

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; HENRY F. OSBORN, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; C. E. BESSEY, N. L. BRITTON, Botany; C. S. MINOR, Embryology, Histology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; J. W. POWELL, Anthropology.

FRIDAY, AUGUST 25, 1899.

CONTENTS:

<i>A Problem in American Anthropology</i> : PROFESSOR FREDERIC WARD PUTNAM.....	225
<i>The Field of Experimental Research</i> : DR. ELIHU THOMSON.....	236
<i>Phosphorescent Substances at Liquid-Air Temperatures</i> : C. C. TROWBRIDGE.....	245
<i>Scientific Books</i> :—	
<i>Dall on the Recent and Tertiary Leptonacea of North America and the West Indies</i> : KATHERINE J. BUSH. <i>Hankel's Electrical Investigations of Crystals</i> : A. J. M.....	249
<i>Scientific Journals and Articles</i> :.....	252
<i>Discussion and Correspondence</i> :—	
<i>On Graduate Study</i> : PROFESSOR CHARLES BUNDY WILSON. <i>Notes on the Nomenclature of some North American Fossil Vertebrates</i> : O. P. HAY. <i>The Proper Name of the Polar Bear</i> : JAMES A. G. REHN. <i>The International Catalogue of Scientific Literature</i> : DR. HERBERT HAVILAND FIELD.....	252
<i>Notes on Inorganic Chemistry</i> : J. L. H.....	256
<i>The British Museum</i>	257
<i>Uniformity in Size of Pages of Scientific Publications</i>	258
<i>Standard Measuring Instruments</i>	258
<i>Scientific Notes and News</i>	259
<i>University and Educational News</i>	264

A PROBLEM IN AMERICAN ANTHROPOLOGY.*

WHILE engaged in writing the address which I am to read to you this evening the sad news reached me of the death, on July 31st, of our President of five years ago, Doctor D. G. Brinton. Although not unexpected, as his health had been failing since he was with us at the Boston meeting, where he took his always active part in the proceedings of Section H and gave his wise advice in our General Council, yet his death affects me deeply. I was writing on a subject we had often discussed in an earnest but friendly manner. He believed in an all-pervading psychological influence upon man's development, and claimed that American art and culture were autochthonous, and that all resemblances to other parts of the world were the results of corresponding stages in the development of man; while I claimed that there were too many root coincidences, with variant branches, to be fully accounted for without also admitting the contact of peoples. Feeling his influence while writing, I had hoped that he would be present to-night, for I am certain that no one would have more readily joined with me in urging a suspension of judgment, while giving free expression to opinions, until the facts have been worked over anew and more knowledge attained.

* Address of the retiring President of the American Association for the Advancement of Science, given at Columbus on August 21, 1899.

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

His eloquent tongue is silent and his gifted pen is still, but I urge upon all who hear me to-night to read his two addresses before this Association: one as Vice-President of the Anthropological Section in 1887, published in our 36th volume of *Proceedings*; the other as retiring President in 1895, published in our 44th volume. In these addresses he has, in his usual forceable and comprehensive manner, presented his views of American anthropological research and of the aims of anthropology.

Dr. Brinton was a man of great mental power and erudition. He was an extensive reader in many languages and his retentive memory enabled him to quote readily from the works of others. He was a prolific writer, and an able critic of anthropological publications the world over. Doing little as a field archæologist himself, he kept informed of what was done by others through extensive travels and visits to museums. By his death American anthropology has suffered a serious loss, and a great scholar and earnest worker has been taken from our Association.

In the year 1857 this Association met for the first time beyond the borders of the United States, thus establishing its claim to the name American in the broadest sense. Already a member of a year's standing, it was with feelings of youthful pride that I recorded my name and entered the meeting in the hospitable city of Montreal; and it was on this occasion that my mind was awakened to new interests which in after years led me from the study of animals to that of man.

