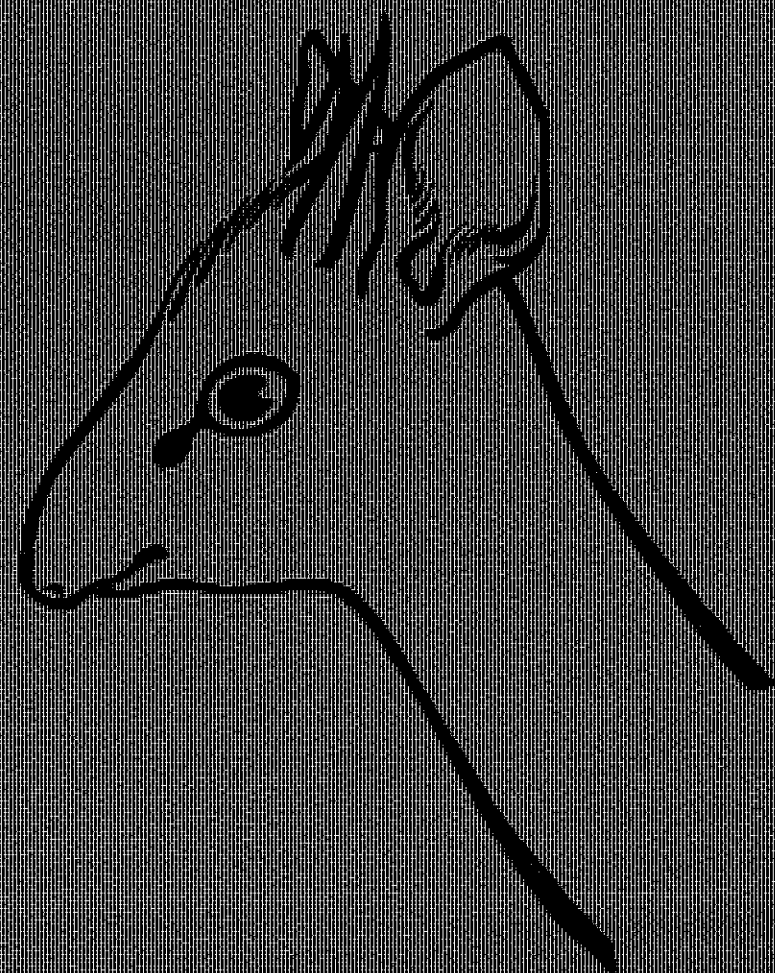


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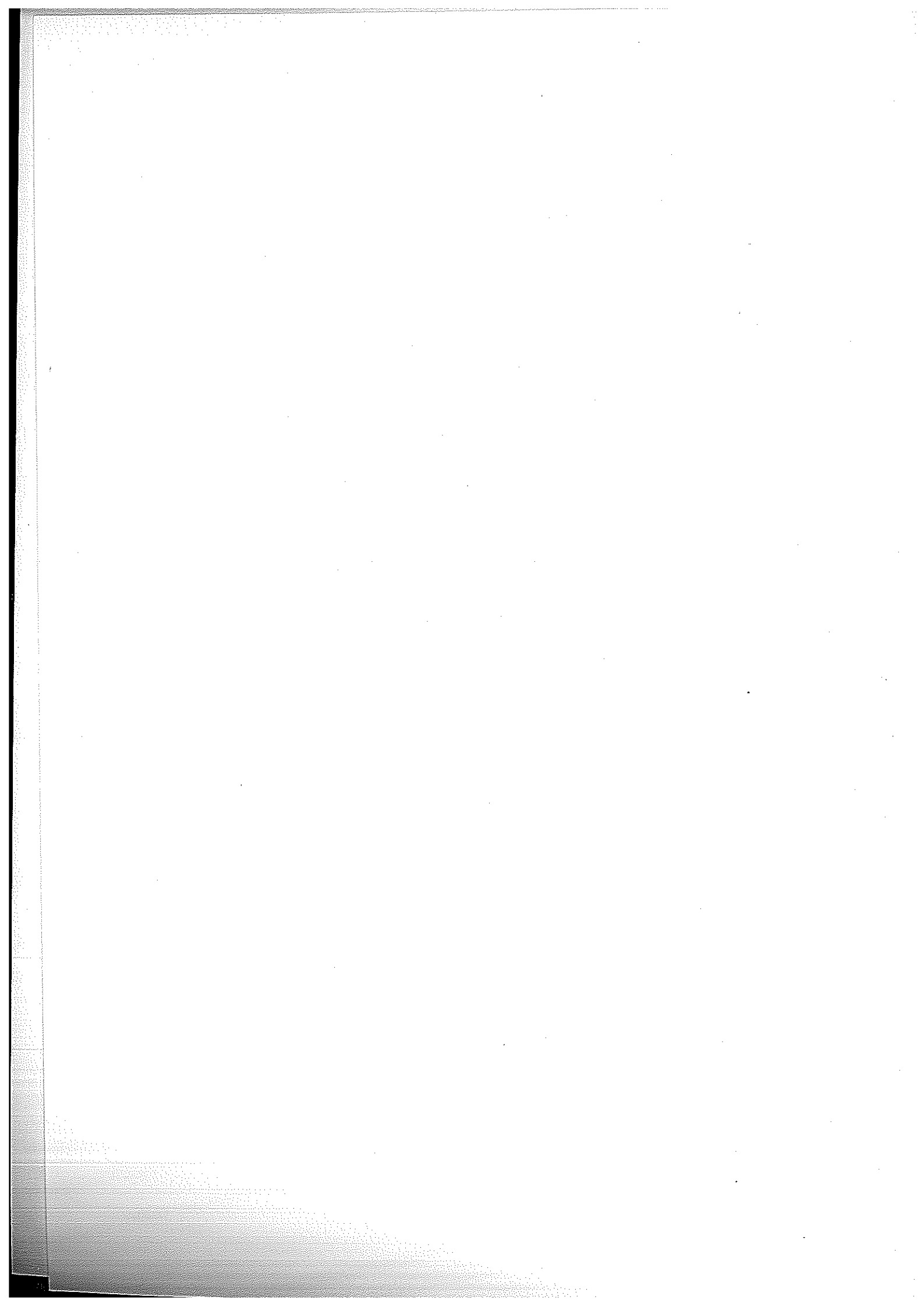
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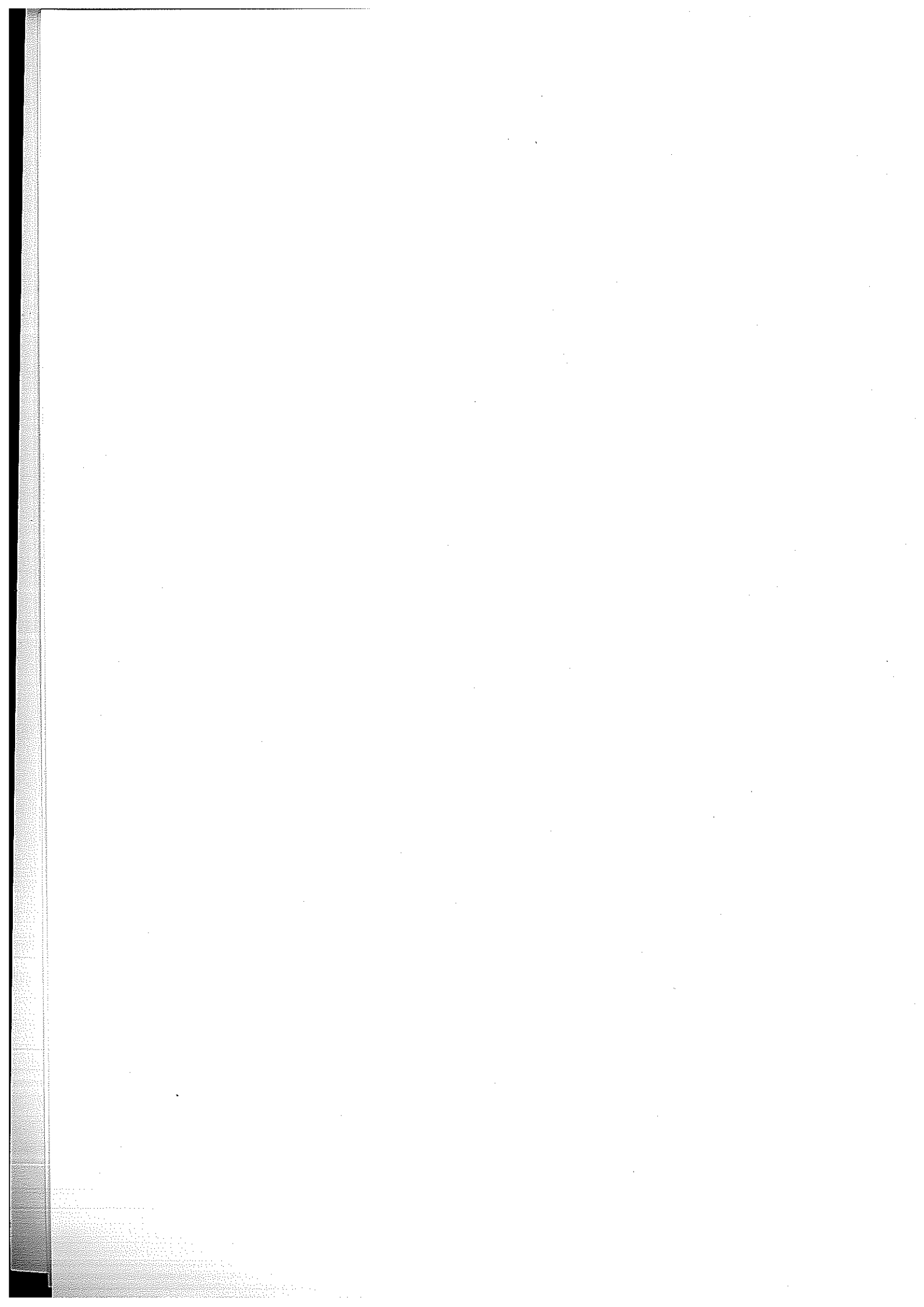


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Mirabib - an archaeological study in the Namib

by

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Accepted: 20 June 1977

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ABSTRACT

This report provides information on what the Namib environment could have been like in the past; how people lived there and on what the past can teach us about man-environment relationships. In the course of reconnaissance work in the different environmental regions of the Namib interest narrowed down to a site on the gravel plains of the central Namib. The material recovered from the excavation in the rock shelter near Mirabib comprised well-preserved faunal, floral and cultural remains spanning the time period of the Holocene.

An intensive sedimentological analysis contributed to the reconstruction of ecological determinants and to the explanation of various degrees of preservation. A three-pronged approach to the study of plant remains supplemented the palaeo-ecological information, led to a microscopic method of anatomical identification and to an ethno-botanical study of the !nara (*Acanthosicyos horrida*) among the Topnaar Hottentots. This, the find of a seven hundred year old skeleton and evidence of sheep herding during the fifth century A.D. constitute interesting information on the history of the central Namib.

The study of the archaeo-zoological data, in particular the analysis of owl pellet remains, contributed to the reconstruction of climatic peaks and cycles of change. The C14 dates of charcoal and bone provided the crucial framework for comparison with data from other sites in Africa and with climatological data from the rest of the world. The Environment-Population-Culture model which is presented in a concluding discussion relates the results of this study to present day problems of management of the Namib Desert Park.

1 INTRODUCTION

Work on archaeological sites in the Namib started during the sixties (Sandelowsky and Pendleton 1970, Wendt 1972). In 1972 a project was outlined which aimed at reconstructing past environments in the central Namib Desert. Apart from general speculations on the geological history of the area, not much was known about environmental changes in the Namib (Martin 1961, Goudie 1972, Scholz 1972). A lack of dates for any changes indicated in the geomorphology was particularly obvious. The immediate purpose which archaeological material could serve would be as a dating tool which in archaeological terms might be vague, but in geological terms could be quite specific. Besides that, the archaeological data could contribute towards a reconstruction of past environments and lead toward a better understanding of the relationship between man and his environment. Ultimately there would be a documentation of the history of people who lived in the Namib.

The Namib palaeo-ecology project was to fit into the programme of the Desert Ecological Research Unit

(DERU), which was established in 1963 at Gobabeb in the Namib Desert Park, where the South West African Division of Nature Conservation and Tourism maintains a magnificently equipped Research Institute. The theoretical framework chosen for this archaeological work relates it to the aims and objectives of Nature Conservation. The results obtained during the first phase of intensive investigation are couched in a model which reflects the system endangering the park, its landscape and wild life. The model leads up to a suggestion for the protection of the park and envisages the co-operation of all those interested in this area.

When the Council for Scientific and Industrial Research (CSIR) made funds available for the first phase of this project, I looked for sites containing evidence of past climatic conditions and human occupation. These were found along the coast, along the river courses, in the dunes and on the rocky plains. In each ecological zone, one or more sites were tested intensively to see how much datable information could be gained within a short period of time (Sandelowsky 1974, Sandelowsky 1975, Seely and Sandelowsky 1974, Sandelowsky and Pendleton 1970).

