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# THE SEARCH FOR MAN'S ANCESTORS

BY

PROF. G. ELLIOT SMITH

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## PREFATORY NOTE

**T**O Professor Eugène Dubois I am under a deep debt of gratitude for his account of the amazing adventure which led to the discovery of *Pithecanthropus*. For the information and illustrations relating to *Sinanthropus* I have to thank Professor Davidson Black, in whose genial company I was privileged to visit the homes of the Peking Man at Chou Kou Tien and of the Ape Man in the Solo Valley of Java. The Piltdown story was told me by the late Mr. Charles Dawson, the discoverer of the famous skull.

The Oxford University Press has kindly permitted me to reproduce two illustrations and a reference to the reconstruction of the Piltdown Skull from my book *The Evolution of Man* (1927), and Messrs. Jonathan Cape, Ltd., have allowed me to use a diagram from my book *Human History* (1930).

Parts of the account of the Peking Skull have been taken from the published report of the lecture delivered in Edinburgh under the auspices of the Henderson Trust, from the Harvey Lecture published in *The Scientific Monthly* (New York, September, 1931), and from an article in the journal *Antiquity* (March, 1931). I am grateful for the opportunity of reprinting these quotations with certain corrections made necessary by the publication of Professor Davidson Black's recent monograph in *Palæontologia Sinica*.

G. E. S.

*September 3, 1931.*



DEDICATED TO  
DAVIDSON BLACK  
IN WHOSE GENIAL SOCIETY  
THE AUTHOR FIRST VISITED  
THE THREE SITES (PILT-  
DOWN, JAVA, AND PEKING)  
WITH WHICH THIS BOOK IS  
CONCERNED.

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## The Origin of the Search

EVERYONE who lectures on the Evolution of Man is repeatedly asked, "Why have so few fossilized fragments of really primitive men been recovered?" It is the object of this little book to provide an answer to that question.

If man has occupied the earth for many hundreds of thousands of years, why, of all the caricatures of half-made men who must have roamed up and down the Old World, should there be nothing more to show than the roof of a skull and three teeth from Java (with an enigmatic thigh-bone); a massive, brutal jaw from the Mauer sands near Heidelberg; and some broken fragments of a brain-case and jaw from Piltown? During the last four years, however, there have been discovered in China more remains of truly archaic mankind than had hitherto been recovered; parts of four skulls and teeth belonging to at least six other individuals, free from the doubts as to the geological age and the uncertainties of interpretation which compromised the significance of the Ape-Man of Java (*Pithecanthropus*) and the Dawn-Man of Piltown (*Eoanthropus*). Other, but relatively much more recent, remains of extinct members of the human family have been found in greater abundance—whole skeletons of Neanderthal Man from La Chapelle-aux Saints, La Ferrassie, and La Quina in France, and important fragments from Gibraltar, Germany, Belgium, Northern Spain, Italy, Croatia, Russia, and Palestine. Then there is the intriguing skull of Rhodesian Man from Africa. In comparison with *Sinanthropus* (Peking Man), *Pithecanthropus*, *Eoanthropus*, and *Palæoanthropus* (Heidelberg Man), Rhodesian Man and Neanderthal Man are relatively recent members of the same genus as *Homo sapiens*, in contrast to those vastly more ancient members of other genera of the human family who lived in Early Pleistocene times, times that are measured in hundreds of thousands of years, instead of in the tens of thousands by which we measure the epochs of *Homo neanderthalensis* and *Homo rhodesiensis*.

To the student of anthropology the surprise is not that so few, but rather that any, fragments of the early members of the human family should have been found. Studying the circumstances under which the various fossils were actually recovered, one realizes how big an element of chance enters into the story. The miracle of the discovery of any of these precious relics appeals to his sense of the romance revealed in the great adventure of searching for our ancestry. When it is recalled how vast was the domain of primitive man's wanderings, and how few in number these nomads were, it must always remain a marvel that any of their remains should have been preserved in places where they would be found by modern men capable of appreciating their significance. We shall never know how many human fossils have been unearthed in the past, when no Dubois, Dawson, or Davidson Black happened to be present to realize the importance of the remains.

At the time when Darwin published his *Descent of Man*, comparatively little was known of the fossil remains either of men or apes, so that the discussion of the evidence of palæontology played an altogether insignificant part in his argument. Apart from the discoveries that had been made in the Neanderthal cave (1857) and at Gibraltar (1848), nothing was known of fossil man, and what little was known was puzzling rather than helpful. Little more had then been recovered of the fossil remains of apes than a few fragments of *Pliopithecus* and *Dryopithecus*.

During the sixty years that have elapsed since those times, however, the evidence of palæontology has come to play an increasingly prominent part in the discussion of human evolution, until at the present day it is the aspect of the problem that appeals most to the man in the street when the question of man's origin comes up for consideration. It is only forty years since any really early remains—of men who did not belong to the genus *Homo*—were discovered, and it is a matter of some interest to discuss the circumstances which led to the recovery of the remains of Early Pleistocene Man.

It was not until the scales were removed from men's eyes in the middle of the nineteenth century that they were prepared honestly to look at such fossils as evidence of man's ancestry or collateral relations. Even after the discoveries at Spy in 1886, when the importance of Neanderthal Man

began to be impressed upon the attention of students of human evolution, the evidence of these fossils was not given much prominence. It was the discovery of *Pithecanthropus* in 1891 that was mainly responsible for attracting attention to Human Palæontology as the most significant field of research for elucidating the evolution of man.

When in 1823 Dean Buckland found in the Paviland Cave human remains in association with fossils of undoubted antiquity, he explained the presence of men in such company by appealing to the Deluge. An earlier attempt to reconcile the progress of geological knowledge with traditional beliefs led Scheuchzer in 1726 to regard the fossilized remains of a huge salamander as "a human witness of the Deluge" (*Homo diluvii testis*) and as evidence of the authenticity of the Mosaic story! This Miocene fossil, found at Enningen, near Lake Constance, is now in the Teyler Museum in Haarlem, a perpetual witness to a futile attempt to corroborate a myth by an ignorant misunderstanding of the evidence of anatomy and palæontology.

The first half of the nineteenth century witnessed the dissipation of the traditional obstacles to a clear vision of the truth. Hence certain enlightened men were ready to begin the deliberate search for man's ancestry. As in most advances, accidental discoveries provided concrete evidence of the practicability of such a search.

If the evidence provided by flint implements convinced archæologists of the vast antiquity of man, and the discovery of fossil remains was beginning to provide anthropologists with corroboration for this inference, it was a very fortunate coincidence that these events happened when the discussion of Darwin's *Origin of Species* and *Descent of Man* was preparing the way for the creation of a science of human palæontology.

The recognition of man's kinship with the great apes provided the inspiration and the guidance for the systematic search for man's earliest human ancestors. Hence it is important not to forget the part this conviction has played in leading to the recovery of the Early Pleistocene fossils of primitive men.

When man first came into existence, and was as yet little more than a big-brained ape, he may have recognized the members of the stock from which he came as creatures like himself. Even, however, if the earliest men did not know

that apes were their cousins, there can be no doubt that ever since human beings made their way into Equatorial Africa and the Malay Archipelago they have recognized the likeness of apes to themselves. The natives of Africa gave names to the chimpanzee and gorilla which suggested that they recognized them as human beings, and those of Borneo and Sumatra referred to the gibbon and the orang-utan by words which frankly implied that they were men. The folk-lore of the countries in which apes are indigenous is eloquent of the conviction which the people entertained of the close kinship of men and apes.

The structural resemblance is, in fact, so patent, and the behaviour of creatures who use their eyes and hands as men do, provides evidence so conclusive of affinity, that even the most untutored people assume as a self-evident fact that the apes are men's near relations. It is only since men came under the sway of the superstitions their predecessors had created and became stupidly sophisticated that they have attempted to repudiate kinship with their poor relations. In the sixteenth and seventeenth centuries the stories of apes which travellers brought back from Africa and the East exaggerated the obvious human resemblances, so that it became customary to represent apes as walking erect like men. In the eighteenth century Buffon hinted at the possible genetic relationship of apes to men. Lamarck expressed the same idea more definitely, and claimed that man was derived from the ape, and that the adoption of the erect attitude by the earliest men was essential to free the hands for their characteristically human uses. When, following the pioneer work of Linnaeus, the scientific classification of mammals was introduced, the Order Primates was made to include not merely the lemurs, the monkeys, and apes, but also men.

Sixty years ago Charles Darwin published his *Descent of Man*. He said that if man had not been his own classifier he would never have thought of founding a separate Order for his own reception, as Sir Richard Owen had done. This remark would have been more cogent if Darwin had used the word "Family" instead of "Order," because most systematists did not question the fact that man belongs to the Order Primates. What Darwin apparently meant to emphasize, however, was that man should be associated more closely with the anthropoid apes. For he goes on to say that there

can hardly be a doubt that man is an offshoot from the Old World simian stem. He says we may infer that some ancient member of the anthropomorphous sub-group gave birth to man. He added further: "It is probable that Africa was formerly inhabited by extinct apes closely allied to the gorilla and chimpanzee [as, in fact, is the Taungs Ape found in 1924]; and as these two species are now man's nearest allies, it is somewhat more probable that our early progenitors lived on the African continent than elsewhere."

Obvious as is the likeness of living apes and men, the contrasts between them are no less obtrusive. But when the details of their structure are compared, the anatomist is amazed at the essential identity revealed in every part of the body. The similarities of their developmental history, the details of the structure of the placenta, and the phenomena of menstruation and reproduction add further impressive corroboration of the real kinship of apes and men. The reactions of the blood and the liability to, and immunity from, diseases, complete the demonstration of the fact that the gorilla is man's nearest relation, and that the chimpanzee is also closely akin. There are many curious anatomical facts that corroborate these inferences. The African apes differ from the other anthropoids in possessing air sinuses in their frontal bones like those of men. The gorilla has cartilaginous plates supporting the openings of the nostrils. The form of its external ear also proclaims its affinity to man. The gorilla and chimpanzee sometimes have a *peroneus tertius* muscle, which until recently was assumed to be the one muscular distinction of man. No more striking demonstration of the amazing closeness of the morphology of man and the African apes can be imagined than the circumstance that for nearly twenty years many of the leading palæontologists in France, Germany, America, and elsewhere have been unable to decide whether the teeth and the jaw found at Piltdown in 1912 are those of a chimpanzee or a human being! For nearly forty years controversies have been going on over the attempt to solve the problem whether the teeth and the brain-case found by Dr. Dubois in Java in 1891 are human or simian!

In 1924 Professor Henry Fairfield Osborn, until then one of the most prominent exponents of man's kinship to the apes, suddenly and wholly inexplicably renounced this view, and put forward the claim that man was evolved from a much



earlier Primate, the common ancestor of men and apes, but not itself an ape! However this action may have excited the American public, it has rendered a great service to students of human evolution. It stimulated Professor William King Gregory, one of Professor Osborn's colleagues, to collect and set forth in clear and unmistakable form the evidence to rebut his chief's strange opinion. This demonstration compelled Professor Osborn to admit that he recognizes the fact of the close structural similarity of men and apes, the importance of the embryological evidence and the value of the blood tests as a token of genetic relationship. He seems to be mainly concerned in pushing back the time of cleavage of the human from the simian line of ancestors so as to eliminate the simian stigma from man's escutcheon!

The difficulties Professor Osborn now emphasizes are the assumed impossibility of deriving the human type of foot from that of the ape, of understanding how man, with his large and highly developed thumb, could have sprung from an ape with a diminutive, and diminishing, thumb; and how from a short-legged ape the long-legged human being could have developed. All these questions have been answered with a wealth of lucid argument by Professor W. K. Gregory, who has thus converted the obstacles advanced by his colleague into the most impregnable buttresses of the reality of man's affinity to the ape. Take the case of the foot. The drawing which I take from a memoir by Dr. Adolph H. Schultz (Fig. 1) clearly shows how closely the sole of the gorilla's foot, and in particular that of the mountain gorilla, resembles the human type. This likeness, so striking in the superficial form of the sole of the foot, is on the structural side even more precise and exact. For Dr. Dudley J. Morton's dissections have shown that the gorilla's foot agrees in structure with that of man, muscle for muscle and bone for bone, with amazing precision. As Professor Gregory has expressed it, Nature has supplied us with an experimental demonstration of the essential changes necessary to adapt the arboreal type of foot inherited by the gorilla to the conditions in which man uses his foot for the new type of terrestrial locomotion. "But," he adds, "if the foot of the mountain gorilla approaches that of man, the foot of the human foetus of the ninth week assuredly recalls the anthropoid type in so far as its great toe is widely divergent from the others." As Dr. Gregory shows, these facts even suggest that man may have developed

from the gorilla branch after its separation from that of the chimpanzee. Thereafter, however, the gorilla and man rapidly became extremely different, the former developing into a big-jawed, gigantic quadruped, the latter into a weak-jawed biped. The features of the brain, of the external ear, of the nasal cartilages, and a score of other peculiarities of the gorilla confirm this view and suggest a nearer affinity to man than other apes display.

The human hand also retains strong evidence of quite special relationship with the hands of the gorilla and the chimpanzee. Bone for bone, muscle for muscle, there is an astounding similarity. As Dr. Gregory expresses it, no other



FIG. 1.—THE SOLES OF THE FEET OF A SERIES OF APES COMPARED WITH THAT OF A HUMAN FOOT.

[After Adolph H. Schultz.]

known type of hand approaches so strikingly to the human type as do those of the gorilla and the chimpanzee.

