

Pithecanthropus Erectus

— A Classic of Science

Biology

PITHECANTHROPUS ERECTUS—A Form from the Ancestral Stock of Mankind. Part of a paper read before the Berlin Anthropological Society on the 14th of December, 1896. Translated from the Anatomischer Anzeiger, Vol. XII. Published in the general appendix to the Smithsonian Report for 1898. Washington, 1899.

PART TWO

The Skullcap—Continued

Its considerably greater size constitutes a significant difference between it and all other skulls of apes. In the length and breadth measurements of the skull the chimpanzee is exactly a mean between it and the largest gibbon. Its cranial capacity I estimated in my above mentioned description, according to a comparison of the external lineal dimensions, as about 1,000 c. cm. Estimating now upon a more recent comparison of the internal linear dimensions with those of gibbons' skulls makes it but little more than 900 c. cm. A capacity of 900 c. cm. is, however, far above anything we know in the skull of apes. The largest skulls of anthropoid apes have, on the average, no greater capacity than about 500 c. cm., and it is very seldom that they have been found to attain the capacity of 600 c. cm.

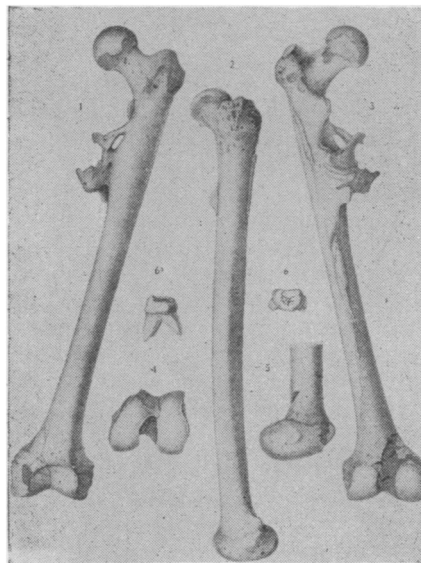
Disregarding this, some believe that the skull may have belonged to a true ape. If we should imagine the skull of *Hylobates agilis* to have somewhat more than doubled its mass, we should have a skull of a similar great ape. But if in actual fact a *Hylobates* had reached such a size, it is quite certain that his cranial capacity would not have increased in the same degree, for we continually find in the most diverse families that large animals have relatively smaller brains than smaller allied species. For example, the dwarf antelope (*Nanotragus pygmaeus*) has in proportion to its bodily weight more than four times as much

Several views of the single leg-bone and one of the three teeth which, with the skullcap, are all we know of the biological puzzle called *Pithecanthropus erectus*. Some biologists say this femur is wholly human, others agree with Dubois who says that it has peculiarities rarely found in man but common in certain apes.

The controversy over the "missing link" has been going on for some thirty-five years with little sign of abating. This does not mean that scientists cannot make up their minds about *Pithecanthropus*. The "anthropists" and the "pithecists" hold each to their own views with passionate fervor. But the fact that opinion is so divided over these ancient bones only proves how intermediate they are between ape and man. A scientist has recently proposed the only solution of the controversy—to find the rest of the skeleton.

brain as the Beisa antelope. The smaller lower apes very much surpass in this respect the large anthropoid apes, and the gibbons possess, in proportion to their bodily weight, at least twice as much brain as the great anthropoids.

Such an imaginary gigantic *Hylobates* would be about as tall as a man and about as heavy as the great anthropoids. Its cranial capacity would therefore not exceed some 500 c. cm. But this is only a little more than that of *Pithecanthropus*. A true ape with a capacity of 900 c. cm., must, on the contrary, be a giant beside which the largest gorillas would be dwarfs. Even if the bodily size increased only in the same ratio as the cranial capacity, the animal would have a body almost twice as large as that of a large gorilla. But the bodily size increases in a greater ratio than that of the brain and the cranial capacity,



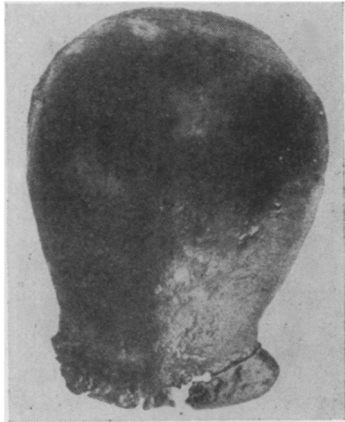
so that it may be assumed that the size of an anthropoid ape having a cranial capacity of 900 c. cm. would be at least three times as large as that of a large gorilla; that is to say, about as large as a pretty large horse. It is not easy to imagine an ape like that leading the tree life of the nimble *Hylobates*.

