CHAPTER I

INTRODUCTION

On 15 August 1959 the first announcement of the discovery of a new fossil cranium from Olduvai appeared in *Nature* (Leakey, 1959*a*). A week later, on Saturday 22 August 1959, at the formal opening ceremony of the fourth Pan-African Congress on Prehistory in Léopoldville, Dr L. S. B. Leakey publicly announced to the astonished and enthusiastic delegates more details of the important new specimen (Tobias, 1960*a*). He reiterated his view, expressed already in *Nature*, that the big-toothed cranium was that of a young male, representing a new genus of the subfamily Australopithecinae. To this genus he gave the name *Zinjanthropus*, *Zinj* being 'the ancient name for East Africa as a whole'. He enumerated twenty features in which he claimed the new specimen differed from members of either of two previously-recognised australopithecine genera, *Australopithecus* and *Paranthropus*. He went on to designate the species as *Zinjanthropus boisei* sp.nov., the specific name being in honour of Mr Charles Boise, whose generous financial help had made the discovery possible. Leakey's (1959*a*) preliminary diagnosis of its specific features reads as follows: 'A species of *Zinjanthropus* in which the males are far more massive than the most massive male *Paranthropus*. The face is also excessively long. Males have a sagittal crest, at least posteriorly. Upper third molars smaller than the second.'

Leakey stressed the tentative nature of his generic and specific diagnosis, recognising that, if and when further material were found, 'the diagnosis will need both enlarging and possibly modifying'.

Less than one month after Mary Leakey's discovery of the cranium on 17 July 1959, the Leakeys brought it to South Africa to compare it with the known australopithecine specimens in the Anatomy Department of the University of the Witwatersrand, Johannesburg, and in the Transvaal Museum, Pretoria. During this brief visit on the eve of the Léopoldville Congress, an opportunity to examine the new cranium was provided for Professor Raymond A. Dart, Dr John T. Robinson and the author. Our first impressions were that the new cranium undoubtedly represented a big-toothed, heavy-muscled member of the Australopithecinae and that its nearest affinities were with the more robust and large-toothed of the existing australopithecine forms, namely *Paranthropus* of Swartkrans and Kromdraai in the Krugersdorp District. From the outset, the wisdom of creating a new genus was questioned, since there seemed to be a *prima facie* case for regarding the new form as an East African member of the genus *Paranthropus*.

In passing, it may be mentioned that the generic distinctness of *Paranthropus* from *Australopithecus*, the criteria for which had been formulated by Robinson (1954*a*, 1956, 1961–3), is not accepted by most recent writers on the subject. Among those who still accept the generic distinctness of *Paranthropus* and *Australopithecus* are Heberer (1960*a*, 1962), Napier (1961) and Coppens (1964). On the other hand, ever since 1948, Dart has maintained that all the australopithecines, gracile and robust, belong to a single genus (1948*a*, *b*, 1955*a*). Likewise, Le Gros Clark (1955, 1964) recognises only a single genus, *Australopithecus*, within the subfamily, Australopithecinae, and relegates the distinctions between the more robust and the more gracile forms to specific differences. This unigeneric classification of the australopithecines is accepted as well by von Koenigswald (1960), Campbell (1962, 1963), Coon (1963), Simpson (1963), Hulse (1963), Mayr (1963*a*), Harrison and Weiner (1964) and others, and it was apparently the consensus at an international symposium on classification and human evolution held by the Wenner–Gren Foundation at its European conference centre of Burg Wartenstein in the summer of 1962 (Washburn, 1963). Furthermore, the unigeneric view was the consensus at a symposium on the taxonomy of fossil man, in which the author participated, during the holding of the Seventh International Congress of Anthropological and Ethnological Sciences in Moscow, 1964. Robinson, on the other hand, has found that he can explain the morphological differences between the two South African forms only by attributing major ecological differences to them (1954*d*, 1956, 1961–3). On the basis of such inferred ecological variations, he feels justified in maintaining two genera.