This morphological resemblance is not really affected by the small size of the thumb. The difficulty with reference to the issue raised by Professor Osborn is illusory. In the primitive Primates the thumb is not so diminutive as it is in the gorilla and the chimpanzee, in whom it has become specialized and reduced. The human thumb is obviously a progressive member, which early in the history of the family increased in size and strength as the perfection of the visual guidance and the increasing ability to effect delicate muscular co-operation made possible the attainment of such skill as conferred upon the thumb a new and fuller usefulness. Hence in course of time it became one of the most important factors in conferring the distinctively

human quality of dexterity upon man's hand. Professor James H. MacGregor has called attention to the fact that young gorillas and chimpanzees use their thumbs in grasping just as men do. In fact, taking into consideration all the distinctive qualities of the hand and foot, in spite of the superficial differences which have been so largely cited in justification of the attempt to dissociate man from his nearest relations, the deep-seated structure of these members affords the most conclusive evidence of man's origin from some ancestor common to him and to the gorilla.

As a result of the circumstance that enamel is the most resisting structure in the animal body, the teeth provide a more complete record of the series of transitional stages in the Order Primates, and therefore the most convincing demonstration, not merely of man's derivation from the apes, but also of the degree of affinity between different human and simian forms.

In a series of fossil apes and men Dr. Gregory has traced back the tooth patterns so as to establish the reality of two divergent lines of evolution from a type revealed in the fossil ape *Dryopithecus* found in the Miocene and Pliocene deposits of India and Europe.

In the evolution of man the delay involved in the growth of a much larger brain seems to be responsible for disturbing the order of development of the teeth and jaws. After the eruption of the deciduous teeth, which is complete at the end of the second year, there is a pause in the growth of the jaws and teeth for the next four years while the brain is growing. When, by the sixth or seventh year, the brain has reached its adult size, the permanent teeth then begin to erupt. During the process of cultivating the enormously complicated mechanism of the human brain, on the acquired efficiency of which man is dependent to a much greater degree than is any other living creature upon its individual experience and acquired knowledge, the rate of growth in the jaws is subject to further delay. Hence another ten years or more is occupied in the eruption of the teeth, while the human child is learning to use its cerebral instrument. Thus the permanent teeth do not erupt so rapidly in the human as they do in the simian child. Moreover, owing to the delay in the growth of the jaws in the human child, the back teeth are restrained to a greater extent than they are in the ape. The wider implications of the phases of growth in the human child have been

PLATE I



(a) SKIAGRAM OF PART OF THE LEFT SIDE OF THE JAW  
OF A TEN-YEAR-OLD CHILD.



(b) SKIAGRAM OF A YOUNG CHIMPANZEE'S SKULL.

PLATE II



JAWS OF TWO YOUNG MEMBERS OF THE NEANDERTHAL SPECIES.

[After Prof. W. K. Gregory.]

elucidated by my colleague, Dr. H. A. Harris, in *The Lancet* (March 28, 1931, p. 691), and the Board of Education's Report of the Consultative Committee on the Primary School, Appendix II, 1931.

Looking at an X-ray photograph of the jaw of a child ten years of age, one sees behind the first permanent molar, which has been fully erupted for four years, the second permanent molar ready to erupt (Plate Ia). In front of it one sees the second bicuspid tooth ready to push out the milk molar lying above it. The race between the second bicuspid and the second molar to erupt is obviously a very close thing. In man the premolars usually win the race. In the anthropoid apes, on the other hand (see Plate Ib, which represents the skull of a young chimpanzee), the second molar erupts at a time when the second bicuspid is still a long way from pushing out the deciduous molar. It is a matter of great interest to notice that in Neanderthal Man the simian order of eruption rather than that distinctive of modern man is pursued. Thus in the two jaws (shown in Plate II) of juvenile members of the Neanderthal species—the upper one, *B*, being the jaw found at Le Moustier, and the lower one, *A*, the jaw found at Ehringsdorf in Weimar—the second molar tooth is seen to be erupted at a time when in the upper figure the two temporary molars are still unreplaced, and in the lower damaged jaw the tips of the crowns of the two premolars are seen just emerging from the jaw. These interesting phases of tooth development serve to eliminate what otherwise might appear to be differences between men and apes.

In his work "A New Classification of Mammals," published in the *Bulletin of the American Museum of Natural History* (March, 1931), Dr. George Gaylord Simpson has united the two families of Anthropoid Apes, Pongidae (Simiidae), and Men, Hominidae, into a Superfamily, which he calls Hominoidea, and distinguishes from the two other Superfamilies of the Sub-order Anthropoidea, which he calls the Cercopithecoidea and the Ceboidea. This new and very useful nomenclature is particularly welcome, inasmuch as it emphasizes the consideration that man is essentially a big-brained ape.

## The Circumstances that led to the Discovery of *Pithecanthropus*

WHEN human remains were found by workmen quarrying in the Neanderthal cave in 1857 they were rescued only because Dr. Fuhlrott, a physician practising in Elberfeld, happened to be interested in cave exploration and was keeping a watch on this cave.

The bones were so peculiar that at first he did not realize they were human. He handed them on, however, to Professor Schaaffhausen of Bonn, who recognized them "as the most ancient memorial of the early inhabitants of Europe." Although Huxley told Sir Charles Lyell that the Neanderthal fossil was "the most ape-like skull he had ever beheld," he regarded it only as a variant of the existing type of men. But in the following year (1864) the Professor of Anatomy in Galway, Dr William King, created the species *Homo neanderthalensis*. Moreover, he expressed the view that the fossil cranium resembled that of a chimpanzee so closely that he doubted the propriety of putting it in the same genus as *Homo*.

Even King's claim for specific distinction was not adopted until nearly half a century had elapsed. In 1886, however, an important step was taken towards recognizing the real importance of the Neanderthal discovery. Marcel de Puydt and Max Lohest found in a cave at Spy in Belgium parts of two fossils of the same type as the Neanderthal skull, which disposed once for all of the suggestions that the latter was a pathological specimen or an individual sport. Moreover, they were able to demonstrate that the human remains belonged to the remote epoch of the Middle Pleistocene, and were contemporaneous with extinct animals such as *Elephas primigenius* and *Rhinoceros tichorhinus*. Further, they were able to prove that Neanderthal Man lived in the cultural epoch known as Mousterian. It was the proof that these ancient men who lived in the Middle Pleistocene were real

men, and not markedly ape-like beings, that fired Eugène Dubois with the idea of seeking elsewhere for "the missing link."

In 1891 Dr. Eugène Dubois discovered in Java the remains of a human skull which did not belong to a member of the genus *Homo*. Faced with the problem of creating for the first time a new genus (other than *Homo*) of the human family, he used the name *Pithecanthropus*, which had been invented by Haeckel more than a decade earlier for the hypothetical "missing link."

Important as the previous discoveries of fossil remains of men of a hitherto unknown species at Gibraltar, Neanderthal, and Spy undoubtedly were, the revelation of a new genus vastly more ancient and more ape-like than any other member of the human family then known, marks the beginning of a realization of human palæontology.

Eugène Dubois was born on January 28, 1858, at Eysden, in the province of Limburg (Holland), and received his first scientific education at the Government Secondary School ("Hoogere Burgerschool") in Roermond. In 1877 he began to study natural science and medicine at the University of Amsterdam, where Van der Waals, Hugo de Vries, Thomas Place, and Max Fürbringer were his principal teachers. Three years later, while still an undergraduate, he was appointed assistant to Professor Fürbringer at the Institute of Anatomy, and a few years later became prosector. From 1881 Dubois also taught human and comparative anatomy to students of sculpture at two newly founded Government Art Schools in Amsterdam. In 1886 he was appointed University Lecturer ("lector") in anatomy.

At that time he was investigating the comparative anatomy of the larynx in vertebrates. One of the chief results of this investigation was the demonstration (1886) of the homology of the thyroid cartilage with the fourth and fifth gill-arches. At this time, however, his thoughts were intensively occupied not merely with the organs of speech, but also with the problem of the descent of man. The conviction was growing in his mind that creatures really intermediate between apes and men might have formerly existed in the present habitats of the man-like apes. He thought the likeliest place might be the Indo-Malay region, rather than Europe. In 1886 the definitely human character of Neanderthal Man, the only type of fossil man then known, had been established by



## 12 THE DISCOVERY OF *PITHECANTHROPUS*

Julien Fraipont's description of the Spy skeletons. There must be some type not so definitely human. If the West had failed to reveal this type, what might not the East have in store for some adventurer? He decided to undertake the search.

Dubois' attempt to obtain from the Dutch Colonial Department a Government commission for palæanthropological investigations in the Netherlands East Indies met with no success. His desire to set out for the purpose of discovering fossil remains of truly prehuman forms, however, became at last so insistent that the director of the Anatomical Institute, Professor Fürbringer, and Dr. Max Weber (Dubois' predecessor in the prosectorship) felt it necessary strongly to dissuade him from interrupting his scientific career at the University, in which he might soon obtain his marshal's baton as a professor. However, he decided to sacrifice his prospects in the Amsterdam University, and to make the Oriental land of promise attainable by securing a commission, for eight years, as a surgeon in the army of the Netherlands Indies. He was confident that when he arrived in the Malay Archipelago he would find an opportunity for carrying out his plans.

In November, 1887, Dubois sailed from Amsterdam, and arrived in Padang, Sumatra, about the end of that month. There, until May 1888, he was wholly engaged in hospital duties, and had no opportunity to begin the investigation which he had gone to the East to undertake. Meanwhile, from Padang in April 1888, he wrote a paper, which was published in *Natuurkundig Tijdschrift voor Nederlandsch-Indie* (Vol. 48, Part 2, pp. 148-165, Batavia, 1888) under the title "Over de menschelijkheid van een onderzoek naar de diluviale fauna van Nederlandsch-Indie, in het bijzonder van Sumatra" (*On the Desirability of an Investigation into the Pleistocene Fauna of the Netherlands Indies, particularly of Sumatra*). In this essay he called attention to the probability that explorations of Pleistocene deposits (in the first place in limestone caves) would yield important results bearing on the palæontology and phylogeny of mammals, and on anthropology, especially concerning the unknown former aborigines of the Malay Archipelago. As the chief aim of his search, however, he put the possible, or even probable, discovery of Pleistocene Man of really pithecoïd type, the intermediate form connecting man with his nearest relatives among mammals, the missing link between the anthropoid apes and man.

At the outset he set his hopes particularly on Sumatra, of the three great Indo-Malay or Sunda Islands, on account of the numerous caves in its limestone mountains, without forgetting, however, the Pleistocene deposits in Java and Borneo.

The argument that inspired his search he has summarized in these words. We may assume that man originated in the Old World, as the human family is associated morphologically with the catarrhine ape type. We may further expect, according to Darwin, the fossil ancestors of man to have occupied a hot country at the time they lost their hairy covering, a territory somewhere in those regions of the world which are at present inhabited by man-like apes—tropical Africa or the Indo-Malay Islands.

In support of the first assumption, Dubois quoted Charles Darwin's words (*The Descent of Man*, Chap. VI, 1st ed., p. 199, 1871): "In each great region of the world the living mammals are closely related to the extinct species of the same region. It is therefore probable that Africa was formerly inhabited by extinct apes closely allied to the gorilla and chimpanzee; and as these two species are now man's nearest allies, it is somewhat more probable that our early progenitors lived on the African continent than elsewhere."

Dubois further quoted Lyell and Wallace in support of the assumption that the Indo-Malay Islands also may have been the former habitat of forerunners of the existing man-like apes, some of which in Pleistocene times (according to modern geological chronology), were *more* man-like, Lyell believed, than those living at present. "For, as we meet with extinct kangaroos and wombats in Australia, extinct llamas and sloths in South America, so in equatorial Africa, and in certain islands of the East Indian Archipelago, may we hope to meet hereafter with lost types of the anthropoid Primates, allied to the gorilla and orang-outang. . . . But according to the doctrine of progression, it is not in (these) Miocene strata (of Europe), but in those of Pliocene and post-Pliocene date, in more equatorial regions, that there will be the greatest chance of discovering hereafter some species more highly organized than the gorilla and chimpanzee" (Sir Charles Lyell, *The Geological Evidences of the Antiquity of Man*, 3rd ed., pp. 499 and 500, 1863).

In his 1888 article Dubois quoted the opinion of A. R. Wallace (*The Malay Archipelago*, p. 61, 1886) expressed as follows: "It is very remarkable that an animal, so large,

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so peculiar, and of such a high type of form as the orang-utan, should be confined to so limited a district—to two islands, and those almost the last inhabited by the higher mammalia; for eastward of Borneo and Java, the quadrumana, ruminants, carnivora, and many other groups of mammalia diminish rapidly, and soon entirely disappear. When we consider, further, that almost all other animals have in earlier ages been represented by allied yet distinct forms—that, in the latter part of the tertiary period, Europe was inhabited by bears, deer, wolves, and cats; Australia by kangaroos and other marsupials; South America by gigantic sloths and ant-eaters; all different from any now existing, though intimately allied to them—we have every reason to believe that the orang-utan, the chimpanzee, and the gorilla have also had their forerunners. With what interest must every naturalist look forward to the time when the caves and tertiary deposits of the tropics be thoroughly examined, and the past history and earliest appearance of the great man-like apes be at length made known."

