SCIENCE

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FRIDAY, MAY 29, 1896.

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*THE APE-MAN FROM THE TERTIARY OF JAVA.**

NEAR the beginning of last year, a discovery was announced that excited great interest throughout the scientific world, especially among those interested in the origin and antiquity of man. The announcement first made was that remains of a veritable missing link between man and the higher apes had been found in Java, in strata of Pleistocene age. The discovery was made by Dr. Eugene Dubois, a surgeon in the Dutch army, who had been stationed in Java for several years and had devoted much time to the vertebrate fossils of that island.

The first definite information received in this country was in December, 1894, when Dubois's memoir on *Pithecanthropus* arrived.† One of the first copies reached the late Prof. Dana, and at his request I wrote a review of it, which appeared, with illustrations, in the *American Journal of Science* for February, 1895.

The memoir of Dr. Dubois was an admirable one, and, although written in Java, with only limited facilities for consulting the literature on the subject, and for comparing the remains described with living

* Abstract of communication made to the National Academy of Sciences at Washington, April 24, 1896.

† *Pithecanthropus erectus.* Eine menschenaehnliche Uebergangsform aus Java. Von Eug. Dubois, Militairarzt der niederlaendish-indischen Armee. Mit zwei Tafeln und drei in den Text gedruckten Figuren. 4to, Batavia, 1894.

and extinct forms to which they were related, the author showed himself to be an anatomist of more than usual attainments and fully qualified to record the important discovery he had made. In my review, therefore, of this important memoir I endeavored to state fairly the essential facts of the discovery, as well as the main results reached by Dr. Dubois after a careful study of the remains. My own conclusions in regard to this discovery, briefly stated in my review, were as follows :

"It is only justice to Dr. Dubois and his admirable memoir to say here that he has proved to science the existence of a new prehistoric anthropoid form, not human indeed, but in size, brain power and erect posture much nearer man than any animal hitherto discovered, living or extinct. * * * Whatever light future researches may throw upon the affinities of this new form that left its remains in the volcanic deposits of Java during later Tertiary time, there can be no doubt that the discovery itself is an event equal in interest to that of the Neanderthal skull.

"The man of the Neander valley remained without honor, even in his own country, for more than a quarter of a century, and was still doubted and reviled when his kinsmen, the men of Spy, came to his defense, and a new chapter was added to the early history of the human race. The ape-man of Java comes to light at a more fortunate time, when zeal for exploration is so great that the discovery of additional remains may be expected at no distant day. That still other intermediate forms will eventually be brought to light no one familiar with the subject can doubt."

In most scientific quarters, however, both in this country and in Europe, Dr. Dubois's discovery was not received with great favor and the facts and conclusions stated in his memoir were much criticised. The early conclusions seemed to be that the various remains discovered were human and of no great age; that they did not belong to the same individual; that the skull apparently pertained to an idiot, and that both the skull and femur showed pathological features. In fact, the old story of the distrust aroused by the discovery of the Neanderthal skull, nearly forty years before, was repeated, although in milder form.

It was a fortunate thing for science that the Dutch government appreciated the importance of the discovery made in its Javanese province by Dr. Dubois, and last summer allowed him to return to Holland and bring with him the precious remains he had found and so well described. Not only this, but he was also permitted to bring the extensive collections of other vertebrate fossils which he had secured from the same horizon and in the same locality where the *Pithecanthropus* was discovered. All these were shown at the International Congress of Zoölogists, held at Leyden, in September last, and on the 21st of that month Dr. Dubois read an elaborate paper on his original discovery and on his later explorations in the same region. This communication was in many respects the most important one of the session, and its presentation with the specimens themselves was a rare treat to the large audience present, especially to those fitted to appreciate the evidence laid before them.*

Prof. Virchow, of Berlin, was president of the meeting on that day, and had brought various specimens to illustrate the remarks he was to make in the discussion. The famous Leyden museum was also drawn upon for an extensive series of specimens of man and the higher apes, so that, if possible, the true position of *Pithecanthro-*

* Compte-Rendu des Séances du Troisième Congrès International de Zoologie, Leyden, September, 1895, pp. 251–271, 1896. See also Transactions Royal Dublin Society, Vol. VI., pp. 1–18, February, 1896; and Anatomischer Anzeiger, Bd. XII., pp. 1–22, 1896.

pus might then be determined once for all. Dr. Dubois, moreover, kindly invited Prof. Virchow, Sir William Flower and myself to come an hour before the meeting and personally examine the remains he was to discuss, and this invitation was most gladly accepted.

