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THE AGE OF THE FOSSILIFEROUS DEPOSITS AT LANGEBAANWEG, CAPE PROVINCE

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Q. B. Hendey

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(With 4 figures and 1 table)

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Contents

Introduction

The age of the deposits at Langebaanweg in the south-western Cape Province has long been a controversial matter (see Hendey, 1969, 1970). This has in part been due to the fact that the mammalian fauna differs from all the well-documented fossil faunas presently known in South Africa, and also because of inconclusive attempts to date the deposits geologically by relating them to past changes in sea-level.

It has been accepted that the deposits are either late Pliocene or early Pleistocene in age, and the tendency has been to emphasize the latter alternative (e.g. Boné & Singer, 1965: 280).

As a result of a recent excavation carried out in 'E' Quarry at Langebaanweg (fig. 1), and also as a result of additional observations on the geology and fauna in general, it has become necessary to reassess the age of the deposits.

The 'E' Quarry Deposits

The most recent interpretation of the geology of the 'E' Quarry deposits (Hendey, 1970 and fig. 2) requires reappraisal. The Varswater bed was thought to have been deposited during a single geological episode, whereas it was probably the result of at least four distinct periods of deposition (fig. 3).

The earliest visible deposit in the succession, termed horizon 1, is made up of light-coloured sand and silt, and appears to have been present everywhere in the quarry, except in areas R4 and S4. This horizon contained many of the fossils recovered from 'E' Quarry. A discontinuously developed deposit of

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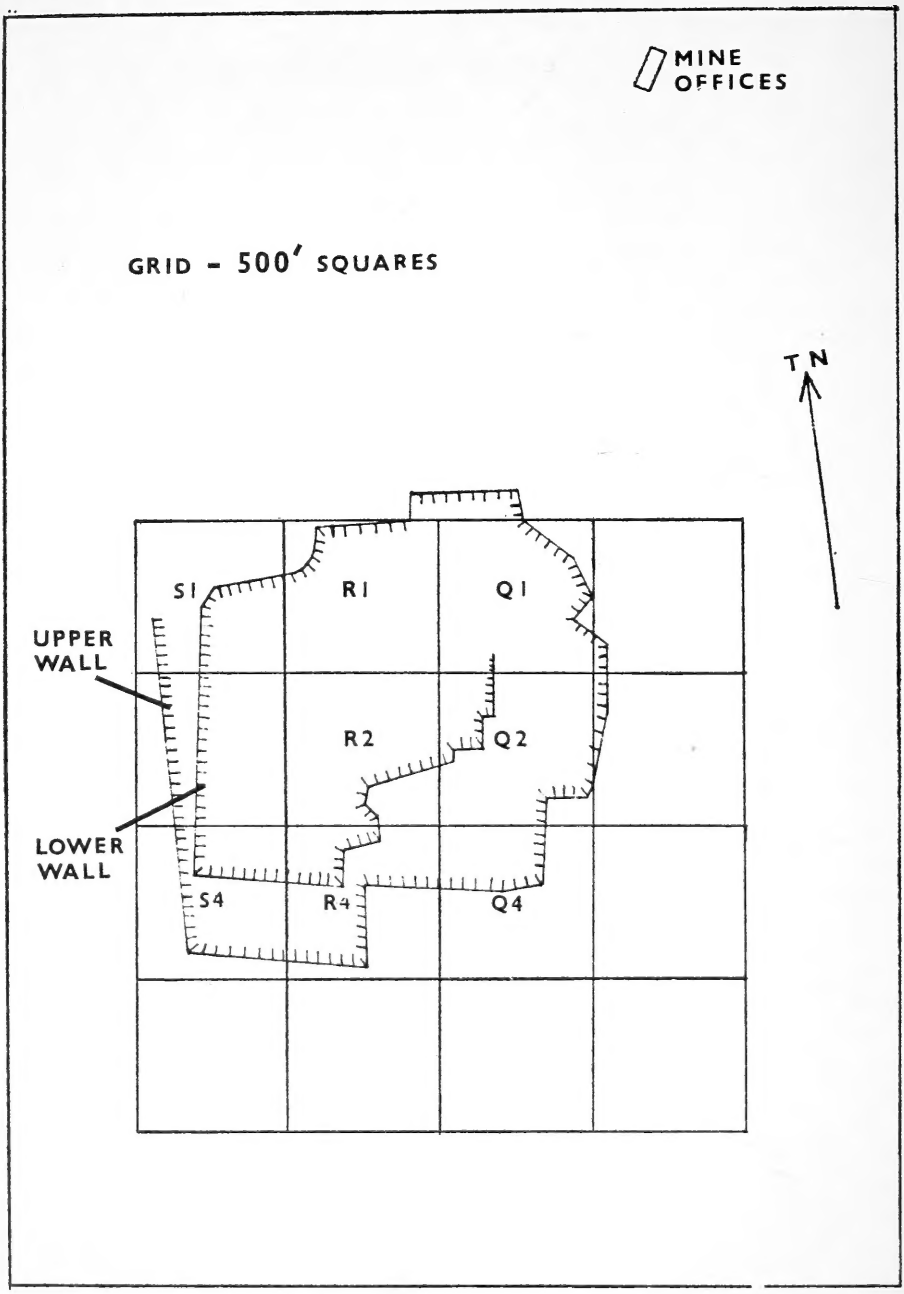

