to be very tense the posterior pillar may be divided; but we are warned by Mr. Tait that atrophy of the soft palate is likely to follow this operation, an outcome which is to be regretted. This condition I have noticed in one of my own cases.

Many cases require two and three operations, but we should not be discouraged. Contrast a good result with the frequent necessity of changing the obturator and the care required in looking after it.

Fig. 1383 shows the little pinhole opening (in some cases larger), which may often be closed by the persistent use of some caustic, such as nitrate of silver or nitric acid.

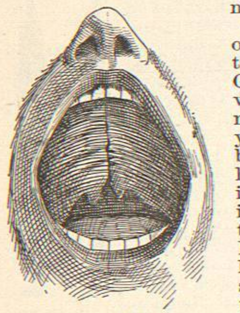

Fig. 1383.

Training the voice after the operation is of great importance as regards the final result. Great patience is required, and we must not expect improvement to follow immediately. A year, or even a longer time, may be required. With children I have had greater trouble in teaching the pronunciation of ch, as in church, chicken, etc., than that of any other sound. Dr. Henry J. Bigelow, of Boston, has in a very able manner presented the following views as to teaching the children to talk after the operation has been performed. He says: "Some years since I devised a short series of exercises for a patient I had operated upon. It begins with the only consonant which a patient can usually best articulate, namely, 't' in '*tar*,' and gradually leads to the rest, constantly referred to the acquired '*t*' as a point of departure. The great difficulty in pronouncing correctly with a cleft palate is in distinguishing the nasals from the mutes; thus, p and b from m; pab or bab from mam; t and d from n; tat from nan; k and g (hard) from ng. '*Tar*' is well pronounced by most beginners with an obturator. When the beginner can pronounce 'stark' and 'car' he has the key to most of what here follows. The above words should be practised carefully; not 'start' and 'tar,' but 'stark' and 'car,' and should be spoken loudly, or, as the elocutionists say, 'exploded.'

1. tar	artar	kar	arkgar	kar
2. kar	arkar	arkgar	kgar	gar
3. kar	arkar	arkdar	kdar	dar
4. kar	arkar	arkpar	kpar	par
5. kar	arkar	arkbar	kbar	bar
6. kar	arkar	arklar	klar	lar
7. kar	arkar	arksar	ksar	sar

Practise all the above with the following vowels:

8. o as in coke.

Thus, instead of kar, akar, etc., ko-oko-oklo-klo-lo.

9. a (long) as in cake.
10. i as in kite.
11. e as in keep.
12. u as in suit.

13. kar	arkar	arngar	arkar	arngar	kar	ngar
14. tar	artar	arnar	artar	arnar	tar	nar
15. par	arpar	armar	arpar	armar	par	mar

Practise reading loudly from a book: { bar mar / dar mar / sar rar"[2]

In the case of children beyond twelve years of age, and particularly with adults, I would perform the operation for closing cleft palate, if for nothing more than to afford comfort in eating.

Regarding the treatment of the acquired form of cleft, I should, in all cases of traumatic origin, operate by forming the periosteal flaps. In cases in which constitutional syphilis is present, I should hesitate somewhat, believing that in the majority of these cases the obturator does best.

A. Vander Veer.

[1] British and Foreign Medico-Chirurgical Review, July, 1870.
[2] From Boston Med. and Surg. Journal, February 7th, 1884.

CLEVELAND.—The second city of size and importance in Ohio, situated on the south shore of Lake Erie at the mouth of the Cuyahoga River. It is a large and handsome city of several hundred thousand inhabitants, and from the abundance of its shade trees is called the "Forest City." The climate is indicated by the accompanying table:

Climate of Cleveland, Ohio—Latitude, 41° 30′; Longitude, 81° 42′. Period of Observations, Thirteen Years.

Data.	January.	July.	Year.
Temperature (Fahr.)—			
Average or normal	26.8°	71.9°	48.9°
Average daily range	13.7	14.9	
Mean of warmest	32.8	79	
Mean of coldest	19.1	64.1	
Highest or maximum	70	96	
Lowest or minimum	−17	49.6	
Humidity—			
Average relative	77.9%	70.1%	71.2%
Precipitation—			
Average in inches	2.50	4.21	38.40
Wind—			
Prevailing direction	S.W.	N.	S.E.
Average hourly velocity in miles	10.7	7.3	9.3
Weather—			
Average number clear days	2.8	9.6	83
Average number fair days	8.4	15.7	141.8
Average number fair and clear days	11.2	25.3	224.8

Edward O. Otis.

CLIFTON SPRINGS.—Ontario County, New York.

