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A REVIEW OF THE GEOLOGY AND
PALAEOONTOLOGY OF THE PLIO/PLEISTOCENE
DEPOSITS AT LANGEBAANWEG, CAPE PROVINCE

By

Q. B. HENDEY

With an Appendix

THE LANGEBAANWEG BOVIDAE

By

A. W. GENTRY

Cape Town Kaapstad



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PLIO/PLEISTOCENE DEPOSITS AT LANGEBAANWEG,
CAPE PROVINCE

By

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South African Museum, Cape Town

(With 4 plates, 4 figures and 3 tables)

[MS. received 24 March 1969]

With an Appendix

THE LANGEBAANWEG BOVIDAE

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British Museum (Natural History), London

[MS. received 22 May 1969]

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INTRODUCTION

The remains of Quaternary vertebrates, especially mammals, have been recovered at numerous places in the south-western Cape Province, and while the majority of these occurrences have yielded only a limited number of specimens, there are four sites from which substantial quantities of material have come, viz. Langebaanweg, Elandsfontein (Hopefield), Melkbos and Swartklip (fig. 1).

The best known of these sites is that on the farm 'Elandsfontein' near Hopefield. From this site have come the 'Saldanha' hominid skull (see Oakley & Campbell (1967) for references), and numerous other vertebrate fossils, many of which have already been described. The greater part of this faunal assemblage

is said to be associated with an Acheulian (Early Stone Age) industry (Singer & Wymer, 1968).

Preliminary reports on the faunas from Swartklip and Melkbos have recently appeared (Hendey & Hendey, 1968; Hendey, 1968). The Melkbos fauna is probably associated with a Middle Stone Age industry, and while that from Swartklip has no certain cultural associations, it is considered to be more recent in age. These three faunas date from the latter part of the Quaternary.

Additions to the South African Museum's collection of Quaternary fossils have increased considerably in recent years, and it is from Langebaanweg that the greatest number of fossils, representing the greatest variety of animals, have been recovered. Additional interest in this assemblage is created by the fact that it predates other known occurrences in the region.

The importance of the Langebaanweg deposits to vertebrate palaeontology was first recognized more than a decade ago, and since then several publications dealing with the site have appeared (Singer & Hooijer, 1958; Singer, 1961; Boné & Singer, 1965, etc.). It is one of the richest fossil occurrences of its kind in southern Africa, and since the fossiliferous deposits are associated with a marine transgression, it may be possible to relate them to similar deposits elsewhere in the world, and consequently to date them on this basis. Hitherto geological dating of the major Quaternary fossil sites of southern Africa has been insecure, since they are not readily related in geological terms to sites elsewhere in the world. Future studies at Langebaanweg could conceivably provide a chronological standard by which other local deposits might be dated, for example, the South African australopithecine breccias, which are probably of the same order of age.

The Langebaanweg fauna includes a minimum of 60 distinct mammalian types, which belong to at least 11 different orders. The remains of cartilaginous and bony fish, amphibians, reptiles, and birds have also been recovered. Some invertebrates are recorded, and pollens are known to be present in the deposits. The fossils occur in a complex association of marine, deltaic, fluvial and terrestrial sediments, which are in places superbly exposed by commercial quarrying operations.

In view of the acknowledged importance of the Langebaanweg sites, it is the purpose of this paper to summarize the results of studies undertaken on them to date. It is hoped that this report will stimulate an even wider interest in the research potential of these sites, since there is a very obvious need for the talents of qualified specialists to be applied to the many unanswered problems relating to them.

THE GEOLOGY OF THE LANGEBAANWEG DEPOSITS

Langebaanweg is situated approximately 32°58' South, 18°9' East, in the Sandveld region* of the south-western Cape Province. It is some 105 kilometres north-north-west of Cape Town, and 15 kilometres inland from Saldanha Bay

* See Talbot, 1947.

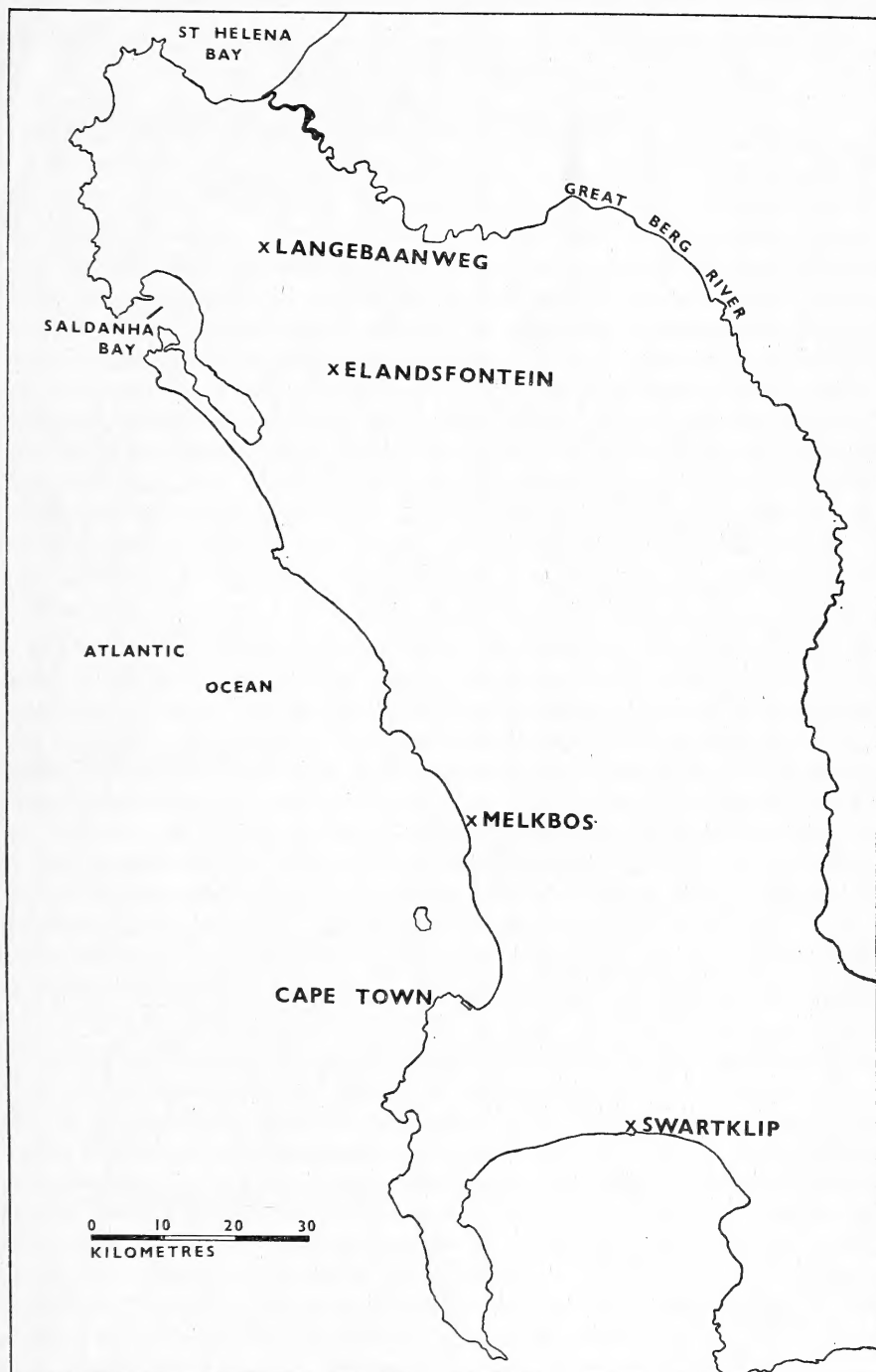


Fig. 1. Location of the principal Plio/Pleistocene fossil sites in the south-western Cape Province.

(figs 1 and 2). The prospecting and mining of phosphate by the African Metals Corporation Limited (AMCOR) has revealed the existence of extensive fossiliferous deposits on subdivisions of the farm 'Langeberg', west of Langebaanweg station.

The Sandveld is underlain by largely unconsolidated Tertiary and Quaternary sediments. The Tertiary is not represented by distinct stratigraphic units, since sub-aerial and marine processes during the Quaternary have altered earlier features in the deposits. Some undoubted Tertiary fossils have been recovered from deposits in the Sandveld; for example, shark's teeth of the species *Carcharodon megalodon* are known from the Cape Flats, near Cape Town.

The three principal sites at Langebaanweg from which fossils have been recovered are Baard's, 'C' and 'E' Quarries (fig. 2). Mining operations are presently being carried out only in 'E' Quarry, and it is from this site that the largest number of fossils have been recovered, and also for which the best geological records exist. The deposits mined in 'C' and 'E' Quarries are referred to as the 'Varswater ore-body', and are quite distinct from those in the Baard's Quarry area. The superficial appearance and physical character of the Varswater and Baard's Quarry deposits differ markedly. Detailed studies on their characteristics (grain size and shape, mineralogy, microfossils, etc.) have not yet been undertaken, and additional information from controlled excavations in the 'C' and Baard's Quarry areas is required to supplement existing records. Consequently it is not possible at present to speak with complete conviction on the origin and history of the deposits, and the observations and conclusions which follow are necessarily of a provisional nature.

It is concluded from a study of all the available information that the main body of vertebrate fossils was originally deposited in a single geological formation. At Varswater this formation comprises a bed of deltaic sediments which includes a basal marine biostratigraphic zone overlain by sediments in which the remains of terrestrial vertebrates predominate. The 'deltaic' sediments may be estuarine and/or lagoonal in part, and in the lower levels almost certainly include some sands which accumulated sub-aerially near the mouth of the river. These deposits are taken to comprise a single unit, and are referred to as the 'Varswater bed'. An horizon of fluvialite sediments tentatively associated with the Varswater bed is present in the Baard's Quarry area, and may also extend beneath this bed in the Varswater area. Since the fluvialite horizon is only definitely recorded on the Langberg subdivision of the farm Langeberg, it is referred to as the 'Langberg bed'. These two units together are referred to as the 'Langebaanweg beds' (table 1; fig. 2).

In the 'E' Quarry area the Varswater bed attains its greatest vertical development of about 23 metres. 'C' Quarry is situated on the western fringes of the Varswater bed, where there may possibly have been some post-depositional disturbance of the bed by a later marine incursion. In the Baard's Quarry area the Langberg bed has been much disturbed by later erosion, and relatively little of its inferred original thickness remains.

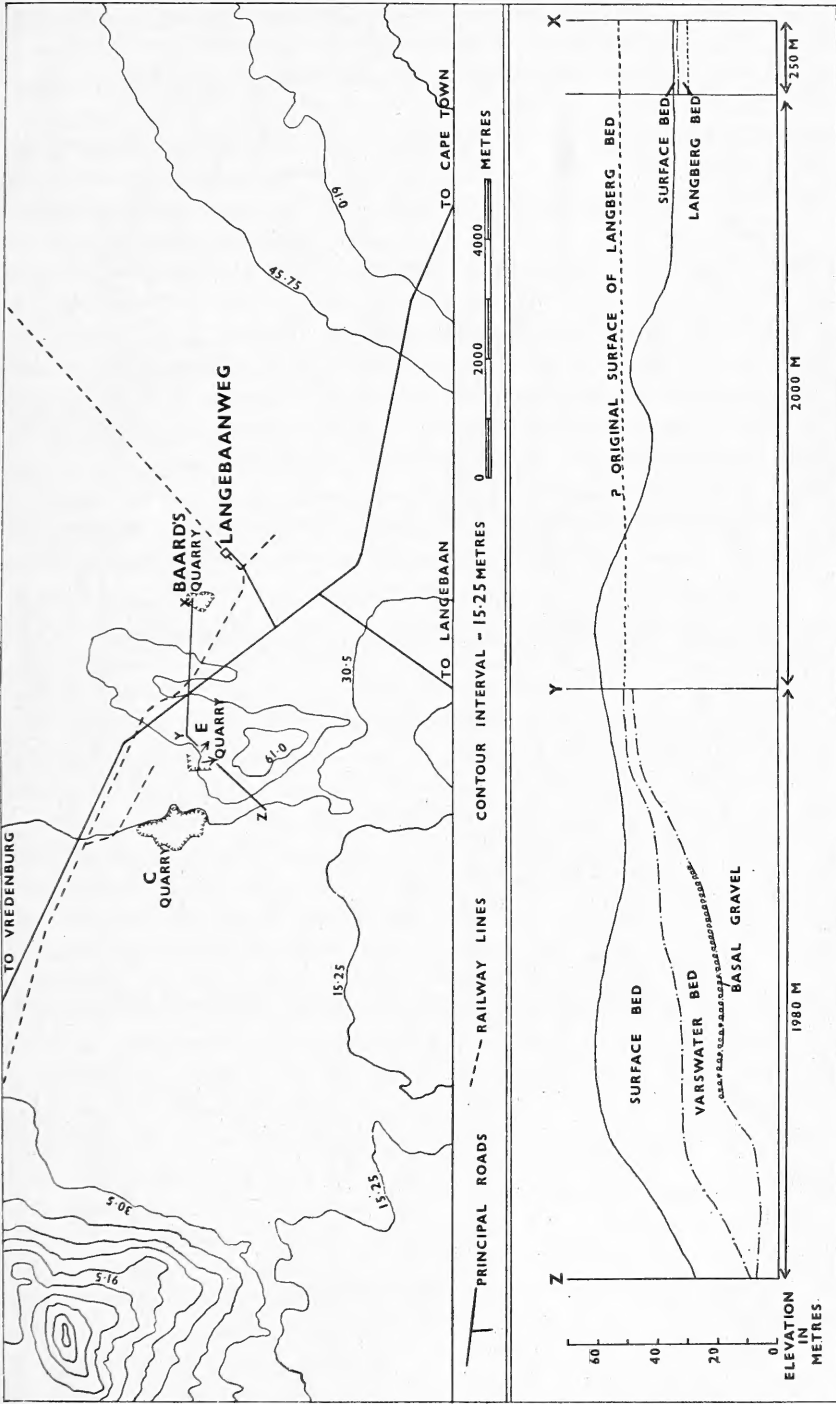


Fig. 2. The location of the Langebaanweg phosphate quarries, and a simplified transverse cross-section of the deposits encountered in the area.

