OLDUVAI GORGE

VOLUME 2

The skull of *Australopithecus* (*Zinjanthropus*) *boisei*, reconstructed by R. J. Clarke under the author's supervision. Photograph by R. Campbell and A. R. Hughes (*see also* pls. 41 and 42).

OLDUVAI GORGE

EDITED BY DR L. S. B. LEAKEY

VOLUME 2

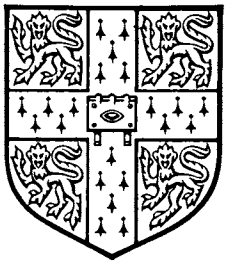
THE CRANIUM AND MAXILLARY DENTITION OF AUSTRALOPITHECUS (ZINJANTHROPUS) BOISEI

BY

P. V. TOBIAS

WITH A FOREWORD BY

SIR W. E. LE GROS CLARK, F.R.S.



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Introductory Note to the 50th Anniversary of the Discovery of 'Zinjanthropus'

The Olduvai Gorge in the Republic of Tanzania came to the attention of the world shortly after my mother Mary discovered the 'Zinjanthropus boisei' skull on July 17th 1959. The field of African prehistory, and in particular the study of human evolution, has changed and developed dramatically over the past 50 years. I am particularly pleased that Cambridge University Press have decided to republish the 5 monographs that comprehensively cover the many scientific studies that have been undertaken on the Olduvai material collected by my parents, Louis and Mary, working with a number of colleagues. As the Golden Anniversary of the discovery approaches, it is timely to reflect on the importance of that find.

I was lucky to arrive at Olduvai two days after the discovery and I well recall the excitement of the occasion. My parents were operating on a very tight budget and the field season was short. Fortunately, on hand was world-renowned photographer Des Bartlett who, aided by his wife Jen, fully recorded on film the first few days of excavations and reassembly of bone fragments back in camp. As pieces were glued back together, and the shape of the skull and its morphology became clear, my parents showed uncharacteristic and unrestrained emotion! At the time, ages for fossils were wild guesses and radiometric dating had not been done anywhere in Africa. The best, guessed age for Zinj was a little more than 500,000 years. Some months later, a real Potassium/Argon date was obtained by Jack Evenden and Garniss Curtis, and the 1,750,000 age was announced. This ignited huge excitement worldwide and for the first time my father was able to raise financial support for extended field work at Olduvai. Everything changed. The unqualified enthusiasm and support of the National Geographic Society from 1960 onwards had a major impact on the later work at Olduvai, and indeed on the growing international interest of Africa as the cradle of humanity.

Since those first exciting years at Olduvai, the investigation of human origins has gone forward and extended to many other sites in Africa. The age of hominins has been taken back to beyond five million years and the collected fossils and lithic records are now numerous. International multi-disciplinary teams are working in many parts of the world and, with the exception of a few fundamentalist 'flat earth' types, the acceptance of the fossil record of our past is widely accepted. Much of this has come about because of the initial Olduvai finds.

The pioneering work at Olduvai was the launch of this fantastic 50-year period when we as a species have come to realize and appreciate our common evolutionary past. Olduvai, conserved and protected by the Republic of Tanzania, remains as a landmark in the epic story of humanity, and these monographs are a wonderful testimony to that landmark.

Richard Leakey, FRS

FOREWORD

BY SIR W. E. LE GROS CLARK, F.R.S.

The discovery by Dr and Mrs Leakey of an australopithecine skull in Bed I of the deposits of the Olduvai Gorge is of major importance for two reasons. First, the skull was found at a stratigraphical level that has been dated with reasonable assurance by the potassium-argon method to well over a million years, indeed probably as much as one and three-quarters of a million. Second, the skull, though fragmented, was found to be practically complete except for the lower jaw; it was possible to piece together the broken fragments with fair accuracy and to demonstrate that it was almost free of distortion and deformation in spite of its prolonged period of fossilisation. In fact, apart from one specimen discovered by the late Dr Robert Broom at Sterkfontein in South Africa in 1947, no australopithecine skull is yet known that approaches in completeness the Olduvai skull.

It is particularly fortunate that the responsibility for the detailed study of this skull should have been given to Professor P. V. Tobias, for he has had many years of experience in dealing with fossil hominid material as well as a wide acquaintance with the skeletal structures of the higher Primates and their degree of variability. 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, even if account is taken of Boule's description of the Chapelle-aux-Saints skull, or of Weidenreich's account of the crania of Chinese representatives of *Homo erectus*. Not only does Professor Tobias describe and define with great clarity the various anatomical features of all parts of the skull, including its endocranial characters, he makes numerous statistical comparisons based on his extensive studies of large collections of skulls of modern apes and modern man, as well as comparisons with a number of fossil human skulls of which he himself has examined the original specimens.

