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GIANT EARLY MAN FROM JAVA AND SOUTH CHINA[1]

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JAVA, which stood in the focus of anthropologists fifty years ago when Eugène Dubois first announced the find of the "missing link," *Pithecanthropus erectus,* became a cynosure again when Dr. R. von Koenigswald, of the Geological Survey of Netherlands Indies, made a series of discoveries, each later one always more important than its predecessor. It began, in 1937, with the discovery of a large fragment of a lower jaw found in the Trinil beds of Sangiran. This jaw was much more complete than the one picked up by Dubois from the Trinil beds of Kedung Brubus, in 1891, and later attributed by this author to *Pithecanthropus.* Then followed the surprising discovery, in 1938, of a skull cap—fragmentary too—but much more complete than Dubois' Trinil skull which it resembles as one egg another in general form as well as in details. This specimen proved beyond the slightest doubt that *Pithecanthropus* is morphologically not a giant gibbon, and as such intermediate between ape and man, as Dubois insisted, but a true hominid very like the Peking man, *Sinanthropus pekinensis.* In 1939, von Koenigswald's native collector picked up an upper jaw from the same site from which the skull cap of 1938 had come. This jaw, almost complete, but slightly crushed, was the second surprise. It was in all dimensions larger than any known fossil or recent human jaw; there was a fairly wide gap between the canine and the incisor; the canine was not tusk-like but showed all the peculiarities of the *Sinan-*

[1] Read before the American Ethnological Society in New York, May 9, 1944. The war and its consequences prevented Dr. R. von Koenigswald from announcing the new discoveries referred to in this paper. Since Java is cut off and neither Dr. von Koenigswald nor the Geological Survey of Netherlands Indies are approachable, I asked the Board for the Netherlands Indies, Surinam and Curaçao, which represents the government of Netherlands Indies, for an official permit to publish the material, being sure of Dr. von Koenigswald's personal consent. Mr. G. H. C. Hart, the chairman of the board, kindly approved the publication.

thropus canines; the second molar was larger than the first and the third ones and, finally, the palate was smooth and not covered with rugosities. In other words, the jaw exhibited several very distinct simian features beside its general human appearance, a combination never observed before. Some weeks later the calvaria to which the jaw belonged was recovered. Although the entire frontal part is missing the rest is impressive enough. The brain case is considerably larger than that of the two *Pithecanthropus* skulls, not because of greater capacity but as the result of the extraordinary massiveness of the bones and the heaviness of the so-called superstructures, the enormous occipital protuberance and a peculiar sagittal crest which runs along the top of the skull.

So the new skull considerably differed from the two *Pithecanthropus* skulls found earlier. But as von Koenigswald and myself were still under the spell that all human remains gathered from the Trinil formation of Java must belong to the *Pithecanthropus* type, we declared the big, massive skull to be male and the two smaller and less massive ones to be females. This was all the easier as no other upper jaw and upper teeth of *Pithecanthropus* were known. But soon I felt a little less sure of this decision when von Koenigswald informed me several months later that a new fragment of a lower jaw had been recovered from the same locality, but obviously from a larger jaw than that of 1937. Unfortunately, this new jaw is very defective, in particular in the canine and premolar regions, so that it is quite impossible to determine the real nature of this specimen as long as nothing but a cast is available. However, one thing seems to be sure. If it is an anthropoid as it appears to be, then this anthropoid is not only much shorter snouted than any known anthropoid but also has some undoubtedly human-like features. If it is a hominid, then it has some simian features not encountered so far in hominids. However this may be, Java and Dr. von Koenigswald provided us, in 1941, with an additional and still more important find which follows the same line as already indicated by the previous ones, but is so unambiguous in its morphological character that it can help us without resorting, for the moment, to the ambiguous jaw of 1939.

