

SCIENCE

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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.

THE HISTORY OF THE BEGINNINGS OF THE SCIENCE OF PREHISTORIC ANTHROPOLOGY.*

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THE BEGINNINGS OF THE SCIENCE OF PREHISTORIC ANTHROPOLOGY.

Denmark.

Scientific investigation into prehistoric anthropology began in Denmark in the

* Address by the Vice-President and Chairman of Section H, American Association for the Advancement of Science, Forty-eighth Meeting, Columbus Meeting, August 21, 1889.

early part of the present century. Its start was more the result of accident than design. The King of Denmark provided, in 1806, for a scientific investigation of his country, corresponding in some degrees with the aggregate duties with what in our country are the Geological Survey, the Natural History Division of our National Museum and Department of Agriculture, and the Bureau of Ethnology.

Dolmes.

Almost the first obstacle the Committee met, and which, being unable to explain, caused it to put on its studying cap and led to an extensive discussion, was a dolmen, one of the common and now well-known prehistoric burial places. Associated with the discovery were the stone hatchets, both polished and chipped for polishing, also now so well known. The studies of the historian and archeologist failed utterly in assigning any of these to any period or people known in historic times. The ancient Sagas were studied in detail, but never developed an age of culture, wherein axes other than those of iron were used. As the Commission's investigations were extended, the number of these objects, both dolmens and axes, were increased, and other implements were added to the list.

Denmark kept the lead in her interest in the discoveries relating to prehistoric man, and in the formation of the new science which was to become prehistoric anthropology.

Shell Heaps. -

Another Commission was formed, composed of Professors Forschhammer, Steenstrup and Worsaae, the latter of whom was the special representative of the Science of Archeology, though the other two would, perhaps, have been equally as great in archeology had they not already been celebrated by their earlier work in biology and geology. Worsaae's labors as an archeologist were overshadowed by his subsequent

greatness as a statesman; he became one of the Cabinet Ministers of the Kingdom, and died in office.

The Committee continued the investigations into the new science by the discovery of the shell mounds. That at Havelse was first and became the representative specimen, but it was soon found that shell mounds or deposits existed along the coast in every direction, and what had theretofore been supposed to be the natural surface of the land, was really the result of human labor and the evidence of human occupation. The farmers and land owners in their respective neighborhoods had already discovered that these mounds were not composed of the usual sand and clay, but mostly shells, which, in a state of great decay, were more or less mingled with black soil; and they had carted away much of the material to be distributed over the surface of their fields for enrichment.

An investigation commenced at Havelse, showed not only the artificial character of these shell mounds, but the presence of many pieces of stone, principally flint, which had been broken in such way as to indicate human intervention and an adaptation to human use. These objects ran pretty nearly the entire range of prehistoric implements as we now know them: hammerstones, axes, hatchets, flakes, scrapers, arrowpoints, spearheads, knives, spindle-whorls, gouges, crescents, daggers, etc. There were also objects of shell, horn and bone, and many fragments of pottery.

The more important implements from certain deposits were found to be of stone, with a piercing point or a cutting edge, mostly chipped into shape, though some had been pecked or battered and then ground or polished.

In other deposits objects of different material were found, and among the rest the presence of bronze implements was detected.

The number and kind of these implements, their methods of burial or deposit, with the associated objects, enabled the archeologist to assign to them a chronological sequence; first in epochs of culture, and second in improvement made within these groups.

These epochs of culture divided themselves according to the material employed for cutting implements, into the ages of stone, bronze and iron. This was the first step in the establishment of the new science of Prehistoric Anthropology. The Royal Danish Museum of Antiquities was established in 1816, now occupying the Prinsessen Palace at Copenhagen. It was to be the home of the archeological collections of the Kingdom, and here Mr. Thomson with the aid of Professors Forschhammer and Steenstrup, classified, arranged and displayed the objects found, and here the new science was born.

Lake Dwellings.

In 1853 and 1854 the waters of the Swiss Lakes were from natural causes reduced to a low stage, and Dr. Ferdinand Keller employed the opportunity to investigate certain peculiarities which, reported to him by the fishermen and builders on the water's edge, had excited his curiosity. One of these was that certain localities, with a sloping shore apparently well suited for drawing the seine, were rendered useless for this kind of fishing because of obstructions believed to be decayed stumps of a submerged forest covering the bottom, catching the lead-line which had to be lifted, the lifting of which allowed the fish to escape. It appeared that excavations had been made during a period of comparatively low water, in the year 1829, as for a building, wherein the piles and other objects of great antiquity, believed to have been Roman, had been found. Being thus satisfactorily accounted for, their discoverers gave them

no further heed, and the objects were not brought to the attention nor submitted to the inspection of any antiquarian. Dr. Keller's first surprise was at the number of these stumps, the similarity of their appearance, and the regularity with which they had grown. His surprise was increased when, on lifting one out from its bed, it was found *not* to be a stump, but a sharpened and pointed pile-bearing evidence of human workmanship, which had been driven into the ground. A cursory examination showed this to be the condition of all. This was evidence of a previous human occupation; and as the late discovery in Denmark began to have its effect upon the mind of Keller, it became apparent that these were the evidences of a human occupation of the Swiss Lakes at some prehistoric period. This ripened into a certainty when it was discovered that like conditions existed in other places, not only in Lake Zurich, but in divers other of the lakes. Reports of these from both Switzerland and Denmark, spread over western Europe and naturally excited the interest and curiosity of many thinking men, especially those of France and England. The objects themselves were passed about, and descriptions of them with illustrations were brought under the eyes of the people of these countries, who turned their attention to similar known objects of their own countries theretofore unrecognized. Like the discoveries in Denmark and Switzerland, the great interest centered in the similarity of the respective implements in the various classes found in these widely-separated countries. If I recur to this question of the similarity of implements found in different countries, it is because of its importance. It formed the foundation of the science. It was by reason of this similarity that the Scandinavian discoverers and early students were able to determine the prehistoric ages. By comparison of imple-