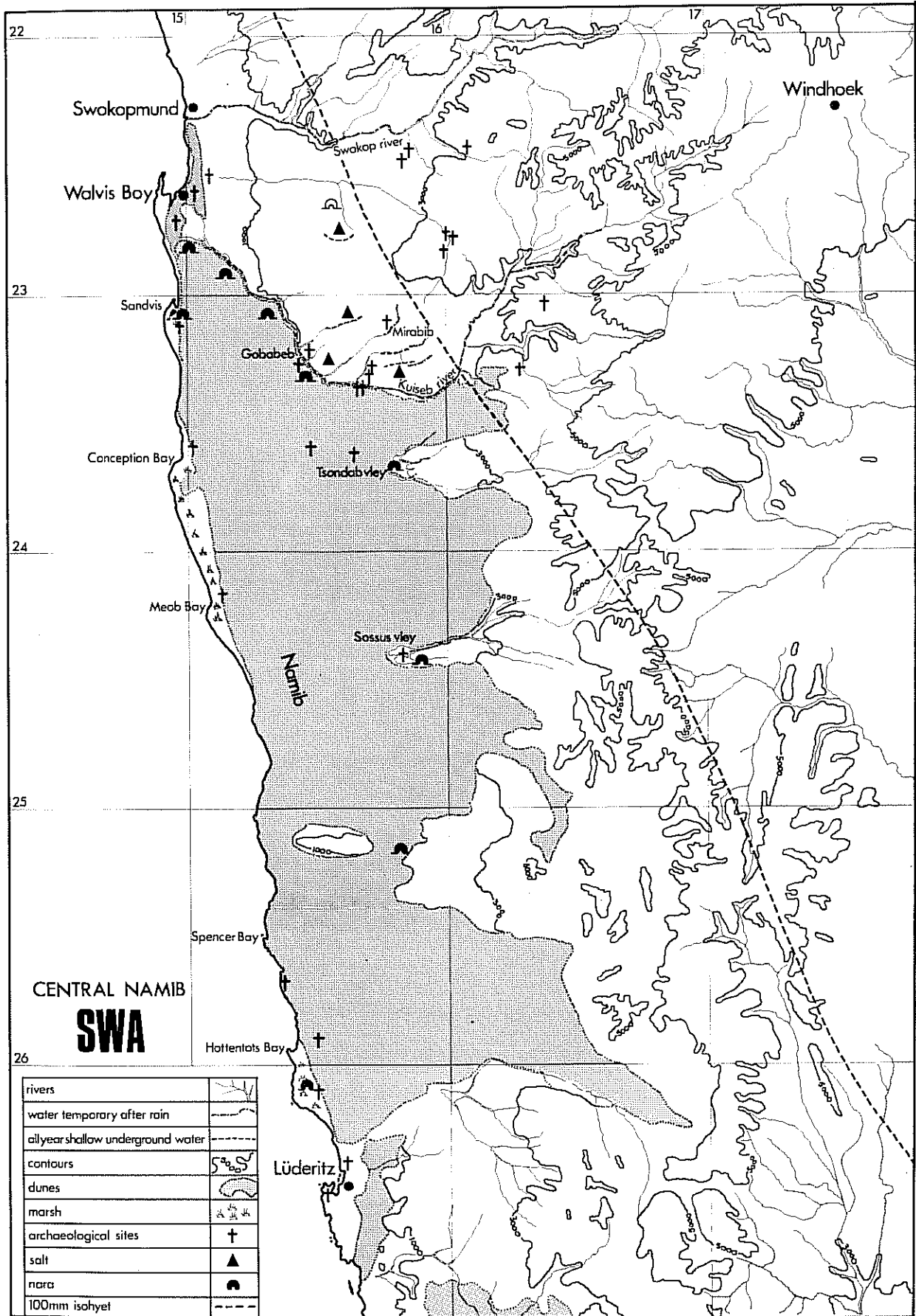
As the Mirabib Hill Shelter (plate 1) on the plains of the central Namib proved to be the most promising site, work was concentrated there. In this large rock shelter, the archaeological deposit, which covers a time period of over 8000 years, contains six different layers of material.

The sediments in the shelter were analysed against the background of present day geology and geomorphology of the surroundings. Organic material which is well preserved was likewise studied against the background of a modern survey. The remains of owl pellets were found in all layers. Modern owl pellets were studied and compared with the archaeological material. A new approach was tested in the treatment of the archaeo-botanical material. !Nara (*Acanthosicyos horrida*) seed-coats were found throughout the deposit, and this, together with the fact that Topnaar Hottentots living along the Kuiseb River today utilise this plant, gave rise to an ethno-botanical study.

No human bone was found in the excavation. The only indication of the physical type living in this area in pre-European times comes from a grave site some 30 km away from the shelter. From an analysis of different kinds of evidence, a rhythm of climatic changes over the last 8000–10 000 years will be documented in the following report. Inferences will be made about the subsistence economy of the people living there during that time period.

2 RECONNAISSANCE WORK

Before research concentrated on the excavation at the Mirabib Hill Shelter reconnaissance work was done in all three regional units of the central Namib Desert (Logan 1969) as well as along the valleys of



Map 1: Central Namib, S.W.A.

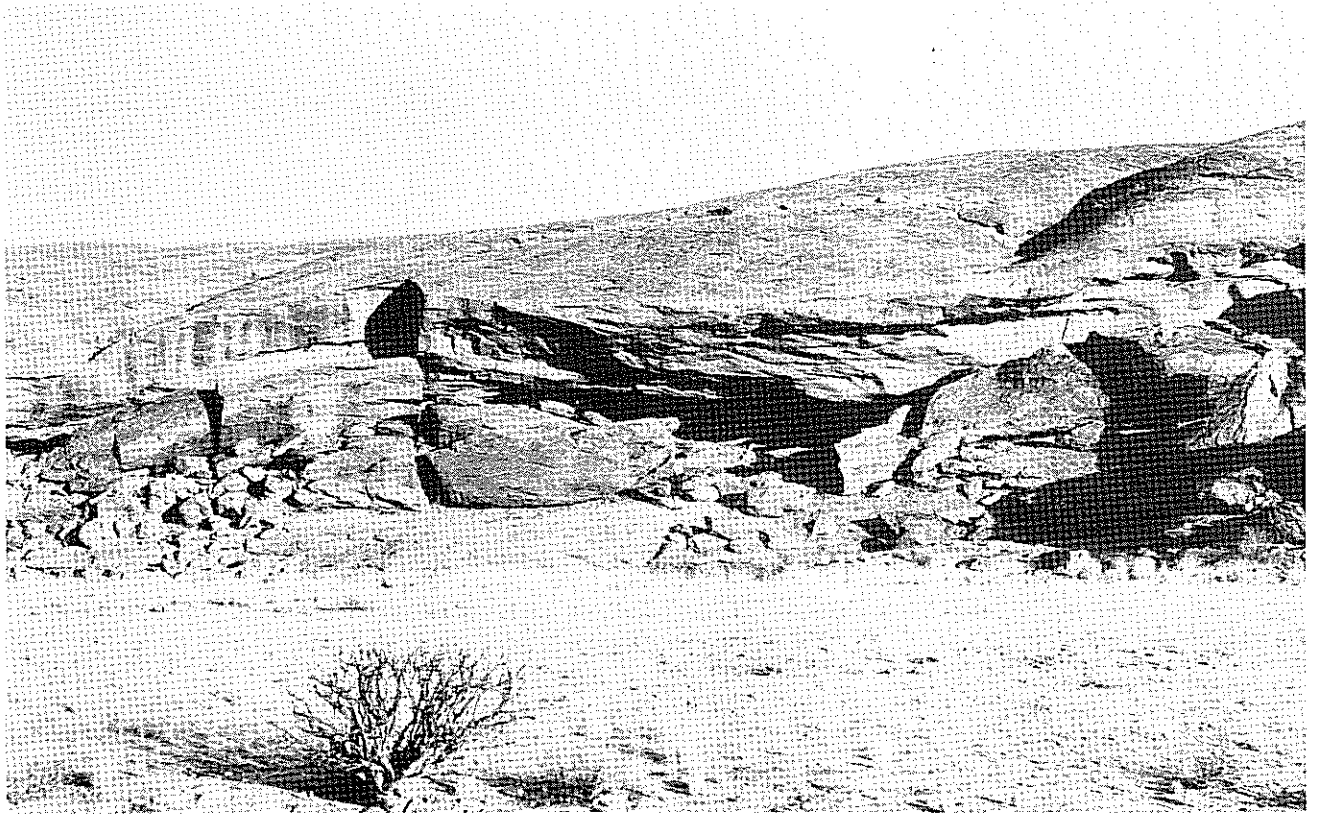


Plate 1: The Mirabib Hill Shelter.

Photo: K. Baedeker

the Kuiseb and the Swakop Rivers. These two stream-beds are usually dry on the surface but their underground water supply supports a vegetation and concomitant animal life likening these areas to longitudinal oases. For parts of their courses these river-beds form impressive boundaries between the Namib platform and the dune Namib (plate 2). The Namib platform is an erosional surface of extreme flatness cut by a few stream valleys and interrupted by widely scattered Inselberge while the dune Namib is a vast sand sea. The third regional variant is the coastal Namib, an area of strongly marine climate (map 1).

In each of these areas, environmental conditions are determined by the amount of rain, earth resources, temperature and wind. The lowest temperatures are experienced along the coast, where humidity occurs primarily in the form of fog. As one moves inland, rainfall starts to occur and the 200 mm isohyet runs approximately parallel to the 300 m contour on the edge of the escarpment (Appendix 1). It is over the central Namib that the winter and the summer rainfall areas merge. This was one of the reasons for founding the Research Institute at this location. In addition it marks the boundary between the fog belt and the inland rainfall area as well as a situation where three contrasting environmental zones con-

verge, namely the dune field, the rocky plain and the oasis-like Kuiseb River.

Although Mirabib is seen in perspective with all the other archaeological sites, it was not possible to devote similar attention to other sites. The wider theoretical framework of this project does, however, envisage controlled comparisons with sites in the adjacent areas. Initially sites were sought which might contain evidence of environmental conditions during the Quarternary. Finds of stone tools from every part of the Stone Age calendar have been reported from the Namib. But as is the case wherever there are too few archaeologists to visit, let alone excavate the known sites, all the finds came from the surface.

An excellent opportunity to observe the levels below the surface came when the Department of Water Affairs, putting down a water pipeline from the Kuiseb River to the Rössing Uranium Mine, excavated a trench 60 km long and 2 m deep, in which a beach terrace was found (plate 3). The profile described below by Dr H. Scholz, a pedologist, is situated approximately 9 km east of the Atlantic, behind the coastal dunes between Walvis Bay and Swakopmund, and approximately 2 km north of the Walvis Bay/Gamsberg road (14°37' E longitude 22°57' S latitude).

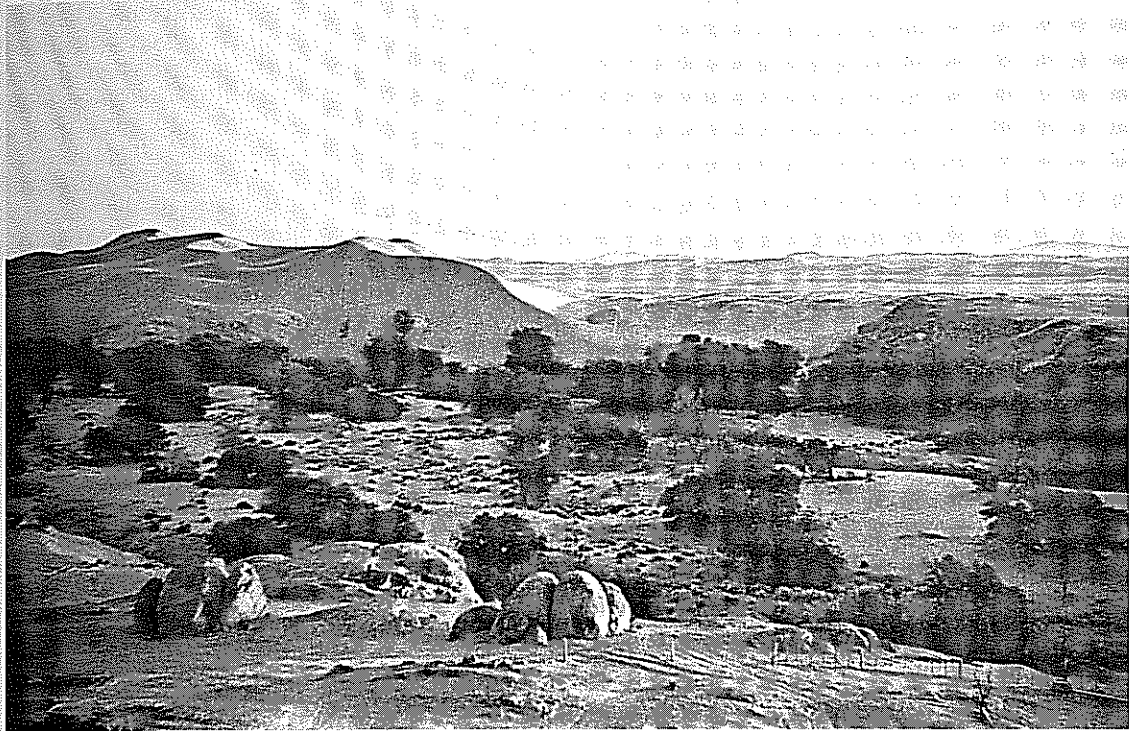


Plate 2: The environments converging: The rocky plains, the Kuiseb river-bed and the dunes

2.1 Description of the section with marine shells

- 0—5 cm: loose aeolian sand, with grit and small stones which have accumulated on the surface as a result of deflation.
- 5—100 cm: gypsic ochre-brown grit, consisting of physically weathered granite, has been cemented to form a hard crust. It becomes less well compacted toward the base, where very small (diameter 2—5 mm) gypsum crystals, sometimes forming desert roses, are found.
- 100—140 cm: buried indurated beach terrace, well enriched with shell remains, whose breaks give the horizon a white appearance. The material that cements them together ranges in colour from ochre brown to light brown. This horizon also contains large, well-rounded gravels (up to 20 cm in diameter), consisting mainly of quartz, quartzite and metamorphic rock.
- 140—160 cm: very coherent, reddish brown sand, with cross-bedding impregnated with reddish iron solution along some of the layers. This material does not contain the round gravels and the shells.
- 160—185 cm: yellowish-brown, silty sands with well-layered horizontal bedding. Due to a light content of the silt constituents, this material is more coherent and baked together.

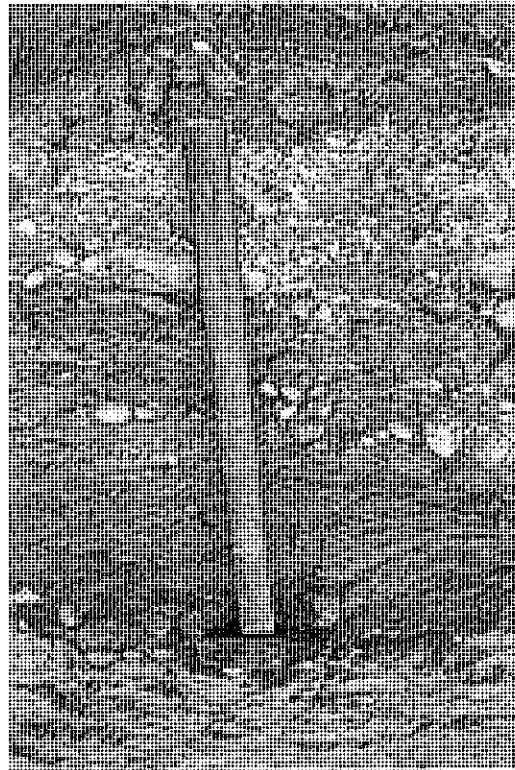


Plate 3: Section showing beach terrace. Photo: H. Scholz

- 185—250 cm: less coherent sand. Bedding is visible due to reddish iron precipitations. In these sediments, layers of gypsum concretions are found up to 5 cm thick. Often they are also along vertically-running, old mud cracks and other fissures. Some could

well be root casts. The lower two horizons most probably represent delta sediments of the Kuiseb.

Shells from the 100–140 cm horizon were submitted to A. J. Tankard of the South African Museum in Cape Town for identification. They are all marine oyster shells, probably *Striostrea margaritacea*. Their robust nature suggests turbulent conditions. This oyster, which inhabits shallow water, is a warm water species not found on the west coast at present. Pieces of rock with bored holes, found together with the shells and waterworn cobbles, are mud stones that have been bored by animals. Some molluscs are capable of doing this (Tankard pers. comm.).

