CHAPTER I

THE GENERAL GEOLOGICAL EVIDENCE

In my report on Olduvai, which was published in 1951, a brief chapter was included which had been written by the late Professor Hans Reck. In it he summarised the geological evidence which was then available as the result of his own 1913 expedition and of his work with us during 1931. This preliminary chapter had, in fact, been written at a time when he had not yet worked through all his field notes. He had planned to prepare a much more detailed report, accompanied by drawings of selected sections of the geological deposits, after his return from his expedition to Portuguese East Africa. Owing to his sudden death on that expedition, this full report was never written, and after the end of the war in 1945 it proved impossible for his widow to trace his many books of field notes. Thus, all that was available for me to use in the 1951 volume was the original preliminary note prepared before the war.

Dr P. E. Kent was a member of my 1935 expedition to Olduvai and he subsequently published a brief general note on the geology of a small part of the exposures which he had examined.

In 1961 Dr R. Pickering, a member of the Tanganyika Geological Survey, spent some four and a half months with us at Olduvai, by kind permission of the Director. He concentrated, mainly, upon making a detailed map of the FLK region where *Zinjanthropus* had been found in 1959. This will be published in volume 3 of this series. He also prepared a general map of the gorge based on aerial photographs and some rapid geological reconnaissance work. This map, with some modifications, appears in the present volume. It had been intended that his report should also be presented in this volume. There was, however, much that did not seem to me to fit the visible facts, while many of the conclusions were also unsatisfactory. Dr Pickering has, of course, every right to his own views both on the nature of the deposits and upon the conclusion to be drawn from what he has observed. However, if his report had been included here, it would have been necessary for me to add so many notes that these would have been more voluminous than the report itself. I therefore invited the Director of the Geological Survey and the Chief Geologist to visit me at Olduvai to discuss the matter. As a result, I decided not to publish Dr Pickering's report in this volume.

Subsequently, I invited Dr Richard Hay of the Geological Department of Berkeley Campus of the University of California to come out to East Africa in 1962 and make an independent study. His preliminary note has been published in America and has, by permission, been included as appendix 1 in this volume. I feel that he has already achieved a greater measure of understanding of the details of the complex Olduvai deposits than any of those who studied the area before him, and I strongly commend his preliminary note as giving an excellent general picture of the Olduvai geology. If I disagree with him on a few minor points—as will become apparent in this chapter and in the chapter on climate—it certainly does not mean that I have anything but praise for his work as a whole.

Since a general outline of the geological position is necessary to an understanding of the palaeontological evidence that forms the main part of this volume, a summary of the present state of our knowledge follows. In particular, an attempt will be made to indicate in what matters our greatly increased knowledge has necessitated modifications of some of the statements which were made in the 1951 report.

In the first paragraph of his report, Professor Reck rightly stressed the differences in the morphological appearance of the gorge in its westerly reaches (where it runs, in main, across the under-

lying basement complex rocks) and in the eastern part, where it cuts through the full series of the lacustrine and other sediments which are exposed in the gorge as it is today.

He then went on to say 'the valley is thus a derivative of the original drainage system of the Central African plateau and similarly is, at least, of early Tertiary origin, showing that, even at that time, the drainage was towards the east'.

This statement about the direction of the pre-faulting drainage of the area seems to require some modification, for the present drainage system appears to be due to the post-Middle Pleistocene faulting, which affects the whole of the area. If the conformation of the land prior to the faulting is reconstructed, it is difficult to see how the drainage could have been 'to the east' at the time when the Olduvai sedimentary series was first being formed. The very much older Tertiary drainage may, or may not, have been in a generally eastward and seaward direction but, in Bed I and Bed II times, the greater part of the local drainage was from the east and south towards the west and north.

Since we know that a valley of mature form was cut through the sedimentary series of Beds I to IV after the faulting, the mature shallow valley in the upper reaches of the gorge may well be nothing more than the westerly extension towards El Garja lake of this same geologically young valley.