TABLE I

STRATIGRAPHIC UNITS		LITHOLOGY	FOSSILS	
Surface bed		Aeolian sands, calcrete, ferricrete & 'surface' quartzite	Terrestrial molluscs and vertebrates	
Langebaanweg beds	Varswater bed	Sands	Terrestrial & marine vertebrates	Mainly terrestrial vertebrates
	Langberg bed	Sandy-clay	Marine forms predominate	
		Basal gravel	Sand	

THE 'E' QUARRY DEPOSITS

The fossiliferous deltaic deposits in 'E' Quarry are made up largely of fairly well sorted unconsolidated sands, in which occasional patches of clay and sandstone are present. The clay has been found to incorporate plant remains, and it has been suggested by J. Wymer in an unpublished report that it was formed on vegetated areas within the river estuary, or on its periphery. On the other hand, some or all of it may have been washed into the delta area attached to clumps of floating vegetation. Whatever its history, it does not constitute a significant element in the sediments, and contains few vertebrate fossils. There are distinct traces of current bedding in the deposit, but this is now much distorted, probably owing to the plasticity of the originally waterlogged sediments (J. Wymer, unpublished report). There are no obvious discontinuities within the deposits, and although colour differences are not uncommon the limits of these are seldom distinct, there being gradual changes from one colour to the next.

Underlying the sands, and apparently conformable with them, is an horizon from which have been recovered internal casts of marine molluscs, shark's teeth, remains of bony fish and fragments of rolled bone from large vertebrates. These fossils occur in a fine-grained light-coloured silty clay, in which pebbles and boulders of phosphatic rock are also incorporated. The only other lithic elements are occasional silt-stone cobbles and pebbles, and quartz pebbles. This horizon is herein referred to as the 'basal gravel' of the Varswater bed. It includes part, or perhaps all of the marine biostratigraphic zone referred to earlier.

Most of the vertebrate fossils from 'E' Quarry have come from the 2 to 3 metres of deposit immediately overlying the basal gravel. While isolated specimens have been recovered at all levels, several pockets of concentration

have been encountered. Such occurrences have yielded astonishing quantities of material, mainly microfauna. Two of them (No. 1 and No. 12/1968) lie approximately one metre above the basal gravel in a fine-grained clayey sand. The fossils were found in greatest profusion in horizontal bands only a few centimetres thick. They gradually diminish in quantity below these horizons, but there is a sharp decrease above them. The horizontal spread has yet to be determined, but it appears to be fairly limited in both cases. Remains of several larger mammals (bovids, a viverrid, etc.) occur in association with those of Selachii, Teleostei, Anura, Lacertilia, Ophidia, Chelonia, Aves and small mammals such as soricids, a chrysochlorid, a macroscelidid, a leporid and at least a dozen different species of rodent. The remains, which comprise many thousands of bones, complete and partially complete toothed elements, and isolated teeth, do not appear to include articulated elements of skeletons. The most commonly represented terrestrial vertebrate is a golden mole (cf. *Chrysochloris* sp.), the remains of at least 721 individuals having been recovered from No. 12/1968, and a further 129 from No. 1/1968. Similar concentrations have been recovered at higher levels, but none with the same quantity of fossils or variety of animals. Even within concentrations at the same level the faunal content varies. For example, macroscelidids are more commonly represented at site No. 12/1968 than at No. 1/1968, while aquatic animals are relatively less abundant.

The basal gravel reaches a maximum recorded elevation of 29.5 metres in the north-west corner of 'E' Quarry, and slopes away to the south and west. The limits of its horizontal extent are uncertain, and it may be more widespread than is shown by existing records. It is variably developed, and may in fact be discontinuous. The maximum elevation of the top of the deltaic deposits is at approximately 51 metres east of 'E' Quarry. Owing to the nature of the available records, this figure may be a little high, but the actual maximum is certainly in the region of 50 metres. The surface of the Varswater bed also slopes away to the south and west, roughly parallelling the basal gravel where it is present. The horizontal dispersal and a north-east to south-west transverse section of the Varswater bed show it to be in an almost classic deltaic form, and indicates that the river flowed into the area from the east and north-east (fig. 2). The river concerned was probably a precursor of the present Great Berg River, which today flows into the sea in St. Helena Bay (fig. 1).

The present topography does not follow that of the surface of the Varswater bed to a very marked degree.

The Varswater bed is overlain by an accumulation of terrestrial deposits, which vary in depth from about 2 to 40 metres and more. These deposits consist mainly of unconsolidated aeolian sands in which is developed at least one horizon of calcrete and calcareous sand. Shells of terrestrial molluscs have been recovered from these deposits, which are herein referred to as the 'surface beds'. Since they are not as obviously fossiliferous as the Varswater bed, little attention has been paid to them. However, during 1965, while a pipeline was

being laid in the area between 'C' and 'E' Quarries, some fragmentary remains of large terrestrial vertebrates (including *Ceratotherium*) were recovered, and these apparently came from the surface beds. A fragmented *Libytherium* skull from a prospect pit ('Sivathere pit') near 'C' Quarry may also have come from the surface beds.

It is concluded that the Varswater bed accumulated during a marine transgression. The question of whether this transgression is related to epeirogenic or to eustatic phenomena will be discussed later.

The regrading of the 'Langebaanweg River' during this transgression must have resulted in substantial quantities of detritus being deposited in its lower reaches, since much of its course was across the unconsolidated arenaceous sediments of the Sandveld. Silting of the river channel probably occurred from time to time, resulting in localized changes in the direction of flow and the spread of sediments at its mouth over a fairly wide area. Sand-bars and sand-spits probably formed and reformed throughout this period, and there may even have been a barrier beach and lagoon in existence at times. Consequently some of the Varswater bed may have been laid down in an estuarine and/or lagoonal environment, while other parts were originally exposed as land surfaces and subsequently covered by the transgressing sea.

The remains of birds and aquatic animals in the deposits are readily explained, since their death in water could easily have led to their being incorporated in the accumulating sediments. The presence of the remains of terrestrial vertebrates may be accounted for in a number of ways. Some of those animals which lived near the river mouth may have been driven into the estuary by predators and fires, or merely have been incorporated in terrestrial deposits which were subsequently covered by the rising sea. Others may have been washed into the estuary by the river, and as complete or near complete carcasses they could have floated into the area of deposition of the fine sedimentary fraction (J. Wymer, unpublished report). This factor has some bearing on the postulated presence of a river, since without a river supplying carcasses of terrestrial vertebrates, it is difficult to account for their quantity and variety at the levels in which they occur.

The occurrence of fossils in a fine-grained deltaic deposit precludes the possibility of the admixture of fossils derived from pre-existing deposits. If any derived elements are present in the 'E' Quarry assemblage, then they may be expected to occur only with those fossils recovered from the basal gravel. The only rolled fossils from 'E' Quarry have, in fact, come from the basal gravel, although partially abraded specimens from the fine-grained deposits are not uncommon, for instance an almost complete skull of an alcelaphine is perfectly preserved except for an abraded area in the occipital region. It is suggested that the skull was partially buried in sediment and that the exposed part was abraded by sand-charged waters flowing over it (fig. 3).

There have been indications of fossils in the fine-grained sediments occurring as complete or partially complete skeletons although the majority

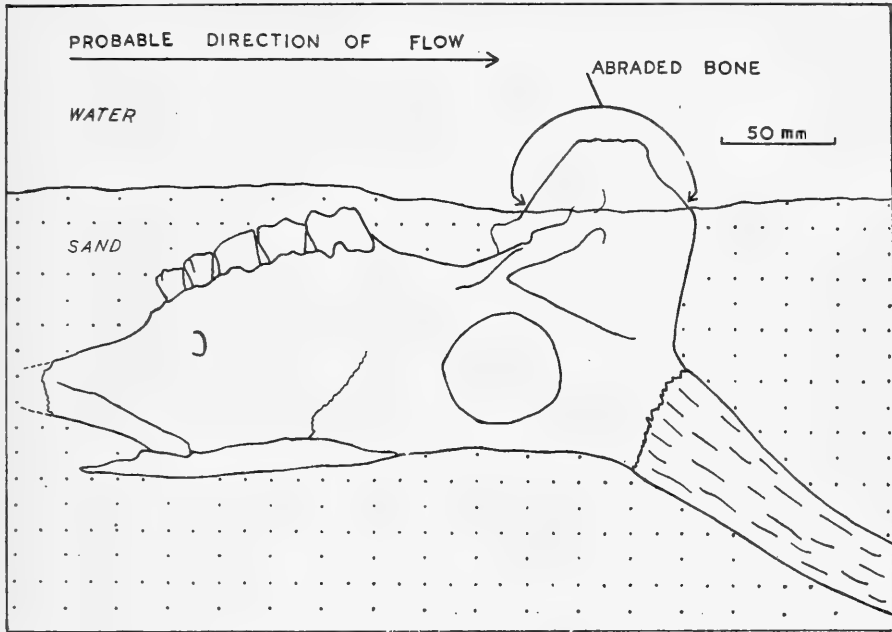


Fig. 3. Sketch of a partially abraded bovid skull showing the suggested way in which abrasion of the occipital region took place.

occur as isolated and incompletely preserved elements. Even if most of the fossils reached the river mouth as parts of complete carcasses, there must have been many factors militating against preservation of the entire skeletons of such carcasses.

The suggested ways in which animals came to be incorporated in the deposits adequately accounts for the manner in which their remains are dispersed in the sediments. Deposition of the upper layers of the deltaic deposits must have taken place away from the river mouth, and there would have been a progressive decrease in the number of carcasses deposited as the distance from the river mouth increased. Similarly old land surfaces near the river mouth on which animal remains may have accumulated, can in most areas only be expected in the lower levels of the bed, since they would have become deeply buried by the accumulating sediments. Consequently, it is to be expected that the upper layers of the Varswater bed would be relatively poorly fossiliferous, which is, in fact, the case. The concentration of marine fossils in the basal gravel is probably due to the effects of wave action in an inter-tidal zone. Similar conditions would not normally prevail in the area of deposition of the higher levels of the deltaic facies. Consequently, while the remains of marine animals do occur in the higher levels they are in no way concentrated.

THE 'C' QUARRY DEPOSITS

Geological records for the 'C' Quarry area are very incomplete, and since mining in this quarry has now ceased there are no good exposures available to study. There are known to be differences between the 'C' and 'E' Quarry deposits, and the condition of the fossils recovered at these two sites is also sometimes different. There is one record of terrestrial vertebrates having come from below an horizon containing a concentration of marine fossils (Pit 3, Dick's Face; see figure 4). Although it has not been convincingly demonstrated that this marine biostratigraphic zone is the same as that exposed at the base of 'E' Quarry, there are no good reasons for supposing that they are distinct. It is tentatively concluded that the fossiliferous deposits underlying the marine biostratigraphic zone in 'C' Quarry are from a westward extension of the Langberg bed, and are therefore probably broadly contemporaneous with the fossils from the overlying Varswater bed. The Pit 3 fossils are dark coloured, and in this respect are similar to the fossils from the Langberg bed at Beard's Quarry. The possibility that both the Langberg and Varswater beds were exposed in 'C' Quarry would account for the fact that part of the fossil

assemblage resembles that from Beard's Quarry (i.e. dark coloured), while the remainder resembles the 'E' Quarry fossils (i.e. light coloured).

The Pit 3 terrestrial fossils constitute one of the more remarkable associations of material at Langebaanweg. At least ten more or less complete tortoise carapaces were found heaped together and cemented by an extremely hard, phosphatic matrix. They may represent a natural accumulation, but no entirely satisfactory explanation has yet been advanced as to the manner in which this could have occurred. In view of the unusual fossil concentrations encountered at sites No. 1 and No. 12/1968 in 'E' Quarry, the Pit 3 discovery is of more than passing interest in the question of the ways in which the Langebaanweg fossils came to

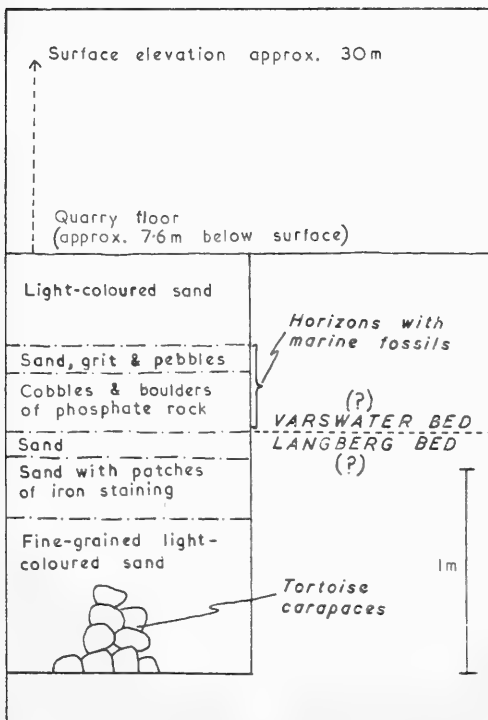


Fig. 4. Sketch section of Pit 3, Dick's Face in 'C' Quarry, showing a marine biostratigraphic zone overlying an occurrence of terrestrial fossils. (Information: R. D. Warren)

be deposited. This is yet another aspect of the Langebaanweg deposits which needs to be studied more thoroughly.

There is undoubtedly a close relationship between the deposits in 'C' and 'E' Quarries, and the greater parts of their fossil assemblages are probably contemporaneous. However, until such time as the 'C' Quarry succession is re-exposed for study, it is considered preferable to treat its fossils separately.

THE BAARD'S QUARRY DEPOSITS

Baard's Quarry is situated some 2.5 kilometres east of 'E' Quarry and a little over 3 kilometres from 'C' Quarry, and is separated from these sites by a low ridge (fig. 2). The deposits in this area differ significantly from those in the other quarries, and the fossils are usually quite distinctive in physical appearance. Many show signs of rolling, all are stained a dark brownish colour, they tend to be very fragmented and there are no known instances of several parts of the same skeleton having been found together. Apart from a few fragmentary pinniped remains, no marine fossils have been recovered from Baard's Quarry.

