

logues of the late glacial floras exist today. Though one might assume that the ash and oak pollen blew into the area from forests lying to the south, the chapter by Brush concerning the late glacial of Iowa reveals no *Fraxinus* pollen at the sites she studied. The question of where the oak and ash source trees were growing during the late glacial is unresolved. The mystery is compounded by the fact that no late Quaternary megafossils of these trees have yet been found in the region.

In southern New England, a late glacial zone containing characteristic hardwood and pine peaks (pollen zone A-3) is opened to reinterpretation by Margaret B. Davis. She offers at least two alternatives for interpreting the "spruce-hardwood zone," which she feels might be of interstadial or of Valders glacial age. One hypothesis accepts all the fossil pollen at face value as originating locally; for this assemblage, Davis finds the nearest modern analogue to be pollen rain of southern Manitoba in the

prairie-forest transition zone. She therefore suggests that the attendant late glacial climate in New England may have been more continental than today's climate.

Davis's second hypothesis dismisses the pine and hardwood pollen as having been blown in from "distant forests" and interprets the remaining pollen as representing a vegetation transitional between tundra and forest late in the Two Creeks interval or during the Valders readvance. Total frequency of hardwood pollen declines only slightly at the upper edge of this zone while conifer pollen increases, so Davis is not convinced that this switch indicates a cooling; but she thinks it may be only a successional development under a warming climate. If the only acceptable pollen elements are deemed to be spruce, fir, and nonarbooreal pollen, then the assemblage probably compares favorably with any number of modern pollen-rain sites in north-eastern Canada. In the end, we prob-

ably cannot worry too much about the ecological meaning of the spruce-hardwood zone of southern New England until we decide what part of it is local pollen, or until somebody pulls some plant megafossils out of that zone.

The irony of the first interpretation of late glacial spruce-hardwood zones discussed above is that if we accept all the observed fossil pollen and megafossils as coming from local sources both in southern New England and in Minnesota, we end up with the suggestion that the eastern seaboard late glacial climate was more continental than the present climate at about the same time that the Minnesota climate was more maritime or noncontinental in aspect.

The volume is beautifully printed, with elegant format and very few typographical errors. For any student of the Quaternary, it is a must.

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Assessment of a Fossil Hominid

Olduvai Gorge. Vol. 2, The Cranium and Maxillary Dentition of *Australopithecus* (*Zinjanthropus*) *boisei*. P. V. TOBIAS. Cambridge University Press, New York, 1967. xvi + 264 pp., illus. \$17.50.

This compendious monograph is devoted to a description of the best-preserved cranium and upper dentition of a member of the genus *Australopithecus* ever found. The format of the book and the careful use of precise terminology throughout are likely to make this work a model for all future treatments of ancient hominid crania, although I suspect the accomplishment will seldom be equaled. The photographic work of the 42 plates is of exceptionally high quality. Its impact, however, is slightly dulled by two plates of substandard pencil drawings and by the fact that there are only four plates comparing this find with any other organism.

As Tobias points out, although several crania of this group have been known for more than a quarter of a century none has been fully described before. W. E. LeGros Clark remarks in

the foreword: "I do not suppose that any such meticulous and exhaustive description of a fossil hominid skull as is to be found in this monograph has ever before been made." The extent of this contribution to paleo-anatomy is the more remarkable in that Tobias completed this impressive volume scarcely more than six years after the cranium, Olduvai hominid 5, was turned over to him for detailed analysis. Tobias's achievement is to be contrasted with the numerous cases in which discoverers of important hominid fossils have failed to produce analyses of their finds within reasonable periods of time.

Naturally, extensive monographic treatment of the sort Tobias has undertaken requires a reviewer to assess the final success of the projected aims. Basically, a single fossil find such as this cranium deserves compendious descriptive treatment to the extent that it represents a wholly novel taxon or is a much better-preserved specimen of a previously known species or genus. It is

also essential that the describer set the find in its proper evolutionary or phyletic position.