Most probably this beach terrace is a Pleistocene phenomenon. The silty material, the cross-bedded reddish brown sand and the shells indicate specific environmental conditions which it would be most interesting to compare with the present situation. The presence of the warm water oyster implies far-reaching climatic changes. Warmer water along the coast could have been related to more rainfall on the land. Silt deposits in this profile, as well as those that can be observed on the banks of the Kuiseb River further inland, may have been related to more surface water in the river-bed as a result of this higher rainfall. The two horizons containing silt are divided by the layer of windblown sand, and aeolian material overlies the shell-bearing beach terrace. A rhythmic pattern of change from dry, windy conditions to warmer, moister conditions could be inferred from these deposits. It is now of vital importance to discover the dates for these changes.

2.2 Archaeological sites along the coast

Fresh water can be found along the dune coast of the Namib, where forelands protrude seawards from the otherwise straight north-south trending coastline. It has been suggested that these forelands have developed from the drowning of estuaries existing when inland rivers were able to reach the coast. This process of drowning is evident today in progression of foreland development from Meob Bay, through Conception Bay and Sandvis, to Walvis Bay (Seely 1975:25, Bremner pers. comm.). Cultural remains, usually in the form of shell middens, were found in the vicinity of all these fresh water sources occurring near the forelands along the Namib coast.

South of Walvis Bay, in an area known as Wortel, (14°29' E, 23°6' S) dune sand is intercalated with, and overlies layers of silt deposited by the Kuiseb River. It is hard to tell the age of these silt layers, because the Kuiseb has probably not reached the sea since 1934. Nor is it known which course it then took, winding through the dunes as it must have done. In three areas near Wortel, interesting finds were made.

In the area closest to the coast there was the smallest amount of glass, porcelain and plastic. There was an abundance of pottery, ostrich egg-shell, both worked and unworked, and animal bone. This ranged from fish bone to large bovid. Not far from here, there is an old silt layer, several metres in extent, on which the tracks of a variety of animals are clearly imprinted. Many of these are foreign to the area today, some of them not readily identifiable. Similar evidence has been recorded in other parts of the Namib (Wendt 1976, Sandelowsky, Scholz and Ahlert 1976). Human skeletal remains were also observed in this vicinity by Mr Willie Knowds, Division of Nature Conservation (pers. comm.). Some of these were recovered, but the skull and the long bones could no longer be found. These bones were embedded in dune sand, which also contained minute potsherds and fragments of clam shell.

South-east of Walvis Bay, in a similar context of dune sand and silt deposits there is a large concentration of human skeletal material (14°32' E, 22°59' S). Much of this may be part of a recent graveyard. Here some disturbance has taken place. Erosion has exposed the material and people, dogs or jackals may have been at work as well. Where intact bodies are uncovered they look mummified, which is not surprising under these environmental conditions. Objects ranging from old bottles to ostrich egg-shell beads were found in association with these graves. In the late forties, similar items were seen in a non-White graveyard at Swakopmund (personal observation).

A systematic archaeological investigation of these sites, correlated with historical and ecological research, would contribute significant information to the history of the Kuiseb delta.

Shallow seismic work has shown that the Kuiseb probably reached the sea at Sandvis. Two distinct channels were located in the bedrock beneath the nearby dunes while brackish water was found seeping through the foreshore at Sandvis at low tide (Hellwig pers. comm.). Consequently the river's course has been deflected to the north by the sand dunes encroaching upon its diminishing surface flow during the present interglacial. The subterranean flow of fresh water at Sandvis gives rise to sedge and reed vegetation. A variety of birds breed here. Seafoods, jackals and smaller mammals would have provided a further source of food for prehistoric inhabitants. The deteriorating ecological situation at Sandvis is being monitored by scientific teams. The vegetation is receding, the bird populations are decreasing and species of invertebrates are disappearing. A deserted wooden house, together with the remnants of a stone house, mark the site of the last permanent resident of Sandvis.

About 200 m south of the last of these structures, on the edge of the Sandvis lagoon, (14°30' E, 23°26' S) there is a small scatter of white clam shells, fragments of glass and chipped quartz cobble. About 1 km south of here Inara bushes (*Acanthosicyos horrida*) gradually cover the low sand dunes.

At the base of the tallest plant, a concentration of copper fragments, pieces of iron and glass in different colours (green, brown and violet), chipped stone, bone and shell fragments was noted. From here the *Nara* plants extend eastward into a dune valley, at the head of which is a fresh water seepage near which the rusted blade of a shovel lies amongst a scatter of bone fragments, *Nara* seed-coats and two large, bead-like metal objects. A midden of small, soft clam shells was located in another dune valley, to the south-east. *Nara* plants grow high up along the steep lees of the dune wall of this valley, the floor of which is moist, and supporting a patch of *Capparis hereroensis*. There are traces of ash and charcoal, a few split pebbles and potsherds, partially exposed. One of these sherds showed an unusual decorative feature consisting of nipples in two circles.

Typologically the artefactual material from Conception Bay resembles that from Sandvis and Walvis Bay.

Within a few hundred metres of the Conception waterhole (14°32' E, 23°56' S) concentrations of midden material were found. Different types of shell were concentrated on individual middens. This contrast was particularly striking where two shell heaps, separated by a distance of only a few hundred metres, contained black mussel shells in the one case, and soft white clam shells in the other case. Other than that, a similar collection of artefacts could be found at all the sites: potsherds, ostrich egg-shell, copper beads and coins, stone flakes, chips and hammering stones, as well as fair quantities of bone. One human skull and an almost complete post-cranial skeleton eroding out on the surface were collected. Fire places were indicated by concentrations of ash and charcoal, as well as bits of burnt bone. Dr John Vogel, a member of our expedition, collected the sherds of one clay pot with a considerable amount of soot adhering to its base. As well as reconstructing the pot, he dated the soot to approximately 1350 A.D. (Vogel pers. comm.). This is one of the few C14 dates available for shell middens along the Namib coast (Sydow 1973, Wendt 1975).

One site in the Conception Bay area does not belong to the shell midden type of site. This is a scatter of stone tools lying on a thin layer of coarse white sand covering very fine, red, silty material. None of these implements resembles the crudely chipped pieces found on the shell middens. Whereas most midden implements are made of the commonly available white quartz, most of those on the site just mentioned are made of fine-grained siliceous material. Triangular flakes and blades are between 4 cm and 8 cm long with well-defined striking platforms and dorsal patterns consisting of three or four converging scars.

South along the coast the next source of fresh water is at Meob Bay (14°40' E, 24°31' S). This coastal foreland, which is even less well-defined than Conception Bay, probably represents the estuary of the ancient Tsauchab, which today ends at Sossus Vlei

where it is blocked by 300 m high dunes. Fieldwork was done at Meob in 1968 (Sandelowsky and Pendleton 1970) and it will suffice to mention that the character of the shell midden material here resembles that of the shell middens further north; the stones are marked by crude chipping and rarely show retouch or signs of careful workmanship. Beach cobbles and pebbles often show pecking marks and/or chopper-like edges. The working of ostrich egg-shell is limited to beads or pendants. Engraved ostrich egg-shell is conspicuously absent. It would be interesting to study the variable accumulations of different species of shell found on the middens. It was recently discovered that a shell previously identified as *Ostraea atherstonei* (Sandelowsky and Pendleton 1970: 50) is in fact another species (Kensley pers. comm.) i.e. *Hinnites* sp. which has not yet been described.

The stretch of coast between Black Rocks, south of Meob Bay and Spencer Bay was not visited because the area cannot be traversed by motor vehicle. But the area between Lüderitz and Spencer Bay was visited. Here, too, there are shell middens, in which some of the cultural material differs from that found further north.

At Diaz Point, (15°10' E, 26°39' S) east of Lüderitz, a small accumulation of shell was found close to a large rock which could provide shelter for one or two people. This is an area frequented by tourists and any diagnostic artefacts that may have been on the surface were most probably collected long ago. Most of the shells were limpets but there were also some mussels and snails.

North of Lüderitz and east of Agate beach (15°17' E, 26°37' S), there are large midden accumulations that are fairly undisturbed, being within the diamond area which may be entered only with a special permit. In contrast to the roughly-made stone tools found along the northern coast, well-made microliths of agate and chert were found here.

Anichab, (15°2' E, 26°18' S) north of Lüderitz, is another place marked by a number of fresh water waterholes, in the vicinity of which were scatters of midden material. They appear to be only surface scatters and do not form heaps. A considerable range of stone tools was found in association with these shells: high backed chert scrapers, quartzite flakes and a quartzite cobble with two dimples. In addition to a few bone fragments, worked and unworked ostrich egg-shell fragments were found here.

At Saddle Hill (14°56' E, 25°55' S), another source of fresh water and the site of an abandoned mining camp, more archaeological material was found. Between the largest concentration of houses and garages and the coast, material scattered on the surface consisted of copper fragments, roughly chipped stones, ostrich egg-shell fragments with engravings, black mussel, limpets, and whelk shells.

There were no potsherds.

Engraved ostrich egg-shell fragments had not been seen along the northern part of the coast. The

shells were in good condition and, together with the metal fragments, gave the impression that this occurrence was of a recent date.

This differed from the impression given by another scatter of artefactual material no further than 500 metres away. Here the seashell was highly fragmented and the stone artefacts of siliceous material were well worked and retouched. Potsherds were not seen. Stone implements resembling the ones just mentioned, i.e. agate and chert scrapers, were also found on piles of stones which had been sifted for diamonds. Obviously the implements would be out of their proper archaeological context, but their presence on the sifted piles indicates that their manufacture predates mining activities of the early part of this century. Mounds of shell midden material with ash extending down to a depth of at least 15 cm occur amongst the deserted buildings in the vicinity of the windpump at Saddle Hill main camp. There was a mixture of shells: black mussel, barnacle, white clam shell and limpets. There were also potsherds, ostrich egg-shell beads, fragments and roughly chipped quartz cobbles. The occurrence of this material across the paths of one mining building to the next resembled the situation at Conception, and raises the question of how the middens are related to the mining structures. It is hard to believe that miners would have ignored pottery and human skeletal material completely, or even have taken pains to avoid the destruction walking over it would cause. The material may have been covered by sand at the time of the mining operations, or, indeed, postdate them.

Spencer Bay was the only place on the route taken along the coast where no archaeological material was noticed in the vicinity of a source of fresh water. Though odd, this does not necessarily imply total absence of sites since, due to lack of available time, the search was not intensive and patches of vegetation covered parts of the valley.

No typical shell midden material was found at Noordhoek, a short distance further north, where there is yet another fresh-water seepage. Large, well-made stone implements were, however, found on the top of a hill of gneiss with a basic dyke ($14^{\circ}51' E, 25^{\circ}41' S$). This was obviously the source of the raw material, a brown chert. Triangular flakes had well-defined striking platforms, while a large, rounded end-scraper made on a flake showed regular retouch scars.

The finds from the coastal sites seem to represent at least two types of archaeological material. Large, well-made stone tools which were found at Conception Bay and at Noordhoek show Middle Stone Age characteristics, while microlithic Later Stone Age material is found on shell middens at the other sites. In the shell midden material found along the northern stretches of the coast and in the southern part, differences are apparent in the working of ostrich egg-shell, as well as in the type of stone implements. At Saddle Hill both types of midden material are found (table 1).

2.3 Archaeological sites in the dunes

Finds of large bifaces, flakes and blades have been reported by many of the people who had the opportunity to travel through the dune field or along its edges. Zur Strassen describes the following site in the vicinity of Sossus Vlei ($15^{\circ}40' E, 24^{\circ}35' S$): North of the Tsauchab River on the farm Sesriem, high shifting sand dunes encroach upon the gravel plain on which dolomite and black limestone materials occur. Amongst the dunes bordering the plain, there is an elongated valley approximately 1 km long, surrounded by sand dunes 30–40 m high. In the lowest part of the valley there are soft, red sandstone formations resembling small Inselberge. These are possibly cemented dune sands which may have been temporarily uncovered by shifting sand. These formations, each sloping gently to the west but dropping steeply on their eastern side, cover an area of ± 200 –400 m. Stone artefacts were found on the surface of the exposed formations, as well as on the gravel flats surrounding them.

A surface collection of approximately 60 artefacts was made, only well-shaped, large tools being selected. No microlithic material was found. The implements collected range from large picks and core axes made from cobbles, to carefully-worked lanceolate bifaces and unifacially retouched points (plates 4 and 5).

Similar tools were found in dune valleys south of Homeb ($15^{\circ}13' E, 23^{\circ}39' S$) (plate 6) as well as west of Tsondeb Vlei at a weather station, Narabeb, ($14^{\circ}56' E, 23^{\circ}51' S$) south of Gobabeb (plate 7). Their vertical and horizontal distribution was tested in relation to the geomorphological features of the site (Seely and Sandelowsky 1974). It was suggested that this site may represent a vlei situation similar to the one presently in evidence at Tsondeb Vlei, further east. Assuming that rivers, today blocked by dunes on the eastern edge of the Namib, penetrated further seawards during times of more rainfall in their catchment areas, the Early Stone Age tools found at Narabeb give an approximate indication of the time at which the Tsondeb may have reached that point of regression.

Accordingly the absence of Later Stone Age tools in the dune area of the Namib could imply that deteriorating desertic conditions since Early Stone Age times prevented people from inhabiting the area. In search of organic material which might date the change of climatic conditions more accurately, Seely discovered fresh-water snail shells in the trough of the ancient Tsondeb, some 10 km east of the present vlei ($15^{\circ}10' E, 23^{\circ}53' S$).

