	86'3
United States	17'8	10'9
France	1'0	11'0
Japan	5'3	5'9
Canada	8'0	2'2
New Zealand	2'0	7'1
Dutch East Indies	7'5	1'5
Belgium	1'1	5'7
Total for all countries	114'0	157'61

¹ The imports figures are given in pounds sterling, the exports in Australian currency values. The total exports were valued at 90*3 million pounds sterling. Reduce the value of individual items to British currency values. Comment on these differences in the value of money.

These figures show that besides offering a home to those Britishers who wish to try their fortunes beyond the seas, Australia is of great value to the Empire, and the Empire is of great value to Australia, on account of their inter-trading relations.

EXERCISES.

1. Take any three natural regions of Australia and describe their leading contrasts. What regions in Asia may be compared to the regions you select? Give reasons for your comparisons.

2. What products would you expect to be brought to Rockhampton by the railway which runs from that port into the interior? Assign them to their respective regions.

3. What will be the approximate height of the sun at Rockhampton: (a) at the equinoxes; (b) at the solstices?

4. State the geographical or other factors which have led to the growth and importance of Sydney, Melbourne, and Adelaide. Draw sketch maps to illustrate your answer.

5. What is meant by the policy of "White Australia"? What is your opinion about it?

6. Keeping in mind the physical, climatic, and vegetation conditions in Australia, draw a map showing the distribution of cattle and sheep, using the figures stated above.

7. "The leading exports and imports of Australia are easily allocated to their places of origin." Discuss this statement by reference to figures given above.

8. "In some parts of Australia there are settlements where once they would have been impossible, owing to the lack of water." Discuss this as it applies (a) to the great central plains, (b) to the West Australian gold-fields.

9. Account for the cool wind known in Perth as the "Fremantle Doctor." Draw a diagram to illustrate your answer.

10. Find out the total population of Australia. Then find out how many people live in the state capitals. How many are left for the rest of the continent? Comment on these figures.

11. "Australia is carried as a sheep's back." What does this expression mean. In what sense, and to what extent, is it true?

12. Which of the States in the Australian Commonwealth is most like Great Britain in its climate and occupations? Which part is most like the Canadian prairies? Can any part be compared with India?

13. Explain how each of the following received its name: Dirk Hartog Island, Torres Strait, Gulf of Carpentaria, Cape Leeuwin, Bass Strait, Endeavour Strait, Botany Bay. Make a list of 12 Australian place names called after explorers.

14. Compare the statistics on pp. 249-50 with those given in the latest copy of the *Statesman's Year Book*. Are there any important changes?

CHAPTER XXL

NEW ZEALAND.

POSITION AND SIZE.

THE Dominion of New Zealand is an archipelago included in Australasia, and situated about one thousand two hundred miles east of Australia. Its total area (103,861 sq. miles) is rather more than five-sixths of the area of the British Isles. The greater part of the Dominion consists of North Island and South Island, which are separated from each other by Cook Strait. South Island is sometimes called Middle Island because of a third island, Stewart Island, which lies farther south, and is separated from it by Foveaux Strait. Stewart Island is so small, however, that it is much better to use the name South Island, so as to keep clearly in mind the two large islands whose combined area is ninety-eight per cent, of that of the Dominion. Besides North, South, and Stewart Islands, the Dominion includes the Auckland Islands, 200 miles south of Stewart Island; Campbell Island, south-east of the Aucklands; the Chatham Islands; the Antipodes Islands and Bounty Island, situated south and south-east of South Island; the Kermadec Islands, north-east of North Island, the Cook Islands, some 2,000 miles north-east of the same island, and the Ross Dependency, the sector of the Antarctic continent opposite New Zealand. On behalf of the League of Nations the mandate to administer the late German possessions in the Samoan Group has been given to New Zealand.

It is often carelessly stated that New Zealand is the antipodes of the British Isles, that is, it lies directly on the opposite side of the globe from our own islands. This is not so, for our islands lie roughly between 50°

and 60° north latitude, whilst New Zealand lies between the 34th and 48th parallels of south latitude. Thus, although the longitudes of New Zealand are roughly

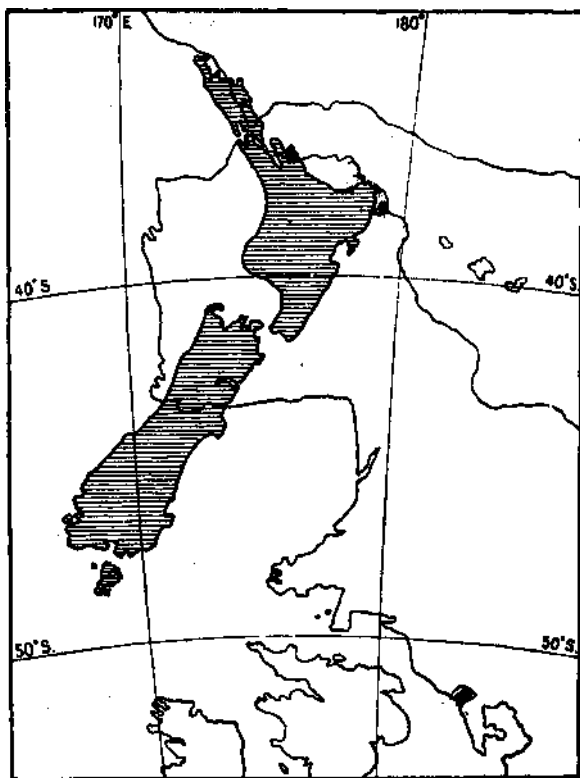


FIG. 63.—The antipodes of New Zealand.

those of a land antipodal to the British Isles, the south of Britain is roughly some eleven hundred miles farther from the Equator than the north of the North Island of New Zealand. The true antipodes of New Zealand are shown on Fig. 63.

PHYSICAL FEATURES.

We have seen that Australia is mainly a land of large plateaux and extensive plains, with no long lines of young folded mountains like those of Asia. New Zealand is quite different. It is long and narrow, and owes its outstanding features to high fold mountains of comparatively recent (geologically speaking) origin. But in one respect the two regions are connected, for Australia is one of the continents which form the western margins of the Pacific Ocean and New Zealand is largely part of one of the two great loops of volcanic islands which mark the real continental coasts of that ocean (see Fig. 67). Like Japan and the other members of this island festoon, New Zealand is essentially a mountainous country.