The several merits of these classifications will be discussed later in this work (chapter XIX). A recent compromise viewpoint may be mentioned here: Leakey, Tobias and Napier (1964) have suggested the recognition of a single australopithecine genus (*Australopithecus*), with, for the moment, three subgenera, *Australopithecus*, *Paranthropus* and *Zinjanthropus*. Since a major part of my description of the Olduvai cranium involves comparison of it with each of the South African forms, it will be convenient in this account to refer to the Olduvai Bed I australopithecine as *Zinjanthropus*, and to use the other two subgeneric labels, *Australopithecus* and *Paranthropus*, to designate the two forms of australopithecine described from the South African sites.

A further opportunity to examine the new cranium and discuss its affinities was provided during the course of the Léopoldville Congress. All physical and palaeo-anthropologists at the Congress were given a private viewing and an intensive discussion followed. Much of the interchange centred around the systematic status of the specimen. Following his examination of the South African specimens in Pretoria and Johannesburg, Leakey averred that, while the Tanganyikan cranium had a number of features in common with each of *Paranthropus* and *Australopithecus*, there was a still bigger list of respects in which it was distinct from both; if, therefore, both of these warranted generic distinction, *Zinjanthropus*, too, should be regarded as a distinct genus. Some were opposed to this view, while others felt that a separate name might be justified as a distinctive label for the time being.[1] The view was represented to Leakey that, if he indeed persisted in regarding the Olduvai specimen as representing a new genus, the new generic name would likely be sunk very soon—probably with the discovery of a second specimen at Olduvai! Leakey was prepared to take this risk; he felt that the name should remain, at least *for the time being*, and until more was known of the range of variation of the Tanganyikan australopithecines.

Thus, the name entered into the literature, despite the misgivings expressed beforehand by many scientists, while others questioned it subsequently (e.g. Sergi, 1959; Heberer, 1960*a*; Kurth, 1960).

Robinson has challenged the validity of attributing separate generic status to the Olduvai australopithecine. In a paper in *Nature* in May 1960 he analysed many of the twenty characteristics which Leakey had earlier enumerated: his analysis led him to conclude that 'separate generic status seems unwarranted and biologically unmeaningful'. He proposed that the Olduvai form be regarded as a distinct species within the genus *Paranthropus* and that its name be *Paranthropus boisei* (Leakey).

In reply Leakey (1960*b*) commented, 'Inevitably, different scientific workers have different ideas of what characters justify specific, generic, and even superfamilial rank.' He summarised the position as follows: 'Dr Robinson and I agree that *Zinjanthropus boisei* is closely related to the Australopithecinae; we agree that it has certain resemblances to *Paranthropus*, and we disagree mainly in that he believes the differences to be insufficient to justify separate generic rank, while I think they do.'

As only a very brief and preliminary report of the morphology of *Zinjanthropus* has so far appeared, and as most of the points at issue are

[1] The same view was later expressed by Heberer (1960*b*): 'Diesen Namen (*Zinjanthropus*) darf man wohl nur als individuelle Fundbezeichnung, nicht aber als systematisch zu wertende Benennung versteken' (p. 317).

based on differing interpretations of the morphology, the disputation was clearly premature. A detailed description of the specimen is the first requirement; from this, the assessment of its systematic affinities should become more readily apparent. Dr Leakey has entrusted the specimen to me for detailed morphological treatment. In the present work, a fairly comprehensive description is presented and comparisons are made with the crania of other australopithecines, hominines and pongids.

In preparing the present report, I have been handicapped by the fact that although a bibliography on the australopithecines included over 380 titles already in 1954 (Musiker, 1954), not a single cranium of this group has thus far been fully described. True, Dart had prepared a 300-page monograph on the Taung child in the 'twenties, but when Keith's lengthy account of *Australopithecus* appeared in *New Discoveries Relating to the Antiquity of Man* (1931), Dart's monograph remained unpublished. The only aspect of australopithecine morphology which has been exhaustively described is the dentition—in Robinson's masterly and meticulous monograph (1956). In the description of the dentition of *Zinjanthropus*, I have leaned heavily upon this work. Inevitably, the teeth of *Zinjanthropus* have received more detailed treatment in the present work than other aspects of the fossil's anatomy, since more published comparative material is available. At the same time, I have enjoyed free access to the original specimens in the Transvaal Museum, Pretoria, as well as to Professor Dart's specimens, the repository of which is the Anatomy Department of the University of the Witwatersrand, Johannesburg. It has thus been possible to compare *Zinjanthropus* with the entire collection of African australopithecines, with the exception of one maxillary fragment with two teeth from Garusi in Tanzania, a specimen which Robinson (1953*a*, 1955) has shown is australopithecine in character.