FIG. 1. 'E' Quarry, Langebaanweg (August, 1969).

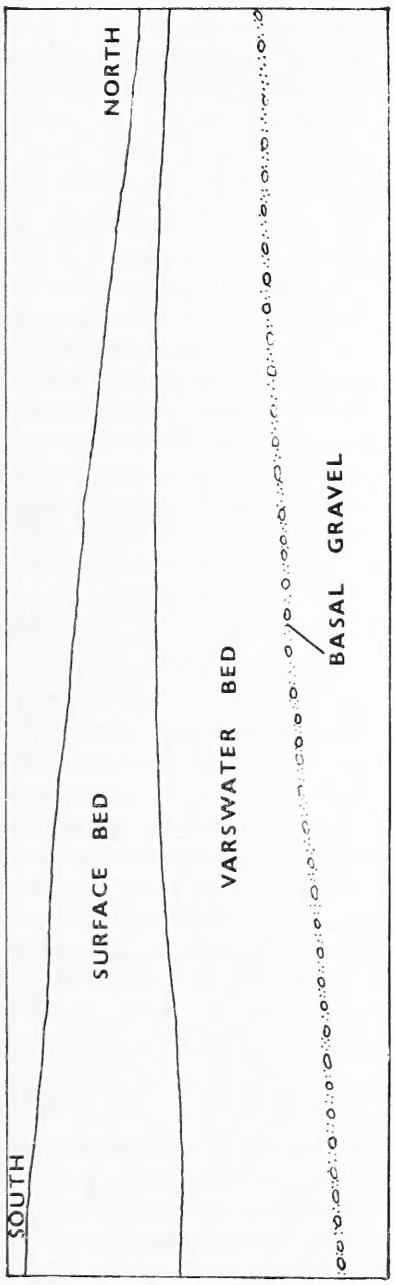

Fig. 2. Sketch section of west wall, 'E' Quarry. Original interpretation of stratigraphy.

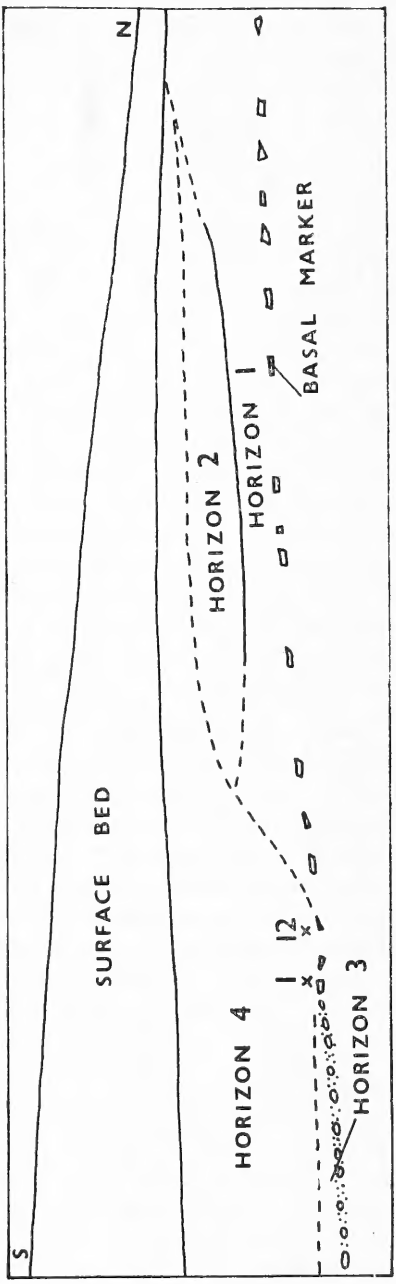

Fig. 3. Sketch section of west wall, 'E' Quarry. Revised interpretation of stratigraphy.

phosphate rock appears over parts of the quarry floor and marks the lower limit of horizon 1. It is referred to as the 'basal marker'. The presence of fish remains with those of terrestrial vertebrates suggests that horizon 1 was laid down under water, perhaps in an estuary or lagoon.