The surface beds in this area average about 1 metre in thickness and are made up of loose aeolian sands, discontinuously developed horizons of calcrete, and an horizon of nodular ferricrete and blocky quartzite. The ferricrete contains phosphate and is often referred to as 'phoscrete'. The quartzite has clearly formed *in situ*, but is quite unlike the other 'surface silcretes' which occur elsewhere in the Sandveld. Since the calcrete, ferricrete and quartzite post-date the main period of fossil accumulation, a discussion on their origin and history is excluded from this report.

The underlying Langberg bed is made up essentially of a sandy-clay. It has a maximum recorded elevation of about 33 metres, and at about 30 metres above sea-level it grades into a pure sand. No 'basal gravel' is recorded in the Baard's Quarry area. It is concluded that this bed represents a remaining part of the fluvial deposits with which the deltaic deposits at Varswater were associated. The inferred course of the 'Langebaanweg River', and the respective elevations of the deposits in the two areas lends support to this conclusion.

It is suggested that during the marine regression which followed the period when the Langebaanweg beds were laid down, the 'Langebaanweg River' began cutting through the Langberg bed, and perhaps also the eastern fringes of the Varswater bed. At the same time, or perhaps even earlier, the course of the river changed and it met the sea south-east and eventually south-south-east of 'E' Quarry. Ultimately it carved out the wide and remarkably flat plain on which Baard's Quarry, Langebaanweg station and the nearby South African Air Force base are located. It then changed course again and, as it does today, flowed into the sea north of the area under consideration. The upper levels of the Langberg bed are incised by small channels, one of which was intersected during controlled excavations undertaken in this area during 1965 (Hendey, 1965). Similar minor drainage channels leading into the main river channel can be seen today on the present floodplain of the Great Berg River.

The 1965 excavations revealed that a concentration of fossils occurs in the ferricrete and quartzite horizon immediately overlying the Langberg bed. The fossils clearly predate these formations since they have been found embedded in the quartzite and encrusted with ferricrete. It is suggested that they were concentrated on the surface of the floodplain as the river eroded away finer detritus. Much of the original assemblage must have been lost during this period of erosion, and that part remaining was significantly affected in both physical condition and composition. More than 90% of the Baard's Quarry assemblage is made up of unidentifiable bone fragments, mainly of larger vertebrates. The reverse is true of the 'E' Quarry fossils, where only a relatively small proportion are not identifiable, and where small vertebrates are well represented. At least some of the distinctive characteristics of the Baard's Quarry fossils may be due to the different environment in which they originally accumulated. This must also have some bearing on the faunal types represented, as, for example, the lack of marine forms.

If old river channels were intersected during mining at Baard's Quarry, then derived elements may be mixed in the assemblage. Furthermore, if the post-depositional history of the deposits has been correctly interpreted, it is possible that the assemblage includes elements which date from the subsequent period of marine regression. Even later elements from the surface bed may be mixed with the assemblage. For these reasons, and also since the geological associations of the Langberg and Varswater beds are not conclusively proven, the Baard's Quarry fauna is treated as a separate unit.

FOSSIL CONCENTRATIONS IN THE DEPOSITS

Concentrations of fossils at certain levels may be the result of greater numbers of animals being washed in at times when the river was in flood. This suggestion, however, does not satisfactorily account for other concentrations, such as the two specifically referred to earlier (p. 80). The association of the remains of hundreds of fossorial and other terrestrial mammals, fish (catfish, and other smaller forms), frogs, reptiles and birds in horizons of which less than one square metre has been exposed in each case, suggest a mode of concentration other than that brought about by normal geophysical agencies.

The specimens recovered at both site No. 1/1968 and at site No. 12/1968 are remarkably well preserved. Although no articulated skeletons or parts thereof were observed, individual skeletal components, including toothed elements, tended to be intact. The loss of incisors from rodent mandibles, and individual teeth from mandibles and maxillae was apparently largely due to the method of collection. None of the specimens recovered show definite signs of having been transported by water or wind, and the impression gained was that they lay at or very near the place where they were dropped.

Several possibilities were considered in attempting to account for the origin of these fossil concentrations.

If they represent the dietary residue of a bird or mammal, then it appears that a predator rather than a scavenger was responsible. The remains of the fossorial chrysochlorid would not normally be available to scavengers, and they are the most abundantly represented animal in both the No. 1 and No. 12 assemblages. The possibility that they were exposed to scavengers after having been driven from their subterranean habitat and then overcome by bush-fires was considered, but then dismissed on the grounds that bush-fires could not have been responsible for the actual death of animals in the assemblages (*vide infra*).

The variety of animals represented in the concentrations excludes many predators from the list of possibilities. Birds or mammals with habits similar to the extant fishing owl (*Scotopelia peli*) and the water mongoose (*Atilax paludinosus*) are the more likely possibilities, since they prey on a wide variety of small aquatic and terrestrial animals. On the basis of the variety and relative numbers of animals present in the assemblages, the creature most likely to have been responsible would be one which actually preys on small terrestrial vertebrates, but which merely scavenges any available remains of aquatic forms and larger terrestrial animals. From site No. 12 a number of the larger bone fragments recovered show signs of post-mortem damage in the form of punctate marks and flaking. This could result from the chewing of the bone by a carnivore, and one of the pieces in question shows small striations on its surface which could be the toothmarks of a medium-sized carnivore.

It is perhaps significant that certain of the smaller Carnivora, such as the African civet (*Viverra civetta*) and the yellow mongoose (*Cynictis penicillata*) use specific spots for excretion (Maberly, 1967), and in such places indigestible materials build up. It is possible that the accumulations in question developed in this way, but since a high proportion of the microfaunal limb-bones are preserved intact, any animal which excreted them would have had to be of large size, and there is no large carnivore known to the writer which habitually preys on such a variety of small animals. Furthermore the bones do not appear to have passed through a digestive tract.

The possibility that the fossil concentrations represent the residue of an accumulation of regurgitated owl pellets requires further consideration. This explanation was used to account for microfaunal concentrations in the australopithecine breccias of the Transvaal (De Graaff, 1960). In the present instance owl pellets accumulating below a roosting place in a tree may have become associated with occasional remains of larger animals from another source.

One further possibility was inconclusively investigated. In a discussion of a hominid living-floor in Bed 1 at Olduvai Gorge (FLK NNI) Leakey (1963) states that,

'On this floor there are fossil remains of many tortoises, a number of cat fish and also tilapia, together with some large mammals and many smaller ones'.

While the physical appearance of the Langebaanweg accumulations is not necessarily the same as those found on the Olduvai living-floors, the range of faunal types represented, and apparently their relative numbers are similar. The Langebaanweg accumulations may also represent middens on hominid occupation sites. The post-mortem damage to the larger bone fragments which was referred to earlier could as well result from hominid activity. Perhaps the most convincing indications of artificial interference to bone is shown by a series of tortoise carapace fragments recovered at site No. 12. Out of the many hundreds of carapace fragments recovered, eight show signs of abraded surfaces. Their appearance is quite distinct from similar pieces of carapace recovered from the basal gravel of 'E' Quarry, which show the effects of water action. They are also quite distinct from carapace fragments which have suffered sand-blasting at the later Pleistocene surface site at Melkbos near Cape Town.

The possibility that they are hominid artefacts has been suggested but not substantiated. Utilized bone fragments are known from Oldowan living-floors at Olduvai Gorge (Leakey, 1967) and from the Makapansgat and Sterkfontein australopithecine breccias (Dart, 1957; Robinson, 1959).

An interesting feature of the No. 1 and No. 12 assemblages is that they include a significant amount of burnt bone. Since fish and bird bones show signs of charring, as well as those of terrestrial and amphibious animals, it is improbable that the burning resulted from animals having been caught in bush fires. There is no apparent pattern to the burning, various skeletal elements of nearly every faunal type represented are affected.

The presence of burnt bone at a site with proven associations with an advanced hominid can be readily interpreted as a further indication of hominid activity. However, all the evidence points to the Langebaanweg fossils being of considerable antiquity (*vide infra*), and this conclusion cannot at present be accepted without reservations.

While conclusive proof of hominid associations with the Langebaanweg fossils is lacking, there are for the first time indications of such an association.

THE LANGEBAANWEG FAUNAL ASSEMBLAGES

The most recently published faunal lists for the Langebaanweg sites (Boné & Singer, 1965; Hendey, 1968) were considerably revised during 1968. Although only a limited number of genera and species have so far been positively identified, the present provisional faunal list (table 2) does serve to illustrate the great variety of forms which have been encountered.

Representatives of all extant classes of vertebrates, except Agnatha, have now been recognized. Mammalia are the best represented group. Certain of the mammalian orders have received more attention than others, and so the list as it stands is subject to radical revision. The non-mammalian groups are less well represented and are virtually unstudied. While new forms will undoubtedly continue to be discovered, it is considered probable that the present list will be most altered in the foreseeable future by the substitution of positive diagnoses

TABLE 2

Provisional list of the vertebrate fauna from the principal Quaternary fossil sites of the southwestern Cape Province (October, 1969)

* Genera and/or species which are extinct. Other extinct forms are probably included under the unclassified or incompletely classified types.

Note: The Bovidae from Elandsfontein are listed on the basis of a preliminary survey carried out by Dr. & Mrs. A. W. Gentry (British Museum (Natural History), London).

	LANGEBAANWEG			ELANDSFONTEIN	MELKBOS	SWARTKLIP
	'E' QUARRY	'C' QUARRY	BAARD'S QUARRY			
Class <i>CHONDRICHTHYES</i>						
Several selachian and batoidean species ..	×	×				
Class <i>OSTEICHTHYES</i>						
Several teleostean species	×	×				
Class <i>AMPHIBIA</i>						
At least one anuran species	×					
Class <i>REPTILIA</i>						
Order <i>CHELONIA</i>						
At least three species	×	×	×	×	×	×
Order <i>SQUAMATA</i>						
Several lacertid and ophidian species	×	×		×		×
Class <i>AVES</i>						
<i>Struthio australis</i>				×	×	×
* <i>Struthio</i> sp.	×					
Spheniscid	×					
Several other species	×			×		
Class <i>MAMMALIA</i>						
Order <i>MENOTYPHILA</i>						
Family Macroscelididae						
<i>Elephantulus</i> sp.	×					
Order <i>LYPOTYPHILA</i>						
Family Soricidae						
cf. <i>Suncus</i> sp.	×					
<i>Incertae sedis</i>	×					
Family Chrysochloridae						
cf. <i>Chrysochloris</i> sp.	×	×				
Order <i>PRIMATES</i>						
Family Cercopithecidae						
* <i>Simopithecus oswaldi hopefieldensis</i>				×		
Family Hominidae						
* <i>Homo sapiens rhodesiensis</i>				×		
Order <i>PHOLIDOTA</i>						
<i>Manis</i> sp.				×		
Order <i>CARNIVORA</i>						
Family Canidae						
* <i>Canis</i> sp.	×					
* <i>Incertae sedis</i>	×					

	LANGEBAANWEG			ELANDSFONTEIN	MELKBOS	SWARTKLIP
	'E' QUARRY	'C' QUARRY	BAARD'S QUARRY			
<i>*Incertae sedis</i>			×			
<i>Canis mesomelas</i>				×	cf.	cf.
<i>*Canis mesomelas</i> s.sp. (?)				×		×
<i>*Incertae sedis</i>				×		
<i>Vulpes</i> sp.						×
<i>*Lycaon pictus magnus</i>				×		
<i>Lycaon pictus</i>						×
Family Ursidae						
Subfamily Agriotheriinae						
<i>*Incertae sedis</i>	×					
Family Mustelidae						
<i>*Incertae sedis</i>	×					
<i>*Enhydriodon africanus</i>	×					
<i>Mellivora capensis</i>			cf.	×		×
<i>*Aonyx</i> sp.						×
Family Viverridae						
<i>*Incertae sedis</i>	×					
<i>*Incertae sedis</i>	×					
<i>Incertae sedis</i>				×		
<i>*cf. Suricata</i> sp.				×		
<i>Herpestes ichneumon</i>						×
Family Hyaenidae						
<i>*Hyaena</i> cf. <i>namaquensis</i>	×	×				
<i>*Incertae sedis</i>	×	×				
<i>Hyaena</i> cf. <i>brunnea</i>			×			
<i>Hyaena brunnea</i>				×	×	×
<i>*Crocuta crocuta spelaea</i>				×		
Family Felidae						
Subfamily Felinae						
<i>Felis</i> aff. <i>caracal</i>	×					
<i>Felis serval</i>					cf.	×
<i>Felis</i> cf. <i>libyca</i>						×
<i>Panthera leo</i>						×
<i>*Panthera leo</i> aff. <i>spelaea</i>				×	×	
Subfamily Machairodontinae						
<i>*cf. Machairodus</i> sp.	×	×				
<i>*Megantereon</i> cf. <i>gracile</i>				×		
Felidae — <i>Incertae sedis</i>						
<i>*Incertae sedis</i>	×					
<i>*Dinofelis</i> sp.	×					
<i>*Incertae sedis</i>			×			
CARNIVORA— <i>Incertae sedis</i>	×					
Order PINNIPEDIA						
<i>*Incertae sedis</i>	×	×	×			
<i>Arctocephalus pusillus</i> (?)					×	
Order TUBULIDENTATA						
<i>Orycteropus</i> cf. <i>affer</i>	×					