There is no question that this cranium is remarkably complete and undistorted. However, the common tendency to feature each new hominid fossil as taxonomically distinct, and by so doing to overemphasize the uniqueness of the discovery, was exhibited in the original name given the find by Leakey: *Zinjanthropus boisei*. This discovery (Olduvai hominid 5) was made at site FLK 1, Olduvai Gorge, Tanzania, by Mary Leakey in July 1959. Its impact on the study of human origins dating from that year is well known to students of anthropogenesis. The cranium is remarkable not so much because it is unlike anything else but because of its completeness and its demonstrated age of about 1.75 million years. In fact, the degree of its taxonomic distinctiveness was immediately challenged, and in 1963 Louis Leakey himself reduced the generic name *Zinjanthropus* to subgeneric status under *Australopithecus*. Although Tobias retains this *nomen* as a subgenus in the title and throughout the greater part of this monograph, he finally remarks in his concluding discussion on its taxonomic status (p. 232):

It may be inferred that *Zinjanthropus* is not even subgenerically distinct from *Australopithecus sensu stricto* or *Paranthropus*.

I therefore propose formally that the subgenus *Zinjanthropus* be sunk and that the australopithecine taxon from Olduvai [Bed I] be considered no more than specifically distinct.

Most taxonomists would consider it inappropriate to use in the title, figure and plate captions, and most of the text a *nomen* which is rejected in the same text. Nevertheless, Tobias's exhaustive study eventually led him to this synonymy, previously suggested by many others, but initially by Sergi in 1959. In the unnecessary naming of this supposedly new genus an important procedure of taxonomy had been sidestepped, that is, that when one has part or all of an organism representing a possible new genus and species its establishment as such a representative should come after thorough study and description—not before. If proper caution had been observed initially by Leakey, the meaningless generic term *Zinjanthropus* now so widely circulated throughout the world of learning in hundreds of books and articles would never have come into existence.

By allowing only a species distinction for this cranium Tobias has cleared up, in part, the question of the distinctiveness of the Oldowan hominid 5: however, some taxonomic ambiguities remain in this text which lead to such confusing final conclusions as the remark on page 244:

As to the first suggestion, we cannot exclude the chance of crossing between *A. africanus* and members of the *A. boisei* → *A. robustus* line. It is not outside the bounds of possibility that such crossing might have led to the "gracilisation" of *A. boisei* into the later and somewhat toned down *A. robustus*.

I suspect that most evolutionary biologists would regard the kind of gene flow described in this passage, if indeed it ever occurred, as more indicative of a single, polytypic species than of three clear-cut species. If the three species are all valid and distinct, evolutionary biologists would have to assume that there were behavioral or temporal barriers to hybridization among the three. Moreover, judging purely from the standpoint of the diagnoses presented by Tobias on pages 233–35, many of the characters cited as distinctive of *A. boisei* are differences of degree only, and are, as Robinson originally pointed out in 1960, due to the great individual robustness of this cranium. Some of the characters listed for *A. boisei* and *A. robustus* are also listed for *A. africanus* and thus are not species distinctions within the genus. About half the characters in these diag-

noses are cited both for *A. robustus* and for *A. boisei* and thus again are not distinctions at the specific level. In essence this study draws the three species of *Australopithecus* now "on the books" closer together. The Oldowan skull not only closely resembles the robust *Australopithecus* of Swartkrans and Kromdraai but shares some features only with *A. africanus*. Tobias's attitude is well exemplified in his plate 9, reproduced here as Fig. 1A, to which is added for comparison the same view of a male and a female lowland gorilla (Fig. 1B). Hominids are thought generally to show much less sexual dimorphism than apes—for instance the gorilla—so the differences between Olduvai hominid 5 and Makapansgat MLD 37/38 probably do indicate species distinction. Nevertheless, it is well to remember that in the earlier phases

of hominid evolution sexual dimorphism might have been greater. Taxonomic splitters should be reminded that nearly as much variation as exists in all known material of *Australopithecus* can easily be found in a single subspecies of living ape, the lowland gorilla.