ments of their own countries with those of Scandinavia, and a recognition of the similarity between them, the students from other countries of Western Europe were enabled to correlate and identify the culture of the prehistoric man; and this knowledge finally crystallized into the universal recognition of the three prehistoric ages of stone, bronze and iron. The prehistoric man had but few kinds of implements: the hammer or maul, the hatchet, the knife, scraper, arrowpoint and spearhead, spindlewhorl, points of bone and horn, objects principally ornaments, of shell and pottery. These implements were substantially the same in every locality so far as concerned the Neolithic period. The polished stone hatchets were identical whether found in the dolmens of France and England, the dolmens and shell heaps of Scandinavia, the lake dwellings of Switzerland, or the terramare of Italy; and in after years, as our knowledge of the prehistoric world increased, this similarity was found to extend throughout the Eastern and Western Hemispheres, as well as the islands of the sea. The similarity was not confined to one class of implements, but included nearly all in every age. To be sure, there were minor differences, but the implements could be recognized as the same whenever found. For example, the hatchets were long or short, had a head or poll, well finished or left rude, and were round, flat or square in section. Those square in section were from Scandinavia; short stumpy ones with unfinished poll, from the British Islands; the poll pointed or rounded and well finished, from Continental Europe; the button-headed, from Brittany. But with all this, they were always the same implement. The material might differ with the locality, but otherwise, as to use and method of manufacture, they appeared the same. As investigation proceeded, this similarity of implement extended. The polished stone

hatchet of America was found to be the same, with the same differences of detail; some from Illinois, made of flint, have a spreading edge, almost of a crescent form, the corners forming the points after the style of some of the battle-axes of medieval knights; those from Chiriqui are flattened on both sides by a sort of chamfer which makes them appear hexagonal in section. It has been argued that this similarity of implement was due to the similarity of human thought adapted to human necessity. The similarity of human thought and action under the same necessities may be admitted, although it necessarily had its limitations.

The similarity of the implements found among different peoples widely separated, is not accounted for by the theory of human thought and human needs. The classification of prehistoric culture into ages of stone, bronze and iron was based on the similarity of the implements in each age found in the respective countries, and this was the result of migration, communication or contact between the peoples.

Discoveries of Darwin and Boucher de Perthes.

By the middle of the century students of prehistoric matters of the Old World had about accepted the prehistoric ages of stone, bronze and iron. Some attempts were made to discover the man who had made and used these implements; and the few skulls that had been gathered in earlier times, the significance of which had not then been understood, were subjected to re-examination in view of the new light upon prehistoric matters. Chief among these were the Canstadt skull, discovered in 1706, and the Engis skull, in 1822. In these studies the pathway of prehistoric science and knowledge was being slowly blazed when, in the year 1859, two great discoveries relating to the origin and antiquity of man were published which had something

of the effect of an earthquake upon former scientific conclusions. One, the origin of the human species through evolution, by Darwin; and the other, the acceptance as artificial of the paleolithic implements found by M. Boucher de Perthes in the valley of the Somme. Boucher de Perthes had, as early as 1836, but seriously since 1841, been investigating the peculiarities of certain chipped flints found at Abbeville, France, as far south as Amiens, along the line of the canals and railroads then in course of construction. These he had recognized as the work of man, and claiming for them the highest antiquity, he asserted them to be antediluvian. His discovery was at first unfavorably received. In 1853 Dr. Rigollot announced his adhesion to the theory; in 1859 Dr. Falconer discovered the presence of the bones of *Elephas antiquus* at St. Acheul, and their association more or less intimate with the chipped flint implements of Boucher de Perthes. In 1859 numerous geologists of England visited the locality and some of them, especially Mr. Arthur J. Evans, now Curator of the Ashmolean Museum, Oxford, then a lad accompanying his father, Sir John Evans, had the good fortune to find one of the chipped flint implements *in situ*. There was much contention over the proposition connecting man with these implements, and there were many unbelievers. Some disputed the antiquity of the deposit, others the human manufacture of the implements and, curiously enough, the greatest opposition came from the French geologists and the greatest support from the English. It is not here declared that the geological formation was not early understood by eminent scientists who visited the locality, but there does not appear to have been any publication *in extenso* of that formation and the strata of which it is composed and the fauna found therein, until that of M. D'Ault Du Mesnil in the

Revue Mensuelle de l'Ecole d'Anthropologie (Sixieme Année, IX., 1896), and of which I translated and published the general portions in the *American Antiquarian* (Vol. XXI., No. 3, 1899, pp. 137-145).

There were found to be several geologic and paleontologic strata. In the lower layers the bones and teeth of *Elephas meridionalis* were found associated with the *Rhinoceros merkkii*; in the middle strata the *Elephas primigenius* and the *Elephas antiquus* were mingled; while in the upper layers the *Elephas primigenius* alone appeared. The implements in the lower strata were large and rude, while in the upper they became smaller and finer and better made, forming the type called by M. D'Ault Du Mesnil, St. Acheulléen. The surface layer contained objects belonging to the later ages, and does not here concern us. The discussion over the theory of the human origin of these implements soon came to a close by its general acceptance. There have been continuous and almost illimitable discussions over details, but none over the general proposition. 'One swallow does not make a summer,' and a single discovery, either of an implement or a locality, is of slight value in the establishment of any general proposition in prehistoric anthropology. If the discovery of chipped flint implements had been confined to those of Boucher de Perthes, they never would have made any headway. But the attention of those interested in the subject having been attracted to these chipped flint implements, they were, as the polished stone hatchets in the Neolithic period had been previously, found in greater or less numbers in many localities throughout the principal countries of western Europe. Then came a comparison of the same implements from different localities, and it was decided that they were related and formed a stage of culture so different from that of polished stone as to show that they

belonged to another people occupying the country at an earlier date. To this period Sir John Lubbock gave the name Paleolithic.