	LANGEBAANWEG			ELANDSFONTEIN	MELKBOES	SWARTKLIP
	'E' QUARRY	'C' QUARRY	BAARD'S QUARRY			
Order PROBOSCIDEA						
Family Gomphotheriidae						
* <i>Anancus</i> sp.	×	?	?			
Family Elephantidae						
* <i>Incertae sedis</i> (' <i>Stegolophodon</i> ')	×	?	×			
*' <i>Archidiskodon</i> ' <i>broomi</i>				×		
*' <i>Loxodonta</i> ' <i>zulu</i>				×		
<i>Loxodonta africana</i>					×	
Order PERISSODACTYLA						
Family Rhinocerotidae						
* <i>Diceros</i> aff. <i>bicornis</i>	×	?	?			
* <i>Diceros</i> sp.			×			
<i>Diceros bicornis</i>				×	×	
<i>Ceratotherium simum</i>				×	×	×
Family Equidae						
* <i>Hipparion albertense baardi</i>	×	×	×			
* <i>Equus</i> cf. <i>helmei</i>	×		×	?		
* <i>Equus</i> sp.	×					
* <i>Equus plicatus</i>				×	cf.	
<i>Equus</i> sp.				×		
<i>Equus</i> sp.						×
Order ARTIODACTYLA						
Family Suidae						
* <i>Incertae sedis</i>	×	?				
* <i>Incertae sedis</i>	×					
* <i>Mesochoeerus paiceae</i> } Probably				×		
* <i>Mesochoeerus lategani</i> } conspecific				×		
* <i>Tapinochoerus meadowsi</i>				×		
Family Hippopotamidae						
<i>Hippopotamus amphibius</i>				×	×	×
Family Giraffidae						
* <i>Libytherium olduvaiense</i>	×	×	×	×		
* <i>Giraffa</i> cf. <i>gracilis</i>	×		?			
Family Bovidae						
Tribe <i>Tragelaphini</i>						
* <i>Tragelaphus</i> aff. <i>angasi</i>	×					
* <i>Tragelaphus strepsiceros</i> aff. <i>grandis</i>	×					
* <i>Tragelaphus strepsiceros</i> s.sp.				×	×	
* <i>Taurotragus</i> aff. <i>oryx</i>				×		
<i>Taurotragus oryx</i>					×	×
Tribe <i>Bovini</i>						
* <i>Incertae sedis</i>	×					
* <i>Homoioceras</i> cf. <i>bainii</i>				×		
* <i>Syncerus</i> sp.					×	
Tribe <i>Boselaphini</i>						
*? <i>Tragocerus</i> sp.	×					
Tribe <i>Reduncini</i>						
* <i>Kobus</i> sp.	×					

	LANGEBAANWEG			ELANDSFONTEIN	MELKBOS	SWARTKLIP
	'E' QUARRY	'C' QUARRY	BAARD'S QUARRY			
<i>*Redunca cf. ancystrocera</i>			×			
<i>Redunca aff. arundinum</i>				×	×	×
Tribe <i>Hippotragini</i>						
<i>*Hippotragus</i> sp.	×					
<i>*Hippotragus gigas</i>				×		
<i>*Hippotragus cf. leucophaeus</i>				×		×
Tribe <i>Alcelaphini</i>						
<i>*Incertae sedis</i>	×					
<i>*? Parmularius angusticornis</i>	×					
<i>*Incertae sedis</i>				×		
<i>*? Beatragus</i> sp.				×		
<i>*? Damaliscus niro</i>				×		
<i>*Incertae sedis</i>				×		
<i>*Megalotragus eucornutus</i>				×		
<i>*Connochaetes</i> sp.				×		
cf. <i>Connochaetes</i> sp.					×	×
Tribe <i>Neotragini</i>						
<i>*cf. Madoqua</i> sp.	×					
<i>*cf. Raphicerus</i> sp.			×			
<i>*Raphicerus</i> sp.				×		
<i>Raphicerus</i> sp.					×	×
Tribe <i>Antilopini</i>						
<i>*Gazella</i> sp.	×	?	×			
<i>*Gazella</i> sp.				×		
<i>*'Gazella' cf. wellsi</i>				×		
<i>*Antidorcas cf. marsupialis</i>				×	×	
<i>*Antidorcas marsupialis australis</i>						×
Bovidae — <i>Incertae sedis</i>						
<i>*Incertae sedis</i>				×		
<i>*Incertae sedis</i>				×		
Order LAGOMORPHA						
<i>Lepus cf. capensis</i>	×			×		
Order RODENTIA						
Family Bathyergidae						
<i>Incertae sedis</i>	×					
<i>Bathyergus suillus</i>				×	×	×
<i>Georchus cf. capensis</i>				×		
Family Hystricidae						
<i>Hystrix cf. africana-australis</i>				×		
Family Muridae						
<i>Otomys cf. saundersiae</i>				×		
<i>Parotomys cf. brantsi</i>				×		
Several other species	×					
RODENTIA— <i>Incertae sedis</i>						
Several species	×			×		×
Order CETACEA						
<i>*Incertae sedis</i>	×					

for the tentative identifications and by the classification of forms in those groups which are as yet unstudied (e.g. Rodentia).

Since most of the fossils from Langebaanweg now in the South African Museum's collections were recovered by quarry workers, and owing to the nature of the commercial quarrying operations, the specimens are, in general, rather fragmentary. Consequently even detailed studies will not result in positive identifications of all specimens. The future recovery of more and better specimens of those forms now poorly represented may alter this situation.

THE FAUNA FROM BAARD'S QUARRY

In spite of the fact that the Baard's Quarry assemblage numbers many thousands of specimens, the amount of identifiable material is limited. The first fossil from Langebaanweg to be described came from this site (Singer & Hooijer, 1958). This was an incomplete upper molar ascribed to the genus *Stegolophodon*.

The greater part of the *Hipparion* assemblage from Langebaanweg described by Boné & Singer (1965) came from Baard's Quarry.

The only other previously described specimen from this site is a giraffid astragalus (S.A.M. 11715), which was mentioned in an appendix to a paper on African giraffids (Singer & Boné, 1960).

In the Langebaanweg faunal list given by Boné & Singer (1965) no distinction was made between the material from 'C' and Baard's Quarries, but most of the material recovered at that time had in fact come from the latter site. The most notable exceptions are the Selachii, all of which were from 'C' Quarry.

Class *REPTILIA*

Order CHELONIA

Chelonian remains are far less common in the Baard's Quarry assemblage than they are in those from 'C' and 'E' Quarries. They are notable only because they include a fragment of carapace belonging to an aquatic form. All the other chelonian remains from this and the other quarries belong apparently to a single genus of terrestrial tortoise.

Mr. Roger C. Wood, of the Museum of Comparative Zoology at Harvard, recently examined some of the Langebaanweg chelonian material and the results of his study are to be published elsewhere.

Class *MAMMALIA*

Order CARNIVORA

This group is poorly represented, but at least four species are recognized.

A mandible fragment with only the P₃ preserved intact (L 1478) is assigned to the family Canidae. It is readily distinguishable from the mandible of the extant *Canis mesomelas*, but no conclusion as to its affinities has yet been reached.

A second mandible fragment (L 179/13) possibly belongs to a canid as well.

The Mustelidae are represented by a single mandible fragment (L 179/12) in which only the P_4 is moderately well preserved. This specimen is comparable in all observable respects to the mandible of the extant *Mellivora capensis*, but owing to the fragmentary nature of the fossil specimen it is only tentatively referred to this species.

Three associated upper teeth (L 179/11 A-C) belong to a large hyaenid. Identification is based principally on an upper carnassial, which lacks only the protocone and roots. Although somewhat larger than the corresponding tooth in *Hyaena brunnea*, the relative proportions of the parastyle, paracone and meta-style resemble this species, and are quite distinct from the proportions of these cusps in the P^4 of *Crocota crocota*. The other teeth (\underline{C} and 1^3) are virtually indistinguishable from the corresponding teeth of *H. brunnea*. As in the case of the mustelid, a positive diagnosis is withheld at this stage, and the material is only tentatively referred to *H. brunnea*.

The limited number of carnivore post-cranial specimens includes a fragment of a metapodial (L 1515 C) belonging to a large felid. It may possibly belong to a large machairodont of the type present in the 'C' and 'E' Quarry assemblages, but for the present is left as 'felid *incertae sedis*'.

Order PINNIPEDIA

Two specimens, both proximal ends of radii (L 1400 & L 1706) are the only pinniped remains presently recognized in the Baard's Quarry assemblage.

Order PROBOSCIDEA

The Baard's Quarry assemblage is notable particularly for the proboscidean remains it includes. Over the years a number of persons have examined this material and differing conclusions have been reached.

'*Stegolophodon*' is listed on the basis of specimens now in the Anatomy Department, University of Chicago, which include the original specimen described by Singer & Hooijer (1958) (S.A.M. 11714). With them there is a specimen which has been referred to the genus *Stegodon*. The validity of this identification is uncertain and it is not listed in table 2. There is some doubt as to whether the genus *Stegolophodon* is represented, and the material thus identified is thought to belong to another primitive elephant (V. J. Maglio, personal communication).

Yet other specimens in both Cape Town and Chicago may belong to more advanced member(s) of the family Elephantidae. Boné & Singer (1965) refer to the presence of both '*Archidiskodon*' and '*Palaeoloxodon*' in the Langebaanweg assemblage, but it is not known on what grounds these identifications were made.

A fragmentary specimen in Cape Town (L 1179) is tentatively referred to the genus *Anancus*.

Order PERISSODACTYLA

Family **Rhinocerotidae**

The rhinoceros is one of the most commonly represented mammals in the Baard's Quarry assemblage, as it is also in the Varswater deposits. Positive identification of the Baard's Quarry rhinoceros has not been possible owing to the fragmentary nature of the specimens. There are no obvious reasons for supposing that the rhinoceros which is so abundant in the 'E' Quarry assemblage is not also present in that from Baard's Quarry.

A notable exception is a complete set of upper cheek teeth (L 1639 A-F & L 1640 A-F) now in Chicago. These specimens are remarkable firstly for their completeness which is unusual for fossils from Baard's Quarry, and secondly because certain of the teeth have pronounced spiky projections on the cingula. This characteristic is not exhibited by any of the other rhinoceros teeth from Langebaanweg. For these reasons it is suggested that the specimens may not belong with the 'main body' of fossils from Baard's Quarry. They will probably be described in detail elsewhere, and for the present are listed separately as *Diceros* sp.

Family **Equidae**

The Baard's Quarry *Hipparion* has been described as *H. albertense baardi* by Boné & Singer (1965). Other undescribed *Hipparion* teeth are now known and these belong almost certainly to the same species.

At least one tooth from Baard's Quarry now in Chicago (L 2) and at least three in Cape Town (L 866, L 2106 & L 2109) belong to a large species of *Equus*. Boné & Singer referred the *Equus* remains known to them to the species *helmei*, but since the taxonomy of South African fossil equids is so unsatisfactory, the large *Equus* from Baard's and 'E' Quarries is here only tentatively referred to this species.

Order ARTIODACTYLA

Family **Giraffidae**

Apart from the giraffid astragalus referred to earlier, the only remains from Baard's Quarry tentatively referred to this family are two incomplete metatarsals (L 637 & L 638) and an ulna fragment (L 413). This material is referred to *Libytherium olduwaiense*, although L 638 may belong to a small giraffid (*Giraffa* cf. *gracilis*), which is present in the 'E' Quarry assemblage.

Family **Bovidae**

The Baard's Quarry bovids have yet to be studied in detail, but at least one alcelaphine, a boselaphine (?*Tragocerus* sp.), a reduncine (*Redunca* cf. *ancystrocera*), a neotragine (?*Raphicercus* sp.) and a gazelle have been provisionally identified by Dr. A. W. Gentry (see appendix). The bovid material is limited in both quantity and quality.

THE FAUNA FROM 'C' QUARRY AND ADJACENT AREAS

The amount of material from the 'C' Quarry area is comparatively limited, but it includes several specimens and groups of specimens of particular interest.

The marine biostratigraphic zone in 'C' Quarry yielded a very large number of fossils, although very little of this material actually came to be acquired by the South African Museum. Some of the marine fossils are very heavily rolled, which suggests that they were concentrated in an area which was subject to wave action.

The remains of Selachii and Batoidea from 'C' Quarry have been examined by Dr. B. Shaeffer (New York) (see Boné & Singer, 1965), the late Dr. D. Davies (Durban) and Mr. P. A. Hulley (Cape Town). At least seven shark genera have been provisionally identified by Mr. Hulley. They are: *Carcharias* sp., *Carcharodon* sp., *Isurus* sp., *Carcharhinus* sp., *Galeorhinus* sp., *Negaprion* or *Hypoprion* sp. and *Glyphis* sp.

All except *Negaprion* and *Hypoprion* have been recorded on the Cape west coast in recent times. Mr. Hulley has also identified the remains of a skate (*Raja clavata*), sting rays (Dasyatidae) and eagle rays (Mylobatidae).

Teleost remains are less common, and a mussel-cracker (Sparidae) is the only form provisionally identified.

A few internal casts and shell fragments of marine molluscs have been recovered, but have yet to be identified. Almost certainly they were more common than would appear from the number collected.

Associated with the marine fossils are numbers of fragments of bones belonging to large vertebrates, most of which are heavily rolled.

Class REPTILIA

Order CHELONIA

Reference has already been made to the number of complete tortoise carapaces recovered from 'C' Quarry (p. 84; fig. 4). They are the best preserved chelonian remains presently known from Langebaanweg.

Class MAMMALIA

Order LYPOTYPHLA

An incomplete chrysochlorid humerus is the only specimen belonging to this order recovered from 'C' Quarry.

Vertebrate microfaunal remains were almost certainly more abundant in the 'C' Quarry area than would appear from the record. No effort was made to collect such fossils at the time 'C' Quarry was being mined, and those that are known were acquired by the South African Museum in association with larger specimens. Their recovery was, therefore, quite fortuitous.

Order CARNIVORA

At least four carnivore species are represented in the 'C' Quarry assemblage.

A canine (L 894) belongs to a small carnivore of uncertain affinities. A mandible fragment (L 1201 A) is comparable in all observable respects to the mandible of the small hyaenid from 'E' Quarry. Several isolated teeth belong apparently to a somewhat larger hyaenid, which is also tentatively identified in the 'E' Quarry assemblage (*Hyaena* cf. *namaquensis*). An incomplete P_4 (L 756) of a large machairodont is tentatively referred to the genus *Machairodus*.

