NATURE AND MAN IN AMERICA

BY PROFESSOR N. S. SHALER

DOMESTICATED ANIMALS. The Dog, Beasts of Burden, the Horse and Birds. Illustrated.

SEA AND LAND. Features of Coasts and Oceans with especial reference to the Life of Man. Illustrated.

ASPECTS OF THE EARTH. A popular Account of Some Familiar Geological Phenomena. With 100 illustrations.

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CHARLES SCRIBNER'S SONS

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BY

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INTRODUCTION.

MODERN science unhappily appears to be in conflict with the religious traditions of our race. The development of our knowledge of Nature has led to a loss of the old confidence in the conditions of human life. Our fathers rejoiced in the conviction that they came directly from the Creator's hands. It is now evident to us that our being is due to what we term more natural causes, — that man's body has been slowly evolved from the earth, passing onward through inconceivable stages, each leading upward from the level of the lowest organic life.

Disguise it as we may, there can be no question that Science has taken much from our heritage of ancient ideals. What can it give in place of the confidence which it has destroyed ? Though as yet the scientific study of Nature has been in the main destructive as regards the ideal foundations of our life, it is my belief that this branch of learning can and will give a great deal to replace that which it has overthrown. Half a century ago, Science appeared as the destroyer of faith and trust in the universe. It seems to me that we now are approaching the time when our knowledge will reaffirm the old belief which our fathers had in the essential control of a beneficent Providence. With each advance in our knowledge concerning the conditions which have brought men to their present estate, we come to a fuller sense as to the order and system by which the processes of Nature have made men what they are. There is reason to hope that the faith of our children may be like unto that of our fathers, — better, indeed, than the old faith, for it will rest on the firm foundations of our own knowledge, rather than on the trust in the opinions of our elders.

It seems to me to be the duty of every naturalist, particularly when he has adopted the tasks of the teacher, to use each fit occasion to show wherein he finds proof of a just confidence as to the relations of man to the creative power which works in Nature. By so doing, he may hope to help himself and his fellow-students to escape from the perplexity which has been brought about through the revolution in the opinions of men which modern science has induced. With this end in view, I shall devote the first four chapters of this book to a general statement concerning the effect of critical conditions of the earth on the development of organic life in general. It will be my aim to show that geographic changes and the consequent revolutions of the climate which our earth has undergone, though rude and in a way destructive, have nevertheless served the best uses of life, driving organic creatures by the whips of necessity upward and onward toward the higher planes of being.

I shall give the latter half of this essay to the discussion of geographic influences upon man, endeavoring to show, at least in a general way, how the development of race peculiarities has been in large part due to the conditions of the stage on which the different peoples have played their parts. I shall endeavor to trace in outline the effect of the geographic conditions on the development of peoples in the past, and to make a somewhat careful study of these problems as they are exhibited in North America.

Although we all feel an interest in mankind considered as a whole, we particularly desire to know, with all the foresight which the study of natural laws may afford, the fate of our own descendants on this earth; and because to each of us our land is the dearest, we wish above all to foresee the future of the nation to which we give our best hopes. Therefore I shall endeavor to trace the probable future of the social and economic development of North America in a somewhat detailed way, endeavoring in the sketch to indicate the manner in which the geographic features of the continent have controlled the settlement and development of the populations up to the present time, and the probable influence of those conditions on the future of our race.

While this work is to be divided into two parts, —

one concerning the influence of environment on organic life, and the other concerning the conditions of man in North America, — the subject matter is really a unit. The life before man has afforded the conditions of his being; and the lower kindred in animal and plant are still the ministers of his days, mediators between his own station and the mineral world below. Whenever we seek to account for the state of any organic phenomena, whether it be such as are exhibited by the lowest animal or by our own species, it is necessary to select some particular part of the creature's conditions, and for the time to devote our attention solely to the problems which it affords. The result of this method of study is necessarily to give us a somewhat one-sided view of the matter. In all divisions of the natural field, the effects of many causes are inextricably intermingled. The consideration of any one of them can give us only a limited and one-sided aspect of its true nature. Therefore, in reading these pages the student should bear in mind the fact that we are considering only one of the many series of influences which have affected the life of man. He may also advantageously bear in mind the fact that the phenomena of inheritance which are ever contending against the immediate influences of environment are scantily considered in the following pages. They are here and there mentioned; but to give them their true weight it would be necessary greatly to increase the size of the book, and with the result that the element of unity, which comes with the consideration of a single series of causes, would be lost.

Although this book is designed in part for the use of the general reader who wishes to obtain some slight idea as to the trend of that modern science which takes account of the relation of organic life to its environment, it is particularly designed for the use of beginners in the study of geology. So vast is the body of fact in the records of our earth-science that it is hard for the student to secure any general conceptions which may serve to guide his efforts in the acquisition of detailed information. Although in general, large views can best be attained by those who have already acquired a great store of detailed knowledge, it is well for the student at the outset to obtain some general conception as to the direction of scientific inquiry. With such suggestions, he can make good use of the information which he secures from textbooks and other sources of knowledge which are open to him.

It should be said that the greater part of the matter contained in this work was first prepared for a course of lectures before the Lowell Institute in Boston. The last four chapters were printed in "Scribner's Magazine," in the year 1890. Considerable additions to the text have been made during its preparation for the present form of publication.

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CHAPTER I.

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Our forefathers looked upon the earth as an inert mass, upon which life had been imposed by the will of a superior being. To them the earth was essentially lifeless; here and there portions of its matter sprang into a plane of higher existence, in animal or plant, to fall back after a brief time into the inert soil. Now and then a philosopher attained to a deeper sense of the relations between the living and the dead parts of the earth. Thus Pythagoras and his school conceived that the fossils of the rocks represented a certain striving of the earthy matter to become living. They thus recognized the essential vitality of the earth; they supposed the particles of matter to be spontaneously seeking a higher state of organism. But the conception of the earth as inert held in the minds of naturalists even down to our own generation. Only in the divine Kepler do we find a philosopher strong enough to conceive this sphere as essentially organized. To him this world is so endowed with activities that it is to be accounted alive. In his reflections on the order of Nature, he holds to the doctrine that the earth is animated in the fashion of an animal; he finds in the tides an evidence of its slow breathing.

Critics have found in this fancy of Kepler proof of a disordered mind, of an imagination which outran the limits of scientific inquiry; but though there is an element of ideality or even of wild fancy in his speculations as to the nature of the earth, it seems likely that his divining imagination brought him clearer to the truth than the hard-mindedness of other naturalists.

In this and the following chapters I propose in outline to trace, as far as the present state of our knowledge will permit, the connection between the functions of our planet and the development of organic life upon it. I hope to show that the apparently rude and massive machinery of our earth has so operated during great periods of geologic time as to nurse and develop the organic life which inhabits its surface. Under my subject, I propose to include the evident natural forces which can have an influence on organic beings, the features in our earth's history which determine the conditions of soil and climate; in a word, those complicated influences to which we give the name of Environment.

In seeking to find our way to an understanding of the relations between the earth and its living inhabitants, we must first bear in mind the fact that we are fighting against an ancient prejudice. Almost instinctively we look upon the living being as something essentially foreign to the earth upon which it is set; the ever present fact of death, the return of the individual to the dust, accents this relation which ancestral habits of thought have fixed in our understanding. As the first step toward this larger view of Nature, I propose to consider the stages of an inquiry which led me many years ago to combat in my lectures to students the prejudice which I seek to do away with. Although the problem is one of many details and required some years for its solution, it can be readily apprehended, for the reason that it involves only simple considerations.

When naturalists began to study the fossils buried in the rocks of the earth's crust, they soon learned that while the newer deposits contained forms which were closely akin to those now dwelling on the earth, the more ancient strata held the remains of animals and plants essentially different from those now living. As long ago as the beginning of the eighteenth century, Dr. Robert Hooke suggested that it might be possible to determine the relative age of strata in different regions by the consideration of these organic remains, or, as he expressed it, "we might raise a chronology from the study of these medals of creation." It was not, however, until the beginning of the nineteenth century, or one hundred years after Hooke's prophetic conjecture, that this chronological study of the rocks through their fossils was actually begun. The first steps in this great work of unravelling the earth's past history were taken by the illustrious Cuvier.

Cuvier and his immediate followers conceived that the ancient sedimentary deposits each contained assemblages of fossils which were alike in all the rocks of a given age. They supposed that the fossils of the Trias or of the Miocene which were found in England or in France would likewise be found in deposits of that age in every part of the world whatsoever. Gradually, however, as our knowledge of the animals and plants now living became more complete, it was perceived that the present life of the planet is divided into limited realms, — faunæ and floræ, as naturalists term them. Thus, to take the most conspicuous instance, the living animals and plants of Australia differ surprisingly from those of any other continent, there being but few of the thousand indigenous species of that island continent which are represented by kindred forms in other lands. So it came first to be conjectured, and afterward to be proved, that the life of the past had a regional division somewhat like that which we find to exist at the present time. Slowly geologists came to see that they could not expect the Miocene of Europe or the Trias of that country to contain just the same forms which characterize those beds in the other continents.

The next step in the development of this idea was taken by my master, Louis Agassiz. Although the elder Agassiz is best known as a zoölogist and geologist, he had a considerable acquaintance with botany, which he mainly derived from his association as a student with the distinguished Dr. Braun, afterward professor of botany at Berlin. Agassiz's wide-ranging geological studies brought him at an early age in contact with the deposits of the Miocene tertiary in Switzerland. These beds contain an amazing number of fossil leaves, shed in the autumns of former ages, and buried in ancient lake-beds of Switzerland. The perfection of these fossils is singular. They are often so well preserved that we miss nothing but the hue which characterized them when they fell.

When Agassiz came to America in 1846, his observant eye noticed the fact that while our American forests were singularly unlike those now existing in Europe, they were very closely related to the woods which had covered central parts of that continent in the Miocene time. At present the forests of Europe contain a small number of species of trees compared with those of North America. Thus, while in North America we have about thirty-five species of oaks, in Europe there are not more than four indigenous species of that group. Moreover, in North America there are many forms, such as our sassafrases, sweet gums, sour gums, tulip-trees, magnolias, bald cypresses, etc., which are no longer found in European woods. Agassiz noted the fact that the greater part of these genera which are now peculiar to North America were in Miocene day characteristic of Europe. In other words, the forests of the European field were once like those of North America; but the Old World has passed by that stage in its arboreal development. Little survives of that period in its history save the fossils in the rocks.

Agassiz went further with his inquiry. He found that a good many animals now living in North America, such as our opossums, many of our fishes, and some of our reptilian group, also survived in North America, though they had vanished from the Old World. This series of facts remained a subject of recurrent inquiry with Agassiz; and in 1860 he called my attention to the matter, and bade me make a further study as to their meaning.

Following the lead which my master gave me, I proceeded to make tables, which would set forth these peculiar differences in the rate of advance of North America and Europe, and to extend the tabulation to the other continents. From the data thus gathered, it soon became evident that this peculiarity was not limited to Europe and North America, but that the stage of advance of life differed for each continent. Taking European life for our standard, and inquiring into the conditions of organic development on the other continents, it becomes evident that Europe had gone farther forward in its organic history than any other land. Thus, in the case of Asia, we find there now living many genera of plants and animals the species of which had formerly existed in Europe, but had disappeared from that land. Elephants, tigers, and many other animals, abundant in Europe in the later Tertiary, but no longer present, still abound in Asia. Africa has yet more archaic assemblages of animals and plants; that is to say, on the African continent there are more forms the kindred of which once existed in Europe, but have passed away. Pursuing the results of our series, we find that the organic life of South America is lower in grade than that of the continents before mentioned; while Australia is last of all in the measure of elevation of its life. In a very general way, we may say that the life of North America has lagged behind that of Europe by something like the amount of one geological period; Asia is behind by about the same term; Africa is yet farther behind in the race; and finally, Australia has an assemblage of animals which remind us more closely of Europe in the Jurassic time than Europe of to-day. We cannot take up the organic species of the continents in detail, but we may note the fact that the native mammals or suck-giving animals of Australia all belong to the group of Marsupials or pouch-bearers, — forms which in Europe appear to have passed away, or at least to have lost their importance at the beginning of the Cretaceous period.

When we come to tabulate the facts, we find that the other continents are characterized by a rate of advance in their organic life which puts them in the following series: Europe at the head of the great procession; next following and in nearly equal advance the continents of Asia and North America; farther in the rear comes Africa; South America is yet farther behind; and far behind the others, the laggard among all the lands, the slow-going continent of Australia.

If the general facts indicated in these considerations came to us through observations made upon any single group of animals or plants, it would have little interest, for it might be supposed to fall into the field of the inexplicable or at least unexplained things, the realm we term Chance; but the statement as to the relative advance of the life on the several continents is true for a great many separate groups. In a general way, it is true of plants, of mollusca reptiles, of fishes, and of mammals. The coincidence in the rate of development of these distinct groups of beings was sufficient to make me hopeful of finding some clew to the cause of the perplexing facts.

It is the habit of naturalists to avoid prolixity by giving their readers only the results of their inquiries, leaving out of consideration the steps by which they attained their successes or failures in the work of research. It seems to me, however, worth while to set forth the method which I found myself driven to pursue in my effort to get some further account as to the causes which led to these peculiar conditions in the distribution of organic beings.

When a naturalist has attained the state of inquiry to which we have now come in the statement of our problem, he needs to beat the brush of fact and fancy in order to get a clew for further search. If he has been well taught or has profited by individual experience, his next step will be to search in the realm of Nature for some series of facts which are in any way coincident with those which he seeks to explain. It is evident at the outset of this particular inquiry after new series of facts to be used in comparison with those in hand, that this difference in the rate of development of life on different continents may be in some way connected with the physical history of the continental masses themselves. Now, the only way to take up the physical history of continents, since we know that history as yet most imperfectly, is to make a study of their existing shapes. The geologist already knows full well that the actual shape of the continental form has been determined by the experiences of that land-mass in the past. The land is what it is because of the various shape-giving influences which have worked upon it. With this general thought in mind, we may proceed to the next step of the inquiry.

It is impossible for any one to grasp the form of a continent in its entirety. It is true that every hill and valley, every outline of surface, however trifling, indicates some part of the history of that land; but the mass of fact is so great that it is beyond the compass of the mind to grasp it firmly. We must therefore find, if possible, some simple index of the continental form, sufficiently clear and general in its nature to be taken into the understanding. This index, as we shall shortly see, lies ready for us in the simple, readily recognizable feature, — the shore-line. Long ago Ritter and afterward Guyot recognized the fact that the amount of shore-line of the several continents in proportion to their internal square-mile area varies greatly, as is shown by the proportionate area of the peninsulated appendages to the solid mass of the lands with which they are united; this is in Europe one to four, in Asia one to six, in North America one to fourteen. The other continents have so few peninsulas that no definite ratios can be established. Europe has by far the largest amount of shore in proportion to its square-mile area of any of the continents; Asia and North America have much less shore-line for their square-mile surface; Africa yet less; while South America and Australia come still lower in the scale. To establish these ratios in the form in which I have presented them, it is desirable to reduce the continents to the same areas, and then to compare their shore-lines.

No sooner do we grade the continents by the proportion of shore-line to square mile of surface, and place this tabulation against that which shows the series in organic development, than we are startled to find that in a general way at least the two sets of facts correspond. Although the parallelism is by no means perfect, it is sufficient to give the naturalist the clew which he seeks to obtain.

It requires little consideration to show us that there can be no immediate connection between the development of the organic life and the ratio of the sea-coast to the square-mile area in the several lands. We must expect to find the causation more remote. We should look for some conditions which will at once give the complicated shore-line and the environment which advances life. Let us begin our inquiry by determining what it is that makes the variation in the shore-line.

Taking first the continent of Europe, let us see what it is that produces this singularly large interlocking of sea and land. Almost as soon as we inspect a good map of that part of the world, it becomes apparent that this complicated periphery is due to the great development of mountains having diverse directions of axial development on that continent. Europe is an aggregation of peninsulas and islands, each the product of a more or less distinct system of mountain-building. The Scandinavian peninsulas, Great Britain, Ireland, Spain, Italy, and Greece, as well as many lesser peninsulas, are each the product of a separate incidence of mountain-building forces, applied at different periods in geological time. We thus come at once upon a set of facts which leads us carefully to inspect the operations of mountain-building forces on the several continents.

Although our information concerning the measure of action of orogenic or mountain-building forces on the several continents is yet imperfect, we know enough to be able to grade the continents in a general way in accordance with the relative number of their mountain systems, and are quickly brought to the conclusion that Europe has the most shore-line in proportion to its area because it has been the seat of more repeated and more varied mountain-building than any other continent, and that the relative lack of shore-line on the other lands is due to a proportionate lessening in the variety of movements due to those subterranean forces which fold the rocks. Thus, if we compare Europe with North America, we find that in the first named of these continents there are more than a score of different mountain systems, the elevation of which occurred in most cases at different times in the earth's history; while in North America there are not more than half-a-dozen different systems, representing perhaps no more than that number of diverse periods of disturbance which built such elevations. We have now come in our inquiry to a point where we may fairly conjecture that the relative advance of life on the different continents may in some way have depended upon influences due either to the processes of mountain-building or to the long continued existence of such elevations on the several lands. We shall therefore proceed to consider the way in which mountains by their growth or presence in any region may affect the advance of organic life.

Before we set about this, — the most critical and, as we shall hereafter see, the most profitable part of our inquiry, — we must take a glance at the conditions of animals and plants as they are affected by geographic changes, such as are induced by mountain growth. This inquiry was not possible in the time of Louis Agassiz, or with students who held to the belief as to the nature of organic changes which he entertained. He believed that each species of animal and plant was the product of direct creative action. Mr. Darwin and Mr. Wallace have forced us to admit that the development of new species is, to a great extent, due to circumstances, to the action of the inorganic conditions upon them or the interaction of species with species in the struggle for existence. Geographic conditions may greatly affect the struggle for existence in most important ways; as, for instance, when the sea advances or retreats, the assemblages of marine and land creatures, the faunæ and floræ of the neighboring waters and lands, move to and fro, with the change of their domains. Such migrations lead to the death of weak species, brought about by a struggle for existence with forms with which they have not previously come into contention. Such times of migration are necessarily periods when rapid selective changes occur.

A sufficient example of such a movement and its consequences may be brought to our minds by an instance taken from the shore of Massachusetts. The peninsula of Cape Cod, a frail barrier of glacial waste, parts on the north and south two very diverse groups of marine animals. There are some scores of species inhabiting Cape Cod Bay to the north of the barrier which are not found in the waters about Martha's Vineyard and Nantucket or in Buzzard's Bay. When Cape Cod disappears, — as but for the intervention of man it will, by marine erosion, in a few thousand years disappear, — we foresee that a great intermigration of these species will take place. They will struggle with one another for the possession of the new field of sea-shore and of the waters. The weaker or less perfect forms will be destroyed, and out of the struggle will come a measure of advance in the character of the life in the given area. Or let us take another instance from far away. Between the low-grade life of Australia and the higher life of southern Asia, there are but narrow barriers of waters. A relatively trifling geographic change might at any time convert the Malayan archipelago into a great isthmus, binding the two continents together and affording a bridge over which by the processes of migration, impelled by the ever present needs of subsistence, the life of the lands might commingle.

There can be no doubt but that the effect of such a union between Asia and Australia would be greatly to advance the grade of organic development in the southern continent. It would only be a question of a short geological time before the Asiatic competitors with the old Australian life would drive it from the field. Some of the species would be destroyed by the direct assault of their more vigorous enemies; others would be displaced by the lack of food, the plants or animals which they originally depended upon and to which they had become adapted having been driven out by the invasion. We see something of the effects which would be produced by the creation of a land-bridge between Australia and India, when we study the action of certain species which have been introduced into Australia by man. Many species of European animals and plants have come to Australia within a century. On the new ground they show a curious power of overcoming and displacing the native species. Thus, the European rabbit, which in its native land is kept in check by weasels and foxes and other predaceous animals, runs riot in Australia, and has become a menace to the interests of the soil-tiller and the shepherd.

Something of the effect of these isthmuses or land-bridges may also be judged by the rapid spread of species which by chance are introduced into new countries. Ships are constantly bringing the seeds of different countries to our land. Gaining a foothold on the shore, these forms frequently spread with startling rapidity, and become usurpers of the places of our native forms. A large part of our common plants in New England — nearly all our most successful weeds — are from other lands.

Although the effect of geographic changes consequent upon mountain-building in bridging the spaces of the sea is the most manifest of the consequences attendant on the development of these elevations, it is not the most important. Whenever a region of plain land is converted into a mountainous district, a great change of climate ensues. The temperatures and the rainfall of the district necessarily undergo a great alteration when its surface is elevated by mountain-folding. It is a well-known fact that nearly all the organic forms are singularly limited by conditions of temperature, and in general much affected by the amount of rainfall. Thus, in the case of our domesticated plants, we find that the limits of their distribution are singularly adjusted either to the average temperature of the year, that of the growing season, or that of winter. The northern limits of our vines, olives, figs, and a host of other plants follow the windings of the isotherms across the surface of the continents. So close is this relation that meteorologists are fairly justified in the assertion that no change in the average annual temperatures of Europe to the amount of one degree Fahrenheit has taken place in two thousand years. They base this opinion on the limits of the plants above-mentioned, which limits are accurately known for a considerable historic period. Now, as the elevation of a surface to the amount of two hundred and fifty feet produces a chilling effect on the climate in general equivalent to that which would come about by moving that region somewhere near a degree to the northward, the action of mountain-building on climate and consequently on the distribution of animals and plants is necessarily very great.

If a mountainous elevation having a height of ten thousand feet could be created in the region immediately north of Massachusetts, the effects upon the climate of the uplifted field would be of vast importance. Nearly if not quite all the species inhabiting the territory would be displaced or have their distribution changed. North of the ridge, because of the barrier which it would create between the southern Atlantic Ocean and Canada, the country would be reduced to a condition of sterility. The heat would be diminished, and the water-supply lowered. South of the barrier and beyond the limits of the elevation, the effect would probably be to increase the temperature and the rainfall by shutting off the north winds and causing a greater precipitation on the southward versant of our imaginary mountains. The effect upon the climate of the region we occupy would be further complicated by the fact that such an elevated district would be certain to become the seat of glaciers. The ice wrap might be limited to the upland district alone; but it is possible that situated as New England is in relation to the waters of the Atlantic, the greater part of the southern versant of this elevation would become occupied by massive glaciers. Indeed, it is possible that it would convert the whole of Massachusetts into an ice-wrapped country, such as is now found in Greenland.

We thus see that the creation of any considerable mountain mass necessarily changes the climatal regimen of a district, and so enforces a change in the limits of the field occupied by organic forms; and, as before remarked, all such migratory movements are in a high measure favorable to that struggle for existence in which the higher forms survive and the lower are destroyed. When we look upon the map of Europe and observe the distribution of its mountain masses, we must imagine that at each stage in the growth of these elevations we have had an attendant alteration in the temperature of the land of that continent, and a consequent marching to and fro of the great armies of life. Each of these movements has meant an increase in the contention between the struggling forms. As long as the land remains in a stable position, the combat for existence takes place within the limits of a given province. Although even under these conditions of stability, the battle is fierce, its intensity is vastly increased when one organic assemblage — one biological army, as we may term it — is compelled to invade the province of another. When such alterations occur, all the old adjustments between species are more or less broken up, and before the new order is instituted many of the ancient forms will probably be destroyed.

We may help ourselves to imagine these conditions by taking the analogical phenomena which occur in those great migrations which brought the people of northern Asia and northern Europe upon the civilized districts about the Mediterranean. Although the wars between the states of southern Europe had proved in many cases disastrous to their civilization, the effects of these struggles were small compared with the ruin which the migratory invasions of the northern peoples brought about. We may compare the ordinary civil wars within States to the combat which constantly goes on between contending species that occupy the same biological province; while the invasional movements of the Hun and Goth afford a certain analogy with the destruction which occurs from the migratory movements of large assemblages of life under the influence of climatal change.

In the sea the effects of mountain-building or of continental growth, though less manifest in geological history, are doubtless quite as important as those which are exercised upon the lands. Marine animals are singularly sensitive to peculiarities of temperature. Even our more vigorous fishes are narrowly limited by the heat of the water which they occupy. Thus the blue-fish (Temnodon saltator) of our New England coast, one of the most aggressive forms of its class, finds at present its northern limit determined by the peninsula of Cape Cod. South of that boundary it is one of the dominant creatures of the sea, and is extremely abundant. Although from time to time, with variations in the temperature of the sea-water at particular seasons, it finds its way north of Cape Cod and establishes itself in Massachusetts Bay, it never has succeeded in maintaining itself in that field. Two or three times within a century it has won a place in those waters, only to be beaten back by the cold of the next season. Occasional invasions of cold water, characteristic of Massachusetts Bay, destroy great quantities of fish in more southern waters. A capital instance of this action was seen in the case of the tile-fish, which was found by the United States Fish Commission to be extremely abundant in the region immediately south of Nantucket shoals. For a while the field occupied by this fish promised to be a valuable station for our fishermen; but all at once the species disappeared from the locality. Vast quantities of their bodies were found floating on the surface of the sea; and the most reasonable explanation of their death seems to be a slight and temporary alteration in the run of the currents about Cape Cod, which brought the arctic waters a little farther south than usual.

The temperature of the North Atlantic depends in very large measure upon the tide of warm waters brought to that region by the Gulf Stream. Dr. James Croll has shown that the Gulf Stream brings to the region within the Arctic Circle more heat than comes to the earth in that region directly from the sun. It is easy to see that the limits of that stream are determined by the existence of geographic barriers. If the region about the northern part of

South America and the isthmian district which connects the twin American continents were lowered beneath the sea, this great current would not enter the northern Atlantic, but would stream forth into the central parts of the Pacific Ocean. The result of such a change would be that the temperatures of the sea-water throughout the North Atlantic would be profoundly altered, and the life of all that wide ocean would be compelled to undergo vast migrations.

Even slight geographic changes may produce most important effects upon the rate of movement of the Gulf Stream and the consequent temperature conditions of the North Atlantic. Thus at a very recent time in a geological sense, probably since the coming of man on the earth's surface, the peninsula of Florida was deeply depressed below its present level, so that the part of the Gulf Stream which passes through the straits of that name flowed freely over the surface of the peninsula, the current having its northern border considerably at the north of Tampa. When flowing in this position, it is likely that the waters of the Gulf Stream had a slower current than at present, and were discharged on their path toward northern Europe with less momentum than now characterizes them. It is mainly if not altogether to this initial velocity that we owe the efficiency of the Gulf Stream as a warmth-bringing current in high latitudes. If its average velocity were diminished by as much as half a mile an hour where it passes Cape Hatteras, the effect would probably be to lower the temperature of the North Atlantic by several degrees Fahrenheit, — a change sufficient not only to affect the distribution of marine life, but also in a secondary way profoundly to influence the temperature and thus the vital status of northern Europe.

Whenever a considerable range of mountains is elevated, we often find as a complement to the upthrust a system of depressions formed on either side of the axis of elevation. If the mountains are of great mass and occupy an extended area, this system of troughs on either side may attain to something like a corresponding profundity and extent. Thus the deep basin of the Mediterranean is probably to be explained by the downward movement of the strata corresponding to the great mountain uplifts which have taken place on its northern and southern shores. The basin may, in a word, be defined as a geological depression between the Alpine and Apennine systems on the north and the Atlas system on the south of this trough.

The great valley of the Mississippi, which for geological ages was a vast mediterranean of North America, is in structure the downward flexing fold between the Rocky Mountains or Cordilleras and the Appalachian system of elevations. The Gulf of Mexico is the small remnant of this great basin. A lesser trough of the same sort lies between the western element of the Cordilleras, which constitute the promontory of southern California and the eastern element composing the mass of Mexico. All our continental shore-lines show to a greater or less degree the effect of these mountain troughs in bringing the ocean waters in the form of more or less enclosed seas far into the land. Often these inclusions of the sea serve greatly to diversify the land climates. Thus the peculiar fertility of the Mediterranean shores is in part due to the presence of that vast system of enclosed waters which has been created by the process of mountain-building.

A few years ago it was proposed to introduce the ocean waters into certain depressed areas of the Sahara. Although the area which it would be possible to cover with the sea is less than one hundred thousand square miles, it was objected to the project that it would be likely to change the climates on the northern shore of the Mediterranean, increasing the humidity of that area and making the grape and certain other crops less valuable than at present. There can be no question that the objection was in a measure valid; and we may judge from it how potent is the influence of these great arms of the sea in the complicated equations which determine European climates or those of other continents.

We have now to consider the peculiar effect due to the presence of mountains in a country, — an effect serving to intensify the phenomena of combat on which advance of organic life so much depends. Where the surface of the land is in the form of a great plain, such as the prairies of the Mississippi valley, the area occupied by any one species is very extensive. We may make a journey from the junction of the Ohio and Mississippi rivers northward to Wisconsin, without noting any very great differences in the species of the animals or plants which we encounter. The fact is that in going this distance we vary the temperature, that of the growing season at least, by a very slight amount. The effect of the difference of latitude is scarcely perceptible, being qualified by many other slight differences. The total number of native flowering plants which may be gathered in this field probably does not exceed fourteen hundred; so, too, the insects, the birds, and the mammals, the various forms which depend upon the plant life, are also relatively few in number. Let us suppose this region now to be converted into a mountainous country, having a variety of surface and a relief which we find in the Alps, and note the effect on the variety and distribution of organic forms. We can best guide our fancy in this ideal experiment, by considering the conditions of organic life in Switzerland, comparing them with those now existing on the prairies of the Mississippi valley. If the observer goes to the southern face of the Alps, on the shores of the beautiful lakes of northern Italy, he finds himself in a subtropical climate. The fig, the pomegranate, and other southern plants can in favored sites maintain themselves in the open air at the lowest points of the surface. The vegetation has not only the botanical aspect but the luxuriance which belongs to southern climes. The same almost subtropical character of the climate is shown also in the physical aspect and the general quality of the people as well as in the lower forms of life.

Ascending the slopes of the Alps, the attentive observer notes that for each thousand feet of ascent great changes take place in the character of the plants and in the higher forms of animal life which are dependent upon them. With each gradation of his ascent he enters on the field of new species; and so within the limits of a single day's climb he may traverse all the zones of organic life which he could encounter in passing along the sea-shore from the parallel of Lake Como to the Arctic Circle. In other words, we have within the narrow limits of Switzerland almost as great a range of climate as we find in passing up the low-lying plain of the continent from New Orleans to Great Slave Lake. Within the limits of the area of Switzerland, which does not exceed one half the surface of Indiana, we may find a greater variety of climate and a wider range of organic forms than is afforded by an area of plain-land having several times the surface of that State. The range in the height of the land in Indiana is less than five hundred feet, while in Switzerland it exceeds fifteen thousand feet.

It is not difficult to see that momentous consequences must arise from this packing within a narrow field of the many different kindred species, placed in zones one above another between the base of the mountains and the uppermost zone occupied by life. Each alteration of climate brought upon a given mountain district by geographic change occurring within its own limits or communicated by other mountain movements will lead to a readjustment of the barriers occupied by different species. This readjustment will be brought about by combat of one form with another for the place in which they live or the food on which they subsist. It is true that such a struggle will also occur on the plain; but on the surface of this level ground there are no distinct, clearly drawn boundaries of climate; while in a mountain district each considerable isolated mass is an independent, sharply defined theatre of combat. Each peak is as it were a battlefield, and the amount of contention is vastly enhanced by the narrow limits of the area on which it takes place.

Moreover, in the mountain district manifold chances serve to bring the creatures of the neighboring provinces into contention with one another. Every strong wind carries the seeds of plants or the eggs of insects or indeed their living bodies from one zone into another. Every avalanche that falls serves to displace certain forms from their accustomed zones, and to give them an opportunity of trying their strength in the contention with the occupants of the lower realms. Thus a mountainous district becomes a sort of natural experiment station, where the relative powers of diverse species, their fitness for particular modes of life, are tried in a far more effective manner than is possible in a region of plains. We are thus forced to the opinion that the crowding of species which necessarily takes place in a mountain-built country, provided it is not exceptionally arid in its character, cannot be without influence in favoring the struggle for existence, thus helping the advance in the scale of being.

There is a yet larger view of the effect of mountains in promoting the combat between species. In a continent such as Europe, where a great diversity in the mountain systems favors the localization of life and the development of peculiar forms, the tendency is to develop in separate mountain strongholds particular species, and evolve their militant peculiarities until the forms are fitted to enter into a larger contention with their kindred species in less localized assemblages of life. Thus each mountain district becomes as it were a cradle for the culture of peculiar forms, which in time, when they have been proven by contention on their own ground, may enter upon a wider field of combat.

It will be observed that we have not yet considered the relation of mankind to mountains, and this for the reason that the circumstances which affect the development of man, circumstances arising from the high measure of intelligence with which he is endowed, make it unsafe to rest general conclusions as to the conduct of nature upon his peculiar history. At a later stage in our inquiry we shall take up the development of man, and observe the effect of the earth's surface upon his qualities. For the moment the reader may supply from his memory abundant instances to show how far the localization of human life in Europe which has been brought about by mountain systems has served to make that country the cradle of strong peoples, and to give them strength for the contention which they had in time to undergo.

Limiting ourselves for the time being to the life below man, we see from the foregoing considerations two reasons which lead us to understand why it is that the rate of development of life on the different continents has in a measure depended upon the physical accidents in the way of mountain-building to which the country has been subjected. Every stage in mountain-building means a variation in the climate, a change in the limits of those organic assemblages termed faunæ and floræ, and a consequent increase in the measure of that struggle for existence on which the development of the higher forms so clearly depends. Advance depends on the contention between differences, and mountains greatly favor this combat.

The reader may help his conception of the effect of stress of conditions on the advance of organic life by the consideration of the organisms on the deeper sea-floors. As soon as naturalists obtained a knowledge of deep-sea life, they were struck by the fact that the forms in the abyssal regions of the oceanic fields — say below depths of five thousand feet — were singularly archaic in their aspect. We find there many groups of species curiously like the forms which dwelt in the shallow water along our sea-shores in the early Tertiary and Cretaceous or even in Jurassic periods. It is evident that while the life of the shore, that which is termed littoral in its character, has in modern times rapidly advanced, the forms of the deeper sea-floor have been hindered in their development much in the manner in which the Australian land life has been retarded in its ongoing during the geological ages. The only explanation of this retardation in deep-sea life is that by which we account for the similar slow ongoing of the Australian life, — namely, that by the absence of a sufficient variety of conditions, the general uniformity in circumstances of environment from age to age has failed to supply the whip which has led in other regions to a rapid advance.

Another striking instance which serves to show us the effect of the conditions which environ organisms is found in the state of advance of organic life within the tropics and about either pole. In the tropical conditions of the earth we observe that organic forms attain on the whole less advance than in the middle latitudes. A host of forms which in the earlier geological days were enabled to meet the climatal conditions of high latitudes have gradually been beaten back by the stress of environment until they survive only in regions near the equator. The elephants which in preglacial days, or perhaps even to the close of the last ice period, were plentifully found in the northern parts of America and Europe, and were fitted to meet the conditions of cold winters by their admirable covering of hair, are no longer able to endure those conditions. The same is true of the rhinoceroses and a number of our great mammals, as well as of many other groups of animals.

When a group of organic forms — owing perhaps to the loss of these powers of resistance with old age, which comes upon species and genera as well as upon individuals — is unfit to cope with the stern conditions of high latitudes, it falls back into the great almshouse of the tropics, where though the struggle for subsistence and the combat with enemies may be severe, the creatures are at least spared the contention with climatal ills. By this fact we may measure the energy with which the whips of necessity are applied to the lower life as well as to that of man in the intemperate climates of the earth. Where the rigors of winter and summer alternate, life finds itself in very trying conditions: each winter a sentence of death is passed upon the unfit, and the creatures which cannot withstand the stress must perish or betake themselves to a tropical realm.

In the circumpolar regions, where the trials of winter are extreme, we obtain another lesson which serves our end. In those high latitudes organic forms are borne down by cold; only those which have succeeded most perfectly in adapting themselves to rigorous conditions survive: the greater part of the creatures have to retain life by accepting a deathlike sleep during the period of cold. Those which cannot meet the besetting dangers in this manner or by other protections must perish or betake themselves to more temperate climes.

We have now considered some of the plainest instances of the effect of physical conditions on organic development. Although the facts which we have noted are of a very general sort, lacking the particularization which is desirable in all such considerations, they are sufficiently clear to show us that in the process of the ages the development of life is singularly affected by the physical conditions of the earth's surface.

CHAPTER II.

Nature and Origin of Continents. — Effect of Continents on Seas. — Interaction of Sea and Land. — Salinity of Ocean and Dead Seas. — Transportation of Material from Land to Sea. — Effect of Volcanoes. — Possible effect arising from Destruction of Continents. — Effect of Sea and Land on Organic Life; Conditions of Passage of Life from Sea to Land. — Brief Statement as to Development of Life. — Effect of Mountain Growth; Absence of such Structures on the Sea Floor. — Relations of Mountains to Continental Growth. — Effect of Mountains on North America. — Movements of Subterranean Materials in the Process of Mountain-Building.

The considerations presented in the preceding chapter show us in a general way how intimate is the connection between the irregularities of form of the land and the circumstances — or environment, as Darwinians call it — of organic life. Whether it be on sea or land, the depth or height — or, in other words, the relief — of the surface has a direct effect upon climate, an effect on the measure of crowding of the organic forms within the same field; while all the changes in this element of altitude have a direct and important influence on the phenomenon of migration. The logical order of discussion would have required us to bring these facts into view at the end of our considerations; but at the outset of an exposition such as we have before us it is well to bring such matters to mind, for they enlarge the understanding with which we consider less ample facts, which we now have to face. Heretofore we have considered in a general way certain effects arising from the form of the land reliefs which we term mountains.