They were found to originate in layers of mud that are intercalated with layers of dune sand. In the attempt to trace a datable sample of shells to one particular mud layer, Vogel found the footprint of a bird on the surface of a polygonal mud layer which had been covered by sand and mud. As a result of this encouraging find, a search for footprints and shells was taken up (Sandelowsky, Scholz and Ahlert 1976), culminating in the uncovering of a

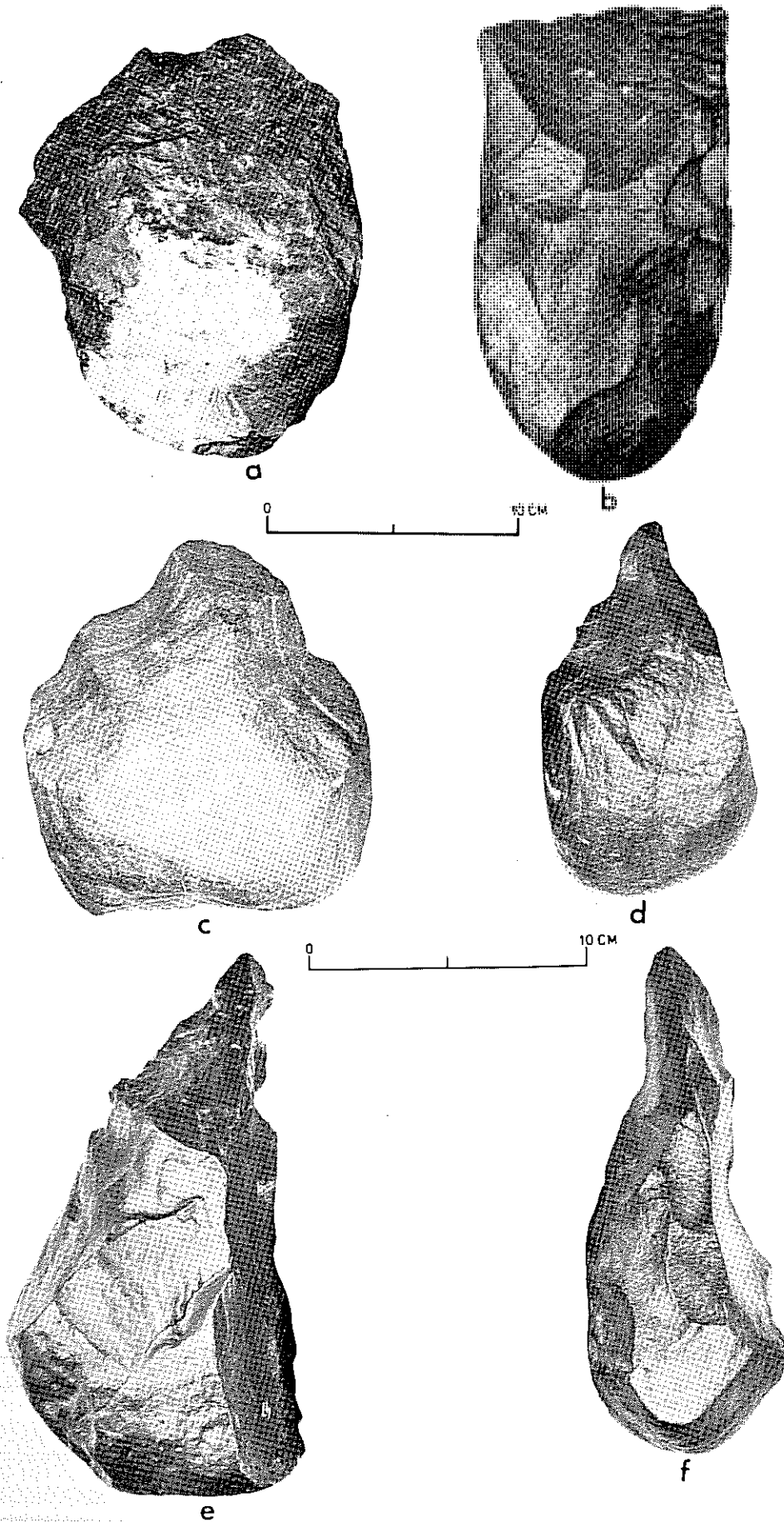


Plate 4: Early and Middle Stone Age tools found near Sesriem; a) diabase cleaver, b) quartzite cleaver, c) quartzite chopper, d), e) and f) quartzite picks

Photo: H. zur Strassen

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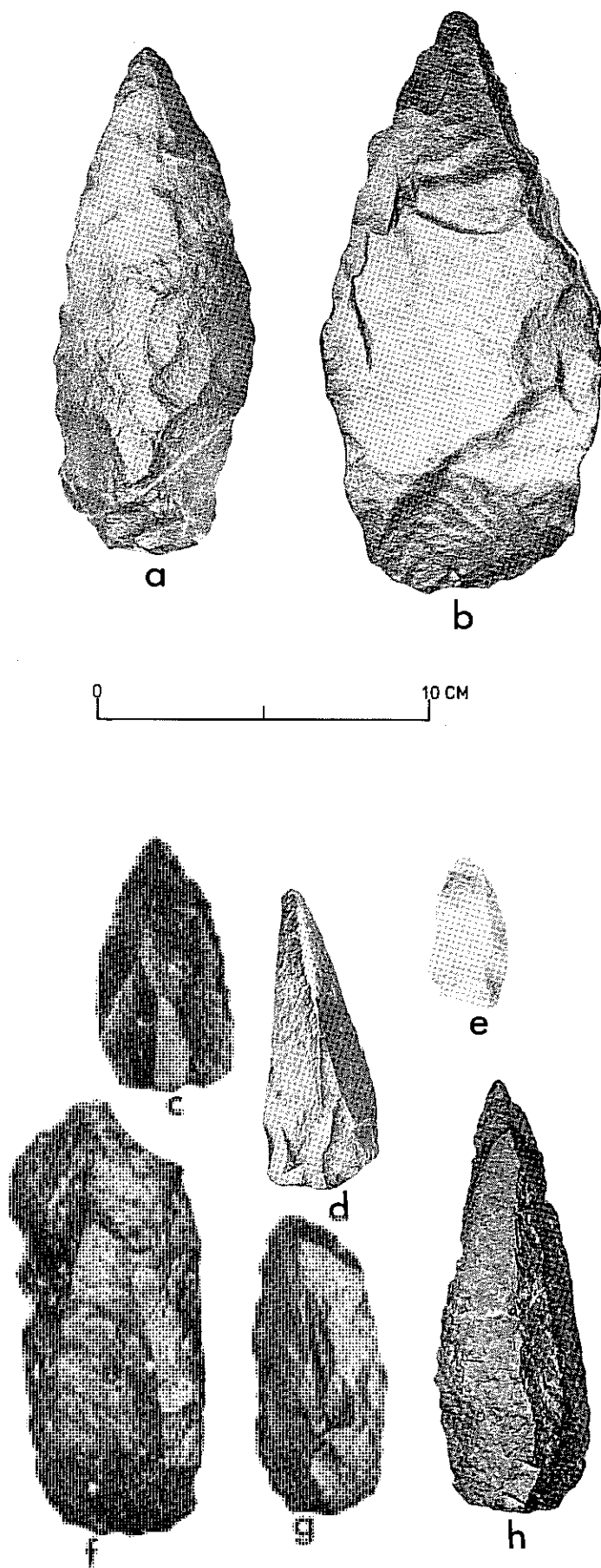


Plate 5: Early and Middle Stone Age tools found near Sesriem; a) quartzite lanceolate, b) quartzite core-axe, c), d) and h) diabase points, e), f) and g) diabase blades

Photo: H. zur Strassen

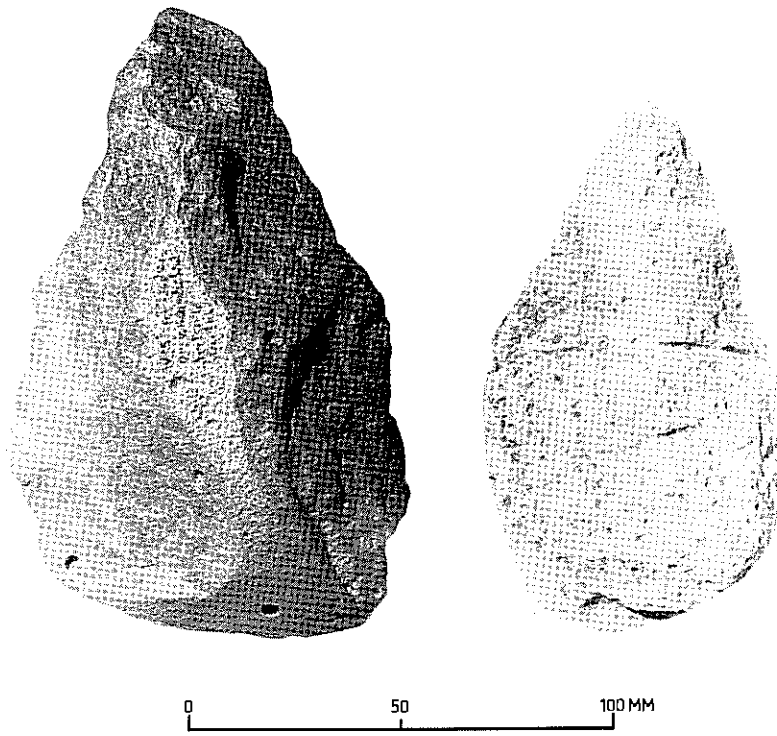


Plate 6: Handaxes found in the dunes south of Homeb

Photo: G. Kornick



Plate 7: Residue of river silt in the dunes at Narabeb

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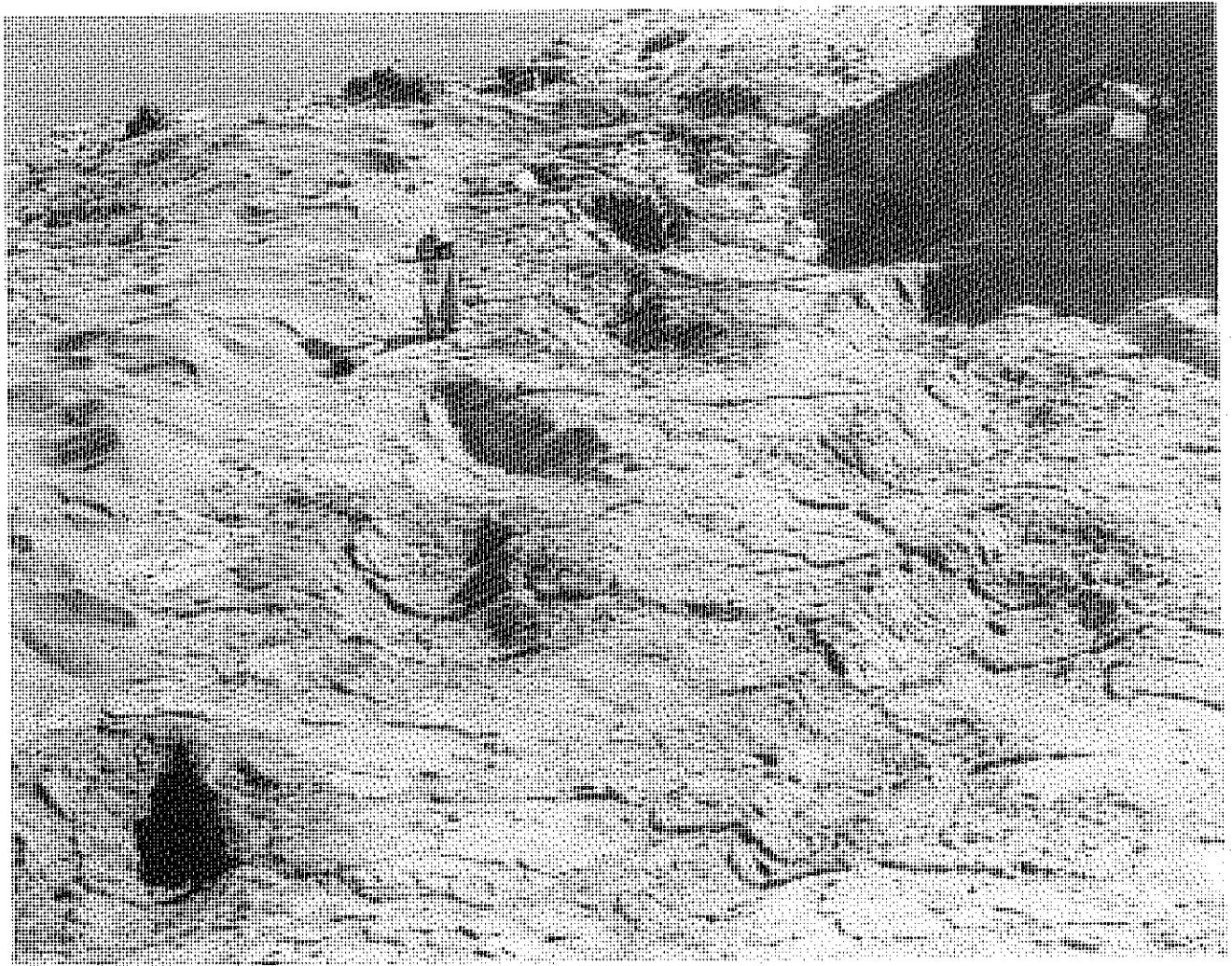


Plate 8: Tracks in the residual silts west of Tsondap Vlei

most curious set of tracks. To date no zoologist, botanist, geologist nor archaeologist has advanced a feasible explanation of their origin. Although snail shells were not found in direct association with these prints, a sample was collected from a layer closely related to this one at a depth of 50 cm below the surface. The remains of a Tenebrionid beetle, *Gyrosis orbicularis*, were found within 5 m from the tracks (plate 8), 50 cm below the surface.

Today these beetles are found on the gravel plains of the southern Namib and not in the dune area. Since they stay near the surface, their remains at a depth of half a metre represent fossils dating to the time of deposition (Endroedy, pers. comm.). Besides providing potential material for dating, they show how well organic material can be preserved here.

A core with three flakes fitting to it (plate 9) was found some 30 m from the site of the tracks. From the size of the flakes and their workmanship, a Middle Stone Age if not Early Stone Age date can be inferred for this find. The fact that the four pieces which fit together were found within a radius of no more than 3 m shows that there has been no

disturbance of this material for over 30 000 years, if not 100 000 years.

The densest easternmost occurrence of !nara bushes gave rise to the name !Nara Valley ($14^{\circ}57' E$, $23^{\circ}33' S$) which is in the dunes west of the Namib Desert Research Institute.

Large cores, flakes, choppers and blades can be found in patches all along the floor of this valley. Frequent visits over a period of three years revealed how the sand, put into motion by the prevailing winds from either the south-west or the east, periodically covered or uncovered these sites. A similar observation was made at the Soutrivier dune site ($15^{\circ}00' E$, $23^{\circ}32' S$), situated on the slope of a dune within sight of the Research Institute (plate 10) (Sandelowsky 1976).

The presence of Middle Stone Age and Early Stone Age material in the dune area, and the conspicuous absence of Later Stone Age finds, constitute important evidence for the age of the sand dunes and related climatic conditions. The projects which these finds suggest are difficult and would take a long time to complete.