It seems impossible to see how the drainage of this part of the Serengeti Plains could have been 'to the east' prior to the faulting. Since we know that the Victoria basin contained a lake standing some 300 ft. above the present water level and that the Serengeti is part of the drainage basin it seems much more probable that the drainage was westwards, towards the lake. It was only when the faulting resulted in the creation of the Balbal depression that a drainage pattern towards the east and south developed.

THE STRATIGRAPHIC SEQUENCE

The deposits which are exposed in Olduvai Gorge in the central part consist of:

(*a*) Consolidated tuffs under the lava, about which little is known.

(*b*) A thick basaltic lava with a very irregular upper surface. Its lower surface is visible only at one place.

(*c*) Bed I.

(*d*) Bed II.

(*e*) Bed III.

(*f*) Bed IV.

(*g*) Bed Va.

(*h*) Bed V.

(*i*) The main steppe limestone or caliche.

(*j*) Bed VI.

To the east, between the second fault and the Balbal, as well as in the Balbal depression itself, the rocks underlying the sedimentary series are not visible. West of the junction of the main and side gorges the base of the sedimentary series cannot be seen for very many miles. When, at last, it is once more exposed it is found to rest upon a welded tuff which, in turn, overlies rocks of the basement complex.

Let us consider each of the deposits forming the sequence.

(*a*) *The deposit under the lava*

There is only one place where the base of the lava sheet is exposed. This is in a low cave, beneath a waterfall, some 300 yards to the west of the third fault. Professor Reck illustrated the under-surface of the lava, as it can be seen in this cave, in plate VI of the 1951 report and he wrote: 'The nature of the underlying beds is not known because the floor of the low cave excavated in the rock, to which the lava forms the roof, is covered with sand and debris.' This was true at the time of Reck's visit in 1931, but subsequently floods scoured out the cave so that the underlying deposits became visible. These were found to consist of stratified tuffs not unlike some of those within Bed I above the lava. In 1962 Dr Hay had a small pit dug near the mouth of the cave. Some 9 ft. down a hard tuff was encountered. Dr Hay believes that the deposits over this tuff consist of *in situ* sediment; but it may well be that they are, in part, material from the main Olduvai series which had been re-deposited by water action in fairly recent times. Dr Hay believes that this tuff may be the same as that which underlies Bed I (in Reck's sense) far to the west. He, therefore, suggests that these under-

lying tuffs, together with the lava itself, be included in a new definition of Bed I.

This seems to me to be unwise, at the present time. We know that Bed I (in Reck's sense) is of Upper Villafranchian age, on the basis of its fossil fauna. There is, however, no fossil evidence upon which we can date the lava or the tuffs which underlie it. They may well also be of Upper Villafranchian age, but they may be older. Consequently, in this chapter and also in the rest of the book (other than the appendix by Dr Hay), the lava as well as the beds beneath it are not treated as a part of Bed I.

(*b*) *The lava*

The basaltic lava which underlies Bed I can only be seen between the second fault and the junction of the main and side gorges near VEK–FLK. To the east, the faulting has buried it deep below the channel of the gorge but it can reasonably be assumed that the lava does extend towards the volcanic highlands, which lie east and south and which were presumably the origin of the flow. Westwards the lower margin of the sedimentary series is not visible for very many miles, and when it does reappear it does not rest upon the lava but upon a welded tuff.

(*c*) *Bed I*

Bed I is visible for a few hundred yards east of the second fault and it can be traced from there westwards for many miles. Its upper limit was defined in 1931 by Reck and Leakey as the flagstone bed, which had then been traced from the second fault through to the region of site VEK. This horizon was chosen as a matter of convenience because it could easily be followed, and has been retained for the same reason by Dr Hay. We now know that it can also be seen in places some miles up the side gorge and that it reappears in the main Gorge at the fifth fault, whence it can be traced westwards.

For a long time it seemed as though this arbitrary dividing line between Bed I and Bed II coincided to some extent with a major faunal change. This view is no longer tenable. It is now clear that the lower part of Bed II belongs with Bed I geologically, faunally and culturally, and that the break occurs within Bed II. When, therefore, the term Bed I is used in this chapter and in the succeeding ones, it is used in the sense in which it was originally defined, as from the lava to the flagstone or 'marker bed'.