Post-Office.—Clifton Springs. Hotel and sanitarium.

Access.—Viâ Auburn branch of the New York Central and by the Lehigh Valley railroads.

This resort is located in one of the most healthful parts of the State, midway between the villages of Geneva and Canandaigua. The location is about six hundred and seventeen feet above the sea level, and the surrounding country is somewhat hilly. An average summer temperature of about 75° to 85° F. is the rule. The springs are very numerous, but only five are in use at present. Dr. Henry Foster, the superintendent, sends us the following analysis by the late Prof. J. R. Chilton:

Sulphur Spring.

One United States Gallon Contains:

Solids.	Grains.
Calcium carbonate	9.68
Magnesium carbonate	13.12
Sodium sulphate	7.76
Calcium sulphate	69.20
Magnesium sulphate	16.48
Sodium chloride	9.28
Calcium chloride	4.08
Magnesium chloride	4.08
Organic matter	Trace.
Total	133.68

Sulphureted hydrogen gas, present.
Carbonic acid gas, present.

This water is quite similar to that of the Greenbrier White Sulphur Springs of West Virginia. It is used to supply the Clifton Springs Sanitarium, the important feature of this resort. A staff of eight physicians (six gentlemen and two ladies) is maintained at the sanitarium and it is believed that the facilities for treating certain classes of diseases are unsurpassed anywhere. All varieties of baths are here to be found, as well as all the modern appliances and methods of using electricity. The use of massage, the Swedish movement, and the various forms of gymnastics also receive due attention. The sanitarium building, with its recently constructed annex, affords accommodation for four hundred and fifty per-

sons. All modern contrivances for the comfort and health of the guests are provided—elevators, an electric bell service, a solarium, roof garden, etc. The surrounding park, containing more than fifty acres, beautified by well-kept lawns, spacious pavilions, attractive walks, miniature lakes, shady groves, flowers, etc., provides a healthful and restful retreat. The house is kept open for guests all the year, but the greater number visit the place during the summer months.

James K. Crook.

CLIMATE.—The word climate comes from the Greek word *κλιμη*, an inclination or slope. It was applied anciently to signify the supposed horizontal obliquity of the surface of the earth from the equator to the pole. The earth was divided by the earlier astronomers and geographers into parallel climates, or zones, that differed successively from each other from the equator to the pole by some arbitrary increment in the length of the midsummer days. Indirectly these zones, or climates, marked out more or less accurately the gradual changes in the characteristics of the weather dependent upon decreasing insolation. In modern usage the word climate has reference to the weather of a place or region, and to the factors that cause the weather to differ in different regions. It is difficult to give a rigid definition of the modern acceptation of the word climate, because different meanings have been given to it by different writers, just as different conceptions of its scope or the intents and purposes of its users have dictated. As used subsequently in this article the word climate is applied to the totality of those physical conditions of the atmosphere of a place or region that recur with more or less uniformity with the recurrence of the natural periods of time. Or, in other words, climate is the totality of the weather of a place or region as experienced there in the course of a long period of consecutive years. Weather itself is the instantaneous condition of the atmosphere with respect to its physical state. In a more extended sense weather is the continuity of the successive variations in the physical conditions of the atmosphere. In this sense, it is common to speak of the weather at noon, sunset, or any other time of the day, or of the weather of the whole day, or of the month, or of the year, and even of several years in succession.

The investigation of the causes that produce the weather and of their laws and principles of operation constitutes the branch of science known as meteorology. The further study of these causes to find out and classify those that are operative in producing the more or less periodical recurrences of the weather constitutes what is known as climatology, or the science of climate. Climatology is dependent upon meteorology, and meteorology in turn derives benefit from the advancement of climatology. For descriptive purposes, climate is usually stated in terms that have reference or regard to the temperature of the air, its humidity, motion, density, transparency, and electrification; also to the amount of precipitation, that is, the quantity of rain, snow, hail, sleet, dew, and frost, that occurs, and to its distribution: these items are referred to as the climatic elements. The conditions that cause variations in the intensity of the climatic elements constitute the climatic factors; the principal ones of which are latitude, altitude, distribution of land and water, mountain ranges, ocean currents, prevailing winds, amount and distribution of rainfall, nature of the soil and its drainage and vegetation, and the slope of the surface. These factors may be classified as fixed or natural factors, and dependent or resultant factors. The fixed factors are altitude, latitude, distribution of land and water, mountain ranges and slope of the surface, and nature of the soil; the dependent or resultant factors are the ocean currents, the prevailing winds, precipitation, soil drainage, and vegetation. As different regions and places on the earth's surface differ with respect to one or more of these factors, the climates of such regions necessarily differ more or less from each other. To describe exactly the climates of the different regions of the earth would be a task too great to be undertaken, but fortunately such exactness is not necessary to a practical comprehension of the climatic possibilities of any given spot on the globe.

