

deposition and internal reconstruction. The cartilages of the mandibular condyle and of the cranial base (spheno-occipital synchondrosis) continue, however, to function as important growth sites in thrusting the facial skeleton forwards from the vertebral column. The muscles of mastication reach their full development at the end of this period with the completion of the permanent dentition.

#### SUMMARY

- (1) The cartilage of the cranial base, nasal capsule and Meckel's cartilage act as pace-makers for the early growth of the facial skeleton.
- (2) The middle segment of the cranial base is complete by the 7th year and is the most stable region of the skull after that time.
- (3) Growth at the facial sutures is secondary to a process of separation at the sutures which is produced by proliferation of cartilage and expansion of such organs as the brain and eyeballs.
- (4) Growth of the face is intermittent in nature and differs in its pattern for different regions.
- (5) The relationship in form between the facial and cranial regions of the skull may be harmonious or disharmonious.
- (6) Analysis of skulls showing abnormal growth illustrates the developmental independence of various regions of the skull.

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## Comments on "The Solution of the Piltdown Problem"

By ALVAN T. MARSTON, F.D.S.

ON November 21, 1953, the British Museum (Natural History) published the *Bulletin*, Geology, Vol. 2, No. 3. *The Times* of the same day published an article from "Our Museums Correspondent" on the "Piltdown Man Forgery—Jaw and Tooth of Modern Ape—Elaborate Hoax". On the same date the B.B.C. further publicized the matter in its news bulletins, and the Keeper of Geology of the British Museum (Natural History) also broadcast on the subject. There can be little doubt that it was a pre-planned and synchronized effort.

By 1952 I had succeeded in getting published fresh evidence relating to the Piltdown problem: "The relative ages of the Swanscombe and Piltdown skulls, with special reference to the Fluorine Estimation Test", in 1950a; "Reasons why the Piltdown canine tooth and mandible could not belong to Piltdown Man", which was submitted in 1950 but not published until 1952, although its salient features had been published in the Proceedings of the Geological Society of London for December 14, 1949 (Marston, 1950b), and finally my note on the "Human Mandibular Lacteon Constant" (*mihi*) had been published in *Man* (Marston, 1952c). The effect of these was to render the British Museum's attitude in presenting *Eoanthropus dawsoni* to the public as a "missing-link", untenable.

Nevertheless *Eoanthropus dawsoni* was allowed to figure in the Dome of Discovery, South Bank Exhibition in 1951, and in a somewhat similar exhibit in the Natural History Museum in 1952 and 1953, to explain the theory of human evolution from an ancestral ape, perhaps the Miocene *Proconsul*. This showed clearly a refusal on the part of the British Museum to face up to the facts of the evidence which I had published.

My 1952 paper (Marston, 1952a) contained sections to show that the worn Piltdown molars which had been claimed to be human, were as truly ape-like as true ape molars, and also that the wear on the canine tooth and on the molars was not human wear but was due to mandibular movement associated with the flat anthropoid type of temporo-mandibular joint, with long-crowned canine teeth which prevented outward lateral movement, and with rapid wear in a young ape in which although the canine and probably the third lower molar had erupted, yet also had incompleting roots.

In the British Museum 1953 Bulletin, on pages 141-2 it is alleged that the mandible and canine tooth are actually those of a modern ape (chimpanzee or orang) which have been deliberately faked to simulate fossil specimens. It is claimed that the results of their investigations have now demonstrated quite clearly that the mandible and canine tooth are indeed deliberate fakes. Because the authors are unable to understand the wear on the Piltdown teeth they ask us now to believe that someone took a modern ape mandible, broke it through near the symphysis, removed all of the teeth excepting  $M_1$  and  $M_2$ , removed the bony septa, broke down the alveolus, scooped out the whole of the cancellous tissue below the whole extent of  $M_1$ , broke off the head of the condyle, carved up the sharp edges of the bone to make them round, reduced the backward extension of the simian shelf to make it less like a modern ape, filed down the occlusal surfaces of the molar teeth, scribed out, in order to make more definite, the margin of the talonid basin on  $M_2$ , made the occlusal surface of  $M_1$  to be differently oriented from that of  $M_2$ , and the lingual border of  $M_1$  to be out of direct alignment with that of  $M_2$ .

To confuse the issue further the supposed faker took an immature ape upper canine of the opposite side, filed down the biting surface in so surprising a manner as to make the contour of the lingual articular facet directly reciprocal to that of the antero-external surface of a first lower premolar as seen in orang; actually filled the open pulp-chamber with sub-angular grains of iron-stone and sand and plugged a larger stone into the open end to serve as a stopper to prevent the sand from falling out.

Was such arrant nonsense ever exceeded in scientific controversy?