On Sunday, August 16th, while strolling along the side of Mount Royal, I noticed the point of a bivalve shell protruding from roots of grass. Wondering why such a shell should be there and reaching to pick it up, I noticed, on detaching the grass roots about it, that there were many other

whole and broken valves in close proximity—too many, I thought, and too near together to have been brought by birds, and too far away from water to be the remnants of a musk-rat's dinner. Scratching away the grass and poking among the shells, I found a few bones of birds and fishes and small fragments of Indian pottery. Then it dawned upon me that here had been an Indian home in ancient times and that these odds and ends were the refuse of the people—my first shell-heap or kitchen-midden, as I was to learn later. At the time, this was to me simply the evidence of Indian occupation of the place in former times, as convincing as was the palisaded town of old Hochelaga to Cartier when he stood upon this same mountain side more than three centuries before.

At that meeting of the Association several papers were read, which, had there been a Section of Anthropology, would have led to discussions similar to those that have occurred during our recent meetings. Forty-two years later we are still disputing the evidence, furnished by craniology, by social institutions and by language, in relation to the unity or diversity of the existing American tribes and their predecessors on this continent.

Those were the days when the theory of the unity of all American peoples, except the Eskimo, as set forth by Morton in his '*Crania Americana*' (1839) was discussed by naturalists. The volumes by Nott and Gliddon, '*Types of Mankind*' (1854) and '*Indigenous Races of the Earth*' (1857), which contains Meigs' learned and instructive dissertation, '*The Cranial Characteristics of the Races of Men*,' were the works that stirred equally the minds of naturalists and of theologians regarding the unity or diversity of man—a question that could not then be discussed with the equanimity with which it is now approached. The storm caused by Darwin's '*Origin of Species*' had

not yet come to wash away old prejudices and clear the air for the calm discussion of theories and facts now permitted to all earnest investigators. Well do I remember when, during those stormy years, a most worthy Bishop made a fervent appeal to his people to refrain from attending a meeting of the Association, then being held in his city, on account of what he claimed to be the atheistic teachings of science. Yet ten years later this same venerable Bishop stood before us, in that very city, and invoked God's blessing upon the noble work of the searchers for truth.

At the meeting of 1857 one of our early Presidents, the honored Dana, read his paper entitled 'Thoughts on Species,' in which he described a species as "a specific amount or condition of concentrated force defined in the act or law of creation," and, applying this principle, determined the unity of man in the following words:

"We have, therefore, reason to believe, from man's fertile intermixture, that he is one in species, and that all organic species are divine appointments which cannot be obliterated unless by annihilating the individuals representing the species."

Another paper was by Daniel Wilson, recently from Scotland, where six years before he had coined that most useful word, 'prehistoric,' using the term in the title of his volume, 'Prehistoric Annals of Scotland.' In his paper Professor (afterward Sir Daniel) Wilson controverted the statement of Morton that there was a single form of skull for all American peoples, north and south, always excepting the Eskimo. After referring to the views of Agassiz as set forth in the volumes of Nott and Gliddon, he said: "Since the idea of the homogeneous physical characteristics of the whole aboriginal population of America, extending from Terra del Fuego to the Arctic circle, was first propounded by Dr. Morton it has been accepted without ques-

tion, and has more recently been made the basis of many widely comprehensive deductions. Philology and archæology have also been called in to sustain this doctrine of a special unity of the American race, and to prove that, notwithstanding some partial deviations from the prevailing standard, the American Indian is essentially separate and peculiar—a *race distinct from all others*. The stronghold, however, of the argument for the essential oneness of the whole tribes and nations of the American continents is the supposed uniformity of physiological and especially of physiognomical and cranial characteristics—an ethnical postulate which has not yet been called in question."

After a detailed discussion of a number of Indian crania from Canada and a comparison with those from other parts of America, as described by Morton, Wilson makes the following statements: "But making full allowance for such external influences, it seems to me, after thus reviewing the evidence on which the assumed unity of the American race is formed, a little less extravagant to affirm of Europe than of America that the crania everywhere and at all periods have conformed, or even approximated, to one type.