Certain important principles are learned from meteorology that go far toward enabling us to anticipate from the geographical position and natural features of a place relative to some other place, whose climate is known, what the climate of the former is likely to be. Primarily, climate results from the effects on the earth's surface of the incident solar energy and its unequal distribution, which follows of necessity from the shape of the earth and its motions and its inclination with respect to the ecliptic. Other disturbing causes are introduced by the heterogeneous nature of the earth's surface. All of these causes have been alluded to as the climatic elements and factors. Their actual operations and effects will become plainer if we first consider a hypothetic earth and sun. From the laws of general physics, we can predict with as much certainty as we can predict the future course of the earth in its orbit what would be the climatic conditions upon every part of our imaginary globe. Starting with a homogeneous, smooth spheroid, either land or water, having an atmosphere of the same composition as our actual atmosphere, situated with respect to its sun as the actual earth is to its sun, only having no axial revolution, the sun revolving round the earth instead, let us consider what kind of climate it would have. The amount of solar energy received on each and every meridian by our hypothetic earth would be distributed from the equator to the poles in a ratio that would vary approximately as the cosine of the latitude (this is also true with regard to the actual earth, and is an important fact to bear in mind): the temperature of its atmosphere would therefore decrease gradually poleward on each side of the equator and every place on the same parallel of latitude would have the same temperature.

As the temperature controls the amount of moisture in the atmosphere, places on the same parallels would have the same degree of atmospheric humidity. The same conditions of equality would be true, also, of the winds and their velocities. In short, the climate of a given spot would be determined by its latitude, and all places in the same latitude would have the same climate. The general circulation of the atmosphere would be simple. The warmer air of the equatorial zone would expand, rise to a higher vertical level, and flow off toward the cooler poleward regions. The air of these regions, under the difference of pressure that would result from the accumulation of the overflowing air from the equator, would flow equatorward. This polar air, however, arriving in the equatorial zone would itself be warmed, expanded, and would overflow in like manner; and so a circulation would be established with surface currents from the poles to the equator, and upper currents from the equator to the poles, the direction of both currents being along the meridians. This would be the general tendency of the circulation. The actual circulation would be somewhat more involved. From the form of the surface of the spheroid over which this circulation would take place, the poleward moving air would be banked up more or less in its course by the lateral diminution of the area over which it was moving. The principle of the conservation of areas enables us to locate this banking up of the poleward moving air in the regions of latitudes 30°. The result that would follow would be an increase in atmospheric pressure in these regions with surface outflows on each side, those on the equatorial sides toward the equator, as in the first hypothetic instance; those on the polar side toward the pole, and opposite and antagonistic to the flow in the first suppositious instance. The result of this opposite poleward flow would be to overcome for a considerable distance the surface currents from the poles; the latter would be lifted from the surface and become middle currents. This underrunning and lifting of the polar currents would obtain to about the polar circles. The final result would be surface winds on the equatorial sides of latitude 30° toward the equator, and on the polar sides toward the poles; surface winds within the polar circles toward the equator; regions of variable winds and calms at the equator, latitudes 30°, and the polar circles. The circulation, however, would still be along the meridians.

If, now, our hypothetic earth and sun assume relations to each other like those of the actual earth and sun, a decided modification of this imaginary atmospheric circulation would take place. From the axial rotation of the earth, there would arise a right-handed deflecting force in the northern hemisphere and a left-handed deflecting force in the southern hemisphere. In the northern hemisphere, north winds would be deflected to the right and become northeasterly winds, and south winds would be deflected to the right and become southwesterly winds. (A wind is named from the direction from which it comes; *e.g.*, a northeast wind is one that comes from the northeast.) In the southern hemisphere, northerly winds would become northwesterly, and southerly winds would become southeasterly. And now on our imaginary spheroid there would be a system of atmospheric circulation such as is shown in Fig. 1384. Subject to the interferences introduced by the land and water surfaces and the irregularities of elevation of the former, this imaginary circulation is the actual circulation on our real earth. Bearing in mind the atmospheric conditions that would exist upon a homogeneous and smooth earth, we are prepared to see how these conditions are modified by the heterogeneous surface of our actual earth, and how the climate of any place is controlled by and may be predicted with more or less certainty from a knowledge of what we have called the climatic factors.

CLIMATIC FACTORS.—The general effect of these factors will now be briefly described.