We will now turn our attention to the larger groups of eminences on the earth's crust which receive the name of continents. The difference between continental elevations and those of mountains is even at a glance conspicuous. Mountains are sharp flexures in the rocks which compose the earth's crust. In them we may find a single fold more or less worn by atmospheric agents, or there may be a number of parallel ridges crowded together into a chain. In most cases the central axis or the group of ridges of a mountain range constitutes a narrow and very elongate field of disturbance; commonly the length of the system of elevations is ten times or more the width of the disturbed rocks. Continents, on the other hand, are very wide, subtriangular masses of land, their apices pointing toward the south pole while the bases face the northern end of the earth's axis. These continental folds, unlike those of the mountain, are extremely wide in proportion to their height. Thus the great elevation of the earth's crust which constitutes the continent of North America springs from the sea floor a thousand miles to the east of the Atlantic coast, rises very gradually to the summits of the continent, and thence declines rather more rapidly from the Pacific coast to the floor of the ocean on the west. The average width of the North American continent exceeds four thousand miles; while the average height above the sea floor on either side does not much exceed three miles. Thus the continental ridge is about a thousand times as wide as high; while the mountain ridges are commonly not more than fifty times as wide as their height.

Each continent consists of a broad irregular fold of the earth's crust upon which rest the sharper ridges of the mountains. In places, as for instance in the isthmian district of Central America, the continent consists almost altogether of mountainous elevations; while in the northern parts of the field the continental elevation is only composed in a small measure of mountain folds.

The division of the earth into the fields of land and water depends altogether upon the circumstances which lead to the formation of continents. Were it not for the growth of these singular elevations, the sea would be entirely unbroken by land. It is true that here and there volcanic peaks pierce the surface of the wide oceans; but, as we shall see hereafter, the development of volcanic energy depends upon conditions which would not exist if the lands were not present amid the waters. It is easy to see that certain important consequences to organic life follow immediately upon this division of the earth's surface into sea and land. All the higher life of our planet finds its theatre upon the land surface, and finds that surface fitted for occupation by reason of the fact that the seas give it their constant tribute of rain. All the life of the earth depends upon the constant presence of water upon its surface in positions suited for the needs of organic forms. Indeed, our bodies are in a physical sense water-engines driven by solar heat.

If the lands were submerged, all the greatest gains from the development of organic life, all the superior groups of animals and plants, would quickly cease to be. The mammals, except the whales, the dolphins, and their kindred, depend upon the land for their development and maintenance. The birds, the insects, and all the higher plants are likewise limited to, or dependent on, the land areas. Important as are these facts, they are only a small part of the consequences which come from the existence of this twofold division of the earth's surface into sea and land. Nearly all the geological processes are intimately dependent on this method of partition of the earth's surface. In order that we may have before us the general importance of this system of surface division, we must now consider the interactive effect of land and sea in the economy of our planet.

To grasp the particular functions of sea and land, let us take the process of erosion which goes on in any river valley, such as that of the Mississippi. The heat of the sun evaporates the water of the sea. The same solar heat sets the air in motion, and the vapor rising from the oceans is borne in from the marine areas upon the surface of the land, and there falls as rain. In the valley of the Mississippi about two and one-half feet of rain come upon the surface each year. This water exercises two classes of effects by the mechanical energy due to the height above the sea to which it comes to the earth's surface; it flows down the slope of the land, and as it flows wears away that surface. At the same time the chemical properties of the water acting on the rocks rot them, or produce what geologists term a corrosive effect, breaking them into bits fine enough to be taken into solution. The torrents of the upland districts bear them on, uniting their floods in the main channel of the lower river, whence there goes into the sea each year from one twentieth to one tenth part of a cubic mile of broken up materials taken from the earth's crust. The larger part of this material swept away from the surface of the continent and discharged through the mouths of the Mississippi is in the state of mechanical solution, as mud in the water; but probably rather more than one tenth of the whole is completely dissolved as sugar is dissolved in water, before the saturation point is attained. The mud and sand which are in the first or mechanical state of solution fall to the ocean floor, and serve to make the ordinary sediments which accumulate about the margin of the continent. These materials are swept to and fro by the tides and shore currents, and built into that broad platform called the continental shelf, which extends along the margin of the seas, forming the shallow water-belt which generally fringes the continents. In this way the larger part of the sediments which compose the rocks such as sandstones, clay-slates, and conglomerates, are gathered about the flanks of the continents, and built into the sea floor to be converted into land in the subsequent uprisings of the continental area.

The material held in the state of complete solution is not taken to the bottom of the sea by gravity, but may remain suspended in the water for an indefinite time. Its history subsequent to its escape from the land constitutes one of the most interesting chapters in the earth's physiology.

We all know that the sea is salt. This evident salinity is due to the fact that certain dissolved substances brought out by the rivers, such as sodium chloride, or common salt, exist in large enough quantities to be evident to the taste; but it is only of late that the chemical study of sea waters has shown us that they contain something of almost, if not quite all, the substances which enter into the composition of our rocks. Thus, for instance, many of our metals, even the rarer kinds, are present in sea water. Silver exists there in such quantities that practical metallurgists at the smelting-works in Swansea and elsewhere maintain that the copper from ships' bottoms amalgamates with the silver in the water through which the vessel passes on its way through the sea, and thus in time this copper becomes so enriched that it is profitable to extract the precious metal from old sheathing. Iron, gold, lead, and various other substances which are of difficult solution combine as chlorides or other chemical associations, and are also dissolved in the ocean waters. There can be no doubt that these substances are present in the sea, and that through the process above described they are maintained in solution. We have in our salt lakes — such as the Dead Sea of Judæa, the Salt Lake of Utah, and thousands of other similar basins — sufficient evidence that rain-water is constantly bearing mineral matters from the land to the oceans. Wherever a lake is formed in an area so dry that the tributary waters are unable to fill the basin, — where, in a word, the drainage of the lake is through the air and not through a river, — we find that the water becomes charged with dissolved substances in just the manner in which the sea is laden with these materials.

It is to this richness of the sea in mineral substances of various kinds that we owe the extensive development of organic life which takes place in its waters. Marine plants find excellent nutrition in these materials. To them the water affords the substances required for their rapid growth. The result is that the sea is occupied by a great variety of water plants, while it would be destitute of such organisms if it had the purity of a mountain stream. Pure, however, as are these streams of the hills, they are constantly dissolving substances from the land in small quantities, and carrying them to the sea, from whose waters there is no escape, except through the machinery of organic life. Plants take the materials from the sea water, and marine animals obtain them at second hand from the plants, or with one further step through the bodies of other animals which they may consume; and the dead bodies of animals and plants alike are built into the sea floor in the form of our limestones and other rocks composed of organic sediments. In this way the deposits formed on the sea-floor are immediately dependent for the materials which compose them on the wear which takes place on the land, either in the basins of the rivers or along the line of the sea-shores.

A portion of the substances which enter into the deposits of the ocean floor are derived from volcanic eruptions. It now appears that this contribution from volcanoes may amount to a considerable fraction, perhaps more than one half of all the sediments which go to the bottom of the wider seas; but even this volcanic waste would probably not be ejected save for the contribution of sediments which come to the ocean floor from the lands. As this effect of volcanic action is of much importance in the physiography of the earth, we must give it some consideration. It now seems tolerably certain that volcanoes are to be explained in the following manner, — in a way which shows them to be dependent on the laying down of strata worn from the land upon the ocean bottoms; and this for the following reasons : —

All volcanic explosions of characteristic nature are essentially outbreaks of steam at high temperatures. The lava and the ashes are accidental elements in the outrush of steam, seeking to escape under the tensions given to it by their great heat. This steam is made from water imprisoned in the rocks at the time when they are laid down on the sea floor. The beds of sand, mud, and lime which are now gathering on the bottom of the seas contain from five to twenty per cent of water built into their interstices when they were formed. In time, when later accumulations of strata are imposed upon them to the depth of many thousand feet as the sea bottoms slowly sink down, a thick blanket of rock is laid upon the lower layers of sediment, which, from the conditions of their construction, contain a large amount of water. This blanket of sediments is a good non-conductor, serving to prevent the escape of the internal heat, which is always creeping out through the earth's crust and radiating away into the stellar spaces. The result is that in time the lower portions of the stratified outer parts of the earth attain a verv high temperature. The water energetically tends to pass into the state of steam, and takes advantage of every chance to burst forth into the open air, blowing before it the more or less broken-up rock, or sending forth a tide of molten stone in the form of lava. Where the energy of eruption is great, this lava may be blown into bits so fine that they will float for a long time in water, or even drift about in the air before coming to the ocean surface; and in this way the material is distributed over a wide surface of ocean floor, and so contributed to sedimentary deposits.

We thus see that the process of sedimentation due to the accumulation on the sea floor of sediments from the lands gives rise to volcanoes. Although the materials thrown out by volcanoes doubtless contribute largely to the growth of sediments on the sea floor, the volcano is itself the product of processes which could not exist but for the presence of land on the earth's surface.

Let us conceive that by some extraordinary, we may say indeed unexampled, accident in the earth's history the continents were all brought below the level of the sea, so that the ocean were universal. The immediate effect would be the destruction of all land life and the arrest of deposition of all mechanical sediments, those carried down in the form of mud by rivers or removed from the shore by the waves. For a while the marine plants and through them the animals of the sea would be sustained by the stored harvest of dissolved matter contained in the ocean waters. Slowly the oceans would be exhausted of the pabulum which maintains marine life, and gradually the creatures of the sea would be starved and disappear. A few forms might maintain themselves in the mud on the ocean bottom where the waters would take up a certain amount of material by the process of re-solution; but the ocean floor would be in a geologically short time even more barren to life than are the wastes of the Sahara or the desert fields which lie beneath our great lakes, where there is but little organic life. As all the important physical history of our planet which is recorded in the rocks has depended upon the process of sedimentation, the world would even in a physical sense be quite other than it is, but for this division into sea and land.

It is not only in the physical development of the earth's surface that this division into land and sea is of importance; it is of even greater effect in the history of organic life. We have already noted in a glance the fact that the land life is very much higher than that of the sea. All organic forms doubtless originated within the waters. The roots of all the great genealogical trees, the foundations of the series which lead up from the basement of life to the higher organization exhibited in plants and animals, must have found their first station within the waters of the ocean. Thus we trace back the mammalian series, to which we ourselves belong, to the fishes. The insects we follow downward to the marine articulated animals. Our higher land-plants are the descendants of organisms which laid the foundations of that life in the sea. The ocean is indeed the cradle of all the groups of beings which have attained a lofty structural or intellectual life.

Although the sea is the cradle of all our organic series which find a place upon the land, none of these series attain the highest degree of their development within the oceanic waters. It is only on the land that we find the conditions which permit the highest development of life in any of the great chains of being. The causes for the limitation of the higher life to the land are probably manifold; but there is one effect which in the present state of our knowledge is quite patent to our understanding. All marine forms, except certain small groups such as whales, which have by a process of degradation descended to conditions of oceanic life from land-inhabiting ancestors, are essentially limited in their breathing to the air which the water may contain. Although the ocean waters contain a good deal of air in solution, the quantity per cubic foot is only a small portion of that which is present in the atmosphere. In order to obtain a given amount of respirable oxygen, the fish has to pass over a given surface of gills many times as much bulk of water as we pass of air over a like area of lung surface. Now, it is a well-known fact that the energy of the body depends upon the amount of oxygen which can be appropriated to those decompositions or reactions which take place in the process of breathing. We may fairly say that all animal bodies are engines which depend on combustion for the supply of force required to maintain their functions. Therefore in breathing oxygen from the atmosphere, the land animal has a very great advantage over the creature of the sea, due to the rapidity with which he can make avail of this organic resource. It is safe to say that the land animal has twenty-fold the advantage in breathing that any marine creature such as our fishes can have, and thereby is enabled to effect a much more swift alteration in the chemical constituents of its body, and thus to secure the energy requisite for the maintenance of its bodily and intellectual activities.

To win a way from the lower field of the waters to the higher level of the land life required time, vast even in a geological sense, during which the animals and plants were undergoing a gradual transition which might enable them to meet the difficult conditions which the land imposes. The animal or plant in the sea is generally secured from all save slight changes of temperature. With the exception of the whales and a few other forms which have descended from the land into the sea by a process of retrograde change, all the marine species are, as we express it, cold-blooded; that is, they depend upon the element in which they live for their temperature. In general the temperature of the sea, excepting the more superficial layers of water, is singularly invariable. The facts already noted, such as the limitation in the extension of the blue-fish, as well as many experiments in marine aquaria, show us that marine forms are very intolerant of changes in temperature of the medium in which they live. In order to meet the conditions of the land in a successful manner, at least in regions which are subject to any considerable changes of temperature, the higher vertebrates had to invent the warm blood which we find in birds and mammals. This invention was attained slowly and with difficulty; for not only had the circulation to be contrived, a system of lungs in place of gills, but a protecting covering to retain the heat, such as hair or feathers, had to be arranged; or if the creatures were destitute of such protection as are our serpents, habits had to be invented to enable them to lie dormant during the winter season at some depth beneath the surface where they would be protected from frost.

We are aware how quickly all our marine forms dry and become shrunken when exposed to the atmosphere. This is because their skins are unfitted to resist the dryness of the air; the water of the body pours through them and evaporates into the atmosphere, thus quickly bringing about the death of the creature. The invention of the air-proof covering, the beautifully contrived skin, which retains the moisture of our bodies, was also attained with difficulty. The same is the case with eggs of our marine animals. They, too, quickly desiccate when exposed to the air. It is a familiar fact that the eggs of our birds and insects are provided with either a tough or solid envelope, which serves to retain the fluids until they have been absorbed by the young creature. In the case of plants the process of preparation for land life was almost equally difficult. All the higher forms of aerial vegetation depend upon the roots for water supply. In the marine form the plant is completely enveloped in water, and may take its supply of food through any part of its surface. Upon the land the plant has invented the contrivances of the root, by which a portion of the body is pushed down into the water-bearing portions of the soil, and there obtains the solid or ashy parts of its structure in substantially the same manner as it did in the sea.

After life had found its way from the sea in the lower forms of terrestrial beings to the surface of the continents, a vast series of changes had to come about in order to lead upward from the creatures which had just risen above the marine functions to the higher forms which now inhabit the land. Between the earliest land ancestors of man and his present state, there have been very numerous stages in the process of development, each requiring a long time for its inception and completion. A thousand years was but a day in the vast series of experiments which have led to our more perfect land animals. If at any stage in this process the lands had been generally submerged beneath the sea, all their inhabitants would have been destroyed. The paleontological records, the chronicles of the great stone-book where the stages of the organic series are written in the unmistakable characters of fossils, show us clearly that no such general interruption in the progress of the land life has ever taken place. From the organic remains of our rocks we are justified in the assertion that since the time when life began to adapt itself to continental conditions, there has been no destruction of these fields of its higher development. We therefore may assume that our continents are great permanences. They change their form, — now a portion bending downward beneath the sea, while another part emerges from the waters; but all the changes which they undergo are made in such a manner that swaying to and fro, abandoning the sunken parts and moving into the newly elevated areas, the land life has always been provided with its appropriate station.

We are thus brought to the point in our inquiries concerning the nature of life where we must consider the conditions of these continental movements involved in the creation and development of the land areas. We must see how the vast and apparently rude machinery which has created the lands has operated so as not to endanger this frail organic life.

So far the formation of continents has formed a stumbling-block in the way of geological theory. There has been a great variety of hypotheses framed to account for their formation; but none of them have proved very satisfactory. I propose now to set forth an hypothesis of continental growth, which seems to me to meet the principal difficulties which we encounter in the endeavor to frame a theory for their origin. I have attained this conception mainly by a study of the distribution of mountains.

It seems to me evident that mountains are phenomena which are limited to the surface of the continental folds, and this for the following reason;

namely, if we consider the distribution of the known mountains over the surface of the earth, we find that they exist on all the continents. No very large field of land, however level its surface, appears to be without these foldings of the underlying rocks. Even where the dislocations do not manifest themselves in the striking irregularities of the surface, we often find that they exist in the structure of the rocks. Thus, eastern Massachusetts is destitute of high mountains. Wachusett, the loftiest peak, rises only a little over two thousand feet above the level of the sea. The greater part of the area of southeastern New England is a rough plain-land, only slightly broken by irregular prominences a few hundred feet in altitude; but the geological structure of the country shows clearly that great mountains once existed in this district. It is likely that if we could go back of the Jurassic period, we should find several ranges in this section having a height of many thousand feet, perhaps, indeed, with the relief of Alpine elevations. There can, in a word, be no question that mountain-building is the ordinary if not a necessary condition in all continental growth, for the reason that there are no continents without mountains.

A little further inquiry shows us that the height of the continents is proportionate to the amount of mountain growth which has taken place in different parts of their fields. Thus, the central portion of Asia, where mountain-building has been very active, has its surface much above the level of any other continent; and in general we may say that the elevation of the continent is roughly proportionate to the amount of mountain-building which has taken place upon it.

Turning now to the height of mountains, we find on the earth's surface numerous peaks which exceed fifteen thousand feet in altitude. It is probable that all the continental masses, except Australia, have numerous elevations which exceed this altitude. In Asia peaks of this height are to be numbered by the hundred. Bearing this fact in mind, let us turn our attention to the question of whether mountains exist on the sea floor. The first point to notice is that the deeper seas — that is, those parts more than a few hundred miles from the continental border — have an average depth of about fifteen thousand feet. If, therefore, mountains develop on the sea floor as freely as they do upon the land, we should expect to find the deeper seas, which occupy more than two thirds of the surface of the earth, scattered over with these lofty elevations. There should be hundreds if not thousands of islands formed by mountain peaks which came to the surface of the waters. The fact is that save just along the shore-lines, or, in other words, within the limits of the submerged portion of the continental folds, there are no mountains whatsoever. The occasional isles which break the surface of the deeper oceans consist either of volcanic cones or of coralline accumulations, which in most cases appear to have been constructed upon the crusts of submerged volcanoes. Thus, from a simple inspection of the distribution of mountains, we come to the conclusion that they do not appear to grow on the sea floor as they do upon the surface of the lands.

This consideration concerning the growth of mountains on the sea floor becomes the more striking when we consider that while a mountain growing in the air from the surface of the lands is subject to constant down-wearing, and is continually losing height by the action of atmospheric agents of erosion, no such effect would take place on the submarine mountain until it came to the level where it would be open to the assaults of the waves. Our land mountains have in almost all cases lost a large part of their height by the action of erosive agents. Thus Ramsay has computed that in the case of the mountains of Wales at least forty thousand feet of rocks have been taken from their summits as they slowly grew upward. So, too, with the Alps, if we prolong their curves so as to restore in our diagrams the parts which have disappeared in the battle with the rain and ice, we find the vast reliefs which have been worn away. In places ten to twenty thousand feet of strata have been thus removed from the summits of these elevations.

It is not to be supposed that our mountains at any one time had such prodigious heights as they would exhibit if we restored to their summits all the materials which had been worn away from them. It is probable that the greater elevations now existing on the earth's surface extend upward as far as mountains have ever done in any state of the earth's history. The fact is that these elevations have worn as they have grown; indeed, as we shall see hereafter, the wearing is probably a condition of the growth. It is evident, however, that if the mountains grew upon the sea floor at anything like the rate that they build their arches under the air, we should find peaks on the submarine ridges at least quite as numerous as they are upon the land; and, as before remarked, they are conspicuous by their absence in that portion of the earth which is occupied by the wide oceans.

Submarine soundings show us that there are many irregularities on the sea floor, which in their form have appeared to some naturalists mountain-like. Thus, in the central portion of the Atlantic, as well as in other seas and oceans, the sounding lead has detected a number of sharp ridges which do not extend to the surface of the water, and a hasty judgment has led some observers to the conclusion that such are submarine mountains; but in all cases it appears more reasonable to suppose that these elevations are in their nature volcanic than to assume that they are such arches of the crust as constitute true mountains. In the case of the Atlantic ridge, we have at its northern extremity unmistakable volcanoes in the region of Iceland, and the Azores afford similar evidence in the south. We may fairly presume that the intermediate elevations commonly have the same volcanic character.

From considerations such as these, which might be greatly extended, we come to the conclusion that mountains are essentially limited to the continental masses; while volcanoes, that other type of great elevations on the earth's surface, are normally developed on the sea floors or in the narrow belt of land about the margins of the greater ocean basins. Having established the proposition that mountains are land phenomena, that is, in some way connected with continents, we are forced by logical considerations to the hypothesis that they are in some way causatively connected with land growth; either mountains are the effect of continental growth, or continents are produced by mountain-growing, or the two are the effect of a common cause. In one or the other of these modes of action we must seek the cause of mountainous elevations. I propose now to set forth a view concerning mountain-building which is founded on the foregoing considerations.

Geologists have already noticed the fact that each important mountain elevation usually consists of two parts, — first, the sharply flexed strata which compose the mountain proper; and next, a sort of pedestal or foundation of uplifted strata which lies on either side of the mountain ranges, and sometimes exists in the form of mountain-walled table-lands in the midst of the sharply flexed rocks. Thus, if we journey from the Mississippi River toward the Rocky Mountains, we find that our path rises steadily upward over the surface of massively upborne rocks, not folded into the mountainous form, until when we come within sight of the mountain walls of the Cordilleras we have attained a height of five or six thousand feet above the level of the sea. This great eastward-sloping table-land of the Cordilleran system extends along the greater part of its eastern flank from the extreme north to the far south of the American continent. Only in the region of Central America, where the elevations diminish in height, is it inconspicuous. In the isthmus proper, where the mountain folds are for a short distance wanting, it nearly or altogether disappears.

In the Appalachian district of elevations we have, both on the eastern and western slopes of the range, more or less distinct evidence of similar uplifts of the strata, which bear about the same proportion to the total height of the mountains as do the greater table-lands built on the east of the Cordilleras. The continent of North America appears to be in the main composed of these massive elevations, which have grown proportionately with the growth of the more dislocated strata which have folded into the true mountain-built attitude. In other continental areas mountains generally exhibit very much the same type of structure. Thus in the Italian peninsula, where a range of low mountains projects far southward into the Mediterranean, we find the promontory consisting in part of table-land elevation, —

that is, of rocks uplifted without flexure,—and in part of flexed rocks or true mountains. Although our knowledge of the reliefs of the earth is not sufficient to enable us to assert that this is an invariable feature, all that has been observed warrants the conclusion that the process of mountain-building is usually attended by the formation of table-land elevation, and that the continental masses, apart from the portion of the areas which are involved in the mountain folds, is in the main made up of these massive uplifts on the crest of which the mountains develop. We are now prepared to consider the processes which lead to mountain growth with the view of determining whether we may not find in these processes a means whereby we may account for the growth of the great land-masses.

Geologists have very generally considered that mountain flexures as well as the larger foldings of the continents on which they rest are due to the loss of heat in the deeper parts of the earth. We know, by actual experiment from mines and deep well-borings as well as by observing hot springs and volcanoes, that the earth is hot in its greater depths, far hotter than it is in the outer parts. We furthermore know that a body in cooling necessarily loses most heat in the parts which are hottest, for the very simple reason that in those regions there is the most heat to lose. The outer portion of the earth, from an early age bathed in the cold of the celestial spaces, where the temperature is some hundreds of degrees below zero Fahrenheit, long ago lost the most of its original temperature. The heat of the depths of the sphere has been hindered in its escape by the non-conductive nature of the outer crust, and has therefore slowly flowed away. Each day there escapes from the deeper parts of the earth enough heat to melt a number of cubic miles of ice; probably somewhere between twenty and two hundred cubic miles of ice would be converted into water by the daily outflow of the temperature. We know furthermore that the earth's interior must be composed of materials which shrink in cooling; therefore we have to believe that the central parts of the earth are always diminishing in bulk from the loss of heat, while the outer parts contract but little.

The most of the loss of volume due to the escape of heat is in the deeper parts of the earth, very little of it occurring in the relatively cool outer rocks. In consequence of this refrigeration the internal mass tends to withdraw from the outer shell toward the centre; but as this outer shell is extremely heavy, being many miles in thickness and composed of compact material, it necessarily follows that the shrinkage of the deeper parts takes place step by step, never allowing any interspaces between the outer and the inner part to form. The result of the contraction of this internal region, while the external does not contract, is necessarily a folding of the crust or some other movement which will permit the adjustment of the rocks, which is evidently required. If the earth's outer part were of perfectly amorphous rock, without any lines of weakness, — if it were, in a word, throughout composed of crystalline material such as we find in a coherent mass of granite, — the probable effect of this internal contraction upon the outer part would be simply to crush it into fine bits, which would then creep over one another, and so effect the movement necessary to relieve the strain caused by the contractions of the deeper portions of the sphere. In this case we should probably have no distinct mountain ridges, but only at most irregular bulgings of the earth's surface; but in fact all the rocks we know, certainly all for a score or two of miles below the crust, have lines of weakness which favor some particular form of mountain-building under the strains which we are now considering.

The greater part of the known rocks have more or less stratification or bedding, — some remnant of the division into horizontal planes which characterizes all rocks when they are laid down upon the sea floor. Even our apparently massive deposits, such as the granites, are divided by joint planes, and in certain cases retain a part of their original stratification in their structure. The result is that under the pressure brought about by contraction, these rocks flex somewhat in the manner of the leaves of a book when they are urged together by lateral pressure. The yielding where the rocks are thin-bedded may be easy, as in the case of these sheets of paper, and give rise to innumerable slight folds, which in turn are folded into larger folds; the secondary folds accumulate into yet greater flexures, and so slaty rocks often become snarled almost as a tangled skein of thread by the tortuous pressures to which they have been subjected. Massive thick-bedded rocks, such as the sandstones, exhibit less considerable though manifest flexing under these strains; and so we find that the extent to which folding is effected is in a way rudely proportionate to the extent to which divisional planes favor the movements by which the rocks are crumpled into mountainous forms.

The continent of North America, especially in the Appalachian system of dislocations, exhibits all grades of the effect produced by mountain-building forces on rocks of diverse resistance to strain. Thus in the Narragansett basin of Rhode Island, where a great part of the strata are of soft shales formed during the Carboniferous period, the thin pliant beds entangled in the old mountain arches, the projecting ridges of which have been entirely worn away, exhibit a surprising complication of folding; while in the same area certain massive conglomerates, beds of closely cemented pebbles having united layers forty or fifty feet thick and almost without stratification planes, are hardly thrown from their original attitudes by the pressures which have so complicated the more yielding strata. Studying the section from central Tennessee, through the mountains of eastern

Tennessee and western North Carolina, we find that the millstone grit of central Tennessee, which has a thickness of two or three thousand feet and is very massive bedded, has hardly yielded at all to the pressures which have violently disturbed the thinner bedded rocks which lie in the valley of the Holston River.

We may therefore regard our mountains as the result of the internal strains arising from contractions acting upon the rocks provided with divisional plains, and therefore fitted as are the leaves of a book, or a series of pasteboard sheets, to fold under the action of compressive forces.

When mountain-building forces operate upon a section of the earth's crust which is favorably situated for folding, they tend to lift the rocks into great billowy arches, the crests of which are in a general way parallel to each other. We may observe many familiar instances of similar movements in our ordinary experiences. Wherever materials used in the arts are in any way caused to swell or enlarge by taking in moisture or by the increase of heat, we find that they assume this form. Thus the asphalt on our sidewalks when expanded by the summer heat is cast into ridges. So, too, a thin sheet of wood placed on the floor in the shape of veneering will at times take in moisture and warp into small ridges; even the ice in our ponds forming at very low temperatures and afterward expanding in warmer weather, often forms sharp, mountain-like ridges around the shores, — elevations which are developed by the pressure which the enlarged ice exerts against the shore. Ice is a substance of proverbial brittleness, more brittle indeed than any of our rocks; and yet, as we perceive, when in thin sheets or in many cases an aggregation of thin sheets produced by successive freezing and thawing, it readily flexes under the action of continuous, slowly operating, and powerful pressure.

Let us now consider what takes place when a mountain-fold is uplifted into the form of an elongated dome such as we find exhibited in normal mountain-built countries, as, for instance, in the Alleghanies of Pennsylvania. We see that the tendency must be to form a great cavity beneath the ridge of the mountain, a hollow arch, which if left open would have perhaps a height of a mile or more, a width of four or five miles, and a length of a score or two of miles, while the uplifted mass of rock would have a thickness of several thousand feet. We know by well-ascertained facts that no such cavity can actually be created, for none of our rocks are strong enough to support themselves in such attitudes as the supposition implies. If we could by any contrivance produce a hollow space of this nature, the weight of the superincumbent material would inevitably crush the rocks into powder, and the mass would disappear in the cavity in the form of comminuted rock. We therefore must believe that in all cases this space is filled in with material which is forced into it as the arch above is formed. This conclusion does not rest upon theory alone. We have in our worn-down mountains amply sufficient evidence to warrant the conclusions that in all cases the domes of these elevations are supported by rocky matter squeezed from below or from the sides into the space.

Taking the natural sections of the mountain arches, we commonly find that granites or similar rocks have been packed in beneath the upcurve so as to support the rising mountain at every stage of its upward growth. It appears indeed, in all cases where we can get a clear view of the facts, that this incoming of matter which underpins a mountain is usually greater in quantity than is required to support the arch. It in a measure serves also to uplift the unarched stratified beds on either side of the ridges so that they lie at a higher level than they would have were it not for this material which is forced in beneath the dome. There can be no question that the elevation of the table-land or unfolded rocks on either side of the mountain arch is a concomitant of this movement of the deep-seated and softer rocks of the crust, softened because of their heated condition, toward mountain upcurves; for wherever we get a section through the table-land, we find that this elevation is also supported by a similar underpinning of material, which we may fairly suppose to have moved on beneath it concurrently with the mountain-folding. Therefore we may advance a step in our definition of mountain elevations. We may now say that they usually consist of foldings in the more flexible outer parts of the earth's crust, which are supported by deeper-lying unstratified material which has been softened by heat, and thereby, though perhaps not exactly fluid, enabled to flow in beneath the mountain curves. We may say, further, that this underpinning material was not only forced in beneath the mountain arches, but also accumulated to a great extent beneath the beds on either side which have not been flexed by the mountain-building pressures.

If the continents are made up of an aggregation of mountain pedestals, and if the development of these pedestals is due to mountain growth, then we come to the conclusion that continents are essentially elevations of the crust formed as the concomitant of mountain-building. All the facts now known concerning the relation of continents and mountains serve to affirm this hypothesis. We have seen that there are no continents without mountains, and evidently no mountains similar to those on the land surface on the deep-sea floors. If any mountains exist in those great hidden fields, they must be so unlike the ridges we know on the earth's surface that they do not deserve to be classed with them. Any further analysis of the facts we have already given would carry us too far from the substance of our inquiry. Although it is not in a scientific sense legitimate to assume that all continental growth is effected as a concomitant of mountain-building, the facts appear to me to be sufficient to warrant the assertion that the portions of the continental masses above the level of the sea are in the main, if not altogether, the concomitant of mountain growth.

It may appear at first sight unreasonable to suppose that the material beneath the mountain arches is as free to move into the arches of the uplifts as our supposition requires. The geologist, however, knows many facts which go to show that at a little depth beneath the crust, in the outer verge of those high temperatures which exist in the earth's interior, rocky matter in a state of more or less complete fusion is able to move with exceeding ease for great distances beneath the crust. The best evidence we find of such ready subterranean movement of the materials in the earth's depths is afforded by volcanic ejections. A volcano is essentially a steam-jet, and the steam almost certainly is derived from water buried in the rocks at the time of their formation.

The quantity of matter extruded by a volcano is very great. We get an inadequate sense of its mass from the cones which are accumulated about the point of ejection. Thus in the case of Ætna, — a volcano, vast though it is, of the second order of magnitude in terrestrial cones, — we find in and around the elevation a mass of ejected rocky material which amounts in volume to somewhere near one thousand cubic miles; yet this prodigious mass of matter is only a small part of that which has been ejected from the vent. The larger part of the ejections from a volcano are probably in the shape of water and other vapors which pass away into the air. Of the solid or earthy matter thrown out, a very great, probably in most cases by far the larger, part is in the form of fine dust, which floats away for great distances, often darkening the air over a wide field. Thus in the case of Vesuvius, in two different eruptions the skies at Constantinople had at midday a midnight darkness, owing to the large quantities of dust drifted away from that cone, beclouding the air for a thousand miles from the point of ejection. The great eruption of Krakatoa so charged the earth's atmosphere with dust that for two or three years our sunsets and sunrises were made to glow by the reflection of the light from the suspended matter. It seems likely from certain computations which rest upon approximate data that in the case of Ætna, somewhere about four thousand cubic miles of matter must have been ejected during the brief geological history of that cone, — a history which extends back only to the early stages of the Tertiary period, or as we may say to the geological yesterday.

As all the rocky materials blown out from the crater of Ætna are surcharged with water, it is safe to assume that it comes from no very great depth in the earth's interior. It appears necessary to suppose that it is from that part of the crust which has been laid down on old sea floors, and buried for a few miles in the depths of the earth by subsequently formed accumulations of rocks. All the evidence is against the supposition that the ejected substances come from the central portions of the earth. We thus have the surprising fact that from a vent such as we are considering, there may be discharged in the course of a few geological periods an amount of matter sufficient to cover the whole of Massachusetts and Rhode Island to the depth of nearly half a mile. It would appear a natural consequence of this vast removal of matter from the crust that the roots of the volcano would sink downward and come to occupy a great concavity. The fact is, however, that notwithstanding this vast discharge of lava, ash, and steam through the vent of Ætna, the surface on which the volcano rests has been gradually uplifted since the time when the crater began to cast forth its materials. It has actually risen to the height of a thousand feet or more above the original level which it occupied. This elevation of the basement of a volcano coincidently with the throwing out of a vast amount of material which presumably is not taken from great depths within the earth, but comes from its more superficial parts, is not a peculiar feature of Ætna. It may be observed in many volcanic districts, and there is reason to suspect that it is a frequent concomitant of eruptions.

The only way in which we can account for the uprising of the basis of a volcanic cone or even for the failure of the region to subside, is by the supposition that the materials which are discharged from the vent migrate horizontally beneath the crust of the earth for great distances toward the point of escape, driven to their movement by the action of expanding vapors, principally that of steam.

It is not in our way to inquire further into the peculiar phenomena of volcanic action; but these wonderful features in the physiography of the earth serve to show us that such a hypothesis of the migration of rocky matter as is required in the supposition concerning the growth of continents and mountains is not irrelevant, but may be fairly assumed in the development of our hypothesis.

Having thus laid the foundation of our theory as to the formation of the continental elevations, we may next proceed to consider the process of land growth and its relation to the development of the life which has thereby been provided with a theatre for its evolution. We may thus hope to see something of the order in the evolution of geographic features which has controlled the development of organic life.

CHAPTER III.

Permanence of Continents ; Evidence that their Areas have been Sea Floors. — Evidence of slow Growth of Mountains. — Proof that the Continents are ancient. — Evidence from Organic Life ; from the Physical Structure of Sediments. — Devonian Black Shale. — Continental Shelf ; Conditions of its Formation. — Progressive Advance in Development of the Continent from Cambrian Time to the present Day. — Successive Positions of Shore-line. — Variations in the Form of Continent ; Subsidence during Glacial Period in Northern Portion ; corresponding Uplift in Southern Portion. — Evidence from the West Indies Islands ; from Florida Rocks — Summary.

Our preliminary inquiry into the condition of continental growth appears to indicate that the great lands we term continents are the result in good part at least of mountain growth. The greater are substantially consequent on the development of the lesser elevations. The principal difficulty we encounter in this hypothesis is that it does not provide us with a beginning. It does not tell us why at certain points on this earthy ball mountains grow, and by the growth of their pedestals and foldings lift a portion of the earth's surface above the plane of the sea. It is something, however, if we esteem the inquiry sufficiently successful to show us in a general way that the two types of irregularities of the earth's surface, the continental masses and the mountains, are due to one and the same mode of action.

The next problem before us concerns the measure of permanence of these important reliefs which in the form of the dry lands afford the principal theatre of the higher realms of life. On this point the opinions of students of the earth are still somewhat divided.

When geologists found that near the summits of many of the highest mountains in every part of the world the rocks were composed of sediments worn from yet older lands containing fossils which lived on ancient sea floors, they naturally came to the conclusion that the continents had undergone great changes in their positions, at one time what is now land being deep sea, and at another time what is abysmal sea floor having been dry land. To certain minds the notion that the earth has been the seat of violent revolutionary changes appears to be singularly agreeable. Revolutions of Nature, like great battlefields, have a fascination to many folk, particularly when they are considered as far-off disturbances. The earlier geologists regarded the earth's history as presenting alternate periods of brief violent action and of long enduring repose. In the periods of disturbance the lands were elevated above the sea or lowered below its level, the mountains were swiftly built, and life was swept away by the commotions in the course of time, to be recreated by the Divine act. Gradually, however, with the advance of science, it was seen that this theory of catastrophic violence at certain stages in the earth's history was unsupported by the facts. We can prove in the case of many great mountain ranges that they have been gradually uplifted to their present altitudes; that they have grown indeed so slowly that there may never have been a stage in their development when they moved upward with such violence as to destroy the animals and plants which dwelt upon them.