Olduvai hominid 5 differs from the South African individuals of *A. robustus* primarily in its very large cheek teeth, in degree of development of molar cingula, and in relative size of M³. Tobias's carefully cited distinctions of *A. boisei* do not in my opinion justify the definite conclusion that a separate species of *Australopithecus* is represented in East Africa, although this may indeed eventually prove to be the case. One important result of this study, however, is the demonstration that both robust and gracile varieties of *Australopithecus* are much more similar dentally,

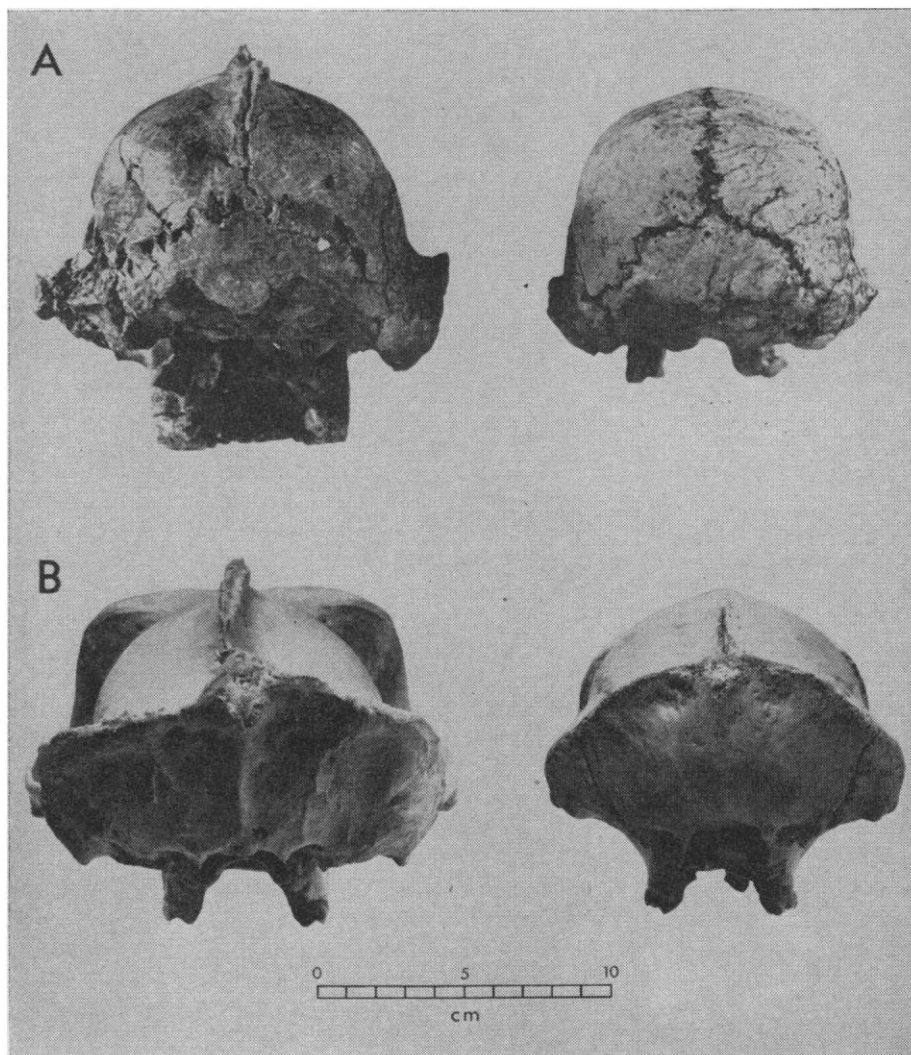
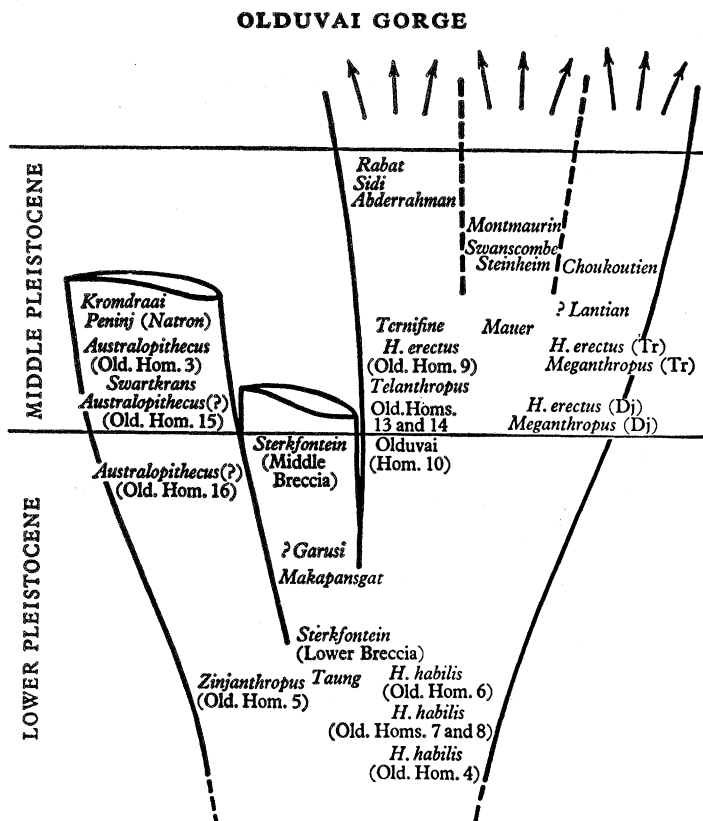