Order PINNIPEDIA

The seal is represented by several elements of the post-cranial skeleton, and an edentulous mandible fragment.

The pinniped remains from Langebaanweg appear to belong to a single species, and one which differs significantly from *Arctocephalus pusillus*, the commonly occurring form on the Cape west coast today.

Order PROBOSCIDEA

Proboscidean remains are extremely rare in the 'C' Quarry assemblage, and none has been positively identified. *Anancus* and/or '*Stegolophodon*' is present, as well as a more advanced elephantid. The latter is represented by a single highly weathered tooth fragment (L 853a). The physical condition of this specimen is quite unlike any of the other Langebaanweg fossils, and for this reason alone it is somewhat problematical. Parts of only two lamellae are preserved, the enamel is extremely thin and is patterned in a most complex manner. It remains for the present unidentified, and is not listed in table 2.

Order PERISSODACTYLA

Family **Rhinocerotidae**

A relatively small number of rhinoceros tooth fragments were recovered from 'C' Quarry. None suggest the presence of a form distinct from that which occurs in the 'E' Quarry assemblage.

Family **Equidae**

Three equid teeth from 'C' Quarry (S.A.M. 11717, S.A.M. 11718 & L 958) were described by Boné & Singer (1965) as belonging to the species *Hipparion albertense baardi*. A few other teeth not examined by these authors apparently belong to this species. Some equid post-cranial material is included in the 'C' Quarry assemblage.

Order ARTIODACTYLA

Family **Suidae**

The only specimen recognized as belonging to a member of this family is an astragalus (L 1957). Although it is comparable in size to the astragalus of

Hippopotamus amphibius, it could belong to a giant pig, such as that known from 'E' Quarry. It is provisionally listed with the pigs in the faunal list.

A tusk fragment from the borehole AA 12 south of 'C' Quarry may belong to a *Hippopotamus*, but this genus is not positively identified in the Langebaanweg assemblage.

The environment in which the fossils are thought to have accumulated makes the absence of this animal something of an anomaly. It is probable that it had not spread into the most southerly parts of Africa by the time the Langebaanweg fossils were deposited. The horizon in AA 12 from which the tusk fragment came is not recorded, and this specimen, even if it does belong to *Hippopotamus*, may post-date the main fossil assemblage.

Family **Giraffidae**

The giraffid, *Libytherium olduvaiense*, is represented by a partial upper dentition (L 1469, L 1470, L 1476 A & B) a P₄ (L 645) and several elements of the post-cranial skeleton.

In a prospect pit south of 'C' Quarry ('Sivathere pit') parts of the skull of a *Libytherium* (L 1875) were discovered. These specimens came from a sandy horizon in which there was a considerable admixture of calcium carbonate. No records on the geology of the pit are available in Cape Town, but it is thought that the calcareous horizon which is elsewhere confined to the surface beds, extends into the underlying Varswater bed in this area. Boné & Singer (1965:279) apparently concluded that these specimens came from a distinct stratigraphic horizon which post-dates the main fossiliferous deposits in the 'C' Quarry area. Although this interpretation is not favoured here, the question can only be finally resolved by new excavations in the vicinity of 'Sivathere pit'.

Family **Bovidae**

The 'C' Quarry bovids include at least one alcelaphine, a ?gazelle, and possibly other as yet unidentified forms.

Order **RODENTIA**

Three isolated incisors of unidentified rodents are included in the 'C' Quarry assemblage.

THE FAUNA FROM 'E' QUARRY

The fossils from 'E' Quarry greatly exceed in number all those discovered at other sites at Langebaanweg. In addition the levels from which fossils have come are known in many instances, and it is the only site from which fossils are presently being recovered. Consequently future palaeontological studies at Langebaanweg will largely centre on the material recovered from 'E' Quarry.

The lower levels of the deposits in 'E' Quarry are highly fossiliferous, and although many thousands of specimens have been recovered, most of the fossils

exposed by mining activities are never collected. Probably less than 10% of the larger bones and less than 1% of the microfaunal elements are eventually acquired by the South African Museum.

The basal marine biostratigraphic zone has yielded the greater part of the assemblage of marine fossils from 'E' Quarry (pl. 1A). The actual number of specimens recovered is still relatively small, since exposures of the basal gravel are limited and until recently were below the water-table. Samples of sediment taken from this horizon have revealed that the marine fossils are present in appreciable quantities. There is a smaller variety of forms represented in the 'E' Quarry marine assemblage than is represented in the 'C' Quarry assemblage, but there are no obvious differences in the genera present, and the physical condition of the fossils is similar. Remains of marine vertebrates are known from the deposits above the basal gravel, recent discoveries having included sharks' teeth, a sting-ray spine (pl. 1C), teleost bones (pl. 1B) and cetacean vertebrae.

Class *AMPHIBIA*

Order ANURA

Remains of frogs are fairly abundant at certain levels in 'E' Quarry. Skull and post-cranial elements are known, but no definitely associated parts of the same skeleton have been found. There is a large size variation in individual bones recovered, but there are no definite indications of more than one species being represented. Two skeletons of large adult *Xenopus laevis* have been used for comparative purposes in the sorting of anuran remains, and although the fossil specimens tend to be rather small, no significant morphological differences between them and corresponding parts of the skeleton of *Xenopus* were noted. The material has yet to be studied in detail.

Class *REPTILIA*

Order CHELONIA

Mr. Roger C. Wood (Harvard) who examined some of the many thousands of carapace fragments from 'E' Quarry concluded that only a single species of land tortoise is represented. There is a considerable range of variation in the size of individuals, some being appreciably larger than any existing South African tortoises.

Order SQUAMATA

Remains of snakes and lizards have been recovered, but have yet to be studied (pl. 1E).

Class *AVES*

Bird remains are fairly abundant at certain levels, and a considerable variety of forms of all sizes are represented. Included in the avian assemblage are a giant ostrich (*Struthio* sp.) and a penguin (Spheniscidae) (pl. 1D).

Class *MAMMALIA*Orders *MENOTYPHILA* and *LYPOTYPHILA*

Insectivores are well represented in the 'E' Quarry assemblage, a macroscelidid and a chrysochlorid being particularly abundant at certain sites.

There is apparently only a single macroscelidid species represented (pl. 1F). The material compares most closely in size and morphology to *Elephantulus rupestris*, which occurs in the south-western Cape today. There are, however, apparently significant differences between the dentitions of *E. rupestris* and the fossil form, and the latter is probably a distinct species.

Soricids are less well represented, but there appear to be at least two species present. The one which occurs most commonly is tentatively referred to the genus *Suncus*.

A chrysochlorid is perhaps the most commonly occurring small mammal (pl. 1G). The peculiarities in the skeleton of this animal have made it possible to sort out certain elements of the postcranial skeleton with relative ease, and the range of material now available for study is quite comprehensive. Since chrysochlorids have a comparatively poor fossil record, the 'E' Quarry material is of particular interest.

Order *CARNIVORA*

The carnivores from 'E' Quarry represent a striking variety of forms, but the specimens are for the most part rather fragmentary.

There are at least two canid species represented. One is a small jackal, and is known only from an incomplete mandible (L 1700). The other is a canid of uncertain affinities, and is also known only from an incomplete mandible (L 2672).

The most remarkable representative of this order is an agriotheriine ursid. The family Ursidae has not previously been recorded in sub-Saharan Africa. The Agriotheriinae, an essentially Pliocene group which was widespread in the northern hemisphere, are now, with the Langebaanweg record, known for the first time in Africa. The 'E' Quarry specimens are fragmentary and few, but exhibit several unusual characteristics. They will be described in detail elsewhere.

At least two species of mustelid are represented. A mandible fragment (L 6385) belongs to a mustelid of uncertain affinities (pl. 2E). Morphologically it comes closest to *Poecilogale*, but is approximately three times as large as the extant *P. albinucha* from South Africa. The second mustelid represented is the giant otter, *Enhydriodon*. The only other African record of this genus is *E. africanus* from Kleinsee on the Namaqualand coast (Stromer, 1931a). There are some differences between an incomplete mandible of this animal from Langebaanweg (L 9138) and that described by Stromer (1930 XI 1), but the Langebaanweg form is here referred to the species *E. africanus*.

Remains of at least two viverrids have been recovered from 'E' Quarry. Neither can be related to extant South African viverrid species. One is a form

only slightly larger than the dwarf mongoose (*Helogale parvula*), while the other is much larger. The latter is known only from an incomplete mandible (L 11847), which is very similar to a mandible of ?*Herpestes* sp. from Kleinzee (Stromer, 1931a).

The 'E' Quarry hyaenids are somewhat problematical. There are apparently two forms represented, a large and a small one. The latter exhibits a number of very primitive characteristics, and in its size and in its dentition is intermediate between the existing species of *Hyaena* and their icthhere ancestral stock (pl. 2A & B). The larger form may be the species *H. namaquensis* (Stromer, 1931a). Comparisons between the *namaquensis* type specimens and those of Langebaanweg are difficult since the former are very fragmentary, but there are no observable features which positively preclude their being identical. The larger 'E' Quarry hyaenid is not morphologically distinguishable from the small form on the basis of the limited material presently available. Since the distinction is being made solely on the basis of size, its validity is questionable. It is hoped that this problem will be resolved as more and better hyaenid specimens are recovered.

The felids include a machairodont which is apparently larger than any previously recorded in southern Africa (pl. 2C). It apparently belongs to the '*Machairodus/Homotherium*' group of machairodonts, and for the present is tentatively referred to the former genus. Of the other felids represented, the smallest is the size of a lynx. Positive identification of this form will not be possible until more complete specimens are recovered. A left maxilla (L 10100) of a somewhat larger felid has yet to be identified. A crushed and incomplete skull (L 2674) and a mandible fragment (L 12237) of a still larger form belong to a member of the genus *Dinofelis* (pl. 2D).

The unidentified carnivore specimens from 'E' Quarry may represent forms in addition to those already listed.

Order PINNIPEDIA

Pinniped post-cranial remains are comparatively abundant in the 'E' Quarry assemblage. A single edentulous mandible and a few isolated teeth are the only cranial remains known.

Order TUBULIDENTATA

A single aardvark tooth (L 12027) is included in the 'E' Quarry assemblage. It does not differ significantly from corresponding teeth of the extant *Orycteropus afer*, but for the present it is only tentatively assigned to this species.

Order PROBOSCIDEA

The 'E' Quarry proboscidean teeth are, in general, more complete than those from the other quarries, and most of them have been referred to the genus *Anancus* (pl. 3A). However, some material (L 12023 and L 12723-L 12730) belongs to the genus presently referred to as '*Stegolophodon*'. Yet another tooth fragment (L 6533) may belong to a more advanced elephantid.

There is at present much confusion about the Langebaanweg Proboscidea, and this is no doubt due to the fragmentary nature of the specimens recovered to date. The situation is perhaps best summarized by the statement that *Anancus*, a form resembling *Stegolophodon* in its dentition, and possibly one other elephantid are included in the Langebaanweg assemblage. Aquirre (1969) recognizes only two proboscideans from this locality, which he designated 'form a' and 'form b'.

Order PERISSODACTYLA

Family **Rhinocerotidae**

The remains of rhinoceros are extremely common in the 'E' Quarry deposits. Several partial and complete dentitions, scores of isolated teeth and skull fragments, and hundreds of elements of the postcranial skeleton have been recovered. The 'E' Quarry rhinoceros is similar in many respects to the extant *Diceros bicornis* (pl. 3B). The most obvious difference is the larger size of the fossil form. The material has yet to be studied in detail.

Family **Equidae**

A number of *Hipparion* teeth have been recovered from 'E' Quarry, and these are assigned to the species *H. albertense baardi* (pl. 3C).

A single upper molar (L 2095) of a large *Equus* is tentatively referred to the species *helmei* (pl. 3D).

Two other teeth (L 2545 & L 5353) belong to a small species of *Equus* (pl. 3E). Two extremely hypsodont lower cheek-teeth (L 10956 & L 10957) belong to this form as well.

Some elements of the post-cranial skeleton have also been recovered.

Order ARTIODACTYLA

Family **Suidae**

Several teeth and post-cranial bones of a giant pig are included in the 'E' Quarry assemblage. This material has some affinities to the East African *Nyanzachoerus*, but for the present is left as *incertae sedis*.

A second pig, a miniature form comparable in size to the extant *Sus salvanius* Hodgson from India, has recently been recognized. Its relationships have yet to be determined.

Family **Giraffidae**

Remains of *Libytherium olduvaiense* are fairly common and include several limb-bones of a single individual, numerous unassociated post-cranial remains as well as isolated teeth, partial dentitions, and horn core fragments.

In addition remains of a much smaller giraffid have been recovered, and these are tentatively referred to *Giraffa gracilis*.

Family **Bovidae**

The 'E' Quarry bovids (pl. 4A, B & C) have yet to be studied in detail, but a preliminary account of them is given in the appendix to this paper.

Bovids are less commonly represented at Langebaanweg than at other Pleistocene fossil sites in the south-western Cape, and they are all quite distinct from those known from other fossil sites in this area.

Order LAGOMORPHA

A number of lagomorph dentitions and isolated teeth are tentatively referred to *Lepus capensis* (pl. 1J).

Order RODENTIA

Rodents are very common in the 'E' Quarry deposits, at least twelve murid and bathyergid species having been differentiated by superficial sorting (pl. 1H & I).

Order CETACEA

At least one cetacean species is represented in the 'E' Quarry assemblage. Although no actual identification of material has been attempted, the largest vertebra recovered to date suggests an animal approximately of the size of a 5-6 metre long killer whale (*Orcinus orca* Linn.). An ulna (L 12034) is very long and slender, comparable in size to that of 13.75-metre long sei whale (*Balaenoptera borealis* Lesson). The size of the cetaceans represented supports the conclusion that deposition of at least part of the Varswater bed took place in the open sea or on an open coastline, rather than in an estuary or lagoon.