This new and so far latest discovery, with which we were becoming acquainted just before the occupation of Java by the Japanese cut all ways of communication, is again the fragment of a lower jaw. It is undoubtedly a human jaw, but the features which render certain this identification reveal such an early state that they stamp this jaw as the most primitive human skeleton part ever found. However, this is not the only revolutionary disclosure. Not less momentous is the fact that this jaw exceeds by far in size, especially in thickness, all that is known of any fossil or recent human jaw, including the famous Heidelberg jaw. Contrarily to the latter, the teeth of the new jaw participate in this gigantism.

Von Koenigswald, recognizing at once the human character of the fragment and, of course, also its gigantic proportions, gave the type the name *Meganthropus palaeojavanicus*. So far we have no other word from von Koenigswald, but by labelling the specimen in this way he makes known that he considers the type represented by the jaw as a giant hominid different from *Pithecanthropus*. The new find not only introduces a completely new and unexpected form into our collection of fossil hominids, it also compels us to revise our view about the uniformity of the human fossils embedded in the volcanic ashes and sands of the Trinil formation of Central Java. As a first consequence of the new knowledge we have to scrutinize again the big skull of 1939 which we ranked as a male individual among the *Pithecanthropus group*. This skull is not a true giant form when compared with the proportion of the new jaw, for the *Meganthropus* jaw is much too large and massive for it. Yet compared with the two "female" skulls found earlier, the big skull already shows a clear tendency toward gigantism and as such appears intermediate between Dubois' *Pithecanthropus erectus* and von Koenigswald's *Meganthropus palaeojavanicus*. In order to emphasize this peculiar position I have proposed to call this intermediate type *Pithecanthropus robustus*.

When we make an inventory of all the lower or upper jaws of hominids recovered from the Trinil beds, we face the singular and certainly surprising fact that all four differ in size, the smallest being the so-called *Pithecanthropus erectus* of Kedung Brubus, the largest the *Meganthropus* jaw, while the lower jaw of 1937 and the upper jaw of *Pithecanthropus robustus* fit in between the two extremes, the former again a little smaller than the latter. As these differences in size go hand in hand with differences in morphological characteristics—the larger one is in general more primitive than the succeeding smaller one—it is obvious that we have before us a group of closely related types each derivable from the other in the sequence of their size.

Before we enter into a discussion of how this fits in with the scheme of phylogenetic evolution of man and the available geological data, we must refer to another discovery Dr. von Koenigswald has made, this time not in Java but in South China. Aware of the well-known fact that the drawers of Chinese apothecaries are places where you can count on gathering rare fossil teeth and bones, he used to hunt for those curios whenever he passed through China. He was

fortunate enough to secure three strange teeth in this way, between 1934 and 1939, each time in chemist's shops in Hong Kong. The first acquired tooth, rather considerably worn but still recognizable, was a right lower molar without roots, but of gigantic proportions. In the same drawers there were, among other teeth and bones, teeth of stegodon, tapir and orang-utang, most of them without roots, but with indication that they were gnawed off. Von Koenigswald determined the big molar to be the tooth of an anthropoid and called it *Gigantopithecus blacki*. However, von Koenigswald was unable to say more about this tooth, but it was evident to him that it has no close relationship to any of the known living or fossil anthropoids. The next tooth, acquired some years later, was an upper molar also without roots but much less worn; and the latest acquired was again a third lower molar but this time a left one and only very slightly worn. The posterior root was preserved, the anterior broken or gnawed off. The degree of wear proves that the two third molars had belonged to two different individuals. Thus, *Gigantopithecus* is represented so far by two or eventually three adult individuals. But the gist of the whole story, which arouses our foremost interest, is the fact that *Gigantopithecus* is not a giant ape, as von Koenigswald assumed, but a giant man and should, therefore, be called *"Gigantanthropus."* This follows beyond any doubt from the very characteristic pattern of the occlusal surface of the teeth, which differs fundamentally in the structure of the cusps from that of any known anthropoids but agrees even in the minutest details with the hominid pattern as shown by the molars of *Pithecanthropus, Sinanthropus* and even modern man. On the other hand, the form of the teeth, especially that of the third lower molar, and the condition of its root indicate that it has preserved a very primitive character, much more primitive than the known third molars of any fossil hominid. Therefore, we have the same combination which struck us in the human fossils of Java; namely, primitiveness together with gigantic proportions. But in the case of *Gigantopithecus* the gigantism reaches a new climax. The volume of the crown of the third lower molar is about six times larger than the average crown of modern man; compared with the corresponding tooth of the gorilla, it is about twice as large.