Mountains.—The main trend of the mountain chains of New Zealand is from north-east to south-west (see Fig. 64). In South Island we have the Southern Alps, whose highest point, Mount Cook, reaches nearly 12,500 ft. The mountains are much nearer the west coast than the east, but it is not correct to say that they rise steeply from the west coast, for, as the physical map shows, along the coast there is the long, narrow coastal plain of Westland. In North Island the continuation of the ranges of South Island is seen in the chains which extend from Wellington to East Cape. Now notice the north-west to south-east direction of the Auckland peninsula of North Island. The same feature is observed in the south of South Island, for the southern Alps do not run through the whole length of that island. Both of these areas consist of older mountains than those of which we have already spoken, that in South Island being the oldest part of New Zealand. Originally, this region (south of South Island) consisted of folded mountains whose direction was north-west to south-east. During long ages these were worn down to a peneplain, which in the course of time was uplifted, and formed a plateau. The highlands we see there to-

day are due to this plateau having been dissected by

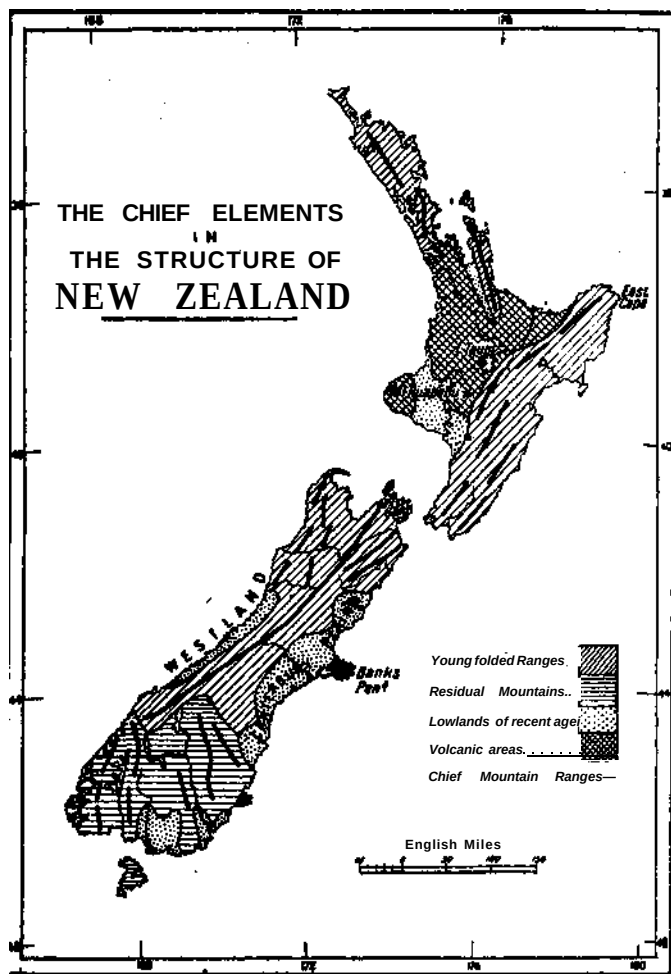


FIG. 64.—New Zealand. Chief elements in structure.

deep valleys which **have** cut into it and have left residual

mountains like the Appalachians of North America or the mountains of Scotland. The south-west coast of South Island is much broken up, and there are long fiord-like openings locally called sounds, *e.g.* Milford Sound. The coasts parallel to the newer fold mountains are comparatively straight.¹

Having noted the two great systems of the mountains of New Zealand, it is very easy to see why New Zealand assumes the shape it does. But other forces have been at work in filling in the details.

The Volcanic Areas.—The uplift of the newer north-east to south-west fold mountains was accompanied by great volcanic activity and disturbances of the earth's crust, which have not yet ceased. Following the same north-east to south-west direction, and bounded by great faults, there is an area of active, quiescent and extinct volcanoes, geysers and hot springs, extending from the Bay of Plenty to Mount Ruapehu (9,200 ft). In the south-west of North Island stands the magnificent extinct cone of Mount Egmont. In South Island there are two volcanic centres, the Banks and Otago Peninsulas, but no signs of present activity occur in either. Their situation is worth noting. Formerly, a land mass extended eastwards from South Island and when subsidences occurred these volcanic masses were built up along the borders of the sunken areas. Similarly Mount Egmont marks the point of intersection of two subsidences, the first of a former westward extension of New Zealand, and the second the subsidence which formed Cook Strait. Most volcanoes are found on the margins of sunken areas, as in such places the fracturing and crumbling of the earth's crust will cause weakness, and that is why the eastern island chain of Asia is largely volcanic, and also why we often find volcanoes along the margins of rift valleys.

The chief area of volcanic activity in New Zealand is in North Island, in the region round Lake Taupo, which is drained by the Waikato, the longest river in

¹ See Book I for classification of mountains.

the island. As in the Yellowstone Park (U.S.A.), almost all kinds of volcanic activity are met with. There are volcanoes in all stages of development, as well as geysers, hot springs, mud volcanoes, etc. In 1886 one of the volcanoes north of Lake Taupo, the flat-topped Tarawera, which was thought to be extinct, was in violent eruption. Many new craters were formed, and the surface of the district was quite changed, but, most of all, the great outburst will always be remembered on account of its destruction of the beautiful pink and white terraces of Rotomahana. In 1931 Napier, on Hawke's Bay, and the neighbouring town of Hastings, were largely destroyed by severe earthquake shocks which resulted in the loss of hundreds of lives, chiefly caused by falling buildings.

The Plains.—The plains of New Zealand are not extensive, but economically they are of very great importance. We know that rivers in their mountainous courses flow so fast that they are able to carry loads of sediment and to push stones along their beds. When they leave the mountains the slope is less, and their currents receive a check. This leads to the deposition of some of the sediment, for only that which is very fine can be carried farther. Now let us apply this to South Island. A large number of rivers rise in the southern Alps and other western mountains, those flowing eastwards having a longer course than those flowing westwards. At the base of the mountains they have built up a series of great fans of *debris* and, in the course of time, these have joined, and have formed continuous plains which are constantly being extended farther and farther. In this way the broad Canterbury plains on the east, and the narrow Westland plains on the west have been formed, whilst in the south the rivers have spread *debris* over the surface of the peneplain of Otago (see Fig. 64). The strong currents flowing along the west coast prevent the accumulation of large deltas, and by the filling up of irregularities help to keep the coast-line comparatively straight. The lowlands of the south of North Island were formerly plains built of deposits laid down when

the area was beneath the sea. A further uplift of these plains has caused the rivers to cut deep gorges which are noted for their beauty, *e.g.* the Wanganui is sometimes called the New Zealand Rhine.

CLIMATE.