When the Olduvai skull was discovered, Dr Leakey at first thought it to be generically distinct from any of the known South African australopithecines, and he gave it the name *Zinjanthropus boisei*. The careful studies of Professor Tobias have now convincingly shown that it is an East African representative of the genus *Australopithecus* and that even the use of *Zinjanthropus* as a sub-generic term is no longer justifiable. Following the recognition that the australopithecines should properly be included in one genus only, *Australopithecus*, possibly comprising not more than one or two species, several of the generic and specific terms that were coined during the early days of the australopithecine discoveries in South Africa, and which were the source of some misunderstanding in the initial controversies about these fossils, may now be discarded. Professor Tobias discusses at some length the details of the dental morphology in the African australopithecines (so far as these are at present known) and sees no reason on the basis of their variability to make any generic distinctions. The variability in the size and cusp pattern of the teeth is remarkable, to such an extent that some of the specimens of the dentition, for example those of smaller dimensions found at Sterkfontein, are not easy to distinguish from the more megadont individuals of the fossil species *Homo erectus*. It seems, indeed, that the dental characters by themselves do not have a high taxonomic relevance for making such a distinction; the latter must depend rather on contrasts in cranial characters, brain size and limb structure. Thus even the generic distinction of 'Telanthropus' may be open to question. This type has more recently been taken by some authorities to be a

South African representative of *Homo erectus*, but to the present writer the dental evidence seems equivocal, and the very fragmentary remains may with greater probability be assigned to small-sized individuals of the australopithecine group.

The cranial capacity of the Olduvai skull is small (530 c.c.) and thus comes within the existing australopithecine sample range. But it perhaps needs to be emphasised that this sample is still very limited, so that we do not yet know what the general population range may have been. If it was anything like that of the modern gorilla it may be assumed that the upper limits of the population range would have reached well over 600 c.c., perhaps nearer 700 c.c. In spite of its small cranial capacity, it is remarkable that in detail after detail described by Professor Tobias the Olduvai skull displays hominid and not pongid characters. It is thus no longer possible to controvert the allocation of the australopithecines to the family Hominidae rather than the Pongidae. The evidence for such a classification is now so complete that we can afford to forget the controversies that were aroused by the earlier discoveries in South Africa. For example, there is now no question of a sagittal crest (when it is present) being continuous with a high nuchal crest as it consistently is in the large apes. On the contrary, the nuchal area of the occipital bone is very restricted, and the external occipital protuberance is actually situated below the level of the Frankfurt plane. Other distinctively hominid characters include a large pyramidal mastoid process of typical hominid form even in an immature individual, a parabolic dental arcade with no diastema, spatulate canine teeth wearing down flat from the tip only, the degree of flexion of the cranial base, the anterior position of the occipital condyles and the nearly horizontal plane of the foramen magnum, the detailed construction of the mandibular fossa of the temporal bone, the moderate subnasal prognathism, and so forth. Of course, these hominid features of the australopithecine skull were already known from the South African fossil material but, as much of the latter consisted of fragmentary specimens, it is highly satisfactory to find such an emphatic confirmation of them in the almost complete and undistorted Olduvai skull.

No doubt one of the most important implications of the Leakeys' discovery is the apparently long time gap between the estimated date of the Olduvai skull and that of the almost identically similar skulls of the robust variety of *Australopithecus* in South Africa, a gap of a million years or more. Clearly the genus *Australopithecus* was long-lived (though not more so than some fossil genera in other mammalian groups). With such a wide temporal and geographical dispersion it would be surprising if the East African populations of *Australopithecus* did not show some degree of morphological difference from the South African populations, though some may doubt whether such differences are adequate to postulate generic, or even specific, distinctions—it may even be that they warrant no more than sub-specific distinctions.

Remains of australopithecines have been reported from other parts of the world outside Africa, but such reports are based on very friable evidence. It may be, therefore, that *Australopithecus* evolved somewhere in Central Africa, and that in the course of many centuries members of the group trekked down to South Africa where they persisted unchanged into the Middle Pleistocene long after the genus *Homo* had arisen elsewhere. Since the discovery of the 'Zinjanthropus' skull was announced, further relics of fossil hominids have come to light in the deposits of the Olduvai Gorge as the result of the energetic field-work of Dr and Mrs Leakey. The interpretation of these later finds is still obscure because full reports on them have not yet been completed and published. The correct assessment of their real significance will doubtless depend on a recognition of the wide range of variability in the different groups of the genus *Australopithecus* already known, with due attention to the differential taxonomic relevance of various characters of the skull, dentition and limb structure. In this monograph, Professor Tobias has shown that he is well aware of the need to take such factors into account.

EDITOR'S NOTE

This is the second volume of the new series of publications dealing with the discoveries made at Olduvai Gorge since 1951. The title of the first volume included the dates '1951–1961'. These have been dropped from the present volume, and will also not occur in the remainder of the series, since, inevitably, data obtained since 1961 will need to be included. The next two volumes in this series will deal with the cultural sequence and excavations of the 'living floors' in Beds I and II, at Olduvai, by Mary D. Leakey, and the detailed geology of the deposits exposed in the Gorge by Richard L. Hay. It is not yet certain which of the two will be ready for publication first.

