

SIGNIFICANCE OF THE AUSTRALOPITHECINÆ

IN 1924, the immature skull of a large ape-like primate was discovered in some lime workings at Taungs in the valley of the Harts River, South Africa. It was briefly described by Prof. R. A. Dart, who regarded it as representing an extinct race of apes intermediate between living anthropoid apes and man. To this extinct race he gave the name *Australopithecus africanus*. There followed a mild controversy on the interpretation of this fossil, but many anatomists quite properly preferred to wait before committing themselves to definite statements until a full and systematic report on the original remains should appear. Twelve years later, Dr. Robert Broom, who had decided to search for more remains of *Australopithecus*, paid a visit to a cave at Sterkfontein, near Krugersdorp. Here he found portions of skulls and jaws of a fossil primate similar to *Australopithecus* but (in his opinion) sufficiently distinct in some of its characters to be referred to a separate genus. He called it *Plesianthropus transvaalensis*. Then, in 1938, the remains of what were taken to represent still another type, called by Broom *Paranthropus robustus*, were brought to light at Kromdraai, two miles east of Sterkfontein. Thus there are now available for consideration three series of extinct ape-like primates from South Africa, which are believed to be representatives of one sub-family, the Australopithecinae. Excellent casts of the skull of *Australopithecus* have been available in Britain for many years now, and during the course of his excavations since 1936 Dr. Broom has been extremely generous in distributing casts of most of the valuable material which he has collected. Thus anatomists in Britain have for some time had this sort of evidence before them. Now there has appeared the long-awaited report on the Australopithecinae by Dr. Broom and Dr. Schepers¹. In this monograph, which is abundantly illustrated and incorporates numerous comparative studies, Broom deals in considerable detail with the osteological material, while Schepers discusses the endocranial casts. Apart from the obvious fact that access to the original material is really necessary to complete the evidence on which to base a considered opinion, it is now possible, at least in general terms, to assess independently the significance of these remarkable fossils.

Dr. Broom has demonstrated beyond any doubt at all that the Australopithecinae are extremely important for the study of human evolution, since they present an astonishing assemblage of simian and human characters. Such an assemblage, indeed, might well be postulated, entirely on indirect evidence, for hypothetical ancestors of the Hominidae. Thus it should be said at the outset of this review that Dart's original interpretation of the *Australopithecus* material has in several respects been completely vindicated. Some of the most outstandingly human features of the Australopithecinae are undoubtedly those of the teeth and jaws. In both the deciduous and permanent dentitions, the incisors and canines are of human rather than simian proportions and pattern. The deciduous premolars are quite similar to those of the human child, while the permanent premolars, though very large, have the distinctive human pattern. The permanent molar teeth, in spite of their size (which is exceeded only by male gorillas and certain large extinct apes such as *Sivapithecus giganteus*), also show

some approach to man in the disposition of their cusps. The dental arcade forms a rounded curve as in man and not an elongated U-shape such as is characteristic of modern large apes. The nature of the wear of the teeth and the anatomy of the temporo-mandibular region show, also, that the teeth and jaws were used in human fashion. In contrast with the remarkably human features of the teeth, the skull as a whole resembles in its general proportions those of anthropoid apes; and in a number of details, for example, the great facial extension of the premaxilla, the contour of the mandibular symphysis, and the apparent absence of a foramen spinosum, it is entirely simian and departs widely from the human condition.

So far, then, the Australopithecinae might perhaps be regarded as a group of extinct apes, somewhat similar to the gorilla and chimpanzee, in which the characters of the dentition had developed (possibly independently) along lines almost identical with those of human evolution. But Dr. Broom has also, in his indefatigable search, brought to light some most important fragments of limb bones, which allow, and even make probable, a much more startling interpretation of these fossil remains. For example, of *Paranthropus* there are available the lower end of the humerus, the upper end of the ulna, and the talus. Judging from casts and Dr. Broom's illustrations, the humeral and ulnar fragments are entirely similar to those of *Homo sapiens*. Indeed, anatomists without the full evidence before them might well be excused if they expressed scepticism at their association with the skull of *Paranthropus*. But Dr. Broom states explicitly that the skull, jaw, humeral and ulnar fragments and the talus were all obtained from one mass of bone breccia less than a cubic foot in size, and that nowhere in any of the same deposits have remains of *Homo* come to light. Thus there seems no reason to doubt that this extinct ape-like creature had upper limbs of human proportions (at least so far as the elbow region is concerned), and which were evidently not used for brachiation. On the other hand, the talus is a remarkably small bone—in its dimensions, so far as these can be measured on a cast, it falls well short of the minimum recorded for modern races of mankind (cf. the data for Japanese women reported by B. Adachi²). Compared with the humeral fragment (which presumably belongs to the same individual) the size of the talus indicates a disproportionately small tarsus—more so, indeed, than would be expected if *Paranthropus* used its hind-limbs for the bipedal mode of progression characteristic of man. Further, the unusual medial extent of the articular surface of the head of the bone seems to indicate a very considerable mobility at the sub-talar joint, while the truncated neck suggests the transference of the major component of the weight of the body to the fore-part of the foot, a feature which Morton³ has shown to be characteristic of the type of foot found in the great apes and therefore different from the trend shown in human evolution.

