South African Museum

Archaeological and Palaeontological Survey: Milnerton Lagoon Mouth (3318CD)

November, 1995

G. Avery

Table of Contents

Introduction

Participants

The South African Museum was commissioned by Knight Hall Hendry & Associates on behalf of the Milnerton Municipality to conduct an assessment of the report on the archaeological survey of the area south of the Milnerton Lagoon mouth (Kaplan 1995) and to undertake an assessment of the palaeontological potential of the same area.

Acknowledgements

Dr. John Rogers, Geological Sciences, University of Cape Town kindly provided details of theses referred to below and commented on sampling needs to characterize the sedimentary and palaeontological history of the area.

Objectives & Method

The objective was twofold. Firstly to comment on the archaeological report submitted by J. Kaplan, Agency for Cultural Resource Management and, secondly to provide information on the palaeontological potential of the area and to recommend ways to mitigate possible impacts on this that could result from the proposed development.

Existing records at the South African Museum were examined. A ground survey was conducted by traversing the area on foot.

Background to the Nature and Importance of Cultural Resources

For the reader's convenience, brief background information on the nature and importance of cultural resources, which include pre-colonial and colonial archaeological sites and palaeontological sites, is provided in Appendix A.

Archaeological Survey of the Milnerton Lagoon Mouth Area

Kaplan Report

Comment on Shell Middens

It is confirmed that much of the area immediately to the south of the levelled parking area is covered with a generally disturbed scatter of shell midden material, and that better-preserved midden material might exist under covering sand.

The main importance of the middens at the Milnerton lagoon mouth is the fact that they have never been sampled. They relate to an important time in our history, and even the remnants are therefore valuable and should be adequately sampled to create an archive for future research.

Erosion of the present primary dune hummocks by the sea and wind has cut profiles which reveal that the shell middens are capped by recent dune material that is younger than 2000 years old (pottery is present) and may be as recent as the period of contact with early sailors and settlers. The middens occur on a darkish soil horizon of variable thickness that contains numerous root casts and rests on a hard calcareous surface that is exposed at sea level. Pieces of rolled calcrete occur on the beach and extend onto this surface, onto which they may, however, have been transported during storms. Between the hummocks and Otto Du Plessis Drive, a pan-like depression appears to form the eastern boundary of the middens.

Many of the shale artefacts have been weathered, but preservation of some bone is good, suggesting that some deflation is recent or ongoing and that sampling of *in situ* remnant material would, therefore, be worthwhile. Sampling of *in situ* material would be important, since the use of the area for recreational purposes has led to a mixture of archaeological and modern remnants.

Two, possibly three, concentrations of shale and calcrete fragments, many of them burnt or shattered by burning, may represent deflated stone hearths.

Visibility is difficult due to vegetation and dune cover, but *in situ* lenses of shells are eroding from at least one dune hummock. Sparse shell midden material is visible in mounds of sub-surface sediment left by Cape dune molerats, but it is not known at this stage whether sub-surface midden deposits of any substance exist, since it is not possible to establish actual densities with a surface survey. My impression is that the more-concentrated midden material is associated with the dune hummocks, but this needs testing. It should also be noted that the areas covered by campsites and human activity extended beyond the middens.

It is important to note that midden material may be preserved under the fill of the parking area to the north. This should be borne in mind when any excavation is undertaken during development activities.

If testing reveals *in situ* shell midden deposit, adequate sampling and/or excavation will be necessary to mitigate. Kaplan does not make the point strongly enough that a permit from the National Monuments Council will be necessary before any shell midden can be damaged or destroyed.

A number of Khoisan burials have already been recovered, by GA, from the mitten areas described by Kaplan and it is possible that more will come to light during any development activity that disturbs the surface. All human remains should be treated with sensitivity and it should also be noted that the above remains included unusually well-preserved items of ornamentation (beadwork) and a toolkit that required special treatment to ensure their preservation.

Comment on Early Stone Age and Fossil Material

The origin of the Early Stone Age handaxes on the beach near the lagoon mouth and near the wreck of the Oosterland has not been established with any certainty. Possible association with palaeontological material will be discussed below.

Although numerous root casts were observed, no fossil bones were noted in the calcrete by this writer, although it must be borne in mind that tides and wind are constantly changing the exposures.