These chipped flint implements were found by scores of investigators and searchers in hundreds of places, to the number of tens of thousands.

As before remarked, it was the likeness or similarity of the implements, not only in general form, but in the details, as well as in their material, mode of manufacture and possible method of use, which clinched the argument. They so closely resemble each other in the details as to show to the student that the men who made and used them not only belonged all to the same stage of culture, but that either through migration or commerce they must have had intercommunication. They might or might not have been blood-relatives, but that they were really acquaintances and taught each other the modes of fracture of these implements, seems to have been admitted on all hands.

The discoveries of the prehistoric ages of stone have been extended to Africa. Professor H. W. Haynes and General Pitt-Rivers in Egypt and Mr. Seton-Karr in Somaliland, have made discoveries of paleolithic implements. Discoveries of neolithic implements have been made by Mr. J. de Morgan in the valley of the Nile, and by a Belgian, in the valley of the Congo. All have been found in sufficient numbers to establish the fact that they were not isolated or sporadic specimens but were evidence of an extensive human occupation of their locality.

Differences Between Paleolithic and Neolithic Cultures.

In treating of the science of prehistoric anthropology, it is imperative that the differences between the culture of paleolithic and neolithic times should be noticed.

Necessarily this must be confined to the Old World, as the discoveries in America have not been sufficient to establish the lines between the two periods.

Mons. Gabriel de Mortillet formulated the differences between his Madelainien epoch (the last of the Paleolithic period) and his Robenhausen epoch (the first of the Neolithic period), and has arranged them in parallel columns that they may make a graphic representation :

LATEST PALEOLITHIC	EARLIEST NEOLITHIC.
(1) Climate cold and dry, with extreme temperatures.	(1) Climate temperate and uniform.
(2) Existence of the last grand fossil species—the mammoth.	(2) The mammoth extinct.
(3) Chamois, marmot, the wild goat in the plains of France.	(3) Chamois, marmot, and wild goat have gone to the summits of the mountains.
(4) Reindeer, saiga (antelope), elk, glutton, white bear, in the center of Europe.	(4) These animals have emigrated toward the Arctic region.
(5) Hyena and the grand cat tribe.	(5) No hyenas or grand cats.
(6) No domestic animals.	(6) Domestic animals abundant.
(7) Human type uniform.	(7) Human type much varied.
(8) Population nomadic.	(8) Population sedentary.
(9) Hunters and fishes, but no agriculture.	(9) Agriculture well developed.
(10) Stone implements always chipped.	(10) Stone implements polished.
(11) No pottery.	(11) Pottery.
(12) No monuments.	(12) Monuments: Dolmens and menhirs.
(13) No burials; no respect for the dead.	(13) Burial of the dead.
(14) No religious ideas.	(14) Religious ideas well developed.
(15) A profound and pure artistic sentiment.	(15) No artistic sentiment.

The radical difference between the Paleolithic and Neolithic periods, and one to be first remarked, was that they were in different geologic epochs. The former belonged to the quaternary, the latter to the present epoch. In the transition from the Paleolithic to the Neolithic the glaciers ceased, the climate became temperate and

uniform, the animals peculiar to the earlier conditions passed away and others affected by the change of climate migrated. There were eighteen species of cold-loving animals in western Europe during the Paleolithic period which migrated to other localities because of the moderation of the temperature incident to the commencement of the Neolithic period. Thirteen of these migrated to cold countries by latitude going to the north, the reindeer, the musk-ox, the blue fox, etc.; five like the chamois and mountain goat, migrated to cold countries by altitude, going up on the mountains.

Comparing the industries of the two periods, we will see some of those of the earlier, continued into the later periods, and some of those the later were invented or improved.

The art of chipping stone into implements was continued from the earlier to the later but to it was added the art of grinding and polishing. All our smoothed and polished stone implements and objects had their origin in this neolithic culture. Sawing and drilling stone began here. The bow and arrow, the first projectile machinery in the world, here had its birth.

The twisting of flaxen thread, weaving and the making of cloth, clothing, commenced in this period. Pottery making was begun which, in itself, wrought a revolution in human culture. The earliest monuments of the world, the great mounds, tumuli, dolmens, menhirs, cromlechs, and the fine specimens of prehistoric architecture, date from this period.

The family was formed, and the clan or tribe organized with a local habitation and a name. Villages, and finally towns were established; animals were domesticated, flocks and herds with farms and pastures came into being; agriculture increased the means of subsistence; a division of labor became fixed, and mechanics with trades were partially inaugurated. Though

the neolithic man, from our point of view, was a savage, yet compared with his predecessor, the paleolithic man, he made a long stride towards civilization, whether from savagery to barbarism may be suggested but need not be decided, nor even argued here.

Paleolithic Implements Employed.

The recognition of the artificial character of the chipped flint implements found by Boucher de Perthes, and the many who came after him, and which gave an impetus to the science of prehistoric anthropology, made an opportunity, if it did not create a necessity, for some sort of classification. The Scandinavian classification of stone, bronze and iron had been accepted, but these late discoveries demonstrated an earlier period and called for a subdivision of the age of stone.

All the implements found were of flint and chipped. During this period man did not know how to rub one stone against another to make either of them smooth or sharp, as he did in the later age; so the first was called the chipped stone age, and the other the polished stone age. Sir John Lubbock gave them the names, respectively, Paleolithic and Neolithic. These paleolithic implements of chipped flint being found mostly in the alluvial gravels, the name alluvial, alluvium (French), diluvial, diluvium (English?), were respectively given them.