The evidence of the slow growth of mountains comes to us in several diverse ways. In part the proof is of a somewhat complicated nature; in part it may be perceived by the ordinary observer. One of the simple proofs of a gradual gain in height is afforded by the many cases in which a considerable river passes directly across the line of a great mountain fold or fault, dislocations such as necessarily occur in mountain-building. In either of these cases we may find a stream passing transversely across the mountain, cutting it through from top to bottom, under such circumstances as to make it plain that the river was on the ground before the elevation was formed. The moving waters of the stream were able at every step in the growth of the elevation to cut its bed downward more rapidly than the mountain-building forces elevated the rocks. If at any one time the current had not been able to make headway against the barrier which the upheaval of the surface tended to raise to its course, it would have been deflected, and the ridge would have remained unriven. Now, the cutting power of a stream is commonly limited within narrow bounds. It can in most cases only cut away rocks at the rate of a few feet in a century, and consequently the upward movement of the strata could never have much exceeded this rate.

Similarly, where a fault exists with a great upthrow on one side and a corresponding downthrow on the other, if the stream flows toward the side which is upthrown and has cut its way through the rocks, we must conceive the dislocation to have taken place with such slowness that at no time was a dam formed sufficiently high to prevent the passage of the waters. If such a barrier had come to exist, through a sudden upward movement of the faulted rocks, we can often prove that the river would have been deflected into a channel which would have carried it around the elevation. Evidence of this kind has been gathered in the case of but few mountain arches in the world; it is indeed not of a nature to be readily discerned. We may yet assume that the phenomena of mountain growth does not naturally lead to sudden disturbances of great violence. As the earth's heat in its internal parts is diminished, the strains accumulate and the rocks yield in a way which even in a geological sense is slow. We can no longer, as did the geologists of the last century, conceive the Alps or the Alleghanies or any of the great elevations of the earth as thrown up at one stroke, but must regard them as structures of gradual growth. They are perhaps growing at present at about the same rate as in all stages of the past.

Inasmuch as mountains and continents clearly develop together in something like the same rate of movement, it is no surprise to find that continents are not, as the earlier students of the earth conceived them, the accidents of the geological ages; but they are rather great, slowly evolved permanences in the structure of the earth.

The proof that our continents are old, that they are of vast antiquity, even in a geological sense, comes to us in part through the history of organic life, and in part from the character and distribution of the sediments accumulated on the sea floor and elevated in the land-masses. The facts which go to support this proposition are so numerous that the weight of the argument in favor of the permanence of continents cannot be adequately given in a brief way. The most that can be done with this part of our exposition is to indicate the general nature of the evidence on which these conclusions rest. These are as follows: —

Each of the continental masses has, as we have already had occasion to note, an assemblage of life more or less peculiar to itself. A naturalist with a broad and accurate knowledge of organic forms would have no difficulty in determining the continent whence came any considerable collection, either of animals or plants. As long as we believed that each organic species came into being as the result of a direct and mysterious creative act on the part of a supreme power, this peculiarity in the distribution of life had no evident bearing on the theory of continental history. As soon, however, as we came to accept the hypothesis that living forms attained to their peculiar shapes and functions by a gradual transition, each important step requiring a considerable period for its accomplishment, it became evident that the lands could not have had anything like the instability in their position which was of old attributed to them. Thus, in the case of the armadillos of South America, a group of forms now peculiar to that continent, we have to suppose that the creature was gradually brought to its present form by a series of transitions which required a great number of species for its completion.

There is no doubt that the armadillo came from an ordinary hairy mammal. The steps which led to the development of the hard plates of the skin and of the concomitant habit of rolling the body into a ball in order to secure protection from its enemies, must have required many geological periods for their accomplishment. Such elaborations of peculiar forms demand that the land area in which they occur shall be permanent, in order that the group in which the changes are taking place shall survive. Furthermore, it is necessary that the continent which is the theatre of the evolution shall remain separate from other land areas. If the South American field had been frequently connected with other land masses, creatures of more vigorous habits would have entered upon the area from other lands and displaced these weak forms.

We see such a process of extinguishing lowly species taking place in Australia to-day. Most of the common wild animals of Europe develop most rapidly in Australia, displacing the ancient native inhabitants. It is a well-known fact that rabbits of Europe have multiplied to such an extent in this southern continent that they are driving out the less vigorous marsupials by occupying their ground and appropriating their food. If wolves or our larger cats, the leopards and tigers, were made residents of Australia, they would doubtless in a very brief time altogether destroy the pouched animals of that region. Thus from a study of the organic life which occupies the region of the continents, we are brought to the conclusion that these land masses have remained from a very remote age above the level of the sea, and that they have maintained a tolerably complete isolation from each other. Now and then the two great land-masses of the Old and the New World which are grouped about the North Pole may have united with each other; but if such connections ever existed, they were probably of a temporary nature.

Similar evidence as to the relative permanence of continents is afforded by the physical characters of the sediments which make up the rocks lying upon our continental areas. In most cases these rocks contain large quantities of coarse detrital matter, evidently worn from the neighboring lands. Only here and there do we find deposits which were manitestly formed on the floor of the deeper seas. Thus in the one hundred thousand feet or so of rock section formed since the dawn of life on the earth's surface within the limits of what is now North America, we find that at least nine tenths of the whole mass is composed of detrital materials or of fossils which show that the shores of the sea in which the deposition took place were not far away from the site now occupied by the strata. Wherever we find conglomerates, coarse sandstones, or muds which have rapidly accumulated, we may be sure that we are near old shores; only the pure limestones and the very fine shales or deposits of volcanic debris can be accumulated at points far from the coast-line. Thus all the mud and sand and small pebbles which escape from the Mississippi River descend upon the floor of the Gulf of Mexico within a short distance of the mouth of the stream; only the completely dissolved matter, that which does not discolor the water, finds its way to a great distance from the coast.

To conceive the nature of this evidence drawn from the composition of the rocks, it would be well to note certain peculiarities of the most characteristic deep-sea deposit which has yet been found in North America. This is the Devonian black shale, so extensively developed in the valley of the Ohio River, and the neighboring parts of the continent, and which is characteristically an open or deep-sea deposit. During the lower Devonian period the district now occupied by the valley of the Mississippi was in the main tolerably deep sea. On the west arose the great islands of the archipelago formed by the emerging ridges of the Cordilleran Mountains; on the east the archipelago of the partially emerged Appalachian system. Between the two apparently flowed the waters of what is now the Gulf Stream. At this time near the shores of this great gulf of the Mississippi valley deposits worn from the islands of the east and west were plentifully laid down. Near these shores they contained coarse debris, indicating the presence of lands but into the middle portions of this great Mississippi gulf and much of the eastern district there came but very small quantities of land sediment. The consequence was that for several geological periods deep-sea beds were laid down in that field. They consist of extremely fine-grained materials derived from the waste of land-rocks, commingled with a great quantity of organic debris. So great is the amount of organic matter in the mass that when we distil it we obtain a considerable part of its bulk of those complicated substances known under the common name of petroleum.

At several points in the Paleozoic rocks of North America we have in ancient coral reefs excellent evidence as to the former position of the shore-line, and therefore of the alterations in the elevation of the land which have taken place since these interesting deposits were formed. Thus in the neighborhood of Louisville, Kentucky, there is an extensive coral reef formed in the Devonian period, the larger parts of which lie at the height of three or four hundred feet above the sea. It is evident, on the study of this structure, that it was formed just below the level of the ancient ocean which at the time of its construction extended over this part of the country. Again, in New York, at a yet greater height above the sea, we have similar reefs which were formed at various ages, partly in Silurian times, and partly in successive epochs up to near the base of the Carboniferous series. Taking all these coral reefs in this country, we can throughout the Paleozoic age determine, at least for limited areas, the height at which the waters lay against the face of the continent.

There are some other beds in the rocks of North America which afford evidence showing that they were formed in pelagic conditions or on the floor of wide seas; but, as before remarked, at least nine tenths of the whole section was evidently deposited in rather shallow water, at no great distances from shore-lines whence the debris composing the rocks came.

The lowland section of the Atlantic and Gulf States from the mouth of the Hudson to the Rio Grande presents one of the most interesting geographic features of the continent. Except in Siberia and the Paraguayan district of South America, there is probably no such extensive plain-land in the world, and it is in fact a more considerable unbroken level surface than is elsewhere known save in Asia. All plain-lands of this or similar nature are due to either of two simple causes. They owe their level surface to the debasement of the land under the action of erosive agents which work within the atmosphere, or they are the result of the constructive processes which go on upon the sea floor along the borders of previously existing lands. The plains which are produced by the wearing away of the land rarely, if ever, attain to a surface anywhere near as horizontal as that exhibited in the great Carolinian plain. There are generally some hard portions of the rock which stand as monuments of the former great elevation of the country. The great plains of the world are characteristically formed of sea-bottom deposits, the beds of which have not yet been disturbed by mountain-building.

If the student should journey from the eastern foot of the Appalachian Mountains straight away to the Atlantic, say across the border-land of Georgia or the Carolinas, he would observe that the surface gently inclined toward the sea at the rate of about five feet in a mile. Here and there the more considerable streams have cut their way across this gently inclined region, making sharp breaks in its otherwise uniform surface; but these occasional interruptions do not materially qualify the level character of the country. Over a large part of the area the plain has a billowy or rolling surface which indicates that the river action has not been able to shape the topography so as to alter its original sea-bottom form.

As the observer proceeds toward the sea-shore he may note at various points, especially as he approaches the present coast-line, the existence of more or less sharply defined benches, which he, if expert, recognizes to be old sea margins, — levels at which the ocean lay for a time during the process of the uprising of the plain. At the present shore-line the last and naturally the most distinct of these sea margins is the bench against which the margin of the sea now lies.

If, now, the student could take on the habits of an aquatic animal and follow the slope which he has been pursuing farther out beneath the ocean's surface, he would observe that it declined to the eastward at the same rate at which he had observed it to fall in his journey from the mountains to the ocean border. Moreover, the general shape of the emerged area, apart from that given by the channels of the streams on the land, would be almost exactly paralleled on the sea floor in the gentle undulations of the bottom. Following the surface from fifty to a hundred miles out from the present shore-line, with the bottom declining to the eastward at the rate of about five feet in a mile, the student would finally come to a point where the plain began to pitch more rapidly toward the depths of the sea, changing the rate of its descent from about five feet to a slope of one hundred or two hundred feet to the mile; and this steeper declivity would continue until the deeper parts of the sea were attained.

Our imaginary submarine geologist would readily note the conditions of origin of this under-water shelf. He would find that owing to the action of the undertow produced by the surf, and of the tide in its reflux from the shore, a quantity of debris won from the land and delivered to the sea by the ocean waves or by rivers, was constantly though slowly journeying down the gentle inclination at its margin. In other words, he would note that this shelf is in effect like the delta of a river, — which is just such a plain as we have been describing, only on a smaller scale, — over the top of which debris is carried to the steep front where it comes to rest. Thus a delta is constantly pushing its margin in successive, somewhat steeply inclined strata out into the sea. The continental shelf may be regarded as the continental delta, vastly greater in area and mass, and much more slowly formed than the delta of true rivers, such as that of the Nile or the Mississippi.

From the facts noted above, we perceive that the great southern plain is but the emerged portion of a vast accumulation of debris which has been formed along the Atlantic coast from the west of the land accumulated on the sea bottom during the geologic ages since the continent began to grow. Nearly all the extended lands in the world have been formed in this manner; but the greater portion of them have been disrupted and given a varied outline by mountain-building forces, while this great southern plain has escaped such disturbance. With the further shrinkage of this sphere it will undoubtedly obey the forces which corrugate the rocks and take on a mountainous shape, for its present plain surface is only one stage in the course of continental growth.

If the student seeks the source of the materials which have been built into this continental plain, he may find them in the worn down uplands, — the mountains of the Appalachian, the Cordilleran, and the Laurentian districts, which have, as we may readily see, lost a great portion of their mass, the materials being borne away to the neighboring sea. From the point of view of the physiographer, this southern plain is a most interesting case of a great land in the second stage of its organization, the first step being the accumulation of debris on the sea floor in a nearly horizontal position, the next the state in which it rises above the sea floor and takes on the aspect of an extended plain, the third being that in which the plain is corrugated by the mountain-building forces, the final step in the series being that in which the surface is degraded once again into the form of a rude plain, only the roots of the mountains remaining to attest the later stages of its history. From Virginia, and thence to the northward to Nova Scotia, these worn down mountains which have returned almost to the aspect of the plain may often be clearly discerned. The materials which composed their worn away portions have been removed by the action of streams of water or of ice; but from the highly tilted attitudes of the rocks beneath the surface we may readily infer the original position and height of the mountains which once stood upon the surface.

Only a portion, perhaps not the greater portion, of these vast continental deltas consists of the waste yielded in the form of sand, gravel, or mud to the sea floors. In large part the debris is formed of organic remains, — the bodies of animals and plants which have died and given their debris to the sea bottom. This element of the strata is of the utmost importance to the organic life which is afterward to dwell on the lands which are formed from these marine accumulations. These animals which yield the fossils obtain the substances which they build into their bodies from the materials which are dissolved in the sea waters, and which being in the state of complete solution are not visible to the eye. These substances which are dissolved in sea water and which give it its saline taste and its hard quality, have come into the ocean mainly from the rivers, and from the volcanoes which are scattered over the sea floor and along the coasts of the continents. If we take a cubic foot of sea-water, we may find in it atoms or molecules of mineral matter which have been derived from every river of every land. Thus the limy matter and other organic waste which rocks contain is not in most cases derived from the shores of the continent nearest to the point where the beds were laid down, but has its source in many different lands and through the volcanoes from the strata beneath the existing seas.

In the considerations as above set forth we perceive that the coast shelf or continental delta which borders the eastern side of North America has only in part derived its materials from the waste of that continent. In large part the materials have been gathered upon it from the great store which the sea contains. Thus if we could take away from the southern plain the portion of its mass which animals and plants have won from the waters of the sea, we should doubtless find that nearly the whole of the great area would by the consequent diminution of bulk sink below the level of the sea. Further inquiry would show us that a similar withdrawal of the organic waste from the rocks underlying the other portions of the continent, would reduce its consolidated area to the state of detached islands.

There is yet another proof as to the relative stability of these continental masses derived from a very interesting physiographic feature known as the continental shelf. Around the greater part of the shores of all the continents which have been carefully studied by the sounding-lead, we mark the presence of a wide fringe of shallow water extending from the shore-line to the distance of some scores or hundreds of miles from the edge of the continent, at its outer or seaward margin descending suddenly into deep water. The existence of this shelf has been well established throughout the region of the north Atlantic, — the only portion of the earth's surface where soundings have been made with such completeness as to show with tolerable accuracy the shape of the sea bottom. Soundings made elsewhere indicate that this feature is probably common along the greater part of the continental shores.

Simple inspection of the facts concerning the continental shelf serves to indicate pretty clearly that it is composed of the waste worn from the continent by the sea or conveyed to the shores by rivers or glaciers, and thence distributed over the portion of the sea floor near the coast-line, partly by the action of the waves, but mainly by tidal currents. This supposition is fortified by several facts. Wherever we can ascertain that the coast shelf is abundantly developed, we find that the continental surface to the inland of it bears the mark of long-continued abrasion by the sea. Thus along the eastern coast of the United States, where the continental shelf is very well developed, we find evidences of great cutting action affected by the ocean waves.

Along the shore from New Brunswick to the Carolinas, the old mountains such as once occupied eastern Massachusetts, Rhode Island, and eastern Virginia, have been worn down to their very roots at times when the sea worked at levels a few hundred feet higher than it does at present. This benching back of the continent by marine action is most clearly shown in Virginia. The Virginian district shows us three distinct sets of mountains: on the west of the Blue Ridge we have a set of well-developed mountains, the Virginia Alleghanies, which though somewhat eroded, retain their relief and much of their original mountainous contours. In the Blue Ridge we have a broad massive mountain range relatively little worn on its western aspect, but profoundly eroded on the eastern face of the chain. Farther to the east, on the plain-land of Virginia, we have another set of mountain-built rocks, which have been planed down to a nearly level surface. Originally the newer mountains of eastern Virginia, lying to the eastward of the Blue Ridge, which were formed at about the same time as those in the west of that axis, were as well developed as the Alleghanies to the west of that barrier; but the whole surface of this eastern section has been so worn by the action of the sea, the material being removed to form the continental shelf, that scarcely a vestige of their original altitude now remains. The sea bench of eastern Virginia, the materials of which have been removed to the ocean floor or dissolved in its waters, probably represents a section having a depth of at least half a mile and a width of somewhere near a hundred miles.

The enormous erosion indicated by this continental bench which lies above the level of the sea and the corresponding shelf of the detrital materials extending out for a hundred miles or more from the coast requires us to suppose that for a great period in the past, perhaps ever since the Triassic age, this shore has been within a few hundred feet of its present altitude in relation to the sea. If during that time the continent had been depressed very far below its present level, the waves could not have operated on this section; so, too, a great elevation would have taken this coast section out of the field of marine erosion. Thus all the evidences from erosive work which we obtain along the shore of this continent point to only moderate variations in the altitude of the shore from a remote period in the geological past. It amounts to substantial proof that for many geological periods the waves have worked within a range of one thousand feet above the present shore-line.

We often obtain similar evidence whenever we can analyze the history of a shore by a study of the successive deposits which were formed at different stages in the earth's history. Thus in the case of eastern Massachusetts, we are now able to affirm that at various stages in the past the shore-line has been near its present position. The facts on which we found this statement are readily apprehensible and may be briefly stated. They are as follows:

Beginning with the lower Cambrian period, the earliest stage in the earth's history in which we have unmistakable evidence of organic life, we find that in this region of southeastern Massachusetts, in the neighborhood of Attleborough, there were deposited thick beds of shales with associated sandstones and conglomerates containing large pebbles such as could not be transported to any considerable distance from the sea-shore. The deposits of this age contain twenty or thirty species of fossils, including a great assemblage of crustaceans, the bodies of which were apparently broken by wave or current action. The beds of this series frequently contain large, somewhat water-worn boulders and great quantities of pebbles which have evidently been stratified by strong currents. The agents which transport pebbles in great quantities operate only near shore-lines; so, too, the strong currents which have tossed these fragments of rock about, can only exist in shallow water. Moreover, on carefully inspecting these pebbles in deposits, we find that in many cases we can ascertain the beds of rock whence the fragments came. They are all derived from the rocks immediately on the west of their present site. In this manner by the use of these old mineralogical museums of the conglomerates we are able not only to affirm the neighborhood of the shore-line in this region in an early stage of the earth's history, but also to show that the greater part of the crystalline rocks now existing in this neighborhood were exposed to the action of the sea just as they are at present.

One stage higher in the geological section brings us to the middle Cambrian of eastern Massachusetts, the beds of trilobite-bearing strata at Braintree. These deposits, which are abundantly developed in Boston and vicinity, contain also great quantities of pebbles and sometimes considerable boulders arranged in strata which bear the unmistakable impress of shallow water. In the case of the Cambrian beds about

Boston, we can prove that the pebbles were derived from rocks at the sea-level lying near the place in which we now find the fragments. Thus we establish the fact that at two stages in the Cambrian period the shore-line of New England in the neighborhood of what is now Massachusetts Bay was not far from its present position.

After the Cambrian period there comes a great interval, representing many geological ages extending down to the Carboniferous time, in which we have no evidence as to the position of the sea in this part of the shore, — it was probably more elevated than at the present time; but in the Carboniferous period, in the basin of those streams which flow into the Narragansett Bay, we have an extensive series of coal-measures, — beds which show by their structure that for a very great period the shore-line was once more near its present position. Here again the evidence is mainly derived from pebbly beds which have a thickness of several hundred feet, with a range and character which indicate shallow water; and the fragments are those derived from rocks which are known to be in places within a short distance of the deposits themselves. They come from the northwest, as do those of our recent glacial deposits.

For the next step in the history of the shore-line of eastern New England we must go to the Connecticut valley, where we have ample proof that during the early stages of the Jurassic period, or perhaps the later part of the Triassic age, the land was near its present level. The so-called sandstones of the Connecticut valley are largely conglomerates, the rocks of which were worn from the hills which border that great valley and accumulated in great quantities in its trough. The evidence of the sea-shore action is not limited to the physical characteristics alone. As is well known, the sandstone layers of the Massachusetts Triassic rocks contain great numbers of fossil footprints, — the marks left upon the tidal shores by certain large creatures allied to our frogs and toads, which appear to have resorted to the tidal waters for food or for breeding purposes, and stamped the exposed mud-flats with their footprints. Although some observers have come to the conclusion that these rocks containing the footprints of the Connecticut sandstone may have been formed in fresh-water lakes, the body of the evidence points rather to the conclusion that they were accumulated in a salt-water basin. It is only where the tide comes and goes that we have the conditions which permit the preservation of such impressions as were made by the feet of these ancient animals on the sands.

After the age of the Connecticut sandstone, we have again a considerable lapse of time before we have another record of the shore conditions in this region. Ascending to the lower Cretaceous period, we find in certain imperfectly revealed deposits on the island of Martha's Vineyard a considerable body of fossils which have a character proper to shallow water, and which belong to the lower stage of that great section. We have here an assemblage of life which has a certain similarity to marine forms of the present day. The relatively modern character is especially indicated by the fact that there are several species of oysters in the beds of this age. The species are evidently those which inhabit shallow water; and the sediments in which they are contained, abounding in small pebbles and composed in the main of coarse sand, affirm this supposition, and show us that at this, the fifth fossiliferous level of the Massachusetts rocks, we have again a shore-line near by. One stage higher in the rocks of Martha's Vineyard, we have in the well-known deposits exhibited at Gay Head, beds probably formed in the Eocene or Miocene Tertiary, proof that the shore-line was near its present position. Here the evidence as to the neighborhood of the shore is mainly of a purely physical nature, but affords satisfactory proof of shore-line conditions.

The Gay Head series of deposits was formed at the mouth or delta section of a great river which probably conveyed the waters now discharged to the sea through the Hudson, the Connecticut, the Black stone, and other streams of southern New England. It is easy to prove that these delta deposits lie at the present time not more than one hundred feet above the altitude at which they were laid down along the old coast-line. They contain large bodies of vegetable matter, — lignites, as they are termed, — composed of driftwood, which gathers in shallows about the point of discharge where a great river escapes into the sea.

Thus we see that the evidence from the coast shelf, or under-water fringe of detritus, and the coast bench, or the scarf whence this detritus was in part obtained, and the fossiliferous record all agree in affirming the conclusion that the New England coast-line has not been far removed from its present vertical position during a great part of the earth's history. There are really no stratified deposits in eastern Massachusetts which appear to indicate that the shore has ever been deeply submerged since it first came above the waters. Every fragment of the geological section which remains appears to indicate the persistence of the coast-line in somewhere near its present position.

Against this evidence which seems to show the tolerable permanence of one portion of this continent we must set the proof which indicates its more or less considerable instability at certain stages in the earth's history. This evidence, though of a fragmentary nature, makes it plain that at certain times and for brief periods particular parts of the continents are uplifted so as to extend the shore margin far out to seaward, while other portions are depressed to a depth beneath the sea. It is in these periods of local depression that beds of marine origin were deposited which were afterward uplifted so as to bring them high above the sea. I propose now to inquire into the character of these movements which have taken place in the continent of North America. As yet our information concerning these changes is so imperfect that we cannot set forth the history of the continent in anything like a complete manner. Enough fragments of information, however, are obtainable to display at least in outline the general character of the oscillations which this land-mass has undergone.

It is a safe rule in geological inquiry to begin our exploration of obscure phenomena in that portion of the earth's history which lies nearest the present day; for in the yesterday of our earth's record we may hope to find the facts less confused than in the remoter past. The last great accident which befell North America was that singular disturbance of its climatal and other conditions known as the glacial period. I hope in a subsequent chapter to show the reader that a glacial period, vast as are the changes in conditions of land and sea which it brings about, is not really as peculiar in its character as is commonly supposed. Leaving aside for the present the physiographic aspects and general geological history of glaciation, we will devote our attention to certain changes of level which came about during the ice time, and the cause of these changes, and their effect upon the continent considered as the theatre of life.

The studies made by Louis Agassiz proved that a large part of the continent of North America had in very recent geological times been occupied by a thick deposit of ice. Agassiz was of the opinion that the whole of the surface of this continent had been covered by a glacial sheet. Subsequent inquiry has shown that the glaciated area occupies only about one half of the continent. The southern margin of the ice sheet passed as an irregular and somewhat broken line from some point on the Pacific coast near the southern point of Oregon across the continent to the sea somewhere between New York and Washington. South of this great wall of ice, which in the period of greatest glaciation occupied the position thus indicated, there were probably a few points of great elevation occupied by ice streams. It is possible that in the higher valleys of the mountains southward to Arizona local glaciers developed in this peculiar stage of the earth's history. It is clear that this glacial sheet attained a remarkable depth. We know that it overrode the Berkshire Hills and such mountains as Monadnock, and even the summit of Mount Washington. In Switzerland, where there was contemporaneously a great extension of the ice, it seems clear that the sheet attained a depth considerably exceeding a mile; and in North America it is difficult to resist the conclusion that the upper level of the great ice plain lay in places at a height of nearly two miles above the surface of the earth.

The phenomena of general glaciation are so unexampled in our ordinary experiences that it is difficult to determine in a satisfactory way the conditions of the land during this ice time. Of late, however, it has become evident that during the glacial period the northern part of North America, and probably the northern part of Europe as well, sank down to a depth increasing from the least submergence in the neighborhood of Chesapeake Bay, where the down-sinking probably did not amount to more than a few score feet, northward to Greenland, where it probably lowered the shore two thousand feet below its present level. The amount of this submergence along the coast of New England has been the subject of much inquiry. Although the task is incomplete, a number of observations have been gathered which make it pretty clear that in the neighborhood of Boston the submergence amounted to at least two hundred feet, the upper limit not yet being well ascertained, but perhaps exceeding three hundred feet of altitude. On the coast of Maine, the evidence of deep submergence persisting for some time after the ice sheet retreated from that district is of an unquestionable nature. The facts are best exhibited in the southward faces of the Mount Desert mountains. Along those declivities of the hills which slope to the Atlantic, we find at various heights evidence that the land in its re-elevation after the glacial subsidence paused from time to time for considerable periods, enabling the sea to cut the rocks in the fashion in which it has scarfed the existing shore-line. Up to the level of a thousand feet of altitude on Mount Desert the proof of these ancient sea margins appears quite indisputable. Indeed, an assemblage of the observations on that part of the coast of Maine leads me to the conclusion that the highest point on the island of Mount Desert, which rises to an elevation of fifteen hundred and twenty-five feet above the present mean-tide mark, was for a brief time submerged beneath the sea after the ice disappeared from its summit.

In Labrador, Packard and other observers have found similar evidence of submergence to the depth of more than one thousand feet; and in Greenland, as before remarked, the marine stratified deposits clearly formed since the last extension of the ice rise to yet greater altitudes. There are reasons to suspect that the submergence of the North Atlantic sea-shore of the continent may have been much greater than is proven by the records of old sea-shore work which have so far been observed. Thus, on the southern and eastern flank of Mount Wachusett, at the height of more than sixteen hundred feet above the sea, there are apparent traces of marine action, shown by the undercutting of the rocks. On the southeastern face of the Catskills, at a height of about twenty-two hundred feet above the sea, there are indentations in the rocks in the fashion of sea caves, extending in for a distance of more than twenty feet from the face of the cliff; and below the level of these excavations, which cannot well be accounted for except by the action of waves, there are benches of shingle such as are normally to be found beneath the level of the water along an ocean coast-line. It may be argued that possibly in the case of the Wachusett and Catskill section these cuttings may have been accomplished by the action of the waves in glacial lakes held at a height above the sea by a barrier of ice; but although this is a possible method of accounting for them, it does not seem to me to afford a probable explanation of these peculiar features. The excavations are too extensive to be the work of such waves as would originate in any sheet of water impounded by the ice. Moreover, they indicate a continuance of wave action which cannot well be supposed in the case of a lake basin held high above the level of the sea by an ice barrier. As is well known, such glacial lakes are extremely impermanent in their water-level, and almost necessarily of small size.

Although the facts are not yet in shape to permit us to frame a satisfactory hypothesis as to the precise nature of continental movements during and at the close of the glacial period, they warrant us in asserting an extreme submergence of the eastern portion of North America in this period of its history. Moreover, the observations made by Gilbert and others on the terraces about the great lakes, particularly those of Lake Ontario in New York, show in a beautifully clear way that the continent was at the close of the glacial period tilted down to the north in that part of its surface, the descent to the north, though locally somewhat variable, being at the rate of about three feet to the mile as contrasted with its present altitude. The benches formed when the lake was at a higher level than at present now rise up to the northward at this rate; this feature can only be explained by supposing that the continent was tilted downward to the north while these coast benches were formed. The same feature is observable all about the great lakes as far west as the head of Lake Superior. It thus appears more than probable that during the ice time the northern part of North America was depressed so that its surface came pretty generally below the level of the sea.

Another evidence of the down-tilting of the continent to the north is afforded by the streams which flow from the south toward the north. In eastern Massachusetts there are a number of small rivers — the Sudbury, the Concord, the Nashua, and the Neponset — which flow northward; while the greater part of the rivers of New England flow in a directly opposite course, having their head-waters in the north and their mouths to the south. Now, we observe that those streams which flow from north southward always have steep channels. Every river in New England having this direction of course lies for a considerable part of its path in a rocky bed, and descends rapidly toward the sea. These north-flowing rivers, on the other hand, have marshes and other encumbering deposits which lie between the bottoms of the streams and their original foundations. It is evident from these facts that since the channels of the rivers were excavated partly before and partly since the glacial period, the land in which they lie has risen, the northern part rising more than the southern, in such a fashion that the natural fall of the stream has been interfered with by the diminution in their rate of descent. Similar evidence of up-tilting in the northern part of the continent may be found in other streams than those just mentioned which likewise flow toward the Arctic regions.

We thus perceive that there is a large body of evidence to indicate the elevation of the northern part of the continent since the close of the glacial period; there is also sufficient proof to show that the shore-lines were, immediately antecedent to the ice time, near the same position that they now occupy; we thus have to believe that when the ice was imposed, the field it covered sank down, recovering its position after the glacial sheet had passed away.

As long as geologists held to the notion that the continents were rigidly supported in their present position, it was difficult to account for this peculiar feature of glacial submergence; but partly from the study of the movements which take place in mountain growth, but in larger measure from observation on other movements of the continental masses, geologists have now pretty generally come to the conclusion that continents are not rigidly upheld in their existing attitudes, supported firmly from below, but that they are what we may term elastic arches, dependent for their position at any one time on a balance between the pressures which urge them upward and their own weight, which bears them downward toward the centre of the earth. It is now the opinion of those best acquainted with the facts that if we could at any point, say, over the surface of an area a hundred miles square, lay down on the earth a bed of sand a thousand feet in thickness, almost immediately we would find the district so covered by the new deposit borne slowly downward until the subsidence was almost equivalent to the thickness of the supposed accumulation. There are very many facts serving to affirm this view as to continental movements which cannot be noted here. It may be remarked in passing that in delta regions where there is a constant accumulation of strata, we normally find evidences of such a down-sinking as the theory supposes would take place.

We are therefore able to account for the subsidence produced during a glacial time by the simple conception that the continental surface was borne downward by the weight of water in the form of ice imposed upon it; and as the ice sheet can fairly be presumed to have had a thickness of something like two miles, it is not difficult to believe that the continent was depressed over the area covered by the ice sheet to the amount of several thousand feet, sinking down in proportion to the thickness of the icy covering in the various parts of the field it occupied.

It is easy on theoretical grounds to see that the northern half of the continent of North America could not well be depressed to the amount of some thousands of feet without a coincident elevation of other regions to the southward. If the continent be an elastic arch the crown of which rises above the surface of the sea, it appears almost a necessary conclusion that if we bear down part of it, another portion would be uplifted. It does not do to trust our conclusions to such *a priori* reasoning: we must undertake to review the evidence to see what proof we have of a recent emergence corresponding to the down-sinking which took place in high latitudes when the glacial sheet was imposed upon the land. It is much easier to obtain evidence that a land recently beneath the sea has been elevated above the ocean than to find proof that a region which has a short time ago been above the sea has sunk beneath its depths. If we could explore the bottom in a satisfactory way, we should doubtless find on the surface which had recently subsided below the ocean a system of partly obliterated river valleys and other marks to indicate the exposure to atmospheric erosion; but we know the bottom of the sea even in shallow water only by the plummet, — that is, most imperfectly. The form of even the best explored portions of the sea floor is most inadequately known. Despite the difficulties of inquiry, there are some lines of evidence which appear to support the hypothesis that the southern portion of North America was uplifted during the time when its northern part was deeply depressed. In part this evidence comes from the distribution of animal and plant life, and in part from physical characters exhibited by the southern part of North America.

The evidence from organic life which seems to bear on this question is obtained by a study of the living creatures on the West India Islands. This great archipelago is composed of many distinct land-masses, and is separated from North America by a rather deep arm of the sea. To unite Cuba with the Florida district would require the elevation of the sea bottom of about two thousand feet. In a similar manner the great islands of the ocean stretching from Cuba to the eastward are separated from one another by deep passages generally traversed by strong marine currents. If now we compare the living creatures of these several islands with the life on the mainland of North and South America, we are struck with the fact that very few of the islands have any great peculiarity in the organic beings which occupy them. There are some species of vertebrates which are in a measure peculiar to these detached masses of land, the insects or the land mollusca exhibit many localized peculiarities; but the organic life of each of the islands is almost as nearly related the one to the other as we would expect to find it in any connected area of land of like extent. There is probably no more difference from point to point than we should find in an equally extensive region of a similarly varied character on the surface of any continent. Alexander Agassiz and others have noted the curious relation of this life of the Great Antilles to Mexico and Central America.

If we compare the fauna and flora of the Antilles with those of the East Indies, the great archipelago extending from Sumatra to Australia, we perceive at once a wide difference in the distribution of life. The passages between the islands of the East Indian archipelago are no wider or deeper than those which separate the West India islands from one another and the mainland. In fact, we may say that the islands of the Antilles are more divided the one from the other than are those of the Indian archipelago; yet in the last-named group of islands almost every considerable isle has many peculiar forms of life; while in the West Indies the vertebrates and the greater part of the other animals are singularly akin on the different isles. The only way in which we can satisfactorily account for the wide difference in the condition between these islands is to suppose that in the case of the East Indies the several fields have long remained unconnected with one another or with the mainlands of Australia or Asia; while in the West Indies the connection between the large several islands and the adjacent continent of South America has recently been completely established. Thus the biological evidence is in favor of the supposition that in comparatively recent times, possibly during the glacial period, a sufficiently extensive elevation took place in this region to bring what are now distant islands into a more or less complete union with that continent, and over this long ridge such a mixture of the living creatures took place as would provide the several parts of the archipelago with inhabitants not differing greatly in the several islands. After discussing the evidence, I have been forced to the conclusion that this supposition of a land-bridge uniting the Antilles in a time not very remote is of itself and quite without other related facts a warrantable presumption, though we cannot prove that this union existed during the glacial period.

The physical evidence of a very recent greater extension of the land in the southern part of North America is fragmentary and of a rather indecisive nature, though it points strongly in the direction of the hypothesis above set forth. The first point to note is that all the larger streams which debouch into the Gulf of Mexico north and east of the Rio Grande appear to flow for a considerable distance in their lower parts in valleys once deeply excavated, which have been in large measure filled by the debris which has been accumulated in them in very recent times. Thus borings at New Orleans have shown that the alluvial deposits of the Mississippi extend for several hundred feet below the level of that town. All the way up to the junction of the Ohio and Mississippi the river flows in a broad low-walled gorge which appears to have been excavated when the surface of the country was at a much higher level than at the present time. Following up the valleys of the Mississippi proper, the Missouri, and the Ohio, particularly the last-named stream, which is best known in its details of structure, there is evidence here and there that the present stream-bed is above its old position.

Where rivers debouch into the Gulf of Mexico or into the Atlantic in regions south of New York, we observe that they terminate at the sea, except in the case of the Mississippi, in broad re-entrant delta-shaped indentations which are not at present the seats of erosion, and where the erosion which formed them could not well have taken place save when the land was above its present attitude. The best examples of these re-entrants are found in the Delaware and Chesapeake bays and in Pamlico and Albemarle sounds. These facts are best reconcilable with the supposition that recently and for a considerable time these valleys discharged their waters into the ocean on a lower plane than that which their streams now debouch into the ocean.

Last of all, we note the fact that throughout the Gulf States borings made in the rocks penetrate for the depth of several hundred feet into strata containing fresh water. In northern Florida it is a common device to bore down a hundred or two feet below the surface, or in certain places to a greater depth, and thus obtain a copious supply of fresh water, slightly charged with sulphuretted hydrogen and carbonic acid gas, which impels the fluid upward to the height of sixty feet or so above the surface, provided the pipes be led to that altitude. In the great well recently bored at St. Augustine, Florida, which attained the depth of thirteen hundred feet below the level of the sea, this fresh-water zone continued downward in the excavation to the depth of about nine hundred feet. At this point salt water was suddenly encountered, and from that station downward to the bottom of the well the water which entered the well was clearly such as is built into rocks when they are formed beneath the floor of the sea. Inasmuch as these beds below the sea-level in the region about the Gulf of Mexico contain rain-water and not the original waters of the ocean in which they were deposited, it seems necessary to suppose that since the time of their deposition they have been for a considerable period elevated above the sea in order to afford the original waters of deposition an opportunity to drain away. It does not appear possible for the rain-waters to penetrate into the deeper strata and displace the sea-water which recently filled the cavities, against the pressure which prevails there. Nothing short of elevation would accomplish the change. That this is the case is shown by the fact that the very ancient Silurian rocks of the Ohio valley contain everywhere below the level of draining streams the original salt waters which were buried in the strata at the time when they were formed.