Fig. 1. Comparison of *Australopithecus* and *Gorilla*. (A) From Tobias. (Left) Olduvai hominid 5, *A. boisei*; (right) *A. africanus* from Makapansgat, South Africa, MLD 37/38. Of these Tobias remarks: "Shorn of its crests and considerable pneumatization, the *Zinjanthropus* cranium bears a strong resemblance to that of MLD 37/38." (B) Male (left) and female (right) lowland gorillas in the Yale collections. The male differs from the female chiefly in the strongly developed sagittal and nuchal crests and in greater pneumatization of the mastoid region.



Schema of Lower and Middle Pleistocene hominids, showing the positions in space and time of the most important specimens discovered to date. Tr—Trinil beds; Dj—Djetis Beds; Old. Hom.—Olduvai hominid.

Fig. 2. Proposed phylogenetic relationships of early hominids, from Tobias. The four samples listed at the base of the phylogeny (below the branchings) comprise, according to Tobias, three hominid species. These "species" include the most disparate individuals among early Pleistocene hominids. Either the lineages should be drawn as distinct at least into the Pliocene, or most of the lower and middle Pleistocene "species" should be included in a single lineage.

facially, and cranially than has sometimes been supposed. Tobias argues convincingly that earlier suggestions that the two differed in diet and in brain volume "fall away" with direct comparative study of known material. To this reviewer it would seem that the implications of this reach beyond the taxonomic sphere alone. If they were so similar, in brain volume and overall cranial anatomy, is it logical to deduce that one form was the hunter, the other the hunted, one a tool maker, the other a shambling "gorilloid"?