These implements and the period to which they belong require a description by which they can be recognized from those of other ages. They were all of flint or some chippable material, many of them were made from boulders or concretions. Some were so chipped as to leave the smooth part of the boulder as a grip for the hand. They varied in length from six or eight inches down to three, in width from five to two, and in thickness from three inches to one.

They were generally almond-shaped and had a point or cutting edge at the small end; some of them made from ledge-rock and not from boulders, were brought to an edge all round. In outline they resemble the leaf-shaped implements of later ages; but when viewed edge-wise the difference was manifest in that these were much thicker. The thickness is usually about half their width; an implement four inches wide would be about two inches thick, and one two inches wide, an inch thick, while leaf-shaped implements of that width would not be one-half as thick.

River Drifts, Valleys and Terraces.

A further explanation is as to the formation of the geologic deposits in which the implements were found, and so a decision as to their geologic age. It is believed that at an earlier period in the geology of the country the water of the rivers on its way to the sea eroded the earth (as is shown by the geologic models, principally of the Rocky Mountains, in the U. S. National Museum) and formed valleys, making them reach from one hill to the other and as deep as the present bottom of the rivers; at the second stage the water in the rivers, becoming less in volume and slower in movement, began the process which has been carried on from that day to the present in all river valleys, the cutting or washing of the river bank at or from one point or locality where the water ran swifter and stronger, and carrying it further down the stream where the water ran slower and weaker. In this manner the river terraces were formed, each successive terrace, counting from the hill, represented a corresponding abasement of the water, until, as at present in many of our American rivers, especially the Ohio, three terraces exist on either side of the stream. In the chronologic formation of these terraces, that nearest the hill was the oldest, that nearest

the stream the latest. The bottom of each terrace was, naturally, laid down first and, consequently, was older than the top. So the bottom of the first terrace (nearest the hill) was the oldest, and the top of the terrace (that nearest the stream) was the latest.

These paleolithic implements have been found in the bottom of the first terrace and, consequently, were a part of the earliest deposit. And as they continued throughout the various terraces and in the different parts thereof, it is believed that the Paleolithic period in these localities began with the formation of the river-valleys and is co-existent with them.

During all this period no implements of less enduring material than flint have been found, if any ever existed. No human remains have ever been found in the river valleys; nor the remains of any animal so small as man or whose bones were so light and frail as are his.

Differences in Climate.

No traces have been brought to light of either the habitation or the raiment of the man of this period. It has been suggested that he had no need for either. The climate was warm, moist and rainy; he required neither dwelling nor raiment to keep him warm or dry, for, like the savages of warm climates generally he may have preferred to run naked. This is regarded as entirely feasible in the climate then prevailing in western Europe.

But there came a change, supposed to be represented by the glacial epoch, when the climate became cold and wet, and man required protection and so was driven to the caverns for shelter. Here is found the first evidence of raiment. Thus began what has been called the cavern period.

Epochs of the Cavern Period.

Different classifications have been made and different names given to these. Some

of the early scientists named them for the animals of the time and locality. Lartet named them respectively, Cave Bear, Mammoth, Reindeer, and Ox; Dupont, Mammoth and Reindeer. The English generally employed the terms 'river-drift' (for the earlier, paleolith) and 'cavern.' De Mortillet made an exhaustive study and a consequent elaborate classification named for, and based on the industries found in certain localities: The Chelléen after Chelles (Seine-et-Marne), Acheulléen after St. Acheul (Somme), Mousterien after the cavern of Le Moustier (Dordogne), Solutreen after the station of Solutré (Sàone-et-Loire), Madalenien after the rock-shelter of La Madeleine (Dordogne), and Tourassien after La Tourasse (Haute-Garonne), the last representing the hiatus between the Paleolithic and Neolithic ages. This classification was carried throughout the prehistoric ages.

experience will satisfy one of its excellence. Its principle is to give an epoch of culture the name of a locality where that particular culture is manifested in its greatest purity. This may be an arbitrary system, but it has the great desideratum of all systems of nomenclature—certainty and definiteness. By such, one knows exactly what is meant, and this is the chief purpose of nomenclature. The American geologic classification is based largely on the same system.

High-Plateau Paleoliths, Ightham, Kent.

Among many discoveries of paleolithic implements in Europe was a certain class which indicated a human occupation earlier than those found in the river gravels. These belong to the high plateaux between the headwaters of the streams. The principal discovery of implements of this class was by Mr. Benjamin Harrison, of Ightham, Kent; but knowledge of the significance thereof is

Mons. de Mortillet's classification of prehistoric chronology, as applied to France.

TIME.		AGES.	PERIODS.	EPOCHS.
Quaternary—Actual.	Historic.	Iron.	Merovingian.	Wabenien (Waben, Pas-de-Calais).
	Protohistoric.		Roman.	Champdolien (Champdolent, Seine-et-Oise). Lugdunien (Lyon, Rhone).
Bronze.			Galatian.	Beuvraysien (Mont Beuvray, Nievre). Marnien (Department of Marne). Halstattien (Hallstatt, Austria).
			Tsiganien.	Larnaudien (Larnaud, Jura). Morgien (Morges, canton of Vaud, Switzerland).
Quaternary—Ancient.	Prehistoric.	Stone.	Neolithic.	Robenhausien (Robenhausen, Zurich, Switzerland). Campignyen (Campigny, Seine-Inferieure). Tardenoisien (Fère-en-Tardenois, Aisne).
			Paleolithic.	Tourassien (La Tourasse, Haute-Garonne) Ancient hiatus. Madelainien (La Madeleine, Dordogne). Solutréen (Solutre, Saine-et-Loire). Moustérien (Le Moustier, Dordogne). Archuléen (Saint-Achuel, Somme). Chelléen (Chelles, Seine-et-Marne).
Eolithic.				Puycournien (Puy-Courny, Cantal). Thenaysien (Thenay, Loire-et-Cher).
Ter- tiary.				