On the west wall of the quarry in areas S1 and S2 a second fossiliferous horizon (2) is distinguished. It overlies and clearly postdates horizon 1. It is readily distinguished from this horizon by its brownish colour which results from the presence of a fine silt fraction of that colour. The silt can readily be separated by flotation or washing. At the contact of horizons 1 and 2 is a rather indeterminate 'zone of mixing', which probably represents that part of horizon 1 which was disturbed during the deposition of 2. The eastern limit of horizon 2 is not known since this part is now completely mined away.

Some of the fossils in horizon 2 may be derived from 1, having been eroded out of the eastern and north-eastern parts of the latter horizon which stand at a slightly higher elevation. However, most of the fossils in 2 have apparently suffered little or no transport and it is thought that they are contemporaneous with the deposition of 2. The proportion of *in situ* to derived fossils is not known and may well be impossible to determine.

In areas R4 and S4 in the south-western corner of 'E' Quarry the phosphate rock of the basal marker horizon has a very different appearance from that elsewhere in the quarry. Large blocks of heavily abraded phosphate rock lie in a fine silt with occasional patches of coarser sand and grit filling interstices in the rocks. Together with the boulders are heavily rolled pebbles and cobbles of phosphate rock, marine fossils and occasional fragmentary terrestrial vertebrate remains. Most, if not all, of the latter are apparently derived from horizons 1 and 2. This deposit was previously referred to as the 'marine biostratigraphic zone' of the Varswater bed and was thought to underlie the whole of the 'E' Quarry floor (Hendey, 1970). It has a maximum observed elevation in 'E' Quarry of about 27 m, and is also recorded in boreholes to the south and south-west of this quarry and was intersected in the now mined-out 'C' Quarry. These gravels are referred to as horizon 3, and the 'E' Quarry exposures mark the upper limit of an ancient shoreline.

The upper parts of the Varswater bed on the west wall are lighter in colour than horizon 2 and appear to be completely sterile. A similarly sterile deposit overlies horizon 1 on the east wall. These two deposits are taken to comprise a single unit which is designated horizon 4, and which is thought to have been deposited sub-aerially. It extends also to the south wall and beyond. Here it is largely sterile except in those parts adjacent to horizons 1 and 2, from whence the fossils it contains may well have been derived. The only fossil occurrences of any note in this part of the deposit are those recorded as No. 1 and No. 12/1968 (Hendey, 1970) which are situated at or near the contact of horizons 3 and 4. The possible origin of these occurrences has been discussed in some detail (Hendey, 1970: 86) and to this must now be added the possibilities that either the fossils in question were concentrated above high

tide mark as sub-aerial erosion was under way on the exposed faces of horizons 1 and 2, or that they accumulated during the deposition of horizon 4.

The 'E' Quarry Fauna

Although the provenance of most of the fossils from 'E' Quarry is either unknown or uncertain (table 1), an examination of the material known to come from horizon 1 revealed the presence of the following species:

Viverrid—A large form tentatively referred to *Viverra leakeyi*, a species recorded from Laetolil (Petter, 1963). A set of upper cheek teeth from horizon 1 differs only slightly from those of the type specimen.

Hyaenid—A species of moderate size having several very primitive characteristics. Comparisons with casts of hyaenid mandibles from East Africa show that a specimen from horizon 1 is slightly more advanced than one from Lothagam.

Machairodont—Contrary to a statement made earlier (Hendey, 1969) the Langebaanweg machairodont is a primitive form. A recently discovered mandible fragment has a relatively large lower canine, a fairly prominent P_3 and a vestigial premolar anterior to the P_3. It suggests a Pliocene rather than Pleistocene date for horizon 1.