Of *Plesianthropus* there have been found the capitate bone of the carpus and the lower end of the femur. The former confirms the evidence of the arm bones of *Paranthropus*, that the Australopithecine upper limb closely corresponded to the modern human type, for the capitate bone seems to come well within the range of variation shown in the Bushman⁴. The lower end of the femur is perhaps the most important of all these limb-bone fragments, and Dr. Broom infers from it that *Plesianthropus* "walked, as does man, entirely or almost entirely on its hind feet". From

the appearance of the femur as depicted in Dr. Broom's drawing of it, we are inclined to agree with his interpretation. But his description of this most important evidence is tantalizingly brief (it is confined to 34 lines!). Indeed, we could have wished that the author had dealt with all this limb material in much more detail. The illustrations, too, while they give a good general impression of the appearance of the bones, are not sufficiently accurate for comparative studies. For example, the text-figure of the *Paranthropus* talus, although stated to be natural size, actually represents the bone as somewhat larger than the cast. So much depends on this limb material for a proper assessment of the Australopithecinae. Thus, when Broom states at the conclusion of his section that "at Sterkfontein there are deposits of breccia probably as extensive as those of Choukoutien, and we may confidently assert that these are likely to yield dozens of skulls and probably fairly complete skeletons of the Sterkfontein ape-man", we can only implore all those concerned to see that facilities are provided forthwith in order that systematic excavations can be continued without interruption.

In addition to the skeletal material of the Australopithecinae, there were available for study the natural endocranial cast of *Australopithecus*, portions of endocranial casts (partly distorted) of *Plesianthropus*, and an endocranial cast of the left temporal region of *Paranthropus*. The study of endocranial casts of fossil man and apes always raises afresh the oft-debated question as to how far the sulcal pattern of the brain itself can really be inferred from them. Studies of endocranial casts of modern man and apes, and their direct comparison with the actual brains, have shown that in these forms attempts to delineate the sulcal pattern may be grossly misleading⁵. Dr. Schepers regards the conclusions drawn from such careful and objective studies as "pessimistic", and, of course, it may be true that, for some reason or other (and very conveniently for the palaeontologist!), the convolutions of the brain were more faithfully impressed on the bony walls of the cranial cavity in fossil than in living species. Nevertheless, neurological anatomists will be surprised to find that Dr. Schepers has apparently been able not only to map out with confidence the sulcal pattern over the whole cerebral hemisphere of *Australopithecus* and *Plesianthropus*, but also to delineate no less than twenty-six separate cyto-architectural areas and to compare them in their relative extent with those of modern apes and man. Cortical physiologists may likewise feel inclined to demur at some of the inferences regarding functions such as speech, abstract thought and motor skill which, it is suggested, can be drawn simply from the examination of a cast of the inside of the skull. But Dr. Schepers, in the introduction to this section, makes his attitude perfectly plain, for he says: "In all attempts at representing these fossils in a reconstructed form, the method employed was that of claiming the maximum dimensions considered likely for the type. It is . . . much less satisfactory to hear that a new find of fossil material does *not* suggest any new hypothesis or does not corroborate evidence already at hand about a cognate theory, than to discover that at least someone is prepared to claim the maximum importance for his discovery. Such enthusiasm encourages criticism and comment, and is therefore to be recommended."