I say that none of those teeth—neither canine nor molar—nor the mandible, has been filed or pared down as alleged; that the morphology of the crown and of the root, and the infilling of the pulp-chamber with sub-angular detritus from the gravel-bed showed that the canine was a fossil tooth and not from a modern ape, and because of the difficulty of matching it in modern apes it had been variously assigned to *Pan vetus*, *Troglodytes dawsoni*, or *Boreopithecus*.

In like manner the feeble development of the simian shelf indicates, as had never before been questioned, that the mandible was a truly fossil ape. Indeed Sir Arthur Smith-Woodward's own description of the finding of the jaw states that both he and Mr. Dawson—to quote—

"We both saw half of the human lower jaw fly out in front of the pick-shaped end of the hammer which he was using" (The Earliest Englishman, p. 11, 1948).

#### THE FLUORINE CONTENT OF THE TEETH

F. J. Brekhus and W. D. Armstrong (1935) gave the fluorine content of sound human dentine as 0.0169%, and from teeth affected by fluorosis as from 0.0371 to 0.0504%.

The Museum Bulletin claims that the left lower Piltdown ii molar found two miles away on a heap of stones raked from the surface of a field, now belongs to the Piltdown mandible. Its fluorine content is given as < 0.01%; those of the Piltdown mandible < 0.04% although the same blood stream supplied both sides of the jaw; and they compare these with the value for a molar of Recent chimpanzee < 0.06% with six times the amount contained in the now supposed ape Piltdown ii molar!

The absurdity of claiming that the molars of the right side of the jaw contained four times the amount of fluorine in that of the left side, is obvious from my findings that the molars of the right side, when measured at the neck, were narrow and the teeth were worn in an anthropoid manner, whereas the molar from Piltdown ii was wide at the neck and was worn in a human manner. The Piltdown ii molar could not belong to the Piltdown mandible.

#### THE EVIDENCE OF THE ORGANIC CONTENT

It was recounted at the Geological Society (25.11.53) how, when drilling into the mandible, a smell of "burning" was noticed. This mandible is now claimed to be a modern "fake". I have seen the mandible and where the bone has been drilled, and have drilled into a modern mandible in the same situation without producing any smell of burning, and have also drilled into bones of 300,000, 100,000, 30,000 years, Holocene age, and one from the previous Sunday's joint, using a No. 10 rose-head, without producing the smell of burning. Some other reason than that of modernity should be sought to explain the smell of burning, e.g. the non-malevolent use of a preservative.

#### THE CHROMATE STAINING

The knowledge that some of the bones had been treated with potassium bichromate did not prevent Dr. A. T. Hopwood (1934) from concluding—

"The Piltdown remains represent a type of humanity which lived in this country at the beginning of the Pleistocene, and which had for contemporaries a very primitive elephant, the last of the European Mastodonts, and a hippopotamus."

My own suggestion is that Mr. Dawson might first have soaked the bones which he found before the "official dig" in gelatine solution (size) to harden them, and later might have used potassium bichromate to render the gelatine insoluble; unfortunately it altered the colour.

"When mixed with potassium bichromate, and exposed to light, gelatine becomes insoluble in water." (Cohen, J. B., Theoretical Organic Chemistry, London, 1908.)

In view of the semi-concreted nature of the lenticle of gravel from which Smith Woodward saw the mandible "fly out"—and anyone who has had actual field experience in working a semi-concreted deposit will recognize the ring of truth in the expression "fly out"—it would appear that the chromate treatment of the mandible occurred later, and after Smith Woodward had seen its original condition.

#### CONCLUSION

I have examined with a lens of 20 × magnification every millimetre of the Piltdown mandible and its two molar teeth, the Piltdown canine and the Piltdown ii left lower molar, and state that, apart from the drilled cavities made for taking test-samples, neither the teeth nor the mandible have been mutilated in any way.

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The following is a copy of a "Notice of Operation" sent out by Mr. Marston as long ago as November, 1936.

#### NOTICE OF OPERATION

*Eoanthropus dawsoni* is about to undergo a major dental operation on Monday, November 23, at the next meeting of the Odontological Section of the Royal Society of Medicine, at 8.0 p.m.

The operation will involve the extraction of the right lower canine tooth and the excision of the mandible. The condition of this tooth and of the mandible which has long been a serious problem, has at length been accurately diagnosed.

After excision, it is proposed to offer the removed parts to the British Museum (Natural History) to be placed in the section of fossil anthropoids.

*Eoanthropus* has been so heavily doped that no anæsthetic will be considered necessary. Assistance may be needed, however, in holding the victim down.

*Eoanthropus* is expected to make a speedy return to convalescence. The prognosis is good. His mental outlook will be more human. He will be less anti-social without a mandible which has prevented him from eating and speaking like a human being.

*Dental Surgeon.*—A. T. Marston, L.D.S.

*Assistants.*—You.

Copies of this to be posted up on the Notice Boards were sent to the British Museum (Natural History), The Royal College of Surgeons, and to the different London Dental Schools.—A. T. M.