Owing partly to its situation in the midst of large ocean masses, and partly to its outline and relief, New Zealand has a marine or equable climate, whilst its position with regard to the Equator determines that the climate shall be temperate in character. On the whole we have in New Zealand the world's best example of the temperate maritime type of climate.

It is about nine hundred miles from the north of North Island to Stewart Island, and on account of this great distance we might expect the temperature differences between these extreme points to be very considerable. As a matter of fact the difference is only about 10° F. both in winter and summer. Of course the temperature is greatly influenced by altitude in the highland areas. Extensive areas of the southern Alps are permanently covered by snow, and some of the great glaciers descend to within a few hundred feet of sea level. At Dunedin, in South Island, the mean annual variation of temperature is from 42° F. to 58° F. For Auckland, in North Island, the figures are 52° F. to 67° F., whilst the mean temperature for the whole of the country varies only from 48° F. in winter (July) to 63° F. in summer (January). The figures given below offer further evidence in proof of the marine character of the climate.

Place.	Latitude.	Height in Feet above Sea Level.	July Temperature.	January Temperature.	Mean Annual Rainfall.
Dunedin	45° S.	500	42° F.	58° F.	35 in-
Christchurch	43° S.	21	42°	62°	24 "
Hokitika	42° S.	10	45°	60°	119 "
Wellington	41° S.	136	47°	62°	51 "
Auckland	37° S.	250	52°	67°	54 "

There is a striking similarity between maps of New

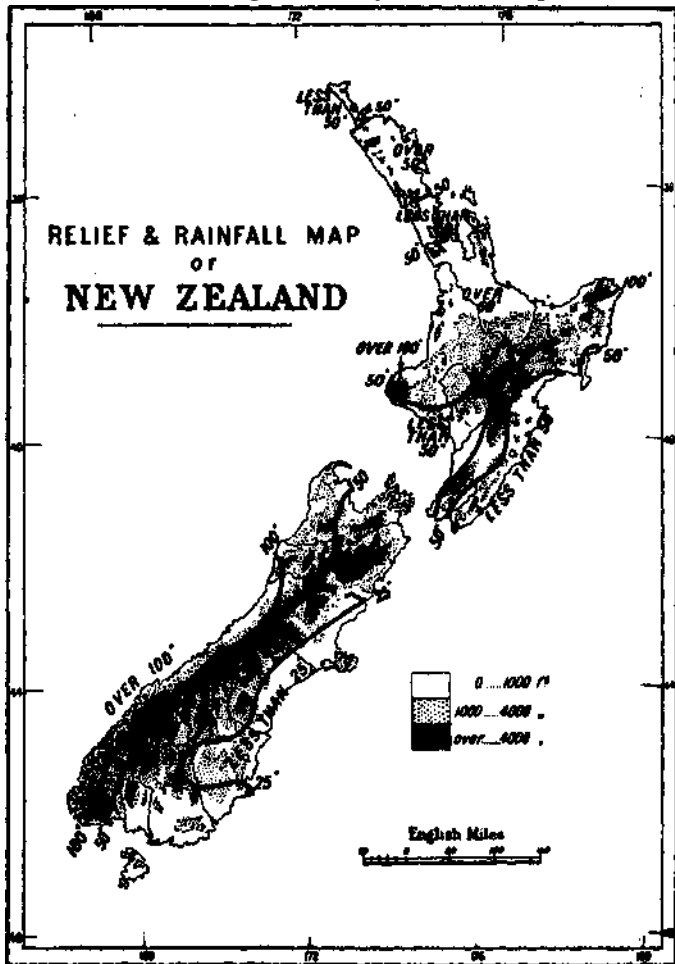


FIG. 65.—New Zealand. Relief and rainfall.

Zealand showing relief and rainfall. Fig. 65 shows the

rainfall marked on a map which also indicates relief. It will be seen that the heaviest rainfall occurs on the west coast of South Island, and that the rainfall decreases towards the east where there is a distinct dry "rain-shadow" area, in parts of which the rainfall is so little that irrigation is necessary. The heavier rainfall of the Banks and Otago Peninsulas is due to the elevation. Such a distribution of rainfall points to the fact that the prevailing winds are from the west. As we should expect from what we have already learned (see p. 52), the Canterbury plains will experience west winds, which have become hot and dry by compression during their descent from the highlands to the plains. Frequently these winds have spoiled crops by causing premature ripening. The rainfall of North Island is more evenly distributed, a fact which is explained by its relief, for it has no great mountains along the westward side of the island as is the case in South Island. The influence of relief is seen, however, in the greater rainfall of the high peaks, *e.g.* Mount Egmont, and in the dry south-west and south-east coasts.

The seasonal distribution of the rainfall is important. In North Island most rain falls in autumn and winter, but there is no season when the rainfall is very slight, that is, there is no distinctly dry season. Fig. 62 shows that North Island lies in the latitude of those European countries which have the Mediterranean type of climate. Now the distinguishing features of this climate, the wet winter and the dry summer, are due to the migration of the pressure belts (see p. 62). In January (southern summer) the southern migration of the southern Horse Latitudes high pressure belts bring the North Island under the influence of high pressure, and in July (southern winter) the northern migration brings the island into the belt of westerlies. For these reasons we should expect autumn and winter to be the wettest seasons. The summer rainfall, despite the relatively high pressure, is due to its marine character and the influence of the surrounding oceans. The South Island has, as its pre-

vailing wind, the westerlies at all seasons, and since it lies in the region of the "Roaring Forties," it encounters the full force of westerly gales. Thus, in the South Island, the rainfall is very evenly distributed throughout the year, the amount being highest, over 100 inches, on the windward side of the western mountains.

NATURAL VEGETATION AND ANIMALS.

Like Australia, New Zealand has long been separated from other lands, and the influence of this is seen in the large number of its plants—over two-thirds—which are not found elsewhere. There is very little in common between the flora and fauna of New Zealand and of Australia, *e.g.* eucalyptus trees and kangaroos, opossums, etc., are not found. When white men first settled in this country, there were few animals, none of them large, and birds predominated.

Owing to the heavy rainfall, a large part of New Zealand is, or has been, forested. In the warmer North Island, the most valuable tree is the kauri, whose wood is exceedingly durable, and is most prized for house and ship building. This tree must not be confused with the karri eucalyptus of Australia. It is found chiefly in the Auckland province, but there are also areas where kauri forests formerly existed, and in these places large quantities of kauri gum, the fossil resin which exuded from the tree, is dug up and used for the making of ornaments, and in the manufacture of varnish.