Elephant—The '*Stegolophodon*' from Langebaanweg (Singer & Hooijer, 1958) was considered by Aguirre (1969) to be a Pliocene species. It has now been referred to *Mammuthus*, and is regarded as being a primitive member of the species *subplanifrons* (Maglio & Hendey, in press). It is more advanced than *Primelephas gomphotheroides* from Lothagam, and is at a stage of development comparable to *Loxodonta adaurora* from Kanapoi.

Gomphothere—An imperfectly known species, but one which is not inconsistent with a Pliocene date (V. J. Maglio, pers. comm.).

Rhinoceros—The horizon 1 rhinoceros is a large form which has affinities with *Diceros bicornis*. It indicates either a late Pliocene or Pleistocene date.

Hipparion—Boné & Singer (1965) concluded a close relationship between the *Hipparion* from Langebaanweg and that from Laetolil.

Suid—The large pig from horizon 1 has been tentatively identified as *Nyanzachoerus*. This genus is known from Kaiso, Kanam, Kanapoi, Lothagam and occurs at Omo up to tuff B (V. J. Maglio, pers. comm.).

Giraffid—The horizon 1 sivathere could indicate either a Pliocene or Pleistocene date.

?*Tragocerus*—The Langebaanweg boselaphine has been compared inconclusively with *Protragocerus* and *Tragocerus* by Gentry (*in* Hendey, 1970). Both these genera are known only from Miocene and Pliocene deposits elsewhere in the world, and the presence of this species suggests a Pliocene rather than Pleistocene date.

Alcelaphine A—One of the Langebaanweg alcelaphines is a primitive and apparently previously unrecorded form. The teeth of this species are less advanced than those occurring in Olduvai Bed 1 and are in a similar

state of development to many of those from Laetolil (A. W. Gentry, pers. comm.).

?*Madoqua*—Another species which could fit a Plio/Pleistocene date.

To sum up, one species (the elephant) indicates an age approximately comparable to that of the Kanapoi fossils, one (the hyaenid) is slightly more advanced than a comparable Lothagam species, three (viverrid, *Hipparion* and alcelaphine) show similarities with species from Laetolil, while one (suid) is referred to a genus known only from Kaiso, Kanam, Kanapoi, Lothagam and Omo below tuff B. According to Maglio (1970) all the faunas from these East African localities are more than 2 million years old, and with the exception of an element in the Laetolil fauna, a date of 3–5 million years B.P. applies to them all. Three of the remaining forms (machairodont, gomphothere and ?*Tragocerus*) suggest a Pliocene rather than Pleistocene date, and three (rhinoceros, sivathere and ?*Madoqua*) could indicate either possibility. None of the twelve listed species positively precludes a late Pliocene date, while nine of the twelve actually suggest such a date.

A similar analysis of the fauna from horizon 2 is not yet possible owing to the uncertainty as to which fossils in this horizon are *in situ* and which are derived from horizon 1. It is clear that the composition of the faunas of the two horizons differs. For example, *in situ* specimens of larger species such as the proboscideans and rhinoceros are known only from horizon 1.

On the basis of their condition some of the hyaenid remains from horizon 2 are thought to be *in situ*, and this species does differ from the horizon 1 hyaenid. However, both forms retain P_1, M_2 and M^2, and in this respect they are equally primitive. If the two forms did not live contemporaneously, it is possible that the horizon 2 form is a derivative of that from horizon 1. The degree of difference between the two suggests a temporal separation of no great magnitude.

Although not yet studied in detail, apparently *in situ* pinniped remains from horizons 1 and 2 are indistinguishable in all important characteristics.

On these admittedly slender grounds it is concluded that horizons 1 and 2 are broadly contemporaneous.

The presence of *Equus* in the 'E' Quarry assemblage was the most important single factor governing the earlier suggestion that the fauna was Pleistocene in age. The small *Equus* species listed previously and which is known to come from horizon 1, is now thought to be an incorrect identification of *Hipparion* deciduous teeth. The large species, which is still accepted as *Equus*, is known from 'E' Quarry by a single cheektooth of unknown provenance.

Also recorded from 'E' Quarry is a large kudu, which is tentatively referred to *Tragelaphus strepsiceros grandis* by Gentry (*in* Hendey, 1970). On the basis of their physical appearance the only known specimens of this species appear to come from horizon 1.