Estimates of cranial capacity have often figured in considerations of the evolutionary grade which given hominids had attained. For example, part of the problem of the distinctiveness of the three apparent species of *Australopithecus*, and in turn the supposed separation of these from the dubious "*Homo habilis*," depends on whether or not estimated population ranges of variation for features such as tooth size or brain volume overlap significantly. In those arguments which derive

from attempts to estimate metrical variation within *Australopithecus* populations there may be a general weakness, for it would seem that Tobias has not fully grasped the statistics involved. In one case he pools data on endocranial volume from groups he recognizes as different species; then, having computed this nearly meaningless mean, he proceeds to underestimate severely the "population" range for this character. When this calculation is performed correctly, the extremes of size variation in estimated brain volume for *A. africanus* rise to about those which have now been demonstrated for large samples of the gorilla (see Tobias, Fig. 11). In this context of endocranial studies reported by Tobias one may well wonder also whether the search for exactitude has not been carried too far in the section which attempts to measure the number of "excess" neurons to be found in the brain of *Australopithecus*!

An example of the pitfalls which often await one attempting to diagram relationships between organisms in time

and space can be found in Tobias's diagram (p. 242) summarizing his phylogenetic conclusions, reproduced here as Fig. 2. In this figure one can see that "*Zinjanthropus*" and the Taung juvenile are closely approximated near the base of this phylogeny; yet these are surely the two most divergent known individual *Australopithecus* finds in terms of comparable morphology. As a consequence of such inherent difficulties, it seems fair to say that this volume is stronger in the area of descriptive morphology than in that of evolutionary interpretation. One is confused by passages such as that on page 215 regarding the megadonty of cheek teeth in *A. boisei*: "Most notably the tendency to B.L. [buccolingual] expansion continues beyond the premolars into the molar field." It is generally accepted among mammalian paleontologists that the evolutionary emergence of cheek-tooth megadonty would begin in the molars and spread by molarization into the premolar field, not the reverse.

On page 243 we find a general summary of Tobias's views on *Australopithecus*:

We should thus arrive at a picture of the ancestral australopithecine as unspecialised and relatively small-toothed. At some time not later than the Upper Pliocene, it must have diversified into several lines. A megadontic line (*A. boisei*) emerged with specialised dentition. Another line remained little changed and unspecialised: presently it dichotomised into a progressively more hominised line represented in Africa by *H. habilis* and later in Asia perhaps by *Meganthropus palaeojavanicus*; and a more conservative residual line (*A. africanus*) which, perhaps because of competition, did not long outlast the emergence of this supposed hominine.

The intensive selection pressures which it must be presumed engendered *A. boisei* at the beginning of the Pleistocene must have subsequently relaxed somewhat. Some populations of *A. boisei* then moved forward with a moderate reduction in cheek-tooth size, loss of the cingulum probably as part of the same process, shortening of the face and reduction of jaws—to become the macrodontic *A. robustus* of the Middle Pleistocene.

In spite of this elegant summary, and with all due respect to Tobias, the reader should not forget that these conclusions remain highly conjectural. It seems to me that there has been an unfortunate tendency to crystallize or canalize the story of early hominid evolution in Africa too early in the game of recovering data. The concept of several distinctly adapted species contending for supremacy in early Pleistocene times in Africa still could prove to

be quite wrong. The effect of this can only be to slow down the spread of true understanding of the earliest phases of evolution of man's relatives and ancestors in Africa. For example, the *A. boisei* and "*Homo habilis*" branches of Tobias's postulated tree are represented in Bed I at Olduvai by significant samples of only one each, the types. Referred materials of these two "species" from Bed I yield almost no additional information about dental-cranial anatomy of either species, for they are mainly postcranial finds. We still do not know whether one or several lines of early hominids differentiated in the Pliocene of Africa. Nor do we know whether the type mandible of so-called "*Homo habilis*" is really advanced or not.

The relatively large canines and narrow premolars of this type jaw associate the find with *Ramapithecus* and

Dryopithecus. These and other features need not be taken as exclusive resemblances to members of *Homo*. One learns from the editor's note to this volume that in a projected fifth volume of this series Tobias has now been committed to defending the very weak case that "*Homo habilis*" is a valid species belonging in genus *Homo*. Students of human evolution look forward to learning how this knotty problem will be unraveled there.