THE DATING OF THE LANGEBAANWEG DEPOSITS

PALAEONTOLOGICAL EVIDENCE

In an Eurasian context the association of *Hipparion* with a number of primitive proboscidean genera, an agriotheriine, *Enhydriodon*, a primitive hyaenid and the boselaphine *Tragocerus*, would indicate that the fauna concerned was Pliocene in age. However, the shortcomings of directly correlating the mammalian faunas of late Tertiary and Pleistocene deposits in southern Africa with those in Eurasia have long been recognized. The difficulties are even more pronounced when correlations are attempted on the basis of a limited number of positively identified genera and species (Ewer, 1957). Some of Ewer's observations in this connection bear repeating since they are as valid now as they were when written. She states (p. 135) that,

' . . . in assessing the age of an African deposit, we can neither assume that the presence of an archaic form indicates great antiquity, nor yet that the presence of a modern species proves the deposit to be recent. . . . What is necessary is a quantitative picture of the fauna as a whole. . . .'

No such picture is yet available for the Langebaanweg fauna, and consequently attempts at direct temporal correlation of this fauna with others in Eurasia are at this stage neither desirable nor useful.

Owing to the present small number of secure identifications, correlations with other African fossil faunas are of only limited value.

It seems fairly certain that the Langebaanweg fauna is closely related to the 'middle Pliocene' fauna from Kleinzee, which was described by Stromer (1931a, b). Kleinzee is situated some 400 kilometres north of Langebaanweg at the mouth of the Buffels River in Namaqualand, in an essentially similar zoogeographic sub-region (Roberts, 1951), and consequently direct comparisons between the two fossil faunas are facilitated. Stromer recorded Carnivora, Bovidae, Rodentia, Aves and Anura from the Kleinzee deposits, and all these groups are well represented in the Langebaanweg assemblage. There are some slight differences between the Kleinzee *Enhydriodon africanus* and that from Langebaanweg, but this could be satisfactorily accounted for by variability within the species. One of the hyaenids from Langebaanweg may be identical to Stromer's *Hyaena namaquensis*. The mandible of ?*Herpestes* sp. indet. (1930 XI 5a) from Kleinzee and the viverrid mandible (L 11847) from Langebaanweg are virtually indistinguishable. The geological associations of the two faunas are notably similar (*vide infra*).

Stromer's conclusion that the Kleinzee fauna is 'Middle Pliocene' is almost certainly incorrect, and Ewer (1967) has suggested instead that it is 'Upper Pliocene' in age, while Patterson (1965:302) listed it as 'Early Pleistocene?'.

Cooke (1963 & 1967) has tentatively suggested that the Langebaanweg fauna predates those from Taung, Makapansgat and Sterkfontein, and, by inference from his discussions on dating, he presumably thought the age to be late Pliocene or very early Pleistocene. A similar conclusion was reached by Boné & Singer (1965:280), who stated that the fauna probably dates from 'the earliest phases of the Pleistocene'. This conclusion was reached principally on the basis of the *Hipparion* from Langebaanweg, but since *Hipparion albertense* apparently had a considerable temporal range (Boné & Singer, 1965, table 1), it is not a good index of chronology on its own. Furthermore, the Langebaanweg *Hipparion* is a distinct subspecies, and is possibly a temporal and not merely a geographical variant of the species *albertense*.

There are certain similarities between the Langebaanweg fauna and that from Kanapoi in East Africa (Patterson, 1966 & 1968), and further work on the fossils from both these sites will undoubtedly resolve the question of their faunal commonality. The Kanapoi fauna is earlier than that from Olduvai Bed 1, and the lava which caps the Kanapoi sediments has been dated at 2.9 ± 0.3 million years before present (Patterson, 1966).

The Baard's Quarry reduncine is not distinguishable from *Redunca ancystrochera* from Omo (see appendix), which occurs below Tuff F. (A. W. Gentry, pers. comm.). The age of this tuff is between 1.81-1.87 million years (Tuff H) and 2.37-2.56 million years (Tuff D) (Howell, 1968). Several of the

genera recorded at Omo recently (Howell, 1968) are also found at Langebaanweg.

From the preceding it can be tentatively concluded that the Langebaanweg fauna is late Pliocene or very early Pleistocene, with a chronometric age of perhaps 2 to 3 million years before present.

However, the presence of the genus *Equus* in the assemblage suggests a Pleistocene rather than Pliocene date. This genus is not recorded at Omo (Howell, 1968) or Kanapoi (Patterson, 1966), but is recorded in Bed 1 at Olduvai (Leakey, 1965). There are in fact two species of *Equus* represented in the Langebaanweg assemblages. One is very large (*Equus* cf. *helmei*), and the other is a small form with very hypsodont cheek-teeth.

Apart from *Equus*, a number of other genera recorded at Langebaanweg are typical of Pleistocene deposits elsewhere in Africa. They include *Dinofelis*, *Libytherium*, *Giraffa* and *Tragelaphus*.

The dating of the Langebaanweg fauna and deposits on palaeontological grounds has hitherto been based entirely on direct correlations and has taken no zoogeographic factors into account. There are indications that at several times during the late Tertiary and Pleistocene the southern, south-western and western Cape coastal areas were zoogeographically isolated from the rest of southern Africa (H. Hendey, in preparation). This hypothesis suggests the possibility that locally endemic species may have evolved at these times, and that an even later survival of certain mammalian genera may have occurred in these areas. Consequently it is possible that a relict fauna, supplemented by some immigrant forms, is represented at Langebaanweg. Long range temporal correlations must therefore be treated with caution at the present time.

The possibility that the Langebaanweg fauna is a local equivalent of that found in Bed I and lower Bed II at Olduvai is suggested on the basis of non-palaeontological evidence (*vide infra*). There are in fact some similarities between these faunas. *Hipparion albertense* and *Equus* are present in both assemblages. *Libytherium olduvaiense* and *Giraffa gracilis* are present in lower Bed II, and the former species is definitely present at Langebaanweg, while the smaller giraffid from this site has been tentatively identified as *Giraffa gracilis*. Possible relationships between the Langebaanweg and Olduvai Bovidae are mentioned in the appendix to this paper.

For the reasons cited earlier these similarities cannot be taken as proof that the lower Bed II and Langebaanweg faunas are contemporaneous, but at least it does not positively contradict the relationship inferred on other grounds. In the case of this alternative the differences between the two faunas could be accounted for by the hypothetical zoogeographic factors mentioned above.

Yet another aspect of the dating of the Langebaanweg deposits on palaeontological grounds needs to be considered. Boné & Singer (1965) suggested that a second, more recent mammalian fauna is represented in the deposits. The later fauna was said to be associated with the calcrete horizon encountered in the area. This horizon is a pedogenic feature found in the upper

levels of the deposits and is here concluded to be of no stratigraphic significance. Although it appears to be confined to the surface beds, it may extend into the underlying Varswater bed south of 'C' Quarry.

The possibility of the admixture of earlier and/or later elements in the Baard's and 'C' Quarry assemblages has already been mentioned, but the assemblage from 'E' Quarry appears to be a single uncontaminated unit. Of the four genera listed by Boné & Singer as belonging to their later fauna, two (*Equus* and *Sivatherium* [= *Libytherium*]), are now known to occur in the 'main' assemblage ('E' Quarry), although the latter may also occur in the surface bed ('Sivathere pit'; see p. 98). The third genus (*Homoioceras*) is not present at all, although a smaller bovine is included in the 'E' Quarry assemblage. The fourth genus (*Ceratotherium*) is tentatively recorded from the surface beds (see p. 82). Owing to the large number of provisional identifications, it is not possible at present to calculate indices of commonality for the faunas from the three quarries, but they do have certain forms in common. It is concluded that no earlier or later fauna, as such, is at present distinguishable in the total Langebaanweg assemblage, although some extraneous elements may exist.

GEOLOGICAL EVIDENCE

The dating of the Langebaanweg deposits on geological grounds depends initially on determining whether the marine transgression responsible for the development of the deposits resulted from epeirogenic or eustatic changes.

King (1962, table VII) records a period of 'strong cymatogeny' at the close of the Tertiary in south and central Africa. The interior plateau of the sub-continent was apparently subjected to widespread and considerable uplift during this period. King (p. 243) states that,

'As the coastal hinterlands were strongly uptilted, so the offshore continental shelf was correspondingly depressed. Where the hingeline lay closely along the previous shore little change of coastal outline occurred, but where the hingeline lay seaward extensive coastal plains were added to the geographical outline of the continent.'

Given such conditions for the late Pliocene/very early Pleistocene, which on palaeontological evidence is the earliest the Langebaanweg deposits could be, it suggests that either the shoreline of the south-western Cape remained more or less stable, or else a marine *regression* took place. The mechanism which gave rise to the marine transgression in evidence at Langebaanweg cannot therefore be explained by this interpretation of events at the critical time period. However, if the hingeline between hinterland uplift and continental shelf depression lay landward of the coastline at that time, then the required marine transgression could have taken place. This would in turn require a subsequent seaward shift of the hingeline in order that the Langebaanweg area be re-elevated above sea-level. This possibility cannot, of course, be dismissed, but it does render the association of the Langebaanweg deposits to the Plio/Pleistocene cymatogeny

more improbable.

An alternative possibility is that the south-western Cape coastal area suffered localized epeirogenic depression and then uplift in Plio/Pleistocene times, independent of the major cymatogenic phenomenon. While this might be expected of an area of crustal instability, it seems improbable for the area in question. This area is tectonically stable today, and there is no reason to suppose that it has been otherwise for most, if not all of the Pleistocene.

While the role played by epeirogenesis (or cymatogenesis) in the origin of the Langebaanweg deposits cannot be entirely dismissed, it does not appear to provide the most satisfactory answer to the problem.

Eustatic shorelines on the South African coast have been the subject of numerous studies (Richards & Fairbridge, 1965), although their relationship to Pleistocene climatic fluctuations and their correlation with shorelines elsewhere in the world have not always been agreed upon.

In reference to the higher shorelines at Kleinzee, which include the horizon from which the vertebrate fossils described by Stromer (1931*a, b*) were recovered, Davies & Walsh (1955:278) state that,

‘. . . the complex of . . . Kleinzee beaches . . . is earlier than the pleistocene fluctuations of ocean level caused by the glaciations of the northern hemisphere’.

Although the reasons for this statement are not understood by the present writer, it has to be borne in mind as an alternative to the tentative statements which follow.

In spite of the statement by Davies & Walsh, it is necessary to reconsider the possible relationship of the Kleinzee fossil vertebrate horizon to a Pleistocene glacio-eustatic marine transgression. According to the persons who discovered the fossils described by Stromer, they came from a coarse ‘fluviatile sandstone’ overlying a diamondiferous gravel at an elevation of 35 metres on the north bank of the Buffels River. On the basis of personal observations made in the area, it was concluded that these deposits formed part of a marine/estuarine horizon associated with a marine transgression which peaked at about 49 m above present sea level in this area. The geology of the Kleinzee fossiliferous deposits appears to have been remarkably similar to that of ‘E’ Quarry and it is concluded that the fossils at the two sites are contemporaneous and accumulated in a comparable manner in essentially similar environments.

A detailed study of the Cape west coast shoreline succession is at present in progress (Carrington & Kensley, 1969), and a final assessment of the transgression in evidence at Kleinzee and Langebaanweg must await the publication of this work. However, some preliminary observations are possible.

Since the maximum recorded elevation of the Varswater bed is approximately 50 metres, it must have been laid down during a transgression which peaked at about this elevation, or, if it has suffered subsequent erosion, at an even higher elevation. The Kleinzee 49 m shoreline is recorded on the basis of

wave-cut platforms, nick points and associated gravels and sands. Mabbutt (1957) deduced the previous existence of a 45 m high sea level on the Cape west coast on the basis of a river terrace in the Olifants River valley. Zeuner (1959) also records a possible 45 m shoreline in South Africa. Carrington & Kensley (1969) report a '45-50 m Transgression complex' on the Namaqualand coast. Since the figures of 45, 49 and 50 metres are recorded for the west coast by different persons observing different shoreline features, and since all are probably approximations to some extent, they are here taken to refer to a single high sea level with which the Langebaanweg and Kleinzee faunas were associated.

The marine molluscs associated with the '45-50' metre shoreline on the Namaqualand coast indicate that this high sea level was Pleistocene rather than late Tertiary in age (Carrington & Kensley, 1969), and since the presence of *Equus* in the Langebaanweg beds is also taken to indicate a Pleistocene date, an attempt was made to correlate this horizon with Pleistocene glacio-eustatic shorelines elsewhere in the world.

Available altimetric records reveal a remarkable similarity between the Cape west coast shoreline sequence and those in other areas, and a tentative correlation with selected examples is proposed (table 3).

Since the Moroccan glacio-eustatic stratigraphy is very well known (Butzer, 1966), it is used as a standard for comparison. The suggested Moroccan equivalent of the Cape west coast '45-50' metre shoreline is the Maarifian (*sensu lato*). This stage has been tentatively correlated with the Milazzian (*s.l.*) and Cromerian of Europe (Butzer, 1966). There is no known mammalian fauna associated with the Maarifian (Biberson, 1963) but it does, however, post-date the Villafranchian (*sensu stricto*). On the basis of the Stone Age industry associated with it, Biberson (p. 428) equates it temporally to, 'the first two levels' of Bed II at Olduvai Gorge. On this basis we might look at the fauna of Bed I and lower Bed II for possible chronological equivalents of the Langebaanweg fauna (*vide supra*).

Recently Ericson & Wollin (1968) presented a revised chronology of the Pleistocene based on studies of deep-sea cores. The Aftonian Interglacial, which is here taken to be the North American equivalent of the Cromerian, was dated by them to approximately 1.4 to 1.7 million years before present.

These tenuous correlations give the Langebaanweg fauna an inferred chronometric age of approximately 1.6 to 1.7 million years before present (i.e. Olduvai Bed I times), which is in sharp contrast to the 2-3 million years suggested on the basis of the mammalian fossils.

