

A NEGLECTED FACTOR IN HISTORY

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In turning the pages of history nothing impresses us more than the imposing array of past civilizations, which have passed through their long and slow periods of development; reached their full fruition, and then relapsed into a decay that has left only ruined monuments as a reminder of their golden age of achievement.

Like vast shipwrecks they lie scattered along the strands of past ages and the causes of their fall from former greatness afford a never ending source of speculation to the thoughtful historian. What impresses us the most is the striking contrast between the past and present inhabitants of those countries that have risen to a high state of civilization.

In the Egyptians of today it is impossible for us to recognize that virile race whose culture dates back almost 5,000 years before the birth of Christ, and which endured in full vigor until about 600 B.C. If we need any proof of the condition of the arts among the ancient Egyptians we have but to consider one of their earliest monuments, the Great Pyramid of Cheops. Covering more than thirteen acres of surface it rose nearly five hundred feet in height, and so accurately was it planned and constructed that modern engineering still marvels at its perfection. When Jacob went down into Egypt that pyramid had been built for more centuries than have elapsed from the birth of Christ to the present day, and it has been well called "the most stupendous of all human buildings."

In astronomy, chemistry, anatomy, medicine and music an extensive literature had developed and the strength of the Egyptian spiritual aspirations is attested by such noble and enduring effices to the gods as no other country can offer.

We pride ourselves on the energy of our 20th century civilization and above all on the modern spirit of initiative. We have indeed accomplished much, but it is well to recall that the first steps are the hardest and that we have built largely upon the secure foundations laid by the pioneers of old.

The Egyptians anticipated the Suez Canal by some thousands of years when they dug a canal connecting the Nile with the Red Sea. It was an Egyptian Pharaoh, too, who sent his ships around the continent of Africa 2,000 years before the memorable voyage of Vasco de Gama. But the valley of the Nile, though preserving the fertility of its soil, has become as a desert in the production of those things that make for the advancement of the human race.

Turning now to the valley of the Tigris and Euphrates, we find the same record of great achievements in the past contrasted with a later history that is barren of all progress.

The great empires of Babylonia and Assyria which rivaled that of Egypt in antiquity and glory are nothing more than a memory, and the fertile plains that supported so many opulent cities are given over to wandering tribes of Bedouins.

Those subtle qualities which constitute the vigor and genius of a race seem for some reason to have forsaken the more southern

countries and found a temporary home in Greece. Here, in the southern part of a small peninsula, there was an outburst of genius unparalleled in the history of mankind. A distinguished anthropologist states that in a single century the Greeks gave to the world out of their small population more genius than all the other races of men have succeeded in producing in a similar length of time. "Athens between 530 and 430 B.C. had an average population of about 90,000 freemen, and yet from these small numbers there were born fourteen geniuses of the very highest rank." This would indicate a general intellectual status as much above that of the Anglo-Saxons as the latter are above the negroes. Even if we accept this statement with reservations, it is none the less true that the contrast between the ancient Greeks and those of more modern times is none the less striking.

Turning to the Greek cities of southern Italy, we find the same contrasts between the past and the present. Sybaris, whose very name has come down to us as a synonym of luxury, was situated in a plain that is now given over to a sparse population of fever racked inhabitants. The neighboring city of Cotrone was one of the greatest of the Greek world. This was the city whose women had been the most beautiful in Greater Greece and the men, according to Strabo, were all cut out for soldiers and athletes. On one occasion all the seven victors of the Olympic Games were Crotonians. So fine was the climate that it passed into a proverb - "healthy as Crotona". Today the Italian government has to maintain quinine stations in an effort to curb the malaria which for centuries has ravaged the people of this formerly

healthy section. The beautiful women and athletes of ancient Crotona are no more, and in their places are to be seen the malaria-ravaged faces of young and old mounted upon puny undersized bodies.

On crossing the Atlantic and surveying the past civilization of the New World the records to be found closely parallel those that have just been considered.

In the jungles of Yucatan and Guatemala, where tropical diseases now ravage the Indians to such an extent that agriculture or any other form of sustained work is almost impossible, the Mayas had developed two or three thousand years ago a civilization that could compare with that of any other people that had no greater opportunities. They had no progressive neighbors to whom they could turn for new ideas. Neither had they beasts of burden for transportation or agriculture. Another handicap was the lack of metal tools. There was some copper in use, it is true, but this soft metal could have been of little service to them in the erection of their elaborate buildings. Flint or obsidian was all they had, and yet with such poor tools they carried to a high perfection the arts of sculpture and architecture. The Incas of Peru erected some striking buildings but they had not the skill with which to adorn them with the columns, arches, pediments and elaborate sculpture that were universal among the Mayas.

These people had also developed the art of writing and had carried it to a higher pitch than that reached by the Chinese, for they apparently began to use signs to indicate sounds instead

of having a sound to indicate each individual word. Astronomy had been developed to such a degree that the Mayas had perfected the most accurate calendar ever known with the exception of the one now in use. Their civilization, however, met with an eclipse even more complete than that of the nations of the Old World, since they had no gifted neighbors to take up and develop the arts which they had mastered.

The long procession of civilizations which reached their full development and then relapsed into decay suggest the thought that nations are like individuals; that they have their struggles of early youth, their attainments of the prime of life, and that they then relapse into the decadence of old age. But is this true? Though there have been times when the development of mankind seemed stationary, and even to have turned back from its progress, the march, nevertheless, has been steadily forward when viewed in its larger perspective.