Objection may be made to the nomenclature of this classification, but a slight due to the great geologist, Professor Joseph Prestwich.

A small stream runs past the town of Ightham where it joins the Medway. This stream has the usual terraces in its valley which, like other terraces, are formed of river drift. These valleys contained paleolithic implements of the usual kind similar to those heretofore described. The theory was, that the river-valley had been eroded, the sand and gravel cut or washed away, then carried down the stream and deposited where the current became weaker; thus would be involved all the paleolithic implements within the scope of the valley or ravines that fell into it. The information furnished by Mr. Harrison's discovery was that, on the high plateau levels *not* involved in the valleys or the ravines leading to it, the same kind of paleolithic implements were found practically on the surface. The theory of Professor Prestwich founded on Harrison's discovery carries us back one step further in the chronology of paleolithic man. He believed that the implements were made and used by man on these high plateaux before the commencement of the formation of the river-valley; that, being scattered over the surface where they had been left by their owners, they have remained until now found undisturbed, uninfluenced by the erosion, the which as it proceeded, cut away the sand and gravel and drew the the other implements into the valley or into the general current which carried the sand and gravel down, and deposited them with the débris in the form of a terrace. These Harrison implements *not* being within the reach of this erosion, remained *in situ* and are now being found on the surface of the plateau above. Implements, and even workshops indicated by the presence of certain tools and style of implements, remained on the high plateaux and are there found to-day. If they had been within the influence of the stream and had been carried down by its waters, they would have been found in the drift of the

terrace below; but not having been thus involved, they were not affected and so remained in their original places until now found. This conclusion, if correct, pushes the paleolithic one epoch farther into the past; instead of the implements being found in the bottom of the river terrace at the completion of their journey, they are found on the high plateau which was originally, and for the others, the beginning of the journey.

Tertiary Man.

Another step in the science of prehistoric anthropology (whether forward or backward is yet to be determined) was the discovery of implements and objects of supposed human origin, or which bore a supposed artificial character, alleged to be evidence of man's existence in the tertiary period. The first report in this direction was by Mons. J. Desnoyers who, on June 8, 1863, presented before the Academy of Sciences at Paris, certain fossil animal bones and pieces of wood, from the quarries of sand and gravel at Saint Prest, near Chartres, France, which were believed to belong to the pliocene formation, whose marks, imprints and striæ were such as could have been made by man and were, therefore, said to be evidence pointing towards his existence in that period. In 1867 the Second Congress of Archeology and Prehistoric Anthropology met at Paris and was largely occupied over a presentation of, and discussion upon the evidences of tertiary man. Mons. L'Abbé Bourgeois presented a series of flint objects which were so chipped or broken as to appear to have been done by man. Other objects were presented by various persons, all alleged to have a bearing upon the main question and tending to establish the existence of man in the tertiary period. These were of different materials: bones cut or marked, teeth or bones drilled, wood and bone carved or gnawed, etc., until a rather

extensive series of objects was gathered and which, if their finders could have successfully maintained, would have gone far toward the establishment of the existence of man in the tertiary period.

Professor Capellini found the fossil rib-bones of a whale in the tertiary deposit at Monte-Aperto, Italy. These ribs had evidently been cut with a sharp knife or tool and might easily have been done by man. There was no attempt at engraving, only certain kerfs across the ribs. Professor Capellini presented his discovery to the Academy of Lincei at Rome, and before the Congresses of Archeology and Prehistoric Anthropology at Budapest in 1876, and at Paris in 1878. I had the pleasure of examining these specimens in the Museum of the University of Bologna, and was much impressed with the contention of Professor Capellini.

Dr. Arturo Issel, one of the leading scientists of Genoa, joined the advocates of tertiary man before the International Congress of Archeology and Prehistoric Anthropology in 1867, by the presentation of a human skeleton, or a portion of one, found at a depth of ten feet in the blue clay, said to have been of pliocene formation, near Savona, Italy. The skeleton was discovered by other persons and had been distributed and portions lost, so that only certain members came to Dr. Issel. There were no other animal bones found in the deposit, but many fossil shells which undoubtedly belonged to the pliocene. If the skeleton was contemporaneous with the original deposit it would be good evidence of the existence of man during that period. Four human skeletons were found at Castenedolo, Italy, by Professor Ragazzoni, then searching for fossil shells. The deposit was determined to belong to the pliocene, or at least to the tertiary.

There were throughout western Europe, perhaps a dozen more instances of objects

alleged to be human or related to human, found in tertiary deposits. The principal of these, and that which obtained the greatest prominence, was the discovery of Abbé Bourgeois at Thenay near Pontlevoy (Loire-et-Cher). Among other reasons for the prominence of the discovery of Abbé Bourgeois was the fact that the discovery was near his own residence, where he could give it much of his personal attention; and he was able to attend many or all of the scientific meetings, whether of archeology, geology or paleontology, wherein the subject would find interested auditors, with many opportunities for the presentation of the subject. From the year 1867, when his discovery was presented to the International Congress of Archeology and Prehistoric Anthropology at Paris, until 1883, before the Association Française at Blois, he kept up an aggressive warfare. The deposit at Thenay was agreed to belong to the tertiary, and it had not been disturbed; therefore, if the objects were made by man, they would be evidence of his existence at the time the deposit was made. They were all of flint and had evidently been worked; whether naturally or artificially was the important question. Some had been crackled as though by fire, and others had been chipped as though by man. I have three of these pieces of flint in the Museum at Washington, and am free to confess that, had they been found under conditions ordinarily possible to prehistoric man, I should have no hesitation in accepting them as artificial. The presentation of these flint objects before the various archeological Congresses created great interest and begat much discussion. At one, that in Brussels, an international committee of fifteen members was appointed to investigate the question and make report. The committee divided, as might have been expected. Eight members were of opinion that the pieces of flint were artificially

chipped: DeQuatrefages, Capellini, Worsaae, Englehardt, Augustus W. Franks, Valdemir Schmidt, D'Omalius and Cartailhac; * five members were opposed: Steenstrup, Desor, Neirynck and Fraas; Marquis de Vibray was favorable but with reserve, and Van Beneden unable to decide.