A fifth volume is in preparation by Phillip Tobias, the author of this volume on '*Zinjanthropus*'. In it he will describe, in detail, the fossil hominid remains from Olduvai that are attributed to *Homo habilis*, and to *Homo erectus*, as well as the new mandible of an australopithecine of '*Zinjanthropus*' type from Peninj, north of Olduvai. The fifth volume will also include chapters dealing with the post-cranial hominid material from Olduvai by Dr John Napier, Dr Peter Davis and Dr Michael Day.

In the present volume, my friend and colleague, Phillip Tobias, has produced a truly magnificent piece of research—a major contribution to the study of the anatomy of the australopithecines, or 'near men' as I call them. This volume is without doubt the most detailed study of any one single fossil hominid skull that has ever been made, and the facts that have emerged from his studies are presented with admirable clarity. I need not enlarge upon this, since Professor Sir Wilfrid Le Gros Clark has done so in his Foreword.

Naturally, Tobias concludes his study of the facts about *Zinjanthropus* with an expression of his views as to the taxonomic status of the members of the sub-family Australopithecinae. He believes that the ancestral stock which gave rise to both *Homo habilis* and to *A. africanus* was an Australopithecine. I would prefer to refrain from suggesting that the common ancestor was closer in morphology to one or the other. We do not yet know. Similarly, it would seem better to leave open for the present the question of whether *Homo erectus* was a derivative of *Homo habilis*.

Finally, it remains only for me to congratulate Phillip Tobias upon a magnificent piece of anatomical study. This book will stand as a model for a very long time as to how a study of a fossil skull should be conducted.

L. S. B. LEAKEY

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I am grateful to both Professor R. A. Dart, who guided me into physical anthropology, and Dr J. T. Robinson, for allowing me freely to study specimens in their collections and for helpful discussions. Doctor Robinson also kindly assisted me with the loan of an unpublished median sagittal craniogram of *Australopithecus* (Sterkfontein 5). Professor Sir W. E. Le Gros Clark, F.R.S., kindly contributed the Foreword and made available a median sagittal craniogram of a female gorilla. In addition, I wish to thank the Keeper of Palaeontology and the Keeper of Zoology at the British Museum (Natural History), Dr K. P. Oakley, Dr J. C. Trevor, Dr D. R. Hughes, Mr D. Brothwell, Miss Rosemary Powers, Professor H. V. Vallois, Dr C. Arambourg, Professor S. Sergi, Dr D. Hooijer, Professor G. H. R. von Koenigswald, Dr V. FitzSimons, Professor L. H. Wells and the Uganda Gorilla Research Unit of the University of the Witwatersrand.

The extremely difficult and laborious task of casting each of the delicate and frequently undercut fragments of the cranium was successfully undertaken by Mr T. W. Kaufman; the casts have been skilfully painted to simulate the originals by Mrs C. R. Esson. The reconstruction of the cranium and the plaster and endocranial cast have been made by Mr A. R. Hughes in conjunction with the author, and it is a pleasure to acknowledge my indebtedness to him for freely imparting the fruits of his long experience at handling, preparing and reconstructing fossil material, as well as in the accurate preparation of dioptographic tracings and drawings. The X-rays were made by Miss J. Dreyer and Mrs D. Coetzee, through the co-operation of Professor J. Kaye, Head of the Department of Radiology at the Johannesburg General Hospital. Miss C. Orkin and Miss J. Soussi sacrificed their personal vacation arrangements to execute painstakingly many of the drawings, graphs, diagrams and dioptographic tracings, while Miss Soussi was largely responsible for the punctilious tabulation and statistical reduction of data, the tests for significance of differences, and for the careful checking and collation of the manuscript. Miss A. Wright helped with such tedious details as the cutting out and mounting of the photographs. Mr T. E. Badenhuizen assisted with the calculation of indices, as well as with the statistical reduction of comparative data in the literature. Miss C. Orkin and Mr D. Gillmer helped me check the proofs. The entire task of photographing the skull—its several components, individual teeth and the assembled reconstruction—was undertaken with finesse, artistry and devotion by Mr R. Klomfass. In all some 200 photographs were taken. A proportion of these is included in this work and eloquently testifies to his skill. Mrs L. V. Hitchings, as well as Mrs R. W. Kaplan and Mrs B. E. Wilson, graciously lavished many weeks of their time on the meticulous and thoughtful typing of the manuscript, the tables and the legends. To all of this fine team, I express my warmest gratitude.

The advice, inspiration and encouragement of Dr and Mrs Leakey have been forthcoming at all times: I am deeply in their debt for giving me the privilege of working on so important and anatomically ideal a specimen.

Finally, I sincerely appreciate the patient, helpful and friendly co-operation of those many people at the Cambridge University Press—in the Pitt Building, at the Printing House, and in Bentley House, London—who have participated in producing this book. It has been a joy to work with them.

P.V.T.