Comment on Shipwrecks

Although the possibility exists, if the original coastline is preserved at the southernmost part of the proposed development area, I am not convinced that burials from the wreck of the Oosterland will be found. Although it is impossible to be sure, the fact that the coastline has apparently been shifted some 80-90 m inland, in the vicinity of the shell midden sites, since the building of Cape Town harbour (Grindley and Dudley 1988) probably precludes this.

Conclusions

1) Later Stone Age shell midden scatters occur on a large part of the proposed development area. These have never been sampled and this should be done if development proceeds.

2) A National Monuments Council permit will be required to destroy shell middens. There is, however, no archaeological reason why the development should not take place if the recommendations of Kaplan and this report are carried out.

3) Although the area has been carefully examined, it is not possible to guarantee that important sub-surface occurrences do not exist. The possibility that this is the case must be tested for before any destructive action is taken. The possibility that middens will be revealed by excavations into the parking area for foundations should be noted.

4) The main *in situ* midden remnant should be excavated and collected if adequate material exists for sampling.

Recommendations

1) Once planners have established the distribution of plots and infra-structure, it will be possible for an archaeologist to focus on specific areas to test for shell midden material that might be preserved under the surface. This applies to sampling and/or testing of *in situ* material preserved by the dune hummock and of the area between the hummocks and the “pan”, particularly towards the north.

2) Funds must be available for an archaeologist to test for and, if necessary, to excavate any occurrences of importance that might come to light during the testing operation noted in recommendation 1. All samples must be maintained as an archive in an appropriate institution (see recommendation 5).

3) During the course of the development, an archaeologist should be contracted to monitor all excavations required by construction, laying of services, roads, borrow pits, etc. It is assumed that, if the first two recommendations are carried out, the discovery of ‘new’ middens will be highly unlikely. It is particularly important in this context, however, that any human burials or isolated archaeological feature be carefully excavated by an archaeologist and sensitively treated. The costs of any such additional archaeological work should be covered by a contingency fund.

4) A National Monuments Council permit to destroy shell middens must be applied for before any work commences on site.

5) Negotiations should be initiated with an appropriate institution (museum) to house and maintain the archive.

Palaeontological Survey of the Milnerton Lagoon Mouth area

Introduction

For decades, the mouth of the Milnerton Lagoon has yielded fossil bones, which have been washed up. More recently, some whale bones and an unrolled handaxe have been found on the sea bed by divers working on the wreck of the Oosterland, some 200 m offshore (B. Werz, University of Cape Town, pers. comm.). It has not, however, been established from which marine or terrestrial deposits the fossils or artefacts originate.

Although the South African Museum has specimens in its collections, coverage of smaller marine and all terrestrial elements is poor. The occurrence of early stone artefacts, possibly associated with faunal material, is of importance, particularly if the sediments from which they originated can be located.

Preserved on this region of the coast, are a number of important fossil occurrences, most of which have not been adequately studied (Tankard 1975; Rogers 1982; Kensley 1985; Olson 1985; Grindley et al. 1988). It is also important to note, particularly in the vicinity of Milnerton, that the character of the present coastline and sediment drift is seasonally variable and that the position of the coast has been subjected to significant inland-movement since the development of Cape Town's harbour facilities (Woodborne 1982, 1983; Grindley and Dudley 1988; McLachlan 1991).

Kensley (1985), Grindley et al. (1988) and Grindley and Dudley (1988) also outline the Late Pleistocene and Holocene history of Rietvlei with regard to the effects of sea level change on the Diep River estuary and Rietvlei. It is important to note that the present location of the lagoon mouth is relatively recent and achieved by the 1840s. Prior to this the river flowed south behind the dunes and entered the sea near the Salt River. This is of great importance, since the earlier sediments between the two mouths are unlikely to have been scoured (J. Rogers, University of Cape Town, pers. comm.).

Palaeontological Survey

Calcareous Beach Deposits

Current sea level is eroding a hard calcareous platform at the base of the primary dunes that extends more or less continuously from the filled-and-levelled parking area (underlies concrete slabs) to the southern extent of the dune hummocks. The surface of this deposit is crossed by root casts related to the overlying soil horizon. It is also possible, judging by the occurrence of small molluscs in this and in molerat mounds fringing the "pan", that the hard calcareous surface on the beach extends under the dune hummocks and forms

the surface of the “pan”. During high seas the hummocks are breached by the sea at two points that link it with the “pan”.