"As an hypothesis, based on evidence accumulated in the *Crania Americana*, the supposed homogeneity of the whole American aborigines was perhaps a justifiable one. But the evidence was totally insufficient for any such absolute and dogmatic induction as it has been made the basis of. With the exception of the ancient Peruvians, the comprehensive generalizations relative to the southern American continent strangely contrast with the narrow basis of the premises. With a greater amount of evidence in reference to the northern continent, the conclusions still go far beyond anything established by absolute proof; and the subsequent labors of Morton him-

self, and still more of some of his successors, seem to have been conducted on the principle of applying practically, and in all possible bearings, an established and indisputable scientific truth, instead of testing by further evidence a novel and ingenious hypothesis."

At the close of this instructive paper are the following words: "If these conclusions, deduced from an examination of Canadian crania, are borne out by the premises, and confirmed by further investigation, this much at least may be affirmed: that a marked difference distinguishes the northern tribes, now or formerly occupying the Canadian area, in their cranial conformation, from that which pertains to the aborigines of Central America and the southern valley of the Mississippi; and in so far as the northern differ from the southern tribes they approximate more or less, in the points of divergence, to the characteristics of the Esquimaux: that intermediate ethnic link between the Old and the New World, acknowledged by nearly all recent ethnologists to be physically a Mongol and Asiatic, if philologically an American."

The third paper of the meeting to which I shall refer was by another of our former Presidents, the then well-known student of Indian institutions and the author of the 'League of the Iroquois' (1851). In this paper on 'The Laws of Descent of the Iroquois,' Morgan discusses the League as made up of five nations each of which was subdivided into tribes, and he explains the law of marriage among the tribes, the family relationship and the descent in the female line as essential to the maintenance of the whole system. He then says:

"Now the institutions of all the aboriginal races of this continent have a family cast. They bear internal evidence of a common paternity, and point to a common origin, but remote, both as to time and place. That they all sprang from a com-

mon mind, and in their progressive development have still retained the impress of original elements, is abundantly verified. The Aztecs were thoroughly and essentially Indian. We have glimpses here and there at original institutions which suggest at once, by their similarity, kindred ones among the Iroquois and other Indian races of the present day. Their intellectual characteristics, and the predominant features of their social condition, are such as to leave no doubt upon this question; and we believe the results of modern research upon this point concur with this conclusion. Differences existed, it is true, but they were not radical. The Aztec civilization simply exhibited a more advanced development of those primary ideas of civil and social life which were common to the whole Indian family, and not their overthrow by the substitution of antagonistic institutions."

After calling attention to the fact that a similar condition exists among certain peoples of the Pacific Islands, he writes: "Whether this code of descent came out of Asia or originated upon this continent is one of the questions incapable of proof; and it must rest, for its solution, upon the weight of evidence or upon probable induction. Its existence among American races whose languages are radically different, and without any traditional knowledge among them of its origin, indicates a very ancient introduction; and would seem to point to Asia as the birth-place of the system."

It would be interesting to follow the succeeding meetings of the Association and note the recurring presentation of views which the quotations I have given show to have been most seriously discussed over a generation ago. An historical review of the literature of American anthropology during the present century would also be interesting in this connection. It is probable, however, that a review of this litera-

ture for the first half of the century would reveal the fact that the writers, with here and there a notable exception, were inclined to theorize upon insufficient data and devoted little time to the accumulation of trustworthy facts. The presentation and discussion of carefully observed facts can almost be said to have begun with the second half of the century, and this is the only part of the subject that now commands serious attention.

A reference to the very latest *résumé* of this subject as presented in the 'History of the New World called America,' by Edward J. Payne, Vol. II., Oxford, 1899, is instructive here. In this volume Mr. Payne expresses his belief in the antiquity and unity of the American tribes, which he considers came from Asia in preglacial and glacial times, when the northwestern corner of America was connected with Asia, and when man "as yet was distinguished from the inferior animals only by some painful and strenuous form of articulate speech and the possession of rude stone weapons and implements, and a knowledge of the art of fire-kindling. Such, it may be supposed, were the conditions under which man inhabited both the Old and the New World in the paleo-ethnic age * * * * Even when a geological change had separated them [the continents] some intercourse by sea was perhaps maintained—an intercourse which became less and less, until the American branch of humanity became practically an isolated race, as America itself has become an isolated continent." (Preface.)