On the basis of the admittedly speculative evidence presented above, the following statements are made:

- (1) Since an association between the Langebaanweg beds and Pleistocene glacio-eustatic high sea levels is indicated, these beds must post-date the European Villafranchian, as defined by Kurtén (1968).
- (2) If the suggested relationships of the local '45-50' metre transgression are

TABLE 3
Tentative correlation of South African Pleistocene shorelines with selected examples of shorelines elsewhere in the world

S.W. Cape fossil sites associated with ancient shorelines	South-western Cape		Namaqualand		Morocco	S. France	S. Australia	Tentative correlation with Kurtén's (1968) divisions of the Pleistocene
	Mabbutt 1957	Gatchouse 1955	Personal records	Carrington & Kenesley, 1969				
— (MELKBOS*)	2 m			2 m	2 m (Mellahian)		3 m (Early Recent)	G-Post-Glacial
	6 to 8 m	7.6 m	6 to 8 m	5 m	5 to 8 m (Ouljien)	7 to 8 m (Late Monastirian)	7.5 & 9 m (Woakwine & Margaret)	F-Eem
	18 m	18.3 m	?	17 to 21 m	15 to 20 m (Kebibatian)	18 to 20 m (Main Monastirian)	19.5 m (Reedy)	E-Ilford
	23 to 28 m	29 m	27.5 m	29 to 34	25 to 34 m (Anfatian)	28 to 32 m (Tyrrhemian)	32 to 34 m (East Avenue)	D-Holstein
LANGEBANWEG ± 50 m	45 m		49 m	45 to 50 m	55 to 60 m (Maarifian s.s.)	50 to 60 m (Milazzian)	49 to 62 m (Cave)	C-Cromerian
	100 m	91.5 m	90 m	75 to 90 m	90 to 100 m (Messaoudian)	90 to 100 m (Sicilian)	78 m (Naracoorte)	E-Waalian
								A-Tegelen

* Post-dates 6 m high sea-level (Hendey, 1968)

correct, then it follows that the Langebaanweg fauna is a local equivalent of that of the European Cromerian.

There are at present obvious shortcomings in both the palaeontological and geological dating of the Langebaanweg deposits, and either or both may be incorrect. However, there is clearly considerable scope for further research following both lines of inquiry, and it may eventually prove that the geological and palaeontological datings are complementary rather than conflicting.

CONCLUSION

This paper is the third in a series of preliminary reports of a study presently being undertaken on the Quaternary vertebrates of the south-western Cape Province (see also Hendey & Hendey, 1968 and Hendey, 1968). This research programme is supplementary to the invaluable contributions already made in this field, mainly by Professor R. Singer (University of Chicago) and his associates.

Only in the case of the Elandsfontein (Hopefield) site has research on a local fossil fauna and its associations proceeded to a stage where a confident overall assessment can be made (Singer, in preparation). The Melkbos and Swartklip sites have yielded far fewer specimens, and there are fewer problems attached to the associations of these two faunas.

In terms of the local Pleistocene faunal succession, Cooke (1967) has placed 'at least a part' of the Elandsfontein fauna in the 'Vaal-Cornelia Faunal Span'. The Melkbos fauna falls within the 'Florisbad-Vlakkraal Faunal Span', while that from Swartklip belongs either in the terminal part of this period, or in the subsequent 'Recent' period. Apart from many other minor fossil occurrences which are not dated, a number of post-Pleistocene cave and coastal midden sites in the south-western Cape have yielded faunal material. All these records, taken in conjunction with historical information and recent studies on modern mammals, give a moderately clear picture of the mammalian fauna of this area during the later Pleistocene and Holocene.

It is hoped that by relating this information to similar records elsewhere in South and East Africa, a clear indication will emerge of the degree to which the southern and western Cape Province can be regarded as a distinct zoogeographic subregion. The modern mammalian fauna of this area, and those of the interior plateau of South Africa and East Africa do differ in certain respects, and it should be possible to assess the extent to which they differed during the later Pleistocene. On the basis of this information, comparisons between specific animals or groups of animals from Langebaanweg and their counterparts from the African australopithecine sites will be made more meaningful when matters such as phyletic relationships and relative ages are considered. As detailed studies of the Langebaanweg fossils progress it should become possible to place this fauna correctly in the South African Plio/Pleistocene succession.

The apparently conflicting conclusions which emerged from the present

survey of the Langebaanweg sites, served to illustrate some of the inadequacies in our knowledge of South African Plio/Pleistocene mammals and their associations. There is little doubt that the keys to the study of the late Tertiary and Pleistocene mammals of sub-Saharan Africa lie in East Africa, where the many astonishingly rich sites are often radiometrically dateable. Nevertheless, the research potential offered by this field in South Africa is considerable and deserves more attention, since the local faunas are a vital part of the study as a whole.

SUMMARY

A considerable increase in the amount of fossil material recovered at Langebaanweg, Cape Province, has resulted in radical alterations being made to the previously published faunal lists for this locality. A revised faunal list is given, and brief comments are made on some of the specimens now available for study. The fauna suggests a Plio/Pleistocene order of age for the deposits, although it is emphasized that an even later survival of certain terrestrial mammals may have been experienced in the south-western Cape Province than was the case elsewhere in Africa. For this reason palaeontological dating of the Langebaanweg deposits is tentative and subject to revision.

A summary account of the geology of the Langebaanweg area is given. Three distinct beds are recognized, viz. an essentially deltaic horizon (the Varswater bed) and an essentially fluvatile horizon (the Langberg bed), which are overlain by more recent terrestrial deposits. It is suggested that the Langberg and Varswater beds are closely associated, and that the fossils from these horizons are broadly contemporaneous. The possibility of the admixture of earlier and/or later faunal elements is mentioned. It is concluded that the Langebaanweg beds accumulated during a marine transgression. Interpretations of the geological evidence are discussed, and it is suggested that the deposits may be early Middle Pleistocene (as defined by Kurtén, 1968) in age.

However, no final conclusion on the age of the fossils and deposits is possible on the basis of evidence presently available.

Possible evidence of hominid occupation sites is also mentioned.

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APPENDIX

THE LANGEBAANWEG BOVIDAE

By

A. W. GENTRY

Tragelaphini

Two horn core pieces, L 4615 and L 6586, spiralled and with a strong keel, are from a kudu bigger than the Olduvai *Tragelaphus maryanus* (Leakey, 1965:40) of which the latest known occurrence is at site HWK East level 2 in lower Bed II. They match the size of *T. strepsiceros grandis* (Leakey, 1965:38) found in Olduvai from MNK II to the junction of Beds III and IV.

A smaller tragelaphine species, not a kudu, is represented by right horn cores L 5922, L 5924 and L 6568, a left horn core L 5868, and others. The anterior and postero-lateral keels are developed to about the extent seen in most *Tragelaphus* species. Compared with the similar sized *T. angasi*, the horn cores are less antero-posteriorly compressed at the base and perhaps inserted less far behind the orbits. A left horn core L 6574 has a weaker postero-lateral keel, but is probably conspecific. This species is smaller than *T. nakuae* from the Omo in southern Ethiopia (Arambourg, 1947:418). A right mandible with P₃ and P₄ L 6287 and some other pieces can be doubtfully placed with this species. Those numbered L 1843C, L 3360 and L 3697 also have P₄'s, and in all the fossils there is no fusion of paraconid and metaconid as occurs in living Tragelaphini. Several lower molars have goat folds (anterior transverse flanges), a character not hitherto known in tragelaphines, and one which diminishes the reliability of the tooth identifications.

Boselaphini

Three horn cores, L 4657, a tip L 5923, and L 1588A from Beard's Quarry, show medio-lateral compression and a step on the anterior edge. Such features occur in *Protragocerus* and *Tragocerus* genera, otherwise known from Miocene-Pliocene faunas of Europe, China and the Siwaliks. The Langebaanweg horn cores are perhaps too large to agree with the common *Tragocerus amalthea* of the European lower Pliocene, and definitely too large for the Dhok Pathan *T. punjabicus*. There are larger *Tragocerus* specimens in European museums, but they lack the curvature of the horn cores in front view (produced by greater divergence nearer the base than higher up) and high basal hollowing of the pedicel seen in the Langebaanweg specimens. *Protragocerus*, which does have a curved course of its horn cores in anterior view, might be a better assignation. It has a more southerly distribution than *Tragocerus*, being absent from China and some European sites, but present at other European sites, in the Siwaliks, and at Fort Ternan, Kenya. The Langebaanweg horn cores are bigger than any known specimens of *Protragocerus*.

Bovini

A bovine species is represented by two right upper molars L 4774 and L 11981, a right M₃ L 2051, and a fragment of a right M₃ L 5338. A small left M₃ set in part of a large mandible L 12116, and a right mandible and left maxilla with deciduous teeth L 1843, may also be bovine. These teeth are not advanced, and agree with bovine teeth from Olduvai of upper Bed II and earlier.

Reduncini

Some horn cores, right L 2611 and L 2612, left L 1847 L 2609 L 6076 and L 10672, belong to a fairly small *Kobus* species. They are short, little compressed medio-laterally, with a flattened lateral surface, inserted close together, and set obliquely in side view. They agree with no other reduncine which I have seen. A cranium L 2604 could belong to this species, and is unlike the Makapansgat Limeworks *Redunca darti* (Wells & Cooke, 1956:17) in its larger mastoid without a pronounced ventral rim, the inflated auditory bullae, and the large anterior tuberosities of the basioccipital.

The largest group of horn cores from Baard's Quarry are from a different reduncine antelope, e.g. L 564 and L 1378. This species differs from *Redunca darti* by having longer horn cores, very divergent in anterior view and set more obliquely in side view. Such horn cores cannot be separated from *Redunca ancystrochera* from Omo levels below Tuff F (see Howell, 1968 and Arambourg, Chavaillon & Coppens, 1967 for Omo tuffs and their dates).

Hippotragini

A frontlet L 1836 appears to be of *Hippotragus*. It gives no sign of being from a young individual, so it may be taken as too small for a female of *Hippotragus gigas* (Leakey, 1965:49). It differs from Siwalik Hippotragini of the Pinjor stage by the closer supraorbital pits. Of the two living species, it agrees better with roan than with sable in that its horn cores are neither large nor medio-laterally compressed higher up, and the frontals are not unduly raised between the horn bases. It is the only record before Elandsfontein of any *Hippotragus* other than *H. gigas*.

Alcelaphini

An alcelaphine species is represented by a skull L 7257, cranium L 2680, and horn cores, including a horn core L 9 from Baard's Quarry. The teeth of this species are unadvanced in their lack of outbowed ribs between the styles on the upper molars, little rounding of the medial and lateral lobes on the lower molars, a simple outline of the central cavities on the molars, and P₄s with no fusion of paraconid and metaconid. Also the nasals are less extremely narrowed than in living alcelaphines and the preorbital fossa is larger. Ancestry to *Alcelaphus* itself is a possible relationship.

A large number of horn cores, more than those of the last species, agree closely with *Parmularius angusticornis* (published as *Damaliscus angusticornis* by Schwarz, 1937:55) of middle and upper Bed II at Olduvai. It is a problem that none of the Langebaanweg alcelaphine teeth, which presumably include many from this species, are as advanced as all those from Olduvai middle and upper Bed II, which must similarly include some belonging to the common *P. angusticornis*. They are also less advanced than in the Olduvai Bed I *P. altidens*, which I believe to be the ancestor of *P. angusticornis*.

Antilopini

Horn cores of a species of *Gazella* occur at Langebaanweg, e.g. L 3491 and at Baard's Quarry L 1521D. They are very medio-laterally compressed, and curve backwards in side view. A similarly compressed gazelle horn core comes from above Tuff G at Omo, and is conspecific with Arambourg's (1947:387) horn core of *Gazella praethomsoni*. One does not know whether more complete examples of these Omo horn cores would have shown backward curvature as at Langebaanweg. *Gazella gracilior* from the Makapansgat Limeworks (Wells & Cooke, 1956:37) might also turn out to be conspecific with the Langebaanweg horn cores, providing that the type frontlet was from a female animal.