The wet, west coast of South Island is densely forested, the prevailing trees being pines, especially the red and white varieties, although the other cool temperate trees are also common. The timber of the white pine is largely made into butter boxes. In many parts of New Zealand there are gigantic tree ferns, which grow to a great height.

In the drier parts of both islands, particularly the Canterbury plains, grassland conditions prevail, although,

as in Australia, the native grass, a wiry variety called "tussock," is not very suitable for food for cattle and sheep. As a consequence, it has been necessary to plough large areas and plant European grasses, in order to provide food for the immense numbers of cattle and sheep which the country now rears. Owing to the mildness of the climate, grass grows all the year round, so that the animals can be fed out of doors at all seasons.

One North Island plant of economic importance has yet to be mentioned. It is a species of lily, *Phormium tenax*, commonly called New Zealand flax. It is confined to the marshy areas. The fibre, despite the difficulty in preparation, is used like hemp in the manufacture of rope. As will be anticipated, many Mediterranean fruits, such as grapes and oranges, have been successfully introduced into North Island, especially in the Waikato valley and the Auckland peninsula.

CHIEF OCCUPATIONS.

Pastoral and Agricultural Occupations.—The great importance of pastoral pursuits is seen in the fact that usually over 90 per cent, of the exports of New Zealand are animals and their products, wool and mutton forming nearly two-fifths of the whole. This emphasizes the importance of sheep, of which there were thirty-two millions in 1938. Sheep-rearing is the most important industry in New Zealand. In the same year there were over four million cattle. Cattle and sheep are found in both North and South Islands. The former are confined chiefly to the plains in the south of North Island, where butter-making is carried on, and to the lowlands of Otago and Southland in South Island, where cheese-making is important. Cattle predominate in these districts, owing to the richer grass, due in turn to the heavier rainfall. Sheep are reared on the Canterbury plains, and on the east side of both

islands generally. The occupations of freezing **and** exporting mutton ("Canterbury lamb") and beef are very large and of increasing importance. Most of the by-products (bones and bone-ash, hair, hoofs, hides, horns, and much of the leather) are sent abroad, whilst what is left is converted into fertilizing materials, so that there is no waste.

Next to pastoral pursuits, agriculture employs most people. Wheat and oats are the principal crops, and do best in South Island. Temperate fruits grow very well, and splendid apples, plums and peaches are exported. Grapes and oranges are produced in the Auckland peninsula. Along the margins of the Bay of Plenty, maize is extensively grown, mainly by Maoris.

Mining and Manufacturing.—Coal and gold are the only important minerals—unless kauri gum be included. The chief coal-fields are on the west coast of South Island, near Greymouth and Westport. The coal is of excellent quality, and can be used for driving machines as well as for household purposes. Gold is mined principally in the north-west of South Island, near Greymouth, and in the Coromandel peninsula of North Island. Other minerals are known to exist in large quantities, especially iron, but at present little is mined.

The population of the country is small, and most of the energy of the colonists is expended upon pastoral pursuits, so that manufacturing is not important. When the population increases, and the development of the country proceeds a step farther, the manufacturing industry will have plenty of coal and iron, as well as vast undeveloped sources of water power, in order to convert into manufactured articles the raw materials now exported. Manufacturing is increasing, but at present the most important manufactures are of those articles which are naturally made on the spot, *e.g.* clothing, furniture, leather goods, etc., as well as the canning and preserving of fruits and such dairy industries as cheese- and butter-making.

THE PEOPLE AND THEIR DISTRIBUTION.

The first European to see New Zealand was Tasman. This was in 1642, and it was not until a century and a quarter later that the country was again visited, this time by Captain Cook, who made a remarkably accurate survey of the whole of the coast-line. In the early part of the nineteenth century, the first missionaries and traders settled in the country, but the annexation⁷ and serious attempts at colonization by England, did not take place until 1840. In that year Wellington was founded, and a year later New Zealand became a separate colony from New South Wales. Settlement proceeded much faster in North than in South Island, where it did not begin on a large scale until after the discovery of gold in 1861. The greatest drawback to active colonization in both islands was the opposition of the natives, the Maoris. In the long series of wars between the early settlers and the Maoris, the numbers of the latter were reduced by more than half, from about 120,000 to less than 50,000.

The population of New Zealand in 1936 was 1,573,810, over two and a half times the population in 1881. Nearly two-thirds of the people were in North Island, whilst nearly two-fifths were in the four largest towns, Auckland, Wellington, Christchurch, and Dunedin. The great preponderance of Britishers is shown in the fact that nearly one-fourth of the people were born in the mother country, while there are very few whites who are not of British stock. Indeed, New Zealand is a splendid example of successful colonization. The chief centres from which English colonization spread were Auckland, in North Island, and Christchurch and Dunedin in South Island. The settlement at Christchurch was distinctly English in character, as is illustrated by the large number of English names given to townships in the neighbourhood, *e.g.* Oxford, Sheffield, Lyttelton, Lincoln, etc. Dunedin and district was settled by Scottish Presbyterians in 1848, and Scottish influence is

also seen in local names, *e.g.* Port Chalmers, Havelock, Roxburgh, Kelso, Dalhousie.

The country's leading industries are, as we have seen, those associated with a very early stage of economic development. If New Zealand is to go still further, there must be a larger population. Most of the best lands have been taken up, and much of the remainder is forest covered, and requires clearing before farmers can settle. This can only be done when plenty of labour is available. In this connection it is noticeable, as in Australia, that an undue proportion of the immigrants go to the towns, and not to the farms.

The Maoris.—The New Zealand natives, the Maoris, have been in the islands for a comparatively short time. It is thought that they are the descendants of peoples who at different times, from six to four hundred years ago, had worked gradually eastwards from the mainland of Asia, via the Malay peninsula and the East Indies and Pacific Islands. But they are not all of the same stock. The prevailing type has features very much like those of a European, except that the skin is light brown in colour. The hair is long, black, and wavy. These handsome natives are undoubtedly akin to Hindu races, but there are others whose straight hair and Mongolian features indicate that more than one race entered New Zealand. The total number of Maoris in 1936 was about 82,000 (79,000 in North Island). We have seen already that the war between them and the early settlers led to a great decrease in their numbers. This decrease has now been checked, and an increase is taking place. The capacity for education and the general ability of the Maori are seen in the fact that many of them practise as lawyers in the large towns, whilst four of their number have seats in the Dominion Parliament. They were very advanced before Europeans discovered the country, but they had no knowledge of metals, and consequently all their weapons and tools were made of stone. Their clothes were made largely of Phormium fibre (New Zealand flax), whilst wood was used in the

Construction of their wonderfully carved houses and large sea-going boats. Maoris are found in both North and South Islands, and their lands have been preserved to them. Many are the ground landlords of rising townships, and thus are wealthy citizens.