Latitude.—Generally speaking, at the equator the sun's rays at midday fall perpendicular to the surface of the earth and their intensity is at maximum. North and south of the equator they impinge at angles that increase with the latitudes and they lose in intensity from two causes: first, because they are spread over a larger sur-

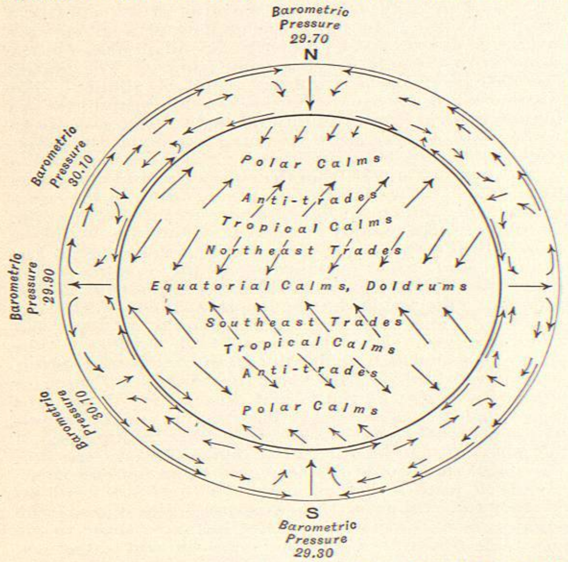

FIG. 1384.—Showing General Circulation and Direction of Atmospheric Currents. (After Ferrel.) Arrows in inner circle show the direction of the surface winds. Arrows within inner and outer circles show the scheme of the vertical circulation.

face; and secondly, because they traverse a greater depth of air and lose energy from atmospheric absorption. With some slight modifications this explanation is applicable to the differences between the intensity of insolation at noon and that at other hours of the day. The following figure will illustrate these two facts. The same beam R,

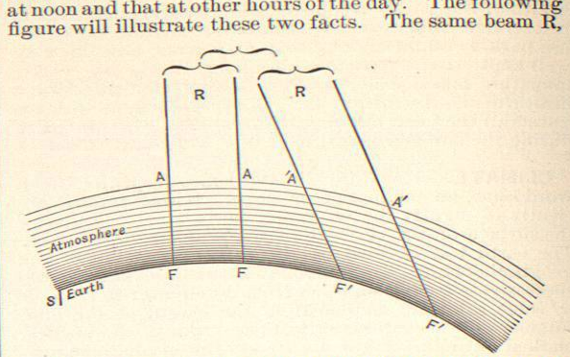

FIG. 1385.—Showing the Effect of Inclination on the Intensity of Insolation.

when the sun is vertical, is spread over a surface such as FF. When the sun is inclined at an angle as represented in the figure, the beam is spread over a surface F'F', which is obviously greater than the first, and it passes through a column of air A'A'F'F' greater than that of AAFF. The intensity of insolation at midday decreases approximately as the cosine of the latitude. If the solar radiation received in the average day at the equator be taken as unity and be called a thermal day, the annexed table will show the annual sum of solar radiation received at different latitudes:

Latitude.	Thermal days.	Latitude.	Thermal days.
0	365.2	50	249.7
10	360.2	60	207.8
20	345.2	70	173.0
30	321.2	80	156.6
40	288.5	90	151.6

The amount of solar radiation also depends upon the length of the day. At the equator the days are practically of the same length and there is virtually no variation in the daily or seasonal amounts of insolation; but toward the poles the variation in the length of the day becomes very great, so much so as to overcome at certain seasons of the year the adverse effect of latitude. The following table shows the intensity of solar radiation on the 16th of December, the 16th of March, and the 16th of June, dates near the shortest, the avèrage, and the longest days of the year, for each 10° north latitude. The figures express the intensity as a percentage of what it would be were the sun to remain vertical for twenty-four hours.

North latitude.	0°.	10°.	20°.	30°.	40°.	50°.	60°.	70°.	80°.	90°.
December 16th	0.30	0.26	0.22	0.17	0.12	0.06	0.02	0.00		
June 16th	.28	.31	.33	.34	.35	.35	.35	.36	0.38	0.38
March 16th	.32	.31	.30	.27	.24	.20	.15	.10	.06	

The eccentricity of the sun with respect to the centre of the earth's orbit is such that at the period of perihelion the effect of the solar energy is about seven per cent. more than at aphelion. As perihelion occurs in the summer time of the southern hemisphere, and aphelion in its winter, the seasons are much more extreme in that hemisphere than in the northern.