In the brief comparison that has just been made of the past and present condition of great nations there are some outstanding facts, applicable to each of them, which arrest the attention.

It is worthy of note that in none of the countries that formerly gave so much to the world are there to be found any of the present standard bearers of civilization, In every case the line of development has shifted to the north. This applies from China westward to the continent of America.

The most surprising thing about the Mayas is that they developed their civilization in what are now the hot, damp, malarial lowlands where agriculture is so difficult, even with

modern methods and iron implements, on account of the continuous encroachments of the jungle. A hundred miles away from the great ruins of the Mayas there is at present to be found a far more healthful climate among the adjoining highlands. There agriculture is comparatively easy, the climate good for the torrid zone, and malarial fevers rare. Today the cities are all in these more favorable regions; the energetic part of the population is there, and the lowlands are shunned by all except a degraded handful. In the past, the present favorable localities were occupied by a race closely akin to the Mayas, yet civilization never arose to a great height. Ruins are found there but they are far inferior to those of the lowlands.

To explain these peculiar conditions we must suppose that the Mayas were the most extraordinary people that ever lived. They were able to carry on agriculture under conditions with which no modern people, not even those of European origin, have ever succeeded in coping. They chose for their home almost the worst place they could have found in America, although there lay close at hand more healthful locations occupied by an allied people few in numbers and relatively backward in civilization. It must also be assumed that they were able to preserve their energy for a thousand years or more under the most debilitating climatic conditions, or else to suppose that in their time tropical diseases were either unknown or else they were less harmful than they are at present.

The conditions that have just been outlined apply equally as well to many parts of the Old World that were formerly seats

of the highest culture. It must be assumed either that malarial fevers were unknown in the old days or else that the inhabitants have lost an immunity which they formerly had.

Even if the question of diseases were entirely eliminated, we are none the less confronted with the paradox that civilization formerly flourished and reached its maximum under general climatic conditions that are now considered debilitating. It is not in Egypt with its long hot summers and sub-tropical climate, but far to the North, that the world's progress is being carried forward. The valley of the Euphrates and Tigris which is considered the very cradle of civilization is one of the hottest places in the world. During the summer months the thermometer at times goes as high as 125 degrees. If civilization cannot flourish under such conditions now, how could it have done so in the past?

It was in the middle of the last century that Buckle published his History of Civilization in England which created such a sensation at that time. This book was a bold criticism of the historical methods that had formerly prevailed; the practice of confining history to the bald recording of events without thought of those fixed and universal laws that govern all nature. The doctrine advanced by Buckle was that climate, soil, food, and the general aspect of nature played a fundamental part in the intellectual development of man.

Nearly half a century after the publication of Buckle's great work, Professor Ellsworth Huntington, of Yale University, has taken up the study of climate and its influence on man, and after many years of research and experiment gives us his theory

of the "Pulsatory Theory of Climate and its application to history. In the preface to one of his books he warns the reader that his theory is one in the process of making and therefore subject to constant revision, but even as it now stands it gives us an explanation of the downfall of past civilizations that bids fair to stand all criticism in its essential points.

Climate may be defined as weather in its more permanent aspects and all the evidence seems to indicate that one is as changeable as the other. The available meteorological records cover a period of less than one hundred years, yet they afford overwhelming evidence of climatic pulsations which increase in magnitude and duration as the records become longer. In the same way the geological record continually discloses new evidence of pulsations. Where one glacial period consisting of a single age was generally recognized a century ago, at least six are now recognized. These date from all parts of geological time and some have several epochs and sub-epochs. From the beginning of the Pleistocene Age, about 500,000 years ago, down to our present time, geologists agree that there have been four major periods of glaciation in the northern hemisphere alternating with periods of inter-glaciation when the climate was as warm, or warmer, than it is now. Since the close of the fourth and last glacial period, which brings us down to comparatively recent times, there have been recognized three sub-periods accompanied by increasing storminess and rainfall. These three sub-periods witnessed an extension of the present glaciers as is shown by their moraines,

and the changes they indicate would have a far reaching effect on the inhabitants of Europe should they be repeated today.

The conclusions of the geologists are the result of many years of painstaking research and much sifting of evidence. Of late years their work has been supplemented by the anthropologists who have found in the caves of southwestern France and northern Spain bone implements artistically engraved with figures of the reindeer and other animals of a colder climate than now prevails in those regions.

There is admittedly a large gap to bridge between the vast climatic fluctuations of the Pleistocene and former periods and the minor ones indicated by the single century during which accurate weather records have been kept; but it is this task to which Professor Huntington has addressed himself. In brief, his hypothesis is this: If we accept the theory of great and continuous climatic fluctuations during past geologic ages, and of minor ones as proved by the records of the past one hundred years, it is logical to infer there have been pulsations of varying intensity during the intervening time, and that these have been one of the chief factors in the development of man. In support of this theory he brings forward evidence from recorded history and the fields of archaeology, geology and botany. Tradition, too, is often of value in reconstructing the past.

The Biblical account of the expulsion of Adam and Eve from the Garden of Eden might well have been founded upon one of those great migrations forced upon man by the advancing ice sheet of a glacial period. The warm climate and easy living conditions

would then have been a thing of the past, and nations would have fared forth from their old habitats and faced a harder struggle for existence.