CHIEF CITIES AND COMMUNICATIONS.

Auckland is the chief port and largest city of the Dominion. It owes its importance to its situation on a narrow neck of land, the narrowest part of the Auckland peninsula, so that it has two harbours, that on the east side being the more important. It is a calling place for vessels journeying between San Francisco and Sydney, and exports kauri gum, gold, and products in connection with pastoral occupations. It is near to supplies of good coal.

Wellington, on the shores of Port Nicholson, an arm of Cook Strait, enjoys a position on the great shipway between the islands, and has thus become an important port of call, as well as the natural meeting place of much of the coastal traffic of both islands. On this account it transacts a great deal of the country's overseas trade. Its central site has led to its selection as the Dominion capital, in place of Auckland, whose position is rather remote from the centre of things. The chief railway of North Island runs from Wellington to Auckland, and sends branches to the most important districts (see Fig. 66). Another line goes to Napier, on Hawke Bay.

Christchurch, the largest city in South Island, stands on the river Avon, seven miles from Lyttelton, its port. Its growth has coincided with that of the Canterbury Plains, which are its hinterland.

Dunedin is the outlet for the produce of the Otago peneplain. Its harbour for very large vessels is at Port Chalmers. Both ports are on Otago Harbour.

Invercargill, on Foveaux Strait, is the chief port of southern New Zealand. Its harbour for large vessels te

NEW ZEALAND
COMMUNICATIONS.

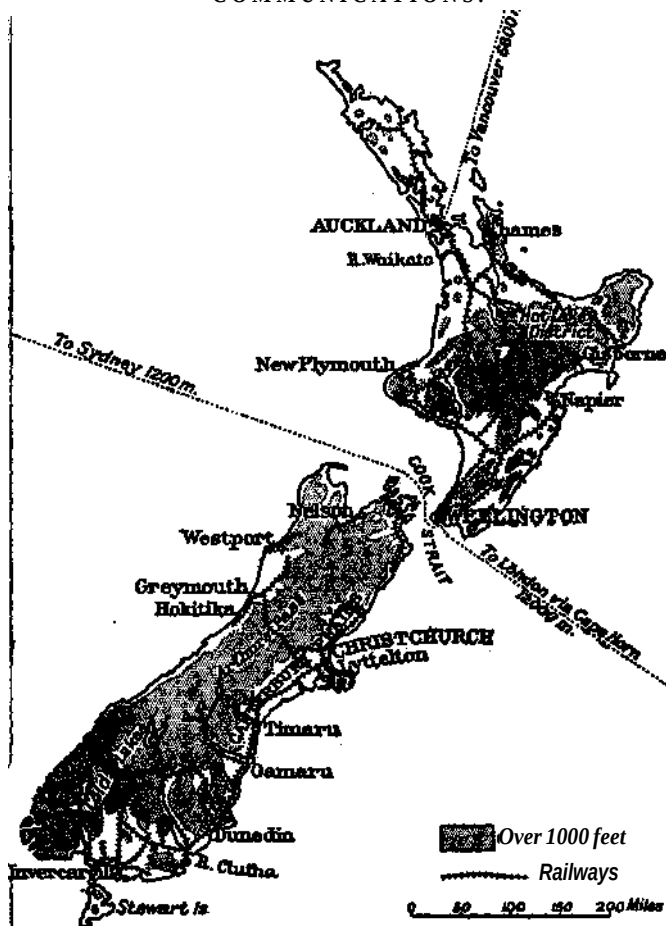


FIG. 66.—New Zealand. Chief Communications.
A.—10*

called " the Bluff." Its exports are mostly " pastoral " in type, although it has & large trade in timber. The east coast towns of South Island are linked together by a railway, from which branches run up country to the ranches and farms.

The Otira Gorge and Arthur's Pass which lie between the plains of Westland and Canterbury are followed by both road and railway. Thus Christchurch and Grey-mouth are in communication with each other. The mining , districts of the north and north-west are all connected With their ports by short lines of railway.

Those islands of the Pacific which form part of the Dominion of New Zealand (see p. 252), will be considered , in the next chapter.

Below are figures which illustrate the trade of New Zealand during 1937.

THE TRADE OF NEW ZEALAND FOR 1937.

EXPORTS.		IMPORTS.	
Article.	Value in million / (N.Z.).	Article.	Value in million £ (N.Z.).
Butter, cheese, and agricultural products .	23.9	Clothing and textiles	9'1
Wool	19'0	Iron and steel goods and electrical machinery .	15'4
Frozen and preserved meat	14'9	Motor-cars	7'1
Hides, skins, tallow, etc.	5'0	Petroleum	2'8
Gold	1'4	Fruits	0'9
Other Articles .	2'0	Tobacco	0'9
		Tea '	0'8
		Leather	0'8
		Other Articles	18'4
Total value	66'2	Total value	56'2

It is at once evident that New Zealand's chief exports are connected With her leading occupation—the pasturage of animals—and her imports are largely manufactured articles, and those articles not yet produced at home in very large quantities.

**COUNTRIES WITH WHOM TRADE WAS CARRIED
ON IN 1937.**

Country.		Value of Exports (in million £ N.Z.) to	Value of Imports (in million £ N.Z.) from
Great Britain .		50'7	28'1
United States .		4.8	6'7
Australia		1'8	7'1
Canada .		1'7	4'5
Japan .		3'1	1'7
Germany		0'9	0'9
India and Ceylon		0'01	1'4
Other Countries		3'19	5'8
Total value		66'2	56'2

These figures show the value of the trade of a daughter country of some one and a half million people to the mother country. The greater part of New Zealand's commerce is carried on with different countries of the Empire, especially with Great Britain.

The completion of the three chapters concerning the "New Britains of the Southern Seas"—Australia and New Zealand—gives us the opportunity of paying tribute to these self-governing colonies for the magnificent part they took in the Great European War, and are taking in the war now in progress (1941). There were those who said that the outbreak of such wars would see the daughter countries of the British Empire break from the mother country and declare their independence. Instead of that, *all* sent help, and in particular, the part played by Australia and New Zealand, by white as well as native citizens, will never be forgotten as long as the glorious word "Anzac" remains.

Nor was our great Asiatic possession, India, behind the others in her contribution. All this magnificent display of loyalty was in no small measure due to the tolerant, sympathetic, and broad-minded manner in which Britain rules her Empire. Indeed we now speak

of the Empire as the British Commonwealth of Nations, a title which better expresses the modern relation between the motherland and the great self-governing dominions.