It will thus be perceived that the question was difficult to determine, and much could be said on both sides. If the opposing forces of learned men who, on the ground, marching in the presence of each other and of the objects themselves, and, as at Blois, with the deposit whence the objects came, under their eyes, were still unable to determine the question, it would be venturesome for us to attempt it. Since the meeting at Blois, there has been but little discussion of the flints from Thenay. It would seem as though neither party was convinced by the other, and both were content to maintain their former opinions and cease the discussion. Sir John Evans revived it after a fashion in his presidential address before the British Association at Leeds in 1890, wherein he took opposite grounds.

Discoveries similar to that of the Abbé Bourgeois were made by M. B. Rames, a distinguished geologist of Aurillac, at a locality called Puy Courney near Aurillac; by Charles Ribeiro near Lisbon, Portugal; and by Joseph Bellucci of Perugia, at Otta, Monteredondo, Italy. They all fall into the same category and received the same treatment. In the conclusion to be awarded to the existence of man during the tertiary period, they stand or fall together.

Pithecanthropus—Dubois.

The presentation of this branch of my subject would be incomplete without a reference to the great discovery made by Dr. Dubois at Tinil, Java. Dr. Dubois is

* Mons, Cartailhac changed his opinion, but not until several years afterward.

an educated physician, a graduate of the Leyden University, interested in prehistoric anthropology, with a sufficient knowledge of geology and paleontology to enable him make satisfactory investigations in the field. He was attached to the Dutch army as a medical officer, and with it sent to Java. He lived there for six years, and having found a deposit of fossil bones at Tinil, prosecuted his researches therein for three summers with great success. During this work he found certain portions of a skeleton which, if not human, was nearer it than was any other. Dr. Dubois has published a preliminary report of his discovery containing a section and plan of the field of his explorations, and photographic copies of the human (?) remains. When this publication appeared and fell into the hands of the physical anthropologists, whether of Europe or of America who, by their knowledge of human and comparative anatomy, were the best qualified to judge, they almost universally settled the question to their own satisfaction in the shortest and easiest way, by the decision that the remains were human and that Dr. Dubois had done nothing more than discover an ancient graveyard. There were few persons in the United States prepared to combat this view. Professor O. C. Marsh visited Leyden in attendance upon the International Congress of Zoology, September, 1895, and upon his return announced that this was a much graver question than had before been recognized.

I had the gratification of visiting Dr. Dubois and seeing his collection. Like Professor Marsh, I was amazed at the showing made. He had, in his laboratory, many thousand pieces of bones from the deposit at Tinil. They were all fossilized, their weight was greatly increased, and their color much darkened, while the human (?) bones had an identical appearance, and it was evident that they came from the

same deposit and were the same age. It is the accepted conclusion on every hand that the bones and deposits belonged to the tertiary period; what particular epoch, I am not prepared to say.

The dilemma presented by the discovery of Dr. Dubois in relation to the antiquity of man is that, if the bones are really those of a human individual, it carries the antiquity of the human species back to the tertiary period. If the individual is not human, because the deposit of the tertiary period is too early, then he must have been the precursor of man and, so the 'missing link.' This dilemma must be recognized and the conclusion made harmonious. Darwin would have accepted this as a representative specimen of his 'missing link.' De Mortillet was of opinion that the animal that chipped the flints of Thenay was not man, but his precursor, which he named 'Anthropopitheque,' or 'Anthropopithecus.' Dr. Dubois has the same idea or theory with regard to the man of his discovery, and he has given it the name 'Pithecanthropus erectus.' The discussion over tertiary man or man's precursor, remains in abeyance. Each of the two parties holds to his respective opinions, *pro* and *con*, and the question awaits further developments.

Neolithic and Bronze Ages Continuous.

If there was a belief in an hiatus between the Paleolithic and the Neolithic ages of Europe, there was no belief in an hiatus between the Neolithic period and the age of Bronze. It seems conceded that there was no appreciable difference in the races of people in western Europe in these two ages. It is also conceded that the stage of culture continued in both practically the same; that all or most of the industries of the Neolithic period were continued into the Bronze age, subject, however, to the natural improvement which came with added experience. The differ-

ence between the two ages, then, was the increased facility in performing the function of civilization by reason of having cutting implements of bronze instead of those of stone. The making of bronze was evidently a human invention and has little or nothing to do with a difference in race, nor beyond the benefit or improvement made by the invention, has it much to do with a change in culture.

Copper was easily procured throughout Europe, and implements of that metal were made in neolithic times and doubtless continued to be made in the Bronze age. But the advent of bronze was a totally different affair. Copper did not require casting; it might have been hammered into the desired form and so made into implements, but the knowledge of melting and casting was indispensable to the age of Bronze. Bronze is a mixture of copper and tin in the proportion of eight or nine parts of the former to one of the latter. The question whence came the bronze which was so plentiful throughout Europe has always been one of the problems of prehistoric archeology. The tin necessary for making bronze appears to have come from the country around the Straits of Malacca. The methods of its migration or transportation to Europe, whether the tin was brought over, whether it was melted, mixed with copper and then brought over, both being in the form of ingots, or whether it was cast into implements and then distributed, are facts absolutely unknown, and they probably will always remain so. Prehistoric bronze objects have been found in southern Asia and throughout Europe. The excavations of Dr. Schliemann into the Hill of Hissarlik brought many of them to light. Foundries have been discovered in most European countries; in France nigh a hundred, the latest by Mons. Paul du Chatelier in Brittany. The most extensive one yet found was that at Bologna, Italy. It contained the metal

in all stages of preparation for casting, together with molds and crucibles ready for use. There were (14,000) fourteen thousand pieces of bronze, some in ingots but most of it in wornout implements broken into small pieces suitable for the melting pot.