The tradition of the Deluge might also be of the same origin. It is found among the aboriginal inhabitants of America and various races of the Old World. Having apparently originated independently among such widely separated families of mankind, why might it not refer to one of those glacial periods marked by swollen rivers and disastrous floods over the entire northern hemisphere?

In the Vale of Kashmir in northern India there is a tradition that in the dim past men could inhabit the land only during the six summer months, and that they withdrew to warmer regions each winter leaving the country to malignant demons. At length a holy priest learned certain rites which freed the country from these demons and it was then habitable throughout the entire year. Standing alone such a myth would have no significance, but to the north, across the Thibetan plateau, there is found indisputable evidence that the rainfall of Asia was formerly much greater than now. This bit of folk lore, then, appears as the record of a climatic change that so affected the lives of these people as to raise them from a nomadic life of wandering between the mountains in summer and the plains in winter, to that higher culture which marks an agricultural life and a settled abode.

The change to dryer conditions that had such a beneficial effect on this valley of excessive rainfall in the mountains of India, was followed by disastrous results in the great arid region to the north which stretches almost across the continent of Asia.

This region is occupied by a number of basins containing salt inland seas and lakes, and without drainage to the ocean. It is such places as these that afford the surest index to the great changes of climate. The numerous old shores, or beaches, show that these bodies of water were at one time of vastly greater extent. Like giant barometers they record the weather of the past. The story they tell is one of progressive desiccation for thousands of years, interspersed with periods lasting a century or more when there was a rise in the level of their waters. One such period was in the 10th and another in the 14th century. The Arab historians of that day write that the walls of towns that had formerly stood on the shore of the Caspian Sea were covered by thirty feet of water, but on neither of these occasions of expanse did the waters stand as high as during the days of ancient history, which may be said to have terminated about 200 years after the birth of Christ.

A chart of the fluctuations of the Caspian based on a study of ancient maps and old beaches would show a very high stage of its waters from the earliest times to about the beginning of the Christian Era; a period lower even than the present from about 300 to 700 A.D. Higher in the 10th century followed by a period of subsidence, and then again expansion of surface in the 11th century. We shall see further on how this chart agrees with data derived from other sources, but it may be noted here that the centuries from 300 to 700 A.D., when the sea was at its lowest ebb, marked those great migrations of Asiatic races into Europe which swamped the Roman Empire and almost extinguished the torch

of civilization. Driven from their homes by the increasing aridity of the climate they repeated the age old tragedy of the struggle for existence and left the Asiatic plains and mountains for the more kindly climate of Europe, bringing their families and herds with them.

Herodotus and Aristotle both reported the Jaxartes river as flowing into the Caspian Sea, and Strabo quotes Aristobulus, the geographer of Alexander, as saying that in the fourth century before Christ the traffic from India came down the Oxus river to the Caspian into which it apparently flowed. A little later, about 300 B.C., Patroclus, the admiral of Seleucus, made a survey of the southern coast of the Caspian. According to his account, the Oxus and the Jaxartes rivers both entered that sea, the mouth of one being 240 miles from that of the other. Today, both of these streams enter the Sea of Aral, their mouths being about as far apart as they were in the days of Patroclus. This would indicate that at that time the Caspian was so expanded, owing to a greater rainfall, that it coalesced with the Sea of Aral which now lies about 250 miles to the east and is separated from it by a desert waste. This is confirmed by the absence of any distinct mention of the Sea of Aral by either Greeks, Chinese, or Persians down to 590 A.C., when the waters of the region had subsided to such an extent as to leave two inland basins, where formerly there was only one. Even allowing for the well known inaccuracies of the ancient geographers this is a reasonable conclusion. Over a great area in central Asia extending for three thousand miles from east to west the same evidence of

desiccation is to be found. In Chinese Turkestan ancient Buddhist cities, with elaborate irrigation systems, lie half buried far out in the sands of the Taklamakan desert, where there is now not a drop of water to be found. Great dried forests, dead centuries ago, lie in this same region, their trunks preserved by the dry air of the desert. Some of these forests are partly buried in sand, but others stand free of it, showing that it was not the sand alone that was responsible for their destruction but a gradually increasing dearth of water. It was at one time thought that these climatic changes could be partly accounted for by the cutting away of the forests, but this theory is no longer considered tenable. Forests conserve water after it has fallen but there is no good evidence that they to any degree increase precipitation.

The route which Alexander followed through Persia on his march to India is exceedingly difficult today even for a small and quickly moving caravan. Sykes, the best authority on this region, speaks of it as follows: "During my journey through south-eastern Persia, in October, which was the time of the year the Greeks made their march, the temperature in the shade was generally about 100 degrees, while water was almost non-existent, and what little there was we could scarcely drink because of its salinity. Forage too was our chief concern although our caravan numbered only twenty men, with a corresponding number of horses." Forage here is so difficult to obtain that the governors of the province hardly ever visit it on account of the difficulty of obtaining supplies. Yet Alexander crossed this

region successfully. No doubt hardships were endured but the essential point is that such an expedition would be impossible under the climatic conditions prevailing today. Arrian, the historian of the expedition, merely remarked that "when Alexander arrived in Kirman, Krateros joined him bringing the rest of the army and the elephants." That this region was once thickly populated is attested by numerous ruins and remnants of old irrigation systems whose water supply has now completely failed.

