THE PILTDOWN BONES AND 'IMPLEMENTS'

At a meeting of the Geological Society on June 30, there was again a series of exhibits concerning the bones, teeth and artefacts obtained from Piltdown. This was the third occasion of its kind within nine months. It may be presumed that it will be the last; for the Piltdown objects have lately been reinvestigated in such detail, by so many specialists using so many techniques, that there can scarcely be factual profit from further work upon them.

It is agreed that the skull fragments are human and not of great antiquity; that the jawbone is ape; that they have no important evolutionary significance. More than five hundred articles and memoirs are said to have been written about Piltdown man. His rise and fall are a salutary example of human motives, mischief and mistake.

The first exhibit at the meeting on June 30 was by Mr. A. T. Marston, who has long maintained that the Piltdown mandible and canine tooth are ape, and unrelated to the skull fragments; but who opposes the claim that the jaw and tooth have been deliberately faked. Mr. Marston showed a modern chimpanzee mandible which he had stained with potassium dichromate. It was yellow, in contrast with the chocolate-brown of the Piltdown jaw. He said that he had tried without success to reproduce the Piltdown colour by treating many modern bones with iron salts and chromate. He also contended, illustrating his remarks by specimens, that all the essential characters of wear on the Piltdown teeth are reproduced when articulated casts of orang jaws and teeth, mounted in an appliance to give ape jaw-movements, are 'ground-in' with carborundum paste; that the facet on the upper canine becomes concave from above downwards and spreads to the anterior border; that flatness comparable with that of the Piltdown molars is produced in the molars of the cast; and that the angles of wear on the molars of the cast and the original are identical.

Sir Gavin de Beer, director of the British Museum (Natural History), then introduced a series of exhibits and speakers on work which indicates, in sum, that the Piltdown finds represent a most elaborate and deliberate hoax, and that not one of them came genuinely from Piltdown. He summarized the methods which had been used, and pointed out that they would not only make a successful repetition of a similar style of forgery virtually impossible, but also would be of future value in palæontological research. Sir Gavin emphasized that the author of the Piltdown hoax remains unknown.

Prof. W. E. Le Gros Clark said that the molars in the Piltdown jaw differed from those of a modern large ape in only two significant features—the flat wear of the occlusal surfaces, and the shortness of the roots as seen in X-ray photographs published in 1913. New X-ray photographs had shown that the roots are in fact much longer, and quite similar to those of modern apes. The artificial character of the abrasion of the molars was demonstrated, *inter alia*, by the facts that the dentine on the antero-internal cusp is flat and flush with the enamel; that more dentine has been exposed on the antero-internal than on the antero-external cusps, the reverse of natural wear; that there is no bevel on the margins of the occlusal surfaces and the central talonid basin; that there is lack of conformity between the surface contours of the two molars; and that there are fine criss-cross scratches on them, apparently produced by an abrasive. The canine is evidently a young tooth, yet the whole thickness of the enamel has been removed from the inner surface crown. An X-ray photograph showed that its pulp-cavity had been opened near the apex and plugged with some plastic substance. Lastly, a re-study of the fragments of the so-called 'turbinal bone' showed that they are in fact fragments of a small limb-bone of some animal.

Dr. J. S. Weiner showed that by grinding and polishing the first and second molars of an orang, occlusal surfaces extremely like those of the Piltdown molars, with similar dentine pattern, can be produced; and that the height of the crowns is then almost identical. The chin region of an orang jaw, broken as in the Piltdown mandible, compares closely with the latter in all characters including the simian shelf. After abrading an orang upper canine to the state of the Piltdown canine, it had been easy to insert sand-grains from Piltdown into the pulp-cavity. Dr. Weiner remarked that the Piltdown canine contains very little of the fine sand or silt which one would expect natural infiltration of sediment to introduce.

An exhibit by Mr. S. H. U. Bowie and Dr. C. F. Davidson dealt with the implication of radiometric assays. Dr. Davidson said that during an investigation of the radioactivity of phosphate rock a few years ago, it was found that fossil bones and teeth often have a noteworthy radioactivity, apparently acquired from percolating ground-waters, and with a quantitative relation, taking account of variants of environment, to geological age. He exhibited a tabular statement of the ranges of radioactivity of a large number of bones from sands and gravels of various ages, and another showing the radioactivity of the Piltdown and Swanscombe primate bones. The Swanscombe measurement, $27(eU_3O_8$ in p.p.m.), falls within the Middle Pleistocene range. The Piltdown primate fragments all have extremely low radioactivity: $3(eU_3O_8$ in p.p.m.) for the left parieto-frontal I; 2, for the occipital I; 1, for the temporal fragment; and all others less than 1. It is possible that the feeble radioactivity of the chromium-bearing left parieto-frontal, and perhaps of other fragments, is due to the presence of the potassium isotope ^{40}K. From these assays, Dr. Davidson said, it appears that the '*Eoanthropus*' remains are Holocene rather than Pleistocene. Dr. Davidson showed that measurements on the other Piltdown vertebrate remains give a remarkably wide range of radioactivity. The three molars of *Elephas* cf. *planifrons* are all far more radioactive than any other British mammalian bones of Tertiary or later age which have been studied; and in an examination of similar *E.* cf. *planifrons* teeth from foreign localities, the same high order of radioactivity is found only once, in a specimen from Ichkeul, Tunisia. On the other hand, the two 'Piltdown' hippopotamus teeth, and some of the beaver bones, are less radioactive than any other Tertiary or Pleistocene fossils which have been examined from any British or foreign source. It seems certain that the bones of the Piltdown 'assemblage' had very different geological and geochemical histories.