In conclusion, it seems that, as is often the case following great discoveries such as the cranium of Olduvai hominid 5 and important and exhaustive studies such as Tobias's monograph, we are left with more new questions to ask than those the find has answered.

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Inferring Man's Prehistory

Human Evolution. An Introduction to Man's Adaptations. BERNARD G. CAMPBELL. Aldine, Chicago, 1967. xvi + 425 pp., illus. \$8.95.

The publisher characterizes the approach used in this book as revolutionary. As compared with other recent books on human origins this one does indeed represent a radical change in that it includes scarcely any mention of genes, no extended account of primate anatomy, no attempt at a historical review of the science of paleoanthropology, and no technical details about bloodgroups, hemoglobins, transferrins, and the like. Readers may well ask what is left from which to develop a sizable book. The answer is that the author proceeds through three kinds of inferences, starting with a few selected facts derived from human fossils and ignoring the historical and controversial details.

A built-up picture of at least some part of a fossilized creature is the first inference. From this Campbell makes a second inference as to the creature's whole biology and way of life. For instance, knowledge of the creature's body tells him something of its mode of locomotion and this in turn of its environment; knowledge of the teeth suggests what its diet might have been; and so on. The third inference concerns the many details of which no clues survive. The author infers these

from the recorded observations on the anatomy, physiology, and behavior of the living primates. In this way, and with an assist from geological sequences, he hypothesizes what any of man's ancestors was like. As he says, "The whole truth will perhaps never be known, but that does not negate the value of making a hypothetical interpretation of what evidence we can lay our hands on."

Exercises of this sort have been a feature at anthropological meetings in England and America for some years, but a book with this approach has been lacking heretofore. Usually a "revolutionary" book is aimed at readers with previous knowledge of the field, but not this one. The writer aims at reaching a not well-informed audience by means of clear writing, simple line drawings, common synonyms in parentheses following technical words, and a 27-page glossary. For those who want to learn more a 14-page bibliography is provided.

The picture of human evolution that emerges can be outlined as follows: The human line stems from an ancient group of primates which had been preadapted for life in open country by a life of semibrachiation in a forest environment. What brought the line into the open is unknown. Bipedalism began to develop from the posture of brachiation when these animals became established in the open (perhaps in the Miocene, 15 to 20 million years ago) and became efficient as subjected to strong selective pressures

by long-distance traveling and burden bearing.

The need to reduce body heat in the open environment led to reduction of body-hair length. By 2 million years ago the erect australopithecines—the immediate precursors of true men—had developed self-awareness, a crudely effective means of communication, and a distinctive social organization; they were beginning to modify as well as use tools. From then on the evolutionary process of this unique line accelerated: The brain doubled in size by around half a million years ago, when there is evidence also that fire had been brought under control; it reached modern size by 100 to 200 thousand years ago.

The success of this book when used as a text in anthropology courses will depend on the teacher's ability to supply missing details and argue for other points of view. One such argument concerns the continuing use of living primates—end results of equally long but different evolutionary lines—as models for the stages of human evolution. The early achievement of erect posture by the human line led it into so many new avenues of change that comparison at any point with an existing primate is likely to be misleading.

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At Work in the North

Ancient Men of the Arctic. J. LOUIS GIDDINGS. Knopf, New York, 1967. xlvii + 391 pp., illus. \$10.

The late J. Louis Giddings is well and warmly remembered by his colleagues, and some of the many reasons glint from the pages of this excellent posthumous book. Giddings's vital contributions to Eskimology, his reshaping of northern archeology, his sense of problem, his energy, perception, and persistence echo through this narrative of his field experiences in arctic America. Here one learns of the mood and motivations of the prehistorian, the procedures and problems of arctic research, especially archeological, and, of course, one learns a great deal of the origin and evolution of Eskimo culture. Although archeologists commonly disagree on interpretations of their elusive data, Giddings gives a balanced view of Alaskan Eskimo prehistory. In the process, he also serves palatable samples of