Another great route of invading armies lay between Egypt and Palestine. Along this way marched first the hosts of Egypt and then of Assyria, with their chariots and horsemen, in the struggle for supremacy, yet we have no record of difficulties that had to be overcome. During the World War, Allenby made the same march, and found a desert that presented obstacles almost insuperable even for all the resources of our 20th century.

It was in this same region, too, and in the neighboring desert of Sinai, where small caravans now find but a scanty supply of water, that the tribes of Israel wandered for forty years. The Bible tells us that there were six hundred thousand men, besides women and children, with great flocks of sheep and goats, and herds of cattle, that went up out of Egypt and made this journey of forty years through what is now a desert. The land of Canann, which was their goal, is described in the Bible as flowing with milk and honey.

The historian, Josephus, A.D. 75, describes Judea and Samaria as "moist enough for agriculture, and very fruitful. They have

abundance of trees and are full of autumn fruits, both wild and cultivated. They are not naturally watered by many rivers, but derive their chief moisture from rain of which they have no want. By reason of their excellent grass, their cattle yield more milk than do those of other places; and as the greatest sign of excellence and abundance they are very full of people." Truly, it must have been a land flowing with milk and honey, but it could scarcely be recognized as an accurate description of the Judea and Samaria of today, since both of these sections are decidedly lacking in rain.

While the arid regions to the south were enjoying a more favorable climate than now, what were the conditions in central and northern Europe? The races who inhabited those regions were semi-barbarous, depending largely upon their herds of cattle and the chase for a living. Agriculture, that essential of a high state of **culture**, was at a low ebb amongst them, probably on account of the excessive rainfall that prevailed.

Caesar constantly referred to the snow and swamps he encountered, and while, like other generals who have succeeded him, he may have been a good press agent for himself, his description seems to have been borne out by the facts. Gibbon in the first chapter of the Decline and Fall of the Roman Empire says:

"Some ingenious writers have suspected that Europe was much colder formerly than it is at present; and the most ancient descriptions of the climate of Germany tend exceedingly to confirm this theory. The general

complaints of intense frost, and eternal winter, are perhaps little to be regarded, since we have no method of reducing to the accurate standard of a thermometer the feelings or the expressions of an orator born in the happier regions of Greece or Asia. But I shall select two remarkable circumstances of a less equivocal nature. 1st., The great rivers which covered the Roman provinces, the Rhine and the Danube, were frequently frozen over and capable of supporting the most enormous weights. The barbarians, who often chose that severe season for their inroads, transported without apprehension or danger their numerous armies, their cavalry, and their heavy wagons over a vast and solid bridge of ice. Modern ages have not presented an instance of a like phenomenon; 2nd, The reindeer, which is of a constitution that supports and even requires the most intense cold, cannot at present subsist, much less multiply south of the Baltic, yet in the time of Caesar the reindeer was a native of the Hyrcinian forest, which then overshadowed a great part of Germany and Poland."

We have now reviewed some of the reasons for believing that the climate of the world has undergone a decided change during the last two thousand years. First, there is the indirect, but none the less conclusive, evidence that the civilizations of the past originated and flourished under conditions that would be disadvantageous, if not impossible, unless a change of climate is assumed. Then there are the ruins of many abandoned cities found in sections that are now uninhabitable deserts; old caravan routes that have been discontinued because of a failing water supply; and the former strands of inland seas and lakes that indicate a much higher level in ages past. This evidence is supplemented by the records of ancient geographers and historians, which point to the same story of fundamental change.

The next step in this effort to reconstruct the climate of the past carries us 10,000 miles from western Asia to the mountain slopes of California. Here the huge trees known as Sequoia Washingtoniana, the oldest existing forms of life, afford the connecting link between the past and present. Their vast size is too well known to need description. The trunk of a well grown specimen has a diameter of 20 or 30 feet, and often towers 250 to 300 feet in the air. Their great age is even more remarkable than their size. A tree that has lived 500 years is still in its early youth, and one that has rounded out a thousand years is only in full maturity.

Professor Douglas, of the University of Arizona, in a study of a number of trees averaging 300 years of age found that their rate of growth since records of rainfall have been kept varies in harmony with the amount of precipitation. A comparison of the rainfall and tree growth of California, and the rainfall of the eastern Mediterranean, shows that the main fluctuations of the two regions are unmistakably the same. The big trees of California grew at an elevation of 7,000 or more feet above sea level, and in such regions, having a well marked difference between summer and winter temperature, it is well known that trees habitually lay on a ring of wood each year. This growth consists of a soft pulpy layer formed during the early part of the season, and a hard darker one that is formed later on. Except under rare conditions, only one ring is formed each year, and where there are two rings, on account of a drought in May or June, it is

usually easy to detect the fact. In dry climates such as California the most important factor in tree growth is rainfall, and the rings show a thickness varying from 2/100 of an inch to half an inch in response to changing climatic conditions. Working on this basis, the stumps of a number of trees were studied. The rings showed that 79 of them were over 2,000 years of age, and three of them more than 3,000 years. A chart prepared from this data gave a record of climatic changes extending back 3,000 years, and showing a remarkable agreement with the information on this subject derived from other sources. There is the period of rapid growth down to the early part of the Christian era, when, as we have seen above, the ancient world must have enjoyed more favorable conditions than now to have developed such a high state of civilization. There is also a period of very slow growth of the trees at the time of the barbarian invasion of Europe that marked the fall of the Roman Empire. This was a time when a change toward aridity in those parts of Asia, already none too well supplied with water, led to famines, wars, and migrations on a vast scale. The period of the Golden Age of Greece is marked by an unusual growth of the big trees. This would mean that that country was responding to the stimulus of a more invigorating climate; to cooler summers and more frequent changes of weather from day to day, such as are found in the present centers of civilization in northern Europe and our own country.