At the southern extent sediments include lenses and isolated individuals of marine molluscs, including *Donax serra* (white mussel), *Lutraria lutraria* (otter shell), *Choromytilus meridionalis* (black mussel), *Aulacomaya ater* (ribbed mussel), *Austromegabalanus cylindricus* (giant barnacle) and sparse shale and calcrete cobbles. From the northern inlet to the “pan”, the larger molluscs disappear and small gastropods, ?*Nodilittorina africana* (African periwinkle) and a turritellid gastropod, ?*Protomella capensis*, occur. These, and *Nassarius kraussianus* (tick shell) also occur in the sediments fringing the “pan”.

On the south bank of the Diep River estuary, near the northernmost parking area entrance, is an exposure of marine molluscs and cobbles, which is loosely cemented in a white calcareous matrix. This is located 1 m+ above the river. It was not possible to establish whether there is continuity between this occurrence and the abovementioned marine deposits. A noticeable difference is the greater concentration of cobbles, pebbles and molluscs. Species composition is also different, *Donax serra* (white mussel), *Lutraria lutraria* (otter shell), *Choromytilus meridionalis* (black mussel), *Aulacomaya ater* (ribbed mussel), *Venerupis corrugatus* (corrugated venus), *Patella miniata* (pink-rayed limpet), *Bullia laevissima* (fat plough shell), *Burnupena* sp. (whelk), *Crepidula* sp. (?extinct large slipper limpet) being present. A fragment of whale bone was seen.

These occurrences, which are not ferrugenized, are most probably of Late Pleistocene age. Kensley (1985) mentions the existence of the hard calcareous platform in his description of Late Pleistocene molluscs found in a deposit near the Milnerton lighthouse. He equates both deposits, although their composition differs significantly. The deposits have been referred to the Bredasdorp Formation. Salmon (1977) described a Pleistocene raised beach at Milnerton.

While they are exposed, these deposits need to be sampled.

Research Potential: High

Development constraint low (cost of sampling and establishing archive)

Sampling should be undertaken to create an archive for future research. Any profiles(walls of excavations) dug during the course of development activities should be logged and sampled with a view to resolving stratigraphic and chronological details and to enhance the existing archive for future research. The same should apply to any exploratory coring undertaken.

Last Interglacial Shell Deposit

About 30 m north of the outfall, a localized occurrence of Last Interglacial marine molluscs can be seen at the high water mark. It extends over some 15 m and is distinguished from the modern beach by the concentration of shells and shell fragments and the fact that some shells and fragments show signs of ferruginization. Among other species, a characteristic mollusc is a bivalve thought to be *Venerupis corrugatus* (corrugated venus). *Donax* sp. (wedge shell) also occurs.

This deposit needs to be sampled and its stratigraphic position resolved.

Research Potential: High

Development constraint low (cost of sampling and establishing archive)

Sampling should be undertaken to create an archive for future research. Any profiles(walls of excavations) dug during the course of development activities

should be logged and sampled with a view to resolving stratigraphic and chronological details and to enhance the existing archive for future research. The same should apply to any exploratory coring undertaken.

Fossil Bones and Early Stone Age Artefacts at the Lagoon Mouth

Fossils of Miocene and/or Pliocene age (12-3 million years), when the sea level was over 40 m above the present, have been recovered from the beach at the lagoon mouth. Tankard (1975) notes the existence of Miocene marine deposits with fossils near Ysterplaat, and submerged late Tertiary deposits at -10 m just off Milnerton, from which fossils derive. At the mouth of the Milnerton Lagoon J. Rogers (University of Cape Town, pers. comm.) cored through some 3 m of shelly marine deposit before striking bedrock. The fossils deposited on the beach at Milnerton Lagoon are mainly of whales, but include shark teeth and a small terrestrial element that includes a Gomphotherium (ancestral elephant). Equid and rhinoceros, may also fall within this time period.