The presence of these two supposedly Pleistocene forms is a problem. On balance the palaeontological evidence strongly suggests a late Pliocene date for

horizons 1 and 2. The difficulties still evident may yet be resolved as more and better specimens of known provenance become available. The earlier suggestion that a relict fauna supplemented by a few advanced immigrant forms is represented at Langebaanweg (Hendey, 1969, 1970) has seemed increasingly improbable since it is difficult to conceive of so many species retaining primitive characteristics for perhaps 3–4 million years. Since none of the species from Langebaanweg which have so far been studied has proved to be identical in all respects with East African species, the question of temporal and zoogeographic relationships still requires further consideration.

The Langebaanweg mammalian fauna is, on the whole, still only poorly known, but apart from a small assemblage of fossils from Kleinzee on the Cape west coast (Stromer, 1931*a*, 1931*b*; Patterson, 1965; Ewer, 1967) it is the only one presently known in South Africa which can be assigned to the Pliocene with any degree of confidence.

TABLE 1. The mammalian fauna of 'E' Quarry, Langebaanweg (April, 1970)

	Horizon 1	Horizon 2[1]	Sites Nos 1 & 12/1968[2]	Horizon unknown or uncertain
Macroscelididae				
Elephantulus sp.		×	×	
Soricidae				
cf. *Suncus* sp.			×	
Incertae sedis		×	×	
Chrysochloridae				
cf. *Chrysochloris* sp.	×	×	×	
Canidae				
Incertae sedis				×
Ursidae				
Incertae sedis		×		×
Mustelidae				
Incertae sedis				×
Enhydriodon africanus				×
Viverridae				
Incertae sedis	×			
Incertae sedis			×	
Viverra cf. *leakeyi*	×			
Hyaenidae				
Incertae sedis	×			
Incertae sedis		×		
Felidae				
Felis aff. *caracal*				×
cf. *Machairodus* sp.	×	×		
Dinofelis sp.		×		×
Incertae sedis		×		
Phocidae				
Incertae sedis	×	×		×
Orycteropodidae				
Orycteropus sp.				×
Gomphotheriidae				
Incertae sedis	×			

	Horizon 1	Horizon 2[1]	Sites Nos 1 & 12/1968[2]	Horizon unknown or uncertain
Elephantidae				
Mammuthus subplanifrons	×			
Rhinocerotidae				
Diceros aff. *bicornis*	×			×
Equidae				
Hipparion albertense baardi	×	×		×
Equus cf. *helmei*				×
Suidae				
cf. *Nyanzachoerus* sp.	×			
Incertae sedis		×		
Giraffidae				
Libytherium olduvaiense	×	×		×
Giraffa cf. *gracilis*				×
Bovidae				
Tragelaphus aff. *angasi*				×
T. strepsiceros aff. *grandis*				×
Bovini *incertae sedis*				×
? *Tragocerus* sp.	×			×
Hippotragus sp.				×
Alcelaphini *incertae sedis* (species A)	×			
? *Parmularius angusticornis* (species B)				×
cf. *Madoqua* sp.	×			
Leporidae				
Incertae sedis	×	×	×	×
Bathyergidae				
Incertae sedis		×	×	×
Muridae				
Incertae sedis (several species)	×	×	×	×

[1] Including both *in situ* and derived fossils.

[2] The relationship of the fossils from these sites to horizons 1–4 is uncertain.

Note: When a form is listed in more than one column it does not necessarily indicate that a single species is represented. Some unclassified Carnivora, Bovidae and Cetacea are not listed.

The Geological History of the Varswater Bed

In view of the suggested Pliocene date for horizons 1 and 2 it is necessary that the earlier interpretation of the geological history of the deposits be re-examined.

Pliocene marine phosphatic siltstones have been reported by Carrington & Kensley (1969: 191) on the Namaqualand coast north of Langebaanweg. Details of these occurrences are to be published later, but Carrington (pers. comm.) states that they are overlain by sediments which occur discontinuously up to an elevation of about 36 m, and which have everywhere been truncated by the higher marine transgressions of the Pleistocene. These deposits are not listed in the succession given by Carrington & Kensley (1969), but occur between the 'Pliocene' and 'basal Pleistocene' elements of their succession

(Carrington, pers. comm.). A 'late Pliocene' age for these deposits might therefore be inferred.