This and other evidence seems to point to the conclusion that the southern portion of North America has recently been elevated above the sea-level, the elevation most likely taking place at the time of great submergence which the ice sheet brought upon the northern part of the continent.

One of the most important evidences as to the recent greater elevation of the southern portion of our continent is found in the fact that along the coast of Florida, both on its eastern or Atlantic and its western or Gulf faces, there rise from beneath the sea a number of great submarine springs which discharge vast tides of fresh water gathered upon the land through openings upon the floor of the sea. Perhaps the most noteworthy of these fresh-water oceanic fountains is that which finds its way to the surface of the sea off the eastern coast a few miles to the south of St. Augustine and three or four miles from the coast-line. At this point, if we may trust the accounts of veracious observers, a considerable river rises from the bottom, the fresh water on account of its lightness rushing to the surface of the sea with such speed and volume that it makes it difficult for a boat to keep its place in the centre of the fountain. From the accounts which I have received it seems evident that the discharge must be at the rate of some thousand cubic feet a minute. Similar springs, though apparently of less volume, are said to break up to the surface in the Gulf of Mexico at some distance from the coast-line. As submarine springs would necessarily have a considerable volume before they would manifest themselves at the surface, it seems most probable that these fresh-water streams which emerge from the sea bottom along this coast are of frequent occurrence.

The only way in which we can account for the formation of these great sea springs is by the following supposition. The greater part of the peninsula of Florida is composed of limestone rocks which are so massive and pure that they readily become excavated into caverns. Wherever the surface of this area rises even a few feet above the level of the shore, we find that the streams immediately leave the surface and flow in subterranean channels. At a great number of points within the peninsula we may observe these underground rivers, where by one chance and another they have been forced to break their way to the light of day. They not unfrequently pour forth a tide which without the addition of tributary waters forms a considerable river. During the time when the peninsula of Florida, as well as the neighboring lands in this part of the continent, stood at a much greater height than at present, these underground streams doubtless excavated their channels to levels very much beneath the existing plain of the ocean. They probably discharged their waters at the margin of the sea along the line which is now far to the eastward of the shore. When the land sank down in the last great movement of this part of the continent, the exits of these cavern waters were brought much below the ocean level. Where, however, the cavern walls were moderately tight, and the land at a considerable height above the sea, the exit might be kept open, and the submarine streams still flow through their own channels. It seems quite impossible to suppose that any such underground water-ways as now produce these ocean springs could have been formed in the present attitude of the land.

The foremost object of our inquiry is to ascertain the conditions of the continents with reference to the life for which they afford the theatre; the conclusions to which we have now attained are of great importance to our aim. They serve to show that the continent of North America, though subject to great oscillations, probably preserves something like its present area and isolation through all these changes of form. When a portion sinks down, another portion rises; and so while the life is pushed about, compelled to migrate from one field to another, and forced to undergo the contentions which arise from these geographic accidents, it is never destroyed by the submersion of the whole land. A similar method of inquiry would prove even more clearly than we can show in the case of North America that the continents of Europe, Asia, Africa, and South America have never been altogether beneath the sea since the time they first appeared above its waters. The alterations in the land forms of those areas have been far greater than on the American continent, but they have followed the same law of successive changes in the position and form of the land, those changes at no time leading to the general destruction of the theatre occupied by the higher air-breathing life.

If I have rightly interpreted the facts of continental movement during the glacial period, they indicate that however the continent of North America may be deformed by temporary conditions, the land tends to retain its broad expanse, so that it affords a permanent field for the organic species which have been bred upon it.

Our next step is to trace the successive changes which lead to the formation of a continent, in order that as far as our knowledge may admit, we may perceive the conditions of land life at the successive stages of the development which the greater lands undergo.

CHAPTER IV.

The Nature of Faunæ and Floræ. — Migration of these Organic Armies. — Individualization of Continents. — Condition of Faunæ and Floræ in Cambrian Time; in Successive Periods. — Effect of Growth of Mountains; Effect of Elevation at Beginning of Coal-measures. — Croll's Hypothesis of Climate Change. — Conditions of Continental Growth in Europe. — Influence of Geographic Conditions on the Development of Life. — Conditions of last Glacial Period. — Relation of Continents to Marine Currents. — Uniform Growth of the Earth's Features. — Uniformity in Condition of Atmosphere. — Climatal Variations; Delicacy of Adjustment thereof; its Measure. — Effect of Variations of Gulf Stream on Extension of Ice. — Review and Conclusion.

The evolution of life from lower to higher planes depends in part at least on the differentiation of organic species by the survival of the fittest, on the organization of these species into great communities, which we term faunæ and floræ, and on the contention of these assemblages of ordered combatants with one another. There are thus two modes of battle between organic forms: within the same ranks — that is, within the limits of each fauna and flora — the species are contending against each other to determine which is the fittest to survive. One of the most surprising and as yet least considered effects of this regional division of life is found in the perfect interaction of the species within a realm, — an interaction which, though determined by the laws of combat, is yet helpful to all the forms which win by it.

Examining the life history of any species, we find that it has a profit both from its enemies and its friends, — from the foes which prey upon it and compel it to remain strong and grow stronger as the price of life, and from the friends which give it shelter or provide it with food. The result is that each organic assemblage becomes in time a great and well-selected army, prepared to do battle as a host with the other similarly perfected aggregations. The Darwinians generally have neglected this combat between the great armies of life. They have considered only the contention between the individual species. The paleontological record shows us, however, that in the progress of life the winning is largely accomplished by the massive migration of these vast cohorts which constitute the faunal and floral assemblages from one region to another. As they move in these marches, to which they are compelled by geographic modifications and the climatal changes which attend such alterations, they overwhelm the weaker assemblages. In most cases when a strong fauna or flora invades a new clime it adopts a portion of the indigines, — those forms which have a peculiar strength and expel or destroy the weaker forms. In all the circumstances of their movement they much resemble those migrations of human races which occurred in the early centuries of our era.

These massive migrations of organic armies can be effected only by the creation of a bridge of land or channel of water which, according as it belongs in the sea or on the land, serves to afford passage for the host. The chance carriage of single species floating across the sea on rafts of ice or the trees torn out by rivers rarely affects any important implantation of a form from one fauna within that of another. A solitary individual or even a considerable assemblage of the same species coming into a foreign region is likely to find that its habits of life, its methods of growth, its ways of finding shelter from the elements, the quality of its food, and its other needs are not met in the new station, and so it is tolerably sure to perish. To be successful, in a word, migrations have to be massive. The species must usually take their beneficent associates in the equation of life with them, to secure an effective foothold in new countries. Thus it comes about that the larger battles of life are not single combats, but contests between consolidated armies.

We may perceive this point more clearly by recurring to our imaginary but very possible instance of the bridge between Australia and southern Asia. The passage which divides the realms of life of Australia and India is very narrow. It consists of the straits of Lombok, a narrow opening, only fifteen miles in width, between the islands of Bali and Lombok. There can hardly be any doubt that the manifold accidents of transportation have frequently conveyed solitary forms from India into the realm of the weaker Australian life. Thus the larger cats of India, its herbivora, and other of its high-grade animals which can swim for long distances may have been often carried across this narrow barrier. That they have not found a foothold in the Australian realm is doubtless due to the fact that they did not secure when they arrived on the southern continent the environment which suits their habitual needs. Accustomed to pursue certain sorts of food, they found that food wanting, and within the lifetime of a single individual or even in that of a family there may not be an opportunity to become habituated to the new and strange surroundings, and thereby secure a chance to maintain existence; but if there were a wide ridge of land formed between these two continents of Australia and Asia, the Asiatic life, vastly more energetic or prepotent than that of the southern realm, would move upon it as a conquering army. Each species would give the needed and accustomed support to the others, and in a very short time they would occupy the Australian continent and drive out the lowly organized because ancient forms. In a single geological period, if these countries were left without interference from man, we should probably find a great revolution effected in the organic history of Australia, thousands of species would disappear, and only a relatively small number be adopted into the new organic order.

The individualization of continents is therefore a problem of the utmost interest to the physiographer. By dividing the earth's surface into separate fields of land and sea, giving to each its peculiarities of environment, and only occasionally permitting intercourse with other areas, the land-masses serve to organize the separate armies of life in air or sea, each within its distinct barriers, giving them an opportunity to contend against each other in the subsequent changes which the geographical development of the earth's surface brings about. I propose, therefore, rapidly to consider the processes of growth of continents, and the concurrent effect of this growth history on the evolution of organic forms. Unfortunately in this inquiry we shall be dealing with very incomplete information. We can obtain only a glimpse of the principles which control these great changes of life's theatre, and of the creatures which play their part on the stage.

Going back to the earliest epochs of the earth's history of which we have a comprehensible record, to the time when life first appeared in the rocks, we find that lands were already in existence. The continents were at that time foreshadowed by a series of insular masses, — archipelagoes we may term them, — which were probably, in this continent at least, grouped in the northern part of the present land area, and extended for some distance south along the lines of the greater mountain axes. For convenience we shall limit our inquiries to the continent of North America, for the reason that in this land-mass we have simpler and more interpretable conditions than are exhibited in the other great lands.

At the beginning of the Cambrian time, the earliest age concerning which we have any clear account, the continent of North America — so far as we have interpreted its history, which is as yet imperfectly — consisted of a considerable land-mass, and occupied probably the greater part of the area of Labrador, Canada proper, and a portion of the northwest part of the existing land. This, the largest insular mass of the ancient continental archipelago, was in the form of a rudely V-shaped body. On the west, in the region of the Cordilleras of North America, lay a series of great islands, or possibly masses of connected land, extending probably from southern Mexico to the Arctic Circle. On the east and south of the extensive Laurentian land lay another strip of islands, possibly almost as great in area as Madagascar, extending from southern Canada to Alabama, or perhaps yet farther south. This Appalachian land was probably riven at one or two points by passages of considerable width, one of which remains still as a great valley occupied by the Hudson River. There were probably yet other detached patches of Cambrian land, one of which lay in the region of the Ozark Mountains. There were possibly yet others in the little known country north of the Laurentian district. We know these regions were islands by the fact that we find their sediments in the recognizable form of pebbles accumulated along the Cambrian shore-lines which extend around their flanks. Among these islands of the Cordilleran and Appalachian districts there were extensive seas which probably were of less depth than the outlying waters of the greater ocean, for the growth of the mountainous elevations which constitute these islands had apparently been attended by a general uplift of the broad basalar folds of the mountain ridges in the manner which we have already described; and by the formation and confluence of these folds the shape of the continent was already dimly foreshadowed. All these ancient islands of the North American archipelago seem to have had a mountainous structure.

This, the archipelagic state of the continent, continued for a number of geological periods; it did not definitely begin to disappear until the dawn of that stage in the earth's history which we term the Carboniferous. We have no evidence as to the land life of these archipelagoes during the Cambrian period; but in the next succeeding important division of the earth's history, in the Silurian time, we find some proof that the land was already occupied by characteristic aerial vegetation, forms related to our living ferns, and that insects of tolerably high organization closely akin to our living scorpions dwelt upon its surface. The scanty fossils which afford this evidence are doubtless the trifling remains of what was an abundant aerial life of a lowly organization.

Before we consider the next stage in continental development, that in which the archipelago begins to merge into consolidated land-masses, it is worth our while to turn aside for the moment to consider something of the then existing conditions of land life as compared with those which at a later stage came about on the consolidation of the lands. Reviewing the existing lands of the earth's surface, those which have developed in the oceanic waters at points remote from the shore, in positions whereunto land life would with difficulty find access, we are struck with the fact that very few important species have developed on these areas, although many of them, as in the case of the Azores, have been for some geological periods separated from the neighboring mainland. The fact appears to be that on islands the conditions which favor the rapid evolution of species do not occur. While they received as tenants chance contributions from the land life of the neighboring areas, the contention between these forms does not seem calculated to lead to rapid advance; and we are justified by the facts in the presumption that island life, from its very isolation, from the lack of combat which prevails there, from the insufficient reaction between form and form, due to the paucity of species, is less favored in the conditions which lead to its advance than life on the continental masses.

Knowing very little of the land life during the ages which preceded the Carboniferous, we turn to the distribution of marine faunæ for indications as to the division in the earth's life into realms which the gradual growth of the several continents was then bringing about. Imperfect as was the original division of the earth's surface in this early stage of its history, the seas had already been sufficiently parted into distinct fields of organic development to give us a certain faunal division in the life which tenanted them. Although there is an interesting likeness among the fossils of the Cambrian in all parts of the world, — in Australia, Asia, North America, and Europe, — we already find that the species of the different regions are generally distinct. The genera are usually the same in all the faunal realms of this age, — that is, we find the faunæ in the first stage of their differentiation; there is, perhaps, not the one hundredth part of the difference between the Australian, Cambrian, or Silurian and that of England, which we find at the present time in the modern inhabitants of the sea about the British Isles and of the Australian coast. At present there are hundreds of genera, scores of families, and many orders of animals which exist in one region which are wanting in the other; in other words, the faunal differentiation at this early stage of the earth's history is in a measure proportionate to the geographic variety which had been instituted at that period in the differentiation of the earth's surface into land areas and sea basins.

In the Silurian period, extending from the Potsdam sandstone up through to the base of the Devonian, we find with the progressive growth of the land barriers the marine forms becoming better delimited into provinces and faunæ; but it is not until a much later day that we approach the great isolation which now characterizes the marine life of the different parts of the shore-lines about the continents.

The processes of mountain growth which in the beginning gave us the mountainous islands of the Cambrian Sea led, through its continuance and the development of the basalar elevations which appear to be a general accompaniment of mountain growth, to the emergence, at the beginning of the Carboniferous period, of the widespread land areas occupying the portion of North America east of the Cordilleras, and also of large areas of Europe and Asia. The upward growth of Europe and North America appears to have been in a general way concurrent, and the coincidence appears to be in some manner due to their neighboring positions. The land areas which came into being in the form of broad plains at the beginning of the Carboniferous time on our continent were singularly widespread, and relatively little broken by mountain ranges. On the eastern side of the continent the Appalachian mountain axis made a division of the newly elevated plain-land into a number of separate fields, those of the Mississippi valley and some level areas perhaps of less extent along the Atlantic shore. As soon as the plain-lands of the Carboniferous period were elevated above the sea, they were occupied by vegetation of a lowly order, — the ancestors or kindred of our ferns, horse-tails, grasses, and rushes, which had been developing on the continental islands for a great period, indeed from the earliest days. We well know that some of these forms in a high state of development were in existence in the later stages of the Devonian age. They had organized their habits and developed their relations to one another in such fashion that they were prepared to move swiftly on those lands which were to be won from the sea, and occupy them with a dense vegetation.

With the dawn of the Carboniferous period began one of the most singular chapters in the history of our continent or the neighboring land of Europe of which we have any record in the great stone book. This history shows us that for a long time, during practically the whole of the Carboniferous age, the surface of these lowlands was extremely unstable. They were frequently and rather suddenly lowered beneath the level of the sea and elevated above its plain; alternately possessed by great swamps which the tangled and swift-growing vegetation constructed upon the imperfectly drained land, and depressed beneath the sea, where they were covered with beds of pebbles, sands, and clays, which accumulated with singular rapidity. All the while the climate appears to have been in a measure equable and singularly moist. It is to this combination of a moist climate, favoring the growth of vegetation, the presence of a vegetation disseminated by microscopic seeds or spores, which blew with the wind and caught upon every surface of land, and to the frequent subsidences and elevations of the land realm which brought it alternately below and above the sea, that we owe the marvellous coal-beds which now supply the dynamic basis of our civilization.

If when the continent came above the sea in the great elevation at the beginning of the coal-measures time, the land had remained permanent with something like the steadfastness which characterizes it at the present day, coal would not have been produced. The plants would have grown and died, and their vegetable matter, in time completely decomposed by the influence of the air, would have returned to the state of carbonic acid gas whence it came to the plants. Thus closely is man knit to the past of the realm he inhabits. The strength of England and of the English race in North America, the dominance in the world of that peculiar kind of man, depends upon coal; and this in an immediate way hinges upon the peculiar conditions of geographic development which caused the plain-lands of North America alternately to sink into and rise from the sea in perhaps a hundred oscillations in the course of one geological period.

We cannot forbear to consider for a moment the cause of these oscillations in the Carboniferous period. The only explanation of the phenomena which has been given has come to us from that able physiographer, Dr. James Croll, who has interpreted the history of the Carboniferous period in a very interesting way. Dr. Croll, in his work on climate and time in geology, has made a strong argument to prove that the Carboniferous age was a period of great and long-continued though recurrent glaciation. The hypothesis which Dr. Croll advocates as an explanation of the origin of glacial periods requires us to suppose the cause to be found in a great eccentricity of the earth's orbit, and a consequent change in the character of the seasons which occur when the orbit is thus eccentric. As this theory is of a somewhat complicated sort, we shall not undertake its explanation, but merely note the important conclusion drawn by the author, that a glacial epoch is divided into periods of twelve thousand five hundred years each. These periods occurring alternately in either hemisphere, for a time the ice sheet accumulates in seasons of rigorous winters, followed by other periods of equal length in which the climate of winter and summer tends to be very much alike. During these recurrent glacial periods Dr. Croll supposes that the surface of the continent was covered by an ice sheet which formed a large amount of glacial debris, and at the same time bore the continent down beneath the level of the sea. Then in the succeeding period of warmth, when the glacial sheet was transferred to the other hemisphere, to the region about the South Pole, the ice disappeared, the land rose from the sea, the glacial waste was scattered far and wide in the process of elevation; and when the emergence was accomplished, the coal-making plants again possessed the surface, bringing it to the state of widespread morasses, again to be suffused by the glacial waste of another ice period.

Although Dr. Croll's hypothesis has been much criticised, it has as a whole fairly well withstood the objections which its opponents have brought against it, and remains the most satisfactory single theory to account for certain glacial periods in the earth's history, though it may not account for all these peculiar stages in the development of the planet. The picture which Dr. Croll draws of the conditions of Carboniferous times reminds us of those which existed in the last glacial period. In both we must conceive advances and recessions of the ice. The periods intervening between each recession and each return of the glacial sheet were characterized by an abundant vegetation. In both the surface of the lands was extremely unstable, swinging down into and up from the sea. Alike in each, we find enormous quantities of detrital matter free to move about under the impulse of the ocean waves, and thus accumulated in thick beds of sand, gravel, and boulders. In both these periods the bouldery element of the deposits grows less conspicuous as we go south, and finally fades away as we approach the tropics.

Shortly after the close of the time during which the coal-measures of the eastern United States were deposited, a very wide-reaching development of mountains took place. The Alleghanies were elevated, and the old Appalachian axis may also have undergone some further folding. Extensive mountain growth also occurred in the Cordilleran range; and as the concomitant of this elevation, the table-lands bordering the elevated districts probably underwent a considerable elevation. It is to this elevation attending the folding of mountains that we owe the final consolidation of North America into a mass which, though not as continuous as it is at the present day, nevertheless assumed the continental form in part. It was still composed of great islands, and it seems likely that as a whole it was at this time not more than half its present size. All the region of the Gulf States, Florida, eastern North and South Carolina, eastern Virginia, the greater part of Texas, the whole of Louisiana and Mississippi, the western portion of Kentucky and Tennessee, and possibly the eastern portion of Missouri, appear to have been still beneath the sea. The western versant of the continent, the region contained in the Rocky Mountain district, appears to have been less consolidated by this elevation than the eastern portion of the land-mass. The Cordilleran district probably remained in the condition of an archipelago to a somewhat later time in the earth's history.

The next great movement of the continent, also concomitant with that of mountain-building, took place after the close of the earlier stages of the Jurassic period. There appears to have been in the time of the Trias or earlier Jura in North America a period of extensive glaciation, in which the sandstones and conglomerates of the Connecticut valley and elsewhere were laid down on shallow sea floors. We find some evidence of glacial work in the large quantities of pebbles which have been gathered in these deposits in a way in which they cannot well be assembled by any other than ice action. We find also at this time evidence of the instability of the land such as appears necessarily to characterize glacial epochs; and here, too, we observe submerged forests converted into coal-beds, just as we find them in other glacial epochs. Following this possible glacial epoch of the lower Jura comes again a mountain-building period, which probably occurred before the close of the Jurassic period. This brought in its train a further elevation of the general continental area, and led to a still greater extension of the surface of North America, particularly in the western portion of the country. There can be no doubt that the Rocky Mountain district achieved in this time a considerable further growth toward continental conditions. After the Jurassic period this land appears to have remained for a considerable period, during the whole of the Cretaceous age indeed, without feeling any great effect from the growth of mountains or the concomitant elevation of the general land-masses; but in the earlier stages of the Tertiary, the mountain-building movement became again active, at this time particularly vigorous in the western part of the country.

To the movements of the earlier Tertiary we owe a good part of the relief of the Rocky Mountains, and the final consolidation of that region with the body of the continent. A slight amount of elevation appears to have occurred at the same time in the eastern part of the United States. As yet we have not determined in a clear way the development of mountain growth in connection with this elevation of the eastern part of the continent. There are a number of facts, however, which seem to indicate that the Rocky Mountains as well as the mountain folds to the east of the Blue Ridge or old Appalachian axis underwent a certain amount of orogenic development.

It would carry us too far into the details of geological inquiry to trace this obscure proof of Tertiary mountain growth in the eastern United States. We may, however, note a bit of evidence derived from the Tertiary beds of Massachusetts. These deposits of the southern shore of Massachusetts, mainly exhibited on the island of Martha's Vineyard, were formed, as we have already noted, at the mouth of a great river. They consist of very numerous alternating beds of white sands, red, yellow, and greenish clays, pebbly deposits, and frequent beds of lignite or the vegetable matter such as accumulates as peat in swamps. These deposits of the Vineyard Series have clearly been subjected to mountain-building action. They are folded so that the beds have steep dips, the ridges trending in a northwestern and southeastern direction. At certain points the crumpling of the deposits has been so considerable as to bring the strata into vertical attitudes, — that is, the amount of dislocation to which these beds have been subjected is about as great as that which is shown in the mountain ridges of the Alleghanies; although the plications themselves have much less amplitude than the folds of those great elevations, they unquestionably show the existence of compressive forces which give rise to mountains. This and other evidence leads us to the conclusion that at a time later than the Eocene Tertiary and perhaps very near the present day, the forces which elevate mountains and thereby construct continents were at work on the Atlantic coast of North America.

In Europe the process of mountain growth and of continental development has been essentially like that which we have considered in the case of our own continent, with the exception that the movements both of uprising and of downsinking have been very much more numerous than in North America. With each stage of the folding of the rocks the lands have become more consolidated, have taken on more of the continental form. What information we have concerning the development of the other continents bears out the supposition that the normal course in the growth of the greater land-masses is as follows: they begin in the archipelagic state as scattered islands in the sea, and proceed by successive accretions of mass dependent on the development of mountains until they assume their perfect or adult form.

Although the process of mountain growth leads to the formation of elevations on the earth's surface not only by the development of folds themselves, but by the growth of the pedestals on which they stand, it generally, if not always, happens that as the elevations grow into their anticlinal ridges or upfolds, they produce by their counterthrust extensive depressions, sometimes of considerable width, on either side of the upfolds. These synclinal valleys or downward bending folds developed during the mountain growth often remain for a long time the seats of deep bays or straits which admit the sea far into the land. A familiar example of such troughs is found in the valley of the Connecticut River, which long continued to exist as a marine inlet, and has only in the more recent stages of the continental development been converted into dry land. Another instance a little farther away is exhibited in the Hudson valley, the trough between the northern part of the Alleghanies and the older northern element of the Blue Ridge of the Berkshire Hills. In Europe these intervals between the great mountain elevations remained for a greater time in the form of channels of the sea; and so the final, complete consolidation of that continent was more delayed than in the case of North America.

These downfoldings attendant on mountain elevations also in certain cases serve to bring portions of the continent, previously elevated above the sea-level, below the plain of the ocean; and we must add this cause to the others we have considered in the list of those influences which lead to change in the outline of the land.

Turning once again to the influences of geographic conditions on the development of life, we perceive that this process of continental growth, beginning with the development of archipelagoes and proceeding steadfastly to greater agglomerations of land, serves to widen the theatre of possible migration of organic forms, while at the same time it promotes climatal stresses, which compel the migrations of the assemblages of animals and plants. It is easy to perceive that this increase in the area of the continents vastly favors the development of new forms of life, while in the archipelagic state the land creatures were necessarily limited to forms which were able to migrate with ease. Plants such as ferns, the spores of which are so light that they may be borne to great distances over the sea by the winds, or insects which by their wings or their small size may drift through the air or be floated on chance fragments of timber which afford them ferriage over the waters, are about the only forms which can meet the accidents which are likely to come to islands through glaciation or through changes of level. In the earlier state of the continent a depression such as that of the last glacial period or those of the coal-measures, sinking an area like the great Laurentian or Appalachian island beneath the level of the sea, would necessarily lead to the destruction of the life of the greater part of the creatures which dwelt upon its surface; when re-elevated it might be readily re populated by the light-seeded plants and by insects, and so regain its original vitalized conditions; but such ready transportation is generally denied to higher forms, during the archipelagic conditions of the land areas. When, however, the continent assumes its united form, migrations would meet the needs of each climatal or geographic change, and the organic assemblage would be free to move during such accidents — as they did in the last glacial period — to fields in which they could survive.

Thus, when the last glacial period came to North America, our large-seeded plants, such as the oaks and the walnuts, and our land animals were, by the broad extension of the continent to the southward, enabled to undergo a massive migration to regions south of the glaciated belt, where they found an ample refuge. By this migration they were not only preserved from utter destruction, but were brought into conflict with the creatures which already possessed this southern realm; and in the struggle the best survived, and so advanced the process of evolution which lifts the plane of organic life.

These considerations make it clear to us that the wide extension of our continental lands and the considerable range of climate which they afford within readily intercommunicable districts are important elements in the array of influences which promote advance in the scale of being.

This advantage derived from the meridional or north and south extension of the continents, and the consequent opportunity given to animals and plants to meet climatic changes such as those which a glacial period brings about, is found in the distribution of the seas as well as of the lands. The elongation of the continents in a north and south direction secures geographic conditions which are favorable for the movement of marine forms in migratory paths, which are easily traversed when changes in the temperature or the depth of the sea make the march necessary. If the land-masses were extended in an east and west direction, if they were in the form of bands encircling the earth on the parallels, there could be no effective migrations, either on the land or in the sea, to meet the accidents of climate which would frequently imperil the life of the earth's surface.

Another very important effect of the consolidation of the lands has arisen from their relations to marine currents. It is a well-known fact that our oceanic streams are, in the main at least, a consequent of the movement which the air has in the trade-winds of the tropical district. These trade-winds of the northern and southern hemispheres unite their forces in the tropics, and shove the surface of the water in a general westerly direction. If the equatorial belt were not occupied in part by lands, or if these lands were in the form of islands, then this current would move continuously around the earth. Let us suppose such a girdling current to exist, and note what would be its effect on terrestrial climates. It is an unquestionable fact that the result of such a girdling stream would be greatly to increase the temperature of the equatorial belt. The mean annual temperature of that region would, on account of the retention of the heat which the ocean currents now convey to high latitudes, probably be elevated by the amount of from twenty to thirty degrees; at the same time the temperatures of high latitudes would be very much reduced. The districts about the pole enclosed by the parallels of forty degrees would, if these conditions should prevail, doubtless undergo a lowering of temperature which would make them absolutely unfit for the occupancy of the higher forms of life. Circumpolar deserts of cold and an equally sterile overheated region near the equator would necessarily exist if the equatorial currents were free to girdle the earth. It is only because of the land barriers which the westward-setting ocean streams encounter in South America and on the coast of Asia and Africa, that we have that wonderful system of superficial oceanic circulation which diminishes the heat of the tropical belt and elevates that of the circumpolar districts. In this way the earth is made habitable; for although life in certain forms would doubtless have had a place on the surface of the earth, even if this machinery of circulation in the seas had not come into play, we cannot believe that organisms could, under these atmospheric conditions, have attained anything like their present advancement. The field of development would have been narrowed down to a very small part of the earth's area, and the struggle of life with the difficulties of climate would have been vastly greater than it has actually been.

The foregoing considerations enable us to see that the process of land growth has been on the whole singularly well fitted to secure the development of organic forms, by providing them a theatre for their life, and arranging the conditions of the stage to promote those interactions on which all advance depends. We will now turn for a glance at the atmospherical or climatic conditions which have prevailed on the earth's surface since organic life began its development on our planet.

When geologists began to unravel the earth's history, they were naturally led to suppose that the present was a time of unusual repose, the earlier ages having been periods when the forces which affect the earth were in a state of often recurring and violent activity. As long as the observer was compelled to conceive the construction of the world to have been accomplished in a few thousand years, it was inevitable that he should assume a certain violence in the development of the earth's features. Gradually the fancy for startling theories concerning the past history of this sphere which led to these views has, under the influence of better knowledge, been put aside. Geologists now believe that the continents have grown slowly from the seas, and that the mountains with all their exhibitions of titanic energy have likewise gradually come to their present state; in a word, that the crust of the earth behaves at the present day substantially as it has acted at all stages in its history, since life came upon it. The last stronghold of the convulsionists, or those who hold that the earth of to-day is essentially unlike the earth of the past, is found in the realm of the air, in the region of climatic changes. Many geologists still hold that the atmosphere at the present day must be in many ways unlike that of the earlier geological periods; they also conceive the glacial epochs to mark peculiar states of the earth's conditions essentially unexampled in this last stage of its development.

The task now before us is to consider the atmospheric influences which environ organic life, in order that we may note the manner in which they have influenced the conditions of its progress. Our first aim will be to show that the earth's climate, though varying from one geological period to another, passing at times into conditions of age-long winter, and again into a state where a mild and uniform climate for thousands of years prevailed throughout a hemisphere, has as a whole maintained a tolerably uniform character. At the same time it will be desirable to show that the body of the atmosphere is at the present time chemically the same as it was in the ages when life was at its dawn. The proof of the last-mentioned point may be somewhat briefly stated. The temperature of the earth's surface in large part depends upon the mass of the air. If that envelope were to be doubled in volume, the average heat of the earth would be increased in something like a proportional manner. Now, the organic life of the earth's surface can only exist within narrow ranges of temperature. It is possible for animals and plants to live only between thirty-two and one hundred and fifty degrees Fahrenheit. A few forms which manage to protect their bodies in winter by their peculiar habits can endure in extreme cold; none can maintain themselves at a greater temperature than one hundred and sixty degrees Fahrenheit. Therefore we may assume that organic life from the dawn of geological history to the present day has found the atmosphere of about the same volume as at present, and that the range of temperature has been limited.

In certain shore deposits of the Cambrian period we find, in the beds which were laid bare by the reflux of the tide and covered by its subsequent incoming, the imprint of rain-drops, which tell us that the ordinary machinery of the atmosphere was operating in those days as it does at the present time. In the rocks formed in the same early stages of the earth's history, we find vast accumulations of conglomerates which in their aspect are so like the deposits made during the last glacial period along the shores of New England that we can conclude them to be the products of the glacial forces. Such considerations show us that in this ancient Cambrian period the climatal conditions were essentially like those prevailing in and near our own day. Geographic alterations have, of course, produced wide alterations of climate. They have dried up realms to deserts, and have turned again to fertility countries which were for a time unfitted for life. But all these changes have been in their nature local; they have never destructively interfered with the majestic ongoing of the great organic armies.

The presence of vast amounts of carbon in the coal-beds and in the limestones and other deposits of the earth has led geologists to the conclusion that the atmosphere must have at one time contained an enormous body of that substance in the form of carbonic acid gas, whence it was taken by plants and by the animals which feed on plants and built into the rocks. This supposition demands a very peculiar atmosphere in the early stages of the earth's history before the carbon was deposited in the rocks. It is now, however, pretty clear that the carbon in our coal-beds, limestones, and other deposits could not have been at any one time present in the atmosphere, for the reason that an air so constituted would be unfit to maintain the animal life which has existed on the crust of the earth from the earliest geological ages to the present day. We are therefore driven to suppose that this substance is in some way fed into the atmosphere; we are reasonably sure it does not come from the earth's interior, there being only a relatively small amount of it thrown out by the volcanoes and other terrestrial sources. On this account geologists are now coming to the opinion that carbon must be slowly brought into the air from the celestial spaces at something like the same rate at which it is taken from the air by plants and buried in the crust of the earth. In a word, all the facts point to the conclusion that in constitution and in mass the aerial envelope of the earth, on which all life so intimately depends, has not essentially varied from the beginning of organic history to the present day. There remains the question of climate. How can we account for such variations of temperature as are indicated in the past history of the earth without recourse to convulsions, without having to suppose that in certain periods the earth was in many regards another sphere than that we now find it to be?

The climatal variations indicated in the record of the rocks may be briefly set forth as follows: At many times in the earth's history organic life — even those forms which are quite sensitive to cold — has ranged close up to the poles. Thus during the Carboniferous period plants allied to tree-ferns were developed within the Arctic Circle. In the Miocene Tertiary other species similar to those now living in the southern part of the Mississippi valley flourished within twelve degrees of the North Pole. At other times, probably at many other periods, an ice sheet, such as now covers Greenland, extended south on the continent of North America to about the parallel of forty degrees, or perhaps in detached ice-caps in elevated regions to points somewhat farther south. At certain other times and places in the earth's history there have been climates of peculiar dryness, which have formed enormous deposits of salts, such as are precipitated from sea-water by its complete evaporation. In some ages deposits of this nature have accumulated to a great depth. In endeavoring to account for the climatal changes of the earth, we must bear in mind such extremes of climate, — of heat, cold, dryness, and wetness, — which indicate the gamut of change the earth's temperature conditions have undergone.

It is worth our while to note the evidence as to the states of climate in the former geological periods in this continent which may be derived from the salt deposits which may be found at various points within its area. The value of the evidence which may be obtained from these accumulations of rock-salt has generally been neglected by geologists. They are, however, of a precious sort, for they enable us to trace the times when the climate of particular regions was remarkably dry; for it is only under conditions of extreme desiccation that such accumulations of saline materials are made. Judging of the past by the present conditions, we may say that only in those fields where the rainfall is extremely limited in amount and the heat of the sun very powerful can we have such accumulations formed.

The most recently accumulated salt-beds of North

America, except those about the dead seas of the Cordilleras, are found in southern Louisiana, near the margin of the Gulf of Mexico. In that field we have very extensive deposits of rock-salt which apparently were formed in Tertiary or Cretaceous times. This is now one of the rainiest districts in North America; but from the large quantities in which the salt was accumulated it was evidently at one time a field of peculiar dryness. To account for the dry climate indicated by these Louisiana rock-salts, we have to suppose a totally different arrangement of the Gulf Stream from that which exists at present.

In the earlier stages of our continent's history, particularly in the Silurian age, rock-salts of vast thickness and extent were formed in the region which lies between central Michigan and eastern New York. This field was at that time the northern border of the now shrunken continental sea which we term the Gulf of Mexico, and which was then visited by a tide of warm water. This warm ocean current must have been the equivalent of the Gulf Stream. The evidence shows us that from time to time that stream was denied access to the Mexican Gulf, — a field which it now possesses.

Although these phenomena concerning the distribution of salt are of exceeding interest, we can only note them here to show how great may have been the climatal variation due to the change in that marine current which is the dominating element in the climate of North America and of Europe.

Next we should note the fact that the temperature of the earth's surface is determined by a singularly delicate adjustment of conditions. In the sun there is a heat probably to be measured by hundreds of thousands of degrees Fahrenheit; in the centre of the earth, a temperature which perhaps surpasses ten thousand degrees Fahrenheit; and in the starry space between — save for a mere skim of atmosphere on the earth's surface, a few miles of the millions which separate the earth and sun — we have a cold far below the zero of Fahrenheit. On a summer day the fleecy clouds which float in the upper air at the height of six miles above the surface are composed of particles of ice. An equal distance below the surface, we probably have a temperature much exceeding that of boiling water. With these facts clearly in mind, we perceive the marvel is not how climatal changes have come upon the earth, but rather how they have been kept within such a range as to have permitted the organic series to go forward steadfastly in their development, essentially unharmed by atmospheric catastrophes.

The conditions which bring about glaciation appear to require no widespread alteration in the circumstances of the earth's climate. Most geologists are now disposed to reject the first and crude hypothesis that glaciation was caused by extreme cold. We now know with approximate certainty that a decrease in the temperature of high latitudes would reduce rather than extend the existing glaciers, for the reason that a greater measure of cold would be attended by a further reduction in the quantity of rainfall, and therefore by lessened glaciers. If by any set of circumstances the snowfall of northern Europe and North America should be doubled, without a very great increase in the annual heat, glaciers would probably return to the lands they occupied in the last ice time. At present the summit of Mount Washington is almost high enough to bear glaciers, the snow enduring there sometimes until the month of August. If the snowfall of that region should be doubled, there can be little doubt that glaciers would begin to gather at the uppermost parts of the mountain. As soon as they were formed, they would tend to gather fogs above, and even to fend off the rays of the summer sun which would melt the snows. Breeding a climate favorable to its preservation, the ice sheet would rapidly extend; and under the supposition of a doubled snowfall over New England, it seems quite likely that the glacial sheet would soon occupy the whole of its surface, the ice beginning to gather in the mountains and growing thence, taking its climate with it as it invaded the lower lands. The last glacial period which affected North America seems to have been mainly limited, at least as far as the development of massive glaciers was concerned, to the region about the North Atlantic, Europe, and western Asia, and the eastern parts of North America. Such an ice time might perhaps be brought about by a considerable increase in the volume of the Gulf

Stream, which would increase the temperature of the North Atlantic waters, and cause them to give more moisture to the air, and thus increase the rainfall of the contiguous lands.