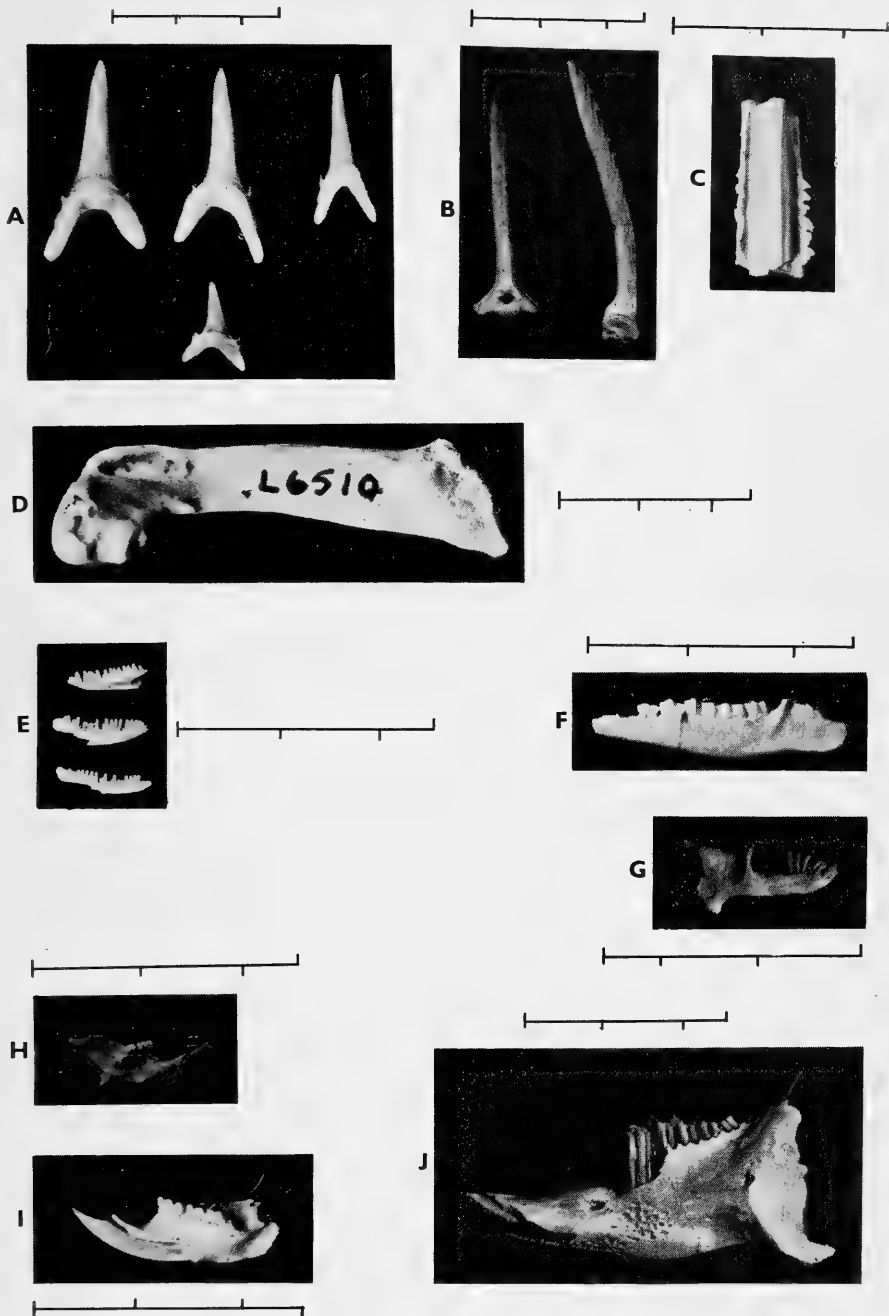
Neotragini

A right horn core and right maxilla L 12238, and other horn cores, belong to this tribe. The horn cores have some compression in the direction antero-lateral to postero-medial, an irregular cross section, a postero-lateral keel for part of the length of the horn core, and oblique insertions in side view. They may be doubtfully regarded as a very large *Madoqua*. The horn core from Makapansgat Limeworks assigned to *Cephalophus pricei* (Wells & Cooke, 1956:13) is inseparable from the Langebaanweg horn cores, but the tooth rows of this species are larger than the Langebaanweg maxilla L 12238. Since the holotype of *C. pricei* is one of these tooth rows, its name cannot be used for the Langebaanweg species. Baard's Quarry contains another neotragine species represented by L 1670 and other horn cores.

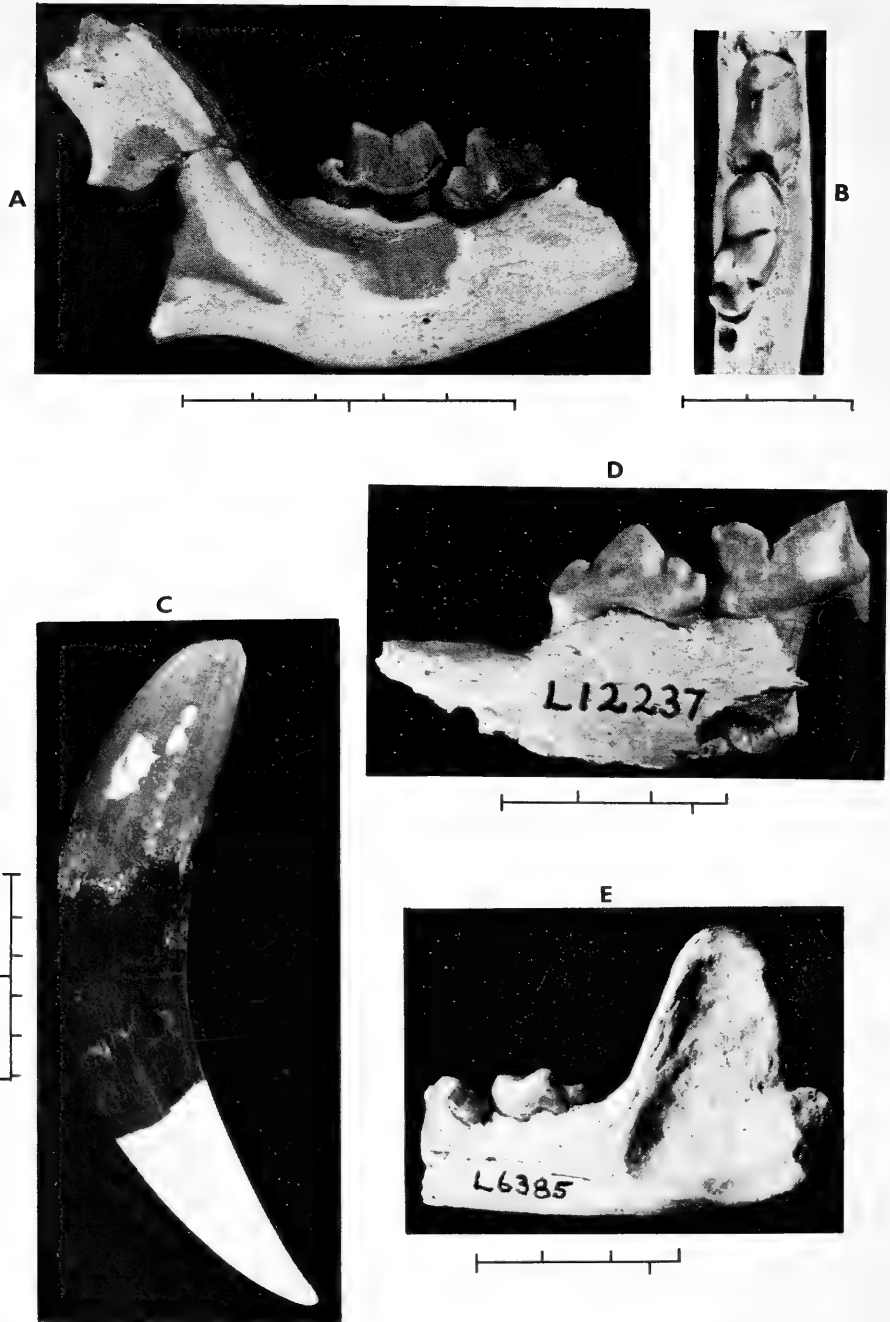
Langebaanweg is a difficult site. The *Tragocerus* or *Protragocerus*, the short-horned *Kobus*, the small *Hippotragus*, and the alcelaphine species represented by the skull L 7257 are all unique in my experience. There is a puzzling discrepancy between primitive alcelaphine teeth and the horn cores apparently of the Olduvai Bed II *Parmularius angusticornis*. If one supposed that the horn cores of the Olduvai Bed I *P. altidens*, type species of its genus, were merely a local variation, and therefore could be preceded at other sites by '*angusticornis*' horn cores, then the primitive Langebaanweg teeth could indicate a pre-Olduvai age. However the kudu horn cores at Langebaanweg are of a size only attained at Olduvai in middle and upper Bed II. Also the long horned buffalo *Homoioceras* at Elandsfontein shows more primitive teeth than any other species of the genus, and if such a late survival could occur in buffaloes in the south-west Cape Province, might it not also have occurred earlier in an alcelaphine lineage?

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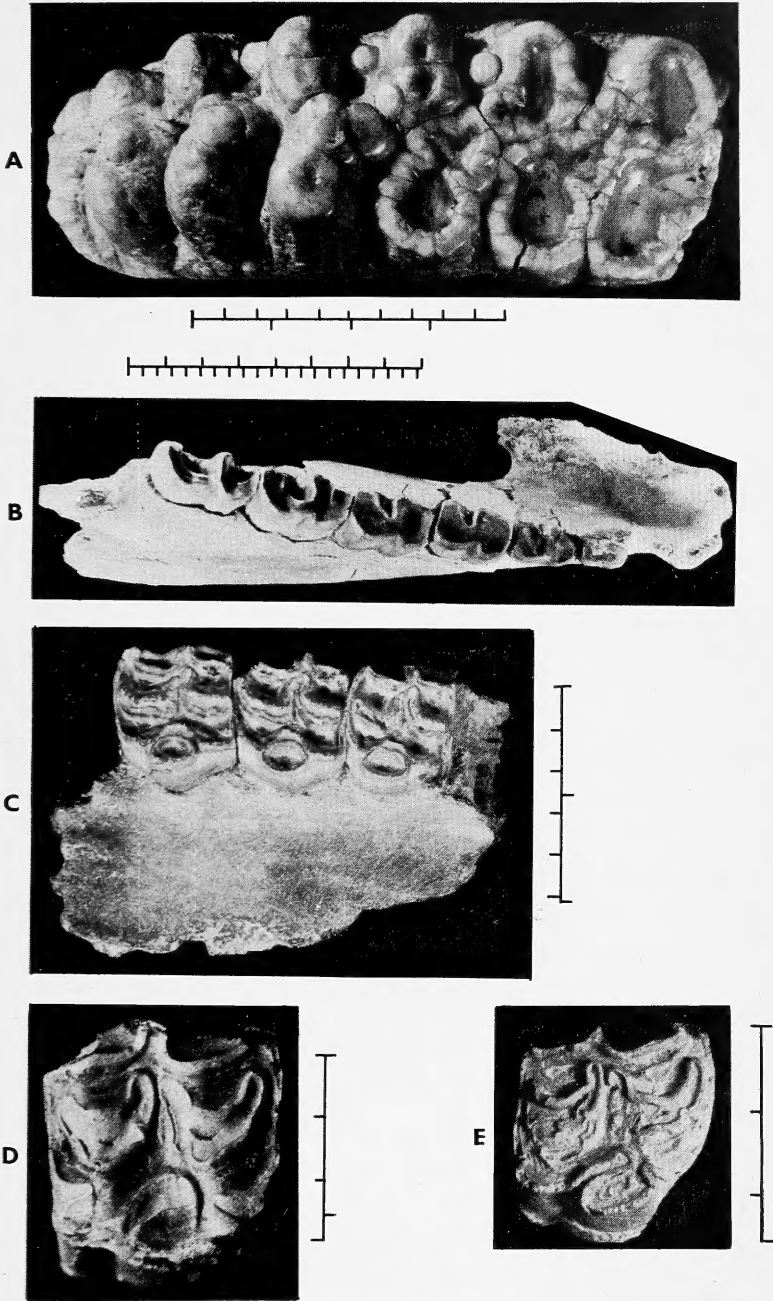
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A. Selachian teeth from the marine biostratigraphic zone (basal gravel). B. Tachysurid spines from site No. 12 (approximately 1 m above basal gravel). C. Dasyatid spine (L 12157) (approximately 5 m above basal gravel). D. Spheniscid humerus (L 6510). E. Lacertid dentaries from site No. 12. F. Macroscelid mandible from site No. 12. G. Chrysochlorid mandible from site No. 12. H & I. Murid mandibles from site No. 12. J. Leporid mandible (L 10529/2).



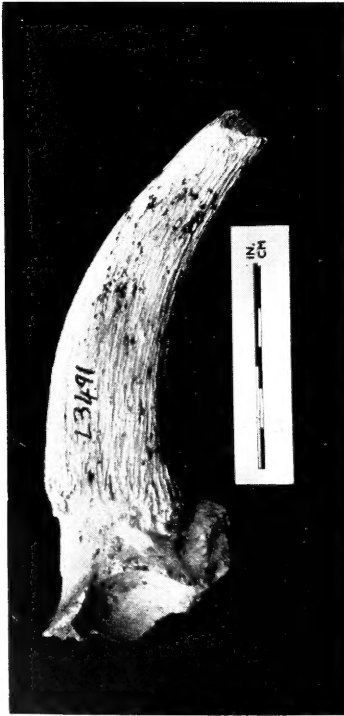
A & B. Buccal and occlusal views of hyaenid mandible (LBW 1966/1/11) (approximately 3.5 m above basal gravel). C. cf. *Machairodus* sp. upper canine (L 11846) (approximately 5 m above basal gravel). D. *Dinofelis* mandible (L 12237) (approximately 5 m above basal gravel). E. Mustelid mandible (L 6385).



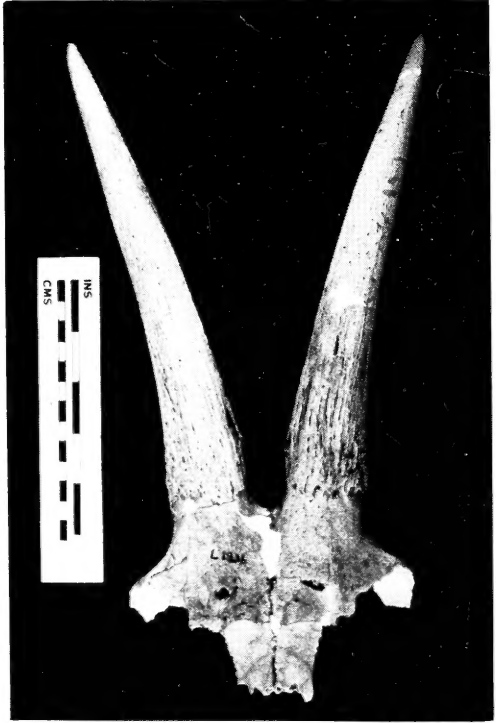
A. *Anancus* sp. molar (L 2557). B. *Diceros* aff. *bicornis* mandible (L 11849). C. *Hipparion albertense* molars (L 11751). D. *Equus* cf. *helmei* molar (L 2095). E. *Equus* sp. molar (L 5353).



A



B



C

A. Alcelaphine skull (L 7257). B. *Gazella* sp. horn core (L 3491). C. *Hippotragus* sp. horn cores and frontlet (L 1836).

INSTRUCTIONS TO AUTHORS

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Style manual for biological journals. Washington: American Institute of Biological Sciences.

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ZOOLOGICAL NOMENCLATURE

To be governed by the rulings of the latest *International code of zoological nomenclature* issued by the International Trust for Zoological Nomenclature (particularly articles 22 and 51). The Harvard system of reference to be used in the synonymy lists, with the full references incorporated in the list at the end of the article, and not given in contracted form in the synonymy list.

Example

Scalaria coronata Lamarck, 1816: pl. 451, figs 5 *a*, *b*; Liste: 11. Turton, 1932: 80.

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