To the east Bed I is very thick, reaching as much as 120 ft. in places. It is composed mainly of coarse volcanic material. At both the second and third faults, the lowest deposits of Bed I consist of fine-grained clays and tuffs, and these contain fossil remains of crocodiles and some fish in addition to the mammalian fauna. They are overlain in this region and also to the west, as far as JK I, by a thick volcanic tuff, which becomes finer-grained to the west. It seems to represent an eruption of considerable magnitude. Further to the west, for example, in the region of HWK, FLK and VEK, the tuffs of Bed I are very much finer-grained and they are interbedded with clays and temporary land surfaces such as those upon which the living floor of *Zinjanthropus* was discovered. Still further to the west, near the fifth fault, even the 'marker bed' at the top of Bed I becomes finer-grained, while the underlying beds are much more clayey, with far fewer intervening land surfaces.

At one time Bed I was believed to contain little fossil material, but this is now known to be incorrect. Even when there is no human occupation level, fossils occur in the clays, while the numerous living-floors have yielded an immensely rich and varied fauna of mammals, birds and some reptiles. This fauna will be briefly considered in subsequent chapters but the detailed reports cannot be ready for many years in view of the quantity of material, both in actual numbers and in variety of species.

(*d*) *Bed II*

Bed II was defined by Reck as 'the deposit lying over the marker Bed at the top of Bed I and beneath the Red Bed', which he called Bed III. This definition is accepted and used here and it is also used by Dr Hay in his appendix, but it involves certain practical difficulties. In the first place, to the west Bed III is not red; and, moreover, it is not always easily recognisable. Secondly, it is now

known that Bed III was, in some places, removed by erosion channels prior to the deposition of Bed IV, so that Bed IV may be found resting directly upon Bed II. Furthermore, there are 'red beds' both in Bed II and in Bed IV and these have sometimes been mistaken for Bed III.

Reck considered that Bed II consisted of a single and relatively continuous series of deposits without any noticeable depositional break. This is now known to be untrue. The lower and upper parts of Bed II are separated by a break of considerable magnitude. This can be established by geological evidence and is also represented by a major faunal change.

Bed II can be traced from the second fault westwards over an extensive area. There are probably better exposures of this horizon than of any of the other Pleistocene deposits of Olduvai. It varies in thickness from a few feet in the region of the second fault to over 80 ft. in the west.

A little to the east of the second fault the dip of the deposits, which resulted from the fracture, has caused Beds I, II and III to disappear below the level of the present-day gorge. Bed II, however, does reappear near the first fault at the edge of the Balbal.

The view is taken here that Bed II may be divided into three parts. The lower series, which is lacustrine and fluviatile, belongs geologically and faunally with Bed I. It represents the closing stages of the Villafranchian. The middle series is represented by aeolian sands, sub-aerial soils and weathered clays. It marks a dry period which is followed by a major change of fauna. The upper series begins with river channels filled with torrential gravels, followed by deposits which are partly fluviatile and partly lacustrine, depending upon where they are exposed.

(*e*) *Bed III*

Reck described Bed III as 'a sub-aerial land deposit—the contents of which were brought down mainly by water action from the volcanic highlands to the east'. It is, indeed, a deposit which is in striking contrast to the beds which are above and below it and from both of which it is separated by marked discordances.

Bed III is dominantly red in colour in the eastern and central areas but to the west it ceases to be red and is sometimes difficult to identify. It is partly of terrestrial origin and partly fluviatile. In some localities it contains torrential river gravels and boulder beds. It seems to be indicative of a marked change of climate from that which preceded it in upper Bed II times. It is also very distinct from the mainly fluviatile and partly lacustrine deposits of the lower part of Bed IV.

To the west of site PLK, in the main gorge, Bed III ceases to be red in colour but can usually be traced because it is different in texture and content from the beds above and below it.

The degree of discordance between Bed IV and Bed III is much greater than Reck believed it to be. Although the contact is almost horizontal in many places, there are also major unconformities.