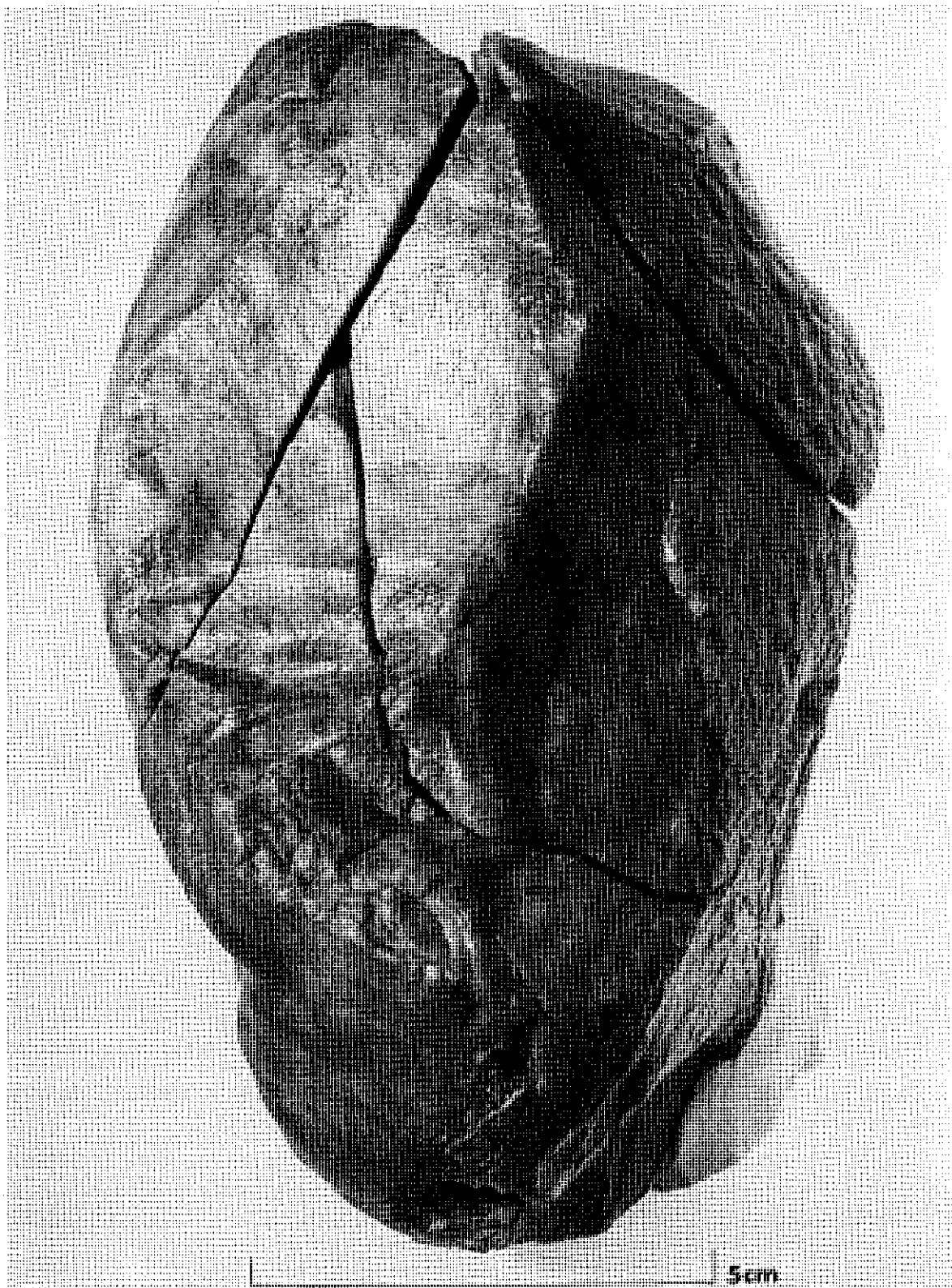


Plate 9: Three flakes fitting onto a core found in the dunes west of Tsondap Vlei

Photo: G. Kornick

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Plate 10: A butcher site eroding out of a dune south of Soutrivier

2.4 Archaeological sites on the gravel plains

The most distinctive sites on the gravel plains are those found in rock shelters, and those consisting of arrangements of large stones.

The Mirabib Shelter ($23^{\circ}27' S$, $15^{\circ}19' E$) was the most promising one of these sites, and the bulk of this report deals with the finds made there.

Two large shelters on the side of the Mirabib Mountain seem to contain similar cultural material, although the deposit appears less deep. Another shelter with white rock paintings of a zebra, a springbok, an elephant and a rhinoceros is situated near the top of Tumasberg. Unfortunately the deposit has been badly disturbed.

At Amichab, ($15^{\circ}32' E$, $23^{\circ}10' S$), east of the Heinrichsberg, water is available in rock pools for a few weeks after every rain. At the foot of the small granite Inselberg, three rock formations of different shape and size were observed. A grinding stone with

a pestle resting on it was found near the edge of the largest circular formation. Another grinding stone was found inside a small, east-facing shelter on the side of the hill. A lugsherd was found amongst some undecorated bodysherds at the foot of the hill below this shelter.

A granite outcrop with exfoliating circular boulders and hollows is a feature of the landscape at Ganab ($15^{\circ}33' E$, $23^{\circ}06' S$), another waterhole. Artefacts of quartz and indurated shale, worked ostrich eggshell and potsherds were found all over this outcrop wherever the rocks provide shelter from the sun or prevailing wind. Many of the artefacts can be found in the paths of water drainages which form even with very little rain. No cultural deposit of any significant depth could be located.

Ubib Vlei ($15^{\circ}08' E$, $26^{\circ}06' S$) is a salt pan near the convergence of the Uspass and Gamsberg roads. Here two types of stone structures were observed. Round enclosures are built of schist slabs, dioritic rocks and quartz. One circular stone wall, up to a

metre in height and incorporating a stationary boulder, had a diameter of approximately 5 m. Nowhere in the wall was there an opening which might have served as entrance, nor were remains of other building materials such as poles or thatching noticed. Isolated stone flakes were the only archaeological artefacts seen on the surface. Other than that, the remains of tin cans and fragments of glass, presumably from beer bottles, litter the area. It is commonly suggested that these structures were erected during European times in the course of mining activities or war, but no definite evidence is available for these assumptions. This is particularly remarkable since most of the known buildings erected at that time are square and have been declared monuments, mapped and marked.

The other type of stone arrangement at Ubib Vlei is less spectacular and is found as an addition to the natural rock formation. This consists of short rows or low walls of rock built at right angles to the wall of an overhang. In one case the overhang was less than 2 m high. The little compartments that are formed by these small rows of rocks are hardly 1,5 m in diameter. A tall man would not be able to lie down comfortably in any of them. The surfaces are often uneven and rocky.

Two more stone circles and a stone cairn were found on the side of a steep valley leading to the waterhole, Groot Tinkas (15°24' E, 22°50' S).

Close to the border of Game Reserve No. 3 and the farm, Ruimte (15°38' E, 23°07' S), more shelters were located. A grinding stone with two parallel oblong depressions in which the pestles still rested, was found at the entrance of one shelter. Potsherds with distinctive designs, as well as fragments of a clay pipe, were collected on the talus of another shelter further up the side of the same hill. A complete clay pot was found amongst some granite boulders in this vicinity.

2.5 Archaeological sites on the escarpment

Two clay pots of similar design were recovered from rock overhangs situated in mica schist formations on the farm Berghof (15°58' E, 23°21' S). Approximately 10 km from the farm house there is a spring, known as Kouefontein. Near it there are numerous gallery-like overhangs. Potsherds and flakes can be found in some of them, but nowhere was a cultural deposit of any significant depth observed.

On the neighbouring farm, Chausib (16°04' E, 23°23' S), there is a large rock shelter with paintings in various shades of red and white, some very well preserved, others hardly visible. Animal and human figures are represented in a naturalistic style. The deposit is at least 50 cm deep, but it has been badly disturbed in several places. Rocks were lying in a row along the dripline. At the one end of this passage-like shelter, which is 2–3 m

deep where it affords most shelter, there is a circular stone enclosure with a diameter of approximately 0,5 m.

A large shelter with well-preserved rock paintings and organic material in the deposit is situated on the farm Onanis (15°42' E, 22°52' S). One other gallery-like shelter, with small paintings in red colour, was found on the farm Naos (17°10' E, 23°10' S) on the highland beyond the Gamsberg. Across a small river valley from this site, another mica schist overhang contains ashy, cultural deposit with decorated potsherds and stone artefacts eroding out on the talus.

2.6 Archaeological sites along rivers

Overhangs of mica schist mark the Kuiseb Canyon (15°16' E, 23°38' S) and are common along the banks of the tributaries of the Kuiseb. One of these overhangs is marked by a prominent structure of stone, holding up a dry tree trunk approximately 2 m high. Four other piles of stone form a row along the wall of the shelter. About 2 km further along on the left bank of the same drainage, a well-constructed wall of flat mica schist slabs juts out at a right angle to the back wall of the shelter. This wall is about 1,5 m high and 2,5 m long. There were no signs of artefacts or fire places.

On the banks of the Kuiseb and Swakop rivers, settlement sites were observed which, abandoned today, still have indigenous names. Topnaar inhabitants along the Kuiseb and Coloureds along the Swakop recall when these were last used. There are other nameless sites which are not known to present day inhabitants. They are marked by stone circles, dung accumulations as left behind by animals in kraals, grinding stones, chipped stone, fragments of worked metal and wood. Stone cairns, isolated or in groups of up to eight, are found on the banks of the Kuiseb River and its tributaries. Near the northern bank of the Kuiseb River one such cairn was excavated and found to cover a human skeleton.

Early in 1974 two assistants from the nearby Gorob Mine came across one of the stone cairns on the gravel plain just above the Kuiseb Canyon, east of Homeb (15°17' E, 23°36' S). They dismantled the unusual stone structure until they found some bone, at which point I was called in (plate 11).

The bones were not buried beneath the natural surface of the surrounding plain and were partially resting against the large mica schist slabs (plate 12) which formed the dome-shaped grave, topped with white quartz cobbles. One of the rocks had probably slipped and crushed part of the skull after burial. Fine windblown sand covered the bones. The skeletal remains, recovered in the course of systematic excavation, were incomplete. The bones which were recovered were in a very friable condition. Some were treated with a mixture of glyptol and



Plate 11: Gorob grave cairn

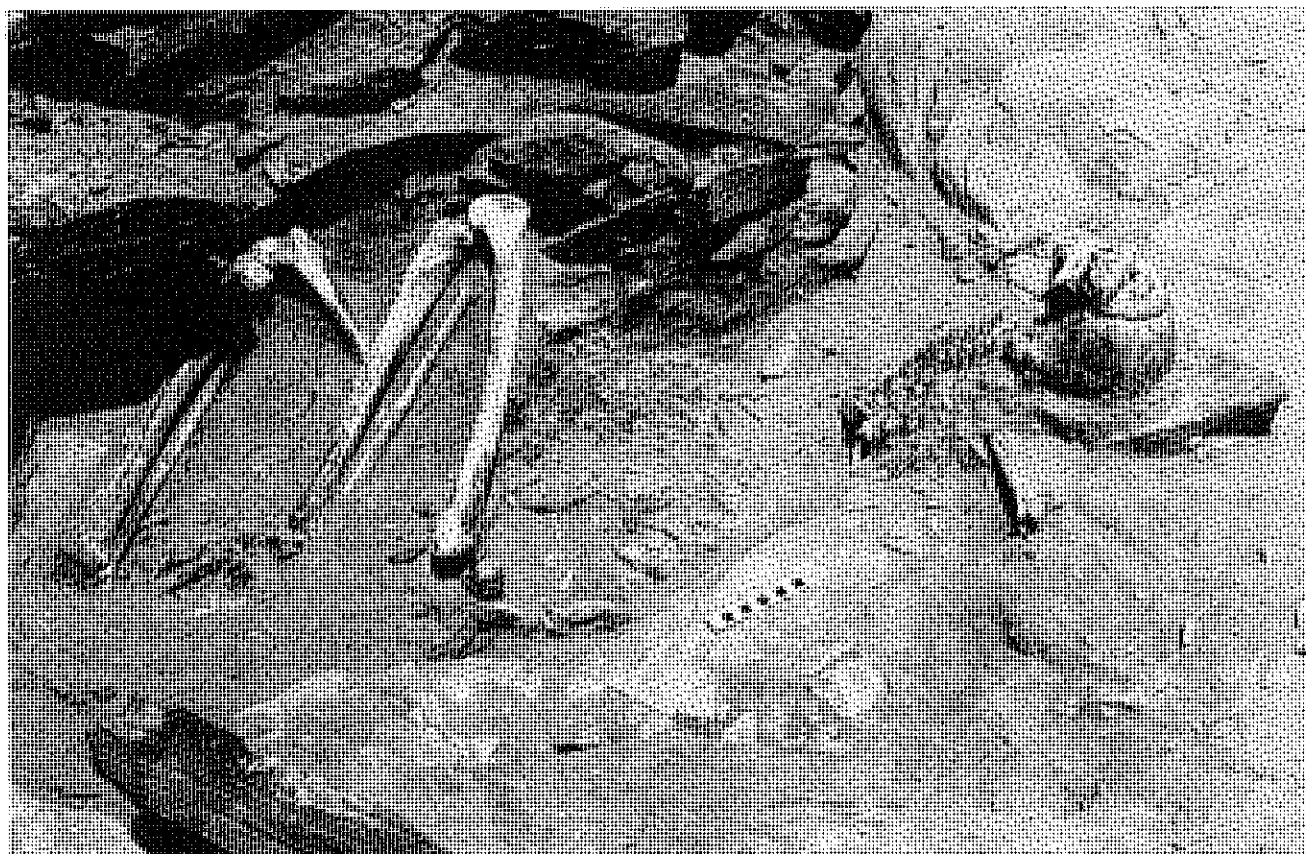


Plate 12: Skeleton found beneath Gorob grave cairn

acetone and in the laboratory 'Kreul Fixative' was sprayed onto some of them. No grave goods were found.

One of the bones was submitted to the CSIR Radio Carbon Laboratory and was found to be 715 ± 75 (PTA 1344) years old, thus dating to approximately A.D. 1235.

The remainder of the skeleton was submitted to Prof. de Villiers of the University of the Witwatersrand for analysis (Appendix III).

She suggests that the individual represented by these remains may have been a member of the Bergdamara population (Bergdama or Dama).

In 1876 Palgrave found 150–200 people in the Walvis Bay area, including Bergdamara and Bushmen. In 1885, 600 to 700 Topnaar and 100 to 200 Bergdamara are mentioned in a report which also states that the Bergdamara were the slaves of the Topnaar (Köhler 1969: 113). The relationship of the Topnaar and the Bergdamara has been discussed by Hoernle (1925: 17), who observed a master-servant relationship which led to intermixture in historical times. Assuming that invaders usually subjugate the local inhabitants, it is possible that the Bergdamara were native to this area before the time of the Topnaar. More work will have to be done before it can be said whether the Later Stone Age features occurring on the gravel plains can be attributed to the Bergdamara as well.

2.7 Conclusion

When tabulated (table 1) a classification of the sites located in the course of reconnaissance work shows a pattern. Shell middens are found along the coast. The differences noticed between the midden material from the northern and the southern parts of the coast may be due to age but this will have to be investigated more carefully. The relative absence of material predating the Later Stone Age sites along the coast could be due to changes in the coastline since the Pleistocene.