Fossils probably of Pleistocene age (2 million to 10 000 years) include an elephant extinct in Africa (*Elephas* sp.), the extinct giant buffalo (*Pelorovis antiquus*), hippopotamus and antelope. The Early Stone Age handaxes of Pleistocene age (approx. 1 million to 200 000 years), most of which are rolled, may have been contemporary with some of the fossil material, in particular, the rolled *Elephas* sp. teeth.

The origin of the terrestrial elements is unknown. One might speculate that a pocket of gravel exists under the present land surface in the vicinity of the mouth, but it is possible, and perhaps more likely, that the gravels in which the fossils and artefacts occur are exposed sub-tidally and are thrown up on the beach during favourable weather conditions. Tankard (1975) mentioned the existence of a submerged deposit, but it is not clear whether this refers to the late Tertiary or Pleistocene material. Such material might be supplemented periodically by transport from estuarine or gravel deposits further inland during major flooding of the Diep River (Woodborne 1982, 1983). During the course of sediment mining of Rietvlei, it was noted (source unknown) that elephant tusks and other bones came to light. Palaeo-channels of the Diep River that exist in Rietvlei might provide a source.

At least some bones of antelope and the *Pelorovis antiquus* have calcareous matrix still attached. This may originate from a subtidal or sub-surface calcareous hard pan that is not currently visible, or as a facies of the calcareous beach deposits described above. Age is indeterminate, but *Pelorovis* is not known from deposits younger than 10 000 years old, however, by which time this buffalo had became extinct.

Research Potential: High

Development constraint low (cost of sampling and creating archive)

Any profiles(walls of excavations) dug during the course of development activities should be logged and sampled with a view to resolving stratigraphic and chronological details and to enhance the existing archive for future research. The same should apply to any exploratory coring undertaken.

Conclusions

1) Important palaeontological material is found in the area of proposed development. This includes palaeo-sediments that contain calcareous deposits with marine molluscs, and marine and terrestrial fossils that are washed up on the beach. Some of the fossil bones may be associated with Early Stone Age artefacts.

2) It is not possible to guarantee that important sub-surface occurrences do not exist. The possibility that this is the case must be tested for. The origins of the Miocene/Pliocene and Early/Middle Pleistocene fossil material is unknown but may exist, as yet undiscovered, in sediments preserved in the lagoon mouth area.

3) Existing samples are inadequate. Since these deposits will, as a result of the development, become inaccessible to science every effort must be made to enhance the status of existing samples of palaeontological material and their sedimentary contexts.

4) Palaeontological material is protected by provisions of the National Monuments Act (as amended).

Recommendations

1) An appropriate sedimentologist (suggest Dr. J. Rogers, UCT) should be consulted to assist engineers in planning the site investigation for foundations. This will be with a view to establishing a grid of cores of sufficient size, number and spacing that will not only provide data for the developer on the nature of the sediments (soft-hard-soft-hard sediments), which will have to be assessed geotechnically, but also on the on the sedimentological history of the area and the possible origin of the Miocene/Pliocene and Early/Middle Pleistocene fossil material. Spatial observations are important, since the existence of uneven sedimentary topography would enhance the potential for the preservation of pockets of fossiliferous material.

2) During the course of the development, an appropriately-qualified sedimentologist should be contracted to monitor all excavations required by construction, laying of services, roads, borrow pits, etc. Any profiles(walls of excavations) dug during the course of development activities should be logged and sampled where necessary to enhance the existing archive for future research.

3) The costs of sampling and the creation of an archive should be covered by a contingency fund.

4) Negotiations should be initiated with an appropriate institution (museum) to house and maintain the archive.

References

Grindley, J.R., Rogers, J., Woodborne, M.W. & Pether, J. 1988. Holocene evolution of Rietvlei, near Cape Town, deduced from the palaeoecology of some mid-Holocene estuarine Mollusca. *Palaeoecology of Africa* 19: 347-353.

Kaplan, J. 1995. *Archaeological Survey: Milnerton Lagoon Mouth Development*. Agency For Cultural Resource Management Report for Milnerton Lagoon Mouth Company. 7pp.

Kensley, B.F. 1985. The faunal deposits of a Late Pleistocene raised beach at Milnerton, Cape Province. *Annals of the South African Museum* 95: 111-122.