Epochs of culture in the age of Bronze have been manifested by improvements in style in the hatchets of Southern Europe and the fibulæ of Scandinavia.

Physical Anthropology.

Physical Anthropology, which includes Somatology and Physiology, has received considerable attention at the hands of some of the European anthropologists. Naturally, these sciences are studied at immense disadvantage when confined to prehistoric man, therefore, it has been extended to include savage peoples, and many of the most ardent anthropologists of Europe have studied the somatology and physiology of the savage in the endeavor to obtain even reflected light or knowledge in regard to prehistoric man. There had been a number of skeletons of prehistoric man found throughout western Europe. The instances are rare and isolated where specimens have been found of paleolithic man. The evidence has not always been harmonious, nor has it always pointed in one direction. The Neanderthal skull has been assumed as the representative of the oldest race. Probably a dozen other specimens of human skeletons, or fragments thereof, have been found, all of which are claimed to have belonged to paleolithic man. The following are the best known: Constadt, 1700; Lahr, 1823; Engis, 1833; Denise, 1844; Neanderthal, 1856; Olmo, 1863; Naulette, Furfooz, Solutr , Cro-Magnon, Engischeim, Savona, 1865; Aurignac, Laugerie, Brux, 1872; Mentone, 1872-75; Spy, 1886. Those of the Grotto of Spy, in Belgium, are the best identified and authenticated.

The conclusions to be ventured are, that paleolithic man had a dolichocephalic skull with prominent frontal sinuses; he was short in stature but had heavy bones with strong muscular attachments. He was prognathous, with large and strong projecting teeth which were unusually sound. He had habitually three molar teeth. His legs were crooked, and it has been doubted whether he regularly assumed an upright position.

The human remains found in the caverns, still paleolithic but of the later epochs, indicate an increase in height, size and symmetry. It has been supposed, from comparison of osteologic evidence from the caverns, notably with the Cro-Magnon skeleton, that the Berbers of North Africa and the Guanches of the Canary Islands represent a similar ethnic type.

The neolithic man had a skull more brachycephalic. He was not so prognathous as was paleolithic man; his forehead was higher and squarer, and his brain capacity greater; his teeth were less projecting and not so large as those of paleolithic man. The conditions of human burials in prehistoric times were not advantageous for the present study of the somatology of the individual. The paleolithic man rarely buried his dead, and when he did the preservation and discovery of the skeletons have been largely accidental. The neolithic man buried his dead in great ossuaries and frequently, if not always, subjected the individual to a second burial after the integuments had disappeared. The immediate and direct result is that modern discoveries of these ossuaries find the bones pell-mell, and we are unable to identify those of individuals.

Classification of Races.

Unable to obtain sufficient specimens to enable them to master the science in its relation to prehistoric man, the students of

somatology have, as already suggested, extended their investigations to modern peoples, primitive and savage, hoping for two results: one, incidentally a knowledge of these peoples *per se*, and the other to obtain by comparison a better knowledge of prehistoric peoples. This investigation induced classification of races which have run into infinitesimal details.

There has been much striving among anthropologists for a satisfactory classification of the human race. The item in this classification which seems to have been received with most favor is determined by the cephalic index. This is the ratio between the extreme length of the skull as compared with the extreme breadth, and this compared with the extreme height. Various subdivisions have been made and various names given: dolichocephalic the long-headed; mesocephalic, medium, and brachycephalic, short-headed. Other schemes are according to the character of the hair, running through lophocomi (tufted), ericommi (fleecy), euplocomi (curly), and euthycomi (straight). Still another classification was that of the dental index by Professor W. H. Flower, the microdont (the lowest index), mesodont (medium), and megadont (the highest dental index).

The earliest and possibly original scheme of classification of the human races was according to color: the yellow, white, black, to which were afterwards added the brown and the red. Probably these stand the test of experience in science about as well as the more complicated classifications.

Dr. Topinard has undertaken an investigation among the people of France by which he is to determine the color of the hair and eyes, segregated according to different departments. Virchow has done the same among the school-children of Germany, and in a late work Dr. W. Z. Ripley, of Columbia University, New York, has reported and published sundry investigations

in some of the countries of western Europe, classifying and separating the peoples according to color of skin, hair and eyes, of the cephalic index, of height, and other physical characteristics. Such a work as his applied to the native races of America would be new and original and a valuable contribution to the science of anthropology. Dr. Washington Matthews made such an investigation of the early occupants of the Salado Valley, Arizona.

Darwin's discovery of the origin of the human species by evolution from lower forms of animals, created an interest in the antiquity of man different from that of archeology. It required a knowledge of zoology and of human and comparative anatomy, and involved a study of anthropology in its subdivisions of somatology, physiology and psychology, involving the physical and intellectual characteristics of man. Based upon this necessity, the various schools and societies of anthropology were organized in many of the great cities of the world, notably Paris, London and Berlin.

The organization of these societies and the investigations involved brought to the front a set of scientists totally different from those who had before been studying archeology.

Broca, in Paris, stood near the head of these, followed by Manouvrier and Topinard; Gosse in Geneva, Huxley and Tylor, Biddoe and Keane in England, Virchow and Bastian and Meyer in Germany, with Mantegazza and Sergi in Italy. The family Bertillon, consisting of the father (now dead) and his two sons (successors), were the discoverers and inventors of the science of anthropometry in its adaptation to prehistoric man. The races of men had been studied before, and the general divisions were those of color. Anthropometry gave an additional interest to this branch of the science and it ran riot, making subdivisions on the bases of infinitesimal details. This was pressed to such a point

that one ardent investigator found sufficient difference in the human species as that he subdivided it into 172 races.

