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RECENT PROGRESS IN THE STUDY OF EARLY MAN[1]

By Sir ARTHUR SMITH WOODWARD

WHEN meeting in East Anglia it is appropriate that the Section of Anthropology should devote some special attention to prehistoric archeology. In this part of England, as long ago as 1797, John Frere made the first scientific observations on Paleolithic implements which he had dug out of a superficial deposit at Hoxne. During recent years J. Reid Moir has excited wide interest by his discoveries of the oldest known stone implements which he has collected with remarkable zeal and discussed with acute observation. Here also arose the "Prehistoric Society of East Anglia," which has been so well supported during its career of over twenty years that it has gradually widened its sphere until now it becomes the "Prehistoric Society" devoted to advances in its subject in all parts of the world. We are, indeed, now confronted with problems much greater than those which the pioneers in western Europe dealt with, when they were laying the foundations of research in prehistory. Traces of men who lived before the dawn of history in widely separated parts of the earth's surface have been discovered in increasing abundance during recent years; and a study which at first was more or less local has now become one of world-wide scope.

Among the several branches of science which contribute to our understanding of the subject, those of paleontology and geology are of considerable importance. Dr. Friedrich E. Zuener has recently demonstrated this by his valuable paper on the Pleistocene chronology of central Europe in the *Geological Magazine* for August, 1935. The period of man's existence on the earth has been so short that there has been no appreciable evolution among the mammals associated with successive human races; but many migrations and extinctions are observable, so that these mammals can often be used for determining the relative ages of the

[1] Address of the president of the Section of Anthropology, British Association for the Advancement of Science, Norwich, September, 1935.

isolated deposits in which human remains and implements occur. In some cases also the mammals are probably enough to show the nature of the climate and the local conditions under which they lived. The contemporary geological changes, though small, likewise help in explaining migrations and perhaps some extinctions; while the peculiar circumstances of the Great Ice Age, under which early man flourished in the northern hemisphere, varied so much from time to time that they have been used in forming a plausible chronology. As a paleontologist and a geologist, therefore, I propose to discuss some of the latest developments of prehistory.

It has long been recognized that the earliest men of which traces have been found in Europe did not originate on this continent but were immigrants from some other region. Western Europe, at least, was a kind of refuge to which successive races retreated. It is thus important to examine the numerous associated mammals to ascertain whence they came; for most of these mammals seem also to have been immigrants to Europe just before or during the Pleistocene period when man began to live here, and they may give a clue to his origins.

Sir W. Boyd Dawkins was one of the first to take a broad view of the mammals which accompanied the successive races of early man in Europe, and he eventually published a map to illustrate their mixed origin. In addition to some which were already in the middle of the European continent, others seemed to have come south from the Arctic regions, others had passed directly west from the middle of Asia, while a few could only be explained as having come north from Africa over old land bridges to Gibraltar and southern Italy. These mammals might not all have lived together, but they at least showed how varied were the routes open to the movements of primitive men.

It now appears that the tracing of the warmer types of mammals to an African source was a mistake. It was due to the erroneous reference of certain fossil elephant teeth from Spain and Sicily to the existing African species, and to the wrong idea that the dwarf elephants found fossil in Malta were closely related to the same species. It was also supported by the fact that the cave hyena of Europe proved to be identical with the spotted hyena, which at present lives only in Africa to the south of the Sahara. Recent researches seem to have proved that during the Pleistocene period there was no direct communication between Europe and Africa, either through Gibraltar or through Sicily or Malta. Geologists are satisfied that certain shells which are characteristic of northern seas could not have entered the Mediterranean to be found there in Pleistocene sea beaches if the Straits of Gibraltar had not been opened. Others have remarked that among the numerous remains of mammals which occur in some of the caves at Gibraltar, there is nothing distinctly African. Dr. Raymond Vaufrey has more recently examined the fossil mammals and stone implements found in the caves and other Pleistocene deposits of Sicily and Malta, and he shows clearly that although these islands were connected with Italy at the time, they never had an extension to Africa.

The supposition that Sicily and Malta are remnants of a former land bridge between Europe and Africa has been so widely accepted that Dr. Vaufrey's conclusions need to be emphasized. There is no doubt that the fossil elephants found both in Sicily and Malta are dwarf forms of *Elephas antiquus,* which was widely distributed in Europe in early Pleistocene times. The fossil hippopotamus of these islands may also have been derived from the species which had already reached southern Europe in the Upper Pliocene. All the fossil mammals, indeed, have European or Asiatic, not African affinities. Associated with them there are no traces of Paleolithic man, such as must have occurred had the islands been a route for migration between Europe and Africa. I agree with Dr. Vaufrey that the two fossil human molar teeth from Malta which have been referred to Neanderthal man are of both doubtful age and uncertain relationship. No Paleolithic implements have been found in Malta, and only very late Paleoliths occur in Sicily above the deposits in which the remains of dwarf elephants and hippopotamus are met with. The earliest stone implements in Malta are Neolithic.