McLachlan, A.J. 1991. *Seasonal Beach Morphology Variation and Sediment Transport Around the Wreck of the Oosterland in Table Bay Between the Estuaries of the Diep and Salt Rivers*. Unpublished B.Sc. (Hons) Project, Dept Geological Sciences, University of Cape Town.

Olson, S.L. 1985. An Early Pliocene marine avifauna from Duinefontein, Cape Province, South Africa. *Annals of the South African Museum* 95: 147-164.

Rogers, J. 1982. Lithostratigraphy of Cenozoic sediments between Cape Town and Eland's Bay. *Palaeoecology of Africa* 15: 121-137.

Salmon, D.A. 1977. A new exposure of the Pleistocene raised beach deposit at Milnerton, Cape Province. *Report of the Geological Survey of South Africa*: 1-15 (unpubl.).

Tankard, A.J. 1975. The marine Neogene Saldanha Formation. *Transactions of the Geological Society of South Africa* 78: 257-264.

Woodborne, M.W. 1982. *Sediment Distribution and the Correlation Between Lithofacies and Associated Side-Scan-Sonar Signatures in Table Bay*. Unpublished B.Sc. (Hons) Project, Dept Geological Sciences, University of Cape Town.

Woodborne, M.W. 1983. Bathymetry, solid geology and Quaternary sedimentology of Table Bay. *Technical Report Joint Geological Survey/University of Cape Town Marine Geoscience Unit* 14: 266-277.

Appendix A: Cultural Resources

Introduction

In this context cultural resources include pre-colonial and colonial archaeological sites and remains and fossil and sub-fossil remains of previous biota

- they are important archives of cultural, natural and environmental information that is relevant to our knowledge of human social, economic and technological history, and the changing natural context in which it took place
- they can provide long-term records and understanding of the changing local and global conditions with which contemporary society must survive
- they are archives of past biodiversity
- together with their sedimentary contexts, they are finite and non-renewable cultural and scientific resources
- since preservation is by chance and variable, each site is unique
- unless disturbed archaeological and fossil sites are normally safely archived in the ground where they remain available for research
- archaeological and fossil occurrences deteriorate rapidly when disturbed or subjected to increased human pressure
- All pre-colonial archaeological sites as well as certain proclaimed cultural-historical sites and shipwrecks from a designated period are protected by the National Monuments Act, No. 28 of 1969 as amended. A permit from the National Monuments Council is required to destroy any occurrences covered by this legislation
- If destruction or disturbance is inevitable, cultural resources must be sampled adequately and archived in appropriate museum collections for future research (as per National Monuments Council and museum requirements).

The negative effects of development, construction and mining are obvious. It must also be remembered, however, that some important archaeological and fossil sites have been exposed during construction work. Provision should be made for the study of such discoveries, however, or their potential is nullified.

Dealing with cultural resources can be more cost effective if local authorities or developers

- undertake adequate forward planning and consultation with scientists competent to assess localities, advise on minimizing mitigatory work and to do any archaeological recovery that may be necessary
- allow full mitigation at time of development rather than opting for long-term maintenance and management controls to protect any cultural resources that remain after development.

The Importance of Archaeological Sites

The archaeological record provides the only information on the pre-colonial existence and activities of indigenous South Africans. Archaeological evidence also supplements the scanty documentary information which was recorded by the early explorers, travellers and colonists from 1488 onwards and the effects of colonization on indigenous peoples.

Archaeological information is gleaned from places where people lived and left remains of their equipment, huts, houses, fireplaces, food debris, elements of their spiritual lives and their dead. Sediments, pollens, old owl pellet accumulations, and other components of archaeological sites can

provide information on past environments and climatic conditions. This provides the context for understanding past human behaviour, but also provides long-term databases on natural fluctuations that are relevant, for instance, to modern studies relating to understanding the effects of global warming.

Types of Archaeological Sites and Chronology

The pre-colonial history of southern Africa is conventionally divided into three Stone Age periods, Early, Middle and Later, and the Iron Age, which relates to settlement by black African agriculturalists. Iron Age remains are not found in the western Cape. Sites relating to these periods can occur in many forms and states of preservation.