The Kleinzee fossils came from a fluviatile sandstone at an elevation of 35 m (Stromer, 1931*a*), while horizons 1 and 2 at Langebaanweg occur at an elevation of 30–35 m. Both these occurrences were thought to be related to the 45–50 m Pleistocene transgression (Hendey, 1970), but on altimetric evidence alone they could as well belong with equivalents of the 'late Pliocene' deposits encountered by Carrington. It is perhaps significant that the basal marker of the Varswater bed is phosphatic, and it could well be the local equivalent of the Pliocene phosphatic siltstones of Namaqualand. Horizons 1 and 2 thus agree with the 'late Pliocene' deposits of Namaqualand in both elevation and their position relative to a phosphatic horizon.

If it is accepted that the Langebaanweg deposits are indeed late Pliocene, the main problem which arises is to explain how these largely unconsolidated deposits managed to survive erosion by at least two marine transgressions during the earlier part of the Pleistocene. This may well have been the result of their position relative to a north-south row of hills whose directional axis passes through 'E' Quarry. The unconsolidated sands which form the present hills are likely to be resting on outliers of the Saldanha–Langebaan pluton of Precambrian Cape granite (see Haughton, 1969: 307, 308). Exposures of this pluton are in two groups, one stretching between the town of Saldanha and St. Helena Bay to the west of Langebaanweg, and the second centred on the town of Langebaan which is south of Langebaanweg. The north-south ridge of hills is a northward extension of the latter group (fig. 4).

'E' Quarry is situated immediately north of one of these hills, Anyskop, while another, Die Kop, lies 8 km further north. The third hill in the series, Kleinberg, lies 3·5 km south of Anyskop. These hills are more or less equidistant from the eastern edges of the Saldanha/St. Helena Bay granite outcrops. During the 45–50 m and 75–90 m Pleistocene marine transgressions the sea must have invaded the area between the Langebaan and Saldanha/St. Helena Bay granite masses from both the north and the south. The present topography suggests that by the time that inundation of horizons 1 and 2 took place there was either no link up of the marine incursion from the north with that from the south, or else this link up had only just occurred. This would have depended on the nature of the area between Die Kop and the most easterly exposures of the Saldanha/St. Helena Bay granite mass at the times in question. Today these two features are about 6·5 km apart and are separated by a valley which is slightly below 30 m in elevation in its lowest parts. The elevation of Die Kop today is about 125 m, while that of the nearest hill in the Saldanha/St. Helena Bay series is 180 m. If the floor of the valley between these features was only 10 m higher than it is today at the onset of the two earlier Pleistocene transgressions then the link up of the northern and southern coastlines would not have occurred until after inundation of deposits in the 'E' Quarry area had taken place.