Altitude.—In climatology, altitude signifies vertical height above the level of the sea. The effect of altitude upon climate follows from its effect upon the mass of the atmosphere. According to the well-known law of Boyle, the volume of a given mass of gas will vary inversely as the pressure for all ordinary ranges of pressure, the temperature remaining constant. The stratum of air at 3.5 miles above the sea sustains only about one-half the sea-level pressure; accordingly, if the temperature remains constant, a given volume of air at the level of the sea if transported to this altitude would expand into two volumes. Conversely, a volume of air at this altitude would be compressed at sea level into but half its original volume. Under natural conditions when air expands freely, that is without doing work, it loses temperature, or, more correctly, its heat is employed in accomplishing the expansion, and becomes latent to the senses and to the thermometer. The opposite is the case when air contracts without doing work: that is, it gains in temperature, or it liberates the heat that was doing the work of expansion; this liberated heat becomes sensible. Alterations of the temperature of the air of this sort are spoken of as adiabatic cooling and heating; *i.e.*, cooling and heating without loss or accession of heat from outside sources.

The general effects of altitude upon the air may be briefly stated, with approximate accuracy, to be that the volume of a given quantity of air increases and its density decreases with the altitude; it decreases in temperature and loses more or less of its humidity by condensation and precipitation; its velocity increases, but its relative momentum decreases, it is more transparent, and offers less obstruction to insolation. The percentage composition remains unchanged, with the exception of the moisture as above stated. The following table shows the approximate decrease in atmospheric pressure for each 1,000 feet up to 10,000 feet.

Elevation above sea level (feet).	Barometric pressure (inches).	Elevation above sea level (feet).	Barometric pressure (inches.)
0.............	29.97	6,000	24.07
1,000..........	28.92	7,000	23.20
2,000..........	27.88	8,000	22.37
3,000..........	26.87	9,000	21.56
4,000..........	25.90	10,000	20.79
5,000..........	24.97		

Land and Water.—These two forms of the earth's surface are the perturbing factors of climate. As already pointed out, a homogeneous, smooth earth would have regularly distributed climatic conditions. The introduction of two kinds of surface, distinct in form and properties, and irregularly distributed with respect to each other, and in the case of the land irregular in its own surface, produces all the anomalies encountered in climate. A knowledge of the land forms and the relative positions and distributions of land and water is essential to the understanding of the actual climates of the earth. The disturbing influence of the land and water surfaces of the earth arises from the different specific heat capacities of these two surfaces and their different powers of conduction, convection, and radiation of radiant solar energy; also, from the rigidity of the one and the mobility of the other; and the general persistency of form in one, the land, and the duality of form (liquid and vapor) in the other, the water. Some of the effects caused by the irregularities of the land surface have been alluded to under altitude, and others will be mentioned under other heads. The specific heat capacities of land and water are about in the ratio of 1 to 4, that is, the same absolute amount of heat will raise the temperature of a land surface four times as high as it will raise that of a water surface. Land is a poor absolute conductor and a poor reflector of heat; it is a good absorber and a good radiator. From its poor conductivity the land retains its absorbed heat near its surface to be as quickly radiated as it was absorbed. Water is a fairly good reflector, and for this reason a considerable quantity of the incident insolation is reflected and exerts no influence upon the temperature of the water. Water permits a considerable part of the incident heat to penetrate it to a not inconsiderable distance. Comparatively little of the heat is absorbed by the immediate surface layer or by any other one layer; the absorption is distributed almost uniformly throughout the depth penetrated. A part of the heat absorbed is expended in evaporating some of the water, and causes no rise in the temperature of the water. The water is in continual motion, and so a further mixing of the layers at different temperatures and depths, and of the waters of different regions, takes place. The warm water in the equatorial regions, heated by the intense insolation of a vertical sun, flows poleward along the surface, and its place in the torrid zone is taken by the cooler waters from higher latitudes that flow equatorward as deep currents. The specific heat of water is great, greater than that of almost any other substance, hence it requires a great deal of heat to cause a perceptible increase in its temperature; *per contra*, it may radiate a great deal of heat without sensibly lowering its temperature. From the operation of all these factors, a water surface maintains a more uniform temperature than does a land surface. It is never as hot in the summer and never as cold in winter. A certain amount of evaporation takes place from all land surfaces not absolutely dry; but the amount is extremely small compared with the distillation that goes on from a free water surface. As a consequence, the atmosphere over the latter contains always more moisture (the temperature being the same) than the former, and clouds and precipitation are more frequent as a rule.