In the main, Bed III is not fossiliferous, nor does it contain many living sites of early man. At one or two places a few fossils and stone tools have been found in fluviatile parts of the deposit.

(*f*) *Bed IV*

Bed IV is also a much more complex deposit than was appreciated by Reck. The lower part is mainly of fluviatile origin but there are some deposits formed in shallow water. At the top there are aeolian sands that are almost desertic in character. A detailed study of Bed IV has not yet been made.

In contrast to Bed III the lower part of Bed IV has abundant remains of *Unio* as well as of fish and crocodile. The lower and middle parts of Bed IV have numerous ancient land surfaces upon which remains of large mammals occur, usually in association with cultural material. This fauna has some elements in common with that of the upper part of Bed II and others which are new. In contrast, the aeolian deposits at the top are practically devoid of fauna or culture. This dry period was marked by the disappearance and extinction of a very large number of mammalian genera and species which had been common in Bed IV.

(*g*) *Bed Va*

After Bed IV had been deposited there was a period of intense tectonic activity and faulting (see

below), as a result of which the drainage of the whole area was reversed. A wide mature valley was cut from the west to the east, draining into the Balbal depression. The various terrace and river gravels and the fluviatile beds of this period of valley cutting are known as 'Va'. The gravels of this time invariably contain many pebbles derived from the basement complex area to the west and they are always very intensely rolled. These gravels are to be seen not only in the western and central regions but also right down to the edge of the Balbal in the first fault scarp, demonstrating the strength of the river that cut this wide mature valley.

(*h*) *Bed V*

Bed V is a fawn-coloured, windblown deposit, mainly consisting of volcanic ash. Locally, in a few places, it contains mammalian fossils, while it also contains rare molluscs of a species of *Limnocolaria*, which is today found living in very arid regions of Kenya. Bed V filled in the mature valley which followed the faulting and often lies unconformably upon Beds I to IV and even in places on the lava.

(*i*) *The steppe limestone*

Although there are some deposits of steppe limestone (or caliche) in other horizons at Olduvai, the main deposit was formed after Bed V.

(*j*) *Bed VI*

In some places, mainly on the east side of side gullies, there is a black volcanic ash, rich in biotite, over Bed V, as well as over the steppe limestone. This is referred to as Bed VI.

THE FAULTING

We have already noted that after the deposition of Beds I to IV (including the closing arid deposits at the top of Bed IV), a severe tectonic movement occurred that altered the whole drainage pattern and initiated the cutting of a wide mature valley from west to east, as well as causing some peneplanation and sheet erosion. This faulting was described by Professor Reck, who estimated that the total throw, caused by the five faults which he recognised, was of the order of 440 ft. There are actually more faults than were originally recognised, and the total throw is much greater.

The first fault forms the western scarp of the Balbal depression. It is not possible to estimate the depth of the throw of this fault since a large accumulation of silt has formed on the floor of the Balbal (especially in the area round the mouth of the Olduvai Gorge), which masks the whole surface. The block that lies between this first fault and the second fault appears to be tilted to the west, before being bent upwards near the second fault. The second fault does not seem to have a throw of much more than 40 ft. It can be seen to affect the underlying lavas as well as the main sedimentary series. It cuts the gorge near where the side gully, known as CK, meets the main gorge. The deposits are bent towards the fracture at the fault line, but to the east they dip very markedly so that Bed III and all the deposits beneath it disappear out of sight below the present stream bed. They reappear near the Balbal as a result of the westward tilt of the fault block in that area.

The third fault crosses the gorge in the region of Elephant Karongo and what is known as 'Reck's Man site'. The fault through the lava is particularly clearly seen as a perpendicular face as one descends into the valley by the footpath on the north side. The throw of this fault is of the order of 100 ft. The displacement was remarkably horizontal. Immediately to the west of the fault line Bed III is visible at the top of the cliff, covered by a thin layer of Bed V and then by steppe lime. The whole of Bed IV has been removed by sheet erosion and peneplanation. To the east of the fault line a large part of Bed IV is preserved.

The fourth fault consists of a double fault with a horst in the middle having a throw of about 40 ft. both to the east and to the west.