In making comparisons between *Zinjanthropus* and non-australopithecine fossil hominids, I have had the opportunity of studying the originals of fossil human crania in the British Museum (Natural History) at South Kensington, London; the Musée de l'Homme and the Institut de Paléontologie Humaine in Paris; the Rijksmuseum in Leiden and the Rijksuniversiteit in Utrecht; Professor S. Sergi's apartment in Rome; the National Museum (formerly the Coryndon Museum), Nairobi; the Department of Anatomy at the University of Cape Town; the Port Elizabeth Museum; and the Department of Anatomy of the University of the Witwatersrand, Johannesburg. In addition, in the latter department, a most comprehensive collection of plaster casts of fossil crania is available, as well as a large collection of endocranial casts of modern man, fossil man, australopithecines and other Primates. For adequate comparison between *Zinjanthropus* and the Pongidae, a study has been made of pongid skulls in the British Museum (Natural History), the Powell–Cotton Museum at Birchington in Kent, the National Museum of Kenya and the Department of Anatomy of the University of the Witwatersrand.

Anatomical terminology

In this description, the author has adhered to the recently adopted Paris Nomina Anatomica, as amended by the Sixth International Congress of Anatomists at New York in April 1960. For the most part, the English equivalents of the international Latin forms have been employed.

In the text, the term 'skull' has been used where the mandible is included. 'Cranium' is used for the skull without the mandible. The cranium, in turn, comprises a facial skeleton and 'calvaria' (brain-case). The calvaria consists of two parts, the 'calotte' or top of the brain-case, and the 'basis cranii' or base of the brain-case (Trevor, 1950).

In the description of the teeth, the terms *length* and *breadth* have been abandoned in favour of *mesiodistal diameter* and *buccolingual* or *labiolingual diameter*. In this account, for simplicity, the inner aspect of the teeth is spoken of as *lingual*; the outer aspect as *labial* in respect of incisors and canines and as *buccal* in respect of premolars and molars.

Classificatory nomenclature

The Hominoidea or, simply, hominoids, refers to the superfamily comprising both apes and man. The Pongidae or the pongids refers to the members of the family of anthropoid apes. The Hominidae or hominids refers to the members of the family of man.

The Homininae or hominines refers to the members of a subfamily of Hominidae, comprising members of the genus *Homo* and including non-australopithecine fossil hominids such as *Pithecanthropus*, *Atlanthropus* and *Hemanthropus*, which are commonly today lumped in the genus *Homo*.

The Australopithecinae or australopithecines, occasionally dubbed prehominids, near-men, half-men or ape-men, refers to the members of another subfamily, comprising those fossils which have been designated *Australopithecus* (including the former 'Plesianthropus'), *Paranthropus* and *Zinjanthropus*, and possibly also *Meganthropus*.[1] This australopithecine subfamily is classified by most students as a subfamily of the Hominidae and, as such, it is regarded in this account; although a few workers still regard it as a subfamily of the Pongidae.

The terms *Sinanthropus* and *Pithecanthropus* are not used in this study. Instead, the specific term *Homo erectus* is used to designate the taxon represented by the group of fossils formerly called by these terms.[2] On this usage, *H. erectus* includes, too, *Atlanthropus* and the cranium of the individual formerly known as 'Chellean Man' (Leakey, 1961*a*) from the upper part of Bed II, Olduvai Gorge. Possibly 'Telanthropus capensis', the hominine from Swartkrans in the Transvaal, should be included as well in this group, as was suggested by Simonetta (1957) and Robinson (1961), and supported by Tobias and von Koenigswald (1964).