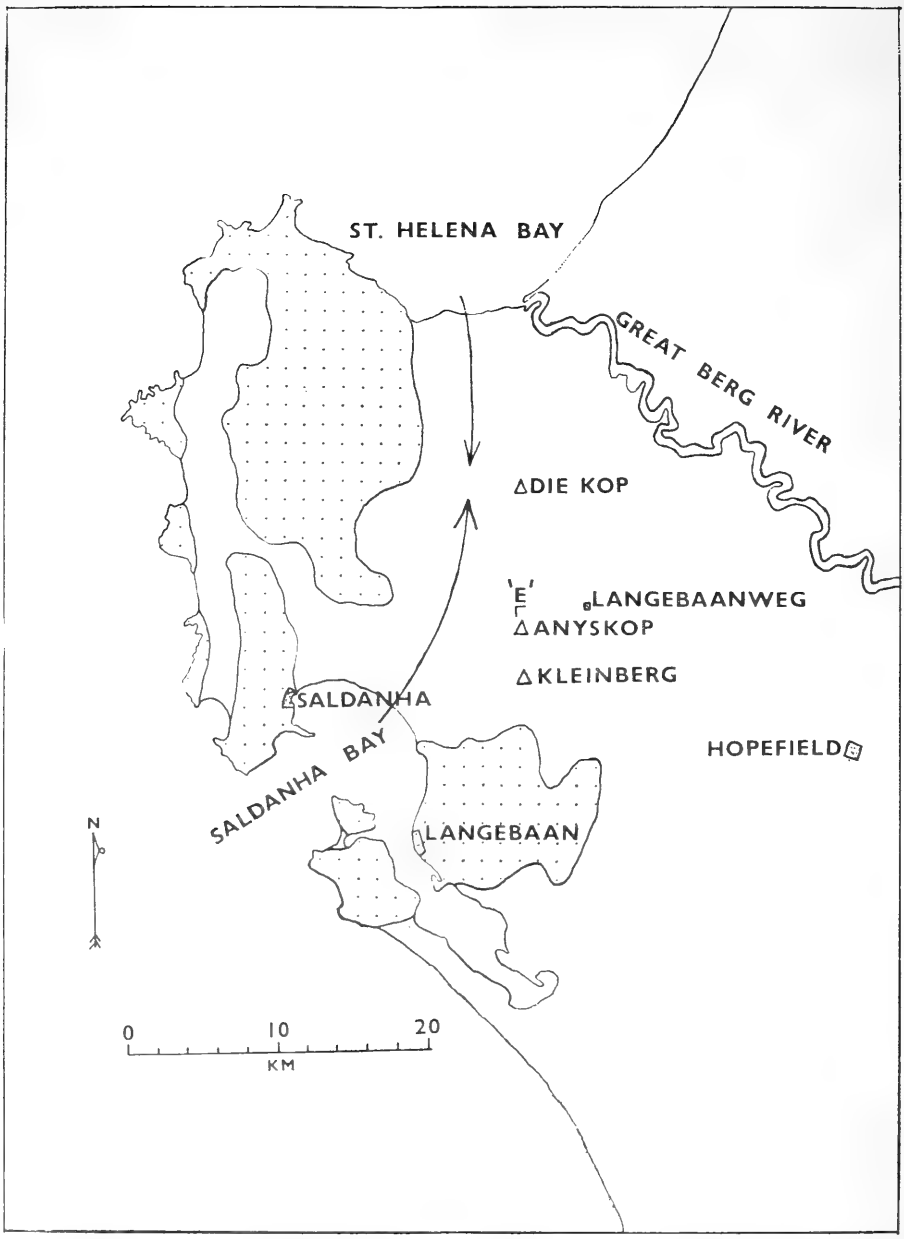

FIG. 4. Sketch map of the Langebaanweg area. Stippled areas show approximate positions of granite outcrops. Arrows indicate directions of early Pleistocene marine inundations affecting the 'E' Quarry area.

Before such a link up these deposits would have been situated near the north-eastern corner of a bay, whereas afterwards they would have been situated on the eastern shore of a narrow channel and have been sheltered from the open sea by islands formed by the Saldanha/St. Helena Bay granite outcrops. Either way the 'E' Quarry Pliocene deposits would not have been subjected to the same degree of marine erosion as would be encountered on a completely exposed coastline.

Furthermore, the position of Anyskop relative to the deposits suggests that it too would have afforded them some protection, lying as they were in the lee of this hill as the sea encroached from the south, or as the northward moving Benguella current swept through the channel.

The configuration of the present coastline in the Saldanha area is still largely determined by the outcrops of Cape granite. The sheltered conditions which exist in Saldanha Bay and its southward extension, Langebaan lagoon, are an indication of what conditions must have prevailed if the 'E' Quarry deposits were inundated in an embayment. Even on the present open coastline unconsolidated deposits between granite outcrops are afforded considerable protection.

If the preceding interpretation of the history of the deposits is correct then it follows that all traces of deposition resulting from the 45–50 m and 75–90 m transgressions have now been lost in the Langebaanweg area.

During the next in the series of Pleistocene transgressions the 'E' Quarry Pliocene deposits were not inundated since this transgression peaked at about 27 m. However, some truncation of the deposits in the south-western corner of the quarry occurred, and at the same time deposition of horizon 3 took place.

Horizon 4 was probably the result of sub-aerial redistribution of sands over horizons 1, 2 and 3 during the period immediately following the 27 m transgression. They have a maximum recorded elevation of about 50 m, which led to the earlier conclusion that the Varswater bed was laid down during the 45–50 m Pleistocene marine transgression.

It is perhaps of interest to note that if the fossils recovered at sites No. 1 and No. 12/1968 prove to be contemporaneous with the deposition of horizons 3 or 4, the possibility of a hominid role in the origin of these bone accumulations becomes less remote. The 27 m transgression has been correlated with the Holstein interglacial (Hendey, 1970: table 3), and the presence of a tool-making fire-using hominid at this time or slightly later is quite within the bounds of possibility.

The sands of the surface bed which overlie the Varswater bed and which form the existing Anyskop were probably laid down late in the Pleistocene or in the Holocene at a time, or times when there was no adequate vegetation cover in the area. Anyskop must be a little to the north-west of its granite core since it would have its maximum development in the lee of the prevailing summer south-easterly winds.