What Professor Reck termed the fifth fault lies some eight miles to the west of the fourth fault. This has a throw of over 100 ft. and forms a long bank which looks as though it might be somewhat younger than the other faults described.

In addition to these five main faults there are several others which have not yet been fully

studied. One of these affects the FLK area, with a throw to the west. This, or a small parallel fault, can also be seen at site MNK in the side gorge. Other small faults can be seen both in the main and side gorges.

A careful level section was made by Richard Leakey from the floor of the Balbal, near the point where the gorge cuts down through the cliffs of the first fault, to a point above the fifth fault, which gave a displacement of 638 ± ft. Since the floor of the Balbal, at the point measured from, is covered by a thick mantle of recent deposits the total displacement must be somewhat greater than this figure.

CHAPTER II

REVIEW OF EARLIER REPORTS ON THE FAUNA

In the chapter which Dr A. T. Hopwood wrote for my Olduvai book, published in 1951, he dealt with certain aspects of the fauna of Olduvai. He gave his interpretation of the fossil evidence then available in respect of the age of Beds I to IV. He concluded that these four beds formed 'a single unit' and that, in his own words, 'there is no faunistic evidence to suggest that the lower part of the Olduvai series is of Lower Pleistocene age'.

In 1935 (Leakey, 1935) I had published the view that Bed I of Olduvai was of Lower Pleistocene age; but because of Dr Hopwood's categorical statement, based upon his study of the fauna, I later retracted this opinion, and in the 1951 book I accepted his suggestion and treated the whole of the main Olduvai sequence as belonging to the Middle Pleistocene. In spite of this, however, Dr D. G. MacInnes and I felt constrained to point out that we considered the break between Beds I and II and Bed IV was more significant than Dr Hopwood had suggested. However, we accepted the fossils of Beds I and II as representing a single faunal unit, for we did not, in those days, see any reason to challenge the identifications which were given in Dr Hopwood's list.

As a result of studying the Bed I fauna obtained during 1959–60 and of comparing it with the large series of fossil mammals from Bed II, found at sites BK II and SHK II, we began to doubt whether all the identifications made by Dr Hopwood in respect of the fauna of Bed I were really justified. Consequently, I re-examined (in the British Museum of Natural History) the collections upon which Dr Hopwood's conclusions were based.

BED I FAUNA

Dr Hopwood listed twenty-three genera as being represented in the Olduvai fauna of Bed I. Of these, one genus, *Strepsiceros*, was supposedly represented by two species, the others by one each. His suggested list for Bed I thus contained twenty-four species. Re-examination of the material shows that a great many of these identifications were founded upon inadequate data. In some cases they seem to have been based upon material which is quite incapable of sound specific identification and only doubtfully of even generic classification. In other cases, the identifications seem to have been based upon specimens which had been found resting upon the surface of Bed I. Some of these may never have belonged to a Bed I context but may have been washed down the scree slope from higher levels, to come to rest upon it. It seems that generic and specific identification of well-preserved material from Bed II sometimes led Dr Hopwood to include the same genera and species in Bed I, upon the basis of much more fragmentary material obtained from that deposit.

Of the twenty-four species which Dr Hopwood listed from Bed I, he considered that no less than ten—the porcupine *Hystrix galatea*, the spotted hyaena *Crocuta crocuta*, the lion *Felis leo*, the leopard *Panthera pardus*, the giraffe *Giraffa* cf. *capensis*, the eland *Taurotragus oryx*, the greater kudu *Strepsiceros strepsiceros*, the lesser kudu *S. imberbis*, Hunter's antelope *Beatragus hunteri*, the wildebeest *Gorgon taurinus*—were the same as the species which are still living in Africa today. If this conclusion was correct, then my suggestion of a Lower Pleistocene age for Bed I, put forward in 1935, was most improbable.

