

Fourth Note on the Piltdown Gravel

(with Evidence of a Second Skull of *Eoanthropus dawsoni*)

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with appendix by Prof. Grafton Elliot Smith, M.A., M.D., F.R.S.

The Piltdown gravel has already been well described by the late Mr. Charles Dawson,¹ who pointed out its variable character and concluded that its two lower layers at least could not be very different in age.² Further extensive excavations last summer round the margin of the area previously explored, tended to confirm this impression, and to show that the whole deposit is a shingle-bank which may have accumulated within a comparatively short space of time. The lenticular patches of the dark-brown ferruginous gravel proved to be even more variable than before, and they were seen to pass both into the sandy clay below and into the less clayey deposit above. Large flints and waterworn pieces of Wealden sandstone were still observed scattered irregularly through the finer material. The characteristic 'sub-angular flints' were also found at intervals in the basal sandy clay. More interesting, however, was the discovery in this layer of numerous large elongated flints and pieces of Wealden sandstone, with their long axis more or less nearly vertical. The evidence of flood-action thus became complete.

Although so much material was carefully examined, neither bones nor teeth were met with. The only noteworthy find was a battered nodule of black flint, which occurred in a rather sandy patch of the dark-brown gravel resting immediately on the basal layer. This specimen, which is conspicuously different from the other flints and very little stained, may have been used by man as a hammer-stone. It measures nearly 13 centimetres in length by 9.5 cm. in width, and about 7.5 cm. in maximum thickness. The largest face, which is almost flat, has been produced by coarse flaking, and bears marks of much battering round the edge, especially at one angle.

The opposite large face is covered for the greater part by the original crust of the flint-nodule, but is strongly battered along the two cross-ridges and one connecting edge, from which lateral flakes have been struck. Where not thus flaked the periphery of the flint is also covered with the original crust. Like the later undoubted hammer-stones, therefore, this flint has been used mainly on two opposite faces; but it appears to owe its present form merely to use, not to any original intentional shaping. All the edges are remarkably sharp, and the black facets bear scarcely any patina.

The wide distribution of the Piltdown gravel, as determined by its characteristic brown flints, was shown by Mr. Dawson in his map of 1912.³ It could easily be traced in the ploughed fields of the district; but, notwithstanding the most careful and persistent search, it yielded no fossils, except at the original locality, until the winter of 1914-15. One large field, about 2 miles from the Piltdown pit, had especially attracted Mr. Dawson's attention, and he and I examined it several times without success during the spring and autumn of 1914. When, however, in the course of farming, the stones had been raked off the ground and brought together into heaps.

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Mr. Dawson was able to search the material more satisfactorily; and early in 1915 he was so fortunate as to find here two well-fossilized pieces of human skull and a molar tooth, which he immediately recognized as belonging to at least one more individual of *Eoanthropus dawsoni*. Shortly afterwards, in the same gravel, a friend met with part of the lower molar of an indeterminable species of rhinoceros, as highly mineralized as the specimens previously found at Piltdown itself.

The most important fragment of human skull is part of the supra-orbital region of a right frontal bone adjacent to the middle line. It is in exactly the same mineralized condition as the original skull of *Eoanthropus*, and deeply stained with iron-oxide. It is also similarly thickened, exhibiting the characteristic very fine diploe with comparatively thin outer and inner table of dense bone. It provides a portion that was absent in the first specimen, its upper end approaching within a few millimetres the level of the anterior broken edge of the left frontal in the latter, while its lower portion now leaves only about 2 cm. of the supra-orbital border unknown. Its gently upward and backward curvature is that already assumed in restorations, and its outer face is marked only by a small and low supraciliary ridge(s), which is well above the orbital border, fades away medially at the beginning of the glabella, and only extends laterally just beyond the supraorbital notch.

On the inner face of the bone the median border bears an unusually stout sagittal crest, which is slightly marked by a groove for the longitudinal sinus. The impressions of the convolutions of the frontal lobe of the brain are feeble, but show some features of interest, as described by Prof. Elliot Smith in the Appendix. The orbital plate, as might be expected, is broken away, and the rather tumid glabellar region is imperfect below, exposing small air-sinuses, which do not appear to extend along the supraorbital notch.

This notch is especially conspicuous (perhaps enlarged by abrasion in the fossil), and the supraorbital border to the right of it forms a comparatively sharp edge. The median plane of fracture follows closely the line of the interfrontal suture, which, however, judging from the appearance of the broken surface, cannot have been persistent. It shows a complete septum between the air-sinuses of the right and left sides, and indicates the total thickness of the bone at the frontal crest.