The latest discoveries of fossil mammals in the caves of Palestine and Syria, as interpreted by Miss Dorothea M. A. Bate, show that during the early half of the Pleistocene period, Asia and north Africa were much more closely connected than they have been since. The country was comparatively well watered, with luxuriant vegetation and forests, and mammals could readily migrate both east and west. Even so characteristic an African animal as the wart-hog (*Phacochoerus*) was then living in Palestine. The connection of Asia with Africa was thus as definite as that with Europe; and the explanation of the partial identity between the Pleistocene mammals of Africa and Europe is probably that they had a common source in Asia and diverged west in two different directions, one southwards, the other northwards.

This conclusion is supported especially by the apparent origin and former distribution of the spotted (or cave) hyena, *Hyena crocuta.* In the Pliocene deposits of the Siwalik Hills in northern India, there are jaws and other remains of hyenas which are not quite *H. crocuta* but may well represent its ancestors. By the Pleistocene period the typical *H. crocuta* was already in existence in India, as shown by a tooth dis-

covered in the Karnul caves, Madras. Remains of the same species have also been found in Pleistocene deposits in central Asia and even in China. They are likewise widely spread over Syria and northern Africa, where only the striped hyena (*H. striata*) lives to-day. *H. crocuta,* therefore, is not an African animal. It originated in Asia, spread thence in different directions in the Old World, and has survived only in southern Africa, which is at one extremity of its former wide range.

The origin of the lion is not so clear, but as it still lives in Asia and was widely spread there until recent times, it is at least as much an Asiatic as an African mammal. The same may be said of the leopard and the caffer cat, which are also found sometimes among the European Pleistocene mammals. As the tiger of Asia is still as characteristic of temperate regions as it is of the tropics to which it seems to have migrated only within comparatively recent times, and as the finest examples occur in the Altai Mountains, the original home of the great cats is probably in the north. The fine cave lion of Pleistocene Europe, therefore, seems to have lived under congenial conditions, though they were very different from those under which the African lion exists to-day.

The hippopotamus, which is also at present an African animal, arrived in Europe probably before man, but it survived during the early part of the Pleistocene period when man was here. Even if it did not originate in Asia, it was in India nearly in its present form when the Siwalik rocks were deposited. It may therefore have reached Europe from Asia; and recent discoveries in the caves of Syria show that it was also widely distributed in the direction of Africa. The occurrence of the animal in Europe, even so far north as Yorkshire, has generally been regarded as proving that mild conditions, with open waters, prevailed over Europe when it lived here. A few years ago, however, Marius Maxwell found in the Lorian Swamp of Kenya Colony a peculiar race of hippopotamus which existed in a region of scrub out of reach of water in which it could habitually swim. The Pleistocene hippopotamus of Europe, therefore, may have been adapted to unusual conditions of life.

It is interesting to observe, in conclusion, that none of the characteristically African antelopes occur among the European Pleistocene fauna. Remains of the gazelle have been found, but this animal is as much Asiatic as African. The Saiga antelope and *Nemorhoedus,* which are Asiatic to-day, the one living on steppes, the other on mountains, are the only other antelopes which reached Europe in Pleistocene times; and *Nemorhoedus* seems to have been the ancestor of the little rock-climbing *Myotragus,* which is now extinct, but has been found in caves in the Balearic Isles and perhaps in Sardinia.