Within the species *H. erectus*, the Choukoutien fossils are regarded here as falling into the *pekinensis* subspecies and the Javanese into the *erectus* subspecies, as in Campbell's scheme (1963). The north-west African forms, it is suggested, could well be classified as a third subspecies which should be called *mauritanicus* after the specific name of *Atlanthropus* (Arambourg, 1954). The decision whether or not the Olduvai representative of *H. erectus* ('Chellean Man') falls into any of these three subspecies or constitutes a fourth minor taxon within the species must wait upon the detailed description of the cranium (in preparation).

The Javanese cranium called by Weidenreich *Pithecanthropus robustus* and by von Koenigswald *P. modjokertensis* is generally called *Homo erectus erectus* IV or, simply, *H. e. erectus* IV in the present study.

For ease of reference, hominid remains are sometimes referred to in this text by their sites of origin. Thus, the forms lumped as *Paranthropus* come from Kromdraai and Swartkrans, whilst those included in the subgenus *Australopithecus* have been found at Taung (formerly spelt Taungs), Sterkfontein and Makapansgat. Following the classificatory system formerly employed by Robinson at the Transvaal Museum, Pretoria, I have sometimes designated individual crania from Sterkfontein by the 'official' abbreviation *Sts*, e.g. Sts 5 for cranium number 5 from that site;[1] in the same way, remains from Swartkrans are designated *SK*. Individual specimens from Makapansgat are identified by the prefix MLD, standing for Makapansgat Limeworks Deposit (Boné and Dart, 1955), e.g. MLD 1 for the first-discovered australopithecine specimen, the occiput, or MLD 37/38 for the most recently discovered and most complete cranium from that site.

Other special terminological usages are explained in the text.

[1] In a recent re-examination of the data and some of the material, Tobias and von Koenigswald (1964) concluded that, whereas the African species of *Meganthropus* (*M. africanus*) seemed indisputably to be australopithecine, the Asian species (*M. palaeojavanicus*) showed more advanced features than the australopithecines and might therefore have to be classified as a member of the Homininae.

[2] I at first hesitated to substitute the term *H. erectus* for *Pithecanthropus*, for reasons which I have discussed elsewhere (Tobias, 1962). Subsequently, however, definitions of the augmented genus, *Homo*, have been published by Robinson (1962) and by Leakey *et al.* (1964). As a result, my objections against the use of the term *H. erectus* have fallen away.

[1] Where Roman numerals are used with Sterkfontein or Sts, e.g. Sts VII, Sts VIII, the reference is to the 'skull numbers' employed by Broom, Robinson and Schepers (1950), and not to the official Transvaal Museum Catalogue number.

Plan of the study

Following an account of the state and degree of preservation and of the reconstruction of the cranium (chapter II), the ensuing description will comprise the following parts:

(1) The calvaria from its outer surface, including the curvature of the vault, the supra-orbital height index, the sagittal and nuchal crests, the basis cranii externa, the mandibular fossa, the position and the plane of the foramen magnum, the indices of porion position, the position of the occipital condyle and the nuchal height index.

(2) The calvaria from its inner surface, including the endocranial surface of the frontal and of the parietal bones, the pattern of the venous sinuses, the basis cranii interna—posterior and middle cranial fossae, the endocranial cast and cranial capacity.

(3) The facial skeleton, including the supra-orbital torus, the orbits and the interorbital area, the nose, the maxilla with special emphasis on prognathism, the zygomatic bone, facial measurements and indices, and calvariofacial indices.

(4) The teeth, including the shape of the dental arcade and the palate, the arrangement of the teeth in the arcade, the pattern of occlusion and attrition, the state of the enamel, the dimensions and indices of individual teeth, tooth size as a whole, and the morphology of individual teeth.

(5) The cranium as a whole, including measurements and indices.

Thereafter will follow a summary of the cranial features of *Zinjanthropus* and a general discussion, with special reference to the affinities, taxonomy and definitions of the australopithecines in general and *Zinjanthropus* in particular; and the cultural status and phylogenetic position of *Zinjanthropus*.