Until recently geologists have sought the cause which produced the wide extension of the ice during the last glacial period in Europe and North America in some general changes which have affected the whole climate of the earth. With the advance in field observations it has gradually become clear that this particular glacial period at least was due to some action which took effect mainly in the region about the North Atlantic. The researches of American geologists made within two or three years have shown that while the ice lay in great thickness over the region from southern New England, central Pennsylvania, and southern Ohio northward to Hudson's Bay, and possibly beyond to the Greenland district, the western margin of the sheet did not quite attain the foot of the Rocky Mountains in the region adjacent to the line between the United States and Canada. It is true that in the Cordilleran mountains there were here and there extensive local glaciers, but it is now unquestionable that the conditions which maintained the ice diminished in their effect as we approach the Pacific Ocean on the western border of the continent.

It appears also clear that when the glacial envelope was thickest in Europe, the deposit thinned out toward central and northern Asia, only certain portions of the greater continent then having extensive fields of ice. In a word, it is evident that when the North Atlantic region was thus icebound, the regions about the shores of the North Pacific were not in any considerable measure enveloped by glaciers. It appears to the present writer that this aspect of the fact naturally leads us to seek a cause of North Atlantic glaciation in the variations in effect which the Gulf Stream has exercised upon its basin. That ocean current is at present the principal factor in determining the North Atlantic climate. Even as far north as the Arctic Circle, where the influence of its tide of warm waters is much diminished, it still brings to the field of the sea more warmth than attains to it from the direct rays of the sun.

It is not yet possible to trace the variations which have taken place in the course of the Gulf Stream in relatively modern geologic times, say during the period at which the ice attained its greatest extension about the North Atlantic. It is, however, apparent that alterations in the form and position of Cape St. Roque, in the elevation of the Antilles or of Florida, or in the conditions of the isthmian district, the land which connects North and South America, might profoundly influence the volume and swiftness of movement of this ocean current. It seems likely that until the recent changes of the Gulf Stream have been carefully studied we cannot expect to attain sound views as to the nature of the causes which brought about the Atlantic glacial epoch.

Such an increase in the volume of the Gulf Stream which penetrates the North Atlantic might be brought about in one of several ways. A change in the position of Cape St. Roque, the eastern promontory of South America, which now divides the waters of the equatorial current, might serve to turn the whole of that great stream into the North Atlantic, or to divert it altogether toward the South Pole; or a lowering of the lands about Behring's Strait might permit a larger share of the Japanese Gulf Stream to penetrate into the Arctic waters, somewhat elevating the temperature and increasing the rainfall of all the northern parts of North America. Thus simple geographical changes such as are within the range of reasonable conjecture appear sufficient to bring about the relatively small amount of climatal modification necessary to produce a glacial period, if all the other conditions were such as to favor its creation.

It is not likely that the institution of glaciation depends entirely upon any one cause. It seems very probable that the interesting hypothesis of Dr. Croll presents us with a condition which under certain circumstances could bring about the imposition of an ice sheet upon the continent. There may be a variety of other accidents, some of which we have noted, which would lead to a large precipitation of water in the form of snow on certain lands, and thus to the creation of a glacial period, the extent of which would be measured by the diffusion of the conditions. Considerations such as these serve to show us that our glacial periods do not demand any singular departure from the conditions which now operate in determining the earth's climate. That climate, both in its general aspects and in the shape which it assumes in any field, is determined by the equation of a wide range of causes.

The great northward extension of relatively warm climates which has occurred at certain stages of the earth's history is perhaps explicable in an equally simple manner. We have already noticed the fact that the Gulf Stream now bears to the region within the Arctic Circle more heat derived from equatorial sunshine than falls upon that area directly from the sun itself. It is to this great body of warmth we owe the habitability to civilized man of northern Europe. The whole process of our civilization, indeed, depends upon this continuous tide of tropical water. In the present conditions of oceanic circulation, the warm water coming from the tropics to the North Pole is not sufficient to lift the temperature of that region into the limits favorable to delicate forms of life; but if the passage of Behring's Strait were as readily open to the Kuro Sivo, or Japan Current, as the North Atlantic is open to the entrance of the Gulf Stream, the temperature of the region about the North Pole would probably be lifted by at least thirty degrees above its present mean annual. This alteration, as before noted, if but partly accomplished, might vastly extend the glaciers which exist about the pole, by increasing the snowfall; but if completely effected, it would bring the mean temperature of the region within the Arctic Circle, which is now about thirty degrees Fahrenheit, to about sixty degrees Fahrenheit on the mean annual. We should probably then have in all the country about the poles a condition of temperature not greatly different from that of southern England or the southern parts of the Mississippi Valley. This climatal state would endure until geographic changes had modified the run of the oceanic currents. Thus on the form of the land and sea, rather than upon remote conditions, we may hope to found a sound theory concerning the ancient climates, with their varying heat and cold.

We must now note the fact that the process of development of continents has not only provided an ample theatre for the migration of life under the influences of climatal and geographic change, but that it also brings a set of influences, through the varying ocean currents and changes in the height of the land surface, which impel the faunæ and floræ to those interactive and continual migrations on which so large a part of organic advance clearly depends. We see the importance of these climatal trials, and their effect in promoting the destruction of the old and weak and the prosperity of the new and strong species, by comparing the organic conditions which exist in the tropics and in high latitudes.

It is clear that organic life tends to its most rapid advancement in those parts of the earth's surface where beings are subject to a considerable stress from climatal conditions, — where from geological period to geological period they are driven about by the changes of temperature, and kept as it were in inces sant motion. We find in the tropical districts an assemblage of animals in which there are many archaic forms. The elephants, once inhabitants of all the greater continents, once endowed with power to meet the cold of the Arctic Circle as well as the warmth of the tropics, have shrunken away from the lands in high latitudes, and find their refuge near the equator. So, too, the tigers, the rhinoceroses, and a host of other forms once strong enough to meet the trials of rigorous climates, have in their decline betaken themselves to the great almshouse of the tropics, where if the conditions of advance are less perfect than those afforded by regions of variable climate, the abundance of food and the absence of climatal stress permit the forms to survive.

To the naturalist who has come to appreciate the sensitiveness of organic forms to their surrounding conditions, who has also seen how organic advance depends upon the completion of each step in the great series of living beings, the most surprising facts of the world are found in the coincidence between the laws of the earth's development and the needs of organic life. Where his predecessors in the study of the earth found in the conditions which lead to the formation of mountains a cause of widespread destruction, he sees only beneficent influences, cruel it may be to individuals, but blessing-giving to the large assemblages of life. Gradually to such a student the world seems more and more purposeful. Slowly the sense of order and relation between the apparently rude machinery of the earth's crust and the delicate beings which are bred upon it becomes clear; and finally he finds himself inevitably led to the conviction that there is an essential unity in all the life of this sphere, — the physical and organic being but parts of one great plan.

CHAPTER V.

Dependence of Man on Environment; Increase of this Dependence with the Advance of Civilization. — Relations of our modern States to the Conditions of the Earth. — Advance in the Sympathetic Motive. — Comparison of Europe and North America. — Discussion of the separate Areas of Europe. — Isolation of Great Britain; its Causes. — Isolated Areas of Asia. — Cradle-land of the Aryan People. — Permanence of Race Qualities. — Race Qualities in Africa; in Australia; in America. — Geographic Conditions of North America; Review of the several Fields of this Continent. — Effect of Physical Conditions of North America on native Indians.

The advance which has been made in natural science during the last century has led to a great change in our conception as to the relations of mankind to the earth. Of old, men looked upon themselves as accidents upon this sphere. In the light of modern science, we regard our species as the product of terrestrial conditions. We conceive man as the summit and crown of the long-continued progressive changes which have led his bodily structure and his mental powers up from the dust to their present elevated estate.

In the progress of organic advance which has led through inconceivably numerous stages of existence from the primal base of life to the estate of man, the dependence of beings on the conditions which surrounded them has always been very close. The low-liest organism is influenced by the temperature in air or water, by the conditions of the soil or sea-bottom, or the circumstances which serve to bring it the needful food. With each advance of intellectual power the dependence on environment becomes more and more intimate, for with that intelligence the creature seeks beyond itself for opportunities to gratify its desires. It chases its prey, flees from pursuers, herds with its kind, and is thereby educated to a sympathetic life.

When the human state is attained, when the progressive desires of man are aroused, the relations of life to the geography and other conditions of environment increase in a wonderfully rapid way. When the tool-making stage is won, the savage must become in a certain way a geologist. He learns perforce to seek for particular kinds of stone with which he may point his arrows and spears, to make the mortars and pestles with which to grind his corn or the clay of his pottery. The next stage — that of agriculture — yet further increases the measure of dependence on the character of the earth. As soon as the rude combats of the earlier man develop into the military art, the work of attack and defence leads to a close relation of the developing savage to the topographic conditions which he encounters. When commerce arises, the dependence of man on the shape of the earth becomes yet more intimate. With the growth of each of these elements of civilization, the arts of the household, of war, and of trade, the chains which bind men to the earth about them become stronger.

It is impossible to depict in an adequate way the measure of dependence of our modern civilized man upon the world about him. The functions of his body and mind depend curiously on objects from the ends of the earth. Thus our meals commonly mean many thousand miles of transit to bring the food to the table; the clothing of our bodies brings the wool of Australia, the cotton of the Carolinas, the silk of Italy or China, the gold of California, the leather of Paraguay, the arts of hands and brains in a dozen different peoples together. Our daily thoughts take hold on the ends of the earth.

The dependence of our modern States upon the conditions of the earth is inconceivably greater than that of the ancient tribe whence they came. In the wonderful State of Britain the national life-functions vary with reference to the topography of high Asia, the climate and surface of Africa, and certain portions of other countries; and almost every storm and every drought which affects the remotest lands and seas reacts upon that State. Ministers, and with them the purposes of the State, are changed by the chance of some battlefield at the antipodes. A bad harvest in the plains of the Upper Mississippi means dear bread in England, fewer marriages, and shorter lives; in other words, it produces an effect on the whole social status of that country. A disturbance such as our Civil War, which arrests the cotton export of the United States, starves Manchester, and sets the rulers of Britain against the cause of freedom in America.

It is, indeed, difficult to present an adequate picture of the physiographical reactions which civilized man experiences through the geographic condition of the earth's surface; for such a picture would have to disclose the infinitely complicated machinery of our society. I must beg my readers to aid me by imagining their own position in relation to the earth's features.

There is, however, one aspect of the increasing dependence of man on Nature which comes about through advancing civilization, — a feature so new and so important that we should notice it at least in a passing way. The largest element of this growth is found in the gain in the sympathetic motives which have arisen from a wider understanding of the world and a closer application of the human mind to its phenomena. It is a curious feature in the culture of Greece that it never seems to have been sympathetically concerned with the people beyond the limits of the native State. The Greek thought of most things which we think about; but this matter, which now much occupies our mind, did not concern him.

It appears to me that the modern sympathy of man with the world about him which manifests itself in the love of the unseen savage, in the love of the beautiful, in the love of scientific inquiry for the sake of knowledge alone, is the last product of those vast interactions which have come from the extension of the contacts of man with Nature, — first through commerce, and afterward through less economic motives. This interaction is to a great extent dependent on peculiarities of the earth's surface, on the diversities of the lands and seas, and the consequent almost infinite variety in the subjects for curious and profitable inquiry which the world affords.

Although on each land-mass the physiographic influences are of the utmost importance with reference to the development of man, we can only glance at certain interesting features dependent on the structure of the lands of Europe and North America, giving most of our attention to the conditions of our own continent. North America is most interesting to us, not only because it is the seat of our own life, but also because it is a region characterized by large, simple, and easily comprehensible geographic features. Europe concerns us almost as much, because it is the cradle of our people, the place of nurture where our race came by its motives and learned how to act its parts in the new theatre of the western world.

The continent of Europe differs from the other great land-masses in the fact that it is a singular aggregation of peninsulas and islands, originating in separate centres of mountain growth, and of enclosed valleys walled about from the outer world by elevated summits. Other continents are somewhat peninsulated; Asia approaches Europe in that respect; North America has a few great dependencies in its larger islands and considerable promontories; but Africa, South America, and Australia are singularly united lands.

The highly divided state of Europe has greatly favored the development within its area of isolated fields, each fitted for the growth of a separate state, adapted even in this day for local life, although commerce in our time binds lands together in a way which it did not of old. These separated areas were marvellously suited to be the cradles of peoples; and if we look over the map of Europe we readily note the geographic insulations which that remarkably varied land affords.

Beginning with the eastern Mediterranean, we have the peninsula on which Constantinople stands, — a region only partly protected from assault by its geographic peculiarities; and yet it owes to its partial separation from the mainlands on either side a large measure of local historic development. Next we have Greece and its associated islands, which — a safe stronghold for centuries — permitted the nurture of the most marvellous life the world has ever known. Farther to the west the Italian peninsula, where during three thousand years the protecting envelope of the sea and the walls of Alps and Apennines have enabled a score of States to attain a development; where the Roman nation, absorbing, with its singular power of taking in other life, a number of primitive centres of civilization, grew to power which made it dominant in the ancient world. Sicily, Sardinia, Corsica, have each profited by their isolation, and have bred diverse qualities in man, and contributed motives which have interacted in the earth's history. Again, in Spain we have a region well fitted to be the cradle of a great people; to its geographic position it owed the fact that it became the seat of the most cultivated Mahometanism the world has ever known. To the Pyrenees, the mountain wall of the north, we owe in good part the limitation of that Mussulman invasion and the protection of central Europe from its forward movement, until luxury and half-faith had sapped its energies. Going northward, we find in the region of Normandy the place of growth of that fierce but strong folk, the ancient Scandinavians, who, transplanted there, held their ground, and grew until they were strong enough to conquer Britain and give it a large share of the quality which belongs to our own state.

To a trifling geographic accident we owe the isolation of Great Britain from the European continent; and all the marvellous history of the English folk, as we all know, hangs upon the existence of that narrow strip of sea between the Devon coast and the kindred lowlands of northern France.

The isolation of Great Britain depends upon such peculiar and interesting circumstances that we may turn aside a moment from the thread of our narrative to see how this strip of silver sea came to be a fortress ditch between the continent and the island. The British Channel is due, in the first place, to the peculiar strength of the tides in the North Atlantic. The energy of these tides is explained by the fact that the North Atlantic is a somewhat wedge-shaped basin pointing up between the continents of Europe and North America. The tidal wave heaps up in this great re-entrant, as it heaps up in the narrowing channels of the Bay of Fundy, Port Royal Sound, Boston Harbor, or any other constricted passage leading in to the land. Next we note the fact that in the British Channel the tides have a rise of about twenty-five feet, as they sweep through its open waters from the Atlantic toward the North Sea; while in the neighboring bay of Bristol, or the Severn Channel, as it is sometimes called, where the bay is closed at its head, the tides rise to about fifty feet in height.

Going back to the last geological period, we are able by divers facts to ascertain that there was a broad isthmus connecting Great Britain with the French coast, perhaps extending seaward as far as the limits of Belgium; there was a bay on the east and a bay on the west of this isthmus. In this state we may make sure that the tides running directly into the Norman Bay, as we may call it, on the west, and the Belgian Bay on the east, were considerably higher than they are at present. Now, the cutting energy of the tide depends upon the speed of the streams of water which its movement brings about, and the swiftness of these streams is proportionate in a high degree to the altitude the tidal waters attain in their quick successive rise and fall. No sooner was the geographic condition we have described in existence than the tides began their work of driving their way through the rocks by cutting out and scouring off into the deeper sea the materials composing the shores. In a short time, in a geological sense, this work was accomplished. The Norman Bay broke through into the Belgian Bay, and the waters had a free run through the channel, which we may presume at first to have been narrow. Although the tides then, when the land was severed, lost a considerable part of their height, they were still, as they are at the present time, powerful agents in scouring the shores, operating to work back the coasts at a rate which in a geological sense is very rapid.

East of Britain lie two peninsulas which have been the cradle of very important peoples. That of Sweden and Norway is the result of mountain development; that of Denmark appears to be in the main the product of glacial and marine erosion, differing in its non-mountainous origin from all the other peninsulas and islands of the European border. Thus on the periphery of Europe we have at least a dozen geographical isolated areas, sufficiently large and well separated from the rest of the world to make them the seats of independent social life. The interior of the country has several similarly, though less perfectly, detached areas. Of these the most important lie fenced within the highlands of the

Alps. In that extensive system of mountain disturbances we have the geographical conditions which most favor the development of peculiar divisions of men, and which guard such cradled peoples from the destruction which so often awaits them on the plains. Thus, while the folk of the European lowlands have been overrun by the successive tides of invasion, their qualities confused, and their succession of social life interrupted, Switzerland has to a great extent, by its mountain walls, protected its people from the troubles to which their lowland neighbors have been subjected. The result is that within an area not twice as large as Massachusetts we find a marvellous diversity of folk, as is shown by the variety in physical aspect, moral quality, language, and creed in the several important valleys and other divisions of that complicated topography.

The fact that Switzerland has maintained its local life comparatively undisturbed by the powerful States about it for more than a thousand years, is due mainly to the peculiar geographic conditions which environ its folk.

The result of the much-divided geography of Europe has been that the continent has become a natural cradle of strong peoples. Almost everywhere the sea is near by; save in Switzerland, all the important centres of population have had contact with the deep, and the peculiar enlargement which it alone can afford to man. This nearness to the sea insures also a tolerably large amount of rainfall, which affords the basis of a varied industry, and gives the lands a measure of fertility which makes it possible to have a considerable population on a small area. Comparing the conditions of Europe with those of Asia, we find that in that greater continent the isolation of areas is less complete, and the detached masses of land, such as Arabia, Hindustan, Malacca, Kamschatka, etc., are not well placed to be the cradle of several great races. They are either in or near the tropics, as are the three first-named peninsulas; in high latitudes, as Kamschatka; or made deserts by their circumstances, as in the case of Arabia. The highland valleys of central Asia are sterilized either by cold or drought. The industries of these uplands are so far limited that varied culture is impossible to the men who occupy them. Only in the peninsula of Anatolia, or Asia Minor, do we find the conditions for the culture of primitive peoples approaching the perfection of those afforded by Europe; and it is only in that section of Asia that we find the natural cradles of peoples such as abound on the European continent.

In order to appreciate the effect of diverse degrees of geographic isolation on the development of the peoples who inhabit islands or peninsulas, the reader will find it useful to consider several instances in which the measure of separation of the given area from the neighboring continents varies on a progressive scale. For this purpose he may take three groups of islands which have played a more or less prominent part in the history of civilized man; namely, Great Britain, the Japan archipelago, and Iceland. The British archipelago is separated from the continent of Europe by only a narrow strait, which is most important as a barrier because of the strong tides and waves which range through it. So moderate is the measure of separation that the shores are intervisible; and even in the earlier days of navigation it was not difficult in good weather for the most primitive craft to cross the water. So slight and recent is this barrier of sea that almost every species of animal and plant in Great Britain has its equivalent form on the mainland. Nevertheless we note the fact that the consequences of its isolation have in the history of man been most momentous. Even in prehistoric times it served to give the population of each of this group of islands a somewhat distinct character.

Considering only the strictly historic part of human development in the British Isles, we note in the first place that the barrier of sea delayed the Roman occupation of the district, and limited that occupation to the principal island. We perceive furthermore that the Irish Channel has kept the great western island singularly separated in its development from the eastern portion of the archipelago; and it can hardly be doubted that if Ireland had been as closely linked with England as Scotland is, the present political and social isolation of the Hibernian population would not exist. The perfect mergence of the

Scottish people with the southern British is doubtless in good part to be explained by the geographic unity of the two countries. In the one case there is a strong physiographic barrier, and in the other the two countries are indistinctly separated.

The independent development of the British State in the times following the Norman Conquest is clearly in large part due to the measure of protection afforded by the British Channel. While every other country on the continent except Scandinavia — which is itself practically as much insulated as Great Britain — has felt again and again the tread of conquering armies, this group of islands has been exempt from successive incursions. Repeatedly military combinations have been made which had for their purpose the subjugation of these islands. Some of these schemes doubtless would have been successful but for the resistance to invasion which this strip of sea interposes.

Few students of Great Britain will doubt that the insulated character of the land has proved of the utmost importance in shaping the fortunes of the English people. By retaining this folk in close but safe connection with the European continent, the geographic conditions have made it possible for the English race to mature its qualities and to extend its dominion in the world in a more perfect manner than would otherwise have been possible. If the connection between Great Britain and the continent which existed during the Tertiary period had been maintained to the present day, the history of the civilized world would have been greatly altered.

Turning now to the Japanese archipelago, we find in that part of the world a group of islands which are more separated from the adjacent continent than are the British Isles. The measure of the isolation is such that while the civilization of Japan in a general way resembles that of China, the independence of its development, as compared with that of the British Isles, is relatively great. There has been no such immigration into the islands from the mainland as has occurred in the British group of detached lands. Thus, though the Japanese are by race and primal education closely related to the Chinese, they have acquired a rather distinct civilization. In their motives they have departed far more from those of the neighboring continent than have the British.

For our third instance we may select the island of Iceland, where colonists of the Scandinavian folk became socially and commercially to a great degree separated from the parent country a thousand years ago, and have remained ever since without danger of invasion, free to work out their development without intermixture of the blood of other peoples. While these wonderful islanders have remained in rather close intellectual relations with the mainland of Europe, we clearly perceive that they have developed and maintained an independent civilization of a remarkable character.

Other instances to show a yet greater independence, secured by a more complete separation of islands from the mainland, can readily be found in such cases as are afforded by the Sandwich Islands, by New Zealand, or other lonely lands scattered in the midst of the great oceans. In each of these fields we may note that the life of the people is peculiar in proportion to the measure of their isolation and the length of time for which it has endured.

To see the importance of these conditions to the early races and states, we must conceive the state of primitive human life; we must picture to ourselves conditions very different from those prevailing in the present day. In order to make a people,—to elevate a primitive folk to the state where it possesses national motives and distinct moral character, and a culture which develops and fits that character,—we must give it a seat where varied industries are possible, a station which may be held against the destructive effect of foreign conquest for centuries, if not thousands of years, while the qualities of the inhabitants are undergoing development. These qualities —which for the want of a better word we term national—being developed in a people, the movement of migration derived from the growth of population brings the separate communities into contention with one another.

The curious diversities of European and Asiatic folk in the centuries immediately before and after the birth of Christ were the result of that preparation which had come about through the long isolation of the diverse groups of men in their several cradles. Culture in the arts of war and peace, and increase of numbers had brought these separate aggregations of men into a state of unstable equilibrium. They were ready to move; one movement of conquest led to another, until in time these peoples were all in motion, after the fashion in which the organic assemblages of animals and plants move when the topography and the climate of a continent are disturbed. This process of movement led to the vast contention which brought about the overthrow of the Roman power, and made an end of the dominancy which the Mediterranean States had previously maintained.

In order to perceive the close relation which exists between the migrations of primitive men and those of the lower animals, it is perhaps worth while to give the reader a brief account of the migratory movements of the lemming of Lapland, a little creature closely related to the rat. This animal inhabits the district of the Kolen, in the northern portion of the Scandinavian peninsula. Ordinarily it is limited to a rather narrow field, where it occupies a very inconspicuous place because of its underground habit of life. Occasionally, however, the lemmings are affected by the migratory spirit, and at such times they gather in large hordes and move forth from their mountain upland toward the west, through Northland and Finmark. In their march they proceed in continuous columns, the leaders of which seek to make a way directly toward the west. When encountering an obstacle, they will with great determination seek to overcome it, and only turn aside when they find it impossible to climb over or gnaw through the barrier. With brief pauses for food, they proceed on their way until they arrive at the shore. There they leap into the water and swim toward the west until they are drowned.

Many other instances illustrative of a similar migratory impulse operating in mammals, in fishes, in birds, and in insects could be given. They all point to the conclusion that whenever a species occupying a rather limited field increases to such numbers that the supply of food suited to their needs is no longer adequate, they become endowed with this singular mob-like desire to win their way to other lands. In all the circumstances of their migrations they remind us of the forced marches which the Huns and various tribes of the Aryan folk made in the centuries about the beginning of the Christian era.

It is now the opinion of those best versed in this complicated question, that the Aryan people, long supposed to have been cradled in central Asia, are really the children of Europe; that they were developed in the Scandinavian peninsulas,—a field which seems to have been the seat of the strongest men of the world for thousands of years. This view is more satisfactory to the naturalist than the older opinion, which placed the cradle of the Aryans in northern or central Asia. It seemed an anomaly that the most vigorous and at the same time the most plastic of the world-peoples should have developed amid the limited opportunities afforded by high Asia, where the chance of education in arts and in commerce is very small compared to what it is in Scandinavia, or indeed in any of the European peninsulas. If on *a priori* considerations the naturalist were compelled to designate the natural seat in which our race obtained its qualities, there is no other site which would so satisfactorily meet his view as to the needs as the peninsulated district about the Baltic; there, better than anywhere else, men may find a hardy, though not so strenuous climate as to diminish the vitality or send all the energies to the care for immediate needs. There the variation in the seasons, the variety of soil, the contacts with the sea are all admirably suited for the training of a folk. From that great nursery of vigor we can well conceive the Aryan people, protected in their infancy by the isolation of their birthplace, in time going forth in their strength to dominate the world from eastern India to the Atlantic. Thence again, in the Danish Northmen days, went forth a second tide of strength. We look indeed with satisfaction, from the naturalist's point of view, on the fact that in the peninsulas of Scandinavia and in the islands of the British archipelago we find the source of origin of the dominant people in the world; for there more perfectly than anywhere else is the environment adapted to making strong races.

After a race has been formed and bred to certain qualities within a limited field, after it has come to possess a certain body of characteristics which gives it its particular stamp, the importance of the original cradle passes away. There is something very curious in the permanence of race conditions after they have been fixed for a thousand years or so in a people. When the assemblage of physical and mental motives are combined in a body of country folk, they may endure under circumstances in which they could not have originated; thus, even in our domesticated animals and plants, we find that varieties created under favorable conditions, obtaining their inheritances in suitable conditions, may then flourish in many conditions of environment in which they could not by any chance have originated. The barnyard creatures of Europe, with their established qualities, may be taken to Australia, and there retain their nature for many generations; even where the form falls away from the parent stock, the decline is generally slow, and may not for a great time become apparent.

This fixity of race characteristics has enabled the several national varieties of men to go forth from their nurseries, carrying the qualities bred in their earlier conditions through centuries of life in other climes. The Gothic blood of Italy and of Spain still keeps much of its parent strength; the Aryan's of India, though a world apart in its conditions from those which gave it character in its cradle, is still, in many of its qualities, distinctly akin to that of the home people. Moor, Hun, and Turk, — all the numerous folk we find in the present condition of the world so far from their cradle-lands, are still to a great extent what their primitive nurture made them. On this rigidity which comes to mature races in the lower life as well as in man, depends the vigor with which they do their appointed work.

These considerations will be of the utmost importance to us in our study of the effect of physiographic conditions found in North America upon the folk derived from other lands, which are to work out their history upon its surface. The Americas, Africa, and Australia have shown by their human products that they are unfitted to be the cradle-places of great peoples. Vast as has been the development of human life upon them, these continents have never from their own blood built a race that has risen above barbarism.

Northern Africa early became the seat of Asiatic and European folk, who remained separated from the body of that continent by a region of deserts. The southern shore of the Mediterranean afforded fair opportunities for the independent differentiation of States, the result of which is expressed in its history; but the national motives of Egypt, of Carthage, and of Moorish civilization which grew up in northern Africa are all exotic. These States all represent the development of peoples who were cradled elsewhere. So, too, the semi-civilized condition of Abyssinia is due to the implanting there of peoples not of African origin.

Although the primitive races of Africa have never attained anything like civilization, there is reason to believe that they rose above the lowest savagery in a very ancient time, attaining at a remote period to about their present condition of culture. This fact is indicated not only by the very great differences in the languages spoken by the various tribes, but also by the condition of their agricultural and other arts. While languages may under favorable circumstances rapidly become differentiated, the arts, particularly those which pertain to agriculture, seem generally to be of much slower growth. Among the African peoples we find a great variety of cultivated vegetables belonging to a few primitive wild stocks. These simple groups of plants have become remarkably diversified among the various peoples, so that varieties in the kinds appear on the whole to be much greater than those which have been secured by the agricultural skill of the Aryan, Semitic, or Tartar peoples. The same is the case with the household arts. When we compare the state of this traditional constructive work with that of our North American Indians, we are struck by the fact that in Africa the occupations of the people have become extremely differentiated, while in North America the variety in this regard is relatively slight.

In Australia there has never been an elevation of the people above the grade of savagery. In the

Americas the only movement which elevated the folk above the lowest grades of barbarism is that which took place at certain points in the Cordilleran chain, where mountain districts afforded a measure of isolation and protection such as is necessary for the dawn of any culture whatsoever. All the rest of these continents, so far as we can interpret their human history, have been characterized by the endless disturbed wanderings of savages, tribe set against tribe, making life so precarious that culture was impossible.

A glance at the geographic conditions of North America will show the observer, especially if he will compare the conditions with those of Europe, how unfitted is this continent to be the cradle-place of peoples. This continent is in the main a geographic unit. The detached masses which border it are, by the circumstances of climate or of surface, unfitted to give the isolation necessary for the nurture of people. This will be evident on a brief review of the geography of this continent.

Beginning with the southern extremity of North America, we find in that region a limited measure of isolation brought about by mountain barriers. Central America and Mexico are to a certain extent protected by such natural defences, but in this region the climate is not suited to the best conditions of man. Although our species came from tropical creatures akin to the anthropoid apes, men need the stress of high latitudes, the moral and physical tonic effect of cold, to drive them into those interactions of activity which constitute civilization. Going up the eastward face of North America, we find in the Antilles an assemblage of lands which but for their tropical climate might have favored the growth of civilization. Next we come to Florida, a geographic unit of considerable importance. This area has, however, a subtropical climate, and a surface by no means favorable to primitive agriculture. It demands the resources of the modern farmer to win crops from the soil. Moreover, there are no barriers save those of swamps and forests to this field. Every part of the surface could easily be ranged over by nomads.

From Florida to eastern Nova Scotia and Newfoundland there are no well-isolated fields on the coast-line of North America. Cape Breton and Newfoundland, the island of Anticosti and that of Prince Edward, have something of the geographic unity which belongs to the cradle-lands of Europe and Asia; but in the aboriginal days of North America these regions were too far north for agricultural industries. Maize, the principal agricultural plant with the Indians, would hardly develop there. The barbarous folk were therefore retained in the state of hunters or fishermen,— conditions which do not permit peoples to emerge from the grade of savagery. Needs cannot advance in those lowly states of existence; there is no basis for commerce, no foundation for the progress of the desires on which all high culture depends. The man is what he seeks, what he desires and must obtain. All civilization is the outgrowth of strivings which go beyond momentary physical needs; and therefore until agriculture affords a firm foundation for subsistence, until life is by the soil made something more than a struggle for momentary support, the foundations of culture cannot be obtained. North of Newfoundland and through all the part of the continent which faces the ice-bound seas, the conditions are too rigorous to permit the development of agriculture, and therefore the geographic environment could not secure the cradling of well-developed races. The same is true of the region of Alaska. Maize culture is impossible until we advance southward on the Pacific coast, to the region which is beyond the peninsulated district of eastern America. This coast is rather uniform in its physical and climatic character until we come to the vast promontory of southern California. This latter district is in form not unlike that of the Scandinavian peninsula; but it is an arid country, affording no basis for agriculture, remaining to this day essentially an unknown desert. From Lower California to the isthmus, the shore is again without isolated areas of land.

The interior of North America is even more undivided than its shore-line. Along the eastern coast extends the great mountain system of the Appalachians, the highest points of which rise to about sixty-five hundred feet above the sea; but the structure of the ranges is such as to make no enclosures of well-defined mountain-walled basins. Every part of the Appalachians is open to the free movements of savage men; the best protected valleys would offer no immunity to a nascent civilization in its struggle with more barbarous folk. We see something of the unfitness of this shore-line of our continent for the cradling of great races in the history of European settlements on this shore. Every colony which was planted in North America had to enter into combat with a host of savages. There were no natural strongholds, such as abound on the coast of Europe, and such as afforded the foundation of the Greek colonies all along the coast of the Mediterranean, or to the Northmen all the way from their own land around to the shores of Sicily. So the European colonists, until they came to gain strength by numbers, were, despite their superior arts and arms, their stronger morale and training in the art of statecraft and war, in jeopardy for generations after their coming to the massive continent. The valley of the Mississippi, the great central trough of the continent, is unbroken by barriers from the Arctic Circle to the Gulf of Mexico.

The Rocky Mountains, by their greater height and certain peculiarities in their construction, afford a good many enclosed valleys which under more favorable circumstances might have become the seat of a vigorous life. Unfortunately this region is excessively arid. There can practically be no tillage within its limits except by devices of an engineering sort, by which water is led from scanty streams upon the land; and even with this resource the population cannot readily attain the numbers which are necessary for the development of culture.

It seems to me that it is rather to the physical conditions of North America than to any primal incapacity on the part of its indigenous peoples to take on civilization, that we must attribute the failure of indigenous man within its limits to advance beyond the lowest grades of barbarism. The Indian shows us in many ways that he is an able person. We may judge any folk by their greater men, and there can be no doubt that the ablest of our American savages rank high in the intellectual scale. It is, it seems to me, to the ceaseless disturbances of nascent civilization that we owe the failure of this folk to attain to a higher grade. Each tribe which retained its primitive savage impulse of migration became, as did the Shawnees, a kind of Hun, to sweep away in their foragings the beginnings of the higher state to which other folk might have attained. As long as a race is purely savage, dwelling in isolated communities, it does not seem endowed with any considerable mobility. When by the arts which constitute the next advance, and bring the people to the state of barbarism, they become dangerous to their neighbors, their motives are stronger, and they are commonly numerous enough to make war successfully. Not tied by systematic agriculture or by architecture to any particular piece of ground, they prey upon their better provided neighbor, and so break up their incipient states. Little as we know of the tribal movements in America, we have yet learned enough concerning them to see how certain bands of barbarians swept to and fro, sometimes in the course of a century, making marches comparable to those of Goths and Huns of the Old World, and bringing equal destruction in their path. The Goths and Huns were perhaps abler people than our American Indians in their best estate; moreover, they devastated States which were so strong as not to be utterly destroyed by their movements. The first effect of their coming was in good part to overwhelm society; but there was enough left, as we all know, to subdue the savages by the arts of peace. But if southern Europe had been struck by the northern invasion a thousand years before the tide broke upon them, the Goths would have had to invent their own civilization in place of appropriating and being appropriated by the earlier culture.

If the problem before our race on this continent were that of cradling civilizations, we should have no right to draw a bright picture as to the future of American life. Fortunately, however, the question is that of disseminating and maintaining race characteristics bred elsewhere, of bringing those characteristics into interaction on a field favorable for their best development. For this purpose the surface of North America affords peculiar advantages. The nature and limitations of these conditions we shall now have to consider.

CHAPTER VI.

Geographic Relations of North America; Variations of these Relations in former Geologic Periods. — Peculiar Fitness of North America for the Nurture of Plant Life; Inferior Position of its Animals. — Contributions of North America to the Domesticated Animals and Plants of Civilization. — Relative Measure of Relation of North America with Europe and with Asia. — Origin of North American Indians. — Conditions of first Settlement by Man. — Condition of American Indians when the Country was first settled by the Whites. — Effect of the Buffalo on the Habits of Indians; Region of Prairies. — Settlement of America by Europeans; Conditions which led thereto. — Scandinavian, Spanish, French, and English Settlements. — Importance of Geographic Features in determining Success of the various Colonies; Effect of the Appalachian Barrier. — Influence of the St. Lawrence and Mississippi Rivers. — Influence of the Tobacco Plant. — Settlement of the Mississippi Valley; Effect of the Geographic Conditions therein.

In considering the physiographic conditions of any area, with reference to the development of organic life upon it, the life of man as well as of lower beings, we have to note not only the circumstances of the given field, its soils, climate, and shape of the surface, but also the relations of the area to the neighboring districts, which in the process of geographical change, brought about by the development of mountains and continents, may send contributions to its inhabitants. We must therefore now turn our attention to the relations of contact between the continent of North America and the other land-masses of the world, particularly those of the northern hemisphere.

A glance at the map shows us that North America is geographically related to the Old World, both on the east and west. Geological history tells us that from time to time the measure of this relation of our country to the lands of Europe and Asia has varied greatly, the present condition being only one state of those connections. In the preceding geological ages, although we cannot as yet construct the ancient geography with any accuracy, we can still discern that the relations of the continent, as regards the freedom of its organic intercourse with Europe and Asia and South America, have varied much.