The following are some measurements of thickness of the new fossil, in millimetres: –

Supero-lateral angle	10
Thinnest part of lateral edge	8
Sharp supraorbital border	12
Upper end of sagittal crest	13
Lower end of sagittal crest	19

With these may be compared the following measurements of thickness of the original specimen of *Eoanthropus*:–

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Left frontal at nearest point of approach to part represented by the new fossil	11
Thinnest part of frontal above the left orbit	9

The second fragment of human skull is the middle part of an occipital bone, which is also well fossilized, but seems to have been weathered since it was derived from the gravel. Though still stout, it is thinner than the corresponding bone of *Eoanthropus* from Piltdown, and differs from the latter in at least one important respect. The outer face of the fossil extends upwards just beyond the superior curved line which passes along a gentle transverse prominence; while the lower edge of the fragment is a little below the inferior curved line. The inner face shows the internal occipital crest, with its protuberance, displaced somewhat to the right of the median line, the fossa for the left cerebral hemisphere being relatively wide.

The broad transverse grooves for the lateral sinus, however, are at the same level on the right and left sides, and the upwardly turned groove at the torcular Herophili of the longitudinal sinus is large and conspicuous on the right. The fossæ for the cerebellum indicate very little asymmetry. The brain must thus have been much more nearly symmetrical than that of the original specimen of *Eoanthropus*—a difference that is to be regarded as merely an individual variation.

When, however, a vertical section of the bone is made along the external occipital crest which marks the median plane, an essential difference is observable between this and the previously-described specimen. The superior curved line of the outer face and (by inference) the inion, or external occipital protuberance, are distinctly above the level of the upper edge of the lateral sinus which denotes the limit of the tentorium covering the cerebellum; whereas, in the first specimen, the same external and internal features are opposite, as in modern man.

It is therefore clear that, in the skull represented by this new fossil, the muscles of the neck must have extended farther up the occiput than is usually the case. Such an upward extension of the neck-muscles is already known in Neanderthal man, where it is supposed to be correlated with the support of a heavy face; and it may be that in still earlier man the condition was variable, perhaps even different in the male and in the female. If this were so, there would be no reason to hesitate in referring the fragment now described to *Eoanthropus dawsoni*.

The following are some measurements of thickness of the new occipital bone, compared with that of *Eoanthropus* previously described:—

	New fossil	<i>Eoanthropus</i>
Greatest thickness	17 mm.	20 mm.
Thickness at internal protuberance	16 mm.	20 mm.
Thinnest part of cerebellar wall	4 mm.	4 mm.

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The tooth, discovered by Mr. Dawson in the same locality as the two pieces of bone, is a left first lower molar agreeing very closely with that of the original specimen of *Eoanthropus dawsoni*, but more obliquely worn by mastication. It is equally well fossilized, and stained brown with oxide of iron in the usual manner. The difference in the mode of wear can be seen in its anterior end-view when this is compared with that of the original specimen. The tooth, as before, is elongated antero-posteriorly, and its grinding surface lacks any well-defined cruciform fissure, its central area being an irregular, nearly smooth depression.

Of its two inner cusps, the anterior is the larger, and must have been more elevated than the posterior cusp (its worn apex exposing a small triangular area of dentine, while the latter is still covered with enamel). Both the outer cusps are worn down to the dentine, the anterior exposing a slightly larger area than the posterior cusp. The small fifth cusp behind is, as usual, nearest the outer border, from which it is visible in side view. It is also worn down so as to expose a very small area of dentine. Between this, the postero-internal cusp, and the posterior border of the tooth, the crown is slightly marked by a small transversely-extended depression. In outer view and inner view, the depth of the crown is well seen, and the two cusps are clearly separated by a fissure. At both ends of the tooth, a pressure-scar is distinguishable. The two roots, of which only the upper portions are preserved, are separate nearly as far as the neck of the tooth, which is but slightly constricted.

If the new tooth be compared with the corresponding molars of a Melanesian, a Tasmanian, and a Chimpanzee, of approximately the same size, it will readily be recognized as essentially human. In the considerable depth of the crown and its gradual passage into the root, it agrees with the human tooth and differs from that of the Chimpanzee, in which the crown is very brachyodont and overhangs the root. As a human molar it is unusual in the feebleness of its cruciform fissure, and in the presence of the slight depression on the crown behind the postero-internal and fifth cusps; but both these features are approached in the Melanesian tooth selected for comparison.