The Pleistocene mammals of Europe, therefore, show that when they flourished on this continent, the only direct land communication was through Asia. The earliest races of men must have reached western Europe by that route; and as a succession of stone implements, remarkably similar to that which is now so well known in Europe, has already been found with early Pleistocene faunas in Africa, it might at first be supposed that there were parallel migrations of the same men from the Asiatic to the African continent. Implements, like languages, however, afford no certain clue to the races which made and used them, and the same tools must have been invented independently more than once. As the late Sir Baldwin Spencer remarked, "In Australia we have in use at the present day a practically complete series of stone implements, representing all the various stages of culture known in prehistoric Europe," yet all these implements are the handiwork of a single race of modern man, *Homo sapiens,* at one and the same time. It is therefore unfortunate that hitherto no human remains have been found in undoubted association with any of the earliest implements and Pleistocene mammals in Africa. Two years ago a committee of geologists which met in Cambridge expressed itself as satisfied with evidence which Dr. L. S. B. Leakey submitted in order to prove that he had discovered modern types of human skull and lower jaw with very primitive implements and early Pleistocene mammals in Kenya Colony. In fact, it appeared as if the same types of implements in the same geological stage in Europe and Africa had been made by two distinct genera of men. Quite lately, however, Professor P. G. H. Boswell, under the guidance of Dr. Leakey, has examined the geological formations in the region where the discoveries were said to have been made, and he is now convinced that there is no proof of the association which has been claimed. The human remains in question seem to have been obtained from disturbed deposits and may have been buried at a comparatively recent date. With later types of stone implements and remains of modern mammals, the only satisfactory fragments of the human skeleton which have hitherto been found in Africa belong to the genus *Homo.* Many of the fossil forms are related to the surviving South African bushman, and if any of these passed directly from northern Africa into Spain, as has sometimes been supposed, they must already have learned to make rafts by which they could cross the Straits of Gibraltar.

The only fossil hitherto discovered in Africa, which suggests that that continent may have produced man,

is the immature skull from a deposit of uncertain age (probably Pleistocene) at Taungs in Bechuanaland, which was named *Australopithecus* by Professor Raymond A. Dart in 1925. It belongs to an ape and seems to exhibit more human characters than the skull of any of the existing apes; but Professor Dart's complete account of the fossil has unfortunately not yet been published.

The earliest known jaw of an ape, *Propliopithecus,* was discovered long ago in the Oligocene of Egypt, and numerous jaws of apes related to the existing chimpanzee are now being found in the Miocene of southeast Africa. Equally abundant, however, are the jaws of apes in the Mio-Pliocene deposits of northern India, and some of the teeth preserved in them exhibit a remarkable approach to those of man. I still think, indeed, that according to our present knowledge the links which connected apes with man are most likely to be found in south-central Asia. As the late Joseph Barrell pointed out, the east to west ridge of the Himalayan Mountains was gradually raised up at the time when northern India was covered with a great forest which swarmed with apes of many kinds. The formation of the ridge separated off a northern portion of the forest which became subject to comparatively inclement conditions. The apes stranded in this northern portion would be disturbed by the extensive destruction of the trees, and the survivors would be driven to be ground-apes and change their habits of feeding. They would thus be modified in the direction of man. Regarded from the zoological point of view, of course, man is an arboreal mammal which has left the forest. His remote ancestors, by continuing to live in the forest, preserved their jaws, teeth and limbs nearly on the primitive mammalian plan, while the brain alone made progress; and, as Dr. H. S. Harrison has remarked, if there had been no trees during the Tertiary era, man would probably not have appeared in his present form.

These considerations, with the geographical distribution of the few oldest known remains of fossil man, led the late Dr. Davidson Black to make plans for a systematic examination of the later Tertiary deposits of south-central Asia. In 1925 he reviewed the whole subject in an important paper published by the Geological Society of China. In the summer of 1932 he actually traversed a route from eastern China, through northern India, to Syria and the western coast. Dr. Black, unfortunately, did not live to see the realization of his project, but we are glad to learn that Father P. Teilhard de Chardin will take his place in researches beginning in India this autumn.

It is very interesting to notice that if central Asia was actually the region in which the human family originated, the few known fragments of the oldest fossil men are distributed geographically just as a paleontologist would expect them to be. The late Dr. W. D. Matthew pointed out that if each race of animals evolved at a single center, a succession of waves of increasingly advanced genera must have radiated outwards from that center. The latest and highest types would be found at the actual place of evolution, and they would be surrounded by rings of less advanced types of lower and lower degree until the lowest would occur at the outer limit.

The fragments of the oldest fossil men hitherto discovered are indeed very few, but although allowance for negative evidence may cause some hesitation, it is at least noteworthy that they are all on the periphery of the Euro-Asiatic continental area. *Eoanthropus* and Heidelberg man were found on the western margin of Europe, *Pithecanthropus* at the southern margin of Asia, and *Sinanthropus* close to the eastern coast of Asia. If human types were evolving near central Asia, the places of these actual discoveries are in a distant partial ring round the source.

It is, of course, impossible to be sure that all the primitive men just mentioned were living at approximately the same geological period. They date back to a time evidently before burials, and three of them were found in river deposits, while the fourth was met with under peculiar conditions in a cave. If, however, the geological and paleontological arguments for their correlation be considered, I think it will be agreed that they must have been nearly contemporaneous. The geological age of *Eoanthropus* from Piltdown, Sussex, is perhaps the most difficult to determine, because it was found in a flood-deposit which contains mammalian remains and flint implements of more than one stage at the end of the Pliocene and beginning of the Pleistocene periods. Attempts have been made to sort the fossils according to their color; but the varied staining has no special significance, owing to the irregular distribution of the different ferruginous materials in which they were buried. The color of the first pieces of the skull of *Eoanthropus* itself, indeed, were altered by Dawson, who dipped them in bichromate of potash with the intention of hardening them.