CHAPTER II

PRESERVATION AND RECONSTRUCTION OF THE CRANIUM

The fossil remains, to which the name '*Zinjanthropus boisei*' has been given, comprise an almost complete cranium with the entire maxillary dentition. In the same level of Bed I were found some fragments of a second cranium and parts of the shafts of a gracile hominid tibia and fibula, while from the slope just below were recovered an upper lateral incisor, an upper molar and a lower premolar of a very gracile dentition.[1] According to Leakey, 'the hominid skull was found as a single unit within the space of approximately one square foot by about six inches deep...The expansion and contraction of the bentonitic clay, upon which the skull rested and in which it was partly embedded, had resulted, over the years, in its breaking up into small fragments...' (1959*a*, p. 491). However, despite its fragmentary condition, the individual pieces of bone are in a beautiful state of preservation: there is no sign of warping or squashing or other pressure effects, nor are the surfaces defaced by weathering. As a result, a wealth of anatomical detail is preserved in the cranium, which compares most favourably with the very best of the australopithecine remains hitherto described from South Africa. In completeness and state of preservation, the *Zinjanthropus* cranium must take its place alongside the child skull from Taung and the adult cranium (Sts 5) from Sterkfontein as the most perfect of the early hominid crania thus far found in Africa.

Reconstruction of the cranium was greatly facilitated because of this freedom from distortion and defacement. Nevertheless, it was a long and tedious process to assemble the hundreds of fragments, many of which were minute and lacking in manifest anatomical character. In this task, Dr Leakey enjoyed the patient and invariably fortunate co-operation of Mary Leakey. To these co-discoverers of the fossil is owing, in the main, the reconstruction of the cranium. The final assembling of the parts was made by Mr A. R. Hughes under the author's direction. The marked degree of pneumatisation of the cranium and the numerous and intricate septa subdividing the air-sinuses provided an additional source of irritatingly undistinctive fragments and, even at the stage of writing this report, scores of minute particles remain unaffixed to the reconstruction.

The portions of bone have been assembled in the first instance into six parts of the cranium and it will facilitate the subsequent description to enumerate these parts:

Part I. The maxillofacial fragment (pls. 16–18)

This comprises most of the lower part of the face: the nasal and subnasal parts of the maxillae including the nasal crest; the alveolar processes and the contained permanent teeth; the maxillary and palatine components of the hard palate; the maxillary antra; much of the body of the maxilla on each side, including the anterior surface and the opening of the infra-orbital foramen, the infratemporal surface and the zygomatic process; most of the right zygomatic bone, including the inferolateral margin of the right orbit, the zygomatic arch as far back as the serrations for the zygomaticotemporal articulation, and a small part of the temporal border of the zygomatic (the frontal processes and much of the orbital surfaces of the maxillae and of the right zygomatic, as well as most of the left zygomatic bone, form part of the upper or calvariofacial element). Attached to the

[1] The teeth and fragments of the second cranial vault have been recorded as a paratype of *Homo habilis* (Leakey *et al.* 1964). It is impossible to determine to which of the two hominids represented on this living-floor the tibia and fibula belong (Davis, Day and Napier, 1964).

back of the maxillary tuberosities are much of the left and right pterygoid processes of the sphenoid bone.

Part II. The calvariofacial fragment (pl. 15)

In this fragment are the nasal bones; the frontal processes and parts of the orbital and nasal surfaces of the maxillae, including parts of the margins of the orbit and of the piriform aperture; a small remnant of the lacrimal bone; much of the body of the left zygomatic bone including its malar and temporal surfaces; the frontal processes and most of the orbital surfaces of both zygomatic bones, including the related portion of the orbital margin; much of the frontal bone, including the frontal squame with its supra-orbital torus; the nasal part, orbitomarginal part and orbital surface, zygomatic process, temporal surface and internal surface of the frontal bone, as far back as a short distance in front of the coronal suture. It is in this position, just behind the postorbital constriction, that most bone is missing from the posterior border of the frontal and the anterior border of the parietals.

Part III. The biparietal fragment (pls. 21 and 22)

The third fragment comprises most of the two parietal bones. They are articulated together along the sagittal suture, which is overlaid for part of its anteroposterior extent by the left and right temporal crests coming into apposition as a sagittal crest. The posterior (lambdoid) margin is practically intact; a small broken-off part of the occipital remains articulated to the right lambdoid suture close to lambda. The lateral (squamosal) margins are likewise intact; but the anterior (coronal) margin is defective, no part of the coronal suture being apparent.