Mr. Payne discusses the growth of the languages of America, the various social institutions and arts, and the migrations of these early savages over the continent, north and south, during the many centuries following, as one group after another grew in culture. He considers all culture of the people autochthonous. "It may, however,

be suggested that, as in the Old World, the earlier and the smaller tribes tend to dolichocephaly, while the better developed ones are rather brachycephalous—a conclusion indicating that the varying proportions of the skull should be taken less as original evidence of race than as evidence of physical improvement."

This volume by Mr. Payne is replete with similar statements of facts and theories, and shows how difficult it is for us to understand the complications of the subject before us. It cannot be denied that, taking into consideration the number of authors who have written on this subject, Mr. Payne is well supported in his theory of the autochthonous origin of all American languages, institutions and arts; but the question arises: Has not the old theory of Morton, the industrious and painstaking pioneer of American craniology, been the underlying cause of this, and have not the facts been misinterpreted? At the time of Morton the accepted belief in the unity and universal brotherhood of man was about to be assailed, and it seems, as we now look back upon those times of exciting and passionate discussions, that Morton may have been influenced by the new theory which was so soon to become prominent—that there were several distinct creations of species of the genus *Homo* and that each continent or great area had its own distinct fauna and flora. Certainly Morton ventured to make a specific statement from a collection of crania which would now be regarded as too limited to furnish true results.

The anthropologist of to-day would hardly venture to do more than to make the most general statements of the characters of any race or people from the examination of a single skull; although, after the study of a large number of skulls from a single tribe or special locality, he would probably be able to select one that was distinctly char-

acteristic of the special tribe or group to which it pertained.

Relatively long and narrow heads and short and broad heads occur almost everywhere in greater or less proportion. In determining the physical characters of a people, so far as this can be done from a study of crania, the index of the height of the skull is quite as important as that of its breadth. These indices simply give us the ready means of expressing by figures the relative height and breadth of one skull in comparison with another, a small part of what the zoologist would consider in describing, for instance, the skulls of the different species of the genus *Canis*. So in our craniological studies we should determine the relative position, shape and proportions of the different elements of the skull. In fact, we should approach the study of human crania with the methods of the zoologist, and should use tables of figures only so far as such tables give us the means of making exact comparisons. Here, again, are the anthropologists at a disadvantage, inasmuch as it is only very recently that we are approaching a standard of uniformity in these expressions. It is now more than ever essential that the anthropologists should agree upon a method of expressing certain observed facts in somatology, so that the conscientious labors of an investigator who has had a special opportunity for working upon one group of man may be made available for comparison by investigators of other groups.

Probably the old method, still largely in vogue, of stating averages is responsible for many wrong deductions. If we take one hundred or more skulls of any people we shall find that the two extremes of the series differ, to a considerable extent, from those which naturally fall into the center of the series. These extremes in the hands of a zoologist would be considered the sub-varieties of the central group or variety.

So in anthropology we should take the central group of the series as furnishing the true characters of the particular variety or group of man under consideration, and should regard the extremes as those which have been modified by various causes. It may be said that this central group is defined by stating the mean of all the characters, but this is hardly the case, for by giving the mean of all we include such extraneous characters as may have been derived by admixture or from abnormal conditions.

The many differing characteristics exhibited in a large collection of crania, brought together from various portions of America, North and South, it seems to me, are reducible to several great groups. These may be generally classed as the Eskimo type the northern and central or so-called Indian type, the northwestern brachycephalic type, the southwestern dolichocephalic type, the Toltecan brachycephalic type and the Antillean type, with probably the ancient Brazilian, the Fuegian and the pre-Inca types of South America. Each of these types is found in its purity in a certain limited region, while in other regions it is more or less modified by admixture. Thus the Toltecan, or ancient Mexican, type (which, united with the Peruvian, was separated as the Toltecan family even by Morton) occurs, more or less modified by admixture in the ancient and modern pueblos and in the ancient earth-works of our central and southern valleys. In Peru, more in modern than in ancient times, there is an admixture of two principal types. At the north of the continent we again find certain traits that possibly indicate a mixture of the Eskimo with the early coast peoples both on the Pacific and on the Atlantic sides of the continent. The north-central Indian type seems to have extended across the continent and to have branched in all directions, while a similar but not so extensive branching, northeast and south,

seems to have been the course of the Toltec type.