The cerebral portion of the skull of such a gigantic ape would, in relation to the rest of the body, be much smaller than that of the gorilla. This relatively small cranial capsule would have all the provisions for the attachment of a powerful masticatory apparatus for furnishing nourishment to the gigantic body, such as is shown by the skull of a gorilla, but in a much greater degree than in this living gigantic ape. For a jaw of such mighty proportions, which would be much larger in mass than the whole of the rest of the skull, there would have to be a zygomatic arch much more extensive and more strongly vaulted than that which the gorilla possesses. Upon the skullcap there would have been formed strong bony ridges for the attachment of the temporal muscles, and these ridges would certainly have formed crests in the middle and behind. The orbital rims would have been raised in a much more striking manner than is seen in the gorillas' skull, and the impression of the bestiality of such a gigantic ape would have been much greater.

We see, however, nothing of this in this fossil skull. It is as smooth, even, and destitute of crest as the skull of an ordinary gibbon.

The skullcap, therefore, in spite of its ape-like appearance, can not have belonged to an ape, because in its excessive capacity it is dissimilar to both a gibbon's skull and that of a great gorilla.

There are, however, some features that separate this skull from that of the apes of the Old World and ally it to that of men. These concern the occiput. As already remarked above, there is a peculiar formation occasioned by the abrupt separation of the *planum nuchale* from the upper part of the *squama occipitalis*, determined by the *torus occipitalis transversus*, which is certainly a pithecoïd feature; compare the inclination of the *planum*



nuchale to a plane formed symmetrically through the most prominent part of the glabella and of the external occipital protuberance, and it will be seen that in this respect there is a great difference between this skull and those of all the apes of the Old World. The most diverse species of the latter show a slighter variation with each other regarding the angle between the nuchal plane and the glabello-protuberantial plane than is shown between them and the fossil skull. Among the anthropoids I find not more than three degrees of variation; in *Semnopithecus maurus* the inclination of the nuchal surface is 4° less, and in *Macacus cynomolgus* it is 10° less than the minimum among the anthropoids. In the Java skullcap, the occiput has the greatest likeness—only being double the size—to the highly vaulted skull of a gibbon. It is not strange, therefore, that I have made the facial portion of the skull not very different from that of the gibbon.

II.—TEETH

The teeth, a left second upper molar and a third right upper molar, belong, if we may judge from the circumstances of their discovery, to each other and to the skullcap. They are also modeled in a very similar manner and are in the same state of preservation and of petrification. The unequal wear of their crowns and the considerable difference in their size are appearances that can often be seen both in the skulls of men and of apes. Both have very strongly diverging roots, such as others as well as myself acknowledge never to have seen in human molars. Only exceptionally are there found in man upper molars with a crown of such great size. I measured on a skull from New South Wales, in Virchow's laboratory, the transverse and sagittal diameters of a left second upper molar, finding it 15.5 by 12.5 mm., and those of a

The top and left side of the *Pithecanthropus* skullcap. The somewhat prominent eye-brow ridge and the lack of ridges for attachment of heavy facial muscles are readily seen. The discoverer believes that these appearances show that the animal was small and lightly built, with a relatively large brain-case.

third upper molar, finding it 15 to 10.5 mm. The same dimensions of the fossil molars from Java are 14 by 12 mm. for the second upper molar, and 15.3 by 11.3 mm. for the third upper molar. A second upper molar from the cave of Spy I found to be of exactly the same dimensions as the molar from Java.