Notwithstanding the difficulty of interpreting the discoveries at Piltdown, I think there is no doubt that the skull of *Eoanthropus* is of the same age as the river gravel itself. It is not water-worn, and the brain-case, the delicate fragments of the face, the half of the lower jaw and the canine tooth were lying separately in four different places, all close together. If these remains had been transported far, and especially if they had been washed out of an earlier deposit, they would not have been associated in this way. Two lower teeth and a piece of the lower jaw of a typically

Pleistocene beaver, found isolated, also seem to be contemporaneous with the gravel; and two teeth of the ordinary Pleistocene *Hippopotamus* appear to be in the same state of mineralization, and are likewise not water-worn. Very similar are the base of an antler of a red deer (*Cervus elaphus*), which is characteristically post-Pliocene, and a piece of the metapodial of a small deer which has evidently been broken and scratched by man. Most significant of all the fossils which are obviously contemporaneous with the gravel and the human skull, is a piece of bone, 16 inches long, which has been worked by man nearly into the shape of the blade of a cricket bat. Direct comparison shows that this piece was flaked from the middle portion of an elephant's femur which was about 5 feet in length. It, therefore, represents an elephant larger than the mammoth of Middle Pleistocene and later date, and doubtless belongs to one of the gigantic Lower Pleistocene elephants, such as *E. meridionalis* or *E. antiquus*.

Highly mineralized and water-worn fragments of teeth of *Mastodon* and *Rhinoceros* (probably *R. etruscus*) are exactly like the fossils from Pliocene crags of eastern England and must have been washed out of a local Pliocene deposit which has been completely destroyed. With them may also be associated some broken fragments of a much mineralized tooth of *Elephas,* which most resembles the Upper Pliocene *E. planifrons*. The fossils clearly contemporaneous with the gravel and with the skull of *Eoanthropus,* therefore, represent a Lower Pleistocene mammalian fauna; while the more highly mineralized fragments have been derived from an earlier formation.

If this mammalian fauna be compared with the fossil faunas occurring in the terraces on the sides of the valley of the Thames, it is found to agree best with that in the "High Terrace," which remains from 80 to 90 feet above the present level of the river. This terrace, which is obviously older than the "Middle Terrace" where the mammoth and woolly rhinoceros are found, is generally admitted to date back to a warm episode at the beginning of the Pleistocene period. The Piltdown gravel with *Eoanthropus,* 80 feet above the present level of the river Ouse in Sussex, may thus be ascribed to the same remote date in the history of man.

The lower jaw of Heidelberg man, *Homo* (or *Protanthropus*) *heidelbergensis,* was found in a river deposit at Mauer, near Heidelberg, in direct association with mammals which are typically Lower Pleistocene in western Europe, though they also include at least two species which are survivals from the Upper Pliocene. In this case the mammalian remains are numerous and well preserved, so that they can be readily named. If, as I suppose, the primitive molar of an elephant at Piltdown is derived from an older formation, not contemporaneous with the gravel in which it was found, there can not be much difference in age between Piltdown and Heidelberg man.

The remains of *Pithecanthropus* were discovered in a river deposit at Trinil in Java, which is a very unstable volcanic region on the southern edge of the Asiatic continent. It, therefore seems possible to date them not only by the associated mammalian remains, but also by the fossil shells in the marine formations, both earlier and later, which now form part of the island of Java. The successive marine deposits, as might be expected, are marked by an increasing percentage of existing species of shells among the fossils. As determined by Dr. L. J. C. van Es, the river deposit at Trinil rests unconformably on a marine formation which is shown by its fossils to be of Middle Pliocene age. The gap in the geological series indicated by this unconformity is filled in other districts by marine deposits which contain 66 to 70 per cent. of existing species of shells, and may, therefore, be regarded as Upper Pliocene. Hence the conclusion that if a marine formation equivalent in age to the Trinil river deposit were found, it would contain more than 70 per cent. of existing species of shells and might thus be referred to the Pleistocene. The percentage of existing species of fresh-water shells in the Trinil deposit supports this conclusion, and as the associated land mammals (*Stegodon, Hippopotamus,* etc.) much resemble those in the Lower Pleistocene Narbada river deposits of India, *Pithecanthropus* evidently dates back to the beginning of the Pleistocene period.