Conclusion

The subdivision of the Varswater bed may be summarized as follows:

Horizon 1—A late Pliocene estuarine or lagoonal deposit containing terrestrial vertebrate fossils and some remains of aquatic animals.

Horizon 2—A late Pliocene estuarine or lagoonal deposit apparently containing some fossils derived from 1. *In situ* fossils include both terrestrial and aquatic forms.

Horizon 3—A mid-Pleistocene marine deposit with fossils. No known *in situ* fossils of terrestrial vertebrates, although some specimens derived from 1 and 2 do occur.

Horizon 4—A largely sterile deposit laid down sub-aerially during the Pleistocene. Of the fossils which do occur some might be derived from 1 and 2 and some might be *in situ*.

In suggesting a late Pliocene date for horizons 1 and 2 and a Pleistocene date for 3 and 4 some of the problems connected with the Langebaanweg fossil occurrences are resolved. Nevertheless much research must still be done on both the fossils and deposits in order that a more precise evaluation of their age may be made.

Of immediate importance is the fact that the often repeated suggestion that the Langebaanweg mammalian fauna predates those from the South African australopithecine breccias (e.g. Wells, 1969: 95) can now be accepted with less reservation. It would now be possible to take the fauna from this locality as characterizing an additional subdivision in the late Tertiary and Quaternary faunal succession currently applied in South Africa (see Cooke, 1967: table 1).

In addition to the importance of the Langebaanweg fauna in South African palaeontological studies, it should, when compared with faunas from East African Pliocene localities, have an important bearing in determining some aspects of the dispersal of mammals in sub-Saharan Africa in late Tertiary times.

Summary

An account is given of the fauna and deposits of the Varswater bed at Langebaanweg. It is concluded that the mammalian fossils from this locality are largely confined to two horizons, which are designated 1 and 2, and which are late Pliocene in age. The remainder of the Varswater bed is made up of horizon 3, a Pleistocene deposit containing marine fossils, and horizon 4, an apparently sterile deposit which was laid down sub-aerially.

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To be typewritten, double spaced, with good margins, arranged in the following order: (1) Heading, consisting of informative but brief title, name(s) of author(s), address(es) of author(s), number of illustrations (plates, figures, enumerated maps and tables) in the article. (2) Contents. (3) The main text, divided into principal divisions with major headings; subheadings to be used sparingly and enumeration of headings to be avoided. (4) Summary. (5) Acknowledgements. (6) References, as below. (7) Key to lettering of figures. (8) Explanation to plates.

ILLUSTRATIONS

To be reducible to 12 cm × 18 cm (19 cm including caption). A metric scale to appear with all photographs.

REFERENCES

Harvard system (name and year) to be used: author's name and year of publication given in text; full references at the end of the article, arranged alphabetically by names, chronologically within each name, with suffixes *a*, *b*, etc. to the year for more than one paper by the same author in that year.

For books give title in italics, edition, volume number, place of publication, publisher.

For journal articles give title of article, title of journal in italics (abbreviated according to the *World list of scientific periodicals*. 4th ed. London: Butterworths, 1963), series in parentheses, volume number, part number (only if independently paged) in parentheses, pagination.

Examples (note capitalization and punctuation)

BULLOUGH, W. S. 1960. *Practical invertebrate anatomy*. 2nd ed. London: Macmillan.

FISCHER, P.-H. 1948. Données sur la résistance et de le vitalité des mollusques. *J. Conch., Paris* **88:** 100–140.

FISCHER, P.-H., DUVAL, M. & RAFFY, A. 1933. Etudes sur les échanges respiratoires des littorines. *Archs Zool. exp. gén.* **74:** 627–634.

KOHN, A. J. 1960*a*. Ecological notes on *Conus* (Mollusca: Gastropoda) in the Trincomalee region of Ceylon. *Ann. Mag. nat. Hist.* (13) **2:** 309–320.

KOHN, A. J. 1960*b*. Spawning behaviour, egg masses and larval development in *Conus* from the Indian Ocean. *Bull. Bingham oceanogr. Coll.* **17** (4): 1–51.

THIELE, J. 1910. Mollusca: B. Polyplacophora, Gastropoda marina, Bivalvia. *In* SCHULTZE, L. *Zoologische und anthropologische Ergebnisse einer Forschungsreise im westlichen und zentralen Süd-Afrika*. **4:** 269–270. Jena: Fischer. *Denkschr. med-naturw. Ges. Jena* **16:** 269–270.

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.