The re-examination which I have made shows that the following animals are genuinely represented in Bed I: *Deinotherium bozasi*, *Stylohipparion albertense*, *Equus oldowayensis*, *Metaschizatherium* cf. *hennigi*, *Libytherium oldowayensis*,[1] and *Parmularius altidens*. Thus, only six out

[1] Hopwood referred to this as *Sivatherium oldowayensis*.

of the twenty-four species which were listed by Dr Hopwood can be identified with any degree of certainty, and none of them is a living species. Only one, the horse, is a living genus. As we shall see later, the new excavations have added numerous new genera and species to the Bed I fauna and so has the re-examination of the earlier material. Before discussing this material in the next two chapters, we must look briefly at that part of Dr Hopwood's list which is rejected, in order to make it clear why it is not considered to be admissible.

1. *Simopithecus leakeyi.* The identification of this genus and species in Bed I was based upon a single specimen. It carries a field mark 'Bed I', but it was not found *in situ.* The colour and condition of preservation make it almost certain, in the light of our much greater knowledge today, that it was derived from the lower part of Bed II. Extensive digging in Bed I has so far not yielded any examples which can with certainty be assigned to *Simopithecus leakeyi*, but this primate occurs commonly in Bed II. The single surface-find does not, at present, justify inclusion of the species, *S. leakeyi*, in the Bed I faunal list.[1] There are, however, bones and teeth of general *Simopithecus* affinities at this level which have not yet been identified as to species.

2. *Hystrix galatea.* The material which led Dr Hopwood to include this living species of porcupine in Bed I apparently consisted of three specimens in the British Museum of Natural History. Two of these are from the site MK I and belong unquestionably to Bed I. At this site, as well as at site FLK N I, further examples of porcupine have since been found. The new finds compare well with the two original specimens. They do *not*, however, represent the living porcupine, but a quite different animal of much larger size. It seems to be comparable to the giant porcupine of the Australopithecine deposits in the Transvaal, which has been described by Mrs Marjorie Greenwood (1955). The third specimen was found lying upon Bed I at site HWK. It resembles the living species fairly closely in size, and it was probably correctly identified as *Hystrix galatea.* But since it is a surface specimen the species cannot be included in the Bed I faunal list. The condition of this last specimen, moreover, suggests that it was probably derived from Bed V.

3, 4, 5 and 6. *Carnivora.* Dr Hopwood listed four carnivores in Bed I. These are, *Crocuta crocuta*, the spotted hyaena, *Panthera pardus*, the leopard, *Felis leo*, the lion, and *Acinonyx*, the cheetah. Re-examination of the carnivore material by Dr Ewer does not confirm any of these identifications. There is clear evidence of the presence, in Bed I, of some species of hyaena, several large felids and some other carnivores, but not of any living species, except perhaps a jackal.

7. *Ceratotherium simum.* Dr Hopwood included the white rhinoceros, *Ceratotherium simum*, in the Bed I fauna. While there is some evidence to suggest that the white rhinoceros occurs in the higher levels at Olduvai, the Bed I rhinoceros appears to be different.

8. *Potamochoerus* (*Koiropotamus*) *majus.* The material which was originally cited by Dr Hopwood as the paratype of the species *Potamochoerus majus* consisted of two upper canines from Bed I. Although we now know a great deal more about *P. majus*, we have still not found any *upper* canines of this pig in direct association with molars which can be proved to belong to the species. Indeed, the two tusks which formed the paratype closely resemble those of *Notochoerus* and *Potamochoerus intermedius*. The listing of *P. majus* in Bed I, therefore, is not justifiable in the present state of our knowledge. A pig ancestral to *P. majus* was, however, present at that level (see chapter III). In my subsequent monograph on the fossil Suidae of East Africa I also identified certain molar teeth from Bed I as belonging to *P. majus.* It is now apparent (see chapter III) that these molar teeth were wrongly identified and that the pigs in Bed I, which have molars like those of *P. majus*, belong to a quite different genus, *Ectopotamochoerus.*

9. *Mesochoerus olduvaiensis.* This is another giant pig. The holotype was found in Bed II, while the paratype was listed by me as coming from Bed I. This would seem to justify including this species

[1] Drs Leakey and Whitworth (1958) have suggested that *Simopithecus leakeyi* is really only a subspecies of *S. oswaldi* (see chapter III).

of *Mesochoerus* in the Bed I fauna. New evidence has since come to light which shows that without the canine teeth it is impossible to identify certain groups of fossil pigs, since the molar teeth of several different genera are often very similar (see chapter III). There is no evidence of *Mesochoerus olduvaiensis* in Bed I, but only of *M. heseloni* and of a new genus *Promesochoerus*.