The outstanding feature of all these records is the continual climatic changes, some greater and others less, that have marked all past history as far as can be determined. The tendency has been steadily towards warmer conditions, from which we may gather that we are well into an interglacial period following the close of the last ice age, about 25,000 years ago. But the progress has not been an unbroken one. In the cooler, moist climate of 3,000 years ago there are evidences of very dry periods lasting a century or more; and again in the later and dryer period the tree growth shows there have been times of greatly increased rainfall.

When those who have studied the big trees tell us their growth clearly records the famine that afflicted the land of Palestine in the days of the Prophet Elijah, we may be inclined to doubt, and wonder if this is not another case of facts being made to fit a theory. That famine was of comparatively short duration, and occurred 870 years before Christ. How then could it have been recorded by a tree growing 10,000 miles away? To test this theory it is best to take a more recent period of history; one that saw a great climatic change that lasted a century, and about which there can be no doubt as to the exact date involved.

It has been stated above that in the 14th century the European and Eastern geographers show on their maps that the Caspian Sea had a much larger surface than now, though not as great as in the period before Christ. During this same century

the big trees of California show by the thickness of their rings a growth of unusually heavy proportions that has not been equalled at any time since. Turning now to the pages of history we find that northern Europe suffered from great climatic stress. "Unprecedented storms caused great floods in France while the severity of the waves was so intense as to break through beaches and sand dunes, and convert large areas into portions of the sea along the coasts of Holland. During the winters the rivers froze to an unheard of degree, and three or four times men and animals passed from Germany to Sweden on the Baltic Sea; an occurrence unknown in our day." In England and Scandinavia the summers were so cold and rainy that the crops failed year after year and the worst famines ever known in the country occurred. As a result of these conditions many landowners had to give up the raising of grain and turn their attention to the raising of sheep and cattle.

The climate of England seems thus to have been thrown back to what it was in the time of Caesar, and had it persisted, it is easy to believe that the history of that country would have been far different from what it is.

From what has been said it appears that during historic times climatic pulsations have taken place which seem to be of the same nature as glacial epochs and the post-glacial stages, the difference being only in degree. This shows the conditions of the geological past merging without a break into the present. The causes of these changes are the subject of heated debate, but they apparently have an intimate connection with the activity of the sun's surface.

The spots of the sun have been observed with accuracy only since about 1749, and they have been found to vary in smaller cycles of twelve years and then again in greater ones of nearly a century. It is fair to assume, therefore, that there may have been cycles of still greater length and intensity, and that these are related to climatic changes that have prevailed both in geological and historical times. The weather observations of the past forty or fifty years show that in times of many sun spots the storm area of the northern hemisphere undergoes a change of location. Along a central belt there appears a diminution of storminess, while to the north and south there is an increase both in extent and intensity. At such times the desert belts to the south, such as are found in our own southwest and in northern Africa and western Asia, are pushed equatorward, and the region of tropical rains is also forced to the south. Should this phenomenon be repeated on a grander scale there would result a climatic condition that would explain much that is now a mystery to us. There would be a dryer and more invigorative climate in Yucatan and Guatemala. One that would make agriculture possible for a people such as the Mayas, and account for their high state of development. The same change that reduced the over-abundant rainfall of Yucatan would increase that of our southwest, which is marked by dried up lakes and water-courses, and many ruins in places where it is now impossible for people to get a living. The like would hold true of north Africa and the desert belt of Asia, where there are so many evidences of a once dense population in regions now uninhabitable.

Penck, one of the foremost students of glaciation, has come to the conclusion that the same minor shifting of storm belts that has been observed in recent years must have been repeated on a larger scale during glacial periods. He shows that on the northern side of desert areas we find densely saline lakes like our Great Salt Lake, surrounded by old strands. These indicate that they have been long contracting so that they have abandoned first one strand after another, while at the same time their water has become more highly concentrated. On the equatorial side of the desert belt, on the contrary, are such lakes as Chad in Africa, a shallow lake of water with no old strands and only slightly saline. It has the appearance of being a new lake formed by a recent increase of rainfall. Penck also points out a similar contrast between the sand dunes on the poleward and equatorward side of the desert belts in both hemispheres. On the poleward side the dunes consist of loose, moving sand appropriate to places that are growing drier. On the other side there are plenty of dunes but they are covered with a sparse vegetation which is sufficient to keep them from moving and prevent the formation of new dunes. Since their formation the rainfall has evidently increased.

One of the objections raised by opponents to the theory of climatic change is that various types of vegetation, such as the palm tree, grew in Palestine in the past and still grow there today. However, the changes that have been postulated point more to an increase of rainfall, and changes from day to day, than they do to any decided difference in mean annual temperature.

The authorities are agreed that a change of 10 or 15 degrees F. in the earth's present mean temperature would bring about a period of general glaciation. If this is true, a difference of two or three degrees would have a decided climatic influence yet would hardly prevent the growth of the palm tree since it is known to stand at a temperature of 20 degrees F.