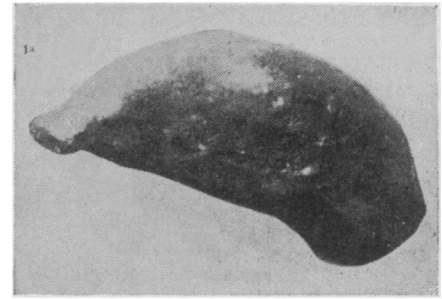
In the form of the crown the Javanese molars show a marked ape-like type; that is to say, in the relative development of their cusps. As in anthropoid apes, the posterior buccal cusp is in both teeth the smallest, so that the cusps of both are smallest on the outer side. In man the reverse is the case. Only in the third molar is an exception to this rule rarely found.

An exhaustive comparison has, however, convinced me that the teeth are in no closer relation to those of any of the living anthropoids.

In spite of all their simian characters, both, especially in the third molar, show a strong retrogression of the crown, such as is more frequently found in man than in the anthropoid apes. According to this the general arrangement of the dental arch must have been widely different from that which obtains with the great anthropoid apes. Comparing the size of the teeth with that of the skull, the proportion is found to be the same as that in the gibbon, but somewhat less than that which prevails with the anthropoid apes. They therefore agree very well with the smooth, crestless skullcap.

III.—FEMUR

The femur was quite generally declared to be human by authors who had closely examined either the actual specimen or drawings of it. It has, as before mentioned, a very deceptive resemblance to the human femur. It differs from the latter, however, and that difference is as great as that between bones of the same name in different but somewhat related species of mammals having a similar locomotion, as, for instance, *Colobus* and *Semnopithecus*, *Cervus* and *Antilope*. The most important difference concerns the form of the diaphyses in the popliteal region. It is much rounder than in man. The *planum popliteum* is therefore less extensive and more convex, so that



exactly in its middle a kind of swelling extends as far as the neighborhood of the condyles. In the human femur the most projecting portion of the popliteal region is in the neighborhood of the lateral lip of the *linea aspera*. In the fossil femur, on the contrary, that lip is situated more on the lateral surface of the shaft.

After examining hundreds of human femora, Manouvrier could find only two that had a somewhat similar shape. It is therefore a very rare form in man. With the gibbon a similar form normally occurs, the median convexity in this species being, however, somewhat higher. This may be explained by the peculiar insertion of the femoral head of the biceps femoris that occurs in this species, it being attached in the middle line below the adductor magnus in close connection with the vastus internus. An extension of these conditions might, as Dr. Hepburn has pointed out to me, produce the median convexity of the entire popliteal region which we find in the fossil femur. In man the popliteal space becomes flattened by reason of the wide separation of the medial and lateral muscles in this region. In those isolated cases of a similar formation, found in an examination of hundreds of femora, there may have been a simian form of muscular attachment.

The exostosis of the fossil bone—considered by me as the result of a traumatic periostitis, and by Virchow as caused by a psoas abscess that had descended from along the spinal column—appears as a so-called tendinous or aponeurotic deposit of osseous tissue, such as occurs not very infrequently in man and is also to be seen, though in a less degree, on the humerus of the skeleton of an orang-outang in the Dresden Museum. This pathological formation has no significance as regards the systematic determination of the bones.

It has been generally allowed by everyone that the femur must have belonged to an animal that walked erect. The circumstances under which it was (*Turn to next page*)

Pithecanthropus erectus—Continued

found, in the neighborhood of the skullcap, make it very highly probable that both belonged to the same individual; and now, since we have shown that the anthropoid skullcap may not have belonged to an ape, but possibly to a being that walked upright, this probability increases quite to certainty, for this reduces the deficiency in human characters which the skullcap showed when compared with the femur. The femur is not human in the usual sense, for it, as we have seen, shows features that occur only very seldom in human femora. Besides, the similarity of form may, as before stated, be sufficiently explained by a similarity of function, so that an entirely human form of femur need not necessarily have belonged to a man, but be found likewise in some other genus. Only an examination of the entire skeleton could give a complete solution to this question.