Mountain Ranges.—The influence of mountain ranges is seen chiefly in their effects upon the rainfall and the prevailing winds. These effects will be more or less general or local according to the height and direction of the mountains with reference to the general atmospheric circulation of the latitude. If a range runs transversely to the prevailing winds, it will either deflect them from their course or force them into higher altitudes. In the former case the range will serve as a wind break to the regions on its lee side and will send the winds into other regions from directions other than they would have come. Most important consequences arise from this fact. The late distinguished American meteorologist, Prof. William Ferrel, has pointed out that the high tablelands and mountains of Mexico deflect the winds of the northeast trade zone toward the north over the southeastern United States and up the Mississippi valley into higher latitudes. "This," says he, "completely breaks up the tropical calm belt and dry zone, so that instead of a dry region with scanty rainfall, such as is found in North Africa, Arabia, etc., . . . we have a region of abundant rainfall, and all the way up the Mississippi valley and in the interior of the continent there is much more rain than in the interior of Asia." When a wind is forced up a mountain it cools by expansion, or adiabatically, and more or less of its moisture is precipitated on the mountain sides and top. On the lee side of the mountain it descends and its temperature is raised by compression, again adiabatically. As the air in its passage up the mountain has lost the greater part of its moisture by precipitation, in its descent on the lee side of the mountain its temperature is raised to a higher point than it was at the beginning of the ascent, because dry air has a less specific heat capacity than moist air. These facts are seen in the well-known phenomena of the Swiss *Föhn* and the American *chinook* winds. Mountain ranges that do not obstruct the prevailing winds of the region exert only local influences upon the climate of the region.

Ocean Currents.—The effect of ocean currents on climate may be inferred almost without further comment from what has been said regarding the difference of insolation on land and water surfaces. The chief effect of ocean currents is to temper the extremes of the shores that they wash, and this tempering effect may extend to a greater or less degree inland, depending on the greater or less elevation of the land near the coast and the prevailing winds of the region. The most notable illustration is seen in the effects of what is popularly attributed to the Gulf Stream, but which are really those of the general circulation of the North Atlantic Ocean. By this circulation the warm water from the tropics is carried northeastward to the shores of Iceland and Northern Europe, rendering habitable, by the aid of the winds of those latitudes, which blow from the ocean, countries that would otherwise be as bleak as Labrador. The better-known ocean currents are, the Gulf Stream of the North Atlantic and the Kuro Siwo of the North Pacific, both warm currents, flowing from the tropics toward the cooler waters of the poleward regions. There are other warm currents less popularly known flowing from the tropical waters. There are also cold currents from the Arctic regions that chill the coasts of the countries they wash. A cold current flows from Davis Strait along the coast of Labrador and even farther southward, influencing the temperature of the coast as far as Cape Cod. Humboldt's, or the Peruvian, current from the Antarctic lowers somewhat the temperature of the Chilian littoral.

Prevailing Winds.—As climatic factors the prevailing winds are the agencies by which the inequalities in temperature and the other climatic elements that result from the effects and distribution of the land and water surfaces of the earth are maintained within a measure of equilibrium, which though varying in different regions, yet remain on the whole constant for each region. To understand the climate of a region, the direction from which the wind of that region comes must always be taken into consideration. If the wind comes directly from over a considerable body of water, it will bring with it in a greater or less degree the temperature and humidity of the air over the water surface. Should, however, a mountain range intervene, the wind would be robbed of the greater part of its moisture, but would retain its temperature, as already referred to under the effects of mountain ranges. On the other hand, if the wind blows from the land, it brings with it the climatic conditions of the surfaces which it traverses.

Winds are classified as permanent, periodic, and variable. The permanent winds are those of general systemic circulation that prevail over the disturbing effects of the land and water distribution. They are well represented in the trades and the anti-trades of the oceans. The periodic winds are characterized by their prevalence from one direction in one season, and from the opposite direction in the opposite season. The Indian monsoons are the most popularly known of this class. The variable winds are members of the cyclonic and anticyclonic circulation systems of the atmosphere. The prevailing winds of a region can be predicted from a knowledge of the position of the region with respect to the general system of the atmospheric circulation, previously indicated, and from the relative position and distribution of the land and water areas of the region, the topography of the region and the consideration of the season of the year, and, in some instances, of the time of the day. From the facts already developed of land heating and cooling more rapidly and more extremely than water, the atmosphere over the land is subjected to greater extremes of temperature and density than that over the water. Air moves in the direction of least resistance, that is, from the denser toward the less dense. In the case of continents these conditions give origin to the class of periodic winds known as monsoons, from the Hindoostanee signifying season. The monsoon results, in the summer, from the overheating of the air over the interior of a continent, its consequent expansion, loss of density, rising and overflowing as upper air currents toward the cooler region of the ocean and the inflowing as surface currents of the cooler air from the water to take the place of the former. This form of exchange keeps up during the summer months. In the winter months the conditions are reversed. The air over the ocean is warm, that over the interior of the continent cold, for reasons that have been explained, and the exchange takes place just the opposite of that in summer. When the monsoon wind is in the direction of the general circulation of the latitude, it adds its force to that of the latter, which appears as a stronger wind than normal. If contrary, the monsoon must either overcome or be overcome by the general wind of the latitude. If the first, it appears as a feeble monsoon; if the latter, it is in evidence negatively as an enfeeblement of the systemic wind of the latitude. The effects of topography upon a monsoon can be inferred readily from what has been said regarding the influence of mountains on winds. Along the littorals of all large bodies of water a familiar illustration of the different effects of insolation on land and water is seen in a periodic wind of shorter period than the monsoon, the daily land-and-sea breeze.