This is not theorizing upon the same facts from which Morton drew the conclusion that all these types were really one and the same. Since Morton's time we have had large collections of crania for study, and the crania have been correlated with other parts of the skeleton and with the arts and institutions of the various peoples.

Although these relations have been differently interpreted by many anthropologists who have treated the subject, yet to me they seem to indicate that the American continent has been peopled at different times and from various sources; that in the great lapse of time since the different immigrants reached the continent there has been in many places an admixture of the several stocks and a modification of the arts and customs of all; while natural environment has had a great influence upon the ethnic development of each group. Furthermore, contact of one group with another has done much to unify certain customs; while 'survivals' have played an active part in the adoption and perpetuation of arts and customs not native to the people by whom they are preserved.

The Inca civilization, a forcible one coming from the north, encroached upon that of the earlier people of the vicinity of Lake Titicaca, whose arts and customs were, to a considerable extent, adopted by the invaders. It is of interest here to note the resemblance of the older Andean art with that of the early Mediterranean, to which it seemingly has a closer resemblance than to any art on the American continent. Can it be that we have here an æsthetic survival among this early people, and could they have come across the Atlantic from that Eurafic region which has been the birth-place of many nations? Or is this simply one of those psychical coincidences,

as some writers would have us believe! The customs and beliefs of the Incas point to a northern origin and have so many resemblances to those of the ancient Mexicans as hardly to admit of a doubt that in early times there was a close relation between these two widely separated centers of ancient American culture. But how did that pre-Inca people reach the lake region? Is it not probable that some phase of this ancient culture may have reached the Andes from northern Africa? Let us consider this question in relation to the islands of the Atlantic. The Canary Islands, as well as the West Indies, had long been peopled when first known to history; the Caribs were on the northern coast of South America, as well as on the islands; and in the time of Columbus native trading boats came from Yucatan to Cuba. We thus have evidence of the early navigation of both sides of the Atlantic, and certainly the ocean between could easily have been crossed.

One of the most interesting as well as most puzzling of the many phases of American archæology is the remarkable development of the art of the brachycephalic peoples, extending from northern Mexico northeastward to the Mississippi and Ohio valleys, then disappearing gradually as we approach the Alleghenies and, farther south, the Atlantic coast, also spreading southward from Mexico to Honduras, and changing and vanishing in South America. Unquestionably of very great antiquity, this art, developed in the neolithic period of culture, reached to the age of metals, and had already begun to decline at the time of the Spanish conquest. How this remarkable development came to exist amid its different environments we cannot yet fully understand; but the question arises: Was it of autochthonous origin and due to a particular period in man's development, or was it a previously existing phase

modified by new environment? For the present this question should be held in abeyance. To declare that the resemblance of this art to both Asiatic and Egyptian art is simply a proof of the psychical unity of man is assuming too much and is cutting off all further consideration of the subject.

The active field and museum archæologist who knows and maintains the association of specimens as found, and who arranges them in their geographical sequence, becomes intimately in touch with man's work under different phases of existence. Fully realizing that the natural working of the human mind under similar conditions will to a certain extent give uniform results, he has before him so many instances of the transmission of arts, symbolic expressions, customs, beliefs, myths and languages that he is forced to consider the lines of contact and migration of peoples as well as their psychical resemblances.

It must be admitted that there are important considerations, both physical and mental, that seem to prove a close affinity between the brown type of eastern Asia and the ancient Mexicans. Admitting this affinity, the question arises: Could there have been a migration eastward across the Pacific in neolithic times, or should we look for this brown type as originating in the Eurafric region and passing on to Asia from America? This latter theory cannot be considered as a baseless suggestion when the views of several distinguished anthropologists are given the consideration which is due to them. On the other hand, the theory of an early migration from Asia to America may also be applied to neolithic time.