The skulls and lower jaws of *Sinanthropus* were met with not in a river deposit, but in a cave which had evidently been occupied for a long period by man. They were associated with rude stone and bone implements, and even with remains of fires. The deposits in which they occurred are proved by the Chinese geologists to be older than the wide-spread loess of China, which in places contains the remains of the woolly rhinoceros (*R. tichorhinus*), and in other places the mammoth (*Elephas primigenius*). These, it will be remembered, are two of the characteristic fossils of the "Middle Terrace" of the Thames valley, which dates back to the latter half of the Pleistocene period. With *Sinanthropus* are found remains of a large extinct beaver, *Trogontherium,* and a rhinoceros very like *R. mercki,* which are specially characteristic of the "High Terrace" of the Thames already mentioned as the probable equivalent of the Piltdown gravel. If, therefore, the widely distributed mammals just enumerated were living at the extreme eastern and western limits of their range in the Old World at one and the same time, as seems most probable, *Sinanthropus* dates back to the early part of the

Pleistocene period and must have been a contemporary of *Eoanthropus*.

These facts, I think, are enough to show that in the beginning the human skull was much more varied than it is at the present day. There were, indeed, several distinct approaches to modern man before his type became fixed and persistent; just as there were parallel lines of evolution, effective and non-effective, in the ancestry of other modern mammals. That the four known examples of the earliest man were all closely related is proved by the skull of *Sinanthropus,* which exhibits a remarkable combination of the special features of the other three. In the contour of the top of the head, with the great depressed bony brow-ridges, it is so like the skull of *Pithecanthropus* that some anatomists have actually referred it (though without good reason) to the latter genus. In the fine spongy texture of the skull it agrees with *Eoanthropus,* and differs from all other known skulls of men and apes. In its relatively broad base and in the shape of the occiput, it also agrees with *Eoanthropus*. In its lower jaw and teeth, it most resembles *Homo heidelbergensis*.

It is also interesting to notice that at the east and west extremes of their range, these dawn men had attained much the same grade in the habits of daily life. *Sinanthropus* made small stone implements by the rude working of flakes, and they are as varied in shape as the implements met with in the Mousterian deposits of Europe. He cut deer antlers into short lengths and seems to have used the bases of the antlers as hammers. Bits of brain-case seem to have been made into cups; some of the upper jaws were evidently used as files, and some of the lower jaws as small picks, with the coronoid process as working tip. The long bones were often broken to extract the marrow. *Sinanthropus* was also acquainted with the use of fire, and numerous successive hearths were discovered in his dwelling place. *Eoanthropus* similarly made rude stone implements by the chipping of flakes of varied shape, and he also worked bone in such a way as to suggest that he had previously used wood. He also had hammer stones, and he split long bones, doubtless for extracting the marrow. He was similarly acquainted with the use of fire, as shown by the discovery in the Piltdown gravel of charcoal and burnt flints, which include stones indistinguishable from the "pot boilers" of later periods.

Up to the present, unfortunately, the earliest men in other parts of Euro-Asia are known only by stone implements, but these are so widely scattered that there is an extensive area which may be hopefully searched for primitive human remains. The greatest difficulty is one which I have already mentioned, the apparent absence of intentional burials.

The next stage in man's development is much better known, because by this time he had learned to bury his dead in security. As examples have been found in caves so far apart as France and Palestine, burial had doubtless become a general custom. Many whole skeletons are therefore available for study.

This stage is that of Neanderthal or Mousterian man, which is geologically the latest to retain several specially ape-like characters associated in a single individual. Its Asiatic origin is now still clearer to a paleontologist than that of earlier man. Burials in caves which seem to be approximately of the same date reveal a comparatively high Neanderthal type in Palestine, a low and bestial type in western Europe. On Matthew's principle already mentioned, the first is therefore nearest to the original source. The accompanying stone implements support this conclusion, for whereas in western Europe the implements are merely trimmed broad flakes, in Palestine there are also many narrow blades which resemble those made by later (Aurignacian) man in Europe. The Asiatic type of Neanderthal man was indeed progressing in skill to meet his increasing needs.