TABLE 1: Summary of finds made in the Namib Desert

SITE	E.S.A.	M.S.A.	L.S.A.	Stone	
				Middens	Structures
Coastal sites					
Wortel					×
Walvis Bay graves					×
Sandvis					×
Conception Bay		×			×
Meob Bay					×
Diaz Point					×
Agate Beach east					×
Anichab					×
Saddle Hill			×		×
Noordhoek		×			
Dunes					
Sesriem	×				
Homeb	×				
Narabeb	×				
Tsondab Tracks	×	×			
Nara Valley			×		
Soutrivier			×		
Plains and escarpment					
Mirabib			×		
Reserve Border			×		×
Onanis			×		
Berghof			×		
Chausib			×		×
Naos			×		
Amichab					×
Tumas			×		
Ganab			×		
Ubib Vley					×
Tinkas					×
Rivers					
Kuiseb Canyon					×
Swakop River					×
Gorob grave					×

In the dune area the presence of Early Stone Age and Middle Stone Age material and the absence of Later Stone Age material is striking. It suggests that the utterly inhospitable conditions of the central Namib sand sea are younger than these tools. The wealth of Later Stone Age material on the gravel plains and the escarpment indicates that people concentrated in these areas during the Holocene.

3 THE MIRABIB HILL SHELTER

On some maps Mirabib is indicated as Anachankirab. On others it is spelt Hirabib or Hirabeb. In the language of the local Topnaar Hottentots it is pronounced with an initial dental click and is said to mean 'the place where the hyena sleeps'.

3.1 The ecological setting of the study area

The Namib belongs to a part of the African continent which has been tectonically very stable (Martin 1961), and it is assumed that the basic geomorphological features have remained the same during the Holocene, i.e. the period of approximately 10 000 years during which people have been using the Mirabib Hill Rock Shelter.

A peneplain dipping gently down towards the Kuiseb River marks the landscape surrounding the granitic Inselberg, Mirabib. The monotony of this plain is broken only by these relatively high Inselbergs and small, shallow erosion gullies, broader and more deeply incised closer to the Inselbergs, where the gradient is steeper. These gullies become shallower as the distance from their source of origin increases and they usually disappear in the plain. The runoff from the Inselbergs, occurring during the episodic rain showers, does not suffice to join these small drainages to the Kuiseb system. The water seeps into the sediments and soils of the plains as it would during a sheet flood.

The pedology of the plains (Appendix II) is marked by shallow calcrete soils containing a large amount of aeolian sand, particularly close to the surface. Apparently these sands are derived from the dune area south of the Kuiseb, the mica content probably coming from the sediments of the Kuiseb itself. The surface of the soil is covered by a protective layer of stones and grit, consisting mostly of weathered granite, quartz and feldspar. With sufficient precipitation these soils represent the primary location for grasses. The prevailing precipitation prevents a more demanding vegetation. According to the extent of the surface area, the peneplains are the main constituent of this landscape. The pediplains of the Inselbergs, the valleys, erosion gullies and undrained depressions, as well as the bare rock surfaces of the Inselbergs, are the other elements of this landscape (Appendix II). The most important places for the more developed fauna, such as the mammals, are obviously those where water can collect. Apart from the fact that open water is occasionally available here, the vegetation here is thicker because the water supply is greater. In addition to grasses, dwarf shrubs, halophytes and leafy plants occur at these locations. Even trees grow in the larger valleys. Here the vegetation can survive longer periods of drought, during which the plains are bare of all vegetation. In some of the undrained depressions, salt crystallises on the surface. The vegetation in the valleys (e.g. *Acacia reficiens*; *A. erioloba*; *Parkinsonia africana*; *Boscia foetida*; *B. albitrunca*; *Commiphora saxicola*) provides not

only the basis for the more highly developed animal organisms, but is also, through the production of organic matter, the basis for the existence of microorganisms. These are stimulated at the base of the plants by other ecological factors, such as shade and the decrease in temperature.

As against the peneplains, the pediplains represent a drier location for vegetation and consequently produce less plant mass. The soils on these pediplains are generally very shallow, but nevertheless older and younger soil formations can be observed close to each other. The older soils can be 10–15 cm deep and contain calcrete. In some places, well-developed calcareous crusts occur. In contrast, the young soils, which are much shallower, consist of no more than a collection of mostly physically weathered material. Pedologically these are syrosemes, distinguished on the surface from the older, deeper soils, by the lack of vegetation.

The pediplains of this area do not consist only of weathered material of the local Inselbergs. Often a considerable deposition of aeolian material has taken place. In such cases the soils of the pediplains are then deeper, as is reflected by a thicker vegetation. But here, too, the necessary moisture for the growth of trees and shrubs is found only in erosion gullies and valleys.

Within the Inselberg complexes, the least degree of soil development is noticeable. The bare rocks themselves may show only brown discolouration along the cracks and fissures, implying a certain chemical decomposition of iron minerals. Furthermore, the decomposition of the rock is limited to the effects of physical weathering. Exfoliation and desquamation can be observed particularly well. The lobes, at first still sticking to the rock, gradually disintegrate along the edges into ever smaller, scale-like pieces. Towards the pediplains these rock particles eventually reach the size of gravel and grit. Further transport is usually fluvial.

Within the Inselbergs there are numerous systems of fissures and cracks which provide the primary starting-point for weathering processes. Water penetrates along these, and is here fairly well protected from evaporation. The result is a very localised but intensive soil development, and the creation of favourable plant locations. An increased supply of water which runs off from larger rock surfaces, the shade of the rock overhangs, and the resulting decrease in evaporation all have a positive effect on the growth of plants.

A very striking phenomenon of weathering can be noticed within the Inselbergs of the Mirabib area. This is the chemical decomposition of the rock on the shady sides and the undersides of individual rocks and boulders. It manifests itself as a disintegration of the granite and is most probably a chemical type of weathering. This specific type of weathering in particular locations is brought about primarily by the following factors:

- a) Water evaporates more slowly in these places and is therefore available as a weathering agent for a longer period of time.
- b) The weathering solution, enriched by salts, pro-

motes decisively the hydrolithic disintegration of the rock.

- c) The relatively high temperatures speed up the process of weathering.

This geological environment provides a number of resources which are important for human survival. Within the granite there are hollows and holes of considerable size. Here rain water can collect and remain in storage. The granite basement complex is commonly dissected by dykes of pegmatite and dolerite. These quartz pegmatites provide suitable raw material for stone artefacts. Ochre is found in iron concretions which occur in alluvial deposits and in metamorphic sandstone. Clayey loam suitable for the making of pots, is found in the Kuiseb River. Salt occurs in pans and salt marshes, of which there are many in this general area, Soutrivier and Ubib Vlei being the best known.

The fauna of the central Namib has been studied by a number of specialists (Brain 1974, Channing 1975, Hoogstraal and Dixon 1977, Coetzee 1969, Haacke 1977, Stuart 1975). In 1974/5 Stuart undertook an intensive survey of the mammalian fauna of the Mirabib Hill region (Stuart 1976). Apart from visual observations live-and kill-trapping was undertaken in the granite outcrops, the lower rock scree, the sandy washes and the open drainages. There is a wide range of small mammals including elephant shrews, different species of rats and mice, ground squirrels and gerbils. In a slightly larger size category there is a similar variety of animals ranging from jackals, different kinds of wild cat and hare to aardwolf, porcupine and hyena. Then there are steenbok, springbok, gemsbok and zebra. Over twenty reptilian species of snakes, lizards and geckos could have represented the most stable food supply which would have been available even during drought years. Over 40 species of birds have been observed to visit the Mirabib area (Dixon pers. comm.). Vultures which are also found in this area may have been useful indicators of the whereabouts of carcasses. Then there are birds which have their nests in this area and breed here. Their eggs could have been collected and they could have been hunted or trapped at waterholes. Finally mention must also be made of insects. Roasted locusts are a well-known dish and grubs and larvae are a potential source of protein.

3.2 The excavation

The Mirabib Hill Shelter was formed when a fault eroded in the granitic pluton. This fault dips at an angle of approximately 45° to the north-west. Shadow weathering took place along the base of the eroded area, from where weathered material was carried out by external agents such as wind, water, people or animals. The boulders near the front of the shelter have split off, possibly as a result of insolation along the cleavage faces which may have been marked by fissures originally. An area of 10 m from the back wall to the drip line and of more than

15 m across is therefore extremely well-sheltered from the elements and provided a spacious living area for its occupants.

The most striking surface features in this shelter are represented by an extensive dung floor (which is eroding out near the drip line), by over 45 upper and lower grinding stones and by accumulations of owl pellet remains (Sandelowsky 1974). A grid of 1 m² was laid out to cover the floor of the shelter and all the surface features were accordingly plotted (fig. 1). A trench 7 m x 2 m was laid out at right angles to the back wall in the centre of the shelter and a trial excavation covering three squares was carried out in 1973 (Sandelowsky 1974). Where it was not possible to follow the natural stratigraphy the deposit was brushed away in 5 cm levels. Dry sifting through a 3 mm mesh was followed by flotation and washing in water. Compact sections of the dung floor, the basal red sand and decomposing layers of granite bed-rock were not treated in this way. Bulk samples were kept.

The trench dug at Mirabib provided a sample of the deposit covering the large living area of this shelter. The greater part of this deposit has not been touched and could provide more information if so required at a later date. In order to maintain the unexcavated material *in situ* the trench was filled in the following way: the floor of the excavation was covered with 5–10 cm thick layer of river sand from a dry wash approximately 200 m away. The sides of the excavation were then shored up with rubble bricks from a broken down wall at the research station. The trench was then filled up with stones from outside the shelter and another two truck loads of brick rubble and stones from Gobabeb. The excavation was then covered with more river sand and on top of that was spread the sifted residue of the excavated deposit which had been piled up at the entrance of the shelter.

3.2.1 The stratigraphy and radio carbon dates

The section which has here been described by Scholz is situated in the centre of the shelter in grid square E where the deposit has the greatest depth (fig. 2). Organic material and charcoal samples for dating were processed and some of them were also collected by Dr J. Vogel of the CSIR Radio Carbon Dating Laboratory in Pretoria.

The deposit in this shelter accumulated under anthropogenic influence. Consequently it is very heterogeneous and does not resemble the structure of a natural profile. The picture is complicated by heavy disconformities of the layers, individual large stones, ash and charcoal concentrations, and accumulations of organic material. On the whole, the mineralogic content has two sources:

- a) the granite from the walls of the shelter as the material eroded and
- b) outside material transported into the shelter by wind. The bulk of the material consists of this aeolian component which, above the red dune sand has a grey colour indicating human activity.