EXERCISES

1. Describe in detail the influence of the Southern Alps upon the climate of South Island. Draw diagrams to illustrate your answer.

2. What is meant by " antipodal" points ?

3. New Zealand takes Standard Time from the meridian $172\frac{1}{2}^{\circ}$ E. When it is 6 p.m. Thursday in London in winter, what time is it in New Zealand?

4. State as many contrasts as possible between North and South Islands.

5. A ship from London arrives at Wellington in November, and discharges her cargo. She is then reloaded with goods for transit to London. Name about six articles which you would expect to be included in both cargoes.

6. " New Zealand is a striking example of successful colonization/" Discuss this statement, and make some reference to future prospects.

7. Compare the Maoris with the natives^ of Australia.

8. State the significance of the following New Zealand place names: Cape Maria van Diemen, Cook Strait, Poverty Bay, Bay of Plenty, Cape Farewell. Make a list of ten other New Zealand place names of historical significance.

9. Where is the Ross Dependency? Who rules it? By whom is its whaling industry being exploited?

10. Why is it that (a) it is possible to sell New Zealand butter in England; (b) it is winter in New Zealand when it is summer in England?

11. Compare the statistics on pages 268-9 with those given in the latest copy of the *Statesman's Year Book*. Are there any important changes?

CHAPTER XXII.

THE PACIFIC ISLANDS.

THE Pacific Ocean, the largest of the oceans, covers more than one-third of the surface of the globe. It is almost surrounded by the west coast of the Americas, the east coast of Asia, New Guinea, Australia, and New Zealand. This is illustrated by Fig. 67, which also shows the depth of the ocean. The Pacific has few continental shelves along its margins; indeed, many of the seas which are more or less cut off from the great mass of the ocean, *e.g.* the South China Sea, are as deep as the ocean itself. Notice how the deepest parts are often along the margins of the belt of volcanic islands as, for example, to the east of Japan. Observe, too, that the ocean as a whole is a huge, deep basin. Its average depth has been computed to be about two and a half miles. West of the Philippines, a sounding of 5,348 fathoms, or 32,088 ft., that is over six miles, has been made. Compare this with the height of Mount Everest, 29,002 ft. Other features of the Pacific are the isolated plateaux and small ridges which rise above the general level of the ocean floor, and on which stand many of the groups of islands we shall consider in this chapter.

The islands of the Pacific are innumerable. In groups, in lines, or singly, from the south-east Asiatic and east Australian coasts, in a belt on each side of the Equator, they extend like stepping-stones two-thirds of the way to America. If we omit New Caledonia, which is built up of ordinary sedimentary rocks, and is believed to be a fragment of a larger Australian continent, we can divide practically the whole of the remainder into two classes; firstly, those which are

volcanic, and secondly, those built of coral. Frequently the two types are referred to as "high" and "low" islands respectively. Examples of "high" islands are to be found in the New Hebrides, the Fiji Islands, the Samoan Islands, and the Hawaiian group.¹ The latter islands have two volcanoes, each rising to an

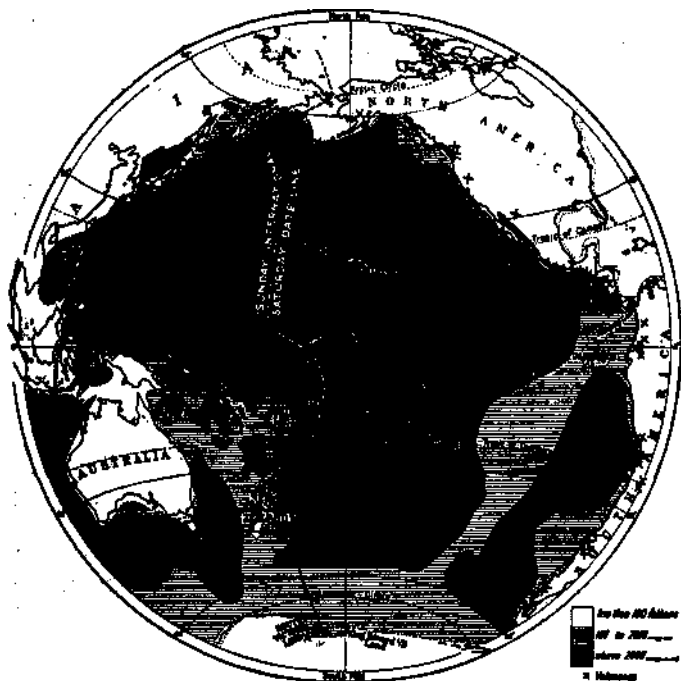


FIG. 67.—The Pacific Ocean.

elevation of more than 13,000 ft. The "low" or coral islands, seldom higher than 12 ft., except where the winds and waves have piled up sand or broken masses of coral, are scattered about the belt in thousands. Let us now consider how they have been formed.

¹ New Caledonia, too, is a "high" island.

CORAL ISLANDS.

An exactly explained account of the origin of this type of island has not yet been made, but we know sufficient to put forward certain solutions. Coral is built by living organisms, coral polyps, of which there are many species, varying in size from tiny microscopic creatures to others measuring several inches in diameter. Most coral polyps, certainly all reef builders, live in colonies, constructing from the lime they extract from sea-water the stony framework which we know as coral. The polyps live in the cavities in the coral, and send out their branching arms in search of food. They cannot leave their cavities as they are fixed. The conditions favourable to the growth of coral polyps are as follows:—*Firstly*, the surface temperature of the water in which they build must not fall more than one or two degrees below 70 F.; this means that coral islands and reefs will be confined mainly to low latitudes, *i.e.* between about 30 N. and S., and also the east coasts of continents in these latitudes (see page 47). *Secondly*, these tiny animals cannot live where there is any sediment, so that they are not found at the mouth of a river which brings down silt, or where sand is present. *Thirdly*, they cannot live in fresh water because it does not contain the necessary food and mineral constituents; and *lastly*, they cannot build freely below a depth much exceeding 30 fathoms.

Three kinds of coral reefs may be distinguished:—fringing reefs, barrier reefs, and atolls. In the first, the reef is built close to the shore of an island or larger land mass (see Fig. 68). In the second, there is a lagoon separating the reef from the coast-line, as in the case of the Great Barrier Reef of Australia, which is an example on a huge scale. An atoll is a ring-shaped reef of coral, enclosing a lagoon in the middle. Atolls vary much in size, from tiny rings to others several miles in diameter. Examples

THE PACIFIC ISLANDS

of each type of reef abound in the Pacific Islands. The seaward slopes of reefs are usually very steep, except near the top, which is rounded or bevelled. On the reef itself, and on the inner slopes, it is unusual to find living polyps, for in the first case they cannot live above the water level, and in the second the supply of food is insufficient. It follows that reefs are constantly extending seawards.