Since 1913 our conception of Neanderthal man has been based on the admirable description of the skeleton from La-Chapelle-aux-Saints by Professor Marcellin Boule in his classical memoir in the *Annales de Paléontologie*. This and the earlier accounts of more fragmentary remains from the Neanderthal cave in Germany and the Spy cave in Belgium have led to the prevalent idea that the type of man in question exhibited too many degenerate features, added to his ape-characters, to be the ancestor of the modern *Homo sapiens*. A few years ago, however, Dr. Aleš Hrdlička pointed out that other skulls of Neanderthal man, especially those from central Europe and the fragment found by Mr. Turville Petre in Galilee, Palestine, were less different from the skull of modern man than most of the western European examples, and *Homo neanderthalensis* might, after all, prove to be the ancestor of *Homo sapiens* if he could be traced to his source. At last, through the discoveries of Miss Dorothy Garrod and Theodore McCown in the caves of Mt. Carmel, Palestine, we seem to be approaching that source. They have disentombed a series of buried skeletons which are nearly complete; and, according to the preliminary reports on the collection by Mr. McCown and Sir Arthur Keith, they belong to a race which exhibited a remarkable mingling of the characters of Neanderthal and modern man. They seem to show us modern man in the making.

Even the latest phases in the development of stone-age man appear to have begun in Asia, as already generally admitted. It is usually difficult to distinguish the skeletons of domestic animals from those of

wild animals, but Raphael Pumpelly's discoveries in Turkestan show that domestication of several familiar animals was probably beginning there at a very early date in Neolithic times.

Until typical *Homo sapiens* had come into being, man's only outlet from Asia seems to have been by land in the direction of Europe and Africa. As soon, however, as he had attained this final stage of development he must have been able to construct rafts or boats, by which he crossed the narrow seas of the East Indies to Australia, and perhaps the equally narrow seas at Behring Straits to North America.

AUSTRALASIA

Australia is shown by its past and present animal life to have been separated by sea from the rest of the world during the whole of the Tertiary era, including Pleistocene times, and it was isolated too early to be inhabited by the ancestors of the apes. Man is therefore certainly an immigrant from overseas, and we know that he reached the country when various relatively large Pleistocene marsupials were still living there, because a fossil human skull has been found at Talgai in Queensland directly associated with their remains. This skull is essentially the same as that of the existing Australian aborigines, who have retained a mode of life like that of the latest Paleolithic hunters of the mainland. Some of the immigrants evidently took with them a semi-domesticated dog, the dingo, of which fossil remains have been found in old inhabited sites.

It is remarkable that very few traces of men who might be related to the ancestors of the Australians have hitherto been recognized in their homeland in Asia. The skulls of *Homo wadjakensis* from an old lake deposit at Wadjak in Java, discovered and described by Dr. Eugene Dubois, may perhaps be placed among them. The skulls named *Homo* (*Javanthropus*) *soloensis* more recently discovered by Dr. W. F. F. Oppenoorth in an old deposit near the Solo river in Java, seem to be intermediate between the skulls of *Pithecanthropus* and the modern Australian, though they have not yet been described in detail. As many have observed, the skull of Rhodesian man (*Homo rhodesiensis*), from a cave in northern Rhodesia, also exhibits several resemblances to the skull of the modern Australian. Other skulls dug up in South Africa have also been described as exhibiting Australian characteristics. Sooner or later, therefore, fossil ancestral types of Australians will probably be found widely distributed in the tropics of the Old World.

NORTH AMERICA

In at least part of the first half of the Pleistocene period there must have been a direct connection between Asia and North America in the region of Behring Straits. There may have been an isthmus of land, or there may have been only islands and continuous ice; but there was certainly a passage which allowed such mammals as the mammoth, bison, sheep, goat, elk, wapiti, reindeer and black bear to reach America for the first time. So far there is no evidence that man accompanied these animals, and it may be that by then he had not yet reached the northeast corner of Asia. The woolly rhinoceros similarly never passed from Asia to America, although it was abundant and widely spread through the northern lands in the Old World. Its absence from America shows that in some cases there were impediments to emigration.

The earliest traces of Paleolithic man hitherto discovered in North America date back only to the latter part of the Pleistocene period. Last year J. Dorsch, when collecting for Childs Frick, found at Fairbanks, Alaska, some small end-scrapers and conical cores, which Dr. N. C. Nelson recognized as identical with those which he had collected a few years before in large numbers in the Gobi desert. These seem to have been made by some of the latest Paleolithic men; and the only stone implements hitherto found in North America in direct association with the remains of typically Pleistocene mammals show that, when man arrived in that country, he had already learned the supreme art of trimming stone by pressure-flaking. In pattern, indeed, his implements resemble those of Solutrean man in Europe, and even include the familiar Solutrean leaf-shaped blades, besides the characteristic spear points.