However this may have been, what interests us more at this time, and in this part of the country, is the so-called 'Mound Builder' of the Ohio Valley. Let us first clear away the mist which has so long prevented an understanding of this subject by

discarding the term 'Mound Builder.' Many peoples in America, as well as on other continents, have built mounds over their dead, to mark important sites and great events. It is thus evident that a term so generally applied is of no value as a scientific designation. In North America the term has been applied even to refuse piles: the kitchen-middens or shell-heaps which are so numerous along our coasts and rivers have been classed as the work of the 'Mound Builder.' Many of these shell-heaps are of great antiquity, and we know that they are formed of the refuse gathered on the sites of the early peoples. From the time of these very early deposits to the present such refuse piles have been made, and many of the sites were reoccupied, sometimes even by a different people. These shell-heaps, therefore, cannot be regarded as the work of one people. The same may be said in regard to the mounds of earth and of stone so widely distributed over the country. Many of these are of great antiquity, while others were made within the historic period and even during the first half of the present century. Some mounds cover large collections of human bones; others are monuments over the graves of noted chiefs; others are in the form of effigies of animals and of man; and, in the South, mounds were in use in early historic times as the sites of ceremonial or other important buildings. Thus it will be seen that the earth-mounds, like the shell-mounds, were made by many peoples and at various times.

There are, however, many groups of earthworks which, although usually classed as mounds, are of an entirely different order of structure and must be considered by themselves. To this class belong the great embankments, often in the form of squares, octagons, ovals and circles, and the fortifications and singular structures on hills and plateaus, which are in marked contrast to

the ordinary conical mounds. Such are the Newark, Liberty, Highbank and Marietta groups of earthworks, the Turner group, the Clark or Hopewell group, and many others in Ohio and in the regions generally south and west of these great central settlements; also the Cahokia Mound opposite St. Louis, the Serpent Mound of Adams County, the great embankments known as Fort Ancient which you are to visit within a few days, the truly wonderful work of stone known as Fort Hill in Highland County, and the strange and puzzling walls of stone and cinder near Foster's Station.

So far as these older earthworks have been carefully investigated, they have proved to be of very considerable antiquity. This is shown by the formation of a foot or more of vegetable humus upon their steep sides, by the forest growth upon them which is often of primeval character; and by the probability that many of these works, covering hundreds of acres, were planned and built upon the river terraces before the growth of the virgin forest.

If all mounds of shell, earth or stone, fortifications on hills, or places of religious and ceremonial rites, are classed irrespective of their structure, contents, or time of formation, as the work of one people, and that people is designated 'the American Indian' or the 'American Race,' and considered to be the only people ever inhabiting America, North and South, we are simply repeating what was done by Morton in relation to the crania of America—not giving fair consideration to differences while overestimating resemblances. The effort to affirm that all the various peoples of America are of one race has this very year come up anew in the proposition to provide 'a name which shall be brief and expressive' and at the same time shall fasten upon us the theory of unity—notwithstanding the facts show diversity—of race.

Let us now return to the builders of the older earthworks, and consider the possibility of their having been an offshoot of the ancient Mexicans. Of the crania from the most ancient earthworks we as yet know so little that we can only say that their affinities are with the Toltecan type; but of the character of the art, and particularly the symbolism expressing the religious thought of the people, we can find the meaning only by turning to ancient Mexico. What Northern or Eastern Indian ever made or can understand the meaning of such sculptures or such incised designs as have been found in several of the ancient ceremonial mounds connected with the great earthworks? What Indian tribe has ever made similar carved designs on human and other bones, or such singular figures, cut out of copper and mica, as were found in the Turner and Hopewell groups? Or such symbolic animal forms, elaborately carved in stone, and such perfect terra cotta figures of men and women as were found on the sacrificial altars of the Turner group? What meaning can be given to the Cincinnati Tablet, or to the designs on copper plates and shell discs from some of the Southern and Western burial and ceremonial mounds? I think we shall search in vain for the meaning of these many objects in the North or East, or for much that resembles them in the burial places of those regions. On the other hand, most of these become intelligible when we compare the designs and symbols with those of the ancient Mexican and Central American peoples. The Cincinnati Tablet, which has been under discussion for over half a century can be interpreted and its dual serpent characters understood by comparing it with the great double image known in Mexico as the Goddess of Death and the God of War. The elaborately complicated designs on copper plates, on shell discs, on human bones and on the wing bones of the eagle

can in many instances be interpreted by comparison with Mexican carvings and with Mexican modes of symbolic expression of sacred objects and religious ideas. The symbolic animals carved on bone or in stone and the perfection of the terra cotta figures point to the same source for the origin of the art.