Now let us consider the formation of a coral island

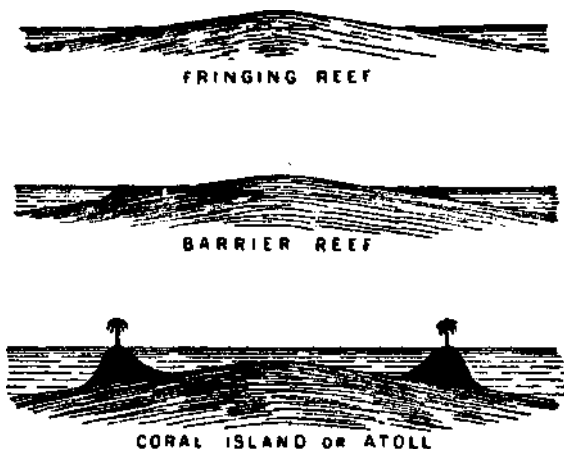


FIG. 68.—Sections illustrating the formation of a coral[^] island.

or atoll. Charles Darwin, the great scientist, explained it as follows: A rock mass, perhaps of volcanic origin, lifts its head above the level of the sea forming an island. Provided the conditions already stated are satisfied, coral polyps will build a fringing reef. The sinking of the rock causes the formation of a barrier reef (see Fig. 68), since there is now a lagoon between the reef and the diminished island. Meanwhile, the coral reef is built upwards to the level of the water.

Further sinking will cause the island to disappear, and this results in the formation of an atoll, which, in the words of Darwin, is one of "those extraordinary rings of land which rise out of the depths of the ocean." This explanation is not accepted by all, and certainly cannot account for those islands resting on bases which have either not sunk at all, or have actually been uplifted. Therefore, other scientists, notably Sir John Murray and Agassiz, of whom we read in *The Americas*, have sought for other theories. Murray suggests that, given submerged mountains or plateaux coming sufficiently near the surface of the sea, coral polyps will make reefs by building upwards. It is very possible that some islands have been made by one method, and others by the other, but whether *all* have been made by one or the other is uncertain. One point is certain, and that is, that corals themselves do not accomplish the whole of the task, for the shells of other sea inhabitants and the limestone secreted by organisms other than coral polyps also form a considerable portion of these interesting islands. Very often the ring of coral is broken, and the atoll is then horseshoe or fret-saw shaped. It is interesting to notice that in such cases, the outer unbroken curve faces the prevailing wind, *i.e.* is on the windward side of the island.

At first, there can be no life of any kind on an atoll. Gradually, however, the waves break up masses of coral, and heaps of sand are formed. Winds, currents, and birds act as the agents whereby the germs of vegetable and animal life are carried. The coconut palm is the commonest tree, and, as it is not affected by salt, it thrives. Trunks of trees, drifting on the ocean, find a resting-place, and with them come insects and lizards, which form the first inhabitants. Sea birds, and occasionally stray land birds, build in the trees, whilst later comes man, who is enabled to live by means of the coconut tree, and by cultivating the soil produced by the mixture of coral sand and vegetable remains.

THE PEOPLE OF THE PACIFIC ISLANDS.

Very commonly the more backward peoples of the world are referred to as "savages," a word often used for the inhabitants of the Pacific Islands. The word is somewhat unfortunate, for it implies ferocity, whilst, as a matter of fact, few Pacific Islanders are ferocious and none without culture of some kind. Indeed, many of them had reached quite a high state of culture of a self-developed kind before the islands were visited by white races. One writer, Sir Everard im Thurn, says, however, that the "savages" had grown in culture without hitting upon the idea of "duty to one's neighbours," which idea, however badly it may be observed, is the foundation of civilization, as opposed to "savagery."

The Pacific Islands may be divided into two great groups, the *Melanesian*, so called on account of the almost black colour of the skins of the inhabitants, and the *Polynesian*. These names have also been given to the people. The line of longitude, 180° E. and W., roughly divides the two groups, although New Zealand should be taken with Polynesia. The Fiji Islands stand at the meeting place of both groups, a fact which accounts for its mixed population, although Melanesian elements predominate. The Melanesians are, in the main, like the people of New Guinea, the Papuans. They are dark and frizzy-haired, and form a very striking contrast to the taller, light-brown coloured, wavy-haired Polynesians, of whom the Maoris of New Zealand are the best example.

CLIMATE AND PRODUCTIONS.

The climate of the Pacific Islands is exceedingly equable, that is, there is very little range of temperature. This is due to nearness to the Equator and to the influence of the sea. Most of the islands lie in the

Trade Winds belt, and where these winds are felt, thus giving a freshness and pleasantness, it is very healthy. Many of the western islands receive Trade Winds only in winter, having variable, damp winds in summer. This is owing to their position near the monsoon area. The rainfall is usually distributed throughout the year, although the particular month or months at which most rain falls, is dependent upon the migration of the rain belts following the sun.

Owing to the more varied relief and soil, and to the greater fertility of the latter, the volcanic islands have a wider range of products than the coral islands. Their cultivated plants include coconut, yam, taro, bread-fruit, and bananas. These form the chief articles of food. Yams and taro are edible tuber roots; breadfruit, which grows on a tree, is about the size of a pineapple, and must be cooked before it is suitable for food. The great disadvantage of these foods is, that in order to obtain a sufficient amount of food for the body, large quantities have to be eaten. Children especially suffer, and, since there are few milk-giving animals, so many of them die in infancy, that the native population seldom increases in numbers to any appreciable extent. In many of the "high" islands, Europeans have introduced plantations of sugar, rice, coffee, cotton, tobacco, etc., and these are meeting with considerable success. The natives, however, show some disinclination to add rice to their diet.

In the coral islands the food supply is particularly poor. The coconut is all important, and forms with pandanus fruit and fish the chief food. Pandanus fruit resembles a huge raspberry about seven inches in diameter, and each seed is like a shaving-brush dipped in cold cream and sugar. -The inhabitants of the fertile "high" islands despise it, but in many of the poor "low" islands it is a luxury. Surplus coconuts are dried and exported as copra, the chief export of the Pacific Islands. It is used in the manufacture of soap and oil.