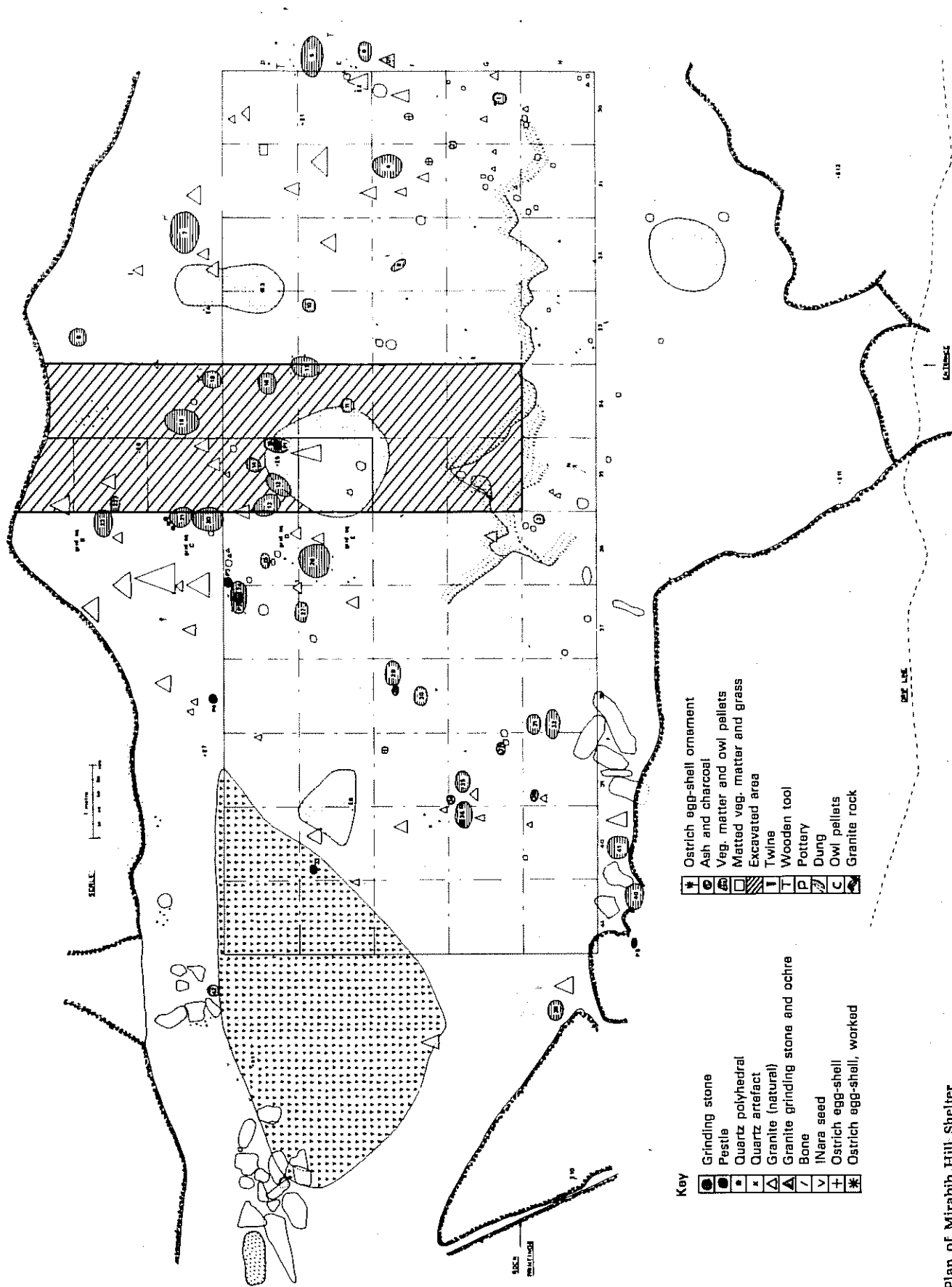
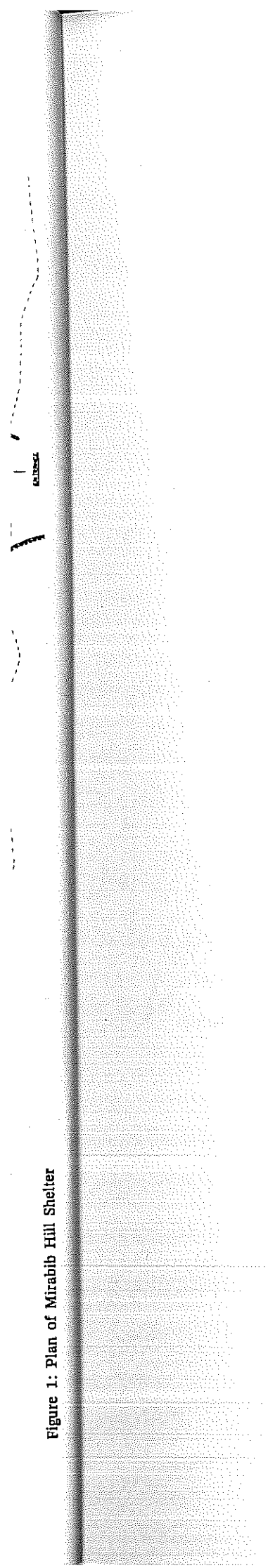
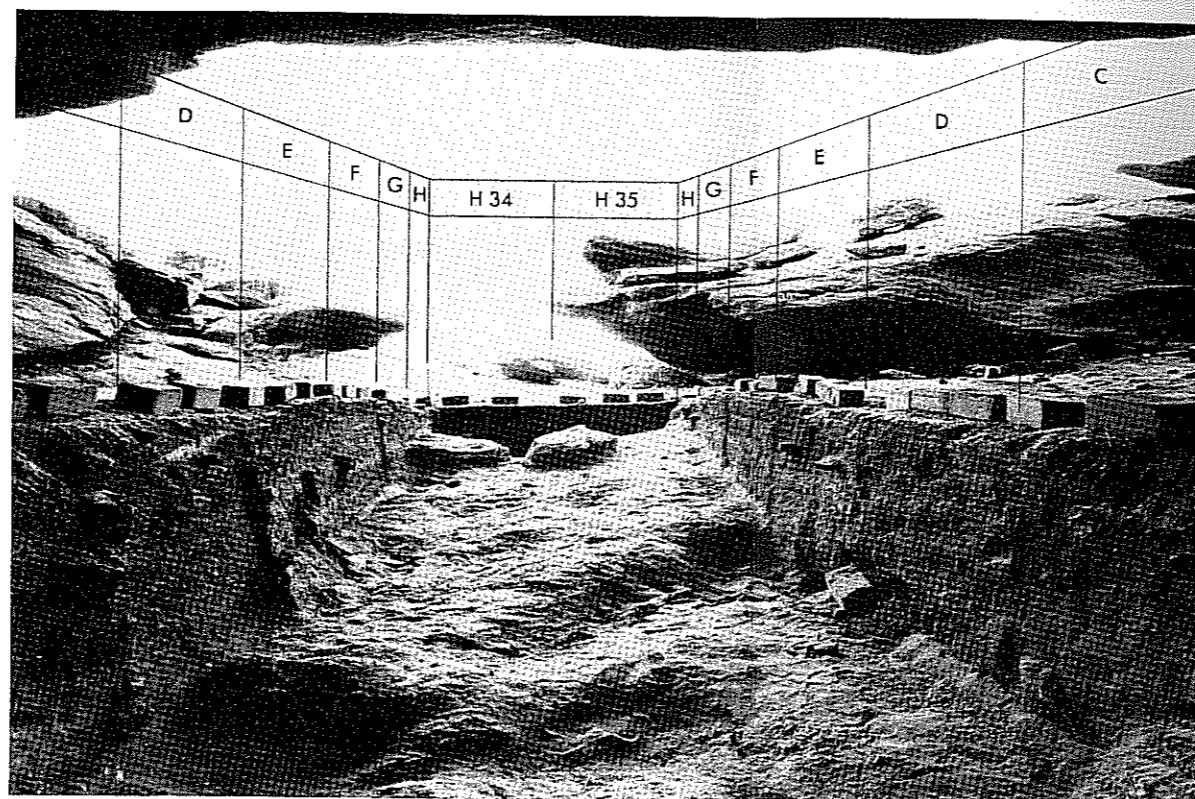
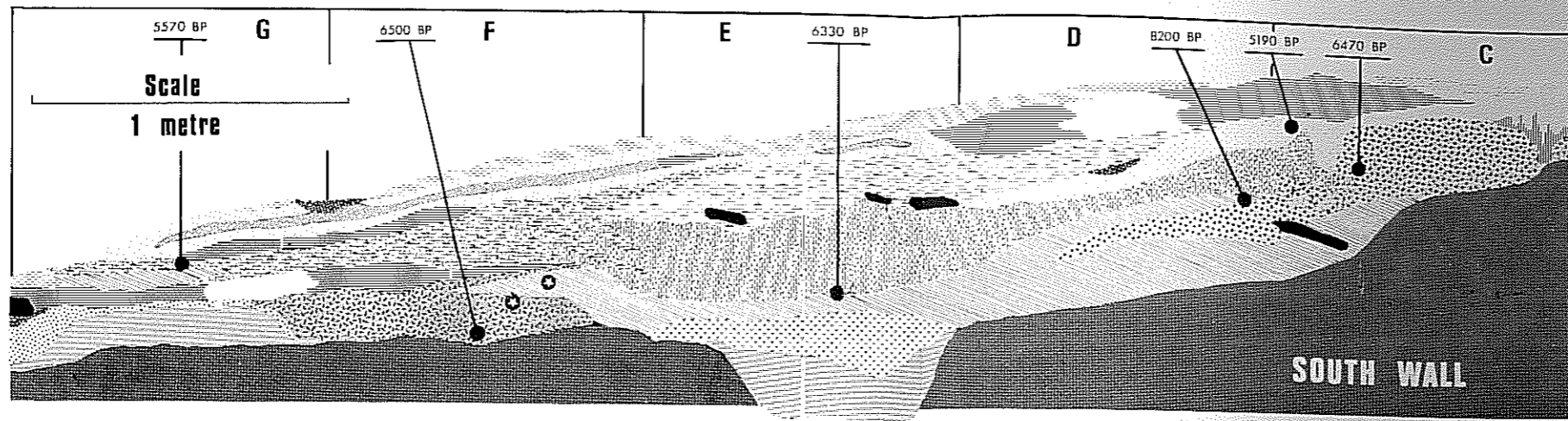


Figure 1: Plan of Mirabib Hill Shelter

Figure 1: Plan of Mirabib Hill Shelter





key

- | | | | |
|--|-------------------------------------|--|----------------------------|
| | fine earth with vegetation matter | | reddish sand & owl pellets |
| | coarse plant remains | | reddish sand |
| | fine plant remains | | lighter coloured sand |
| | brown layer & decomposed p. remains | | dark grey sandy layer |
| | sandy layer with plant remains | | dark ash and charcoal |
| | dung floors | | dark red sterile sand |
| | white ash | | decomposing granite |
| | grey ash | | granite bedrock |
| | dark ash | | quartz stone |
| | concentrations of charcoal | | stone |
| | reddish sand and ash | | dated charcoal samples |
| | sand and plant remains | | undated charcoal samples |

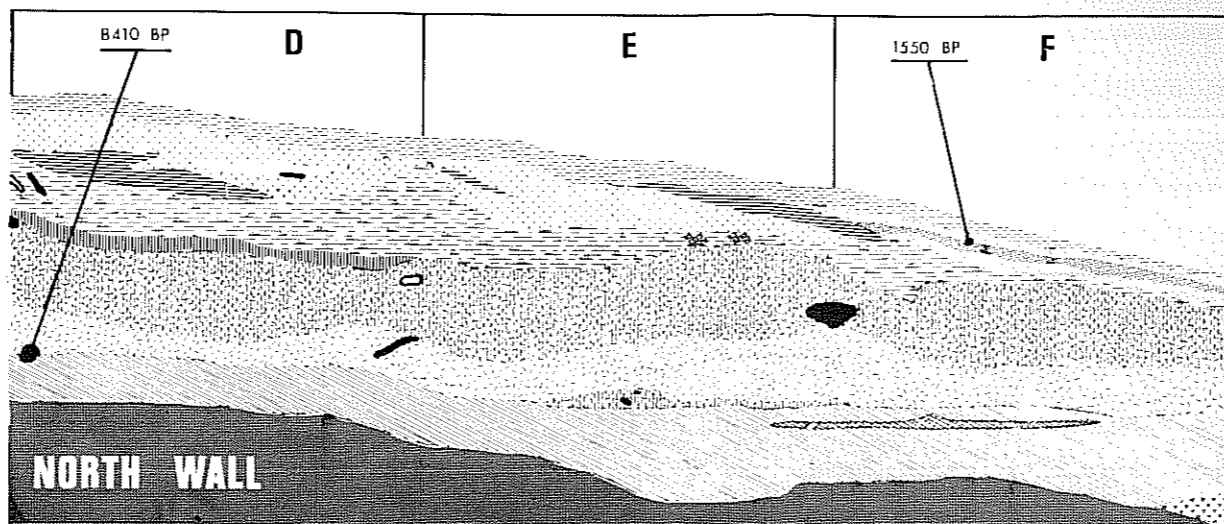
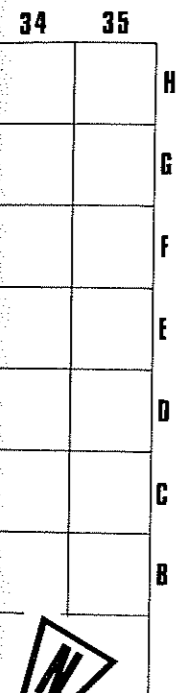
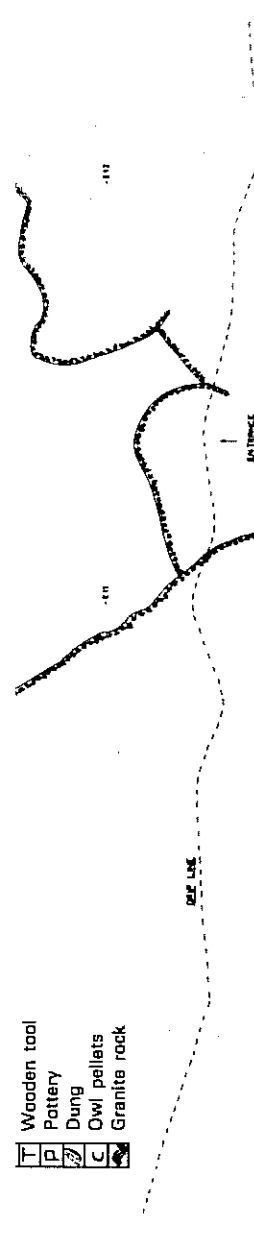


Figure 1: Plan of Mirabib Hill Shelter

Figure 2: Section of the deposit at Mirabib Hill shelter

- Wooden tool
- Pottery
- Dung
- Owl pellets
- Granite rock

- Granite grinding stone and ochre
- Bone
- Inara seed
- Ostrich egg-shell
- Ostrich egg-shell, worked



Plan of excavation as viewed in photograph

- 0—10 cm: brown-grey, loose sand; slightly gritty with a few stones mixed with ash dust; granitic weathering material which contains mica; furthermore preserved organic remains. This material is so loose and the possibility of contamination so great that an attempt to date this layer was not thought practical.
- 10—20 cm: dung floors; thinner (3 cm) and thicker (15 cm) light brown layer of predominantly organic nature; dung with a few grey bands, particularly in the lower parts; in the upper part well-consolidated and very coherent, probably stamped, in the lower part loose and more disintegrated nest-like accumulations of preserved grass stalks; occasional ash concentrations. A sample taken 6,5 cm below the top dung floor was dated to 1550 ± 50 B.P. (Before Present) (Pta 1535). Hair embedded in this layer was identified as belonging to sheep (Forensic Lab. S.A.P. Pretoria).
- ± 20 —35 cm: vegetation-rich layer; in the centre of the excavation there is a layer 15 cm thick which tapers out towards the sides. It is a mixture of sand, ash, charcoal, grit and stones, ostrich egg-shell and above all a large quantity of organic matter, consisting mainly of grass; numerous artefacts and a few large stones (up to 15 cm in diameter). Here too, layering can be noticed. A charcoal sample for dating was taken at 5—10 cm depth in grid square C 35, well below the lowest dung floor level, although the dung floor did not extend over the entire surface of this grid square. The date obtained was 5190 ± 75 B.P. (Pta 1011)
- ± 35 —60 cm: central sandy layer; brown-grey, poorly coherent sand, consisting predominantly of aeolian material, with artefacts and ostrich egg-shell; less organic material which, though well-preserved, is smaller and finer. A charcoal sample taken from a thin lens of ash and charcoal in this layer towards the back wall at 25—30 cm depth in grid square C 35 gave a date of 6470 ± 80 B.P. (Pta 1012).
Another charcoal sample was taken near the front of the shelter at 25 cm depth, in grid square G 35, 3 m from the first one. It gave a date of 5570 ± 50 B.P. (Pta 1348).
- ± 60 —75 cm: dark grey layer; dark grey to grey; poorly coherent; gritty; artefacts with very weathered organic re-

mains (grass and bones) which disintegrate upon touch. The material is predominantly of aeolian origin but has mixed with the granite grit of the shelter.

A charcoal sample was taken from the top of this layer at 35—40 cm depth, in grid square C 35, and was found to be 8200 ± 80 B.P. (Pta 1013).

Another charcoal sample was taken in grid square D 34, where the dark grey layer rests on bed-rock. This gave a date of 8410 ± 80 B.P. (Pta 1368).

A third sample for dating the dark grey layer was taken from grid square E 35, at 50—55 cm depth, where the dark grey layer forms a band between the central sandy layer and the deposit of red sand found in hollows of bed-rock. This sample gave a date of 6330 ± 60 B.P. (Pta 1347). Possibly this section of the dark grey layer, lying as it does on soft sand, has been contaminated by the central sandy layer, due to pressure from activity on the surface.

A further sample, taken close to bed-rock (70 cm—bed-rock) in grid square F 35, gave a date of 6500 ± 75 B.P. (Pta 1536). This sample was taken at a point towards the front of the shelter, where the deposit as a whole tilts downwards parallel to the bed-rock and where the dark grey layer may have petered out. Further samples are available for dating.

± 75 —80 cm: red, very poorly-coherent fine sand, which has collected in pockets and hollows of the bed-rock. It is free of grit and contains a strikingly large amount of mica. Probably mica-bearing material from the Kuiseb has been transported here, in addition to the dune sand. The absence of organic material precluded the dating of this layer.

85 \pm cm: gritty grey granite which is preserved in its original structure (possibly salt weathering), gradually changes into the solid granite bed-rock.

The apparent discrepancies between the depth measurements of the charcoal and those of the different layers described in the section are due to the fact that some of the samples for dating were not taken directly out of the section. They could have been taken as far as a meter away from the profile where the layer could have had a different thickness.

3.2.2 Sedimentological analysis

Samples from the three layers closest to bed-rock were submitted for chemical and physical analysis (table 2). In addition five thin sections, representing the four bottom layers i.e. the basal red sand, the dark grey layer, the central sandy layer (two samples), and the vegetation-rich layer, were made (plate 13 a-e).