There may be some who doubt the propriety of preparing a scientific report with a bias of this kind, but at least it makes for lively reading. At the same

time it does make it somewhat difficult for the reviewer not to appear in the role of the carping critic; and any appearance of carping criticism in the present instance is certainly to be avoided, if only because it might seem (unintentionally) to belittle the importance of this fossil material of which, in fact, the importance can scarcely be exaggerated. Also, the thoroughness with which Dr. Schepers has pursued his studies, and his evident eagerness to squeeze every drop of information from his material (even when this is defective) must evoke the greatest admiration for his assiduity. The cranial capacity of *Australopithecus* is estimated at 500 c.c., and of *Plesianthropus* at 435 c.c. The cranial capacity of *Paranthropus* is judged to be as high as 650 c.c.; but since this estimate is based on little more than the left temporal region of the skull, it is not easy to accept it without qualification. For the same reason, the contours of the reconstructed endocranial cast of *Paranthropus*, which are used for graphic comparison with casts of other primates, should probably be discounted as being too conjectural. Thus, so far as the absolute volume of the brain is concerned, the Australopithecinae appear to fall well within the limits of the anthropoid apes. On the other hand, if, as Dr. Schepers surmises might be the case, the endocranial casts hitherto obtained happen by chance to represent the lower limits of variation, the cranial capacity of the Australopithecinae may in its upper limits have transcended the range of variation found in modern large apes. Only the accession of further material can decide this point. But it remains a matter of very considerable interest that the volume of the Australopithecine brain *relative to the body size* (so far as this can be inferred in a very general way from fragments of the limb skeleton) does appear to have exceeded somewhat that of modern large apes.

Enough has been said in this review to indicate the intermediate position which many of the anatomical characters of the Australopithecinae in their combination occupy in relation to apes and men. Whether on the basis of this morphological evidence the South African representatives of this sub-family, which have so far been found, may be assumed to bear any direct relation to the line of human evolution, depends partly on the geological age of their remains. The evidence for this hitherto rests almost entirely on faunistic data. Dr. Broom is now of the opinion that the presence of a primitive hyæna, *Lycyaena*, and of two species of sabre-tooth tigers, in the deposits at Sterkfontein signifies a date not later than Upper Pliocene, and that the Taungs site is probably still older, perhaps Middle Pliocene. But he specifically states that, as with the deposits at Kromdraai, it is quite impossible at present to determine the geological age with certainty. However, the importance of the Australopithecinae is so great for the study of primate palaeontology, and particularly human palaeontology, that it becomes imperative to obtain more information about their antiquity. Even the skeletal remains, in spite of the magnificent work of Dr. Broom, still remain too scanty for firm conclusions regarding their significance. For Dr. Broom and Dr. Schepers they provide evidence for an assumption that the modern apes, and even the fossil apes of the *Dryopithecus-Sivapithecus* group, have no close relation to man (they are the result of a prolonged period of parallel development), and that the line of human evolution diverged from that of other primates so far back as Eocene times. On the other hand, the distinguished palaeontologist, Dr. W. K. Gregory (who has also had

the opportunity of examining the original Australopithecine material) concludes⁶ that "the evidence afforded by the morphology of the braincase and skull structure can hardly leave a well-founded doubt that the Australopithecine group were derived from the *Dryopithecus-Sivapithecus* stock", and that "although it is too much to expect that the close structural approach of *Plesianthropus* towards *Sinanthropus* will discourage those who cling hopefully to the myth of Eocene man, all the facts . . . tend to confirm the conclusions of [those] who regard man as the result of a morphological revolution which took place during the later Tertiary period".

Such a divergence of opinion among recognized experts only serves to emphasize the need for still more fossil material. In this connexion we would quote a remarkable statement by Dr. Broom: "When some wealthy man or corporation undertakes the systematic exploration of our deposits . . . I think one can safely affirm that within three or four years we will discover more of the origin of man than has been revealed during the past hundred. Practically all the discoveries described in the present work, except the Taungs skull, were made by me in about two years working almost single-handed. Not only had I to find all the specimens, I had to develop them out of the matrix, give all the descriptions and make all the drawings."

Dr. Broom is a veteran palaeontologist unequalled to-day in experience and reputation. This monograph on the Australopithecinae is a fitting climax to a long life devoted to palaeontological research, and to a record of fossil-collecting which is quite unsurpassed for its rich discoveries. Moreover, with the preliminary work on *Australopithecus* contributed by Prof. Dart, he has very considerably enhanced the prestige of South African science in the eyes of the world generally. Surely one may express with some confidence the expectation that his magnificent contributions to the story of human evolution will be recognized by his fellow countrymen, to the extent that they will provide the funds and the facilities for the realization of his hopes for further discoveries at Sterkfontein and elsewhere. No greater service could be done to the study of human origins, and no more appropriate expression of gratitude could be made to Dr. Broom.