The following broad generalizations as to the prevailing winds, and also ocean currents, of the globe may be of service. Within the warmer latitudes, the tropics and sub-tropics, the winds and ocean currents have a prevailing direction from the east; within the temperate latitudes, the winds and ocean currents have a prevailing direction from the west; within the polar latitudes, the wind and ocean currents have a prevailing direction from the poles toward the equator. There are a few winds that should be mentioned because of the frequent reference to them in climatic literature. These winds are all cyclonic in origin. The disagreeable *east wind* of Britain, referred to so often by Dickens in one of his novels, is dry and cold. The *mistral* of Southern France is a violent cold, dry, northwest wind, and is the *tramontana* of the Adriatic coast. The *northers* of Texas and the West are very cold and dry winds. The *scirocco* of the Mediterranean littoral is a torrid south wind, hot from the sands of the Sahara and damp from the moisture of the Mediterranean. The *khamsin* of Egypt, and the *Harmattan* of the west coast of Africa, are easterly and southeasterly winds, dry and hot from Sahara. The dreadful *simooms* of the Arabian and Persian deserts are but violent local whirlwinds, mixing the air and the heated sands of the desert together, with resultant temperatures that would be unendurable if continued longer than a few moments. The simoon passes over in about ten minutes.

Rainfall.—The effect of rainfall as a factor is rather passive than active. Rain itself is the result of the operation of the other climatic factors and elements. To save a certain amount of repetition, its further consideration is deferred to rain as an element of climate.

Soil.—The nature of the land surface, apart from the great irregularities that have been considered under mountain ranges, exerts a considerable influence upon the climate of the region. The physical construction and chemical composition of the soil affect in no inconsiderable degree the quantities of insolation and of moisture that remain for a greater or less time in its surface. The general relation of the kind of soil to the absorption and radiation of heat is approximately about as follows:

ABSORPTION AND RADIATION OF HEAT IN PERCENTAGE.

Sand, with some limestone	100
Pure sand	96
Light clay	77
Gypsum	72
Heavy clay	71
Clayey earth	68
Pure clay	67
Fine chalk	62
Humus	49

From this table it will be observed that a sandy limestone soil absorbs practically all the heat falling on it. The absorptive and the emissive thermal powers of a body being equal, it follows that the same soil radiates under given conditions all the heat it absorbs. Observation has shown that sandy deserts are subject to the greatest ranges in temperature. Earth containing much humus shows less range of temperature than any other kind of soil. The quantity of moisture taken up by the different kinds of soil varies greatly. Sand and sandy soils absorb moisture quickly and in great quantity, but retain it badly. Humus may take up from forty to sixty per cent. of its own volume of water and will retain it strongly. Rain falling, therefore, on sandy soil is quickly absorbed and quickly lost, the loss is mostly by percolation; falling on humus it is slowly absorbed, but what is taken is strongly retained. The damper the soil the more nearly it approximates the behavior of a water surface with respect to temperature and humidity. Frost