In connection with the art of the builders let us consider the earth structures themselves. The great mound at Cahokia, with its several platforms, is only a reduction of its prototype at Cholula. The fortified hills have their counterparts in Mexico. The serpent effigy is the symbolic serpent of Mexico and Central America. The practice of cremation and the existence of altars for ceremonial sacrifices strongly suggest ancient Mexican rites. We must also recall that we have a connecting link in the ancient pueblos of our own Southwest, and that there is some evidence that in our Southern States, in comparatively recent times, there were a few remnants of this old people. It seems to me, therefore, that we must regard the culture of the builders of the ancient earthworks as one and the same with that of ancient Mexico, although modified by environment.

Our Northern and Eastern tribes came in contact with this people when they pushed their way southward and westward, and many arts and customs were doubtless adopted by the invaders, as shown by customs still lingering among some of our Indian tribes. It is this absorption and admixture of the peoples that has in the course of thousands of years brought all our American peoples into a certain conformity. This does not, however, prove a unity of race.

It is convenient to group the living tribes by their languages. The existence of more than a hundred and fifty different languages in America, however, does not prove a common origin, but rather a diversity of

origin as well as a great antiquity of man in America.

That man was on the American continent in quaternary times, and possibly still earlier, seems to me as certain as that he was on the Old World during the same period. The Calaveras skull, that bone of contention, is not the only evidence of his early occupation of the Pacific coast. On the Atlantic side the recent extensive explorations of the glacial and immediately following deposits at Trenton are confirmatory of the occupation of the Delaware Valley during the closing centuries of the glacial period and possibly also of the interglacial time. The discoveries in Ohio, in Florida and in various parts of Central and South America all go to prove man's antiquity in America. Admitting the great antiquity of one or more of the early groups of man on the continent, and that he spread widely over it while in the palæolithic and early neolithic stages of culture, I cannot see any reason for doubting that there were also later accessions during neolithic times and even when social institutions were well advanced. While these culture epochs mark certain phases in the development of a people, they cannot be considered as marking special periods of time. In America we certainly do not find that correlation with the Old World periods which we are so wont to take for granted.

We have now reached the epoch of careful and thorough exploration and of conscientious arrangement of collections in our scientific museums. It is no longer considered sacrilegious to exhibit skulls, skeletons and mummies in connection with the works of the same peoples. Museums devoted primarily to the education of the public in the æsthetic arts are clearing their cases of heterogeneous collections of ethnological and archæological objects. Museums of natural history are being arranged to show the history and distribution of animal

and vegetable life and the structure of the earth itself. Anthropological museums should be similarly arranged and, with certain gaps, which every curator hopes to fill, they should show the life and history of man. To this end the conscientious curator will avoid the expression of special theories and will endeavor to present the true status of each tribe or group of man in the past and in the present, so far as the material at his command permits. A strictly geographical arrangement is, therefore, the primary principle which should govern the exhibition of anthropological collections. A special exhibit may be made in order to illustrate certain methods by which man in different regions has attained similar results, either by contact or by natural means. Another exhibit may be for the purpose of showing the distribution of corresponding implements over different geographical areas. These and similar special exhibits are instructive and under proper restrictions should be made, but unless the design of each exhibit is clearly explained, the average visitor to a museum will be confused and misled, for such objects so grouped convey a different impression than when exhibited with their associated objects in proper geographical sequence.

The anthropology of America is now being investigated and the results are being made known through museums and publications as never before.

The thoroughly equipped Jesup North Pacific Expedition, with well-trained anthropologists in charge, was organized for the purpose of obtaining material both ethnological and archæological for a comparative study of the peoples of the northern parts of America and Asia. Although only in the third year of its active field work, it has already furnished most important results and provided a mass of invaluable authentic material.