According to Professor Huntington, the conditions in regions such as western Asia and eastern California, appeared to be as follows in periods of climatic stress: 1st, The average temperature of the year was a little lower than at present, probably by two or three degrees; 2nd, The greater mixing of the air from wide areas by means of the winds that accompany storms would presumably lower the summer temperature a little over the lands and raise the winter temperature; 3rd, The amount of rain was apparently considerably greater than now; 4th, The amount of atmospheric moisture over the lands was greater than now; 5th, The winds were apparently stronger than at present and this was the cause of greater variability in the temperature as well as variation in other respects.

These five conditions are highly important, not only on account of their effect upon agriculture, but upon man's health and vigor. If the physiology of man was the same in the days of ancient history as now, we have to assume such a climatic environment if we are to explain the splendid civilizations which they developed.

We are all observers of the weather in a general way and recognize its importance in our daily life. Everyone feels the

same exhilaration of a bright day following a storm. We know that a long period of hot, damp weather lessens our energies and makes us disinclined for work, while the cool grey days which break the hot summer drouths stimulate us to new efforts. We recognize, also, that in the temperate zones of both hemispheres are to be found the most energetic races, and that both to the north and south of these regions the conditions are less favorable. We go to Florida in the winter, and the northern mountains and seashores in the summer for the changes that are universally considered as beneficial, yet we know little of the particular climatic elements which are considered most depressing or invigorating.

The census figures throw an interesting light on this question. In 1904 our government published a bulletin on the Negro. From the data obtained a table has been prepared showing the relative position of white and negro farmers in the north and the south. Taking the value of northern white farm products as the standard of greatest return the figures are as follows:

Northern Whites	100	per	cent
Southern Whites	51	"	"
Northern Negroes	49	"	"
Southern Negroes	34	"	"

The southern section considered embraced the Carolinas, Georgia and Florida, and the figures are of deep significance as showing both a racial and a climatic contrast.

The northern white man gets twice as much from his farm as the southern white, and also twice as much as the northern negro. The southern white gets no more than the northern negro, but about one third more than the southern negro.

To a large extent these figures are misleading, for the poverty following the Civil War, contact with large numbers of an inferior race, and lack of opportunity have done much to pull down the standing of the southern states considered. Even with these allowances, however, it is evident that climate must be a factor so far as the element of human energy is concerned, since in the south with its longer growing season two crops are often possible where in the north there can be only one. But it is just this longer growing season, with the long, hot summer which it implies, that would account for a diminution of vigor as compared with a cooler section. In all parts of the world it is the same. Turn where we will there is to be found the same diminution of man's energy as we leave the temperate zone and approach the tropic zone. This effect of climate seems to apply regardless of race, if we are to believe the census figures just quoted.

It is well illustrated, again, in the Bahama Islands, These islands have probably been inhabited longer by the Anglo-Saxon race than any other part of the world lying in such southerly latitudes. They are free from malaria and other tropical diseases and their race inheritance is as good as that of Canada. Yet to what a low state have they fallen as compared to their sister colony! There is a larger population of "crackers", or "poor whites" in the Bahamas than in any other Anglo-Saxon colony.

An employer of labor in these islands has said that when he hired a man it was not necessary to ask him if he had been living in Florida; he would know it by his superior work. The summers are equally as long in both places but the Bahamas consider the climate of Florida more stimulating on account of the frosty days in winter. On the other hand, a factory superintendent of Atlanta complains that the Florida workmen in his establishment are so much more shiftless than those of his own town that they almost drive him frantic. Perhaps the Atlanta workmen would appear equally as slow to those further north. Certainly Virginians have complained that the climate there was so "soft" as to make them feel less energetic. It may be that the New Englanders consider us less enterprising than themselves, but the difference lies in the line of endeavor that has been followed and not in actual accomplishments. In letters and commerce they have surpassed us, but in the broad constructive statesmanship and military genius that have laid the foundations of our country they show a poor second best.

The contrast between the people of the tropics and those of the temperate zone is so generally recognized that it may be passed over briefly. Aside from the effect of tropical diseases, the races living near the equator are characterized by a dullness of thought and slowness of action that are universal.

Quite an extensive literature has developed on the subject of the white man in the tropics. When persons of European extraction make their home in the torrid zone a change sets in that is both quick and disastrous in its effects. This deterioration is more rapid along the coasts, and on the low inland

plains, but even in the highlands it overtakes the white man eventually. Presumably from physiological causes, there seems to be a degeneration of the moral fibre itself. This is manifest in many ways, such as a lack of industry, an irascible temper, drunkenness, and sexual indulgence. Those of strong character and body can resist these tendencies, it is true, but even those most favored in this respect find it essential to renew their vigor from time to time by a sojourn in a colder climate.

But the facts that we have been mentioning are too indefinite in nature to be conclusive. They lack that element of certainty which is demanded in all scientific investigations. We realize from personal experience that climate is of tremendous importance but we are unable to gauge its exact effect.