In the antero-posterior elongation of the crown and in the characters just mentioned, it obviously resembles the corresponding tooth of the Chimpanzee; but the cusps in the latter are so brachyodont that much larger areas of dentine are exposed when they are worn down to the level reached in the fossil. These comparisons are made because it has been stated that the molar teeth in the Piltdown mandible are those of a Chimpanzee: reference to the teeth of other known Apes is not necessary.

The following are the extreme measurements (in millimetres) of the teeth taken between the convexities of the sides:—

	Melanesian	Tasmanian	New Tooth	Chimpanzee
Length	13	13	13	12
Width	11.5	11.5	11	10.5

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The following are similar measurements of the two lower molars in the original specimen of *Eoanthropus dawsoni*:—

	M1	M2
Length	12.5	13
Width	11	11.5

From the new facts now described it seems reasonable to conclude that *Eoanthropus dawsoni* will eventually prove to be as definite and distinct a form of early Man as was at first supposed; for the occurrence of the same type of frontal bone with the same type of lower molar in two separate localities adds to the probability that they belonged to one and the same species.

Again I have to thank the Lord of the Manor, Mr. G. M. Maryon Wilson, and the tenant of Barkham, Mr. Robert Kenward, for facilities in continuing the exploration of the Piltdown gravel-pit. I am also indebted to Mr. C. G. Turner, of Uckfield, for much kind service. Finally, I desire to thank my colleague, Mr. W. P. Pycraft, A.L.S., for his valuable help in making comparisons with the osteological collection under his charge.

Footnotes

1. Q.J.G.S., vol. lxx (1914) p. 82.
2. Ibid. vol. lxxi (1915) p. 147.
3. Q.J.G.S. vol. lxix (1913) p. 118.
4. G. S. Miller, 'The Jaw of the Piltdown Man' *Smithson. Miscell. Collect.* vol. lxxv, No. 12 (1915). Endorsed by W. K. Gregory, 'Studies on the Evolution of the Primates' *Bull. Amer. Mus. Nat. His.* vol. xxv (1916) pp. 313-20. Replied to by W. P. Pycraft, 'The Jaw of the Piltdown Man' *Science Progress*, No. 43 (1917) pp. 389-409.

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APPENDIX.

On the Form of the Frontal Pole of an Endocranial Cast of *Eoanthropus dawsoni*
Prof. G. Elliot Smith, M.A., M.D., F.R.S.

Although the fragment of the right side of the frontal bone reveals the form of only a small area (little more than 5 cm. long x 3 cm. broad) of the endocranial surface, which is devoid of obtrusive features, it is of interest and importance because it sheds some light upon a part of the endocranial cast of which nothing was known before. Moreover, it is a part of the cast, the frontal pole, the form of which is of peculiar significance in the study of the features of early Man.

In a communication dealing with the endocranial cast of the Boskop skull, which I presented to the Manchester Literary & Philosophical Society last month,¹ I called attention to the small size and lack of roominess of the prefrontal region of the cranial cavity in Neanderthal man, and made special use of the form and relative size of the prefrontal area of the Boskop cast to establish the fact that the skull from which it was obtained conformed to the modern type (by some authorities regarded as the species *Homo sapiens*, as distinct from *H. neanderthalensis*).

The small fragment of endocranial cast now under consideration presents at its medial border about 4.5 centimetres of the broad deep median furrow, corresponding to the endocranial sagittal crest of the frontal bone; and below, part of the orbital margin, although not sufficient to display the form and extent of the orbital rostrum. There are no distinct indications of the situations of any of the cerebral sulci. although there is a definite flattening of the surface parallel to, and about 1 centimetre above, the orbital margin. Passing upwards from the middle of this flattening is an even more definite depression proceeding sagittally at a distance of about 2 centimetres from the median plane.

The surface between this depression and the median groove is raised up into a prominent hillock, the exact analogy for which I have been unable to find in any human brain or cranial cast. It presents a much closer analogy to the condition found in the casts of skulls of the Neanderthal series (more especially the Gibraltar, Neanderthal, and La Quina casts) than in those of any more recent varieties of man. But it suggests also the paramedian ridge formed by the anterior part of the superior frontal convolution in the anthropoid apes, the prominence of which is due in part to the falling away of the ill-developed lateral part of the prefrontal area.

If these tentative suggestions are justified, this small fragment affords further corroboration of the opinion that I expressed with reference to the endocranial cast of the Piltdown skull; namely, that it presents features which are more distinctly primitive and ape-like than those of any other member of the human family at present available for examination.

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Footnotes

1. This will be published by the Transactions of the Royal Society of South Africa.

Discussion.