In the case of the Javanese *Meganthropus* with a considerable part of the jaw preserved, we can risk computing the probable size of the skull and the body. If a gorilla is taken as standard size we shall not fail much in estimating that *Meganthropus* reached the size, stoutness and strength of a big male gorilla. Concerning *Gigantopithecus* we are more in the dark, because the lower and the upper molars are the only basis for calculation. Nevertheless, it seems safe to say that *Gigantopitheeus* considerably exceeded *Meganthropus in size and robustness.*

The next question which arises is, of course, as to whether there is any evidence of connection between the giant hominids from Java and China, and, if so, what kind of connection exists. In spite of the deficiency of the material in both cases, and although we seemingly do not know more of the provenance of the *Gigantopithecus* teeth than the fact that they were gathered from drawers of a chemist's shop, we are surprisingly well off if we follow the traces provided by the conditions of the teeth. Teeth of stegodon, tapir and orang-utang with defective roots are common articles of commerce in South Chinese apothecaries and come from caves in the Provinces of Kwangsi, Yunnan or Szechuan, where they represent the characteristic leading fossils of the so-called "yellow deposits."[2] The same fauna is characteristic of the Trinil beds in Java, for which reason it has been called the "Sino-Malayan" fauna. *Gigantopithecus* is apparently the hominid member of this faunistic association in South China, as are *Meganthropus* and the *Pithecanthropus* group in Java. The "yellow deposits" in the South China caves belong geologically to the Lower or Middle Pleistocene. The Trinil beds in Java which yielded all the hominid material we have spoken of are also considered as Middle Pleistocene formations. But there is evidence that at least one early hominid form, the baby skull of *Modjokerto* recovered by the Geological Survey of Netherlands Indies in 1936, goes down to the Djetis bed, which belongs to the Lower Pleistocene. On the other hand, the determination of the Trinil beds as Middle Pleistocene does not exclude the possibility that some of the fossils embedded in the layers are in reality older and washed into the beds by torrents and mud streams which accompanied volcanic eruptions very frequently during this whole geological period.

As the Sino-Malayan fauna immigrated into Java from the Asiatic continent, the different hominid forms, and certainly the most primitive ones, must have taken the same way. This may have happened in the Late Pliocene or in the Lower Pleistocene, at which time south-east Asia apparently was a seat of human evolution. Therefore, neither geological nor morphological facts can be produced against the assumption that *Gigantopithecus* is an ancestral hominid

[2] Dr. C. C. Young, of the Geological Survey of China, my collaborator at the Cenozoic Research Laboratory in Peiping, who has just arrived in this country from Chungking, informs me that, according to investigations during the last few years, the caves containing the "yellow deposits" are widely distributed over the whole territory of South China south of the Yangtse River extending eastwards even to the coast, and that their fauna have the same character everywhere.

form which has been reduced in size and massiveness as it developed in the direction of modern man. *Sinanthropus pekinensis* is morphologically so close to *Pithecanthropus erectus* that he can be regarded as a parallel form of the latter. *Sinanthropus* may have taken its origin also from *Gigantopithecus,* with the only difference that in this case his transformation may have taken place on the mainland of Asia itself to the north of the original center.