The best and fullest test of efficiency is a person's daily work, and in order to determine this a series of careful tests has been made embracing several thousand individuals employed in factories from Connecticut to Florida, and extending over a period of four years. As a test for mental efficiency similar experiments were conducted at the U.S. Naval and Military Academies at Annapolis and West Point. It is evident that in selecting the factories for these investigations great care had to be exercised in order to secure accurate data. In the first place, the employees must be piece workers, who are paid according to what they do and not by the day. There must be no restrictions on output by labor unions, and the work done must be essentially

of the same kind each day so that there would be the minimum of variation of output on account of unfamiliar tasks. The object of these experiments was three fold:

- 1st: To test efficiency by the seasonal variations.
- 2nd: By the variations of temperature from day to day.
- 3rd: By the variations in humidity.

Taking first the results from 550 operations in three different factories in Connecticut, and 1,200 from one in Pennsylvania, the figures are the same, and in some respects surprising as to the effects of the seasons on human energy.

We are accustomed to think of winter as the season of greatest efficiency, and that the approach of warmer weather brings on the so-called "spring fever" with a slowing up of activity. But the charts of the work of these factory operations show that this is not the case. The period of lowest efficiency is in the winter; then there is a steady increase until about the first of June; another period of low efficiency during the hot summer months, and from then on a steady increase to the highest efficiency of the year in November. These figures are borne out by the mortality tables of the State of New York, which has the same climate as Connecticut and also by the mortality tables of Pennsylvania. In each case they show a steady rise and fall of deaths in agreement with man's working efficiency. As we go south the charts show a gradual change. The maximum spring efficiency comes earlier and the fall increase later. The low energy of the northern winters is reduced, but this is more than offset by the slowing down of work during the long hot summers of the south. Finally, in the most southerly tests, we find the

Connecticut winter conditions reversed, for in Florida the greatest efficiency is found in the cool months of winter. All of these experiments disclose two outstanding facts. The first is that physical energy is highest at a temperature of about 65 degrees; and the second is the benefit of seasonal changes of temperature. The change from cold to warm is beneficial, and the change from warm to cold is even more so, as is indicated by the maximum of efficiency during the fall months in the northern half of the United States and the winter months in Florida.

Coming now to the mental tests of the West Point and Annapolis students, results of a different nature are found. No records are available for the warmer months on account of the summer vacation, but the same seasonal variations are to be observed. The difference lies in the fact that mental activity appears to attain its maximum at a temperature of 40 degrees as against 65 for the physical. Since human progress depends upon the co-ordination of the physical and mental activity, these experiments would indicate that the temperature of optimum efficiency is about 52 degrees, or the average of the two.

The second factor of pronounced influence on man's energy is found in the variations of temperature from day to day. These depend largely upon the cyclonic disturbances which are a characteristic of the storm belts in the temperate zones. In the northern hemisphere they reach their maximum intensity in western Europe and the northeastern two thirds of the United States.

These storms are marked by a fall and then a rise of the barometer, a similar variation in temperature, and a shifting of the direction of the winds. In effect, they may be compared to the wonderful stimulation of a Turkish bath, or the Swedish bath in which first a hot, and then a cold steam of water is played upon the patient.

The physical and mental tests we have been discussing show the same kind of stimulation as the result of minor variations of temperature. Instead of the highest efficiency being found when the optimum temperature is maintained unchanged, frequent variations from this figure, of from four to seven degrees, either up or down, give the greatest returns in energy.

The question of humidity we will pass over briefly, for it is so involved with that of temperature that it is difficult to gauge its independent effect. It has been definitely determined, however, that extremes are detrimental. A hot damp day, for example, is unquestionably debilitating, and very dry days also show a diminution in the work accomplished.

It seems strange that we have had to wait so long for these experiments on man. They have frequently been made before on plants and the lower orders of animal life. With plants the commonest method is to grow large numbers of seedlings at different temperatures and then measure the length of the shoots.

In all cases growth is slow at low temperature, increases gradually with higher temperature, reaches a maximum like that of man, and then falls off quickly. There is also the same

stimulation of vitality when the temperature is varied a few degrees above and below a fixed point. Apparently we have to deal with a quality which pertains to the whole organic world, and which is presumably an inherent characteristic of protoplasm.

What then is the ideal climate? Florida and such places as the Riviera and southern California lay claim to it in winter, but as work is the most essential part of our daily lives the palm should be awarded to those sections where energy is maintained at the highest annual level and where the most can be accomplished.

On the basis of his investigations and available weather records, Professor Huntington has prepared a chart of the climatic energy of the world. He does not claim that it is more than an approximation of the truth, but it shows a surprising agreement with other information bearing upon the distribution of civilization. The first thing that impresses us about this chart is the smallness of the area of maximum energy. It is only two per cent of the land surface of the earth, yet it vivifies the life of the entire human family. The main features of the chart are two large areas of highest energy; one lying in the United States and southern Canada extends from the Rocky Mountains to the Atlantic, and from a point in northern Virginia shades off gradually to the south. The energy is still considered as "high", however, as far south as northern Georgia. The other large area lies in western Europe with its center around

the North Sea. The remaining high areas are of limited size, embracing New Zealand, Japan, and the southern portions of the Argentine Republic and Australia.

This chart, of course, is based on the assumption that all people are subject to the same climatic influence as the factory operatives and students of the eastern United States. It should be tested in order to find out, if possible, whether the distribution of civilization corresponds to it in any way. With this in mind, Professor Huntington has also prepared a world chart of civilization as a standard of reference. To do this only two methods appeared feasible: one by statistics, and the other on the basis of opinion. The statistical method will eventually prove the better, but since the available data is incomplete it was necessary to fall back upon the method of opinion.