The American continents seem, from the record of the rocks, to have been better constituted for the nurture of plant than of animal life. A good measure of this difference may be had from the contribution which America has made to the animals and plants which are domesticated by man. It needs no argument to show that in order to meet the requirements of man's uses, animals and plants must be highly specialized, having peculiarities of strength as in our horses and elephants, a tamable nature as in almost all our domesticated animals, highly organized fruits, seeds, or fibres as in the most of our cultivated plants; in other words, it is in general from the highest members of each organic series that man selects the forms which he is to domesticate in his barnyard or his tilled fields. With this point in mind, it is interesting to note that North and South America and Australia, though they have about as many species of vertebrates as the Old World. have contributed but one animal to the domestic uses of civilized man, — the wild turkey; while the Old World has given more than a score to such service. On the other hand, the contribution of plants to domestication from the Americas has been most important. Indeed, we may say that the plants which the New World has afforded have been sufficient to make something like a revolution in the economic conditions of our civilization. The potato and Indian corn have profoundly altered the agriculture of Europe. Tobacco has changed the habits of men throughout a large part of the world. The species of cinchona whence comes quinine have been of invaluable advantage to human life; and a score of other American species, such as the tomato, have come to play a more or less important part in the field or garden. All these species of plants are highly elaborated forms; and the number of them which have been contributed to man's needs from the New World shows the relatively high differentiation of plant life in the American continents.

The geographic conditions which determine the relations of America to the centres of human development in the Old World are fixed by the position of the lands and the currents of the sea. By both these sets of circumstances, North America is more clearly related to Asia than it is to Europe.

Since the coming of man upon the earth the geographic relations of this continent have most likely been more intimate with the Asiatic land-mass than with that of Europe. It is possible that during the glacial period the region about Behring's Strait was lowered beneath the sea, but the subsidence was probably of a temporary nature. We may reckon that the continents have generally, at least since the beginning of the Tertiary period, been nearer together in the northern Pacific than in the northern Atlantic. The great depth of the ocean basin between the coasts of America and those of Europe points to the conclusion that the great lands in that part of the world have long been widely separated. Moreover, the ocean currents of the northern Pacific favor the movement of man as well as the migration of animals which may float on chance rafts from the region of China and Japan to western North America, while they oppose the westward movement of peoples from Europe to the American shore; the set of the atmospheric currents operates to the same end. It is a well-known fact that the sailing voyage, even to our modern ships, requires very much longer time from western Europe to eastern America than in the direct passage from this country. In the earlier states of the navigator's art, before the invention of the keel, it was well-nigh impossible for the primitive craft to find their way across the northern Atlantic to the European coast, while the chance of currents in ocean and air tended to bring vessels from the eastern shores of Asia to the western coasts of North America. Hence it came about that the first men planted on the American continent were probably Asiatic in their origin; and these peoples remained for many centuries unaffected by the higher races bred in the more favorable conditions of Europe. It should be noted that this point is disputed by some recent writers, but the position still seems tenable.

It is barely possible that some chance drifting of ships containing people blown away from about the mouth of the Mediterranean may have found a lodgment on the coast of South America, to which they were brought by the equatorial stream. The distance is, however, so great, and the time of the journey so long, that it is improbable that a ship scantily provisioned as were the vessels of old, should have borne living voyagers across this wide field of waters. The Peruvian traditions appear to point to the coming of their royal house from the East. It has been conjectured, by fanciful interpreters of those myths, that this race was of European origin. It appears on inquiry that there is nothing which may be called evidence to support this opinion.

It is easily seen that in the case of the lower animals chance wanderers to any land would have great difficulty in establishing themselves on the new-found shore. Difficulties arising from the lack of reconciliation with the environment, the unaccustomedness of the food, the unfitness of organization and habit to withstand the attacks of native enemies, would, in most cases, lead to their destruction. The history of North America shows very clearly how this principle holds in the case of human settlement as well as that of the lower animals. The first European colonies to be planted in North America, though reasonably well provided with the resources necessary for the colonist, had a hard battle to fight with their new conditions. Disease and native enemies brought many of these settlements to destruction. Chance voyagers in drifting ships, cast upon the shore without provision for their immediate needs, would have a yet more arduous battle before them. Therefore, though we may have had accidental immigration of European men to our American shores, we need not be surprised that none of these accidents led to the establishment of the higher races of the Old World on this continent, until in modern times its colonization was determinedly undertaken by civilized people.

As long as North America was unoccupied by man, its settlement from Asia would have been relatively easy. As soon as it had been filled with the descendants of Asiatic peoples to the point where the population was as dense as savagery permits, any further settlement would have been difficult, for the same reason that it was hard for the Europeans to make good their lodgement on the Atlantic shore. History makes us familiar with the fact that the colonies which came to the Atlantic coast from the Old World, except certain settlements in Pennsylvania and some of the early French establishments, found themselves in immediate hostile contact with the aborigines. The struggle for existence between the two kinds of men would in all cases have led to the extinction of the new-comers, had it not been that their ranks were fed by continuous reinforcements from the Old World. Thus, as soon as the continent was peopled from Asia, it stood out against further settlements, whether they came by chance or by design. In this way we may account for the failure of Asiatic colonies representing the higher life of Japan and China to establish themselves on the Pacific coast. It is almost certain that America was peopled before those civilizations were developed, and so there were tribes of savages ready to oppose the occupation of the country by the higher life which in time grew up in the eastern part of the Indo-European continent.

We now come to the effect of the geography of North America on its savage tribes.

The effect of the physiographic conditions of North America upon the development of the aboriginal peoples is so obscure as not to warrant much more discussion than we have given to it. There are, however, certain points which demand further inquiry. We have already noticed the fact that the massive geographic form of North America did not favor the creation of those divisions between people which are such a striking feature in Europe and Asia. The several tribes, developing evidently from the family relation, could only attain a limited measure of separate growth. If any of these ancient peoples could have found shelter such as a Swiss valley or a Scandinavian peninsula affords, the original differentiation dependent on the family tie would have readily extended into the larger bond of the state, but from the lack of geographic isolation, war, and various other accidents naturally arising in this massive and undivided continent, led quickly to a limitation in the measure of tribal development. In Mexico and in certain other sequestered parts of the Cordilleran region, where the people were in part protected by natural defences, the folk advanced to a somewhat higher grade of civilization than that which generally characterized our American savages; but even in these regions the protection was incomplete, and the folk were at all times liable to destructive incursions from neighboring less civilized tribes.

It appears from certain fragments of evidence, that some of our American Indians, a few centuries before the coming of the whites to the shores of the continent, were in a rather higher state of advance than that in which they were found by the first Europeans. Thus in the Mississippi valley the people were evidently more sedentary, some time about a thousand years ago, than they were when their conditions first became a matter of historic record. This is shown by the fact that the tribes had attained a point where they constructed extensive earthworks both for the purpose of defence and to indulge themselves in the expression of certain religious ideas. The Ohio and the Upper Mississippi valleys abound in the tumuli and fortifications which apparently indicate that the people had been more numerous than they were when our race first knew them; that they depended more upon agriculture and less upon the chase than their successors who met the white man when he first came to this country.

For a long time these aboriginal monuments were esteemed sufficient evidence to prove that the country had been inhabited by a peculiar race, to which the name of "Mound-Builders" was given. We now know that these works were constructed by the immediate ancestors of our American Indians, and that, indeed, in the more southern parts of the Mississippi valley, as for instance in northern Mississippi, the people had not quite abandoned the mound-building habit when they came in contact with the whites. The cause of this decadence is interesting. The explanation seems to be as follows: In the state of savagery men depend altogether upon the products of the chase, or upon the untilled resources of the vegetation about them. As the population increases, the game becomes less abundant, and the folk are gradually driven to tillage. They become sedentary; they exercise the forethought which agriculture requires, and so advance to the next higher stage in development, where they depend in the main upon the resources which the soil affords. Each further increase in the population diminishes the relative value of the hunter's art, and tends to separate the people from the vagarious and brutalizing habits of their ancestors, who lived by the chase.

In the higher state of development, such great constructions as Fort Ancient or the Picture Mounds of the Upper Mississippi and the Ohio valleys become possible; and to this state the peoples of the Ohio and neighboring valleys appear to have arrived some centuries before the advent of Europeans. Then came a peculiar biological accident which shows us how dependent man is upon the other living tenants of the earth he inhabits. In the pre-European state of the country, probably down to some time after the year 1000, the American bison or buffalo appears to have been absent from all the region east of the Mississippi. It is doubtful if the creature existed for any distance east of the Rocky Mountains. There had been an earlier and less plentiful species of bison in this country; but he appears to have disappeared many thousands of years ago, perhaps before the coming of man to this continent. Our well-known species probably was developed in some region far to the west of the Mississippi, whence it gradually spread to the eastward. The Mound-Builders apparently did not know the creature. We determine this point by the fact that we do not find bison bones about the old kitchen fires, and we fail to find any picture of the beast in the abundant delineations of animals made by these ancient people.

They figured all the other important forms of land animals, including birds, snakes, and also many of those from the far-off waters of the Atlantic and the Gulf of Mexico; but they have given us no representation of this, which would have been to them the king of beasts. We therefore justly conclude that it was unknown to them.

When in his westward movement the buffalo came to the semi-civilized inhabitants of the Mississippi system of valleys, he brought a great plenty of animal food to the people, who had long been in a measure destitute of such resources, for they had no other domesticated animals save the dog. Not yet firmly fixed in the agricultural art, these tribes appear, after the coming of the buffalo, to have lapsed into the pure savagery which hunting entails. To favor the pasturage of these wild herds, the Indians adopted the habit of burning the prairies. These fires spread to the forests on the east, killing the young trees which afforded the succession of wood, gradually extending the pasturage area of the wild herds until the larger portions of the western plains eastward to central Ohio and Kentucky, probably even into the Carolinas, and southward to the Tennessee River, had been stripped of their original forests, making way for the vast throngs of these creatures which ranged the country at the time when we first knew it. With the rehabilitation of the hunter's habit, and with the nomadic conditions which this habit necessarily brings about, came more frequent contests between tribes, and the gradual decadence of the slight civilization which the people had acquired.

The relatively recent advent of the buffalo into the Mississippi valley is well indicated by the facts disclosed in a section of the remarkable deposits which have been accumulated around the salt-springs at Big Bone Lick in Boone County, Kentucky. At this locality a number of springs whose waters are saline and therefore tempting to the larger herbivora emerge on the earth in the level bottom of a small valley. In the olden days these waters were evidently poured forth into a swampy field of some acres in extent. A section through the deposit shows us the following order of events in the later geologic days of this district. During and perhaps before the coming of the last glacial sheet upon the northern parts of this continent, these springs were greatly resorted to by the elephants which inhabited this district. When in 1868 the present writer made extensive excavations around these springs, he found at a depth of ten feet below the surface and thence downward for an unknown depth many remains of these gigantic pachyderms, the skeletons being broken to pieces by the pressure of the feet of the successive generations of these animals. Above that level, in the section which probably represents the time when the margin of the great glacier lay only a few miles to the north of the site, lay the remains of a musk ox allied to the living form of the Arctic regions and of the caribou or American reindeer. These remains were mingled with those of the elephant and mastodon. At about the same level occur the bones of a bison belonging to the same genus as our so-called American buffalo, but specifically quite distinct from that form. After all the above-named creatures had passed away, near the very top of the section, in positions which seem to indicate an exceedingly recent arrival in the district, we find the bones of our ordinary bison. The conditions in which their skeletons are found are such as show that they could not well have been for more than a few centuries in this part of the continent at the time when it was first visited by Europeans.

Thus the deforested condition of our prairies, which gives a very peculiar physiographic condition to the central basin of the continent, is probably to be accounted for by the interference of man. It is an effect, though unintended, of the savage's action in relation to an important wild beast. If the advent of European folk in the Mississippi valley had been delayed for another five centuries, the prairie country would doubtless have been made very much more extensive. Thus in western Kentucky a territory of about five thousand square miles in area had recently been brought to the state of open land by the burning of the forests. All around the margin of this area there were only old trees scarred by the successive fires, there being no young of their species to take the place as they fell. It is probable that with another five hundred years of such conditions the prairie region would have extended up to the base of our Alleghanies, and in time all the great Appalachian woods, at least as far as the plain-land was concerned, would probably have vanished in the same process.

In the district south of the Tennessee the Indians long maintained agricultural habits in a measure not common with their northern kindred. Indeed, when the settlements of the Creeks and the allied tribes about the Gulf were destroyed by the advancing tide of European life, the sedentary condition of the population had not been destroyed by the invasion of the buffalo.

In general, north of the great lakes and the St. Lawrence the climate is such as to make the development of people beyond the stage of savagery quite impossible, for the reason that agriculture, at least such as a primitive people could invent, is not possible in that country. We therefore find in the considerable Indian and Eskimo population of the high north of our continent much less trace of advance than in the southern section. We may say, indeed, that the possibilities of culture are in a descending scale from the subtropical districts of Mexico to the northern fields of the continent; the measure of advance depending on the ratio between the proportion of food-supply derived or derivable from hunting and from tillage. Still further we note on this continent a feature better shown in the Old World, — that the stronger and more militant people develop in tolerably northern stations, between the tropic heat and circumpolar cold. The conquering tribes among the Indians were those which were nurtured south of the great lakes and north of the Ohio River. In that district some agriculture was possible — indeed, it was imperatively demanded in any considerable aggregations of people — in order to meet the trials of the winter. The rigor of climate tends to breed vigorous, somewhat forethoughtful men; such races as the Iroquois, or Six Nations, appear to have acquired their soldierly qualities in these northern climates, as the militant folk of Europe were bred in moderately cold lands.

In a general way it is true that the North American aborigines, through the lack of geographical isolation, never attained the state when the physiography of the region they inhabited would do the most to develop the original tribal groups into states. The natural divisions of the continent did not come to have much importance in relation to man until North America became the seat of European settlements. We shall therefore, without further consideration of the aboriginal peoples, give our attention to the history of European immigrants on this continent.

The history of the earlier settlements of Europeans in North America is one of the most interesting chapters in the records of man. The discovery and the Europeanization of America depended in the first place upon the ancient commerce of Europe with the far East. This trade, which began in very ancient days, had attained considerable importance before the growth of the Mahometan religion. The development of this faith in the eighth century, and the consequent combats between the Christians and the followers of Mahomet, made the intercourse of Europe with the Orient soon more difficult and costly than it had been in earlier times. The commercial men of Europe as well as the statesmen were anxious to find a new way to the great, though somewhat fabulous wealth of southern and western Asia. Then came the important scientific conclusion familiar to the ancients, but new to modern people, that the earth was a sphere; and from it naturally arose the project of attaining to the Orient by sailing around by the west, so escaping the barrier which Mahometanism interposed to the path of commerce. Neither of these conditions would have been sufficient to push the explorers across the Atlantic, but for the great advance in the art of navigation which the Normans had brought to southern Europe. The classic ships of the Mediterranean, or their imitations in other parts of Europe save Scandinavia, were probably all flat-bottomed: they had to go with the wind. The Northmen had invented the keel, which alone makes navigation something better than waiting for the chances afforded by variable winds. Taking advantage of the trade-winds, even a Roman ship could have sailed to America; but it is doubtful if any vessel without a keel could have compassed the return voyage save by the rare opportunity of continued westerly winds, which blow only in the North Atlantic. Moreover, in Roman times water was conveyed with difficulty. The vessels used for this purpose were the skins of animals, or earthen jars, necessarily frail and generally of small size. The invention of the cask, one of the most considerable elements in the establishment of the economic conditions on which civilization rests, came in relatively modern times. The cask as well as the keel was, it seems to me, a device of northern Europe; and the two together did more to make long-distance navigation possible than any other inventions.

After the Middle Ages there was a rapid increase of population in Europe, due to the consolidation of States and a consequent steadfaster condition of society. With this increase in numbers the commercial spirit became stronger. The conflicts with Mahometanism developed a measure of missionary ardor which, combined with the commercial motive, supplied the strong incentive which pushed European peoples on the ways of western discovery.

It is not surprising that the first of these movements, save the accidental voyages of the Scandinavians to the northern coasts, came from the Spanish peoples. The reconquest of Spain to Christianity had served to develop the military motives of that people. A part of the conquering population of Spain was of Gothic blood, and still retained something of the seafaring impulse of the Northmen; furthermore, Spain is near the parallels of the trade-winds. As soon as a vessel is a little way from its shores, it feels that great western-setting breath which will carry a ship straight forward to the Antilles. If Columbus had sailed from the British Channel, the conditions of the "roaring forties" would probably have insured the failure of his adventurous voyage. The trade-winds determined, in a way that was most fortunate for our race, the fact that the Spaniards came to the tropical districts of America. These regions they possessed before the more northern peoples of Europe began to have an interest in the western empire. When the French and the English entered into the scramble for the new lands of the west, Spain had already laid its strong hand upon about all the countries south of the straits of Florida and north of the Equator. The English and French were fended from the tropical parts of America by the pre-emption of those lands by Spain, whose claim was fortified by the decisions of the Pope, and even more effectively excluded from them by the currents of the air and sea. The Gulf Stream makes a strong opposition to the mariner seeking to find his way to the Gulf of Mexico by cruising down the coast of the continent. To the slow-sailing ships of the colonial days, vessels which under the most favorable conditions did not generally make more than five or six miles an hour, this stream was a considerable barrier to the southward movement along the shore of North America. The only easy way to the lands about the Caribbean and the Gulf of Mexico was one pretty thoroughly guarded by the Spaniards; hence the French and the English were practically limited to the country north of Cape Florida. Thus we see the fact that the trade-winds and their current, which led Columbus to America, helped to bar the French and the English from the tropical portions of that country.

We must now note that the French, owing to their geographic position, shared with the Spanish in the missionary motive which was so large an element in continental Europe at the time of American discovery. The French at first and mainly sought America, not as a territory in which to plant their race, but as the Spaniards sought it, as a place of commercial enterprise and of spiritual domain. It is sometimes the fashion of Protestants to contemn the spiritual element of the Latin colonists in America, and to consider that the missionary portion of the enterprise was hypocritical, and that the commercial and national supremacy was the only end sought. History as well as a fair respect for human motives opposes this interpretation. We must regard the missionary element of these expeditions as of great value in directing the westward movement of the Spanish and French empires. In England, owing to circumstances which we cannot discuss, the Crusade motive was never as strong as on the Continent; the divisions in the Church, already rife, had led to a loss of such proselyting spirit as may once have existed. In this period England, though much less peopled than at the present time, already felt the stress of over-population; moreover, the much regretted loss of her continental possessions had given the people a desire to secure new lands. The commercial and colonizing impulses, unaffected by the spirit of religious proselytism, were also stronger than on the Continent. The result was that the English colonies in the New World were planted with a very different motive from those of France and Spain. They consisted of people who came to stay, to breed upon the ground, and to found New Englands on the foreign shore. Though in part led by religious convictions, seeking a haven for peculiar creeds, they were on the whole commercially minded, — true colonists in their intent, as were the Greeks in their time, or their ruder imitators, the Northmen, in a later age.

The conditions which determined the first seats of French and English settlements on the coast of North America may be termed accidental; or, in other words, we cannot perceive that physiographic conditions in any distinct way affected the location of the colonies. It came to pass, however, that the French obtained control of the region about the mouth of the St. Lawrence, and thence they extended their settlements up that wonderful valley, the great eastern gateway of the continent. At the same time the region about the mouth of the Mississippi was held by the other Latin people, the Spaniards, through the fact that they possessed the straits which led to the Caribbean, and the strength to maintain that empire of waters against intruders. The English and their kindred folk, the Dutch, found their way to the shore, and founded settlements from the Bay of Maine southward to and beyond Cape Hatteras.

It is difficult, in the present state of our control over this continent, to conceive the importance which lies in the facts concerning the original sites of the French and English settlements on the American shore. We now traverse this land in every direction with perfect ease; as for the mountain barriers of the Appalachians, with their great forests and unnavigable streams, they now demand but a ton or two of coal to carry in one railway train a greater population than was ever at one time before the beginning of the eighteenth century imported to our coast. In those old days the Appalachian system of mountains constituted a really impassable zone extending from Georgia to the far north, broken only at one point by a navigable water-way and the great valley it occupies, the St. Lawrence basin and river. It is true that the Hudson in its principal tributary, the Mohawk, in a fashion divides the Appalachian axis, but it opens no pathway into the Mississippi Valley. The Mohawk is unnavigable, and the region about its head-waters contained perhaps the densest part of the Indian population north of the Ohio, composed of very vigorous and combative tribes.

Although the Appalachians have peaks of no great height, their ranges are singularly continuous, and the passes formed by the streams in the numerous wall-like ridges afforded in early days no natural ways whatever. From Maine to Alabama the woods were unbroken and impassable. This great Appalachian forest was in primitive days an exceedingly dense tangle. At a few points the aborigines had worn narrow footways through it; but these trails were not adapted to pack-animals, the original means of transportation brought by the Europeans, but for the use of men who journeyed on foot, and could thus climb steeps inaccessible to a burdened beast. To add to the difficulties of the country, a large part of the district from central Pennsylvania northward was boulder-strewn, affording no footing for horses. Even in the present state of New England, where the superficial layer of glacial erratics has been to a great extent cleared away, it is easy to conceive how impassable the surface must have been in early times. It required a century of enterprising, unrecorded labor to open the paths across the stony and swampy fields of New England to the valley of the Hudson. The undergrowth of this forest country is far more dense than that which is commonly found in European lands. The shrubby plants, and the species of smilax or green briar and other creeping vines, make the most of our Appalachian forests very nearly impassable, even at the present day. Only once during the Civil War — in the retreat of George H. Morgan's army in 1862, from Cumberland Gap to the Ohio — did any considerable body of troops make an extended march through our trackless forests; and this redoubtable enterprise was accomplished in a portion of the Alleghany district where the woods are far more open than they are in the more eastern part of the country. Although this march extended for only two hundred miles, and was partly over roads, it wore out the well-trained army which had part in it.

The Appalachian barrier of forest and mountain was to civilized men almost as impassable as the Alps. It had a width of about three hundred miles; it was long before its geography was known, and therefore we need not be surprised that nearly a century and a half of growth had to take place in the English settlements before their people fairly broke their way through it and obtained access to the Mississippi valley; and that another fifty years passed before the central settlements were closely united with the seaport by ways which trade could traverse.

It fell to the lot of the French to secure in the St. Lawrence River possession of the only practical access from the Atlantic coast to the fruitful interior of North America. Although there are some difficulties of navigation in the St. Lawrence system of waters, as in its rapids and in Niagara Falls, that channel affords, for more than half the year, by far the most natural way into the heart of the continent. Along this path the French extended their settlements and their influence over the aborigines into the Mississippi valley, before the English colonists or those of the Hollanders had penetrated beyond the lowlands of the Atlantic shore; and in a military sense they took the English settlements in the flank and rear.

At the beginning of the eighteenth century, the historian, in making a survey of the conditions existing in North America, would have most likely declared that the Latin folk had vastly the advantage over the English in their control over the continent. On the south the Spanish possessed all that portion of the continent which was blessed with what is commonly esteemed a fortunate climate. On the north and west the French, by their control of the St. Lawrence and Mississippi valleys, over which they claimed and in a fashion exercised dominion up to the western base of the Appalachians, had apparently secured a hold upon all the fairest fields of the country. The British and the Hollanders, on the other hand, occupied a narrow strip of shore-lands which were only moderately fertile. Back of them lay an almost impassable barrier, separating them from the heart of the continent. On the north and west they were wrapped around by the French; on the south they were hemmed in by the Spanish possessions.

A closer view would have shown the investigator that there were certain conditions affecting these diverse peoples which were destined in the end to give dominance to the English folk. In the first place the British settlements of the Atlantic coast were tolerably ready of access at all times of the year to the Old World. It was only about five weeks' voyage from Great Britain to any part of the coast, while it was a six months' journey from France to the outposts of the French settlements along the upper great lakes or in the Mississippi valley. Moreover, the northern way, that by the St. Lawrence, was closed for nearly half of the year, while the Mississippi, even after its channel was well known, was a very difficult path for ascending navigation until the invention of steamboats. The French settlements in the valley of the St. Lawrence were ill placed for successful agriculture; their crops were scanty, and won with much labor. As before remarked, the continental peoples never seriously intended to transfer a large body of their population to the New World, making there the homogeneous equivalent of the European State. Their scheme was rather of a missionary nature; they proposed to incorporate the native people into the State after the fashion of the Roman colonists. This idea of obtaining control over the native population appears to have had some small share in the plans of the earlier English settlers. The scheme was, however, quickly abandoned. The settlers soon came to the plan of exterminating rather than domesticating the savages. The results were that the Latin settlements became in general the seats of a mongrel race, neither savage nor civilized, while the English and Dutch settlements were developed as true offshoots of the parent folk.

There was a certain advantage arising from the hemming in of the British colonies in North America by the Appalachian boundary. In place of the detached settlements which characterized the Spanish, and more particularly the French plantations, the British colonial establishments were by their geographical conditions compelled to develop in a more connected way. It was possible in 1700 to ride from Portland, Maine, to southern Virginia, sleeping each night in some considerable village. If our ancestors on the continent had secured a ready access to the interior, it is likely that a hundred years would have gone by before the colonies became sufficiently dense in population to permit the interactive life which prepared the way for the American Revolution.

A very important effect arising from the limitation of the British colonies near the coast region of the Atlantic is found in the rapid development of maritime life during the two centuries before these colonies obtained access to the interior of the continent. The best lands of these narrow fields were rapidly possessed by the people. After this first stage in the agricultural development of the district had passed, the fields of the country afforded but scanty room for the enterprise of its population. For the same reason that the Scandinavians and the British became seafarers, the portion of the British colonies where the shore afforded good harbors turned toward maritime life, and for a hundred years or more enterprising men ploughed all the oceans with their keels.

In the present century we see the effect arising from the opening of the Mississippi valley to our Atlantic coast peoples, in the gradual decadence of our shipping interests. The vigorous youth who in the last century would have resorted to the sea now betakes himself to the prairies, and finds there the opportunity of winning his way to fortune which his ancestors were compelled to seek along foreign shores. Although there have been many influences at work in the diversion of our people from maritime life, it seems on the whole that the most important cause is to be found in the way opened to enterprising people through the ready access which this century has given to the central fields of the continent. After that great domain is possessed, we may fairly expect that the Atlantic coast population will again turn to maritime life.

Although the Atlantic coast presents no very great diversity in its physical conditions, its range in climate is sufficient to afford a considerable variety in agricultural products, and the geographic divisions serve in a measure to intensify certain regional differences of character in such a measure that the inhabitants of the several British colonies on this coast became tolerably distinct in their character. This process was aided by the fact that most of the earlier settlements were composed of somewhat diverse peoples, each of the colonies coming to the possession of individual motives either through peculiarities of religious faith, peculiar social habits, or other original varieties in the parent stock. The long-continued absence of any political association between the separate colonies kept them in a good measure apart, and thus served to foster the development of diverse character in different sections; so that upon this shore there came about a state of society in which the New Englander, the Hollander of New York, the Quakers of Pennsylvania, the Catholics of Maryland, and the churchmen of Virginia were somewhat different from one another.

These characteristic differences between the several peoples of the Atlantic coast were due in part to physiographic circumstances of their environment. The development of the American colonies, their rapid growth in the century preceding the American Revolution, depended in a large measure on a botanical accident, — on the introduction of tobacco into the commerce of the world. No contribution from newly discovered lands has ever been so welcomed as this so-called noxious weed. No new faith has ever travelled so fast and far among men as the habit of smoking. In scarce a century from the first introduction of the plant in Europe, its use had spread to nearly half the peoples of the Old World. The eastern coast of America from the Hudson southward to South Carolina, is peculiarly well suited for the growth of the tobacco plant: and the rapid extension of the British colonies in America, which brought their population at the time of the Revolution to a point where they numbered about one-sixth part of the English people, was largely due to the commerce which rested upon the use of this plant. It was a source of a vast income in the tobacco-growing States, and in a secondary way it served greatly to promote the growth of New England and New York. It is true it in good part laid the foundations of the American slave-trade, on which the culture of cotton built a vast structure; but at the same time it served to promote the growth of our race on this continent in a very important way, for it provided the means for an extended trade with the Old World, and thus gave a degree of wealth to the New.

There is one aspect of the African slave-trade which has been generally neglected by persons who have written on that important feature in the history of this country. This is the way in which it operated upon the early development of our American colonies. The first settlement on the shore of North America naturally consisted in the main of vigorous, enterprising, and intelligent people from the several states of the Old World. Although the present state of the immigration movement brings to our shores mainly the peasant class of the Old World, these laboring people were relatively wanting among the early colonists. The result was that the early societies of our shores lacked the substratum of population on which the development of a State so intimately depends. The colonies had more than a fair proportion of intellectual capacity, but less than their share of rude human strength. It was at first supposed possible for these new States to acquire a laboring class by enslaving the Indians; but all these efforts at subjugating the American savage have been as unsuccessful as the similar efforts to domesticate the buffalo. Both of these American creatures have a fair measure of physical vigor, but they are alike untamable.

The Spanish, who owing to their control of the tropical portion of the Atlantic, alone had access in the early colonial period to the coast of Africa, were the first to begin the importation of negroes into this continent; but the trade soon extended, so that they were brought into all the European colonies. Unlike the Indian, the negro proved to be a singularly useful laborer. No other savage in the world has ever proved so readily domesticable in a civilized country. Patient, laborious, and enduring, endowed with a rare capacity for imitating the ways of his master, he became in the hands of the colonists a most invaluable servant. It is a peculiarity of this singular man, that, though given in his own land to very brutal ways, he readily adapts a large part of the motives of civilization. In the course of two or three generations the descendants of these wild men became in the most essential features of their nature substantially akin to the peasant class of our own peoples. The most singular and exceptional of all the characteristics of the negro which fitted him for the use of the American colonists consisted in the remarkable readiness with which he became acclimatized in relatively high latitudes. While all other tropical peoples appear to suffer greatly from a change of climate, the negro endures the relatively great cold in the winter season of North America, at least as far north as the Potomac, about as well as the white man, who is by origin and nurture a creature of the high north.

The effect arising from the introduction of negro slaves into the Atlantic coast colonies of North America was clearly very great and for a time advantageous. It gave to the enterprising people of this country a means whereby they could, at a relatively small cost, secure all the labor which they cared to control. This labor was particularly serviceable in the extension first of tobacco culture, and subsequently in that of cotton. As the commercial success of the English colonies in the first two centuries of their history depended mainly on the crop won from these plants, we must regard the geographic conditions which led to the introduction of negro slaves as of very great importance in the history of this land. But for the existence of a body of savages in Africa, folk uniquely fitted for the needs of this country; but for the fact that the African shores were only separated from those of eastern North America by easily navigated seas, — the commercial advance of the American colonies would have been relatively very slow.

Although the American people in the end paid dearly for the good which they won through the institution of slavery on this continent, the immediate effect of the institution was undoubtedly very beneficial. It made it more possible to have in this new and rude land a cultivated class. It led to the rapid accumulation of wealth, and in this way brought the people the sooner into a condition in which they could control their own destiny.

The effect of the Appalachian axis on the development of the English people might also be traced in the protection which it afforded against the more powerful bodies of the aborigines. The tribes which originally dwelt between the sea and the mountains were relatively weak; although they held some intercourse with their western kinsmen, they were so far separated from them that at no time did the eastern peoples, save in the valley of the Mohawk, have to meet any considerable body of warriors who were bred in the inland parts of the continent. Hence the struggles of the earlier settlers on the Atlantic coast with the savages was a relatively unimportant matter; though it more than once brought the feeble colonies into great jeopardy. But for the Appalachian barrier, the English, owing to their rude ways of contact with the savages, would necessarily have met the hostility of a vastly greater body of warriors. A Pontiac or a Prophet would have effected what the feebler King Philip vainly essayed. It may well be doubted whether the Puritans of New England or any other of the settlements, except perhaps the Quakers, could have held their own against the aboriginal folk of this country but for the protection this barrier afforded.

It is in good part to the commercial growth of the British colonies in America that we owe the speedy overthrow of the French empire, which at the beginning of the eighteenth century seemed likely to control North America. The New England settlements developed rapidly, and were pushed up toward the north; and from them as a base it was easy to capture the strongholds of the St. Lawrence valley, and thus make the great scheme of France impossible.

The settlement of the Mississippi valley by the English people was first effectively accomplished through Virginia and its western extension beyond the mountains in the then district of Kentucky. It is at this part of the Appalachian system that we find the most practicable path for a wagon-road from the coast to the navigable waters of the Ohio. Following up the great valley of Virginia, that known as the Shenandoah, thence to the broad open basin of the upper Tennessee, thence over the low gap in the Cumberland Mountain to the westernmost of the Alleghanies, it was easy to take pack animals, and with a moderate amount of labor to make a wagon-road from the Virginia settlements to the most fertile portion of the Mississippi district. The process was easy, because this country is south of the glacial belt, and thereby not encumbered with boulders, and also because a succession of breaks in the mountains makes a natural way, the sole moderately easy passage from the Virginia district to the centre of the continent. Thus it came about that the first settlement in the Mississippi valley, the settlement which gave character to a large part of that basin, came from Virginia, and took with it the institution of slavery into the Mississippi valley, establishing the black line on the banks of the Ohio. If the conditions had been slightly different; if the way from the Hudson or from Pennsylvania to the west had been as easy to traverse as that from Virginia to the Ohio valley, — the fertile fields of Kentucky and Tennessee might well have been occupied by people from New England and New York; in which case the boundaries of the slave-holding States would probably have been drawn much farther south, if indeed the institution had ever obtained a firm foothold in the central portion of the Mississippi valley.

CHAPTER VII.

Effect of the Appalachian Mountain System on the Distribution of Slavery. — Influence of the Prairies; Rapidity and Ease with which they are won to Tillage. — Effect of Invention of Agriculture. — Original Division of North America. — Atlantic Coast; its Agricultural Capacity. — Mississippi Valley and Pacific Arable Land. — Effect of Modern Economies in producing local Peculiarities of Society. — Lack of Geographic Variety in North America. — Three Marine Regions of this Continent. — Details of the New England District; Surface Tillable Soils; Variety of Occupations. — New York District; Comparison of its Resources with those of New England. — Virginia District. — Absence of Glacial Erosion; Influence of Blue Ridge; Character of Plain Country; Condition of Population. — Effect of Diverse Climates on the Negroes. — Florida Peninsula; its Soils; Shore-Line Fisheries; probable Future of the District. — Mexican Gulf Group of States; Region of the Lowlands; Climate; Mineral Resources; probable Increase of Negro Population. — Ohio Group of States; Climate; Soil; Contrasts in Fertility; Effect of these Contrasts on the People; Influence on the Civil War. — District of the Great Lakes; Peculiarities of the Region; Climate; Variety of Mineral Resources.

THE effect of the Appalachian Mountain system upon the distribution of slavery, and consequently on the political and social history of this country, was of great importance. Slavery, as is well known, depended for its extension on two important crops, both of which demanded a large amount of cheap labor, and afforded articles which commerce greatly demands. The institution rested on the industries of tobacco and cotton growing. Only where one of these crops could be profitably tilled did the institution ever firmly establish itself. A glance at the map will show that the Appalachian system of mountains widens as we go southward from Pennsylvania, until it occupies nearly one fifth of the Southern States, extending southward so as to include half of Virginia and North Carolina, a considerable part ot western South Carolina, much of Georgia, Tennessee, and Kentucky, and a part of Alabama. In this section the character of the soil and form of the surface, and the nature of the climate, make the land unsuited for the extended culture of either tobacco or cotton. The result was that slavery never firmly established itself as an economic institution in any part of this vast territory. Here and there in the more fertile valleys a few slaves were employed; but there are counties in this area where a slave was never held, and where to this day a negro is so great a curiosity that people will journey miles to behold him. The natural result of this distribution in the negro population was that the mountain districts of the South were separated in their political motives from the plain country. When the rebellion occurred the Appalachian country was a region where disaffection toward the Confederacy prevailed; to a great extent the men cast in their lot with the North, or at least gave their sympathies to the Federal cause. The peoples of eastern Kentucky and Tennessee and western Virginia — and generally those of western North Carolina as well — recruited the ranks of the Federal army. Some of the counties of eastern Kentucky sent more troops to the Union forces than the voters who ever appeared at an election in those districts.

Owing to these conditions, the Appalachian upland region divided the South in a political and geographical way, and served greatly to enfeeble the resistance which it opposed to the Federal arms. About one fourth of the population of the slave-holding States lay in this upland country. Not only did this district afford over a hundred thousand soldiers to the Federal army, but the prevailing sympathies of the population were with our troops in every stage of their work. It is to this non-slave-holding element of the Appalachian districts that we owe the adhesion of Kentucky to the Federal cause, and the partial co-operation of half of the Old Dominion, now known as West Virginia. But for the existence of this extensive territory inaccessible to slavery, and the consequent weakening of the South, it is doubtful if the Federal arms would have been able to prevail in that momentous contest.

It would be possible to extend these considerations concerning the influence of geographic features on the development of European settlements and the history of our peoples on this continent. Analysis would show that almost every feature, every river and plain, had its effect in controlling the distribution of the population in its westward march. It would also be easy to show that the climatal characteristics have vastly affected the political conditions through the character of the crops which are tilled.

Thus, for instance, the Western prairies, which apparently owe their origin, as before remarked, to the Indian's habit of burning the plains to favor the spread of the buffalo, greatly affected the distribution and the prosperity of our population. The forests being removed from the prairie countries, they were ready for the plough, without the arduous labor required in the districts previously occupied by our race to clear away the timber. Possibly owing to their long deforested condition, the soil greatly abounded in the elements fitted for the production of corn crops. The climate excluded the profitable culture of cotton and tobacco, — the staples on which negro slavery rested. The result was the rapid economic development of that region through the export of grain, and the consecration of the country to the interests of free labor. History shows us that it was only narrowly that the States of Illinois and Indiana escaped the institution of slave-owning within their territories. If the isothermals had been drawn one or two hundred miles farther north, so that the southern crops could have prospered in these States, the evil of slavery might well have been fastened so firmly that it could not have been uprooted from our country.