Part IV. Right temporal bone (pl. 23)

The fourth part of the cranium comprises the virtually complete right temporal bone. Slight defects are present along the upper edge of the squame, over the surface of the pars mastoidea and near the apex of the petrous part. The zygomatic process is broken across at the level of the articular eminence, that is, some distance behind the zygomaticotemporal suture. In front, part of the greater wing of the sphenoid is attached.

Part V. Left temporal bone (pls. 24 and 25)

The fifth part of the cranium comprises most of the left temporal bone. There are somewhat more defects than on the right, including much loss of the pars mastoidea and of the posterior half of the squame. On the other hand, most of the petrous process is preserved and the zygomatic process extends forward as far as the zygomaticotemporal suture. In front, part of the greater wing of the sphenoid is attached: this includes the base of the pterygoid process and part of the lateral pterygoid lamina.

Part VI. Occipitosphenoid fragment (pls. 26 and 27)

Finally, the sixth fragment comprises virtually the entire occipital bone, save for the detached fragment in the region of lambda mentioned above and slight defects in the lateral (exoccipital) part. Fused to the front of the basilar part of the occipital is part of the body of the sphenoid, completing the clivus and including the dorsum sellae and posterior part of the hypophyseal fossa. On the inferior aspect of the sphenoid, its rostrum bears part of the superior border and the alae of the vomer.

Apart from the defects enumerated above, the posterior parts of the walls of the orbits, the posterior parts of the nasal cavity, the posterior and medial parts of the anterior cranial fossa, and the anterior part of the middle cranial fossa are missing. All these defects follow from the lack of the ethmoid bone and of much of the sphenoid bone, especially the anterior part of its body, its lesser wings and much of its greater wings.

These defects are, however, relatively minor and it is not difficult to associate the six parts so as to assemble an almost entire cranium. Parts III–VI—the temporals, parietals, occipital and body of the sphenoid—articulate perfectly with one another, so as to constitute most of the calvaria, from its posterior limit almost as far forward as the plane of the coronal suture (pls. 10–13).

Parts I and II—the maxillofacial and calvariofacial fragments—make good contact with each other in the inferolateral part of the right orbital margin; a further approximation below the left orbit permits faithful alignment of the upper and lower parts of the face. The orientation of the upper fragment on the lower is further controlled by the co-planarity of the internasal suture above with the intermaxillary suture below, as well as by the relationship between the temporal surfaces of the frontal bone above, and those of the zygomatic and maxillary bones below (pls. 1–3).

The cranium is thus assembled into anterior faciocalvarial and posterior calvarial moieties. The joining of these major portions depends upon the approximation between two parts of the left lateral pterygoid lamina attached respectively to the maxillary tuberosity below and in front, and the greater wing of the sphenoid above and behind. A further precise guide is provided by the happy circumstance that the temporal process of the right zygomatic bone is intact as far back as the zygomaticotemporal suture, while the zygomatic process of the left temporal bone is intact as far forward as the same suture. It is thus a relatively simple matter to align the anterior and posterior moieties, so that the centres of the sloping sutural surfaces of these two processes lie in the same transverse plane. Such alignment satisfies the contours of anterior and posterior portions of the calotte and cranial base. The hafting of the facial on to the calvarial part has been facilitated by modelling the missing parts of the zygomatic arch on each side and by making an endocranial cast. In this way, the entire cranium has been assembled on an endocranial cast (pl. 5).

Our final reconstruction differs only slightly from that made by Dr and Mrs Leakey and published in *Nature* (1959*a*) and the *Illustrated London News* (19 September 1959*b*, and 4 March 1961*a*).[1] For instance, our final estimate of the maximum cranial length (from glabella to opisthocranion, which in this instance practically coincides with inion) is 173·0 mm., as compared with Leakey's (1959*a*) figure of 174·0 mm., obtained on the provisional assembly and reconstruction of the skull. Our estimate of the length is, however, an absolute minimum, as shown by the approximation of the parts of the lateral pterygoid plate and the alignment in the same coronal plane of the left and right zygomaticotemporal sutures.