Early Stone Age (approximately 2 million to 200,000 years ago)

- usually represented only by stone artifacts and debris and very rarely with preserved bone
- sites mostly in the open, rarely in caves
- one of the most important Early Stone Age/fossil bone occurrences in Africa is in Middle to Late Pleistocene sands in the vicinity of Langebaan (Singer & Wymer 1968; Klein 1978)
- remains of *Homo erectus* and archaic *H. sapiens* occur
- with Early and Middle Stone Age occurrences, in particular, it is difficult to distinguish food debris from human activity from bones left by larger carnivores or scavengers (Avery 1988).

Middle Stone Age (200,000 to approximately 30,000 years ago)

- also usually represented only by stone artifacts and debris but are occasionally associated with fossilized shells and/or animal bones (Mabbutt *et al.* 1955; Klein 1976; Volman 1978)
- sites mostly in the open but they are known to occur in caves and rock shelters (Schweitzer 1970; Singer & Wymer 1982)
- remains of anatomically modern people, *Homo sapiens sapiens* like ourselves, occur from about 130 000 years ago
- sub-surface sites containing important information may be exposed during construction work.

Later Stone Age (approximately 30,000 to 300 years ago)

- more recent, therefore preservation is often good
- generally numerous because they are at or near the surface and therefore more visible
- they may occur in different forms:

Open Scatters of Artifacts, Bones, etc. Archaeological sites are only represented by remnants that have been able to withstand the ravages of time. Often the only clues to the existence of an archaeological site will be a scatter of stone artifacts, and sometimes potsherds, exposed on the surface or in an eroded gully. In exceptional cases, bones and shells might also be preserved. Such scatters can extend over a number of hectares.

Shell Middens. Shell middens are the commonest and most visible archaeological remnants on the coast. Shell middens are heaps of food and artifactual debris left by people (Robertshaw 1978, 1979; Schweitzer 1979; Parkington et al. 1988). They vary from less than one metre in area to over 0,5 hectare. In addition to marine shell, most middens contain bone, stone artifacts and ceramics. Their size and frequency are greatest near the shore, particularly in the vicinity of rocky intertidal zones. Features such as huts and fireplaces may occur near middens. Middens may extend almost continuously over long distances of coastline and over 10 km inland.

Tidal Fish Traps. Fish traps are artificial tidal pools constructed of boulders across gullies in the intertidal zone of rocky shores (Avery 1975). In the recent past some were rebuilt and used by local landowners. A number were destroyed during the construction of tidal swimming pools.

Burial Sites. Graves are often found in or near shell middens, but can be expected almost anywhere. They are sometimes marked by a cairn of rocks. Grave goods are rare. Details of burials must be carefully recorded since they can provide information on aspects of past behaviour which are not otherwise preserved. It is illegal for members of the public to keep human remains.

European Contact and Colonial Periods (from AD 1488)

- includes shipwrecks, survivors' camps, early and later dwellings and structures relating to colonial lifestyles and expansion
- effect of colonial activities on the indigenous peoples.

The Importance of Fossil Sites

Fossil and sub-fossil sites contain remains of marine, freshwater and terrestrial animals, molluscs and plants. Impressions of plant remains or traces of early animals, e.g. tracks, burrows or fossilized droppings, are also important signs of past life.

The oldest fossils in South Africa (algal cell and bacterium) are found in the eastern Transvaal Figtree cherts that are 3,2 billion years old. South Africa is also renowned for the mammal-like reptiles that are found in ±300 million year old Karoo rocks (Cluver 1991). Fossilized remains of many of the animal, mollusc and plant ancestors of our modern fauna and flora occur, for instance, at Langebaanweg in the western Cape (Hendey 1982). Fossilized remains of hominid or early human ancestors are found in association with other fossils in deposits dating to the past 3 million years. The Saldanha calvarium is the oldest human fossil in the western Cape at about 500 000. Remains of anatomically modern people go back about 130 000 years ago.

Evidence from fossils has provided valuable information on the origin of our modern continents and on past environments and climatic conditions. During the last 3 million years this is important as context for past human evolution and behaviour, but also provides long-term databases on natural fluctuations that are relevant, for instance, to modern studies relating to understanding the effects of global warming.