Manifold and interesting as are these considerations, we must turn from them for a glance at certain other features dependent on the structure of the continent which have had a profound influence on the development of our American population, and are to have yet other important effects in the time to come, — those which arise from the distribution of the soil and the deeper-lying mineral resources of the national area.

In his savage state man's dependence on the under earth, or even upon the soil, is very slight. It is true that in a fertile country the game is commonly somewhat more abundant than in a region of scanty soil, but differences in this regard do not greatly or immediately affect the people. With the invention of agriculture dependence on the soil begins; with the need of tools a slight relation with the metallic resources of the under earth is instituted. With each step in the further development of the arts, man's interest in the crust of the earth increases. At first the non-precious metals — iron, copper, lead, and zinc — are sufficient for his needs; but in ever-increasing ratio with the development of civilization this dependence on the under earth is augmented. The greater portion of these geologic materials are either prepared for the use of man, or brought nearer to the earth's surface by the process involved in mountain-building. The development of the Appalachian axis, as well as the similar processes which led to the formation of the Cordilleras, has shaped and revealed in this continent an ample store of mineral materials suited to the needs of man, and has placed these stores in remarkably advantageous positions in relation to the regions suited for the purposes of agriculture.

In general the continent of North America is divided into three regions of arable land and three great mineral districts. Along the Atlantic coast and east of the Appalachians there is the tolerably fertile country of the Atlantic slope, extending from Florida to the St. Lawrence. The agricultural capacity of this district compares favorably with any equal section in the world. In the Mississippi valley we have, considering the circumstances of the soil and climate, the largest and most fertile area — the area best suited to maintain a great body of our English race — which the world affords. On the Pacific slope we find a third arable field, containing less area than the Atlantic territory, but with great agricultural possibilities. Dividing these three fields, or facing them on the north, we have the mineral districts; on the east the Appalachian country, abounding in coal and iron and considerable quantities of other important metalliferous or mineral deposits. In the Cordilleran districts we have, so far as known, the most plentiful deposit of the more important metals, except of tin, which the world affords within equal area. On the north, in the Laurentian field lies a third mineral area extraordinarily rich in iron, phosphates, copper, and other valuable earth materials. In the great valley between the Cordilleras and the Appalachians, and to a certain extent on either shore-land, there are extensive beds of coal and important deposits of the fluid fuel petroleum, as well as of natural gas. This distribution of agricultural and mineral resources of this country is singularly favorable for the conjoint development of tillage and of mining, and for a vast interstate and foreign commerce, of which we, in our day, see but the beginning.

Before we proceed to consider the details of this natural order in the distribution of the earth resources of North America, we must turn aside for a moment to note the effect of modern economies in producing local peculiarities in human life.

In the earlier states of man the nurture places of the races depended for their effects on the presence of strong geographic barriers — seas or mountains — which might fend the people from the interference of their neighbors, and thereby enable them to undergo the nurturing process which led to racial or national peculiarities. It is easy to see that the effect of commerce is to destroy these boundaries. The Alps, once a formidable barrier, are now pierced by tunnels, and are as easy of passage as the plain-lands to the north and south. A season's earnings will now carry a man to the farthest civilized countries. But while commerce and the industries on which it depends have served to break down the natural barriers between peoples, they have served also, in a singular way, to create other limitations of habit and action which are likely to have even greater influence in the cradling of people than the old geographic bounds. It is evident to any one who has studied the varying effects of occupations, that the herdsman, the soil-tiller, the manufacturer, the miner, pursue employments so different one from another, that men who follow them become in hand and mind specialized and unlike those of other occupations.

A German phrase has it that a man is what he eats. We may better say that a man is what he does; and that persistent doing in one line of deeds for a few generations will serve to give character to a population in much the same manner as a thousand years of isolation in a peninsula or an Alpine valley. Within the limits of either of the great classes of occupations noted above, as well as many others to which we cannot conveniently refer, we find a wide range of diversities dependent on the peculiarities of the employment. Thus the population engaged in the iron furnaces or rolling-mills differs widely in character from the folk employed in weaving and spinning fibres. The watchmaker and the shoemaker are both, in a sense, manufacturers; but the mental training which the two receive, and the consequent habits of life, both moral and physical, differ in a very wide way. The orange-gardener of Florida and the wheat-farmer of Nebraska pursue employments which differ entirely in their nature: the one labors throughout the year with his tasks, the other is subjected to the peculiar influences which come from seasonal activities. The wheat-field of the Far West calls for action in but four months of the year; for the rest the workman is but a drone, unless he turns his attention to other tasks than his crops afford. Indeed, the variety of character which civilized occupations give to a population is much greater than that which in the same time could be instituted by any purely natural circumstances.

Although North America is almost destitute of the geographic divisions which in the earlier conditions of man served to diversify the character of peoples, the diversities of occupation are easily and necessarily instituted in the great American mixture of folk. Varieties of men as characteristic and as important in the history of our people as those which Nature has produced in the folk of the Old World, divisions resting upon modes of activity bred in men by occupations and by habits which occupations engender, will at once unite and diversify the people of this country, linking particular districts in one interest and way of thought and action, and separating those districts on the basis of industry from the folk who pursue diverse methods of life.

I now propose to make a general review of that part of this continent which is occupied by English-speaking folk, with the hope that we may thus obtain a basis on which to foretell, in a general way, the divisions of character in our people which are likely to arise from the varieties of their tasks.

We have already noted the fact that the continent of North America is divided into three great mineral and three great agricultural districts. We may profitably add to the consideration the fact that there are three regions of a maritime sort where the people have experienced the important effects of close contact with the sea. These maritime districts consist of the North Atlantic shore, from Cape Hatteras to Labrador; the Pacific coast, from Alaska to the Gulf of California, both regions abounding in good harbors; and the third, the southern coast, from Hatteras around Florida to Mexico, which is not well provided with ports, and where the maritime conditions are less important than along the other shores. Despite the imperfection of the harbors from Hatteras southward, the coast of North America is, on the whole, the most completely maritime of any continent except Europe. Its landlocked waters, including the great lakes, are of vast extent; the total number of excellent ports possibly exceeds that of the Old World. It is clear, therefore, that we are to have in North America two great maritime districts, and a third in the south, of less importance, to add to our list of national labor-fields.

In this general survey we have to consider the natural-employment divisions of this country, and endeavor to forecast their economic history and the quality of the population which their condition is likely to induce. This task may advantageously begin with the New England section, — a region which, by its geographic as well as its economic conditions, is one of the most specialized parts of North America. In our considerations it is not desirable to take an account of the line. in the main of a very arbitrary nature, which now separates Canada from the United States. Whatever be the political future of these countries, there can be no doubt of their destined economic and social unity. The several questions which now separate them are of such a nature that we may be sure they will in the end lead to a closer union.

The matter of the relations between the United States and Canada is now so much under debate that it may be worth while to turn for the moment aside from the path of our considerations to note the geographic aspects of this international problem. We may in the first place observe that the lines of separation between the northeastern and southeastern portions of North America which lie to the eastward of the head of Lake Superior are in a geographic way tolerably accented. Although the narrows between the several basins of the great lakes are tolerably constricted, these inland seas afford a strong line of parting between the two English-speaking peoples of North America for the distance of nearly a thousand miles between the outlet of Lake Ontario and the westernmost portion of Lake Superior. From Lake Ontario to the Gulf of St. Lawrence the river of that name, for the greater portion of its length an arm of the sea, is also a very distinct line of demarcation. If this stream and its tributary lakes constituted the frontier between the countries, we should have a line about as strong as that which separates Germany from any of the States which border upon it. The fact is, however, that a large portion of Canada lies to the south of the St. Lawrence system of waters; and throughout that greater portion of the boundary which lies between the Lake of the Woods and the Pacific Ocean, the parting is drawn along a line which has no more physiographic reality than the parallels of latitude.

The mineral and soil resources of Canada and the United States are of such a nature that in a commercial sense the products of each are necessary to supplement those of the other. Although Canada abounds in stores of metallic wealth, its supply of coal is scanty, being limited to certain small fields along the St. Lawrence, to areas of lignite in the central portion of the continent, and to some poor coals of Mesozoic age on the Pacific coast. It is evident that this region, which from its climate as well as on account of its mineral resources needs a vast supply of good fuel, must look to the United States for such materials. On the other hand, within the limits of Canada there are doubtless extensive deposits of iron and other ores which could be advantageously used at the furnaces of the United States. The high-grade mineral phosphates known as apatite, which have a large place in certain important arts, abound in Canada, and have not been found in workable quantities south of the boundary-line of the Dominion. A careful inspection of the relative mineral resources contained in the two States would show a similar relation to that which we note with reference to the great staples of coal and iron. The Canadian district contains great quantities of copper ores, extensive deposits of iron pyrite, manganese, and a variety of other rough products which should enter with perfect freedom into the commerce of the continent.

A glance at the soil resources of the two regions shows us also that a complete and uninterrupted interaction of the laws of supply and demand should prevail between the two countries. The greater portion of the Dominion, even those parts which have a decided agricultural value, is too far north for the farmers to rear Indian corn. A great number of other agricultural products of the United States are also excluded from the Canadian fields by the brevity of the summer season. On the other hand, the Canadian district is very well suited for the cultivation of edible roots such as the potato, the average yield and quality of the crop being much greater than in the United States. Any commercial barriers which tend to prevent the free exchange of these products of the soil or of the under earth are contrary to the order of Nature. In so far as they exist, they serve to deprive each region of the opportunities for subsistence which the other part of the country affords.

Looking at the matter from the point of view of science alone, we note the fact that the continent of North America, being a curiously united land, affords a field in which the people can, more than in any other country in the world, profit by a free exchange of supplies. In fact, the slight amount of localization in the characteristics of the country clearly points to the conclusion that a perfectly free intercourse between its several parts is a general principle which should prevail in its commerce. Thus, even granting that there may be portions of the world in which it is well to limit the course of trade, it seems to me clear that on this broad land at least we should have a perfectly unembarrassed exchange of resources.

There is yet another reason why it seems to me desirable that there should be a complete commercial union between the northern and the southern portions of this country. North of the United States there is a great area which is very well fitted for summer use; but the winters are very long, and of such severity as to hamper all forms of economic activity. If the conditions were such as to permit and favor the ready exchange of resources and of population, it seems to me likely that in time to come we might look for a considerable annual migration of population along the meridional paths. Transportation is now so cheap that many laborers in the fields might advantageously begin their season's work with certain crops of the southern States of this Union, and with the advancing summer continue their labors in the more northern realm. Something of such a movement may already be noticed in the portion of the United States west of the Mississippi River, where the harvesters of grain follow the crop from Texas northward into Dakota, and so extend the period during which they earn high wages over a term of some months' duration.

It may further be urged in favor of an intimate relation between the Canadian Dominion and the United States that the social status of the people of both countries would thereby be advanced. There is now no question that the Canadians of the Laurentian district, at least those of British origin, constitute a most valuable element in the population of the continent. They are a vigorous and hardy people, less mingled with the blood of immigrants from Europe or Africa than the folk of the United States. A perfectly free economic intercourse between these sections of the continent would doubtless be advantageous to the condition of its people.

It does not seem desirable to confound the questions as to the commercial boundaries between these two countries with any debates concerning their political status. In the present state of the government of these two portions of North America, the United States and Canada, it is a matter of very little moment to which of them a citizen owes allegiance. His general status is practically the same in both countries. Even the social or caste differences which are to be observed in Great Britain have practically no place in Canada. Therefore from the point of view of the physiographer, as distinguished from that of the politician, it seems a matter of no moment whether Canada and the United States are members of a common political system; while it is of the greatest importance whether their peoples are alike to be made free to share in the advantages which the continent as a whole affords.

As regards the division line between Mexico and the United States, the situation differs a good deal from that which we have just considered with reference to the Federal union of the Dominion, and this for the reason that Mexico has a relatively low-grade population, — the greater part of its people being of a hybrid race, arising from the commingling of Spanish and Indian blood. So far as the United States is concerned, it is clearly desirable to avoid a commingling of our population with that of the countries on our southern border.

The New England section of North America, including as such all the varied district from Newfoundland to the Hudson, is well named. On the whole it more closely resembles, in its conditions of shores, the surface and soil, the islands and peninsulas of northern Europe, in which our Northmen folk developed, than does any other part of this continent. The geological history of the two regions is very similar. Both are mainly composed of ancient rocks, and both these ancient rocks have been much crumbled by the mountain-building forces. Both have been subjected to a vast amount of glacial wearing; their soils have certain common qualities given by ice action. In both we have a close combination of agricultural and mineral resources.

The New England section of North America, including the St. Lawrence district in that field, is essentially the maritime portion of North America. Within its limits we find the largest amount of shoreline for a given distance along the main coast of the continent. There are more deep bays and fjords, and larger islands, than along any other portion of the Atlantic border of the United States. The depth and intricacy of these indentations of the shore steadily diminish from the region about the St. Lawrence to the district about the Hudson River, where the coast altogether loses its fjord-like character. Thus on Cape Breton the wonderful inlet known as the Bras d'Or, which divides the island almost in twain, has, it is said, an aggregate shore-line of about fifteen hundred miles, counting in this total the shores of the numerous islands which it contains as well as those which bound the water. These singular recesses are abundant along the coast of Nova Scotia as well as that of Maine. They are rarer in Massachusetts, and are scarcely distinguishable in the part of Connecticut to the west of New London. The origin of this interesting topography, which has so great an influence on the sea-faring conditions of the northeastern part of the continent, is found partly in the action of glacial ice, which has served to deepen and complicate the river valleys of this part of the country, and partly in the fact that after the valleys had been formed the region was lowered to such a depth beneath the sea that its water flooded all the low ground, leaving the divides between the streams in the form of elongated promontories or islands. We see in this instance as in many others, when we come to examine into the condition of the earth's surface in regard to the uses of man, how the geological actions of a remote and at first sight apparently unrelated past have had a vast influence upon the status of man.

The surface of the New England and Laurentian district throughout its whole extent may be described as mountainous. Save in the southeastern portion of the country, every part of the field contains decided mountain ridges worn to their roots by the work of the rivers and the recurrent action of glaciers and sea, but still giving the surface a truly mountainous character. The result is here, as elsewhere, that in a large part of the mountainous districts not far from one half of the whole field is sterile from the lack of sufficient soil, or fit only for the growth of forest-trees. This feature insures to the district the permanence of the timber industry.

The tillable soils of the New England and Laurentian field lie mostly in the valleys between the important mountain-ranges; they are glacial soils, formed of the materials brought to their place by the ancient glaciers; they have certain peculiar characteristics. When first won to the plough they are of only moderate fertility. Largely composed of pebbles and boulders, the amount of plant food they contain does not compare with that which is held in the prairie soils, where for ages the conditions have favored the preparation of the materials required by vegetation. They have, however, the peculiarity that they gain in fertility by skilful tillage, even without artificial fertilizing, while the prairie ground steadily diminishes in its productiveness under cultivation. All the pebbles in our stony fields, except those composed of quartz, are constantly yielding some part of their materials to refresh the soil. A pebble of granite or of the kindred crystalline rocks commonly contains considerable quantities of potash, soda, lime, and phosphorus, — substances which are most rapidly brought into the state where they may be appropriated by plants when the soil is used by man.

At present the tide of immigration sets from New England to the West, where cheap lands with their great though unenduring store of fertile materials await the settler. This stage in our history, where cheap but unpermanently fertile lands are to be had almost for the asking, is now nearly passed by. In another generation these opportunities will no longer exist, and it is thus likely that with the relative increase in the value of soil products the agricultural position of New England will be improved. From a somewhat careful study of the New England States, as well as a portion of the Laurentian district, I have become convinced that this northeastern field has far greater agricultural possibilities than is commonly supposed. A very large part of the neglect to which these fields have been subjected is due to the withdrawal of the population from them to manufacturing life, to occupations which for a time afforded a larger remuneration than the tillage of a stubborn but not unfruitful soil.

When the Western country is fully occupied through immigration, and the natural increase of our native people, there is every reason to believe that agriculture in the northeastern part of our country will attain something of the relative importance which it had in those districts a century ago. This seems the more probable when we note the fact that a large portion of the richest soils of New England — the swamp-lands — was never won to the plough. In the Laurentian and New England district we have not far from ten thousand square miles of morasses, — areas which demand a considerable expenditure of capital before they can be brought to the tiller's use, but which, when so won, afford fields of surpassing fertility. Up to the time when the great West was opened to settlement, the population of New England had not become dense enough to drive the people to this class of soils; but with the inevitable crowding of our American population which the next century is to bring about, these swamps will be drained, and by their drainage a vast area of excellent land will be won to tillage.

This northeast section of the continent has a fair share of subterranean resources, including a wide range of metals and a very plentiful and varied store of building materials. Last of all, it is peculiarly the seat of the greater water-powers of this country. This abundance of streams suited for mechanical purposes is due to the relatively considerable height of the district and the frequent great thickness of the glacial deposits in which the rain-waters are retained and slowly yielded to the streams.

It is easy from the facts stated above to foresee that in the future the New England district — including as we have done, the region about the St. Lawrence — is to be the seat of the most varied occupations. No other part of the United States so well combines the conditions for maritime, agricultural, mining, and manufacturing labor as this territory. Further variety in the life to come is insured by the remarkable mixture of races in this territory. In Nova Scotia we have perhaps the largest body of Highland Scotch outside of the mother country; and in this region, where this blood is so little mingled with that of other lands, the Gaelic language is the common form of speech. In Lower Canada there are several large settlements where the people are almost entirely derived from northern France. New England proper has many areas where Irish Celts and their descendants outnumber the original New England stock. Here and there are considerable colonies of other peoples, — Scandinavians, Germans, and Azorian Portuguese. At present it seems likely that the peoples presumably of Celtic stock — the Irish, Canadian-French, and Highland Scots — will in another fifty years greatly outnumber the original New Englanders. So far, however, the immigrants from continental Europe have in the main betaken themselves to the cities of New England, and have shown little disposition to obtain control of the soil. The rural neighborhoods are still characteristically English, and for all that we can see at present bid fair to remain so for a hundred years to come. Although much of the strength of New England has gone West to found new States, enough remains to insure the perpetuation of the original stock, so that we may look forward to another element in the diversification of New England conditions wherein the towns will be largely composed of descendants of foreigners of alien race, and the country districts of folk of English blood.

South and west of New England we have another characteristic group of States in New York, Pennsylvania, New Jersey, and Delaware, — a region tolerably well marked by its conditions of surface and climate so far as those affect the development of man. In this district, which is about as extensive as the New England and Laurentian district above described, we have an area in which the maritime conditions are less pronounced, the agricultural resources — as determined by the soil and climate — proportionately more considerable, and the mineral resources very much larger than in the more northern realm. While in the New England section, practically, the whole of the surface is mountain-built, and not more than one third of the area is suited to agriculture, in the New York district, as we may term it, the mountainous sections occupy not over one third of the total area, and the soil is, on the whole, much more tillable. The mineral resources of this field, particularly those which are applied to the production of power, — coal, petroleum, and natural gas, — are the staples of its geological wealth. Including a small portion of Ohio, we have in this section the largest store of these materials that is afforded by any equal portion of the earth. On the other hand, while the power derived from ancient sunshine and stored in the form of carbon in the rocks is more plentiful in this district than in New England, the immediate energy of water-power, due to the heat of the present day, is less available than in New England. Except at Niagara Falls, where there is a vast but as yet unusable store of solar energy, this district, owing to the relative thinness of its glacial accumulations and the consequent impermanence of the rivers, presents no such advantages to the manufacturer as are afforded by the New England streams.

In general, the physiographic conditions of this group of States afford the basis of an exceedingly varied life. The different forms of activity are likely to be only less closely associated than in New England. The natural manufacturing centres are widely distributed, and the mineral resources lie well in the body of the tillable land.

South of New Jersey and Pennsylvania we have a somewhat characteristic group of Commonwealths, including Virginia and the Carolinas. This, which we may call the Virginia group of States, differs in many ways from the two northern associations which we have just considered. The first and most important peculiarity consists in the character of the soils. The whole of New York and a large part of Pennsylvania and New Jersey have had the character of their soils determined by the peculiar grinding of the surface and distribution of the waste which was brought about by the glacial period. Although a trace of this ice action is observable in Virginia, the region as a whole was substantially unaffected by the tread of the marching ice. This difference leads to a great modification in the character of the soils. In place of being the product of that distinct carriage which has brought the soils of the glaciated countries to their places, the upland portion of these States is covered by an earthy coating derived from the immediate decay of the rocks beneath the surface.

The Appalachian Mountain system, in its two elements of the Blue Ridge and the Alleghanies, widens as we go southward from the Potomac. The result is that an even greater share of these States consists of mountainous elevations than we find in the New York group. The western portion of each State is occupied by heights which rise so far above the level of the sea that the climate is greatly affected by the uplift. These mountains are, however, far less sterile than those of the New York and New England districts; not having been swept over by the ice, they retain their original soils, and thus afford larger areas for tillage than are found in the more northern highlands. In each of these States, by way of contrast with their upland districts, we have along the shore a broad belt of lowlands, — territories which were until very recent times beneath the level of the sea. This great southern plain, which extends from New Jersey southward, widening as we go toward the equator, affords, compared with the mountain districts, one of the sharpest contrasts of conditions which are found in any part of this country.

Owing to the slight elevation of the plain region, its nearness to the Gulf Stream, and the protection which the mountains afford on the northwest, the climate becomes very much warmer on this plain as we proceed southward. Between dawn and dark of a winter's day we can journey from the frigid conditions of New York to the semi-tropical climate of Charleston, — from the realm of frost to one of flowers. With a shorter journey from the mountainous heights of the western Carolinas, which have a winter temperature about as low as that of New York, we may pass toward the sea through the same range in temperature conditions. This contrast in climate is equalled by that between the under-earth resources of these two sections. In the mountainous portion of the States of the Virginia group we have an abundance of mineral wealth, the search for which has but begun. Gold, iron, copper, zinc, and various other substances of economic importance exist in the upland portion of this area, while the lowland parts have as yet afforded but small supplies of such materials, phosphates being the only geologic element of great importance. It is evident, therefore, that the plain-land region of this district is to develop purely agricultural industries, while the upland section, by its admirable combination of soil, noble forests, and mineral resources, is to have more varied industries, and therefore a more diversified life.

Although within the above-mentioned States the resources of fossil fuel are limited, we find immediately on the west of the district and everywhere convenient to it, the vast coal-measures of Tennessee, Kentucky, and West Virginia fields, which afford bituminous coals quite equal to those which have been the foundations of the commercial industries of Great Britain. Thus, this region of southern uplands has in its soil, its forests, and its mineral resources, a combination of advantages perhaps greater than those of any other equal area in the world. In addition to these favoring conditions, the region possesses an admirable climate. In winter the temperature falls low enough to insure the preservation of bodily vigor; in summer the heat is less ardent than in the lower-lying regions of the New England and New York group of States. In the

Virginia section we find a climate resembling in its range of temperatures those which characterize the most favored regions of the Old World; and it is there perhaps we may look for the preservation of our race's best characteristics.

The lowland country, on the other hand, appears to be too warm to afford the most satisfactory conditions for our people. Although the whites appear to be able to work in the fields during the summer season, the malarious influence common to a large part of the territory, as well as the lack of a really tonic winter, does not promise a brilliant future for European peoples in the seaboard portion of the district.

The population of this group of States is as diversified as their physical conditions. In the lower-lying lands the negro folk constitute a large, and appear to be physically the most successful, portion of the population. In the plains between northern Florida and Chesapeake Bay the negro finds apparently the most satisfactory environment which this continent affords him. His contact with the whites is sufficiently close to stimulate his languid industrial motives, and the climate fits his needs in a very tolerable way. It is doubtful if the tribes of Africa, from which our blacks came, are in any better physical condition than their descendants on the Atlantic coast.

Although the negroes constitute the largest element in the population along the shore-lands of the

Carolinas and Georgia, the upland section is almost devoid of Africans. This peculiar feature in the distribution of the blacks was brought about, as before remarked, by the unfitness of the upland country for the crops on which the plantations of the South depended; it has been maintained by the disinclination of the negro to dwell in cold countries, and the indisposition of the white population to tolerate their presence. There is good reason to believe that the negro population will not become more extensive in the upland section of the South than it is at the present time. On the contrary, it is most likely that they will spontaneously gather to the warm lowlands, leaving the cooler grounds to the white race. If this be the case, — if the Southern mountains are left to the whites, we may reasonably expect this region will become one of the most important seats of an unmixed American population. It is not in the pathway of immigration, and as yet it is occupied almost altogether by the descendants of British immigrants.

South of Georgia we find ourselves at the base of the most singular peninsula of this country, if indeed it be not the most remarkable mass of land on the borders of any continent. The peninsula of Florida affords the most distinct field, in a physiographic sense, of any part of North America. Including the northern portion of the State, it has a length of about six hundred miles, an average width of near one hundred miles, and a total area greater than that of New

York, and nearly as great as that of New England. In all this great realm the maximum height above the level of the sea does not exceed about four hundred feet. The whole of the soil is composed of materials recently brought together on the sea floor. About one fourth of the soil area is limy, due to the coral rock which underlies it. The remainder is nearly pure sand of a rather infertile nature. All the soil owes its value in the main to the admirable climate which the region enjoys.

The mineral resources of the Florida peninsula are of the most limited nature. Certain deposits of phosphatic rocks exist, apparently of sufficient richness to give them a great economic importance. From the point of view of geological values, save for these mineral resources, it is perhaps the most absolutely sterile section of North America.

Owing to its peninsulated form, Florida has a shoreline of more than two thousand miles in length; owing also to the extended system of harbors which the coral reefs have created, this region has a maritime character and fitness of contact with the sea which is not enjoyed by any other portion of the coast south of Chesapeake Bay. The harbors, though shallow, afford tolerable protection to small vessels; and the extraordinary wealth of fish in the waters makes it certain that in the future this region is to have an industry resting upon the harvest of marine life such as is afforded by no other section of the Atlantic coast. Not only do the food fishes abound, but the waters afford vast quantities of sponge; and the species of marine turtles find a better station along this shore than in any other section of the continent.

The physical conditions of Florida favor the development on this shore of several industries which have not as yet any place in its economies. Thus we may instance the culture of the sponge-making communities of animals, many species of which find a very favorable station in the shallower parts of the sea near the coast-line. The area of sea-bottom which seems to be fit for this form of culture is very great, probably in all exceeding three thousand square miles.

At present the propagation of sponges is left altogether to accident, while the search for them is untiring, and carried on by processes which bid fair to lead to the extermination of the creatures. European experiments, made it seems in less favorable situations, have shown that it is possible to plant sponges in a methodical way and at no great cost on the bottoms of the shallow seas, and after a few years of growth to harvest an abundant crop. So, too, the green turtle of commerce, which once abounded along these shores, has been greatly diminished in numbers by persistent and unreasonable pursuit. Not only have the adult creatures been recklessly captured, but it is the habit of the people as well as of several wild animals to seek out and destroy their nests. The eggs of this interesting reptile can doubtless be artificially hatched, and their young kept in captivity for a sufficient time to protect them from the dangers incident to their immature state. It seems, indeed, not improbable that it may be possible to breed it in captivity by some system of enclosures at the mouths of the many small embayments which abound along the coral reefs. Retained within such basins, the creatures could be supplied with appropriate food during the process of their growth.

The physical conditions of Florida make it plain that this peninsula is to develop its life on the lines of agriculture and of marine industries. The agriculture is destined to be of a peculiar sort, — gardening, in fact, rather than the ordinary field tillage. The tropical and subtropical fruits — the orange, the lemon, the lime, and tenderer sorts of vegetables — may be easily reared, and assure the agricultural possibilities of this district. It can never be a corn-bearing country, and an extensive grazing industry is practically excluded by the imperfect growth of the grasses. Owing to the fact that this land is wrapped around by the sea, the summer temperature as well as the winter is insular in its character; although at present the region is a prey to fevers, they seem due, not to an essential unhealthfulness of the climate, but to the bad sanitation. Even in the extreme south, on the Keys and the shores of the beautiful Bay of Biscayne, the people appear to be very healthy; the children are vigorous, extreme old age is frequently attained, and there appears to be an exemption from deadly malarial fever. We may best judge as to the climatal effect on man by the condition of the Indians, which is excellent. No portion of our aborigines appears to be in a better physical or moral state than the Seminoles of Florida.

It is an advantage enjoyed by this section, which it shares with the highlands of the South, that the negro population is very small. Although the climate is one which suits the negro, the present industries, and those which we may foresee for the future, make it likely that this race will be slow to take possession of the country.

On the west of Florida and Georgia lie a group of States which face the Gulf of Mexico. Between western Florida and western Louisiana, and back to near the northern border of Alabama and Mississippi, we have a region of lowlands which derive their quality from their relations to the Mexican Gulf. The low-lying portion of these States is, in its geological history, like the equivalent section of the Atlantic coast. It is an old sea-bottom which has recently been elevated above the ocean. The soil, save along the banks of the rivers, is of only moderate fertility; but it bears luxuriant forests, and is excellently suited to the great staple, cotton, on which the commercial development of the section has rested. Owing to the fact that these States lie at the southern end of the Mississippi valley, and are unprotected by mountains from the winter blasts, they are subject to great variations in temperature. The summer heats are great, and to the white population enervating. The winter cold, on the other hand, is considerable, sufficient indeed to bring something of the tonic effect upon which our race is so accustomed to depend.

The northern part of Alabama, as is well known, abounds in stores of coal and iron. In topography it is sharply contrasted with the southern portion of the State, and its wealth of mineral resources insures in that section a large manufacturing industry dependent on the materials from below the soil.

The population of the States between western Florida and eastern Texas is, on the whole, a less satisfactory part of our American people, for the reason that the negro element holds at present, and is likely for all the foreseeable future to hold, a greater place in this territory than in any other part of the United States. It is true that at present South Carolina abounds in blacks in an equal measure with Alabama and Mississippi; but with the growth in population of the highland district of the former State, we may fairly expect that this preponderance of the African element will disappear. On the other hand, in southern Alabama, in Mississippi and Louisiana, the conditions of the soil and of the climate clearly point to a vast increase in the number of blacks, without a proportionate gain in the European population. There is more danger of

Africanization in this section than in any other part of the United States.

North of the Gulf States, and thence to the great lakes, and westward to the Mississippi, we have the valley of the noblest tributary of the Mississippi, — the Ohio, containing within its basin the northernmost portions of Mississippi and Alabama and a portion of western Georgia, of North and South Carolina, a part of Virginia and West Virginia, the whole of Tennessee and Kentucky, and the greater part of Indiana and Illinois. Although the geographic limitations of this great basin are not sharp, they are sufficiently accented to make it one of the most characteristic divisions of the continent. This individuality is further affirmed, as we shall see, by its qualities of soil, climate, and its subterranean resources.

The basin of the Ohio, with the exception of some parts of its headwaters, the Upper Kanawha and the tributaries of the Tennessee, lies well within the broad trough of the Mississippi valley. It is thus in the path of the great air movements from the Gulf of Mexico northward, and from the Arctic Sea southward. Atmospherically considered, it is like the other parts of the Mississippi valley, — a region of combat between torrid and frigid conditions. In the winter season the dominance of polar winds brings low temperature upon all parts of the area. In the summer half of the year the superior power of the tropical northward-setting winds brings it into almost torrid heat. The range of climatal variation, measured by the periods of seasonal length, is perhaps greater in this valley than in any other part of the continent. The surface of this region is essentially without mountains. Though the western tributaries of the Ohio rise in the highest land on the Atlantic side of the continent, the portion of the valley which can be termed mountain-built does not include more than one tenth of its area. The result is that nearly the whole of the surface is tillable. Probably not more than one fiftieth of the total area is permanently unfitted for the uses of the husbandman.

The soil of the Ohio district has been but little affected by glacial action. It is true that the ice in the most developed state of the old continental glaciers overlaid the greater part of the Ohio, touching the surface of Kentucky immediately south of Cincinnati, and occupying by far the greater part of Indiana and Illinois, as well as those parts of the headwaters of the Ohio which lie in Pennsylvania and New York; but over the most of this district the ice was thin, and the amount of glacially transported material less considerable than in the normally glaciated districts of the north and east. As a whole, the soils may be classed as those of immediate derivation, those originating with the decay of the subjacent rocks. As the geological strata of the Ohio valley vary greatly in their mineral constitution, the soils derived from them are naturally divided into a good many classes. Thus we have in Kentucky and Tennessee a wide range of Silurian limestones, which by their decay afford soils of extraordinary fertility, those which give character to the well-known blue-grass district. It is worth while to note in passing that this singular richness of the earth is due to the fact that in these limestones there are certain thin layers composed almost wholly of the remains of minute creatures which had the peculiarity of taking lime phosphate from the sea and building it at their death in the deposits formed on the old sea-floors. When elevated into land and subjected to the process of decay, these rocks afford, under the action of the atmosphere, soils of great fertility. So we see that the fruitfulness of our fields may depend upon the nature of organic beings in the remotest past.

Throughout the Ohio valley, except along the margins of the streams where the soil has been brought to its resting-place by flood-waters, we find everywhere sharp contrasts in the fertility of the soil. Already, although the history of the country extends back for but a century, we perceive very clearly that these natural variations have been of great importance in differentiating the people. There is no greater contrast in any country between neighboring people of the same blood than that which exists between the so-called mountaineers of eastern Kentucky, who occupy the soil of sandy carboniferous beds, and those who dwell in the rich grass country of the central district of the Commonwealth. The fertile soil of the limestone region has given abundant wealth to the inhabitants of that region; wealth has brought culture and all the circumstances of a high civilization. The sandy soil giving little to tillage, the people have remained poor; their contacts with the world have been slight, and they yet abide by their customs and intellectual development in the conditions of the eighteenth century.

It is worth our while to go one step farther, and to note the effect of these diversities induced by differences of soil. When, in 1861, it was to be determined whether Kentucky should go with the South or North, the question turned in the main on the occupations of the population. Where the soils were rich, the plantation system was possible, the slave element was large, and in general the voice of the people was for union with the South. Where the soils were thin, the people had no interest in slavery, for they owned no negroes. Old frictions with the slave-holding portions of the State existed, and consequently the people of this sterile land were generally devoted to the Union. A soil-map of Kentucky would in a rude way serve as a chart of the politics of the people in this crisis in the nation's history. If Kentucky possessed a soil altogether derived from limestone, there is no question but that it would have cast in its lot with the South.

The mineral resources of the Ohio valley have a somewhat singular distribution. From western

Alabama around to the headwaters of the Ohio in Pennsylvania, we have a continuous belt of country abounding in coal and iron. Nowhere in the world, so far as it has been explored, is there any region of equal extent where these two substances, both of the first interest to man, each requiring the other for its most important uses, are geographically so united. In the western part of the Ohio valley, and separated from this eastern and southern section by a wide interval of fertile lands, lies the western coal-field, extending from central Kentucky to central Indiana and Illinois. Taken as a whole, the area of the Ohio valley has a more perfect association of fuel and iron resources along with those which are afforded by a fertile soil than any other part of the world.

In addition to the supply of energy contained in the coal-beds tributary to this district, there are two other sources of power accessible to the inhabitants of this valley, — petroleum and natural gas. The deposits of petroleum appear to be in the main limited to a field occupying a portion of western Pennsylvania, western Virginia, and eastern Ohio, and to another smaller and less important district on the waters of the Cumberland River near the point where it crosses the division between Kentucky and Tennessee. Although the quantity of petroleum accessible at any one point in this valley appears to be rather less than that which can be obtained in the famous Caspian or Baiku field, the district is probably, all things considered, the most extensive source of supply of this substance which the world is likely to afford. The natural gas of the Ohio valley appears to be far more considerable in quantity than that contained within any other equal area. Thus in this district we have three known sources of valuable subterranean energy, — coal, petroleum, and natural gas, — in more advantageous conditions, as regards quantity and nearness to fertile agricultural areas, than in any other region of the world.

We thus see that the Ohio group of States has, from the point of view of its resources, singular advantages over any other part of the continent for the maintenance of a vast population engaged in industries, both those of the soil and those of the shop. Within a century the area occupied by these States is likely to contain a larger population than that which now exists in all English-speaking countries. Although this population is destined to be to a great extent engaged in mining and manufacturing, there is room in this region for an agricultural people exceeding in numbers the present population of the United States; for, as before remarked, there is hardly any untillable land in its area, and except for the limitations which the necessary preservation of the forests put upon the extension of the tilled fields, ninety-nine hundredths of its area can be won to husbandry.