10. *Hippopotamus gorgops*. While whole skulls of this species are known from Beds II and IV, only fragments of hippopotamus have so far been studied from Bed I. It is possible that they may represent the species *gorgops* but this is not yet established. No skull with the basic characters of this species has yet been found in Bed I. The presence of *Hippopotamus gorgops* in the faunal list for Bed I is therefore still doubtful.[1]

11. *Giraffa* cf. *capensis*. Specimens representing a giraffe are certainly present in the deposits of Bed I. There is, however, no specimen sufficiently diagnostic to justify specific identification. Since neither of the giraffes from Bed II represent living species, it is most unlikely that the earlier giraffe was of this type.

12. *Taurotragus oryx*. The Bed I specimens identified as the living species are very fragmentary and do not justify specific identification, while even the genus is not completely certain. Members of the genus are certainly present in the higher levels of Olduvai, but even in Bed IV, from which there is a nearly complete skull, the species is quite distinct from either of those now living in Africa.

13 and 14. *Strepsiceros strepsiceros* and *S. imberbis*. Dr Hopwood's inclusion of the two living species of kudu in the fauna of Bed I seems to have been based upon fragments, some of which resemble the horn cores of these species. We now possess two skulls, with the horn cores intact, which have been found *in situ* in Bed I. They clearly represent a wholly different species with quite different skull structure, although the horn cores resemble, in some respects, those of the living greater kudu. There is nothing in the fossil material from Olduvai in the British Museum of Natural History that would justify the inclusion of *Strepsiceros imberbis* in the lists for Bed I. Both the identifications of living kudu, as part of the Bed I fauna, must therefore be abandoned.

15. *Damaliscus angusticornis*. This alcelaphine, which Dr Schwarz described from material found in the upper beds of Olduvai, was listed by Dr Hopwood as also represented in Bed I. Re-examination of his material shows that this identification is doubtful. The specimens from Bed I were too fragmentary to be assigned to the species *angusticornis* with any degree of certainty. The *Damaliscus* specimens subsequently found in Bed I are of primitive type and belong to a distinct species, *antiquus*.

16. *Beatragus hunteri*. An antelope which is similar in some ways to Hunter's antelope occurs in Bed I, but it is a distinct species. It was, therefore, incorrect to list the living species as occurring in Bed I.

17. *Gorgon taurinus*. The wildebeest of Bed I, Olduvai, is not the living species. There is nothing identifiable as *Gorgon taurinus* in the Bed I collections in the British Museum of Natural History. Even the specimens from Beds II and IV are distinct and belong to the species *olduvaiensis*.

18. *Elephas* (*antiquus*) *recki*. Relatively few elephant remains have so far been found *in situ* in Bed I and these cannot be regarded as belonging to the species *recki*. They represent a more primitive elephant with low-crowned molars, which is provisionally identified as *Elephas* cf. *africanavus*. (This is a species which has been reported from North Africa in Villafranchian deposits.)

From the foregoing pages it is clear that the suggestion made by Dr Hopwood that Bed I Olduvai contains many living species is wholly unfounded. The various conclusions which have been based upon this assessment must now be disregarded. Similarly, a number of the earlier identifications of the fauna of Beds II, III and IV, prove to be untenable in the light of new discoveries.