In the same connection Dubois quoted so cautious an authority as Rudolf Virchow, who in 1870, when discussing possible pithecoïd forerunners of man, said: "All the researches hitherto have only led to presumptions, but not to proofs. Is the question settled? Certainly not for the naturalist. Large regions of the world are still wholly unknown in respect to their fossil treasures. To these belong precisely the home regions of the man-like apes; tropical Africa, Borneo, and the adjacent islands are still entirely unexplored. One single new discovery can change the whole state of the problem." Dubois determined to take up this challenge. A piquant situation arose when he made such a discovery as Virchow had adumbrated, and found that the latter had become his most determined critic.

Dubois had particular reasons for expecting to find the fossil remains of the missing link he was seeking in the deposits of the Indo-Malay Islands. This expectation was based chiefly upon faunistic considerations; first, on the present geographical distribution of the gibbons (*Hylobatidæ*) and the evidence supplied by the then known fossil remains of anthropoid apes from Tertiary formations in Europe and India (*Pliopithecus*, *Dryopithecus*, *Palæopithecus*) of the morphological primitiveness and generalized (and at the same time particularly human) character of the hylobate anthropoid type; secondly,

on the affinity of Pliocene and Pleistocene, and even the existing mammalian fauna in the Indo-Malay sub-region, to a fauna of continental facies, such as that of the Indian Sivaliks, fossil remains of which had been recorded from Java by K. Martin in 1886.

The land connection of the Indo-Malay Islands with the Indian Continent thus established could not have failed to promote in Pleistocene times a great conformity of fauna. We might thus expect, in the Pleistocene deposits of those islands, descendants of the Sivalik *Palæopithecus* and other Anthropoids.

Dubois lays great stress, moreover, on the consideration that many descendants of the Indian Pliocene (and earlier) mammalian fauna, especially such species as were adapted to a hot climate, must, at the time of the first glaciation of Northern India, have migrated to the more equatorial Indo-Malay sub-region, one reason more to expect in the Pleistocene there "lost types of the anthropoid Primates," some of which might have been more man-like, morphologically, than any existing man-like ape.

From Padang, on the west coast of Sumatra, Dubois, in May 1888, at last attained his ambition to explore the interior of the island. His appointment as surgeon in charge of a small hospital for military convalescents, at Pajokumbu, provided an opportunity for making excavations in limestone caves—at his own expense—when he was relieved, to a certain extent, of his hospital duties by the aid of a convalescent colleague. Then the results of his cave investigation, together with the arguments advanced by him in the above-mentioned paper, induced the Colonial Government in 1889 to entrust him with a commission for the palæontological investigations he had so earnestly sought to make. Fifty convicts, under the supervision of two sappers, were put at his disposition for excavation and other research work.

It became apparent to him, however, that the fossil fauna in the caves was too recent to provide the evidence he was seeking. Apart from differences in the geographical distribution of mammalian species, such as the orang-utan, of which abundant remains were found in uninhabited primitive jungle country, far from the present range of this anthropoid, now extinct in Sumatra from some important ecological change which must have required a long time, the character of the fauna appeared to be recent. Regarding this as an effect of

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the change in climatic conditions having been quite different from that in Europe, Dubois now found it necessary to investigate the older fauna in Java—that with Sivalik (Indian) affinities.

In the Sumatra caves neither human bones nor artifacts were found. Some fossil bones, fragments of a skull, had been sent to him from Java, where they were found in 1889 by Mr. B. D. van Rietschoten in a marble quarry. Those fragments, compared by Dubois to an Australoid human skull (the “Wadjak man” of his later description), provided the first evidence of the aboriginal inhabitants of the Indo-Malay Islands. He did not publish an account of this specimen until more than thirty years later, in 1920, when S. A. Smith’s description of the fossil skull from Talgai in Australia seems to have stimulated Dubois to describe his Wadjak skull from Java.

In 1890 Dubois resolved to transfer his sphere of action from Sumatra to Java, intending to devote himself to two departments of investigation: the palæanthropological task of cave exploration, and the more important work of searching in the open the northern part of the Madiun residency (in Central Java), where, according to an earlier observation by Junghuhn, fossil bones, described by Martin as remains of a mammalian fauna with Sivalik affinities, had been found.

Excavations, chiefly in the southern limestone range of the Kediri residency, Central Java, then yielded Dubois a number of fossil human bones and another skull of “Wadjak man,” and also human remains evidently of later age. In Java, however, the fossil mammalian cave fauna had the same recent character as in Sumatra.

The case was different with the Java “Sivalik fauna.” It appeared to be as old as the earliest European Pleistocene or the latest Pliocene.

A few days after his arrival in Java, in May 1890, Dubois recognized that the previously unknown deposit containing bones of much older fossil fauna than that of the caves is a volcanic tuff, mostly soft sandstone, from which, on the first day of his exploration, he extracted the maxilla of a hexaprotodont hippopotamus, thus confirming the fauna’s affinity with the Sivalik fauna of India. During the further course of his explorations he found the principal deposit to extend west-east for about 150 kilometres (and a few kilometres in width), to the north of the Lawoe and Wilis volcanoes, along

the boundary between the Madiun and Kediri residencies and the Rambango residency. He recognized it as an old fluvial formation, resting on Tertiary marine marls, limestones, and volcanic breccias of not exactly determined age. In some parts erosion by the present Bengawan (Solo river) cut it to the bottom.

The fossil vertebrate remains, chiefly mammals and reptiles, belong everywhere to one and the same fauna, which, although showing distinctive local characters, display a high degree of affinity with the Pliocene Sivalik fauna of India, although they are somewhat later and, according to Dubois, apparently of the Pliocene-Pleistocene transition stage.

Many fossil bones were gathered from the rain-washed surface of the tuffaceous deposits; many others were obtained by excavations. Mainly in that region (partly also in the Pati ajam, at the foot of the Moeria volcano, Samarang residency), Dubois collected such a quantity of bones during five years of exploration that, in 1895, more than three hundred large boxes were sent to Europe.

The first remains regarded by him as "prehuman" were found in November, 1890, at Kedung Brubus (near the place where some of the earlier fossil bones were found by Junghuhn, 40 kilometres east of Trinil, the site of *Pithecanthropus erectus*). It was a fragment of a mandible, which at first he attributed to a human being of hitherto unknown type, differing from any living or known fossil race of men. When, however, he discovered the skull of the Ape-Man, he assigned the Kedung Brubus jaw fragment also to *Pithecanthropus*.

Then, in September, 1891, he excavated at Trinil, some seven kilometres north-west of Nagawi, on the left bank of the Bengawan, near the bottom of the tuffaceous layer, a right upper third molar, which at first he ascribed to a very large and exceptionally man-like chimpanzee (*Anthropopithecus*), an animal not known except in Africa. Soon afterwards, however, he became convinced that it belonged to the new genus he had created, *Pithecanthropus erectus*.

A month later, 3 metres away from the tooth, and in the same stratigraphic plane (the rapilli layer), the skull-cap of *Pithecanthropus* was excavated.

The amazing thing had happened. Dubois had actually found the fossil his scientific imagination had visualized! It is a marvellous chance that in the vast territories of the Sunda Islands he should have discovered this solitary fragment

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of skull, when forty years of intensive search since then have failed to reveal another.

As the site on the bank of the Bengawan was regularly inundated by the river in every wet season, Dubois had to wait until the second quarter of 1892 before continuing the excavation. It was not until August, in fact, that he found another tooth, the left upper second molar, at about 1 metre distance from that of the previous year. Both, showing the same sort of peculiarities, evidently belonged to the same individual.

In August, 1892, a human left femur was found, at about ten metres distance (according to Dubois' notes made at the time) from the skull cap, again in exactly the same stratigraphic plane of the rapilli layer.

Further search (continued until 1895, the year in which Dubois returned to Europe, after visiting the Indian Museum in Calcutta and the Sivalik Hills) did not yield any more *Pithecanthropus* remains. Excavations continued under his direction, however, led to the discovery, in 1898, of the left lower first premolar, which tooth very closely resembles what remains of the homonymous tooth in the Kedung Brubus mandible-fragment.

Before he left Java Dubois published his monograph, (*Pithecanthropus erectus, eine menschenähnliche Übergangsform aus Java, Batavia, 1894*), and exhibited the fossils, in September 1895, at the Third International Zoological Congress at Leiden, in a session attended by Rudolf Virchow, O. C. Marsh, Sir William Flower, A. Milne Edwards, and many other distinguished zoologists and anthropologists. In the same year he showed the remains in Liège, Paris, London, Dublin, Edinburgh, Berlin, and Jena. At the Fourth International Zoological Congress, held in Cambridge in 1898, he demonstrated on an endocranial cast of the skull cap the real transitional character of the *Pithecanthropus* brain.

The momentous discovery of *Pithecanthropus* at once provoked the liveliest controversy. Was the skull simian or human? Was it normal or pathological? Was its age Pliocene or Pleistocene? Did the teeth belong to the same individual as the skull? Was it possible to associate a thigh-bone so thoroughly human in type with such a lowly type of Ape-Man or Man-Ape? The discussion of these difficult problems during forty years has produced a vast mass of contradictory opinions. Yet it is now coming to be generally

accepted that the teeth belonged to the same individual as the skull, and that he was a member of the human family in Pleistocene times. There are still, however, wide discrepancies in the views of different writers on the femur.

The whole issue has recently been subjected to a keenly critical discussion by Dr. Hans Weinert, who, after a careful examination of the actual fossils, in collaboration with Professor Dubois, has written a monograph entitled "*Pithecanthropus erectus*," which was published in 1928 in the *Zeitschrift für Anatomie und Entwicklungsgeschichte* (Bd. 87).

Dr. Weinert has demonstrated that the skull cap of *Pithecanthropus* closely conforms to the type of the chimpanzee's skull, and not to that of the gibbon, whose habitat extends into the Malay archipelago. He has no doubt that the three teeth belong to the same individual whose calvaria has been recovered. Turning to the more difficult problem of the femur, he expresses the opinion that the circumstances of its discovery and the state of fossilization are in favour of the view that it is contemporaneous with the skull, and probably part of the same individual. He thinks that the arguments, morphological or statistical, adduced in opposition to this conclusion are not adequate to refute it. Hence he does not subscribe to the objections to the use of the specific name *erectus* that other writers have put forward.

How much simpler the problem would have been, Dr. Weinert says, if the Trinil femur had been found at Piltdown and the Piltdown jaw at Trinil! For one might easily imagine the better-brained Piltdown man walking upright and the degraded Ape-Man of Java equipped with an ape-like jaw.

There is no adequate reason for assuming that a primitive man like *Pithecanthropus* did not walk on lengthy vertical legs, even if, in comparison, Neanderthal Man's limbs were relatively short and crooked. The changes in the brain involved in the attainment of human rank were such as to promote the full erect posture, for reasons I have given in my book *The Evolution of Man* (1927). The crouching gait of the gorilla and chimpanzee, in which all four limbs are commonly used for locomotion, is probably due in part to retrogressive changes in (or rather specialization of) the limbs for the arboreal arm-swinging mode of progression which Sir Arthur Keith has called "brachiation." According to Professor Abel, the structure of the femur in *Dryopithecus*, the Miocene Ape which Dr. W. K. Gregory, I think correctly, regards as the sort of



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type from which the living apes and men were derived by divergent differentiation, suggests that the upright posture was more habitual than it is in the great apes now living.

Then there is the question of the geological age of the fossils. When Dubois first discovered them, he was impressed by the fact that the associated mammalian remains seemed to be identical with types which occur in the Pliocene beds in the Indian Sivaliks. Hence he regarded the fossils as evidence of the former existence in Java of Tertiary Man. The further study of these remains, and in particular the gradual accumulation of knowledge regarding the fossil mammalia of Asia, has since convinced most palæontologists that the age of the Java fossils is Pleistocene, and not Pliocene. In 1929 (February 22) Professor Henry Fairfield Osborn, the President of the American Museum in New York, called attention (*Science*, Vol. 69, p. 216) to the fact, which had impressed both Professor Dietrich of Berlin and himself, that the Proboscidean and other mammalian remains associated with the human fossils belong not to the Early Pleistocene, but to the Middle Pleistocene Age, suggesting that the Ape-Man of Java was relatively much more recent than had hitherto been supposed.

The total result of these discussions is that the precise age and the significance of the fossils found by Dr. Dubois forty years ago are still matters of lively controversy and considerable doubt.

The further discussion of the points at issue may therefore profitably be postponed until the history of the discoveries at Piltdown and Peking has been described.

## The Discovery of the Men of Heidelberg and Piltdown

ON October 20, 1907, there was found in the Mauer sand-pit, 6 miles from Heidelberg, a very ancient human jaw, which is so distinctive that Dr. Otto Schoetensack (in 1908) created a new species, *Homo heidelbergensis*, for its reception. It is so primitive, and so far removed both in age and type from all other species of the genus *Homo*, that Bonarelli is probably right in insisting (*Rivista italiana di Paleontologia*, 1909) upon its right to be accorded generic distinction and the name *Paleoanthropus heidelbergensis*.

This important discovery was made as the result of a prolonged and intensive search. For many years the digging in the Mauer pit (for industrial purposes) had attracted widespread interest among geologists, because the 80 feet of cut surface revealed, with diagrammatic clearness, a series of twenty-four strata, the lower (Pleistocene) members of which had provided an interesting series of fossil remains of extinct mammals to determine the ages of the various layers. Dr. Otto Schoetensack, of the University of Heidelberg, had been watching the excavations in the Mauer pit for many years, when, on October 21, 1907, the owner of the pit, Herr J. Rösch, was able to inform him that the search of twenty years had been rewarded by the finding of the lower jaw of primitive man.

The discovery of this remarkable fossil was doubly important. Its intrinsic interest and significance are obvious. Moreover, it was in large measure responsible for stimulating the search which led to the discovery of Piltdown Man.