[1] The reconstruction published by the Leakeys in 1959 is less complete than the later reconstruction, because additional parts were recovered subsequently.

CHAPTER III

THE CRANIAL VAULT

A. The curvature and components of the vault

1. *The vault as a whole*

The posterior part of the calvaria of *Zinjanthropus* is well filled and well rounded (pls. 9–12). From the external occipital protuberance, the posterior parieto-occipital plane rises steeply for a considerable distance before turning forwards over the summit of the vault. This striking feature, brought out in Fig. 1, was stressed by Leakey as the third of his twenty diagnostic criteria of *Zinjanthropus* (1959*a*, p. 492). However, Robinson (1960) claimed that this feature applied also to *Paranthropus*. In Fig. 1, Robinson's (1961) reconstruction of *Paranthropus*, based on the crushed specimen SK 48, has a remarkably similar parieto-occipital contour to that of *Zinjanthropus*, whereas the earlier reconstruction of SK 48 by Broom and Robinson (1952, p. 11) had a very different parieto-occipital contour from that of *Zinjanthropus*. As none of the specimens of *Paranthropus* is sufficiently undistorted to permit the contour in this region to be reconstructed accurately, it seems very likely that the *Zinjanthropus*-like contour in Robinson's later (1961) reconstruction has been influenced, at least subconsciously, by the intact parieto-occipital contour of *Zinjanthropus*. Robinson's (1960) claim that the steep parieto-occipital plane occurs as well in *Paranthropus* may therefore be discounted, at least until more intact cranial material is discovered. *Australopithecus* (Sts 5) has a more evenly-curved parieto-occipital surface.

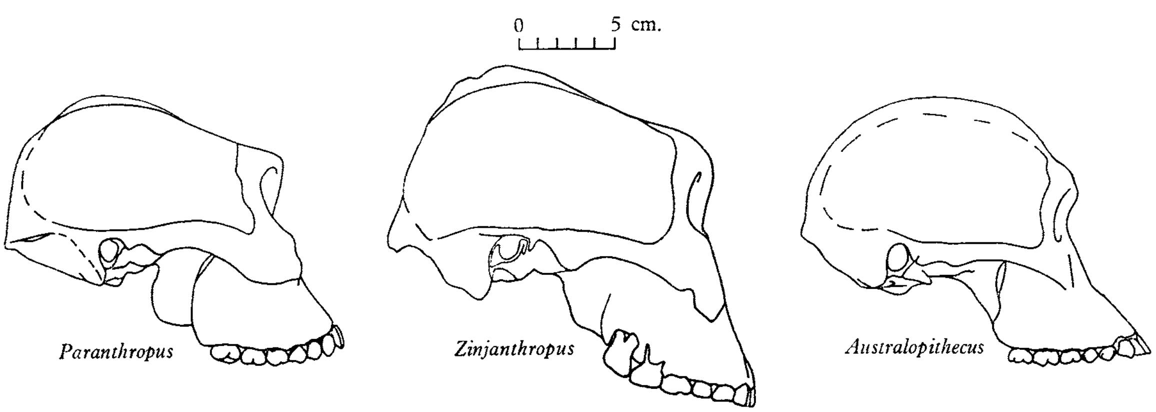

Fig. 1. Craniograms of norma lateralis of *Paranthropus*, *Zinjanthropus* and *Australopithecus*. The dioptographic tracing of *Zinjanthropus* was made with the cranium in the F.H.; the missing parts have been restored. The other two craniograms, also aligned on the F.H., are from those published by Robinson (1961) and are based on the reconstruction and restoration of SK 48 (*Paranthropus*) and on Sts 5 (*Australopithecus*).

Part of the full rounded contour of the vault is contributed by the high, steep, parietotemporal walls (pls. 9 and 11). They rise almost vertically before bending over to become a dome, as Leakey pointed out in the eleventh of his twenty criteria of *Zinjanthropus*. When this contour is compared with that of the *Australopithecus* cranium, MLD 37/38 from Makapansgat (Dart, 1962*b*), it is seen that the latter, too, is characterised by steeply rising side-walls of the vault; if anything those of MLD 37/38 are somewhat steeper than those of *Zinjanthropus* (pl. 9).