The Yuma points, however, as these American spear points have been termed by Professor E. B. Renaud, of Denver, are accompanied by more elaborate points of a peculiar type which has not hitherto been found in the Old World. These are known as Folsom points, from Folsom in Union County, New Mexico, where they occur associated with the remains of an extinct species of bison. The Folsom points are somewhat elongated and pointed blades, with a truncated base which is usually a little excavated; and the middle of each face is hollowed by the skilful removal of a longitudinal flake, which allows it to be clasped by a projection from the end of the spear. These points were, therefore, hafted differently from any of those known from the Solutrean of western Europe. They show that the American late Paleolithic man evolved new ideas on the spot.

The skeletal characters of this race of man are still not known with certainty. The only human bones and teeth hitherto dug up closely resemble the corresponding parts of the surviving North American Indians, and it is uncertain whether any of them are as old as

the remains of the Pleistocene mammals with which they are supposed to have been sometimes associated. The Solutrean-like implements, however, have lately been satisfactorily proved to be contemporaneous with extinct mammals of Pleistocene age in several localities, especially in New Mexico, Texas, Colorado, Nevada and Nebraska.

Two years ago, I had the privilege of visiting one of these localities, by the kind invitation of Dr. John C. Merriam, president of the Carnegie Institution, Washington, and Dr. Edgar B. Howard, of the University of Pennsylvania Museum, Philadelphia. It was on the dry prairie between Clovis and Portales in Curry County, New Mexico. Excavations were then in progress by Dr. Howard and a party of fellow-workers, and the results have lately been described by Dr. Howard himself in a valuable well-illustrated memoir on "Evidence of Early Man in North America," published in the *Museum Journal of the University of Pennsylvania,* vol. xxiv, Nos. 2–3, June, 1935. I can appreciate and endorse his conclusions.

The locality near Clovis is in the course of an old river which deposited gravel and then dried up into a series of shallow lakes which eventually became filled with silt and sand, probably windborne. There are sand-dunes around to-day. In the sandy silt of the old lakes there are well-preserved remains of the mammoth and extinct species of bison, besides fresh-water shells which indicate a colder climate than that of New Mexico at present. There are also stone implements, including Solutrean-like blades and less elaborately worked scrapers; and in one spot the explorers found a mass of charcoal which contained burnt bones and chipped flints, evidently the remains of a contemporary hearth. Beneath the sandy silt several Folsom and Yuma points were obtained, and still further down, below the handiwork of man, there were remains of horses and camels.

In Burnet cave, near Carlsbad in New Mexico, Dr. Howard also found a Folsom point and bone awls directly associated with remains of extinct bison and musk ox, and traces of old hearths; and in Gypsum cave, near Las Vegas in Nevada, Dr. M. R. Harrington, of Los Angeles, discovered stone implements with remains of horses and camels and the small ground-sloth, *Nothrotherium,* again with the charcoal of old hearths. Several other equally clear cases of the association of human implements with typically Pleistocene mammals in the southwestern states of America might be cited, but these are enough to show the nature of the evidence which has been obtained. There can be no doubt that during the latter part of the Pleistocene period, when extensive northern ice still reduced the normal temperature of more southern latitudes, man who made stone implements by the technique which is still practiced by the modern North American Indians was very widely distributed over the continent.

It is generally supposed that a few of the typically Pleistocene mammals survived in North America to a later geological date than any in Europe. The remains of the Ohio mastodon, for example, occur in post-Pleistocene swamp deposits; and dried mummies of the little ground-sloth, *Nothrotherium,* have been found in southern caves with coprolites, which show that it fed on the same vegetation as that which still exists in the neighborhood. It seems, therefore, very difficult to determine the geological age of the earliest man in North America as compared with the successive late phases of stone-age man in the Old World. The only hope centers in satisfactory discoveries of human remains and implements in the deposits on the fluctuating edge of the northern ice-sheet.

South America

Some of the typically Pleistocene mammals in the southern part of South America also appear to have survived until comparatively recent times. Man was almost certainly associated with them, but nothing is known to distinguish this race from modern South American Indians. The supposed ancestors of the human family reported by Florentino Ameghino from the Tertiary rocks of Argentina are due to erroneous interpretation of the fossils, as already pointed out by Hrdlička and others.

The first fossilized remains of man in the South American continent were discovered exactly a hundred years ago in the caves of Minas Geraes, Brazil, by the Danish naturalist, Dr. Peter Wilhelm Lund, whose centenary has just been celebrated by the scientific men of Brazil in Lagoa Santa and Bello Horizonte. Under the direction of Professor Anibal Mattos, three volumes have been published in Bello Horizonte, giving an account of Lund's researches, with a Portuguese translation of his scientific papers. At first Lund hesitated to conclude that the human skeletons which he found in the caves were as old as the bones of extinct mammals with which they were associated: he thought they might be burials or otherwise accidentally introduced into the old deposits. In the end, however, after much experience of many diggings, he became convinced that, although the fossil skeletons were very like those of the existing Botocudos, they must have belonged to a man who was contemporary with the mammals which afterwards became extinct.