In the year 1908, soon after the publication of Dr. Schoetensack's memoir *Der Unterkiefer des Homo Heidelbergensis* (Leipsig, 1908), the late Mr. Charles Dawson, a lawyer practising in Sussex, who had devoted his leisure during more than thirty years of his life to the hobby of hunting for fossil remains of extinct animals in the Sussex Weald, was attend-

ing a land court at the Manor of Barkham near Piltdown, when he noticed that the road leading up to the manor house was being repaired with flint. During the sitting of the manorial court over which he was presiding, instead of giving the whole of his attention to the legal business in hand, he was unable to restrain his roving fancies from wondering why people should be using such poor material as flint to repair a road, when, as he thought, the cost of bringing it from the nearest source known to him, which was more than four miles away, would have been almost sufficient to defray the cost of proper road metal. Hence, as soon as the court rose for lunch he went out to make further inquiries, and discovered from the workmen that flint was being used because it was present on the spot, the road crossing a small patch of gravel which had been overlooked and hence omitted from the geological maps of Sussex, and which was now being dug up for road material. Mr. Dawson instructed the workmen to keep a look-out for any fossil remains which they might find in this bed of gravel; and from time to time, whenever any excavation was going on, he visited Barkham Manor to keep a watch on the operations.

On one of these visits a workman handed Mr. Dawson a small piece of a phenomenally thick human parietal bone, but the latter was unable to find any further fragments. Some years afterwards, however (in 1911), he picked up, among the rain-washed spoil-heaps of the gravel pit, another and larger piece of bone, including the frontal region of the same skull. The massiveness of the skull and the geological antiquity of the deposits suggested to Mr. Dawson's mind that he had realized the object of his search, and had found part of the brain-case of the only really early man at that time known in Europe—the man of Heidelberg, whose jaw had been found four years previously (the announcement of its discovery had stimulated Mr. Dawson's quest) and which is all that we know of this particular type of the human family, a type which probably represents a distinct genus (*Palæoanthropus*) of the human family. He therefore took the fragments to Dr. (now Sir Arthur) Smith Woodward, at that time Keeper of Geology at the British Museum (Natural History), and they set to work to dig the gravels at Piltdown.

In the summer of 1912 they found a fossilized jaw, which at once convinced them that they were dealing with a creature totally distinct from the Heidelberg Man—one who was very

much more primitive and ape-like, and also much older even than the Pleistocene Man of Germany.

In the same area, by the end of the summer of 1912, there were found the greater part of the left side of the skull, including part of the frontal bone, the whole of the parietal, the temporal, and a large piece of the occipital bone, as well as part of the right parietal bone and the greater part of the right side of the mandible.

In the following year Père Teilhard de Chardin, the French palæontologist and archæologist, who was destined later on to play an important part in the great discoveries in China, offered his services to Sir Arthur Smith Woodward, and was responsible for the dramatic discovery of the canine tooth of Piltdown Man, which caused so much controversy. The nasal bones and a turbinal were also recovered.

Before these events of 1913, however, the announcement of the discoveries, at a meeting of the Geological Society of London in December, 1912, started a series of controversies which were even livelier and, to the scientific world, more confusing than those which had raged since 1894 around *Pithecanthropus*. For there was not only the same doubt as to the significance and age of the Piltdown fragments, but there were also several new elements of controversy in the Sussex discoveries. The question of age was subject to the same uncertainty as I have mentioned in the case of *Pithecanthropus*; the fragments of bone had been deposited by running water in gravels in which were the remains of Pliocene as well as Pleistocene mammals. Above all, there was a wholly unjustifiable conflict over the question of the mode of reconstruction of the skull. The essential facts which confer particular importance on the Piltdown skull have been so gravely misunderstood and misrepresented that I make no apology for repeating what I wrote in 1927 in the second edition of *The Evolution of Man*.

The brain-case differs so profoundly from those of *Pithecanthropus* and Neanderthal Man that many anthropologists have, quite unjustifiably, assumed it to conform to the type of *Homo sapiens*, because it lacks the prominent eyebrow-ridges that it had been customary to associate with primitive man. Yet it was found in association with the fragment of a jaw presenting so close a resemblance to the type hitherto known only in apes that ever since the year 1912 many competent biologists have been claiming the mandible to be that

of a chimpanzee. Reading again, in the light of our present knowledge, the history of this amazing error—one, however, that is particularly illuminating at a time when man's kinship with the apes is being denied by several writers—it is clear that several anthropologists in foreign countries, not having examined the actual fossils, misunderstood Sir Arthur Smith Woodward's account of them. He emphasized the human characters of the brain-case so as definitely to establish the fact that the fossils which he claimed to be early Pleistocene were beyond question the remains of a member of the human family. While he entertained no doubt that the jaw found with the skull was actually a part of the same individual, he called particular attention to its simian features, to justify his action in creating a new genus for the reception of Piltdown Man. Those of us who were privileged to be associated with Sir Arthur Smith Woodward in these investigations (in 1912 and 1913) failed to detect any source of confusion in these claims. It is now apparent, however, that many of those who were drawing inferences solely from the published reports (and the plaster casts of the specimens) failed to realize that the brain-case, although unquestionably human, presents a number of very primitive features that were not sufficiently emphasized in the early reports. The jaw and teeth, in spite of their superficial likeness to those of the chimpanzee, are definitely human. There was therefore no warrant for assuming that Nature had played the amazing trick of depositing in the same bed of gravel the brain-case (*without* the jaw) of a hitherto unknown type of Early Pleistocene Man displaying certain simian traits never before seen in a human skull, alongside the jaw (*without* the brain-case) of an equally unknown Pleistocene Ape displaying human traits unknown in any ape. If it seemed difficult to believe that such a chance association—an ape-like man who left his brain-case without a jaw alongside the jaw of a supposed man-like ape who had left no brain-case—really happened once, the faith of even some of those who had most obstinately refused to admit that the jaw was human was not adequate to sustain a second miracle of the same sort. For when, some years later, Mr. Dawson found fragments of a second skull precisely similar to the first, but in a patch of gravel two miles distant from the site of the earlier discovery, and with these a molar tooth like those set in the supposed ape's jaw, it became clear that the association was not fortuitous. The primitive human brain-case with simian traits was

really part of the same individual as the more obtrusively ape-like jaw. But when the original skull was reconstructed in strict accordance with the anatomical evidence clearly displayed in the various fragments, a brain-case (Fig. 2) like that of any other human type was revealed, which

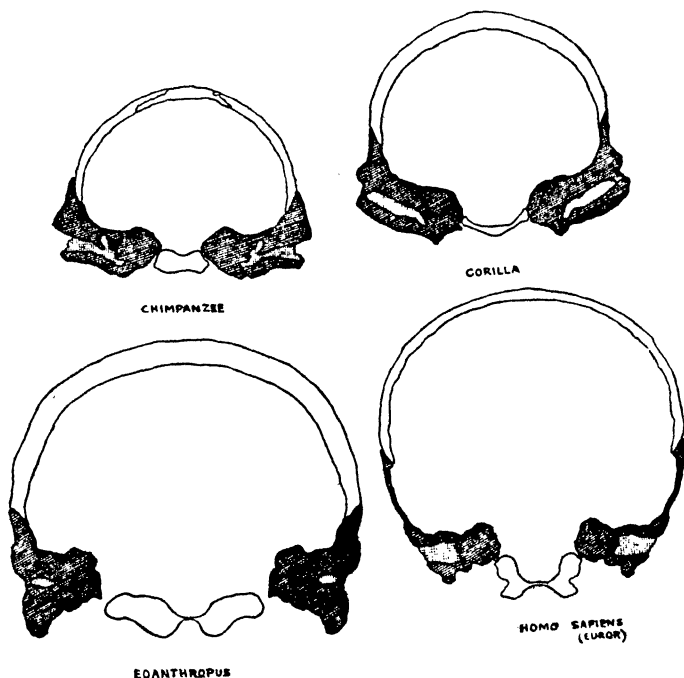


FIG. 2.—SECTIONS OF THE SKULLS OF A CHIMPANZEE, A GORILLA, AND A MODERN EUROPEAN MAN ARE COMPARED WITH THAT OF THE PILTDOWN MAN TO PROVIDE AN OCULAR DEMONSTRATION OF THE SIMIAN RESEMBLANCES OF THE LATTER.

[From G. Elliot Smith, "Evolution of Man"; Oxford University Press.

harmonizes with the much-disputed jaw. The skull is at least as ape-like in its architecture as is the more obvious shape of the jaw.

The recent discoveries in China have revealed two other jaws presenting the same sort of simian peculiarities as the Piltown jaw. As each of these was found in association with

the remains of an undoubtedly human brain-case, the objections to the possibility of such an association in the case of Piltdown Man are once more invalidated.

There has never been any justification for the doubts that have been expressed as to the methods to be adopted for (and the results that emerged from their application in) the reconstruction of the skull.

When the skull is restored in accordance with the anatomical evidence, its conformation is quite distinctive, and differs profoundly from all other human skulls, recent or fossil. The parietal bone exhibits a peculiar depression between the diverging temporal lines, and the lower margin of the bone, below the depression, is everted. This creates a peculiarity in the form of the cranium that is found in the gorilla and chimpanzee, and also, as we shall see in the next chapter, in the Peking skull. But the simian resemblances are revealed most strikingly in a transverse section of the reconstructed Piltdown skull, when compared with corresponding sections of those of a chimpanzee, a gorilla, and a modern European (Fig. 2). It will then be realized how much more nearly the Piltdown skull approaches the simian type. The general form of the cranium in transverse section is greatly expanded, like that of an ape. This applies particularly to the contour of the parietal bones. In *Nature* of May 30, 1931, I have called attention to the amazing similarity of the corresponding section of the Peking skull to that of the Piltdown skull. The construction of the temporal bone is even more strikingly ape-like in character. The squama and the petrous temporal are not only very massive, but they quite unite at an obtuse angle that contrasts with the approximately right-angled relationship usually found in man. In this respect the Piltdown temporal bone is definitely intermediate in type between those of the apes and men of the genus *Homo*.

These simian peculiarities of the Piltdown skull are intimately correlated with the distinctive features of the brain as revealed in the endocranial cast.

There are many other simian features in this skull; but enough has been said to establish the two issues that concern us in the argument of this book. First, the Piltdown brain-case reveals features of simian likeness that harmonize with the jaw with which it was found. Secondly, the facts that I have set forth should be sufficient to convince the reader that the size and form of the brain genuinely express the extra-

ordinary primitiveness of the organ of the mind in this most ancient member of the human family so far discovered in Europe. Although the size of his brain (roughly 1200 c.c.) comes definitely within the range of variation of the modern brain, it is not only small, but also singularly defective in those parts upon which the display of man's distinctive qualities depends.

As the skull itself showed no signs of rolling, such as many of the Pliocene fossils displayed, Sir Arthur Smith Woodward inclined to the opinion that it was contemporaneous with the undamaged Pleistocene fossils, rather than with the rolled fossils of Pliocene age. But there were many elements of uncertainty in the determination of the geological age of the specimens, and recently Professor Osborn has been putting forward the view that the Piltdown skull may possibly be Tertiary in age, and not Quaternary, as is generally supposed. "The problem is whether it came from a Pliocene gravel bank with a primitive elephant and mastodon, or from a Pleistocene gravel bank with a primitive hippopotamus" (*Science*, 1929, p. 217).

He bases this opinion on the consideration that the dark-coloured fragments of the skull of *Eoanthropus* were intermingled with similarly coloured fragments of Proboscidean molars of unquestionable Upper Pliocene age belonging to *Archidiskodon planifrons* and *Anancus arvernensis*. As other tooth fragments (which, however, are lighter in colour) belonging to a Lower Pleistocene hippopotamus are also present, it is possible that *Eoanthropus* also may belong to the Lower Pleistocene.

The peculiar ape-like feature of the Piltdown jaw, which has been the subject of such intense controversy from 1912 until the present time, is a matter of great significance in the consideration of human affinities; in particular since the evidence has been confirmed by the discoveries of similar peculiarities of the jaw in the case of Peking Man. If these facts are viewed in right perspective, the evidence of the jaw affords striking corroboration of the inferences which have already been drawn from the teeth and from the comparative anatomy of apes and men in general. This point is made clear in the diagrams (Fig. 3) prepared by Professor William K. Gregory. Starting from the jaw of *Dryopithecus* (A), and comparing it successively with the chimpanzee's (B), the Piltdown jaw (C), the Heidelberg jaw (D), the Ehringsdorf



jaw (E), the Neanderthal jaw (F), and that of the fossil of the Upper Palæolithic period, Cro-Magnon man (G), a complete gradation of types is revealed in the jaw as a whole, and

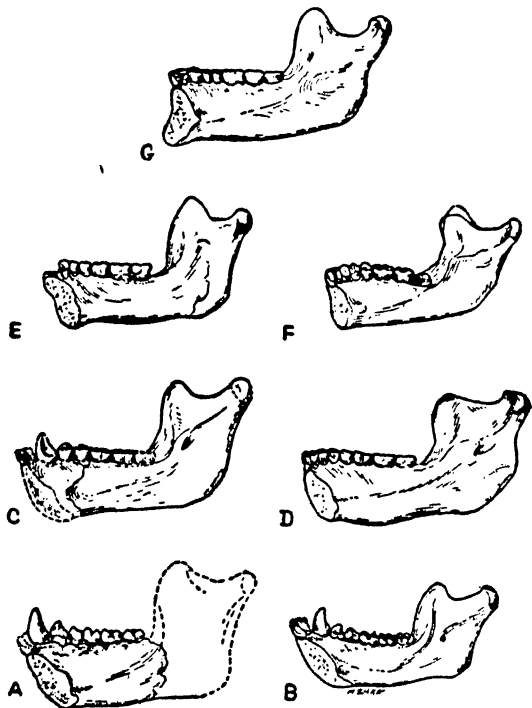


FIG. 3.—THE RIGHT SIDES OF A SERIES OF MANDIBLES CUT IN THE MIDDLE LINE.