BED II FAUNA

Dr Hopwood's list showed thirty genera for Bed II. One of these, *Hippotragus*, was reported to be represented by two species, both the same as those

[1] The only specimen from Bed I so far examined seems to differ in many important respects from *Hippopotamus gorgops*.

living today, namely, the sable and roan antelopes. Re-examination of the material that was available to Dr Hopwood in the British Museum of Natural History confirms the presence of the following twenty-six genera: *Simopithecus*, *Canis*, *Aonyx*, *Elephas*, *Deinotherium*, *Stylohipparion*, *Hippotigris*, *Equus*, *Ceratotherium*, *Diceros*, *Mesochoerus*, *Phacochoerus*, *Hippopotamus*, *Giraffa*, *Libytherium*, *Taurotragus*, *Strepsiceros*, *Bularchus*, *Hippotragus*, *Damaliscus*, *Alcelaphus*, *Beatragus*, *Gorgon*, *Gazella*, *Phenacotragus* and *Pultiphagonides*. The following four do not seem to be present: *Felis* (*Leo*), *Anancus*, *Notochoerus*, and *Tragelaphus*. Of the twenty-six valid genera the specific identification in fifteen cases seems well founded, while in ten cases it cannot at present be sustained. The *Simopithecus* is *oswaldi* not *leakeyi*, the *Ceratotherium* is almost certainly not *simum*, the *Phacochoerus* is not *africanus*, the *Giraffa* is not *capensis*, the *Taurotragus* is not *oryx*, the *Strepsiceros* is not *S. strepsiceros* but *grandis*, the two *Hippotragines* are similar to *equinus* and *niger* but not necessarily identical, the *Beatragus* is not *hunteri*, while the *Gazella* is not *G. gazella*.

Dr Hopwood stated that in his opinion there were a number of living species represented in Bed II. He listed these as the lion, the zebra, the white rhino, the black rhino, the wart-hog, the eland, the greater kudu, the roan, the Hunter's antelope and the gazelle. Had this been true, it would be difficult to place Bed II in the lower half of the Middle Pleistocene. It is possible that the zebra and the black rhinoceros are the same as those living today. None of the others seem to represent the living species.

As will be seen in the next three chapters, a number of additional genera and species have been added to the faunal list for Bed II since Dr Hopwood's report, and a review of the present state of our knowledge of the Bed II fauna will be given in chapter VI.

BED III FAUNA

Dr Hopwood listed eleven genera as being represented among the fossils from Bed III. There is some doubt whether any of them were represented by *in situ* material.

BED IV FAUNA

When we come to Bed IV, Dr Hopwood's list contained twenty-nine genera, two of which are each represented by two species. Re-examination of the material confirms the identification of twenty-seven genera. The only doubt is in respect of *Felis* (*Leo*) and *Tragelaphus*. Of the listed species, however, twelve are doubtful. For example, the *Giraffa* is *jumae* not *capensis*, the *Gorgon* is *olduvaiensis* not *taurinus*, the *Phacochoerus* is *altidens* not *africanus*. The *Taurotragus* is *arkelli* not *oryx*, the *Hippotragus* is probably not *equinus*, the *Beatragus* is not *hunteri* and the *Gazella* is not *G. gazella*.

A few of the species which we can accept as certain in Dr Hopwood's list for Bed IV represent living forms. These are the black and white rhinoceros, the zebra and possibly the *Nesotragus* identified by Schwarz. Relatively little has been added to our knowledge of the Bed IV fauna since 1931.

The fauna of Bed IV seems to fit in very closely with that from the deposits of Olorgesailie and Kanjera.

DISCUSSION OF THE OMO FAUNA

Reports about the fossil fauna of different sites all too often cause confusion among non-specialists. Even my friend Professor Arambourg's excellent study of the fauna of Omo (1947) can be misleading to those who do not examine the published data very critically. A certain number of genera and species are represented at Omo by such well-preserved specimens that they are beyond dispute. Others are represented by much less complete material. Professor Arambourg himself made this very clear but he has often been misquoted. A brief review of the Omo fauna is, therefore, given here.

Professor Arambourg has stated that, in his opinion, the fauna of Omo should be regarded as belonging to the Upper Villafranchian or the closing stages of the Lower Pleistocene. Recently, some scientists, who do not seem to have studied Professor Arambourg's reports carefully, have treated Omo as the equivalent of the Kanam East and Kanam West deposits. Others, including myself, have equated it with the Kaiso sequence.

Considering the Proboscidea first: *Deinotherium bozasi* and *Elephas recki* are certainly present at