All this is, of course, hypothetical and must be verified by additional and more complete material, and particularly by stratigraphic work on the sites concerned. Also the answer to another question which forces itself upon the mind has to be postponed until further evidences are at hand. Are gigantism and massiveness indispensable features of the earliest mankind and, consequently, characteristic of all human forms; or have they to be regarded as accidental, regional or individual variations as they occur in other mammalian groups? The occurrence of large fossil human skulls with very thick individual bones in early or late stages, for instance in *Homo soloensis, Homo rhodesiensis* and in the Heidelberg jaw, seem to indicate that gigantism and massiveness may have been a general or at least a wide-spread character of early mankind.[3]

ON NATURALLY OCCURRING PORPHYRINS IN THE CENTRAL NERVOUS SYSTEM[1]

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WE have found that the fluorescence spectrum of the white matter of the central nervous system, in numerous animals, reveals a well-defined emission band at 630–620 mμ with a maximum at about 625 mμ. When the brain and spinal cord of an adult rat are examined under the light of a mercury vapor lamp which has passed through a Corning filter No. 5874, the reddish fluorescence of the spinal cord is found to contrast strikingly with the greenish fluorescence of the cerebral and cerebellar cortex. When portions of white matter are removed from larger mammals, such as freshly killed monkeys, dogs or pigs, and examined, the 625 emission band is found to appear in the funiculi of the spinal cord, the fiber tracts of the pons and medulla oblongata, the medullary center and laminae of the cerebellum, the cerebral and cerebellar peduncles, the internal and external capsules, the corpus callosum, the fornix, the anterior commissure, the optic chiasm, the centrum semiovale and the medullary centers of the frontal, parietal, occipital and temporal lobes. The cortex and the basal ganglia, with the exception of the globus pallidus, exhibit a continuous fluorescence spectrum (about 630–430 mμ). The 625 band, although relatively weak, is found to be present in the globus pallidus, thalamus and lateral geniculate body.

Spectroscopic examination reveals the presence of the 625 band even in the white matter of a live animal. After death, the band is still present in animals killed with ether, chloroform, carbon monoxide, pentobarbital sodium, lactic acid, methylene blue, insulin, mescaline, bulbocapnine, metrazol, quinine, harmine or strychnine. Furthermore, an emission band in the red region remains present in the white matter: (1) after immersion in liquid nitrogen, (2) after boiling for 1 hour in distilled water, (3) after irradiation with 200 r or 2,000 r of x-rays and (4) after several weeks in darkness at room temperature. Exposure of the white matter to light, however, leads to a disappearance of the 625 band.

In examining the brains and spinal cords from animals of 33 different species, the 625 band has been found to be present in the white matter of all the following 25 species of mammals and birds studied: man, rhesus monkey, green monkey, cebus monkey, spider monkey, squirrel monkey, common brown bat, cat, dog, rabbit, guinea pig, rat, mouse, pig, ox, sheep, goat, hartebeest, Grant's gazelle, opossum, common rhea, duck, chicken, pigeon and great horned owl. On the other hand, we have been unable to detect the 625 band in any of the following 8 species of fully grown amphibians or reptiles: leopard frog, bull frog, iguana, gila monster, Texas collared lizard, bull snake, milk snake and indigo snake. It seems, therefore, that the fluorescence spectrum indicates the presence of a fundamental constituent of the white substance of warm-blooded animals. The position of the band and the fact that the spectrum is one of Dhéré's[2] Type I strongly suggest a porphyrin.

In an attempt to extract and identify naturally

[1] This research has been aided by a grant from the Committee for Research in Dementia Praecox founded by the Supreme Council 33°, Scottish Rite, Northern Masonic Jurisdiction, U. S. A.

[3] For details, illustrations and references the reader is referred to a paper of mine in preparation which will be published under the same title in the "Anthropological Papers of the American Museum of Natural History," Vol. 40.

[2] C. Dhéré, "La fluorescence en biochimie." Paris, 1937.