A, The fossil ape *Dryopithecus*; B, the chimpanzee; C, Piltdown Man; D, Heidelberg Man; E, Ehringsdorf (a primitive type of Neanderthal Man); F, Neanderthal Man; G, Cro-Magnon Man (*homo sapiens*) of the Upper Palæolithic Epoch.

[After Prof. W. E. Gregory.

particularly in the chin region, which provides a striking demonstration of the progressive evolution of the mandible. Instead of the peculiar characters of the Piltdown jaw being a difficulty to circumvent, it becomes clear that in fact they

provide a most important confirmation of the argument which has been set forth.

One of the striking results of such a comparison is the fact that the presence of a chin is distinctive of *Homo sapiens*. No other member of the human family has a really projecting chin. Much speculation has been devoted to the attempt to explain the factors which brought the chin into being, and none of the theories appears to be entirely satisfactory. It seems not improbable that the fundamental factor in the process of chin development is the retardation of the eruption of the teeth in *Homo sapiens*. Although the enamel caps of the human teeth become calcified in the same order as the corresponding teeth in the apes, the order of eruption in man is different (see Chapter I and Plates I and II). As the result of a lagging in the expansion of the jaws, there is, until the time of adolescence, inadequate space for the second and third molars to erupt. In the apes, however, and also in all other members of the human family except *Homo sapiens*, there is more room for the eruption to take place at an earlier period of life. In *Homo sapiens* the delay in the eruption of teeth limits the growth of the tooth-bearing part, or alveolus, of the jaw, so that it lags behind the rest of the jaw, the bone of which is subject to the general growth tendencies which affect the body as a whole. Hence where the alveolus is, so to speak, held back, the rest of the jaw pushes forwards and produces the chin. Hence the chin can be regarded in a sense as a symbol of man's higher mental development. The growth of a larger brain in man is responsible for restraining the growth of the jaws and the eruption of the teeth, and so for allowing the rest of the jaw to expend some of its material and energy in forming the chin.

## CHAPTER IV

# The Discovery of Peking Man

IN addition to the interest and importance of the material actually found, the circumstances which led to the discovery of *Sinanthropus* have a fascination of their own, and are not without importance in the interpretation of his significance. The history of the investigation is of peculiar interest, and differs in essential respects from that which led to the discoveries in Java and Sussex, in which inspired individuals were rewarded by almost incredible strokes of fortune. The discoveries in China were not due merely to such a happy chance. *Sinanthropus* has been made known to us as the outcome of a comprehensive and well-organized search extending over several years, in which a team of investigators of different nationalities participated. One after another, a series of men of insight and imagination, stimulated by slight clues, pushed on with the search, until bit by bit the impressive series of relics was recovered which establishes upon a secure foundation our knowledge of the earliest men.

Nearly thirty years ago Dr. K. A. Haberer, a medical man well known to anthropologists as the author of a monograph (1902) on the skull and skeleton of the modern inhabitants of Peking, purchased in a druggist's shop in Peking a collection of "dragon's bones," which he sent to Professor Max Schlosser in the University of Munich. Shortly afterwards, in 1903, Professor Schlosser published (in *Abhandlungen der königl. Bayerisch-Akademie, Wissensch. Math. Phys. Klasse*, Bd. XXII, 1903) a report, under the title "Die fossilen Säugethiere Chinas nebst einer Odontographie der recenten Antilopen," giving his identifications of the series of fossil remains he was able to recognize among this collection of Chinese drugs. On pages 20 and 21 of this memoir there is a section called "The Description of the Primate Types," which is of such exceptional interest and importance that the portion of the description which is defined as "? Anthropoide g.n.et sp.ind" may be quoted. Professor Schlosser says: "In the

collection recently sent by Dr. Haberer from Peking there was a left upper third molar, either of a man or a hitherto unknown anthropoid ape. This tooth is completely fossilized, and is quite opaque. Moreover, it exhibits between its roots a reddish clay such as is found only in teeth which belong to the Tertiary period and are earlier than the loess. Hence it is probable that a Tertiary age should be ascribed to the specimen. Unfortunately the tooth is already much damaged and its surface corroded by the roots of plants, so that the original appearance of its surface cannot be accurately determined." After giving an account of the position of the various projections on the surface of the crown in comparison with other types, and describing the form of the body of the tooth and its roots with their respective measurements, Professor Schlosser proceeds to consider how to determine the zoological status of the creature to which it belonged. The form of the tooth and morphology of the roots are distinctly human. On the other hand, the state of preservation of the fossil makes it clear that it is of remote antiquity, possibly as old as the Tertiary period, which suggests the improbability of it belonging to the genus *Homo*. In fact, the Tertiary existence of any type of man is not yet established. Hence the possibility has to be considered whether this tooth may belong to a hitherto unknown genus of anthropoid ape, which in its structure approached more nearly to that of man than any known anthropoid ape. Another possibility, he says, is that it may be part of a human being which in some way became displaced and got into the Tertiary beds although belonging to a more recent period. He suggests, for instance, that possibly the fossil was only of Pleistocene age, which raises the difficulty that the state of fossilization is such as he has only found in teeth which are either Tertiary in age or are referable to the very beginning of the Pleistocene. He admits that he cannot pretend to distinguish between the state of fossilization in the earliest Pleistocene and the Tertiary. A definite answer to this riddle must necessarily be only tentative—for no other early human remains except *Pithecanthropus* were then available for comparison. No useful purpose would be served by comparing this third molar tooth (with its marked difference in size and much more strongly reduced roots) with the second molar tooth of *Pithecanthropus*, the roots of which were abnormally divergent. He calls particular attention to the fact that the fossil found in China presents a much nearer likeness to the

tooth from the Indian Sivaliks described by Lydekker under the name *Troglodytes sivalensis*, which Dubois calls *Palæopithecus sivalensis*. The third molar tooth in this Indian anthropoid presents a close resemblance to the Chinese tooth. It is distinguished, however, only by relatively slight differences in size and the position of the roots. After detailed comparisons between these teeth of fossil anthropoids and primitive men (including *Pithecanthropus* and the Neanderthal remains from Krapina), Schlosser refers to the possibility that the tooth from Peking may be the remains of the oldest human being known at that time, and one that displayed a closer likeness to the apes than any other known fossil. He thought it would be unpardonable tacitly to evade the issue. Hence he made tentative suggestions to define its systematic position which obviously could not be finally determined by the scanty evidence at that time available.

Hence he defines the aim of his communication as a suggestion to later investigators who may enjoy the privilege of carrying out excavations in China of the desirability of searching for the remains either of a new fossil anthropoid or a Tertiary (or an early Pleistocene) human being. In recording the complete realization of the last possibility adumbrated by the veteran German palæontologist, it would be unpardonable to overlook Professor Schlosser's insight and courage. One cannot withhold admiration for his wonderful imagination, which enabled him to make this amazingly accurate prediction, so amply corroborated by the events of the last three years in China.

This brilliant forecast was made in 1903, but nothing further was done towards the realization of it until the year 1921.

The circumstances which were responsible for the discovery of *Sinanthropus* were created by the National Geological Survey of China, and it becomes a matter of interest and importance to get a clear idea of the various factors that shaped the course of events.

Dr. Sun Yat Sen, who lit the torch of the Chinese revolution in 1911, received a scientific training in the Hong Kong medical school. He realized the value of the application of scientific knowledge and discipline for the attainment of economic prosperity.

One of the first acts of the provisional Government was to appoint Mr. H. C. Chang, who was educated in the Tokyo

Imperial University, to be chief of the Section of Geology in the Department of Mines under the Board of Commerce and Industries. In 1912 Mr. Chang published (in the *Proceedings of the Geographical Society of China*) his programme for a systematic geological survey of the country. On the removal of the Government from Nanking to Peking, Mr. Chang became the geological expert to the Ministry of Agriculture, and when this Ministry was amalgamated with that of the Board of Commerce and Industries, the Section of Geology was placed under the able direction of the brilliant geologist, Dr. V. K. Ting, who had received his training under Professor J. W. Gregory in the University of Glasgow. The serious difficulty encountered in the almost total lack of experienced field geologists in China was met by the establishment in September, 1913, of a school for training geologists under the direction of Mr. Chang. In 1918 Dr. W. H. Wong, who had been trained in the University of Louvain, became associated with Messrs. Ting and Chang on the Board of Directors of the Survey, and at once became acting director during Dr. Ting's absence in Europe. In the year 1916 the Ministry of Agriculture and Commerce invited Dr. J. Gunnar Andersson, formerly Director of the Swedish Geological Survey, to act as Adviser in affairs relating to mining, and to co-operate with the Chinese Geological Survey in its general activities, as well as in the special work of creating a museum.

The primary object of the institution of the Survey was the strictly economic business of gathering information concerning China's mineral resources. The work had not proceeded far, however, when the directors of the Survey realized that they could not carry out this technical programme in a way that was satisfactory either to the administrative authorities or to the industrial world without devoting attention also to purely scientific investigation. The study of fossils is of fundamental importance for the elucidation of the geology of the coalfields and of a variety of problems of economic importance. Hence the Directors of the Geological Survey decided to make an intensive study of the palæontology of China.

The importance of the results of these investigations impressed upon Dr. Ting the need for adequate publication. Hence he instituted the series of memoirs, *Palæontologia Sinica*, in which the achievements were fully recorded.

In 1916 Dr. Andersson began his investigation of the Cenozoic deposits of North China and made large collections

of fossil vertebrates, for the most part mammals. In the work of examining this material he co-operated with Professor Carl Wiman of Upsala.

The Western Hills, forming the picturesque background to the palaces and temples of Peking, are the scene of the epoch-making discoveries. Throughout the history of Peking these hills have played an important part in the development of the city. For many centuries the builders of temples and palaces have obtained from the Western Hills the supply of the beautiful white marble which lends distinction to the architecture of the former capital, as well as to the bridge which many centuries ago Marco Polo built on the road leading from Peking to the marble quarries. Not only did the beauty of this material appeal to the æsthetic interest of builders, but the Chinese name "white jade" gave a sanctity and a magic virtue to this stone which enormously enhanced its attractions. The builders also resorted to the Western Hills to obtain the limestone from which they get the lime needed for building operations. Lime also is, and for many centuries has been, extensively used for putting in the coffins of the dead while they are awaiting a propitious time for burial. About a quarter of a century ago the construction of a branch line from the Peking-Hankow Railway at a point 30 miles south-west of Peking brought the railway to the village of Chou Kou Tien to provide a means of bringing to Peking what Marco Polo called "the combustible black stone" from the rich deposits of coal near that village. The building of this railway line served other purposes, for it led to the development of the quarrying of limestone for lime-burning at Chou Kou Tien, and thus was responsible for exposing the fossil-beds in which the remains of the *Sinanthropus* family were found.

When Dr. Andersson began the palæontological survey he chose the Western Hills, not only because they were easily accessible from Peking, but also because their general geological nature was well known. Nor is it surprising that he first turned to the bone deposit with the suggestive name of Chi Ku Shan ("Chicken Bone Hill"). Two years later (1921), while excavating fossils on this site, he overheard his workmen expressing surprise that he should be spending his time at Chi Ku Shan when there was a much richer deposit of fossils near by at Chou Kou Tien, which had been exposed by the lime-quarrying near the coal mine. It was this chance

conversation which first directed his attention to the site which has yielded such important material. He took the hint, and transferred the scene of his excavations to Chou Kou Tien. When he was collecting the Early Pleistocene fossils he found a piece of quartz, a material not known to occur naturally within a couple of miles of the site, and remarked to his assistants: "This is primitive man"—for, so he believed, nothing but human agency could have brought this bit of quartz to the Early Pleistocene deposit. He had to wait, however, for five years before the evidence was forthcoming which seemed to justify this surprising anticipation.

The funds available for the Chinese Geological Service were inadequate to carry out the examination of these fossils with the thoroughness which their importance merited, but Mr. Ivar Kreuger of Stockholm provided an endowment which enabled Dr. Andersson to bring his assistant, Dr. Zdansky, to China to excavate the site.

The fossils collected at Chou Kou Tien in 1922 were taken to Professor Wiman's laboratory in Upsala for examination; and in 1926, on the occasion of the visit of the Crown Prince of Sweden to Peking, it was announced that two human teeth had been found—an immature left lower molar and a somewhat worn adult right upper premolar.

In the *Bulletin of the Geological Society of China*, 1927, Vol. 5, Nos. 3-4, p. 284, Dr. Zdansky gave an account of these teeth, the concluding two paragraphs of which I quote in his own words:—

"Granted the human origin of the teeth, there arises the question of their relation to the living and prehistoric races of man. . . . I am, indeed, convinced that the existing material provides a wholly inadequate foundation for many of the various theories based upon it. As every fresh discovery of what may be human remains is of such great interest, not only to the scientist, but also to the layman, it follows only too naturally that it becomes at once the object of the most detailed—and, in my opinion, too detailed—investigation. I decline absolutely to venture any far-reaching conclusions regarding the extremely meagre material described here, and which, I think, cannot be more closely identified than as *Homo sp.*

"The above has been written largely because I find I am credited, in certain quarters, with the discovery of the 'Peking



Man' (*vide* daily newspapers), which is supposed to be of Tertiary age. Leaving until a future date the publication of a detailed description of the fossil fauna from Chou Kou Tien, my purpose here is only to make it clear that my discovery of these teeth (which are of Quaternary age) should be regarded as decidedly interesting, but not of epoch-making importance."