Site Visibility and Predictability of Site Location

Many archaeological and fossil sites are covered with sediment and vegetation. Not all surface sites are readily visible to the observer, since the density, height and type of natural vegetation can effectively mask their presence. Visibility of sites in eroding areas and dune fields is often good, since covering sediments have been removed.

Generally, archaeological sites are located at a convenient distance from available resources such as food or water or a source of raw material for the manufacture of artifacts. This distance, which can be up to 10 to 12 km or more, is also governed by such factors as the availability of shelter, prevailing wind, aspect or visibility.

However, since environments have changed over the millennia, the present-day availability of resources is not always a reliable guide to predicting the location of sites. Exceptions exist, but in the light of what is known about the distributions of sites it can be predicted with reasonable certainty that archaeological sites will be found near outcrops of intertidal rocks, in caves or rock shelters or where rocky outcrops provide shelter, in dune fields and wherever there are Middle and Upper Pleistocene calcretes and ferricretes.

Fossils occur in terrestrial, fluvial and marine sediments, where preservation is enhanced, in old rock formations and in cemented or loose sediments in volcanic craters, caves, limestone deposits and calcretes and in the open. Some occurrences become exposed on the surface, but others are covered by variable depths of rock or sediment. Borehole cores often provide important palaeontological and palynological (fossil pollen) material.

Pollens and macro-vegetation remains are likely to occur in waterlogged or clayey conditions where peat or lignites are encountered.

These factors should be borne in mind when contemplating development or mining.

References

Avery, G. 1975. Discussion on the age and use of tidal fish traps (visvyvers). *South African Archaeological Bulletin* **30**: 105-113.

Avery, G. 1988. Some features distinguishing various types of occurrences at Elandsfontein, Cape Province, South Africa. *Palaeoecology of Africa* **19**: 213-219.

Cluver, M.A. 1991. *Fossil Reptiles of the South African Karoo*. Cape Town: South African Museum.

Hendey, Q.B. 1982. *Langebaanweg a Record of Past Life*. Cape Town: South African Museum.

Klein, R.G. 1976. A preliminary report on the `Middle Stone Age' open-air site of Duinefontein. *South African Archaeological Bulletin* **31**: 12-20.

Klein, R.G. 1978. The fauna and overall interpretation of the 'Cutting 10' Acheulean site at Elandsfontein (Hopefield), southwestern Cape Province, South Africa. *Quaternary Research* **10**: 69-83.

Mabbutt, J.A., Rudner, I., Rudner, J. & Singer, R. 1955. Geomorphology, archaeology and anthropology from Bokbaai, Darling District, Cape Province. *South African Archaeological Bulletin* **10**: 85-93.

Parkington, J.E., Poggenpoel, C., Buchanan, B., Robey, T., Manhire, A. & Sealy, J. 1988. Holocene coastal settlement patterns in the western Cape. *In*: Bailey, G. & Parkington, J., eds. *The archaeology of prehistoric coastlines*: 22-41. Cambridge: Cambridge University Press.

Péringuey, L. 1911. The Stone Ages of South Africa. *Annals of the South African Museum* **8**: 1-218.

Robertshaw, P.T. 1978. Archaeological investigations at Langebaan Lagoon, Cape Province. *Palaeoecology of Africa* **10/11**: 139-148.

Robertshaw, P.T. 1979. Excavations at Duiker Island, Vredenburg District, Cape Province. *Annals of the Cape Provincial Museums (Human Sciences)* **1**(1): 1-26.

Rudner, J. 1968. Strandloper pottery from South and South West Africa. *Annals of the South African Museum* **49**(2): 441-663.

Schweitzer, F.R. 1970. A preliminary report of excavations of a cave at Die Kelders. *South African Archaeological Bulletin* **25**: 136-138.

Schweitzer, F.R. 1979. Excavations at Die Kelders, Cape Province, South Africa: the Holocene deposits. *Annals of the South African Museum* **78**: 101-233.

Singer, R., & Wymer, J. 1968. Archaeological investigations at Saldanha skull site in South Africa. *South African Archaeological Bulletin* **23**(91): 63-74.

Singer, R., & Wymer, J. 1982. *The Middle Stone Age at Klasies River Mouth in South Africa***.** Chicago: University of Chicago Press.

Volman, T.P. 1978. Early archaeological evidence for shellfish collecting. *Science* **201**: 911-913.