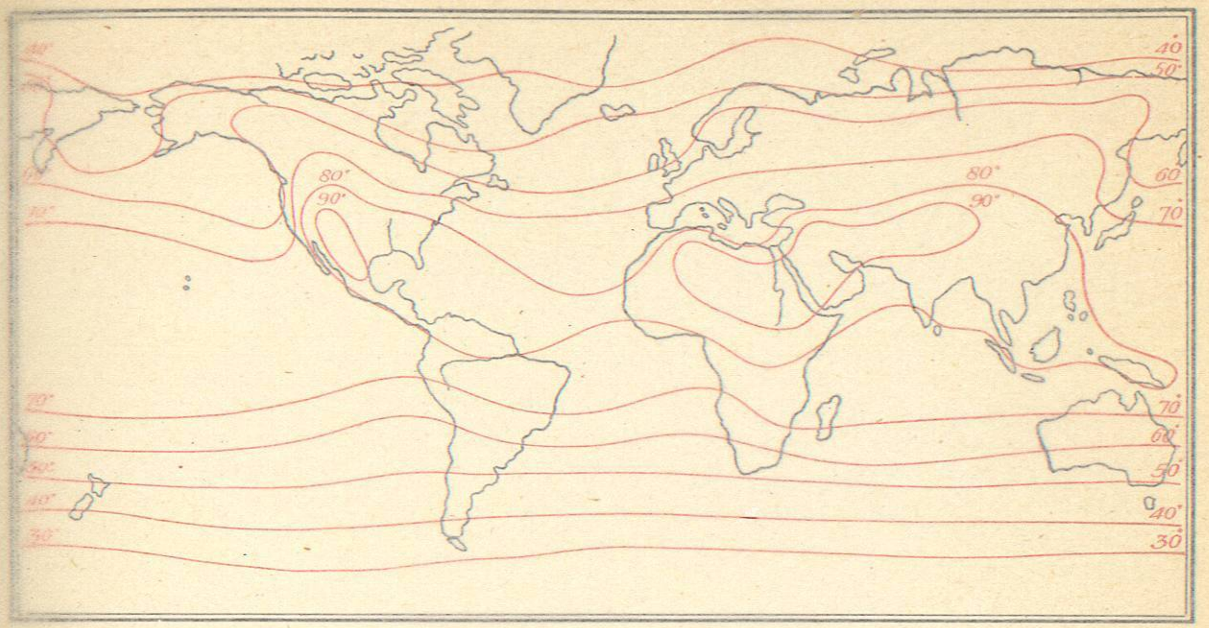

FIG. 1.

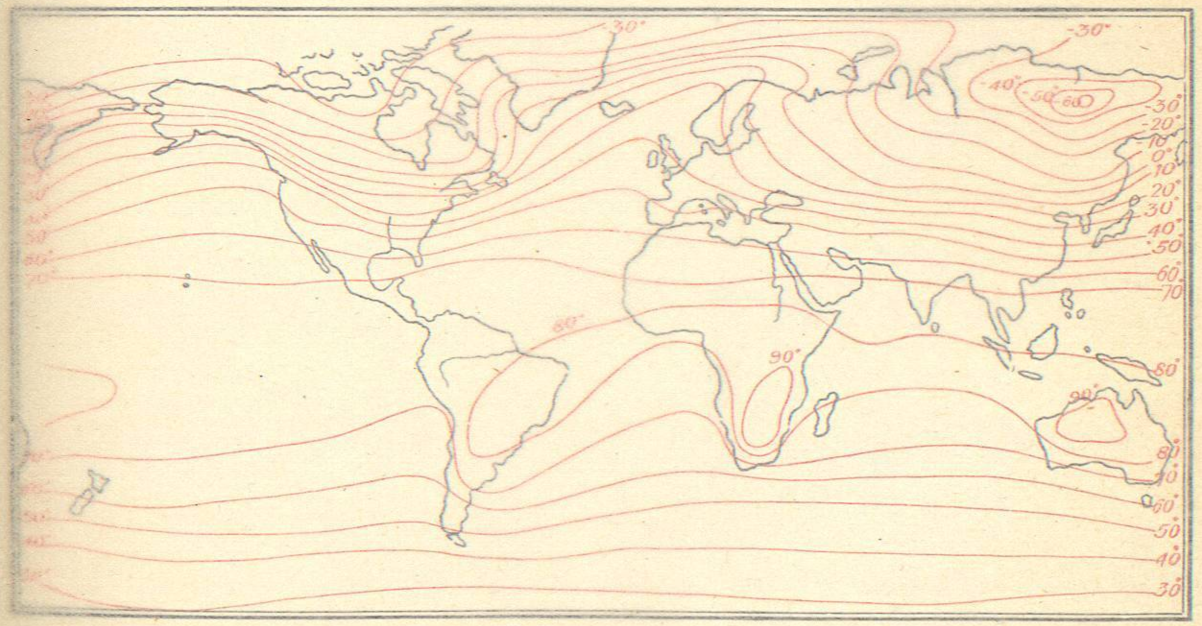

FIG. 2.

CHART OF ISOTHERMS OF THE WORLD

(Degrees Fahrenheit)

Fig. 1, for July; Fig. 2, for January.