The Professor of Anatomy in the Peking Medical College, Dr. Davidson Black, took a different view of the significance of the teeth. He had been profoundly influenced by the memoir published in 1915 by the late Professor W. D. Matthew, "Climate and Evolution" (*Annals of the New York Academy of Science*, XXIV, 171). In fact, the possibility (suggested by Dr. Matthew's argument) of the discovery of primitive man in China decided Dr. Davidson Black to accept the invitation, which he received after the war, to join the staff of the Anatomy Department in the Peking Union Medical College. The reality of Dr. Black's conviction was revealed in the memoir which he published in 1925, entitled, "Asia and the Dispersal of Primates" (*Bull. Geol. Soc. China*, Vol. IV, No. 2, p. 133). Hence when, a year later, Dr. Zdansky found human teeth in the Early Pleistocene or, as was then thought, Late Pliocene, beds, Davidson Black was convinced that the aim he had set before him several years before had been realized, and naturally regarded the discovery as truly epoch-making.

In a communication which, at the request of Dr. Andersson, he made at the scientific meeting held in Peking on October 22, 1926, he emphasized these considerations, and was able to interest Dr. Henry Houghton, then Director of the Peking Union Medical College, and Mr. Edwin Embree, then Secretary of the Rockefeller Foundation, to support an appeal for financial help to carry on the search at Chou Kou Tien. The late Dr. Richard Pearce, at that time Director of the Medical Division of the Rockefeller Foundation, so far appreciated the significance of the possibilities that he was able to induce the Foundation to make an appropriation for two years' work on the site.

This project met with immediate success, for on October 16, 1927, Dr. Birger Bohlin found a human lower molar tooth (Plate IIIa) in the deposit at Chou Kou Tien, where Dr. Zdansky found the teeth reported on October 22, 1926.

On December 2, 1927, Dr. Davidson Black announced to the Geological Society of China this important discovery and his courageous decision to use it as evidence for the creation of a new genus and species of the human family.

On the suggestion of Dr. A. W. Grabau, Professor of Palæontology in the National University of Peking, he called it *Sinanthropus pekinensis*. The age of the deposits in which the fossils were found was thought at this time to be Upper Pliocene; but a more careful sifting of the evidence provided by the associated mammals subsequently led the geologists to decide that the real age was Lower Quaternary (very early Pleistocene). Professor Schlosser in 1903 and all subsequent writers for the next quarter of a century believed that fossils found in deposits earlier than the loess of the Chili plain were Pliocene. But investigations during the season 1927-28, fully recorded in the exhaustive report published by Père Teilhard de Chardin and Dr. C. C. Young (*Bulletin of the Geological Society of China*, 1929, p. 173), established the age of the fossils as Early Pleistocene. The absence of truly archaic forms, such as the big *Hipparion*, *Chalicotherium*, etc., and the presence of horses and deer with more recent characters, showed that the beds were not so ancient as the Pliocene. The demonstration of its Early Pleistocene date was completed by the absence of fauna characteristic of the Middle Pleistocene—*Rhinoceros tichorhinus*, *Bos primigenius*, *Hyæna crocuta*, *Cervus elaphus*, etc.—and the presence of earlier forms.

Dr. Davidson Black claimed that the morphology and the proportions of the tooth left no doubt either of its human origin or of the fact that it is generically distinct from all other known human types. He came to the conclusion that its original possessor was a child corresponding in age to that attained by modern children at eight years, and presumed that it was derived from the same jaw as the lower premolar tooth whose discovery was reported in 1926 by Dr. Zdansky.

In 1903 Professor Schlosser had emphasized the fact that while the tooth he was describing on that occasion differed from those of other known human and simian remains, morphologically it was essentially human in type, but revealed certain remarkable points of similarity to one of the fossil apes from the Sivalik Hills. The tooth found in 1927, like that of 1903, was partly embedded in a stony matrix, which,

in addition to the condition of mineralization of the tooth itself, corroborated the extreme age of the specimen.

In a monograph published in 1927 (*Palæontologia Sinica, Series D, Vol. 7*) Dr. Davidson Black gave a detailed description of the tooth found by Dr. Bohlin in that year. He called attention to its distinctive characters, and contrasted it with a series of primitive human and simian teeth. He provided ample justification for his action in creating a new genus and species of the human family. He shows how every character of the tooth—the form and proportions of the crown, the peculiarities of the roots, and the size and form of the pulp cavity—all agree in conferring upon *Sinanthropus* a distinctive position intermediate between man and ape. Moreover, he showed how generalized are the characters of the tooth, so that it enables us to understand how the peculiarities revealed in the later types of the human family have been derived from this extremely primitive type by differentiation of some of the potentialities so clearly manifest in this interesting tooth. He showed also with great clearness the distinct likeness of the pattern of the crown to that revealed in the fossil ape *Dryopithecus*.

In spite of the very thorough and complete demonstration of the fact that the tooth of *Sinanthropus* was of early Pleistocene age, and definitely different from that of all other known human teeth (an extremely generalized human type presenting obvious analogies to the conditions found in the fossil apes which most nearly conform to the human type), Dr. Black's action in creating a new genus did not meet with any widespread support. A year later, however, the discovery made by Dr. Birger Bohlin, working in conjunction with Dr. C. C. Young and Mr. W. C. Pei, of fragments of two jaws and brain-cases, provided evidence which confirmed the validity of the genus founded in 1927 (Plate IIIb). The tooth upon which Dr. Black based his definition of the new genus conformed in character to the two teeth whose discovery was announced in 1926, as well as to the tooth described by Schlosser in 1903, and there can be no doubt that these four teeth all belong to *Sinanthropus*. One of the teeth found by Dr. Zdansky in 1926 probably came from the same jaw as the type-specimen found in 1927. The two jaws found in 1928 contained a number of teeth conforming to the same characteristic morphological type as that found in 1927. Both jaw fragments, one of a child and the other of an adult,

display very significant peculiarities in the chin region. The oblique slope of the anterior surface is comparable only to that of anthropoid apes and the Piltdown jaw; and a peculiar conformation of the lingual aspect of the jaw is analogous to, though not exactly identical with, the peculiarities of the jaw found at Piltdown in 1912, which has been discussed in the preceding chapter.

While the finding of this peculiar ape-like type of jaw in association with fragments of brain-cases, which are unquestionably human, provides corroboration of the justice of regarding the tooth of 1927 as that of a new genus, it also affords evidence which cannot be ignored in support of the validity of regarding the jaw found at Piltdown as part of the same human individual whose broken skull was also found alongside it. The features of the jaws of *Sinanthropus* seemed to suggest the possibility that the fossil man of China might be more nearly akin to the early Pleistocene Man of Piltdown than to the Ape-Man of Java. It would, however, be more accurate to say that, as nothing whatever is known of the type of jaw of *Pithecanthropus*, the only human jaw comparable with the Peking jaws was that found at Piltdown. The contrast between the teeth of *Pithecanthropus* and those of *Sinanthropus* suggests that there must have been a significant contrast between the jaws of those two primitive genera.

The importance of the work accomplished during the two years covered by the first appropriation of the Rockefeller Foundation led in 1929 to the renewal of the grant, and the creation of a special Department, the Cenozoic Research Laboratory, of the Geological Survey of China, under the honorary directorship of Professor Davidson Black. This significant action was due in large measure to the support of Mr. Roger Greene, the Executive head of the Peking Union Medical College.

The confidence which was implied in the granting of the new appropriation was immediately justified by the most impressive and significant discovery in the whole history of human palæontology. At four o'clock on December 2, 1929, Mr. W. C. Pei found an uncrushed and almost complete brain-case of *Sinanthropus*. While it was still embedded in the hard matrix of travertine (involving the base and a greater part of the sides of the skull) it seemed to be much more nearly akin to the skull of *Pithecanthropus* than to that of

*Eoanthropus*. While there is this obtrusive general resemblance to *Pithecanthropus*, however, it is important not to minimize the peculiarly significant expansion of the frontal and parietal parts of the brain-case, which so definitely distinguishes it from the skull of *Pithecanthropus*. There can be no doubt, however, that just as the finding of the jaws in 1928 suggested the possibility of some kinship with the Pilt-down Man, the skull found in 1929 caused opinion to swing in the other direction, and suggested a nearer kinship with *Pithecanthropus*. In 1930, however, when, after four months of intensive work, Professor Davidson Black completely liberated the skull from the matrix of travertine, the brain-case was revealed with a curious blend of characters hitherto regarded as distinctive, some of them of *Pithecanthropus* and others of *Eoanthropus* (Plate VI). The combination in the same specimen of peculiar characters hitherto regarded as incompatible one with the other was important as a revelation of the extremely primitive and generalized qualities of *Sinanthropus*. What was even more significant, it formed a link between the other two genera of early Pleistocene Man, concerning the validity and significance of which there had been so much doubt and suspicion. Hence the skull found in 1929 not only established on a firm foundation our knowledge of primitive man, to which it gave coherence and in which it inspired confidence, but, in addition, it revealed a type which was so primitive as to enable us to visualize the characters of the common ancestor of all three genera.

If the size and form of the eyebrow-ridges and the median frontal crest suggest a kinship with *Pithecanthropus*, the form of the posterior aspect of the skull presents a marked contrast to the Java fossil and a definite likeness to *Eoanthropus* (Plate IV; Fig. 4).

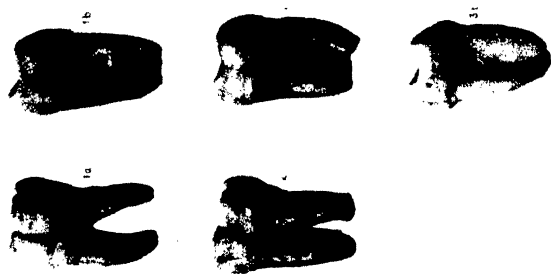
As long ago as 1903 Professor Schlosser defined the contrast between the tooth he was discussing and those of *Pithecanthropus*, differences which have been still further emphasized by Professor Davidson Black with the fuller material at his disposal.

The brain-case of *Sinanthropus* differs from that of *Pithecanthropus* not only in the matter of the local expansions of the frontal and parietal areas, but also in its general form and the characters of its cranial bones; for the exceptional thickness of the cranium and the peculiar architecture of the bones reproduce conditions which hitherto have been regarded as

# PLATE III



P. T. OF THE RIGHT SIDE OF THE ADULT MANDIBLE  
*Sinanthropus* FOUND IN 1928.  
 nts f hiarities analogous to, but not identical  
 that are distinct ve of *Eoanthropus*.  
 [Davidson Black.



TWO VIEWS OF THE PEKING  
 TOOTH (2a AND 2b) COMPARED  
 WITH SIMILAR VIEWS OF A  
 MODERN HUMAN TOOTH (1a  
 AND 1b) AND OF A CHIMPANZEE  
 (3a AND 3b).

PLATE IV

PITHECANTHROPUS



SINANTHROPUS



THE LEFT SIDE OF THE SKULLS OF *Pithecanthropus* AND  
*Sinanthropus*

(for comparison with Fig. 4).

[After Dubois and Davidson Black.

PLATE V



POSTERIOR ASPECT OF THE PEKING SKULL.

*[Davidson Block.]*



PLATE VI



UPPER ASPECT OF THE PEKING SKULL, REVEALING THE  
EXCEPTIONAL THICKNESS OF THE BRAIN-CASE AND THE  
DIMINUTIVE SIZE OF THE BRAIN.

[*Davidson Black.*]

distinctive of *Eoanthropus*. The form of the surprisingly small cranial cavity presents a significant contrast to that of *Pithecanthropus*, being narrower and loftier, and free from the grosser type of distortion revealed in the broad, flat endocranial cast of *Pithecanthropus*. The brain-case of *Sinanthropus* reveals many features which are unknown either in the Ape-Man of Java or in the Piltdown skull, and throws a great deal of light upon the characters of the common

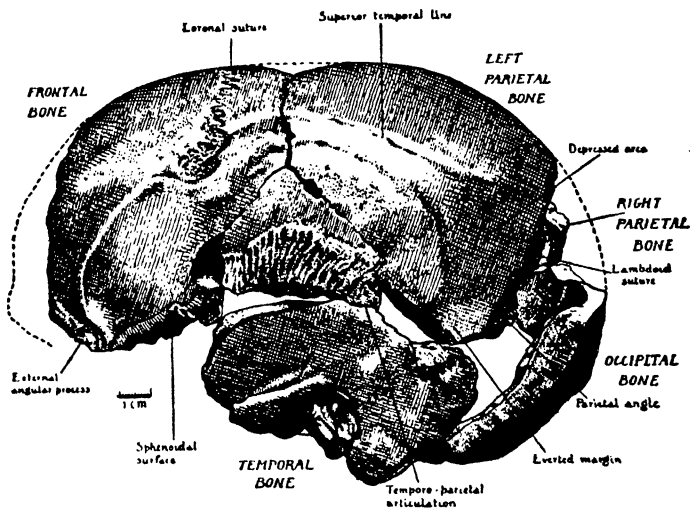


FIG. 4.—THE LEFT SIDE OF THE RECONSTRUCTED *Eoanthropus* SKULL.