By and large, the vault of *Zinjanthropus* is spheroidal in shape as seen in norma verticalis, tapering from a greatly expanded posterior portion to a narrow postorbital constriction (Fig. 2). In this respect, it more closely resembles *Paranthropus*, as reconstructed by Robinson (1961), than *Australopithecus*, as represented by Sterkfontein 5 (Fig. 2). In comparison with *Paranthropus*, however, *Zinjanthropus* is clearly a 'long-spheroid' cranium, while that of Swartkrans has been reconstructed as a 'short-spheroid' or more truly spheroid cranium. In this respect, *Zinjanthropus* approaches slightly the condition in *Australopithecus* (Sts 5), which has a long, ovoid cranium, with a lesser degree of postorbital constriction. *Zinjanthropus* thus appears to be intermediate in calvarial shape between the two South African australopithecines, though obviously resembling more closely that of *Paranthropus*, as reconstructed by Robinson in 1961 and 1962.

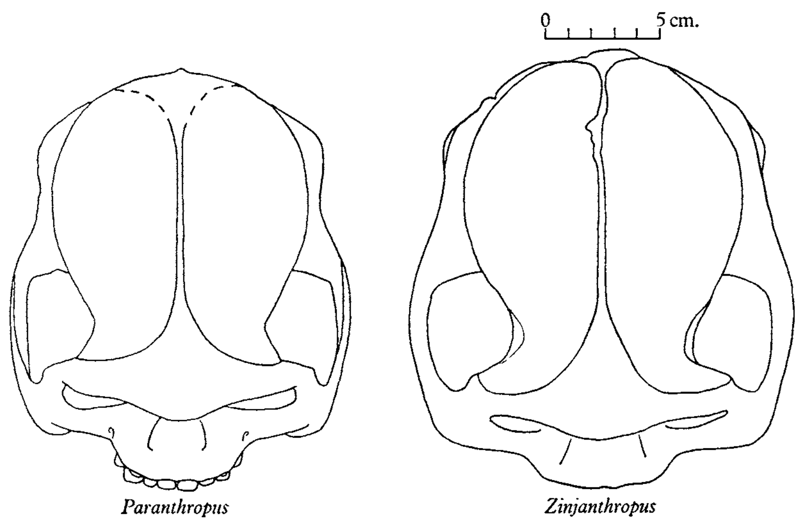

Fig. 2. Craniograms of norma verticalis of *Paranthropus*, *Zinjanthropus* and *Australopithecus*. The dioptographic tracing of *Zinjanthropus* was made with the cranium orientated in the F.H.; the missing parts have been restored. The other two craniograms were enlarged from those published by Robinson (1961) and are based on the reconstruction and restoration of SK 48 (*Paranthropus*) and on Sts 5 (*Australopithecus*). Note that in *Zinjanthropus*, a small part of the mastoid process protrudes laterally beyond the supramastoid crest.

The dimensions and curvature of individual vault-bones may next be considered.

2. *The parietal bones*

In Table 1, the chord and arc along each of the four borders of the parietal bones of *Zinjanthropus* are compared with those of other hominids. The sagittal readings in *Zinjanthropus* have been taken just to the left and just to the right of the sagittal crest; so these values may be taken as reflecting the dimensions of the vault itself, excluding its superstructures.

Most of the dimensions (mm.) of the parietals in *Zinjanthropus* fall within the range of variation of four *Australopithecus* crania from Sterkfontein and Makapansgat. The only exceptions are the coronal margin chord (69·4), which somewhat exceeds the top of the range (60·5 to ±66·5) for three *Australopithecus* crania; the temporal margin chord (81·8) which falls slightly above the value of 78·0, measured on two *Australopithecus* crania; and the temporal margin arc (89·3) which lies above the range (83–85) for the same two *Australopithecus* crania.

In Table 2, values measured on *Zinjanthropus* have been added to those of *Australopithecus* to make a total australopithecine sample of five crania. The values for Sts 58 have, however, been omitted from the range, since they could be measured only on the endocranial surface and are thus too small. The australopithecine parietal dimensions are compared with those of samples of *Homo erectus* from Java, China and north-west Africa (Ternifine) and of modern man. The values