POLITICAL DIVISIONS AND CHIEF ISLANDS

The Ladrões, Caroline, Marshall, Bismarck and Samoan Islands (except Guam, in the Ladrões, and the eastern islands of Samoa, which belong to the United States) were formerly German, but are now ruled by different Allied Powers under mandates from the League of Nations. German Samoa is ruled by New Zealand, the isolated island of Nauru by the British Empire, the two German islands of the Solomon group by Australia, and all the rest by Japan. The island of Nauru is believed to contain the richest phosphate deposits in the world. The United States also own the Hawaiian Islands. New Caledonia, the Loyalty, Society, and Marquesas Islands, together with the Low Archipelago or Paumotu Islands, are ruled by France. The British and French jointly control the New Hebrides, whilst all the remainder are British.

We will now consider a few of the more important islands.

New Caledonia.—This mountainous though not volcanic island is about the size of Wales, but supports only about fifty thousand people, of whom nearly two thousand five hundred are of convict origin. The presence of descendants of convicts in the island is due to its use by the French as a penal settlement. The convict element in the population is quickly disappearing, because for many years now no convicts have been sent thither. The island is very rich in minerals, especially in nickel, cobalt and chrome ores. The ancient rocks which form the highlands do not yield a fertile soil, and on this account one-half of the total area cannot be cultivated. All the products of "high" islands are found. The rearing of cattle and sheep is also important. The capital and chief port, *Noumea*, has a population of nine thousand, and is reached three times monthly by steamships from Sydney (N.S.W.). New Caledonia was discovered and named by Captain Cook.

The Fiji Islands.—This group comprises over two hundred islands of which eighty are inhabited. The total area, like New Caledonia, is about that of Wales, but the population numbers about one hundred and ninety thousand. The islands are mountainous and often reach 4,000 ft. above sea-level. Like the other "high" islands they are forested, and have a varied list of productions. Of the plantation products, most space is devoted to coconuts, sugar-cane, rice and bananas. The capital of the group is *Suva*, on the south coast of Viti Levu, the largest island. It is a very important calling station for vessels journeying between Australia, New Zealand and the west coast of North America. A glance at the map is sufficient to show the great importance of the position of the group from this standpoint. It is worth remembering that the line of latitude 180° E. and W. runs through the Fiji Islands. For the purposes of time, the International Date Line so runs as to give the islands the same day as Australia and New Zealand. The same applies to Samoa.

The Samoan Islands.—The products are similar to those of other "high" islands. The inhabitants are Polynesians; those of Fiji, it will be recalled, are partly Polynesians, though mainly Melanesians. *Apia*, on the north coast of Puolu, is the chief port. Notice that its harbour is on the sheltered leeward side of the island.

The Hawaiian or Sandwich Islands.—This group lies south-west of San Francisco, just south of the Tropic of Cancer. The largest island, Hawaii, is rather more than half the size of Wales. The group belongs to the "high" islands, and its climate and products are similar to those of the islands already mentioned. Rice, sugar, and pineapples are especially important. The volcanoes of Hawaii deserve special mention, for the usual idea of a volcano would be somewhat shaken on seeing one of these for the first time. In Book I, we explained the ordinary type of cone-shaped volcano, built up of lava and ashes. The whole island of

Hawaii is really a gigantic Volcano, the greatest in the world, rising about 14,000 ft. above the level of the sea, and 30,000 ft. from the ocean floor. It has two great volcanoes, Manua Loa and Manua Kea. The latter is believed to be extinct. The crater of Manua Loa is between two and three miles in diameter, but that of Kilauea, on its flanks, is better known. It is elliptical in shape, having a longer diameter of three and a half miles, and a shorter one of two and a half miles. Standing on the lip of the crater and looking towards the gigantic cauldron, one would see that it is surrounded by precipitous cliff-like walls varying in elevation from 300 ft. to nearly 800 ft., according to the condition of the floor. When the crater is empty,



FIG. 69.—Section of a Hawaiian crater.

the cliffs are of even elevation. During an eruption, lava rises through cracks in the floor, and begins to fill the crater. But before it reaches the lip, thus threatening to overflow, its great weight aided by the force of steam causes fissures to appear in the side of the mountain below the crater. The lava finds an outlet through these fissures, which are sometimes beneath the sea, and thus the crater is gradually emptied. A volcano of this type has what is called a *caldera* crater. The sides of the crater are often stepped (see Fig. 69), due to faulting and consequent collapsing, processes which have caused the volcano to assume the shape it does.

Commercially, the Hawaiian Islands are of great importance as a calling station for steamships. They lie on the great Trade Routes between the Panama Canal and North America on the one hand, and Australia and Asia on the other. The native inhabitants, who are Polynesians, number less than one-seventh of

the total population, which is nearly three hundred and seventy thousand. They are outnumbered by Japanese, who form three-sevenths of the people, the majority of the remainder being Portuguese and Chinese. The immigration of Chinese, Japanese, and Koreans is now prohibited by law. The capital is *Honolulu*, on the island of *Oahu*. Its inhabitants number over one-third of the total population.

We will now conclude the chapter by some references to the future of the Pacific Islands. First, as to the people. Contact with white men cannot leave them as they were before. On the one hand, missionary societies have done a very great deal of educational work for their uplift. It is almost incredible to think that it is not very long since a Fijian native king had a small club put in his hand when only seven years of age, and that his task for the day was to kill another boy. This king, Cakoban, died a sincere Christian. On the other hand, new diseases, new drinking habits, and alien customs have been acquired from traders and others, and these have helped to reduce the number of natives. Whether as a whole they will be improved by the work of missions and by wise government measures aimed at improving their status; whether they will become pawns in rival commercial enterprise, or whether they will be degraded by drink and debauchery, as unhappily many have been already, remains to be seen. As to the islands themselves, it would appear that those in the neighbourhood of Australia and New Zealand and other large centres of population, will become more and more gardens supplying the demand for tropical fruits and products. This change will not be without its difficulties since it means the introduction of Asiatic labourers. Many of the smaller islands, even if unfit for agricultural or other development, may be used as cable and wireless telegraphy stations, a use to which a few are already put. As regards the future political control, it remains

to be seen whether the mandatory rule of the former German islands by Britain, Australia, New Zealand and Japan will lead to greater happiness for their inhabitants. Rule under mandate is indeed to be preferred to dual control, for the dual control of the New Hebrides by France and Great Britain has not been fully satisfactory, and it would be an advantage if some arrangements could be arrived at whereby one country renounces its rights in favour of the other. Finally it should not be forgotten that Canada is not a disinterested party in the affairs of the Pacific Islands, for they form a link or stepping-stone between her and her great sister British Dominions of Australia and New Zealand.

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