Anthropology the Science of Man.

Anthropology was defined to be the science of man, and included everything relating to man, his physical, intellectual, psychologic characteristics; and these extended through all ramifications.

Subdivisions of Anthropology.

Some scientists, chiefly the French, have proposed to confine the term 'Anthropology' to the physical structure, but it is deemed better to include within it everything pertaining to man, making the various subdivisions as represented by the minor sciences, even though they might be treated independently. The following is little more than suggestive:

Biology and comparative anatomy.	Architecture and fine art
Human anatomy.	—Continued.
Anthropometry	Cliff or cave dwellings.
craniometry.	Towers, ruined or otherwise.
Comparative psychology.	Engraving.
Literature, language	Painting.
(written, oral, sign).	Sculpture.
Religious creeds and	Ceramics.
cults.	Decoration.
Industry.	Ornamentation.
Materials and imple-	Sociology.
ments of every craft.	Love and marriage,
Clothing and personal	child-life.
adornment.	Social organizations,
Habitations, and house-	customs, and beliefs,
hold utensils.	pastimes.
Weapons. Pottery.	Tribal organization.
Objects for amusement.	Government, property,
Articles, uses unknown.	law, etc.
Architecture and fine art.	Mythology, folklore.
Monuments and public	Education, relief and
works.	charities.
Roads, trails, canals,	Mortuary customs and
irrigating, etc.	furniture.
Mounds—sepulchral,	
effigy, altar.	
Forts and earth-w'ks.	
Graves and cemet'ies.	
Idols and temples.	

The subdivisions made by the Society of Anthropology of Paris, as set forth in the course of lectures given by its professors during the present year, are as follows: Prehistoric Anthropology, Anthropometry and Embryology, Ethnology, Biology, Language and Ethnography, Sociology (history of civilization), Zoologic Anthropology, Geographic Anthropology, Physical Anthropology.

The Society might not accept the foregoing as a correct or complete subdivision of the science. Other branches may be added on the employment of more professors.

The Society of Anthropology at Washington has, during the past year, made the following rearrangement of sections according to what was deemed proper in matter and terminology:

Section A. Somatology,

" B. Psychology,

" C. Esthetology,

" D. Technology,

" E. Sociology,

" F. Philology,

" G. Sophiology.

It will be understood from the foregoing that the subdivisions cannot be made on hard and fast lines, but are susceptible of infinite changes and varieties. It would be scarcely possible for any one to master all these sciences and so become a perfected and all-round anthropologist. Classification, however, is largely a matter of definition; the material facts remain the same. The field of any particular science is well-understood, whatever name may be given or to whatever classification it may belong, and it is not worth while to engage in extensive discussion of any particular classification or the nomenclature or terminology of any of these sciences. It is deemed more satisfactory to group them all under the generic name of 'Anthropology.' This plan has been pursued generally in the Societies of Anthropology and in the edu-

educational organizations where it is pretended to be taught.

United States.

It is my duty on this occasion to give some expression to this subject in its relation to America or to the Western Hemisphere. The length of this address precludes an exhaustive examination. The student or reader might, before proceeding further, read the address delivered before this Section, the first by Dr. Daniel G. Brinton* at New York in 1887, the title being 'A Review of the Data for the Study of the Prehistoric Chronology of America'; and the second that of Dr. C. C. Abbott at Cleveland in 1898, the title being 'Evidence of the Antiquity of Man in Eastern North America.'

The conditions under which the beginnings of our knowledge of prehistoric man were made, were quite different in America from those of Europe. In western Europe the historic period began with the invasion of Caesar, fifty or more years before the Christian era, and the prehistoric period with which we have had to deal came to a close about that time.

On the contrary, in America the prehistoric period continued until the discovery of the country by Columbus, and its subsequent occupation by the white man who was thus brought face to face with the prehistoric man. The superstitions, myths and folklore concerning stone hatchets and flint arrow heads so prevalent in western Europe, had no place in America. It was useless to talk to the white man of the heavenly origin of the stone hatchet or the flint arrow head, when he knew by the evidence of his own senses that these were the implements and weapons of the prehistoric savage with which he had to deal.

THOMAS WILSON.

U. S. NATIONAL MUSEUM.

(To be concluded.)

* Died at Atlantic City, July 30, 1899. Resolutions of condolence were adopted by Section H at the meeting after the delivery of this address.

*CHEMISTRY AT THE AMERICAN ASSOCIATION
FOR THE ADVANCEMENT OF SCIENCE.*

As has been the custom for several years, the American Chemical Society united with the Section in its meetings, the program on Monday and Tuesday being in charge of the Society and on the other days in charge of the Section. This has resulted very favorably to both parties and never more so than this year when over fifty papers were on the program and the attendance of chemists has been only once if ever surpassed.

The address of the Vice-President, Dr. F. P. Venable, on 'The Definition of the Element,' has already been published in this JOURNAL.

On Monday morning after the adjournment of the general session of the Association, several reports of committees were read. The most important was that of the Committee of the Chemical Society on Coal Analysis. This was presented by W. A. Noyes, the chairman of the committee and was the final report, and took up chiefly the matters of sampling and of moisture. Much discussion was elicited. The reading of papers began on Monday afternoon and continued until Thursday afternoon, when the Section adjourned.

A number of the papers read presented special interest in the field of inorganic chemistry. One of these was by W. R. Whitney on the nature of the change in chromium salts from violet to green on heating. It has of late been quite generally recognized that the chromium salt, say the sulfate, is decomposed on heating its solution into free acid and a more basic salt. The hitherto unsolved problem has been to determine the amount of free acid formed. This Mr. Whitney solved in a very ingenious manner. By enclosing the salt between gelatine walls in a U-tube the acid is made to diffuse, under the influence of an electric current, completely into the jelly,