Mr. W. P. Pycraft exhibited a specimen of the right half of a mandible of a chimpanzee, sent to him for examination by Mr. Gerritt T. Miller, of the Smithsonian Institution, Washington. Mr. Miller, in his Memoir of the Piltdown jaw, laid no little stress on the importance of this specimen, from the fact that the molars are worn so as to present flattened crowns similar to those of the Piltdown jaw. Hence, this specimen formed a link in his chain of evidence that the Piltdown jaw was unquestionably that of a chimpanzee.

It is clearly the jaw of an adult of one of the small races of chimpanzee, and apparently of a female. But, as a witness for Mr. Miller, it must be held to have failed; because, although the molars are worn flat, this is due, not to normal wear, but to some interference in the normal 'bite' of the jaw caused by the abnormal position of PM, which projects above the level of the worn surface of the molars as much as 5 mm. That this is not due to post-mortem displacement is clear, since the posterior border of the crown, where it impinges upon the anterior border of PM, shows no sign of faceting as a consequence of the mutual pressure of the two teeth. Nor does the crown show any sign of wear. Unfortunately, about half of this is missing, the tooth having split longitudinally.

The second premolar shows but very slight signs of wear, and is conspicuously flat-topped—a feature peculiar to the tooth rather than due to wear.

The first molar is, as Mr. Miller described it, worn to a flat-topped surface, but the wear has been from in front backwards, so that the crown presents a decided backward slope when seen in profile.

The surface of M2, though worn flat, is not in the same plane as that of M1. This much can easily be demonstrated if a straight-edge be placed over the two teeth; a large wedge-shaped gap will then be found between the straight-edge and M1, the apex of the wedge being pointed forward. The worn surface of this tooth (M2) is not absolutely flat, but presents a shallow depression running from the entoconid obliquely forwards to the protoconid.

The incisors have been worn down to about half their original length. In no other chimpanzee that the speaker had examined had he ever found anything in the matter of wear comparable with the molars of Mr. Miller's specimen. These are quite abnormal in this regard, and therefore of no value as evidence that the Piltdown teeth might, even in

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the wear of their crowns, agree with teeth of chimpanzees. Normally, one might affirm that the molars of these animals never wear flat; but the outer cusps disappear before the inner cusps are perceptibly reduced by wear.

Prof. A. Keith said that these further Piltdown 'finds' established beyond any doubt that *Eoanthropus* was a very clearly-differentiated type of being—in his opinion a truly human type. He agreed with Dr. Smith Woodward and Mr. Pycraft that the lower molar now found and the original mandible and teeth must be ascribed to *Eoanthropus*, and constituted the characteristic features of the type. He did not think that the relationship of the external occipital protuberance to the position of the lateral venous sinuses had any great value in the differentiation of human species. Among modern English skulls it was not uncommon to find the external occipital protuberance above the level of the lateral sinuses, as in the newly-found fragment. The position of the protuberance changed with age, and it ascended on the occiput as the neck expanded; it was low in position in women and children, and high in men with thick necks. The high position of the protuberance in the specimen found either indicated that it belonged to an older individual than the type-specimen, or pointed to a difference of sex. The frontal fragment was a particularly valuable addition, because it cleared up any doubt as to the contour of the forehead over the root of the nose. The supraciliary parts of the supraorbital bar were but slightly prominent, there being a wide shallow depression separating the right and left supraciliary eminences. The depth and thickness of the internal frontal crest were altogether remarkable.

Sir Ray Lankester said that all must appreciate the clear and interesting statement made by Dr. Smith Woodward. He congratulated the Author on the gradual addition, by his patient work and that of the late Mr. Charles Dawson, of new bits to our knowledge of the Piltdown man. He pointed out that it was a possibility—although highly improbable—that the piece of the frontal bone and also the molar tooth now described belonged to the same individual as that represented by the imperfect skull and lower jaw already known. But this was not true of the fragment of the occipital bone, since the region corresponding to this fragment was present in the imperfect skull now in the Natural History Museum. The present 'find' therefore makes it impossible to regard the Piltdown man as an isolated abnormal individual. The fragments hitherto found must be referred to two, and possibly to three or even four individuals.

Mr. W. Dale observed, with regard to the flint that was said to have been used as a hammer-stone, that it had probably sunk down from a higher level and was of newer date. At a previous meeting on the same subject, palæolithic implements had been shown which were of the deep-ochreous colour of the bones. This 'hammer-stone' was scarcely patinated at all.

Dr. A. Smith Woodward thanked the Fellows present for their reception of his paper, and mentioned that the new specimens of *Eoanthropus* exhibited had been presented by Dr. F. DuCane Godman to the British Museum.