Dr. G. F. Claringbull and Dr. M. H. Hey reported on mineralogical and chemical tests. Drillings from the Piltdown cranium were found, on examination by X-ray diffraction, to be mixtures of apatite and

gypsum. Gypsum was later found in many other Piltdown specimens. Gravel and loam from the site, and ground-water nearby, were analysed by Dr. R. C. Hoather and Dr. C. Bloomfield and found notably low in sulphate content. But gypsum had also been found in a skull from Barcombe Mill in the C. Dawson Collection in the British Museum (Natural History); and in matrix adhering to this skull there were calcium and ammonium sulphates—though these were not present in freshly collected samples of matrix from Barcombe Mill. It had been thought possible that the gypsum arose from reaction during soaking of the bones in an iron salt to produce staining, and experiments were therefore made on white bone from a neolithic skull. A solution of iron alum even as weak as 2½ per cent produced a fairly full-brown colour accompanied by conversion of the apatite of the skull to gypsum. With ferrous sulphate solution the reaction was less, but there was some replacement of apatite by gypsum. No natural conditions (except perhaps close proximity of a sulphide ore-body undergoing active weathering) could be postulated to produce the same effect. It therefore seemed that the gypsum in the Piltdown specimens was in fact an incidental effect due to artificial treatment by iron solutions in order to produce brown staining.

Dr. K. P. Oakley was the last speaker. He said that other tests had confirmed that the Piltdown mandible is entirely recent. In addition to the nitrogen test, its organic content had been found to be the same as that of fresh bone; and by means of the electron microscope, Prof. J. T. Randall and Dr. A. V. W. Martin had shown that intact collagen fibres occur in decalcified samples of the mandible, whereas none could be detected in the calvaria. Dr. A. E. Werner and Miss R. J. Plesters, of the National Gallery, had reported that the black coating on the canine tooth is a paint of bituminous earth pigment, probably vandyke brown. Dr. Oakley said that the work of Drs. Claringbull and Hey indicates that both the Piltdown skulls I and II are fraudulent; and their composition shows that, unlike the mandible, they are sub-fossil though post-Pleistocene. There is a further complication: the right frontal of Piltdown II could anatomically, from its unusual thickness and histology, have originally been part of Piltdown I. Since analyses have shown that their fluorine/phosphate ratios are in agreement, it could be inferred that these right frontal fragments did belong to Piltdown I, and not to the thinner occipital fragments said to have been found with them. All the Piltdown flints figured as palæoliths, he said, show evidence of artificial iron-staining. Dr. A. E. Moss has estimated that the stain on the flint *E* 606 contains *c.* 0·1 mgm. chromium per sq. cm. A chip from the cortex of this flint showed that the staining is superficial, with pure white cortex beneath. Dr. Oakley said that the worked elephant bone is certainly fossil, but experiments have demonstrated that it could not have been whittled to its shape while it was a fresh bone, and he showed a fossil bone from the Swanscombe gravel carved with a steel knife to reproduce all the features of the Piltdown implement. From the chemical and other evidence it was judged that the Piltdown bones and teeth had been assembled from a wide variety of sources and that some of them were foreign. The low nitrogen and low fluorine content of the hippopotamus molar can be matched only by material from cave deposits, for example, in Malta [see also p. 65].

OBITUARIES

Prof. J. B. Buxton

Prof. James Basil Buxton, principal and dean of the Royal Veterinary College, died suddenly in his office at the Field Station, Streatley, Berks, on May 25. His death is a severe loss to the veterinary profession in Great Britain, of which he had been a leading figure for many years.

Born in 1888, the son of a veterinary surgeon, he graduated at the Royal Veterinary College in 1919 and, after studying in the University of Liverpool, was for a short time lecturer in hygiene at the Royal (Dick) Veterinary College, Edinburgh.

In 1912 he became the first veterinary superintendent of the Wellcome Physiological Research Laboratories under the directorship of Dr. H. H. (now Sir Henry) Dale, an appointment which afforded him ample scope for development and a congenial atmosphere for work. He there laid the foundations of a department which is noted for its achievements in the field of veterinary research and the control of animal diseases.

In 1922 Buxton joined the scientific staff of the Medical Research Council and was in charge of the Farm Laboratories at Mill Hill, where he organized the investigation into dog distemper which the Council undertook with the aid of *The Field* Distemper Fund. He designed the buildings in which to breed a supply of fully susceptible dogs for experimental use, and drew up the programme of work which was largely followed by Laidlaw and Dunkin in their classical studies on the disease. It was the successful outcome of this project which paved the way to the subsequent work on human influenza.

In 1923 Buxton was appointed to the newly created chair of animal pathology at Cambridge and became responsible for planning and staffing the Institute of that name then about to be established. Within a few years he built up an organization known throughout the world as a centre of research and a training ground for research workers from home and overseas. Among the studies on which he himself was engaged during this period special mention may be made of those on the double intradermal tuberculin test, the standardization of tuberculin and the value of B.C.G. vaccine as an immunizing agent against tuberculosis in cattle.

In 1936 he was elected to succeed Sir Frederick Hobday as principal of the Royal Veterinary College, and under him the College has made great progress as the result of improved staffing and organization. He deserves much credit for the skilful way in which he organized its work in most difficult circumstances when it was evacuated from London during the Second World War, and for the part he afterwards played in its being accepted as a School of the University of London.

Prof. Buxton had a long record of distinguished service to the National Veterinary Medical (now British Veterinary) Association and the Royal College of Veterinary Surgeons and was a past-president of both bodies. For some time he was chairman of the Examinations Committee of the Royal College, and it was largely through his initiative that the course of study leading to the M.R.C.V.S. diploma was extended in 1932 from four to five years.

His name will always be associated with the organization and development of veterinary research