W. E. LE GROS CLARK

¹ The South African Fossil Ape-Men: The Australopithecina. By Dr. B. Broom and G. W. H. Schepers. (Transvaal Museum Memoir No. 2.) Pp. 272+18 plates. (Pretoria: Transvaal Museum, 1946.)

Mitt. med. Fac. Kais.-Jap. Univ., 6, 307 (1905).

² Morton, D. J., *Amer. J. Phys. Anthropol.*, 7, 1 (1924).

³ See Kaufmann, H., and Sauter, M., *Arch. Suisses d'Anthrop. gén.*, 8, 161 (1939).

⁴ See, for example, the most recent monograph on the subject, "Anthropoid and Human Endocranial Casts". By Pierre Hirschler. Pp. ix+150+11 plates. (Amsterdam: N. V. Noord-Hollandsche Uitgeversmij., 1942.) n.p.

⁵ *Ann. Transvaal Mus.*, 19, 339 (1939).

their wish was fully gratified. Alike at school and at Cambridge, Maufe distinguished himself. So early as 1896 we find him contributing with T. Sheppard to the *Glacialists' Magazine*. Thereafter he was caught up in the excitement aroused by P. F. Kendall's interpretation of glacial diversions of rivers in Yorkshire—as instanced in a description Maufe furnished with A. Jowett to the British Association at Bradford, 1900, to be expanded in 1904 in *Proc. Yorks. Geol. and Pael. Soc.*

After joining the Geological Survey of the United Kingdom in 1901, Maufe was identified with particularly interesting work, both in Ireland and Scotland. In the former country, where he had the good fortune to work under G. W. Lamplugh and alongside W. B. Wright, his problems continued mainly glacial. His account with Wright of "The Pre-Glacial Raised Beach of the South Coast of Ireland" in the *Scientific Proceedings of the Royal Dublin Society*, 1904, is a classic. In Scotland he was originator of three great non-glacial conceptions, covering the cauldron subsidences of Glen Coe and Ben Nevis; the recumbent fold of Ballachulish; and the dyke swarms of Etive and Mull.

Maufe's recognition of the curvature of the Glen Coe boundary fault, which leads it to bend from north-west to north, south of Glen Coe, and of the significant association of this fault with an external granitoid intrusion, can clearly be recognized in notes he contributed to the Survey's "Summary of Progress" for 1904. The next point came to him early in the field season of 1905. One Sunday morning, when I climbed across from Loch Leven to visit him at Clachaig Inn, Glen Coe, Maufe told me of his new discovery. He had already seen enough on my side of our mutual boundary to show that north of Glen Coe both the fault and its attendant intrusion swing round to run approximately east-south-east. "If this be so," I exclaimed, "we are dealing with what Suess calls a cauldron subsidence, and the granite around it has spurted up like the liquor of a full bottle when the stopper settles home!" At that time eroded cauldron subsidences were an unknown phenomenon in world geology.

As regards the Ballachulish fold, Maufe wrote in the "Summary of Progress" for 1905: "The structure of the district [part of Glen Etive] is evidently that of a huge overfold, the limbs of which dip gently westwards and are at least 3 miles in length (from trough to crest). The quartzite which caps the hills also forms the floors of the valleys."

Maufe seems to have been the first among geologists to recognize the individuality of great swarms of parallel dykes that sometimes extend both ways from an igneous focus. His work in the West Highlands took him across the margins of two such swarms: the Etive swarm running north-north-east, of Devonian age; the Mull swarm running north-west, of Tertiary age.

Before severing his connexion with the Survey of Great Britain, Maufe was lent in 1905 to examine railway cuttings in Uganda. His account, issued as a "Colonial Report", 1908, contains much of value. So, too, does a description, written jointly with R. G. Carruthers, of a holiday research on "The Lower Palaeozoic Rocks around Killary Harbour, Co. Galway and Co. Mayo". This last was communicated to the Dublin meeting of the British Association, 1908, and was reproduced more fully in the *Irish Naturalist*, 1909.

In 1910 Maufe was secured as director for the newly founded Geological Survey of Southern

OBITUARIES

Mr. H. B. Maufe

It has been sad news indeed for many friends of Herbert Brantwood Maufe to hear of his unexpected death in London on May 8 at the age of sixty-six. Only a few days previously he had been speaking of an early return to Africa.

It had been an ambition of Maufe's parents that their son should engage in scientific research; and