The first sight of the fossils was a surprise, as they were evidently much older than appeared from the descriptions. All were dark in color, thoroughly petrified, and the matrix was solid rock, difficult to remove. The skull-cap of *Pithecanthropus* was filled with the hard matrix, firmly cemented to it. The roughness of the superior surface, especially in the frontal region, was apparently due to corrosion after entombment, and not to disease, as had been suggested by some anatomists. The femur was free from matrix, but very heavy in consequence of the infiltration of mineral matter. The exostosis on its upper portion was a conspicuous feature, but of course is pathological. This feature is of little consequence, as very similar outgrowths occur on fossil bones of even Eocene age. The two teeth showed no characters that indicated their interment under circumstances different from that of the skull or femur. All the physical characters impressed me strongly with the idea that these various remains were of Tertiary age, and not Post-Tertiary, as has been supposed. The description of the locality and the account of the series of strata there exposed, as given by Dr. Dubois in his communication, confirmed this opinion, and a later examination of accompanying vertebrate fossils placed the Pliocene age of all beyond reasonable doubt.

The facts relating to the discovery itself, and the position in which the remains were found, as stated by Dubois in his paper, together with some additional details given to me personally, convinced me that, in all probability, the various remains attributed to *Pithecanthropus* pertained to one individual. Under the circumstances, no paleontologist who has had experience in collecting vertebrate fossils would hesitate to place them together.

The three specimens originally described, the tooth, skull and femur, were found at different times in the same horizon, all imbedded in the same volcanic tufa, in the bank of the river Bengawan, near Trinil, in central Java. The tooth was found first, in September, 1891, in the left bank of the river, about a meter below the water level during the dry season, and twelve or fifteen meters below the plain in which the river had cut its bed. A month later, the skull was discovered, only a meter distant from the place where the tooth lay. In August, 1892, the femur also was found, about fifteen meters distant from the locality where the other specimens were imbedded. Later, in October of the same year, a second molar was obtained at a distance of not more than three meters, from where the skull-cap was found, and in the direction of the place where the femur was dug out.

The fossils thus secured were all carefully investigated by Dubois, who regards them as representing a distinct species and genus, and also a new family, which he has named the *Pithecanthropidæ*, and distinguished mainly by the following characters:

Brain cavity absolutely larger, and, in proportion to the size of the body, much more capacious than in the *Simiidæ*, yet less so than in the *Hominidæ*. Capacity of the skull about two-thirds the average of that of man. Inclination of the nuchal surface of the occiput considerably greater than in the *Simiidæ*. Dentition, although retrogressive, still of the simian type. Femur equal in its dimensions to that of man, and like that adapted for walking in an upright position.

Of this skull, the upper portion alone is preserved, the line of fracture extending

from the glabella backward irregularly to the occiput, which it divides somewhat below the upper nuchal line. The cranium seen from above is an elongated oval in

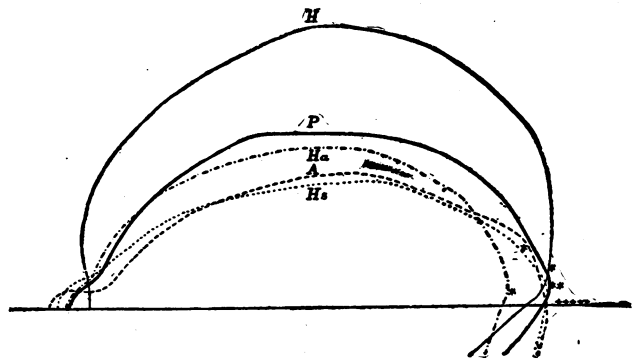

FIG. 1.—Longitudinal outlines of crania. H. European man; P. *Pithecanthropus;* Ha. *Hylobates agilis;* A. Chimpanzee; Hs. *Hylo- bates syndactilus.* (After Dubois.)

1 and 2. The greatest length from the glabella to the posterior projection of the occiput is 185 mm. The greatest breadth is 130 mm, and the smallest, behind the orbit, is 90 mm. The cranium in its original condition must have been of somewhat larger dimensions. The upper surface of the skull is without ridges, and the sutures all appear to be obliterated.

This dolicocephalic skull, with an index of 70°, is readily distinguished from that of the Orang-utan, which is decidedly brachycephalic. The absence of the characteristic cranial crests will separate it from the skull of the adult Gorilla. In its smooth upper surface and general form, it shows a resemblance to the skull of the Chimpanzee, and still closer to that of the Gibbons (*Hylobates*).