[From G. Elliot Smith, "Evolution of Man"; Oxford University Press.

ancestor of the human family, from which all these genera had been derived. One of the most striking illustrations of this fact is the peculiar form of the mastoid region of the temporal bone, recalling as it does the condition found in the new-born child and in the adult anthropoid apes. For it lacks that salient character which is so distinctive of the adult human being of other genera.

The skull found in 1929 is that of an adolescent boy corresponding in the state of its development with the condition found in modern human skulls at about fifteen or sixteen

years of age. When the skull was first examined, Professor Davidson Black was impressed by the grace of its contours in comparison with the uncouth outlines of *Pithecanthropus*, and suggested the possibility that it might be female. Its grace, however, is probably a sign of its primitiveness and the fact that it is free from those secondary distortions which give the degenerate *Pithecanthropus* its bizarre character. The discovery of another brain-case was made in July, 1930 by recovering from material brought in from the Chou Kou Tien cave (in October, 1929) a series of fragments which naturally articulated one with the other to form the greater part of the calvaria of an adult. This discovery of a more lightly built skull with small eyebrow ridges, a less prominent forehead, and less obtrusive parietal eminences, enabled Professor Davidson Black to decide that it was female, and by contrast that the other skull was masculine. The discovery of a second skull (of a woman probably more than ten years older than the boy) enormously enhances the value of the information we have, because it permits comparisons to be made.

In the material found in 1928 there are remains of two other broken skulls (still embedded in travertine), which provide other important comparative material for studying the range of variation of the skulls.

Whether or not the Peking Man was older than the fossils found in Java and Sussex, there was no doubt that he represented a more primitive type. His characters were more generalized, some of them distinctly reminiscent of man's simian ancestry and others strangely foreshadowing the qualities hitherto regarded as distinctive of *Homo sapiens*. In other words, *Sinanthropus* enables us to picture the qualities of the original members of the human family by revealing a type which, though human, was curiously ape-like, and obviously close to the main line of descent of modern man.

The work of investigation and the recording of results have been carried on with exceptional thoroughness and imaginative insight. It was hoped by Dr. Davidson Black that the prompt publication of *Bulletins* and the wide circulation of manuscript reports, even before they were published, would have prevented the development of such misunderstandings as had marred the discussions of the fossil remains of man in the past. In spite of these precautions,

eminent palæontologists in Germany and France are already claiming that the Peking Man belongs to the genus *Pithecanthropus*; others in America have suggested that he is merely a Far Eastern example of Neanderthal Man; and others, again, that the Chinese fossils were not human.

Having just made a careful examination of the actual fossils in Peking and compared them with human and simian skulls, and the casts of the other kinds of extinct members of the human family, I can confidently support the opinion of Dr. Davidson Black that *Sinanthropus* is an undoubted member of the human family, who reveals in every part of his skull and teeth evidence to distinguish him from all other known human types, and to justify the separate generic rank suggested to define his status.

In studying the remains of early man, it is always a matter of particular importance to search for the tools and implements which might bring the human beings into association with some definite phase of industry. It is a very significant phenomenon that at Chou Kou Tien, in spite of the most careful search in the caves during the last three years, no trace whatever of implements of any sort has been seen. When it is considered how vast a quantity of fossil remains has been found, and the scrupulous care which has been exercised in the search, it must be something more than a coincidence that there is no trace of any stone implements. Not only have the various excavators been on the constant look-out for such artifacts (in particular Father Teilhard de Chardin has been looking for archæological evidence), but after the material was removed from the caves, a group of boys was set to sift the material once more, to make quite certain that no such evidence had been overlooked by the geological explorers. It must not be forgotten, however, that Dr. Andersson in 1921 found pieces of quartz in association with the fossil bones, and that in the later stages of the excavation Mr. Pei found further examples of this alien material. Those who have been searching in vain for evidence of human craftsmanship on this site are being forced to the conclusion that the Peking Man was in such an early phase of development as not yet to have begun to shape implements of stone for the ordinary needs of his daily life. Whether or not he made tools of wood or other perishable material, it is impossible to say, but presumably the chances are that a creature who had acquired the type of brain which

is distinctive of the human family, the development of which is intimately associated with growing skill and understanding, would have used implements of some sort, if nothing more than sticks, to protect himself and to obtain food either by digging or by killing animals.

## The Cradle of Mankind

IN searching for the earliest representatives of the human family, the question of the location of the birthplace of mankind naturally arises. In the preceding chapters it has been seen how large a part such speculations have played in directing the search for fossil remains. Dr. Dubois was led to the East Indies when he thought that the West had failed to provide the missing link. Dr. Davidson Black was encouraged to go to China as the result of the late Professor W. D. Matthew's speculations on the possibility of finding fossil remains of man there. And the question naturally arises when any new discovery is made as to what bearing it has on the big problem of determining the place where human beings first came into existence.

It may be said at once that none of these discoveries sheds any decisive light upon this problem. The mere fact that the earliest remains of man were found as far apart as Java, England, and China (Fig. 6) conclusively demonstrates that by the beginning of the Pleistocene period primitive men had already roamed as far as they could get east and west in the great continental land-mass of Europe and Asia. Hence the ancestor from whom these three divergent genera must have sprung, probably hundreds of thousands (if not millions) of years before, may have lived anywhere within this vast continental area. Yet although, in the present state of our knowledge, it is impossible to arrive at any definite conclusion upon this interesting matter, it is none the less fascinating—perhaps it is for that very uncertainty even more fascinating—to consider the evidence available at present to guide our speculations as to the possibilities of the situation.

In the course of the discussions in this book, reasons have been given for tracing the divergent stems of the anthropoid apes and the human family back to a common ancestor such as the ape *Dryopithecus*, the remains of which have been found in the Miocene beds of the Sivalik Hills north of Delhi in

north-west India, from which spot it seems probable different kinds of apes, orangs, chimpanzees, gorillas, as well as several types which are now extinct, such as *Dryopithecus* itself and the *Australopithecus*, wandered in different directions,

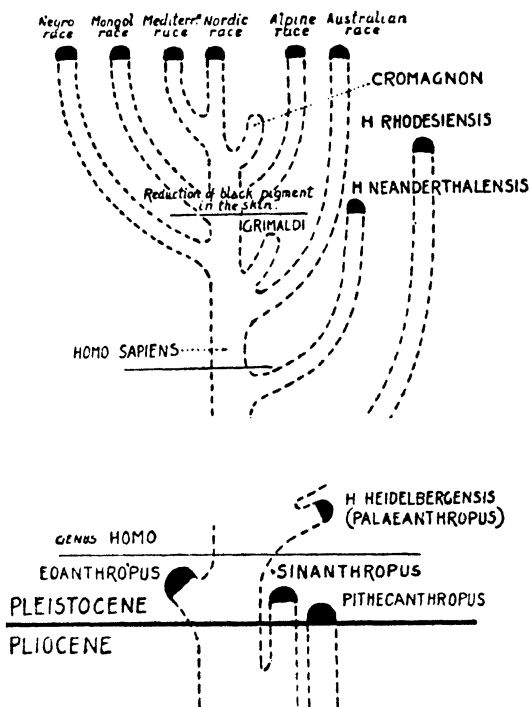


FIG. 5.—A TENTATIVE SCHEME OF THE RELATIVE POSITIONS OF THE DIFFERENT MEMBERS OF THE HUMAN FAMILY.

[From G. Elliot Smith's "Human History" Jonathan Cape.

some of them to the east as far as Borneo, keeping to the warm southern coast of Asia in their migrations; and others to the west through Persia and Arabia, there diverging into two branches, one passing to Europe as far as France and Spain, and the other passing to Equatorial Africa to provide the Dark Continent not only with the ancestors of the chimpanzees and

gorillas, but also with that interesting man-like ape called by Professor Dart *Australopithecus*, which moved further south, and left its remains at Taungs in Bechuanaland (Fig. 6, T).

The wanderings of these apes took place in the Miocene and the beginning of the Pliocene period. It is important not to forget these facts, because the apes were subject to severe restrictions, from which man emancipated himself when he acquired a fuller understanding of the world in which he lived and the power of more readily adapting himself to the changing conditions in his environment as well as to alterations of climate. Not only did man acquire the freedom to leave the forest country to which the apes are tied, and come out into the open, but he also learnt to adopt devices to circumvent the difficulties which prevented apes from wandering rapidly. Hence if the apes, with all their limitations, were yet able to wander as far as Spain and France in the west, the whole range of Africa to the south, and as far as Borneo and Sumatra in the east, obviously the earliest human beings may have wandered over a still wider area, and have done their travelling more quickly and more directly. Hence the presence of the earliest fossil remains of man in Java, England, and China affords tangible evidence of the fact that men had, in fact, roamed as far as they could in the genial regions of the great continental land-mass, and that anywhere within the range of Europe, Africa, and Asia might have been the original home of the human family.

In such speculations it is important not to forget the vast length of time that separates the wanderings of the giant apes we have been considering and the subsequent wanderings of primitive men. The wanderings of the apes took place mainly in the Miocene period, whereas the earliest human remains belong either to the beginning of the Pleistocene or to the end of the Pliocene period. Hence the whole of the Pliocene period, the duration of which is estimated at the present time as possibly as much as 16 million years, intervenes between the simian and the human wanderings, and during this enormous span of time no doubt a great variety of more or less grotesque caricatures of human beings tramped up and down the vast extent of country represented by the three continents of the Old World. Whatever be the relative ages of the Peking, Java, and Piltdown skulls, we know that these three are more ancient than any other human remains. The Heidelberg jaw, found in Germany, and a primitive type



of man found in Rhodesia, the actual representative of which may be comparatively recent, even if the type itself is ancient and possibly akin to the Heidelberg Man, indicate that after the early wanderings men still continued to roam, from Northern Europe to South Africa. Next in order come the Neanderthal Men, the area of whose wanderings, so far as we know at present, was restricted to Europe and Western Asia, a large series of remains having been found in Gibraltar, in France, the Channel Islands, Germany, Italy, Jugoslavia, Southern Russia, and Palestine.

Finally we come to *Homo sapiens*, whose age and birth-place are unknown to us. Until 1925 the earliest remains of *Homo sapiens* that had been recovered were the so-called Grimaldi skeletons found in the Riviera near Mentone, and the Combe Capelle skeleton from France, or possibly the completely fossilized Talgai skull found far afield in Australia. In 1925, however, during the excavations for the new building for the Corporation of Lloyd's in the City of London, there was found a fragment of a completely mineralized skull, which, in spite of certain peculiarities and of an antiquity vastly more remote than any other representative of *Homo sapiens*, seems to belong to that species. If this opinion should eventually be confirmed, London will have provided a representative of the modern type of man which is much older than, possibly ten times as old as, any other known member of the species. But where this species came into existence is still unknown. In my book *Human History* (1930) I suggested that Turkestan, Persia, or Mesopotamia—in other words, somewhere in the region around the Caspian—may have been the place of birth of *Homo sapiens*. The reason for such a suggestion is that if the distribution of the existing races of mankind be plotted upon a map, they will be found to radiate out from that part of the world, and what little is known of the wanderings of these various races emphasizes this consideration, and suggests that the aboriginal Australians wandered through India and the Malay Archipelago to reach their present habitat, that the Negroes wandered south-west to Africa, that the Mongols wandered north-east to reach their home in Eastern Asia, and that the Alpine and Mediterranean and Nordic races radiated from this same area respectively north, west, and north-west, to reach their areas of characterization.

This, of course, is a mere speculation made to give expression

to what we now know of the distribution of the various races of the human family, but it cannot be regarded as any final solution of the problem, which at present is insoluble simply because we have no evidence. The discovery of the Lloyd's skull in London suggests that this species, *Homo sapiens*, may be vastly more ancient than most anthropologists had hitherto supposed, and the very fact of this added antiquity makes the problem of deciding where the species came into existence increasingly uncertain and difficult.

Putting aside the question of the origin of the different branches of the human family, let us return for a moment to the problem of the place of origin of man—in other words, the place where one division of the apes, which had cultivated a larger brain than its fellows, was able to provide its hands with work of sufficient biological importance completely to emancipate them from participation in locomotion, and enable these brainy apes to cultivate their powers of skill and to train their observation and to devise articulate language and to become human beings. Darwin's argument was that, as man presents much closer affinities to the chimpanzee and gorilla than to the other apes and must, therefore, have arisen from the same group of apes which gave birth to these African anthropoids, it was highly probable that fossil remains of more primitive apes would eventually be found in Africa, and that possibly man himself was evolved in that continent. The discovery of the Taungs ape, revealing as it does—in the face, the size and form of the brain, and the structure of the teeth—definite evidence of greater resemblance to man than any other ape, living or fossil, presents, corroborates the general argument of Darwin, and definitely adds to its strength. Even if we admit that the actual specimen found at Taungs is too recent to be a direct ancestor of man (most authorities suggest that it is not older than the Pleistocene, but Dr. Robert Broom has raised the possibility that it may be as early as the beginning of the Pliocene), it may be the descendant of one of the apes from which man's ancestors were derived and who made their way into Africa, possibly in the Miocene period. Some of the fellow-travellers of this hypothetical ancestor of *Australopithecus* may have become more definitely modified in the human direction, until eventually they assumed the rank of human beings.

I have already explained the circumstances which induced Dr. Dubois in 1887 to look to the east for the birthplace of

mankind, or at any rate for the fossil remains of some creature who was intermediate in type between men and apes. He undertook this eastern pilgrimage when the discovery of the Spy skeletons convinced him that the Neanderthal type was unquestionably human, but not nearly primitive enough to be regarded as an early member of the human stock, much less "a missing link" between men and apes. When these theoretical considerations led him to discover *Pithecanthropus*, a member of the human family vastly more ancient and more primitive than any other type then known, this seemed to confirm the validity of his hypothesis, and suggest that, after all, the Far East may have been the place where the human family was evolved.