The Hyde Expedition planned for long-continued research in the archæology and ethnology of the Southwest, a successor in regard to its objects to the important Hemenway Expedition, is annually adding chapters to the story of the peoples of the ancient pueblos.

The results of the extensive explorations by Moore of the mounds of the southern Atlantic coast are being published in a series of important monographs.

The Pepper-Hurst Expedition to the Florida Keys has given information of remarkable interest and importance from a rich archæological field before unknown.

The United States government, through the Bureau of Ethnology of the Smithsonian Institution, has given official and liberal support to archæological and ethnological investigations in America.

The constantly increasing patronage, by wealthy men and women, of archæological research at home, as well as in foreign lands, is most encouraging.

The explorations in Mexico and in Central and South America, the publication in fac-simile of the ancient Mexican and Maya codices, the reproduction by casts of the important American sculptures and hieroglyphic tablets, all have been made possible by earnest students and generous patrons of American research.

The numerous expeditions, explorations and publications of the Smithsonian Institution and of the museums of Washington, Chicago, Philadelphia, New York and Cambridge are providing the student of to-day with a vast amount of authentic material for research in American and comparative anthropology.

The archæological Institute of America, the American Folk-Lore Society and the archæological and anthropological societies and clubs, in active operation in various parts of the country, together with the several journals devoted to different branches

of anthropology, give evidence of widespread interest.

Universities are establishing special courses in anthropology, and teachers and investigators are being trained. Officers of anthropological museums are preparing men to be field workers and museum assistants. The public need no longer be deceived by accounts of giants and other wonderful discoveries. The wares of the mercenary collector are now at a discount since unauthentic material is worthless.

Anthropology is now a well-established science; and with all this wealth of materials and opportunities, there can be no doubt that in time the anthropologists will be able to solve that problem, which for the past half century has been discussed in this Association—the problem of the unity or diversity of prehistoric man in America.

FREDERIC WARD PUTNAM.

HARVARD UNIVERSITY.

*THE FIELD OF EXPERIMENTAL RESEARCH.**

PHYSICAL research by experimental methods is both a broadening and a narrowing field. There are many gaps yet to be filled, data to be accumulated, measurements to be made with great precision, but the limits within which we must work are becoming, at the same time, more and more defined.

The upper ranges of velocities, temperatures and pressures, which manifest themselves in the study of the stellar universe, are forever beyond the range of experiment. But while the astronomer must wait for opportunities to observe, the experimenter can control his conditions and employ his methods and his apparatus at once to the question in hand. Still this work must be done within a certain range or must be limited to conditions more or less easy to

recognize. In spite of this fact, however, the progress made during the past century is not likely to cease or abate in the next, and the ever-increasing number of workers bodes well for the future enrichment of our science.

Whatever may be our ideas of fundamental entities, as expressed in various theories; whether, as an example, we regard the ether as like an infinitely mobile fluid, or as an incompressible solid, or as a jelly; or whether we incline to think that being an electromagnetic medium, it may be without mechanical properties, which properties depend in some way upon the electromagnetic nature of the ether, we cannot reach sure ground without the experimental test.

The development in the field of research by experiment is like the opening of a mine, which, as it deepens and widens, continually yields new treasure, but with increased difficulty, except when a rich vein is struck and worked for a time. In general, however, as the work progresses there will be needed closer application and more refined methods. We may, indeed, find our limit of depth in the mine of experiment in inordinate cost, in temperatures too high, or in pressures beyond the limits of our skill to control.

It is but a few months since Professor Dewar, by the evaporation of liquid hydrogen in a vacuum, closely approached, if he has not reached, our lower limit of possible temperature. Investigations of the effects of low temperature upon the properties of bodies must, from the present outlook, be forever limited to about 20° C. above absolute zero, unless a lighter gas than hydrogen be discovered upon the earth, the actual existence of which it is, of course, impossible to conjecture. Before the actual experimental demonstration of this limit the limit itself was known to theory, at least approximately, but the spur of the experi-

* Address of the Vice-President and Chairman of Section B, Physics, before the American Association for the Advancement of Science at the Columbus meeting, August, 1899.