A figure of the present specimen and the skull of a Gibbon for comparison are shown in figures 2 and 3, below, reproduced from illustrations in Dr. Dubois's memoir.

The tooth, the first specimen found, is represented in figure 4, below. It is the last upper molar of the right side, and is in good preservation. It indicates a fully outline, dolichocephalic; and is distinguished from that of other anthropoid apes by its large size and its higher arching in the coronal region, as shown below in figures adult, but not very old, animal. The crown is subtriangular in form, with the corners rounded, and the narrowest portion behind. The anteroposterior diameter of the crown

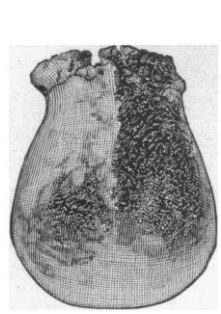

FIG. 2.—Cranium of *Pithecanthropus erectus,* ⅓.
FIG. 3.—Skull of *Hylobates syndactylus,* ⅓. (After Dubois.)

is 11·3 mm, and the transverse diameter 15·3 mm. The grinding surface of the crown is concave and less rugose than in existing anthropoid apes. The diverging roots are a simian feature.

The femur, which is from the left side, is in fair preservation, although it was somewhat injured in removing it from the surrounding rock. It belonged to a fully adult individual. In form and dimensions it resembles so strongly a human femur that

only a careful comparison would distinguish one from the other.

These various remains of *Pithecanthropus* were again described in detail and compared with allied forms by Dr. Dubois in his paper at Leyden, and in the discussion that followed the whole subject was once more gone over by anthropologists, zoölogists and geologists in a most thorough and judicial manner. To attempt to weigh impartially the evidence as to the nature of *Pithecanthropus*, presented by Dr. Dubois in his paper and by those who took part in the critical discussion that followed its reading, would lead far beyond the limits

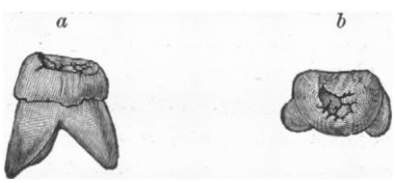

FIG. 4.—Third right upper molar of *Pithecanthropus erectus*, ⅔. (After Dubois.)
a, back view; *b*, top view.

of the present communication. I can only say that this evidence was strongly in favor of the view that the skull of *Pithecanthropus* is not human, as the orbital and nuchal regions show, while at the same time it indicates an animal much above any anthropoid ape now known, living or extinct. Opinions differed as to whether the various remains pertained to the same individual, but no one doubted their importance.

The varied opinions expressed in regard to the anatomical characters of each of the specimens have already been published, and need not be repeated here. Dr. Dubois, in his papers above cited, has met all the principal objections made to his views since he announced his discovery. He has also given full reference to the literature, which promises to be voluminous as the importance of the subject becomes better known.

After a careful study of all the *Pithecanthropus* remains and of the evidence presented as to the original discovery, the position in which the remains were found, and the associated fossils, my own conclusions may be briefly stated as follows:

(1) The remains of *Pithecanthropus* at present known are of Pliocene age, and the associated vertebrate fauna resembles that of the Siwalik Hills of India.

(2) The various specimens of *Pithecanthropus* apparently belonged to one individual.

(3) This individual was not human, but represented a form intermediate between man and the higher apes.

If it be true, as some have contended, that the different remains had no connection with each other, this simply proves that Dr. Dubois has made several important discoveries instead of one. All the remains are certainly anthropoid, and if any of them are human the antiquity of man extends back into the Tertiary, and his affinities with the higher apes become much nearer than has hitherto been supposed. One thing is certain: the discovery of *Pithecanthropus* is an event of the first importance to the scientific world.

O. C. MARSH.

THE METRIC SYSTEM.

THE issue of SCIENCE for May 15th contains the report of a meeting of the Engineers' Club of Philadelphia, at which, by a vote of 100 to 60, the Club urges upon Congress the adoption of the metric system as the only legal standard in the United States, and the promotion of such international coöperation as will provide unity of practice among commercial nations.

In connection with this it may be of interest to note the issue of a circular entitled 'Should the metric weights and measures be made compulsory?' It is signed by J. Emerson Dowson, of London, who is a member of the Institute of Civil Engineers and Chairman of the Executive Committee