There remains, in the part of the continent east of the Mississippi, another interesting district, which constitutes a singular physiographic unit. It is the basin of the Laurentian lakes, commonly known as the great lakes of North America. In this great district of inland waters we have an area situated so far north that the rigors of the climate limit the operations of agriculture to less than half of the year. The soils are throughout glacial in their character, of moderate fertility, but more enduring to tillage than those which lie to the south of the glaciated country. This district includes the whole of the Canadian provinces of Quebec and Ontario, the northern part of Ohio, the western portion of New York, the whole of Michigan, a small part of the northern sections of Indiana and Illinois, and a portion of Wisconsin and Minnesota. Although the northerly site of this area gives it a short season for the growth of plants, the region near the lakes has the climate somewhat modified by these great surfaces of water during the time when they are not locked in frost. The northern portion of this area — nearly the whole of the region north of the great lakes, and a considerable part of the Michigan peninsula — is mountain-built, having been subjected to the disturbances attendant on the formation and growth of the Laurentian system. The elevations have, however, a small relief. In the Canadian section nearly if not quite one half the surface is barren or too infertile for tillage in the present state of our agriculture; while perhaps nearly the whole of the district south of the great lakes is covered by tilled fields or luxuriant forests. The soils and the climate afford, on the whole, as favorable conditions for farming as are found in the Scandinavian peninsula and the other regions about the Baltic which have been the birthplace of great peoples.

The mineral productions of this area are extremely varied. Coal of valuable quality does not exist within its limits. There is a considerable area of carboniferous rocks in Michigan, but they have as yet given little promise of important contributions of fuel. Iron, copper, silver, and the phosphates of lime and salt are the geological staples of this region. All these substances, both as regards the mass of the deposits and their purity, appear to have in this region a pre-eminence among all the fields of this continent. The distribution of these resources of the under earth and the variations of climate in this continental Mediterranean district, provide an ample basis for a great differentiation in the population. Thus western New York and the northern border of the Ohio States which face the great lakes are destined to be agricultural communities, with a certain share of manufacturing industry. These parts of this field are not to be the seats of mining. The same is true of southern Michigan and southern Wisconsin. The region about Lake Superior, owing to the sterility of its soils and the rigor of its climate, is not likely to be the seat of a considerable agriculture or of much manufacturing. It is evidently destined to be a region engaged in mining and in timber culture.

The foregoing inadequate glance at the conditions of North America, east of the Mississippi and south of the region which is sterilized by cold, shows us that despite the generally consolidated character of its geography, the variations of the soil, of climate, and of the under-earth resources are such as to insure the profound diversifying influences which come to man from his occupations. This measure of diversity will increase with each step in the advance of civilization.

CHAPTER VIII.

Section of North America west of the Mississippi. — Division into Sections as determined by Rainfall. — Aridity of the District; probable Future. — Central District of Canada. —Region of the Red River; Condition of Climate; Fitness for the Use of European Settlers. — Rocky Mountain District; Effect of Cordilleran Barrier. — Condition of Cordilleran District in northern Mexico; within the United States; Form of the Mountains; Recent Change in the Rainfall; Character of Soil; Variation in Climate. — Mining Industry of Cordilleran District; Variety of Resources; Fitness of Region for Aryan Race. — Pacific Coast District; Division into Three Areas. — Section of southern California. — Relation of Mining and Tillage Fields. — District of Oregon; Mineral Resources; Soil; Climate; Fitness for Aryan Race. — Alaskan District. — Effect of American Conditions on the Life of Europeans; on Africans. — Evidence of Longevity of Europeans; from Surgery; from Field Sports; from Measurements. — Endurance of Soldiers in Civil War. — Effect of American Climate on Negroes. — Conclusion.

We have now to consider the section of English North America which lies to the west of the Mississippi River, — a region where the under-structure, the topography, and to a great extent the physiographic conditions which affect the advance of man are determined by the Cordilleran system of mountains.

First, let us note the fact that this western section of the continent, at least the part of it which is south of the Canadian region, is generally characterized by a scanty rainfall. Only on the Pacific coast north of California do we find anything like the annual share of moisture which comes to the earth in the regions east of the Mississippi. East of the Mississippi the annual supply of rain amounts on the average to about fifty inches, — a share of precipitation probably unsurpassed in any equally extensive area in the same latitude, unless it be in China. Moreover, the seasonal distribution of rain in the part of North America east of the Mississippi is, on the whole, favorable to the interests of agriculture. The greater part of the annual fall, it is true, takes place in the winter half of the year, when it is of the least value to vegetation; still, almost all the territory is entitled, by the regimen of the air, to receive abundant showers during the growing season.

West of the Mississippi the average rainfall, though not yet well determined, probably does not exceed twenty inches, and may in the end prove even less in quantity. Moreover, in this section the rain is ill distributed; the greater part falls in the time between the first of January and the first of May, the summer and autumn being, in a large part of the area, times of continued drought. From the Mississippi River westward this diminution of the rainfall goes on rapidly as we approach the Rocky Mountains. The most arid section lies within the mountainous belt; on the western borders of that district we have a narrow strip of country extending from southern California, widening to the north, wherein the rainfall is sufficient for the needs of a vigorous vegetation. In the mountain districts local circumstances cause the rainfall to vary greatly in amount. There are considerable territories tolerably well provided with rain, but as a whole the region is arid.

The trans-Mississippian portion of North America is, from the point of view of economic interests, divided into several distinct sections. On the east we have a strip of country including eastern Nebraska, Iowa, Missouri, eastern Kansas, Arkansas, and eastern Texas. In this section the annual rainfall is sufficient to promote the development of grain and the other staples appropriate to the soil and temperature. Throughout this belt the surface is, except in the Ozark district of Arkansas and Missouri, substantially unaffected by mountain-building forces. The whole of the area affords excellent soils. This section is in the main fitted for agriculture. There are, however, at several points, as in the lead district of Iowa, the lead and zinc country of Missouri, the iron district of the Ozark, considerable sources of mineral wealth. Throughout this section of States bordering upon the Mississippi, but west of its line, the climatal conditions are apparently favorable to the development of our race; for though the summers are, in the southern section of this district, extremely hot, the winter is sharp enough to maintain the physical energy of the people.

West of the country just considered, and thence to the eastern boundary of the Cordilleras, we have a section where the diminished rainfall renders ordinary agriculture unprofitable. Now and then a season favors the tillage of grain over the most of this vast expanse; but the annual supply of water varies too much to make agriculture trustworthy. Along the streams irrigation is possible, and a small portion of the land may be made fertile by this expedient. Still, after all such engineering works are constructed, at least nine tenths of the surface will remain unsuited to ordinary husbandry. Its only use will be for the pasturage of herds.

A great portion of this Cordilleran Piedmont district is destitute of mountain ranges. The Black Hills form a curious outlier on the north, and one or two slight disturbances have affected other parts of the field. The result is that no important mineral resources are as yet known in this country, except in the detached mountain mass of the Black Hills.

The facts above stated make it plain that this great section of the continent has a limited future, save by a change of climate which it is unreasonable to expect; and we fail to see how it can ever be made to afford a dwelling-place for large bodies of people. The absence of fuel, of timber, and water powers excludes manufactures. The dryness renders extensive agriculture impossible, and there remains only the chance of the scanty industry which comes with a pastoral life.

North of the above-described section, within the limits of Canada, and in the drainage area where the waters flow toward the North Pole, we have a large territory in the Saskatchewan, the Red River, and the other valleys, including an area of about one hundred and fifty thousand square miles, where the rainfall is considerably greater than it is in the Piedmont district of the southern Cordilleras of North America. In this section the surface of the country is more diversified; it contains a great many lakes; the larger rainfall is marked by the greater number and size of the rivers, and there is a brief season of growth in which the smaller grains and root-crops prosper exceedingly. Although the surface of the country is generally level, the rocks are sufficiently disturbed to reveal a variety of mineral resources, the value of which is not as yet even approximately known. There is no question that this Hudson Bay area, as we may term it because its waters drain into that basin, is in many ways of agricultural importance. As before remarked, it is exceedingly well fitted for the growth of certain staples, — the smaller grains. Unfortunately, the region is too far north for the extensive growth of Indian corn. Moreover, the length and severity of the winters make it too cold to profit by the rearing of horned cattle or of sheep. At present the cultivation of small grains secures this section a fair measure of prosperity. It is to be feared, however, that this is but a temporary success, for the reason that all the wheat-fields in the central part of the continent are prone to rapid exhaustion from the rude tillage to which they are subjected. When the primary fertility of the ground is exhausted, it is necessary to have recourse to mixed farming, to artificial fertilizers, and other expedients which are not likely to prove profitable in this high northern realm, where the population must mainly depend on one class of crops.

So far as the matter of climate is concerned, this region appears suitable to the people derived from the more northern countries in Europe. Scots, English, North Germans, and Scandinavians appear to be well accommodated by their bodily habits to the rigors of the climate. There remains, however, the fact, that for nearly one half the year work in the fields of this district is impossible, and this in a purely agricultural country is a grave economic disadvantage. Therefore, despite the present success of this high northern settlement, it seems likely that it is in the end to become a country of the second order, in which, though the population may maintain itself and attain a certain diversity, the fullest development of life will not be secured because of the unvaried nature of the industries.

We turn next to the territories contained within the vast area of the Rocky Mountains, extending from the Western pastoral lands to the border district, which lies upon the Pacific Ocean. For nearly two and a half centuries after the advent of the English settlers upon our shores the Cordilleran region remained a practically impassable barrier between the settlements of the Atlantic coast and Mississippi valley and the western sea. For two hundred years of this period the idea that this great natural barrier to commerce would ever be broken down does not seem to have entered into the minds of our people. Even after California was settled and the prospective importance of the group of States on the Pacific coast became evident, few dared to hope that the great American desert and the mysterious mountains which lay beyond it would ever be made as readily passable as the Alleghanies. Nothing shows so well the swift advance of man's control over terrestrial conditions within the lifetime of our generation as the speed with which these barriers have been overcome. The journey from New York or Boston to San Francisco is to us a much less serious undertaking than it was to our fathers to go from the sea-coast to the Ohio valley.

In northern Mexico, and thence northward to the farthest point where the Cordilleras have been explored, the Cordilleran mountain district has an average width of about one thousand miles. The topography of this region differs considerably from that of most other important mountain ranges. In the first place, the mountains proper rest upon a very elevated pedestal, so that the greater valleys and enclosed table-lands often have a height of six or eight thousand feet above the level of the sea. This feature causes the climate of the region to be generally more rigorous than its latitude alone would cause it to be. The form of the mountains gives a curious type to the topography. The predominant ranges extend in a general north and south direction, as do those of the Appalachian system; but in the Rocky

Mountains we have a feature unobserved in the Appalachian elevations, in that there are some subordinate ridges having a general east and west course. The consequence is that the Cordilleran district contains many extensive elevated valleys, great surfaces sometimes of tolerably level floors of many thousand square miles in extent. Striking examples of these enclosed areas are found in the well-known parks of Colorado.

In the last glacial period, when the rainfall of this country was far greater than at present, this system of mountains was by its condition calculated to afford a great number of isolated areas having a high order of fertility, as is shown by the fact that it had great lakes in many of its basins, water areas rivalling the Laurentian fresh-water seas in extent. The Rocky Mountains were probably at that time a verdant country, and would have been wonderfully well suited to the uses of man. At present, however, no considerable portion of this region is fitted for agriculture, save where it is artificially irrigated.

Although a large part of the Rocky Mountain section consists of mountainous peaks, probably nearly one third the total area is well covered by soil which, owing to the fact that its resources have not been drained by vegetation, is of exceeding fertility. The researches of the United States Geological Survey have made it probable that over a hundred thousand square miles of this Cordilleran area can be won to tillage by storing the winter rains in convenient reservoirs and using the husbanded waters for irrigation. The Mormons have proved in a remarkable way the success which attends the application of water to this soil, and there is every reason to believe that in all the important valleys of this country there will be extensive areas of land in this way won to agriculture. The irrigated lands of the Rocky Mountains have very great fertility, and are singularly enduring to tillage. We may fairly assume the arable value of these redeemable soils to be at least three times as great as that afforded by the State of Illinois.

Owing to the great north and south extent of this Cordilleran system, we have within it a vast range of climate, so that the products of the artificially watered fields may have a great diversity. Thus in Montana and Idaho the natural products are grains, grass, and the other ordinary tillage crops of this country; while in New Mexico and Arizona the finer fruits may be advantageously cultivated. There can be no question that the development of the irrigation system in the Rocky Mountains is sure to give rise to a great many definitely limited agricultural populations, each separated from the other by broad fields of arid mountains, which here and there will afford employment to miners. When this condition of culture is instituted, we shall thus have a singular localization of life and industry, the like of which cannot exist in the other parts of the continent, where there are no barriers of a distinct sort between the several fertile districts.

The principal economic basis of the Cordilleran life must for many centuries rest upon the mining industry. The geological development of this section from the time the rocks were laid down on the old sea floors, through the periods when they were deeply buried and finally uplifted by the mountain-foldings, has served to prepare a vast range of mineral wealth by nature and position well suited to the needs of man. So far the mining industry of this region is in the main turned to the precious metals, and we have come to associate the idea of mining in this district with the winning of gold and silver. Although we as yet know comparatively little concerning the under-earth resources of this district, it is evident that it contains a wide range of mineral products, perhaps a greater variety than is known to exist in any other country, all which will, with the progress of exploration and the cheapening of mining costs, become the bases of industries. Coal, iron, and various alkaline salts, the varieties of bitumen, quicksilver, lead, zinc, and a host of other substances which have a place in our industries, exist in profitable quantities in this part of the continent. The fact that a large part of the country can be made fertile by irrigation, will afford a basis for food-supply to the mining population without the distant carriage now required to bring it to this field.

Great as is the measure of man's dependence on the resources of the under-earth in the present condition of his development, there is every reason to believe that this dependence will be manifolded within a century from our day. We are evidently nowhere near the end of the growth in our mineral industries. The underground workers are evidently to be, in the century to come, about as numerous as the soil-tillers. Therefore, in our forecast, we must reckon on the development of a body of population in the regions of the Cordilleras which cannot readily be imagined by the traveller who hastens through their apparently sterile wastes.

The general climatal conditions of this section give promise that it will afford an admirable field for the nurture of northern Europeans. Although new-comers in the highlands generally suffer from certain maladies attendant on the change of station, the children born in the region seem very vigorous, and the acclimatized man finds little in his surroundings to contend with. The generation of success which our race has secured in the Cordilleras is a matter of no small interest to the philosophical student of our country. Until the settlement of this district our Anglo-Saxon folk had never come to occupy a region of highlands. They were characteristically low-landers in their origin and history, and it was an open question whether the blood would prosper in such countries. It might have been feared that it would have proved unfit for mountain life, as it has proved unfit for the conditions of the tropics. The sight of vigorous children, and young men and women of admirable physique, who have been bred in the Cordilleran highlands, is most satisfactory to those who have a keen interest in the future of our race.

On the Pacific slope we have three areas which are open to our race, — the Californian, Oregonian, and Alaskan.

The Californian section, extending from the peninsula of southern California to the northern borders of California proper, is a region of mountain valleys, lying in the foot-hill district of the Cordilleran province. In this section the rainfall is sufficient to make an extensive and varied agriculture possible; the climate is in general of an admirable quality, and the soil, which occupies perhaps one half the total area, of great fertility. Although such a long shore, the coast is poorly provided with harbors. The fishing-grounds so far as known are not very good, and the maritime life is likely to be less considerable than along any equally extended part of the American coast. On the other hand, the mining districts are blended with the tillage grounds in such a manner that they complement each other. So far the under-earth resources which have been won have been mainly those of the precious metals; there is every reason to believe, however, that in the future the grosser earth products are to play a very large part in the economic success of the district and in the diversification of its industries. A high grade of agriculture, exceedingly varied mining, under a climate which is on the whole favorable in its effects on the human frame, give promise of admirable conditions for the development of a powerful people.

The district of Oregon, including the western portion of that State and the neighboring sections of the State of Washington, as well as a considerable part of the Frazer River district on the north, differs from California in its more humid climate, the proportionately wider extent of its tillage grounds, but most markedly in the great extent of its inland maritime waters, the abundance of its harbors and straits, the nurseries of seamen. Here, too, the fisheries attain a considerable value, so that there is a great foundation for ocean industries.

The mining opportunities of the Oregonian district, though perhaps less considerable than those of the central Cordilleras or of California, are still great. In this section, from the Frazer River to the Columbia, extending back two or three hundred miles from the sea, we have the most varied opportunities for industries which are afforded by any portion of the American continent. Coal is possibly abundant; there are numerous excellent water-powers, and the soil within the limits of the humid area is very fertile. The forests are of good quality and of great extent, and the maritime resources appear to have a value unequalled on any portion of the American continent. The region has been blessed by the character of its settlers, for they have been derived from the most vigorous portion of the race. Taking it for all and all, the physiographer is more disposed to foretell greatness for this section than for any other equally extensive area on the western border of the continent.

North of the Frazer River, and thence to the Yukon, we have a district which by its physiography is peculiarly suited for a maritime life. In general the character of the surface, soil, and climate of this region more clearly resembles the Scandinavian peninsula than any other part of the American continent; save that the area open to tillage is less considerable than in Sweden and Norway, the general conditions very closely reproduce those of our race's cradle-land. In this field, which is destined to have a peculiar place in the development of our race, agriculture can have but a small part in the activities of the people. Indeed, with the development of any considerable population, they must depend upon the Oregonian and Californian districts for their grain-supply. Mining and fishing are the natural occupations for the populations which are to be developed in this interesting region.

We have now completed our rapid survey of the physiographic conditions which determine, in a general way, the development of our race on the continent of North America. It will be observed that we have excluded from consideration the whole of Mexico and Central America, the archipelago of the Antilles, as well as all the wide expanse of lands neighboring to the Arctic Ocean. The Arctic region does not greatly interest us, because in the present condition of its climate these territories are sterilized by cold, and are therefore without the province of our people. The southern parts of the continent, though they afford regions of delightful climate and great fertility, are also unsuited to our race.

Much has been said concerning the change which the European population has undergone in the course of generations from life upon this continent. Many persons have maintained that the British portion of our population has been greatly altered by its experience on the continent of North America. There has been a good deal of talk about the American type of man. He is supposed to be a thinner and more angular creature than his cousins of the parent isle. It has been held that though quicker-witted, readier to fit himself to circumstances, he has less solidity, less endurance than his ancestors from beyond the seas. There can be no question that our climate, as a whole, differs considerably from the conditions of northern Europe, whence our race came. It is generally drier, the alternating seasons cooler and hotter; it has, because of its relatively unclouded sky, more sunlight. There is a natural presumption that such variations would lead to considerable alteration of the race; and it may be that a certain measure of physical change has taken place.

I propose at once to set forth the reasons which lead me to the opinion that the change, if it has occurred, has been small in amount, and that it has not injuriously affected the qualities of the people. It is worth while, at the outset of our inquiry, to note the evidence which serves to show that racial qualities are not always the playthings of climate. Fortunately for our argument we have in this country some striking bits of evidence on this point. A large part of our population is of African descent, mostly derived from the Guinea coast, from conditions of climate very different from those which prevail in the Southern States of North America, from a social as well as a physical environment differing vastly from what exists in this country. The African race has by its transplanting undergone a great change in its conditions. The negroes have been, so to speak, on the average, upon this soil for nigh two hundred years, — that is, they are as Americans about as ancient as the white population. So far as we can determine, the several generations of this race's life in a totally foreign climate have not affected any of their original peculiarities. The form, color of the skin, character of the hair, and the mental qualities still remain, so far as we can determine, essentially unchanged, except so far as the blood has become mingled with that of the whites. This stubbornness of race characters is all too little appreciated. We commonly neglect it in our political considerations, but the naturalist cannot omit to consider it in his reckonings.

Although the history of British settlements in torrid regions shows that the population of northern Europe is not suited to equatorial conditions, there is nothing in the experience of the race which would lead us to suppose that the measure of change undergone in passing from the parent country to the portion of the United States north of the region about the Mexican Gulf should produce any marked alteration in the racial qualities. It is a difficult matter to compare the condition of two bodies of people on opposite sides of the sea. We cannot trust to the impressions of travel, for no man can retain sufficiently accurate memories for such judgments. Here and there, however, we find certain data which serve as indices, and perhaps afford a sufficient basis for an opinion on this point. The most important of these facts are those pertaining to longevity, as determined by the experience of life-insurance companies, those obtained by the measurements of soldiers and sailors, and the endurance which such men exhibit in their callings. The results of surgical operations serve also to indicate the vitality of the patient; and the success attained in games of a sort which demand a higher measure of mental and bodily vigor shows something concerning the essential qualities of the men. It would be desirable to add to this list the measurement derived from the intellectual accomplishment of the two countries, the success in various walks of a learned and imaginative work. Unfortunately, this last measurement cannot be justly applied, for the reason that intellectual accomplishment depends not so much on native ability as on peculiar circumstances of scholarly environment, on education, and on the competence of the social conditions to stimulate the mind to creative activities. Shakspeares or Bacons possibly may remain with their genius unknown even to themselves, unless there is the stimulating air to quicken the native spark into a flame.

Taking the conditions which I have mentioned in the order in which they are presented, we note in the first place the conviction on the part of our actuaries, — the computers who determine the measure of insurance risk on human life, — that the longevity of people in America is at least as great as in Europe; and this despite the fact that men's lives in this country are more seriously taxed than in the Old World. We are supposed to be dying of overwork; but the fact is that, witnessed by the duration of life in the case of men who have appeared on the records of insurance companies, there is no indication that the term allowed to man is growing less in this country than it is across the seas. On the contrary, the evidence seems to point to the conclusion that the American man lives longer than those of the same race in the Old World.

We have next to consider the endurance of American bodies to grave surgical operations. It is a well-known fact that in this country, during our Civil War, there was a surprising percentage of recoveries from gunshot and other lesions incurred in battle. I believe it is a fact that in no European campaigns has the percentage of recoveries ever been as great as it was during our Civil War. Although our surgeons were devoted, and the noble auxiliary corps of nurses untiring in their efforts to assuage the ills of battle, we cannot, it seems to me, attribute this remarkable proportion of survivals to remedial measures alone. Our surgeons and physicians employed in the Civil War were not in general so well instructed as those of Europe, and the means of succor on our battlefields were probably no better than they are in modern days in the Old World. It seems to me that this fact of ready recovery from wounds cannot be explained save by the supposition that, on the whole, the American's body has more recuperative power than that of the European. It may possibly be that this advantage is due to better food, less average consumption of alcohol, and in part to the mental activity and courage in adversity which is bred in our men by their varied activities. Be this as it may, the rude experience of war seems to indicate that our men are as enduring as any from other countries. The probability that the survival from wounds is due in part to the innate condition of our people finds some support in the observations of Dr. Brown-Séquard, which were communicated to me personally some years ago. This gentleman, as is well known, is a distinguished physician, as well as a physiologist of the foremost rank, having a place among the famous experts in this branch of science who are now the glory of France. Dr. Brown-Séquard had observed that American animals generally — not only men, but the lower mammals down to the level of the rabbit — are much more enduring to wounds than the kindred forms of the Old World. He regarded this peculiar resistance to lesions as the result of a difference in the nervous system, which made the creatures of this country feel the effect of shock much less considerably than those of Europe. He stated that in order to produce a given amount of destructive effect in experimenting on a rabbit, he had to make the wounds of the nervous system much more severe than in the case of European animals upon which he was performing the same experiment. In his opinion, the American man had something of the same element of resistance to injuries.

The next point of evidence is that which is afforded by the record of field sports in this country and of Europe. While the conditions of higher intellectual accomplishment differ so in the two countries as to make comparison impossible, such amusements, especially those which require at once, as most of them do, the effective co-operation of mind and body, afford an excellent test as to the general condition of our folk in comparison with our English kindred, — a comparison which includes not only the human kind, but extends also to the companions of man. It is now pretty well established that the American horse is as good as any of his kindred in the world, as is proved not only by the race-course, but by the wonderful cavalry marches made during the Civil War, — marches in which the sorest part of the contest came upon the *mounts* of the soldiery. Our ordinary field-sports have, except lacrosse, been derived from England; even base-ball, which appears as a distinctively American game, is but a modification of an English form of sport, which is really of great antiquity. The sports which we may compare in England and America are the games of ball, — in which base-ball, because of our customs, must take the place of cricket, and foot-ball, which is identical in the two countries, — rifle-shooting, rowing, and the ordinary group of athletic sports in which single contestants take part. We may add to this the amusement of sailing, wherein, however, the quality of the structure as well as the nerve and skill in management play an important part.

It is not worth while in this writing to make an accurate comparison between the success attained in the two countries in these several out-door amusements. It is now clear, however, that in all of them the American is not a bit behind his transatlantic cousins. Most of the people have the same spontaneous interest in sports as their forefathers, and they pursue them with equal success. It is unnecessary to do so, but we might fairly rest the conclusion as to the undecayed physical vigor of our population on that spontaneous activity of mind without which games are impossible.

There are, however, two divisions of the proof to which we have yet to attend. Among its many beneficent deeds the United States Sanitary Commission, which did so much to relieve the miseries of our Civil War, did a remarkable service to anthropology by measuring, in as careful a manner as the condition of our knowledge at the time permitted, about two hundred and fifty thousand soldiers of the Federal army.

The records of these measurements are contained in the admirable work of Dr. B. A. Gould, a distinguished astronomer, who collated the observations and presented them in a great volume. Similar measurements exist which present us with the physical status of something like an equally large number of European soldiers, particularly those of the British army. From Dr. Gould's careful discussion of these statistics, it appears that the American man is on the whole quite as well developed as those who fill the ranks of European armies. As but a small edition of Dr. Gould's book was printed, and as it is not ordinarily accessible to most readers, I venture to give some of the important conclusions which I derive from it.

From these records it appears that there is a considerable difference in the men born in different parts of the United States. Unfortunately the results include only a small part of the Southern troops, and for various reasons these measurements are less trustworthy in the case of troops from those fields.

The measurements appear to show that the size of man increased, in a general way, as we go from the seaboard into the Mississippi valley. About fifty thousand men who were subjected to these measurements were from the States of West Virginia, Kentucky, and Tennessee. It is a fact well known to those who are acquainted with the history of these Commonwealths during the Civil War, that the Federal army did not receive an even share of the most vigorous element of their population; those grown upon the richest soils of these Commonwealths, men from the blue-grass district regions of Kentucky and Tennessee, went in the main to the Confederate army, for the reason that these fertile lands were slave-holding districts. Despite this cause, which doubtless serves somewhat to lower the average measurements of the troops, these two States furnished about the best developed native soldiers who appeared in the Federal army. This last point is of much importance, for the reason that the white population of this district derived almost all its blood from Britain, in perhaps nearly equal measure from the Scots and from the dwellers in the southern portion of that island. Moreover, it has been longer upon the soil than perhaps any other part of the American English. New England has been so far affected by the immigration of Irish and other Europeans, that it would be difficult to recruit fifty thousand men in that region with so small an admixture of other than British blood as was secured in the troops of Kentucky, Tennessee, and the neighboring States. The admirable development of these soldiers has completely proved that two centuries of Americanizing has not debilitated the race.

Last of all, we have the test afforded by the trials of the struggle between the North and the South. War has ever been the rudest and most effective gauge of certain important qualities. The actual advance to which living beings have attained has been in large part determined by the measure of resistance which creatures have been enabled to make against adverse circumstances, — not the passive inertia of inanimate things, but the active and long-continued contest in which all the latent powers are applied in determined action. The military struggles of men are but an advanced and complicated form of the immemorial rivalry of lower creatures, out of which, through infinite pain, infinite good has been won. There is no more searching test of the moral and physical development of a people than that which is afforded by a great and long-continued civil war. That such a strife affords a measure of the physical endurance, the power which is in the people of maintaining determinations, is manifest. The contact of armies in the field gives, moreover, an excellent measure as to the moral state of the people. Nothing so tests the firmness with which the motives of sympathy, of justice, are rooted in men as the temptations to which campaigns expose them.

It is hard, in our ordinary well-regulated societies, to ascertain how far men are held to right-doing by the machinery of the law, how far their relations to their fellows are fixed by their own motives. The ratio of compulsion to spontaneous motives becomes evident when the men of the State are marshalled into armies. This test was made thoroughgoing by the circumstances of our Civil War. In the first place, the combatants fought for more ideal issues than men commonly do. It was not for the love of chieftains or for conquest, but for theories of institutions, of plans for States, that they contended. No war was ever so humanely conducted as this. There were grievous things about it, — all war is a succession of griefs; but the conduct of the armies in the field was more humane than in any other similar campaigns which the world has known. The interests of women and children were almost invariably considered. The soldiers born upon the soil generally carried the civic sense, the order of peaceful society, with them in march and battle. Good-nature and sympathy were written on their banners. We have but to compare the struggles between the French and Spaniards in Florida, or the wars between the American colonies of the British and French, to see how humanized our armies were under circumstances which in other lands and times have awakened the devil in men. The issue of the combat, the perfect accord and loving humor which now marks those who met on battlefields, shows this in the clearest possible manner. I take it to be plain that the Rebellion proves our people to have lost nothing in the moral gains which the race won in the Old World. If we compare the results of the contest with the chronic conditions of dispute between Great Britain and Ireland, I think we may claim that we have gained in the moral qualities which appear in the conduct of public affairs.

The behavior of our armies in the field shows clearly that the combination of physical vigor and moral earnestness which make a good soldier exist in unsurpassed measure in the men whose ancestors dwelt long upon the American soil.

Some years ago I sought carefully to find a body of troops whose ancestors had been for many generations upon our soil, and whose ranks were essentially unmixed with foreigners, or those whose forefathers had been but a short time upon this continent. It proved difficult to find in the Northern armies any commands which served the needs of the inquiry which I desired to make. It seemed necessary to consider a force of at least five thousand men in order to avoid the risks which would come from insufficient data. In our Federal army it was the custom to put in the same brigade regiments from different districts, thus commingling commands of pure American blood with those which held a considerable percentage of foreigners, or men of foreign parents. I found in my limited inquiry but one command which satisfied the needs of the investigation, and this was the First Brigade of Kentucky troops in the rebel army. In the beginning of the war this brigade was recruited mostly in the slave-holding district of Kentucky, its ranks being filled mainly with farmers' sons. It is possible to trace the origin of the men in this command with sufficient exactitude by the inspection of the muster-rolls. Almost every name upon them belongs to well-known families of English stock, mainly derived from Virginia. It is possible, in a similar way, to prove that with few and unimportant exceptions, these soldiers were of ancient American lineage. Speaking generally, we may say that their blood had been upon the soil for a century and a half; that is, they were about five generations removed from the parent country.

When first recruited, this brigade contained about five thousand men. From the beginning it proved as trustworthy a body of infantry as ever marched or stood in the line of battle. Its military record is too long and too varied to be even summarized here. I will only note one hundred days of its history in the closing stages of its service. May 7, 1864, this brigade, then in the army of General Joseph Johnston, marched out of Dalton eleven hundred and forty strong, at the beginning of the great retreat upon Atlanta before the army of Sherman. In the subsequent hundred days, or until September 1, the brigade was almost continuously in action or on the march. In this period the men of the command received eighteen hundred and sixty death or hospital wounds, the dead counted as wounds, and but one wound being counted for each visitation of the hospital. At the end of this time there were less than fifty men who had not been wounded during the hundred days. There were two hundred and forty men left for duty, and less than ten men deserted.

A search into the history of warlike exploits has failed to show me any endurance to the worst trials of war surpassing this. We must remember that the men of this command were at each stage of their retreat going farther from their firesides. It is easy for men to bear great trials under circumstances of victory. Soldiers of ordinary goodness will stand several defeats; but to endure the despair which such adverse conditions bring for a hundred days demands a moral and physical patience which, so far as I have learned, has never been excelled in any other army. I doubt not that as satisfactory evidence can be obtained from the records of our Northern troops; indeed, my inquiries have clearly indicated that if our men from the districts settled with purely English blood could be made the subject of careful study, we should find that the best Federal soldiers were generally as good as these Confederates.

The foregoing considerations, as well as many other points which cannot be traced in this brief study concerning the effects of climatal and social conditions on the American man, have satisfied me — as I think they will satisfy any other unprejudiced inquirer — that our race is safe upon this continent;

that we need have no apprehensions concerning the effect of the existing conditions upon its development.

We may safely presume that the climate and other features of our continent, with perhaps the exception of the district about the Gulf of Mexico and the Arctic country, are on the whole as well fitted for the uses of northern Europeans as any part of the mother-country. We may reasonably conclude that it suits the whole Teutonic branch of the Aryan race.

As to the Latin peoples, the case is not so clear. The Canadian French are doubtless in the main descended from the people of northern France. It is likely that a large part of their blood is derived from the Northmen. There can be no question that, with certain limitations, this population has been thoroughly successful on American soil. The fact that they speak a foreign language and have been deprived of education, may account for their general failure to advance in the intellectual field. They are, however, people of vigorous minds and enduring bodies. They have developed a fecundity now unparalleled in France. They take naturally to laborious occupations, which is a proof of physical vigor. We may therefore consider the northern Frenchman as well fitted to the conditions of northern America. The Latin peoples about the Gulf of Mexico have not been equally successful. The upper class has maintained something of its pristine quality, but the peasant has not taken hold on the soil in a successful way. How much of this failure of the Spanish and

French to attain a high development in the region about the Gulf of Mexico and the Caribbean is due to climate, and how much to the institution of slavery, or to their intermixture with the indigenous people, it is impossible to say.

There remains one important inquiry as to the effect of geographic conditions on the development of races from beyond the sea on the surface within the limits of North America, — a question of the utmost importance to our political and social future. We have in this country a very large African population. Within the limits of the United States, the number of people of this blood probably exceeds that of any other stock, save that from the British Isles. As we have previously remarked, this race on the whole appears to have remained substantially unchanged by the conditions of the new field. Intellectual contact with the white has doubtless led to a certain development in the general status of the African, but except so far as his blood has been mingled with that of Aryan or Indian people, the bodily form, and in general the moral and mental characteristics, have remained substantially what they were on the parent continent of this people. There are two questions concerning this race which are of the utmost importance to the future of our nation, — indeed, to that of all our own people in North America. The first concerns the natural fecundity of the population, their rate of increase from decade to decade; and the second, the limitations which climate may put upon the extension of the folk.

The rate of increase of the negro has not yet been ascertained. During the conditions of slavery a satisfactory census was impossible. The slaves were subject to taxation, and the owners had a sinister interest in reducing the numbers which were given to the accounting officers. The census of 1870, the first taken after the overthrow of slavery, partly intentionally or by neglect, served to underestimate the total number of negroes. The next accounting, that of 1880, was careful, and doubtless gave us the first accurate knowledge as to the ratio of this element of our population to those of European blood. It will not be until we obtain returns of the census which has just been taken, that we shall know whether the negro is more or less prolific than the white. In case it should appear that in the extreme Southern States the negro increases in a greater ratio than the whites, the regions in which this increase is marked have a doubtful future before them; for unless the black population can be quickly lifted to a higher intellectual and moral plane than now characterizes it, those parts of the South will be apt to relapse into barbarism. The advance of the negro to a satisfactory grade in development still depends upon his remaining in close contact with the superior race. If he increases in numbers more rapidly than the whites, he is sure to create massive communities of his own stock, in which there can be no certainty as to the maintenance of our race motives.

As to the distribution of the African population in his country, though the evidence is not clear, it seems that the negro is not likely, in the immediate future at least, to extend for any considerable distance beyond the limits in which his race at present is fixed. There is now no distinct movement of the blacks toward the North. The scanty African population in the old non-slave-holding States has mainly accumulated in the cities, and would probably die out were it not for the occasional accessions it receives from the South. Unless the rate of increase of the negroes should be so great as to crowd them from the extreme Southern States, we may be pretty sure that this population will remain in good part limited to a small portion of our country, — to a region which though not unfitted for the occupation of our race, is the most undesirable part of the country for its development.

Our review of the physiographic conditions which environ our race on this continent makes it tolerably plain that North America is well suited for the development of northern Europeans. We may dismiss the fear that our race is to deteriorate in this country. We may further put aside the notion that we are to be a massive, unvaried people, destitute of those differences which by their reaction bring about the advance of man. It is true that the continent is not divided into the separate areas which have constituted the cradle-lands of the Old World; but it is evident that the wide diversities in occupation will institute and maintain variations in the character of the people probably in time to be as great as those which in the more natural state of man depended on purely geographic conditions. At present, while the open structure of our social and economic life permits a rapid change in the occupations of men, the effect of industries dependent on physiographic conditions is not much felt; but with the increase and consolidation of our population, we may be sure that vocations will become more hereditary. Men will follow the occupations of the plough, the mine, or the mill from generation to generation, and so the communities will receive the individualized stamp which comes only through ancestral habit.

In the beginning mankind was dependent for culture and diffusion mainly upon geographic conditions. Each tribe was environed by rigid customs which fended off its neighbors. The movements were necessarily massive, for they were to result in displacements of pre-existing peoples. Therefore the first stages of man's development resemble, as regards the conditions of increase and diffusion, those of his lower kindred in the ranks of life; the progress of intellectual capacity has given to certain races a larger measure of control over their circumstances. Still, even in our own centuries, the implantation of our race in new lands already possessed by men has proved a task of exceeding difficulty. The would-be colonists of the sixteenth and seventeenth centuries, on the eastern coast of America, found something of the difficulty in gaining their foothold which stray plants or animals from one flora or fauna find when they are cast within a foreign field. Even in the present state of their development the most advanced races of men are limited by the climate, and can only dwell where the larger nature permits.

For all that we can foresee of the future, this dependence of man upon the conditions of his environment is of an insuperable nature. The good he wins he secures by obedience to the commands of his mother-earth. Looking back over the history of life upon the earth's surface, the physiographer is forced to the conclusion that its highest estate embodied in the moral and intellectual qualities of man has been, in the main, secured by the geographic variations which have slowly developed through the geological ages. Thus our continents and seas cannot be considered as physical accidents, in which and on which organic beings have found an ever-perilous resting-place, but as great engines operating in a determined way to secure the advance of life.

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