Some years ago the late Dr. Francisco P. Moreno, Dr. Rudolph Hauthal and I described the discovery of dried skin and other remains of an extinct ground-sloth (*Neomylodon* or *Gryptotherium*), with fragments of other extinct mammals, in a cave in Last Hope Inlet, Patagonia. Here again, the presence of fires,

cut and worked bone and masses of hay cut for food for the ground-sloth led us to infer that man lived in Patagonia with the various Pleistocene mammals which are now extinct.

REMOTE ISLANDS

The races of men who eventually reached New Zealand and other remote islands were so far advanced in civilized life that they scarcely concern a paleontologist. They only interest him on account of the disturbance of the existing wild life and the extinctions which they have caused. The ethnologist now joins the human anatomist in attempting to explain the distribution of these people and to discover their relationships. They occupy a lowly sphere in the modern world.

SCIENTIFIC EVENTS

INTERNATIONAL HEALTH SERVICES

ACCORDING to the Geneva correspondent of the *British Medical Journal,* the Health Organization of the League of Nations received the usual compliments during the discussions in the Assembly, both in the second committee where the work of the organization is reviewed, and in the fourth, where the budget is approved. The amount estimated in the budget of 1936 for the International Health Organization is 1,180,000 Swiss francs, or about $375,000 at the present rate of exchange. Of this sum the League contribution represents about three fourths, and the remainder is supplied by grants from the Rockefeller Foundation. The allocation which the League itself affords for health purposes is a sum about equal to the contribution it receives from Australia or Czechoslovakia. The health section consists of twenty-three posts, under a medical director, who receives a maximum salary of 53,000 Swiss francs, and eight immediate assistants, whose maximum is 28,000. The grants of the Rockefeller Foundation are made chiefly to provide the salaries of the special technical staff, which comprises a further eleven members, and is engaged in the service of epidemiological intelligence and health statistics.

A contribution of 20,000 Swiss francs annually is made by the Foundation to the Eastern Bureau at Singapore, which is also supported by League contributions and by contributions from certain Governments in the East. This Eastern Bureau has a director, two deputy directors and a staff of ten. Two considerable items in its budget for 1936 are to meet the expenses of a rural hygiene conference and an international course on malaria, both to be held in the Far East. The League is also committed to certain health and other investigations in Latin America, for which a sum of 100,000 francs has been set apart; a part of this will be devoted to the international leprosy center placed under the auspices of the League by the Brazilian Government.

During 1936 the Health Organization will pursue certain special technical studies which have been referred to it, such as rural hygiene and housing, nutrition and physical education. Its permanent tasks are the collection of epidemiological intelligence and health statistics, international studies on malariology, biological standardization, technical studies in the sphere of the campaign against narcotic drugs and general and technical liaison with the national health administrations. The discussion in the Assembly revealed a "push" in various countries towards rural rehousing. Signor Mussolini some time ago ordered a census of rural dwellings throughout Italy, and as a result 170,000 such houses have been marked for demolition, 500,000 for serious reconditioning to make them fit for human habitation and a million more for minor repairs. The Duce has declared that within ten years every agricultural laborer must be provided with a healthy and spacious dwelling. To this end a rural housing exhibition and conference is to be held next year in Rome. France also has made an extensive inquiry into the same subject. To the discussion on health organization Great Britain contributed an account of the forthcoming conference in Geneva on biological standardization, which it is hoped may give rise to concrete proposals for a wider use of the various standards prepared by the permanent commission of experts.

THE FLOWER AND FIFTH AVENUE HOSPITALS OF NEW YORK CITY

AT a meeting of the Board of Trustees of the Fifth Avenue Hospital in New York City, held on October 16, the following members of the Board of Trustees of the New York Homeopathic Medical College and Flower Hospital were elected members of the board of the Fifth Avenue Hospital: William M. Baldwin, Thomas C. Buek, Eversley Childs, Jr., Joshua B. Everett, William H. English, Charles D. Halsey, David Q. Hammond, Clifford Hemphill, James M. Hills, Henry Clay Irons, George Link, Jr., James M. Mathes, Samuel R. Milbank, George S. Piper, Robert T. Pollock, Charles Presbrey and Webster B. Todd.

This action, which follows months of quiet negotiation between the two institutions, represents the first step in developing a close affiliation. For the present, each institution through its respective boards will operate independently although along parallel lines.