The way in which this was carried out was to send questionnaires to a number of eminent authorities, such as historians, geographers, anthropologists, etc., who were asked to give their opinion of relative civilizations of the different countries of the world. These authorities were divided into five groups, American, English, German, Latin, and Asiatic, and the opinion of each group was given an equal rating in summing up the results.

The replies to the questionnaires, when embodied in a chart, show a resemblance to the chart of climatic energy that is truly

remarkable. In Europe, where the findings are not complicated as they are in America by a Negro question, the lines of the two maps are almost identical.

One of the best indications of the civilization of a nation, or of the quality of climate, is that afforded by health conditions. Let us see how this works out. If we take a map of the distribution of health in Europe, based on official statistics, and place it beside that of climatic energy, and the one of civilization, the three would be so much alike that if the titles were removed the difference could hardly be distinguished. Civilization and health undoubtedly go hand in hand, and the similarity of their charts is to be expected. It is the close resemblance of both to the chart of climatic energy, based on actual physical experiments, that is significant.

The distribution of genius in Europe is another important link in this chain of evidence. The biographies of eminent men listed in the Encyclopaedia Britannica, and other Encyclopaedias of Europe, show that the production of genius follows closely the three charts we have been considering. Even if these men had been endowed with no greater natural ability than others in the south and east of Europe, they would still have had an advantage. They would have been continually stimulated by a bracing climate that fitted them for hard work the year round, while their less favored colleagues would have been subject to the depression that follows periods of excessive heat and cold.

The similarity of the maps of civilization, health, genius, and climatic energy is too great to be explained on the theory of mere coincidence.

Of late years the anthropologists have come to the front and endeavored to explain civilization in terms of race alone, but their science, which is based on bodily traits such as head form, complexion, etc., seems to ignore all other factors completely. Undoubtedly, race inheritance is a factor of the greatest importance, though its distribution fails to show the same close relation to civilization as does that of climate.

What, then, is the greatest objection to the theory of climatic energy? It is very apparent. If the climate of the United States is so favorable for the development of civilization, why was it inhabited only by savages when first discovered by Europeans? In reply it may be said that the races of the earth are like trees. Each according to its kind brings forth the fruit known as civilization. For the production of fruit, the three factors of good stock, proper cultivation, and favorable climatic conditions are equally necessary.

In aboriginal America one or more of the factors necessary for a high degree of culture seem to have been lacking. Whether by chance or through some inherent deficiency, the Mayas of Central America had failed to discover two of the greatest essentials of civilization; the art of making bronze and iron, and the use of beasts of burden. This alone would have placed the natives of our continent at a serious disadvantage, but there

seems to be a better reason for the low state of culture of the North American Indians. When the Mayas gradually succumbed to the unfavorable changes of climate, and their civilizations became decadent, there was no virile, gifted nation to the north to take up their work and build upon what they had accomplished.

In Europe this was not the case. The center of climatic energy shifted from the home of one great race only to rest above that of another of equal ability. Yet even this change was marked by a period of the greatest chaos known to history. The fall of old civilizations, wars, and migrations on a gigantic scale threatened for centuries to throw the world back into barbarism, and undo the patient work of thousands of years.

Of all the anthropologists none lay greater stress upon race than Madison Grant. In his wonderfully interesting book The Passing of the Great Race he divides the people of Europe into three large groups. The round headed, stocky Alpines living in the central mountain regions; the Mediterraneans, with long heads and dark hair and eyes who are found on the borders of the sea bearing this name, and in England; and, thirdly, the Nordics of great stature, blue eyes, and fair complexion, whose home is found in the countries bordering the North and Baltic Seas. It is the Nordics who are described as the great race of pioneers, soldiers, and organizers; the dominating force of Europe and America. We are told that this race founded the Persian Empire, and that the Greek heroes were blonde giants leading their armies of "little dark men" against the city of Troy. Yet Grant admits that it was the Alpines who taught the half naked Nordic hunters

the arts of domesticating animals, of agriculture, pottery, and the use of metals. He tells us, also, that the Mediterranean race founded the great civilization of Egypt, Crete, Mycenae, and Phoenicia. With such a splendid race inheritane why should the Nordics have remained in barbarism whicle the Alpines and Mediterraneans were developing their wonderful civilizations?

Could it not be that climate was the determining factor? They bore the germ of greatness within them, but, like a seed, it lay through the long post-glacial winter awaiting the spring-time of a kinder climate to bring it to full flower.

In conclusion, it is well to sum up the theory that has been considered.

It teaches us that throughout the entire period of the earth's history there have been constant fluctuations of climate. These vary in magniture. There are the great swings from glacial to interglacial conditions lasting for thousands of years; those of a century or more recorded by history; and finally those smaller cycles that have been observed by the modern science of meteorology. But these changes have been pulsatory in nature, for the smaller cycles have been constantly superimposed on the greater, just as our weather varies from year to year.

In applying this theory to the development of man, we are to believe that up the birth of Christ the nations that developed such high civilizations in the past were living under the influence of a post-glacial climate which gave them that vigor as essential to progress.

If civilization cannot flourish now in these seats of ancient culture, we must suppose either a change of climate, or change in the physiology of man. There is much evidence in support of the former hypothesis, but none for the latter, for the law of optimum temperature apparently controls the phenomena of life from the lowest activities of protoplasm to the highest activities of the human intellect.