According to the relative proportions of these parts they can not both have belonged to an ape. For an ape with such a cranial capacity would, as we have seen, have been a giant, whose femur would certainly have been much larger than twice the size of that of a siamang. But a man with a cranial capacity of 900

cm. would have a shorter femur; for all men, except microcephali, that have so low a capacity as this have a much smaller stature than that of 165 to 170 cm., which is the height of the individual, as calculated from the length of this femur according to human proportions. This is again an evidence that the individual in question was, in the anatomical sense, neither an ape nor a man.

With the length and breadth measurements of the skull, however, the length and breadth of the femur well, both from a human and anthropoid point of view. A man with a skullcap of these dimensions could well have had a femur of that size, and if we conceive the proportions of a siamang to be doubled, the length and breadth of the skull and the length and breadth of the femur will exactly correspond with that of *Pithecanthropus*.

Nothing contradicts the view that the possessor of this cranium had a body to which this femur belonged. The skull requires exactly such a femur and no other.

As therefore, from different points of view, probability speaks most strongly in favor of the common origin of these fragments, it is carrying skepticism too far to longer doubt that both of them, and the

teeth as well, belonged to one skeleton.

I believe that it now hardly admits of a doubt that this upright-walking ape-man, as I have called him, and as he is really shown to be after the most searching examination, represented a so-called transition form between men and apes, such as paleontology has often taught us to recognize between other families of mammals; and I do not hesitate now, any more than I formerly did, to regard this *Pithecanthropus erectus* as the immediate progenitor of the human race. This is my conviction after the most careful testing of the matter, and has only become stronger after having submitted the specimens to many anatomists.

The exact position to be assigned to the ape-man in a system is more or less a matter of taste. According to the anatomical characters ordinarily used to separate the groups of mammals, we must at any rate exclude it from the genus *Homo*. Unless we considerably change and extend the characters that have hitherto been considered good for the family of the Hominidæ, it can not even be admitted there. Quite the same may be said of the Simiidæ and its species.

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Solving a Scientific Hoax—Continued

asserting that the jumble of ideas about the alphabetic writing on the inscription proved pretty well that it was not alphabetic at all.

The joker, if he lived through these decades, continued to enjoy his private jest with the world's scholars. There is no doubt that he has died long before now, and so he is missing the present climax of the affair.

To Andrew Price, printer, the Grave Creek mound and its inscription have long been part of the familiar local traditions of his state. He never saw the stone, but he has seen various copies of the inscription, and being a printer, his first interest was to sort out the separate letters on the stone. This gave him his first clue. The figures do not stay neatly on their separate lines, like most printed letters, but instead he saw that they run together in some instances above and below the lines.

In his statement, he says humorously, "I conceived a new test for the tablet, and hunted up a number of

alphabets, including Hieroglyphic, Hieratic, Babylonian cuneiform, Semitic, Phoenician, Greek, Hebrew, and Roman, and sat down to draw a few far-fetched conclusions."

But before he began struggling with these ancient texts, he happened to glance at the picture of the inscription which lay on a chair some feet away. From that angle, he thought he could read the last line, "Oct 14 1838."

"As that was the year the tablet was discovered, I put the alphabets back in the bookcase and tried to read it in good old West Virginian," says this astute printer.

Long experience at puzzling over badly written manuscripts kept him at the job, and with his valuable clue that the letters extended over more than one line, he picked out the entire message, recognizing at once its connection with Dickens' satire.

The statement of Mr. Price's solution of the mystery has been received at the U. S. National Museum, by Dr. Walter Hough, curator of archaeology.

"The inscription from the Grave Creek Mound is one of the most famous tablets in American archaeological annals," Dr. Hough stated, in commenting on the new turn that the situation has taken. "The inscription has been a mark for linguists to shoot at for almost a hundred years. There is no doubt that Mr. Price has solved the problem, aided by his knowledge of letter forms."

Jubilant at his success, Mr. Price has added his own satirical fling at the antiquarian who once solemnly asserted that science would continue to ask how the stone came to be in the mound but the question would never be answered.

"Fiddlededee!" chuckles Mr. Price, "Never be answered? The Dickens it won't! The man to answer it is a man who has read Dickens' books at least twenty times; who set type from illegible manuscripts for years; and who is an unworthy member of the Academy of Science. Hooray for Bill Stumps' stone!"

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