Against this there were two arguments—in the first place, the anthropoid types which most closely resemble man roamed to the west, and not to the east, at the great dispersal of the giant apes from India. The only apes that were known to have wandered to the east in the direction of Borneo and Java were the gibbons and orang-utans; and no one in these days assumes that man sprang directly from either of these more primitive anthropoids. In the second place, even if, as was at one time supposed, *Pithecanthropus* was as early as Pliocene in age, there was probably a vast interval between this date and the time of the evolution of man from a primitive ape such as *Dryopithecus*. In 1912 the finding of the Piltdown skull in England caused the pendulum to swing in the westerly direction again, and although no one suggested that England was the home of the human family, the discovery did restore the balance toward the west, and in the minds of certain anthropologists seemed to strengthen Darwin's claim for Africa as the home of the human family. It is obvious, however, that, for the reasons given in the case of *Pithecanthropus*, it afforded no conclusive evidence for the western origin, any more than *Pithecanthropus* did for the eastern.

The discoveries that have been made in China were in large part due to speculations on this question. Studying the wanderings of fossil mammals from the Miocene period onwards, the possibility seemed to take shape that the Miocene apes may have wandered north along with the *Baluchitherium*, north of India, and that possibly the great transformation of an ape into a human being may have occurred somewhere in Central Asia. Dr. Davidson Black was so impressed by the argument as it was developed by Dr. Matthew that he persisted in his

search for the remains of ancient man in China. Naturally when this search was rewarded by the most significant discovery in the whole range of human palæontology, and the recovery of a type of human being which, whatever its age, was certainly more generalized and primitive than either *Pithecanthropus* or *Eoanthropus*, it seemed that significant support was forthcoming for the hypothesis which had prompted the search.

Without attempting to minimise the strength of this argument, it is important not to forget the consideration I have already mentioned. The mere fact that *Pithecanthropus* and the Piltdown skull were found in the most distant parts, east and west, of the Old World suggests that the common ancestor of the genera and his descendants (during possibly hundreds of thousands of years in the Pliocene period) wandered up and down Asia, Europe, and Africa. Hence the mere finding of Peking Man, even if we admit that he is the most primitive of the three and structurally more nearly akin to the common ancestor of the other two, does not settle the question of origin.

In the discussions of this important problem which have been taking place in China during recent years, Dr. Grabau and Dr. Davidson Black have revived the old theory of the possible influence of the raising up of the Himalaya range in providing the circumstances which compelled certain anthropoid apes to adapt themselves to new conditions, and in the process to be transformed into men.

The argument will become more intelligible if the reader will look at the map (Fig. 6). Until the beginning of the Miocene period there was no range of vast mountains in Northern India to separate India from what is now Chinese Turkestan. There was complete continuity of level country between India and Central Asia, and we know from the distribution of the fossil remains of certain animals that they were free to pass from India into Central Asia. We have no positive evidence that the giant apes which were living in the Sivaliks in India in the Miocene period had wandered as far as Turkestan, but it is not unreasonable to assume that they had done so, seeing that there was no barrier, and the climatic and natural conditions were uniform between Northern India and what is now the valley of the Tarim. When, therefore, in the Miocene period the Himalaya range (H) was thrust up to cut off the Sivalik region (O) from what is now the Sinkiang

province of China, the giant anthropoid apes akin to *Dryopithecus* would be separated into two groups, the habitats of which are marked in the map as O and S. The former, living in the Sivalik region under conditions which were essentially identical with those under which their ancestors had dwelt before, in warm forest regions which would provide the same

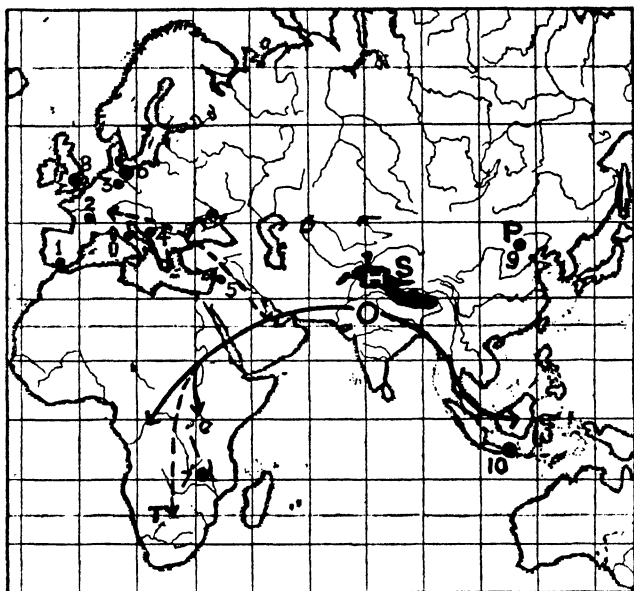


FIG. 6.—MAP TO ILLUSTRATE THE EARLY WANDERINGS OF APES AND MEN.

O, Sivalik Hills; H, Himalaya Mountains; S, Sinkiang Province (Chinese Turkestan); P, Peking; T, Taungs; 8 (Pitldown), 9 (Peking), and 10 (Java), the habitats of the earliest men; 6 (Heidelberg) and 7 (Rhodesia), the habitats of later primitive men; 1, 2, 3, 4, and 5, some of the localities where remains of Neanderthal men have been recovered; lines of migration of the Orangs to Borneo and the ancestors of the Chimpanzees and Gorillas to Africa; broken lines to suggest the route of *Australopithecus* (T) in Africa and *Dryopithecus* in Europe.

type of food to which they had been habituated, would not have been compelled to change their habits or to modify their

structure. They would continue to live on in these forests as apes not very different in structure and function from their predecessors, and could wander freely in the tropical area east as far as Borneo, into which the oranges intruded; west into Africa and Europe, invaded by the ancestors of the chimpanzees and gorillas, *Australopithecus*, *Dryopithecus*, and some of its Miocene fellows. The hypothetical group of *Dryopithecus*-like apes which became stranded in Sinkiang (S), and cut off from India by the vast range of the Himalayas (H), are assumed by this theory to have been subjected to a profound change of climate and conditions of life, changes so extreme that the creatures would have to become transformed in structure and habits if they were to survive under these novel and drastic conditions. Hence the speculation has been put forward that the sudden raising up of the Himalayas in the Miocene period threw one particular group of these primitive apes into circumstances which compelled them either to suffer extinction or to become capable of a different type of existence, which demanded a greater power of adaptation to changing circumstances. It must not be assumed, however, that, even if evidence should be forthcoming—evidence in the shape of fossils found in the Tarim valley or elsewhere in the Sinkiang province—in corroboration of this theory, the Sinkiang apes at once became transformed into human beings. All that one could claim for such a hypothesis is that it would explain how a particular group of primitive apes was forced into circumstances which would promote *the beginning of the change* in the human direction, and probably compel apes to adapt themselves to a mode of life away from forests and arboreal habits. They would have to seek new kinds of food, and to adopt in very much larger measure than any anthropoid apes a dependence upon animal food, possibly shell-fish obtained from the rivers and eventually meat such as no ape ever uses for food. Even if this were the case, it can only be regarded as the beginning of the process which converted an ape into a human being, and it does not, in any case, settle the question of the home of mankind. Probably it took a vast period of time between the later Miocene and the early Pliocene to change this hypothetical, most man-like of the apes into a real man. Moreover, once a group of apes became emancipated from their dependence upon forests for their habitat and upon particular kinds of vegetable food, those more adaptable apes would begin to search far and wide, with the greater freedom they

then enjoyed, for a greater variety of food and attractive places to dwell in, and in this process they did, no doubt, extend into Africa and to Europe, and possibly to China. We have no evidence at all that they did so, excepting in the case of *Australopithecus* in Africa—a fact which affords a certain amount of corroboration for the reality of such an ape as I have depicted. For it is claimed that the Taungs ape had become emancipated from dependence upon forest country, and had begun to change its face, its brain, and its teeth in the human direction.

I have called attention to these considerations not merely because of their bearing upon the general discussion as to the original home of the human family, but also to criticize certain suggestions which have been put forward by Dr. Grabau of Peking ("Asia and the Evolution of Man," *China Journal*, March, 1930). For one of the arguments that Dr. Grabau uses in support of his theory is the facility with which primitive man who came into existence in the Sinkiang province could have wandered east to Peking and west to Piltdown and south-east to Java. This suggestion takes no account of the vast period of time which elapsed between the raising up of the Himalayas in the Miocene and the migration of the Peking Man at the beginning of the Pleistocene period. There is an interval of 20 or 30 million years between these two events; and during this time, to judge by what the apes themselves accomplished in the Miocene, the more adaptable apes which were on the way to become human beings no doubt wandered much more rapidly up and down the same area many scores of times before the birth of Peking Man. In other words, the proximity of the Sinkiang province to the Western Hills near Peking is an essentially irrelevant consideration to bring into this argument, seeing that these half-formed men in the later Miocene and the Pliocene epochs had probably roamed east and west.

Interesting as these questions are for speculation, one is bound to admit in the end that we have no decisive information as to the place or the time of birth of the human family, but we have certain indications which suggest that the first step in the transformation of apes into men may have occurred north of the Himalayas. This raises the further possibility that the chimpanzee, the gorilla, and *Australopithecus*, may represent three of the different experimental types which show a definite advance upon other apes in the direction of man

and may indicate the way in which the transformation was begun and the direction in which animals which were being transformed wandered during the process of evolution. In other words, even if one tentatively accepts the speculations put forward by Dr. Grabau and Dr. Davidson Black, these in no sense exclude the possibility suggested by Charles Darwin of the likelihood of Africa being the home of the human family.

If the discoveries of the early fossil remains of man do not carry back his history into the Pliocene period, the existence of three widely divergent Pleistocene genera makes the existence of Pliocene Man certain. Wherever he was evolved, he displays evidence of close kinship to the African anthropoids, and has certainly sprung from the same source as that which gave them birth.

The romantic story of the recovery of human remains that are so ancient and primitive as to compel their finders to create new genera for their reception is a very recent chapter in the growth of knowledge. The author of *Man's Place in Nature*, who would have been so keenly interested in the realization of his convictions, was denied any adequate knowledge of these momentous discoveries. Four months before his death Huxley was told (in a letter from Professor Marsh) of the discovery of *Pithecanthropus* and wrote a letter to Sir Joseph Hooker on Feb. 14, 1895, which is reproduced in facsimile in Leonard Huxley's *Life and Letters of Thomas Henry Huxley* (Vol. II, p. 395), with an amusing sketch of what he imagined the living Ape-Man to have been in the flesh, and this verbal picture:—"a Socratic party, with his hair rather low down on his forehead and warty cheeks. *Pithecanthropus erectus* Dubois (fossil) rather Aino-ish about the body, small in the calf, and cheese-cutting in the shins."

For fuller information on the issues raised in this book the reader is recommended to consult—

*The Guide to the Fossil Remains of Man* (British Museum, Natural History), by Sir Arthur Smith Woodward.

A. C. Haddon, *Anthropology* (Watts' Popular Science Series).

M. Boule, *Fossil Men* (Edinburgh, 1923).

W. J. Sollas, *Ancient Hunters* (3rd Edn., 1924).

Sir Arthur Keith, *The Antiquity of Man and New Discoveries relating to the Antiquity of Man* (1931).

G. Elliot Smith, *The Evolution of Man* (2nd Edn., 1927 and *Human History* (1930).



- Davidson Black, "On an Adolescent Skull of *Sinanthropus Pekinensis* in comparison with an Adult Skull of the same species and with other Hominid Skulls, Recent and Fossil," *Palæontologia Sinica* (Geological Survey of China, Peiping, April 28, 1931). Reviewed in *Nature*, May 30, 1931.
- William K. Gregory, "The Dentition of *Dryopithecus* and the Origin of Man," Anthropological Papers of the American Museum of Natural History, Vol. XXVIII, Part 1, 1926; "Dawn-Man or Ape?" *Scientific American*, September 1927; "The Origin of Man from the Anthropoid Stem—When and Where?" *Proceedings of the American Philosophical Society*, Vol. LXVI, 1927; "The Upright Posture of Man, a Review of its Origin and Evolution," *Proceedings of the American Philosophical Society*, Vol. LXVII, No. 4, 1928.
- Adolph H. Schultz, "Embryological Evidence of the Evolution of Man," *Journal of the Washington Academy of Sciences*, Vol. 15, June 19, 1925.
- Hans Weinert, *Menschen der Vorzeit* (Stuttgart, 1930).
- George Gaylord Simpson, "A New Classification of Mammals," *Bulletin of the American Museum of Natural History*, March 31, 1931.
- A. W. Grabau, "A Summary of the Cenozoic and Psychozoic Deposits with Special Reference to Asia," *Bulletin of the Geological Survey of China*, Vol. VI, 1927; "An Outline of the Geological History of North China," *Peking Natural History Bulletin*, 1929-30, Vol. 5.

In the latter memoir Professor Grabau writes:—"So far as I know the first to point out the influence of the rising Himalayas on the evolution of man was the late Professor Joseph Barrell of Yale University."

Since this book has been in print Professor Othenio Abel's valuable treatise, *Die Stellung des Menschen im Rahmen der Wirbeltiere* (Jena, 1931), has been published. It is the most complete book of reference on Primate palæontology so far issued.