3.2.2.1 Chemical and physical analysis

Comparing the particle size distribution in the samples from the three layers, the dark grey layer shows up expected differences. The basal red sand contains the highest concentrations of fine earth and fine sand, probably relating to dry, windy conditions. Both these components recede in the dark grey layer but increase again in the central sandy layer. It is not certain to what the higher amount of coarse and medium sand can be ascribed. The increase of the silt and clay fractions in the dark grey and the central sandy layer is striking. Assuming that these fractions derive from the silt terraces at present situated along the banks of the Kuiseb River, it is suggested that the basal red sand predates their deposition. Wind which would have transported the

TABLE 2: Analysis of soil samples
(done by R. F. Loxton, Hunting & Associates, Johannesburg)

Sample	Central sandy	Dark grey	Red sand
Particle size distribution (%)			
fine earth (< 2 mm)	93	81	99
c. sand (2.0-0.5 mm)	12	16	6
m. sand (0.5-0.2 mm)	16	21	13
f. sand (0.2-0.02 mm)	58	52	74
silt (0.02-0.002 mm)	3	1	1
clay (<0.002 mm)	11	10	6
Net extractable cations (me/100 g)			
Na	0,40	0,45	0,40
K	1,00	0,65	1,05
Ca	6,40	0,90	1,35
Mg	1,40	1,15	0,70
S. value	9,20	3,10	3,50
C.E.C.	9,40	3,60	3,80
S. value/100 g clay	84	31	58
C.E.C. clay	85	36	63
Ph.H ₂ O	7,0	7,2	7,4
Ohmns R 60°F	46	79	80
Saturation extract: soluble cations (me/100 g)			
Na	9,60	5,80	4,10
K	2,10	0,70	0,60
Ca + Mg	15,80	11,85	1,00
EC 10 ³ cm 25°C (mmhos)	42,86	25,14	19,29
% CaCO ₃ organic matter	5,95	2,95	2,05
% C	0,63	0,15	0,03
% CaCO ₃	5,95	2,95	2,05
% organic carbon in clay fraction	1,71	1,99	12,17
% CaSO ₄	9,00	7,90	0,27
% NaCl	5,70	3,10	2,42

coarser sand would also have brought the finer material, had it been available, into the shelter. Once deposited in this particular location it is unlikely that subsequent, weaker wind would have blown this material away again.

In the distribution of net extractable cations there is a similarity between the basal red sand and the central sandy layer. The dark grey layer diverges from what would have been consistent increases or decreases in the various components. A certain degree of such consistency is shown in the distribution of soluble cations. Here the remarkable feature is the sudden sharp increase of all the components above the basal red sand. The difference in this increase between the central sandy layer and the dark grey layer is attributed to the fact that during drier conditions such products of weathering as natrium chloride, gypsum and lime would have been blown into the shelter together with the greater quantities of sand. The virtual absence of organic substance in the basal red sand is considered to reflect an absence of vegetation cover in the vicinity of the shelter at that time.

The content of charcoal and organic carbon in the dark grey layer is only slightly higher than in the overlying layer, although it appeared to be much richer in these materials. The explanation for these conflicting impressions was provided by the thin sections because the element of fossilisation was recognised here. The results of these two approaches and the initial impression of this layer being interspersed with ash and charcoal suggest intensive habitation of the shelter. Accordingly more fire heat could have caused the brittleness characterising the organic remains in the layer.

3.2.2.2 Soil microscopy

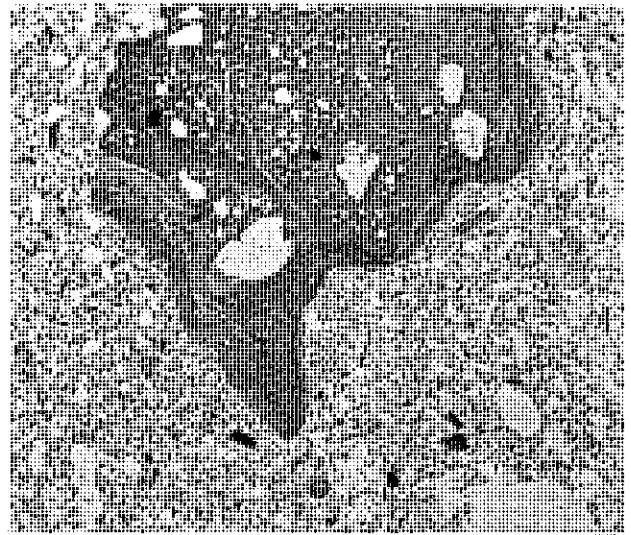
The International Soil Museum at Utrecht upon the request of Dr H. Scholz kindly prepared thin sections of five soil samples taken out of the profile at the Mirabib Shelter.

3.2.2.2.1 E 35: sample taken 55-60 cm from the surface (plate 13 a)

This sample was taken from a pocket in the basal red sand. Mostly it consists of fine, sandy quartz grains, some of which are well-rounded while others are sub-angular. The next most commonly occurring mineral is muscovite appearing in long narrow pieces up to 2 mm in length. There are also opaque mineral grains (ore), tourmaline and monacite grains. The material is very poor in clay which lies embedded in between coarser grains. The sample only contains such traces of organic matter as evident from the chemical analysis (table 2).

3.2.2.2.2 D 35: sample taken 45-55 cm from the surface (plate 13 b)

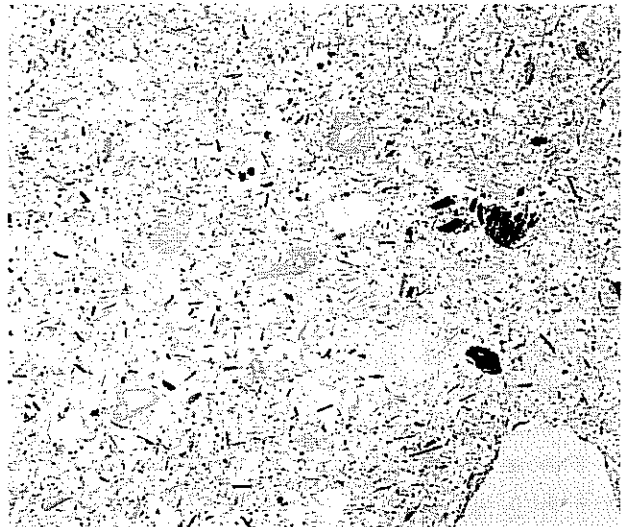
This sample which was taken from the dark grey layer consists of rounded grains of quartz, fragments



c) central sandy-layer (1:6)



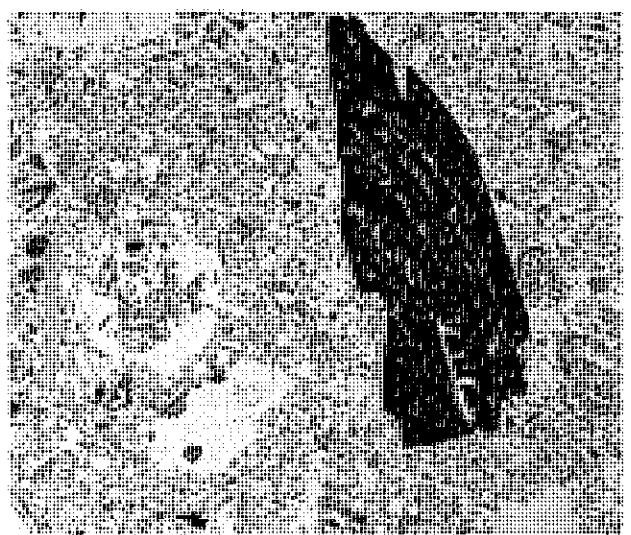
a) basal red sand (1:5)



d) light band in central sandy layer (1:6)



b) dark grey layer (1:6)



e) vegetation-rich layer (1:4)

Plate 13: Photographs of thin sections of soil samples

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of muscovite and feldspar. In addition to these minerals which constitute the bulk of the sample there are also larger, angular rock fragments which do not indicate an aeolian origin but which have become mixed up with the aeolian material. The silt and clay fraction consists mainly of ash. In comparison with the central sandy layer there are also more charcoal remains and more numerous fossilised organic remains.

3.2.2.2.3 E 34: sample taken 24–35 cm from the surface (plate 13 c)

This sample represents the bulk of the central sandy layer. It is marked by great heterogeneity. The skeleton consists of:

- a) grains of quartz, muscovite and feldspar implying an aeolian origin;
- b) large angular quartz fragments with a diameter greater than 10 mm;
- c) plant remains which can also have a diameter of more than 10 mm;
- d) charcoal remains, most of which do not exceed 1 mm in diameter.

Evidently the sediment has been thoroughly mixed by anthropogenic agency. The sample contains less charcoal than that from the dark grey layer and the ash content seems to be smaller as well. The fossilised plant remains are larger and better preserved and the cell structure can be recognised quite well in these dark brown or red brown fragments. The bone fragments seem to have a lighter, yellow colour and the cell structure is not clearly discernible.

3.2.2.2.4 E 34: sample taken 47–52 cm from the surface (plate 13 d)

This sample represents a coherent lighter-coloured band within the central sandy layer. It differs from it by larger charcoal fragments and by a higher content of ash in the silt and clay fraction. Organic particles of faunal and floral origin occur to a lesser degree. They are also fossilised.

3.2.2.2.5 E 35: sample taken 6–15 cm below the surface (plate 13 e)

This sample was taken from the vegetation-rich layer. It is marked by a very high content of organic material, particularly of very well preserved plant remains. Pieces of charcoal are larger than 1 cm and quartz fragments exceed a diameter of 5 mm. The plant remains show incipient signs of fossilisation. On the whole and by comparison with the central sandy layer the aeolian component of sand with its typical fraction is much smaller. Instead there is an increase in the fine fraction of silt and clay. Here too, there seems to have been thorough mixture of the deposit by anthropogenic agency.

3.2.2.3 Conclusion

The results of the sedimentological analysis are interpreted in the following way: the major component of the basal red sand originates in the dunes south of the Kuiseb River. The sand was transported into the shelter during extremely dry, windy conditions such as have not been experienced since. The lack of substantial amounts of organic material as well as of silt and clay implies a virtual absence of vegetation prior to the formation of the silt terraces which are found along the banks of the Kuiseb River today.

The dark grey layer differs from the underlying red sand on account of its organic components and the lower content of aeolian material. This and the high content of ash and charcoal suggest a denser vegetation cover and more intensive human occupation of the shelter. In accordance with this it is probable that the heat of many fires contributed to the fragmentation and brittleness of the material in this layer.

Conditions conducive to fossilisation prevailed in the dark grey layer as well as in the central sandy layer. Age may be the reason for the material in the vegetation rich layer not yet being fully fossilised. More aeolian material in the central sandy layer indicates windier conditions and less soil-anchoring plant growth. Such concentrations of ash and charcoal which occur in bands or lenses within the central sandy layer most likely result from more intensive habitation during relatively short periods of more favourable conditions.

Longer duration of such conditions are signified in the vegetation-rich layer. The high content of well-preserved organic material, the low component of windblown sand and the greater concentration of silt and clay implies a well vegetated environment less wind and intensive utilisation of the shelter. Conceivably similar conditions prevailed when the dung floor was laid down.

The results of the sedimentological analysis suggest that there is scope for intensifying this approach. The pedology of the study area indicates what the potential of the site can be, depending on the rain. With more care the origin of the sediment could be determined more precisely. For example, experiments could be constructed to establish more accurately the relationship between different components of the sediment (e.g. the silt and clay fraction) and their suggested place of origin e.g. the silt terraces along the Kuiseb.

The number of thin section samples could be increased and studied more carefully. As the anatomical study of the plant remains progresses it should become possible to identify fossilised organic fragments preserved in the thin sections. Where no other organic material has been preserved this could be of crucial importance.

3.2.3 Archaeo-ethno-botany

The reason for studying the plant remains found in the Mirabib Hill Shelter was twofold. Firstly, the botanical data was to provide an additional source of information on palaeo-environmental conditions, which were being reconstructed on the basis of faunal and sedimentological evidence. Secondly there was the hope of finding information on patterns in the subsistence economy of human populations inhabiting this area during the Holocene.

This information is emerging from an ethno-botanical study of the !nara (*Acanthosicyos horrida*). Seeds of this endemic cucurbit were found throughout the Mirabib deposit. Ricinus seeds (*Ricinus communis*) occurred in marked concentrations in the vegetation-rich layer, but have not yet been dealt with in detail, beyond establishing that *Ricinus communis* was present in this general area much earlier than was believed, and that it does not occur in the immediate vicinity today. Apart from the !nara and ricinus seeds, obviously collected by people and possibly brought from some distance, the bulk of the plant material is considered to have come from the immediate vicinity of the shelter. This material was studied with the aim of reconstructing the environmental conditions of this area. In this context it is not considered important that non-human agents might be responsible for the presence of some of the plant remains. Three different approaches were applied in the study of the archaeo-botanical evidence, whilst a survey of modern conditions provided comparative data.

The excavated material was analysed quantitatively as well as qualitatively. The qualitative analysis established that material from this excavation was well suited to an anatomical method of identification. Samples taken to test the presence of pollen were mostly sterile. Only the dung floor contained pollen, as yet unidentified (van Zinderen Bakker pers. comm.).

The third approach arose from an observation of the distribution and appearance of !nara seed-coats. This led to an ethno-botanical study of the !nara plant and its utilisation by the Topnaar Hottentots living along the Kuiseb River, some 40 km from the Mirabib Hill Shelter (Dentlinger 1977).

3.2.3.1 Preservation and recovery

Uninterrupted dry conditions are necessary for the long term preservation of plant remains. Situated in the central Namib Desert, Mirabib is therefore well suited as a site for the study of archaeo-botanical material. Not only does the deposit in the shelter contain well-preserved remains from the greater part of the Holocene, but also the present-day flora of the area is so restricted that it provides a reasonably small body of data for comparison with the archaeological material. Anatomically the flora of southern Africa has not been studied in detail. The simplicity of a desert ecosystem, such as that around

Mirabib, therefore serves as an ideal starting point for a botanical analysis related to the interpretation of habitat conditions.

The test trench covering an area of 14 m² was excavated at intervals over a period of 20 months, during which the excavation technique was altered to suit the demands of the material that was being recovered. When large quantities of highly-fragmented plant remains had been found in the first two grid squares, which were excavated next to the back wall, a method of flotation was judged the most practical means of recovery. After the deposit had been dry-sifted and hand-sorted as far as possible, the residue in the sieve was submerged in water. Material floating on the surface was caught in meal sieves and dried in the sun before being stored in plastic bags until further sorting was done in the laboratory.

At three central points in the excavation a 20 cm² sample column was collected to serve as a control for testing the total organic content in the deposit.

3.2.3.2 Sampling

The plant material from four central squares in the deposit was chosen for an intensive quantitative and qualitative analysis. The material was processed in excavated units of volume (100 × 100 × 5 cm). To ensure that this was a representative sample, spot checks were made by comparing the weights of units in the sample with those of twelve units from other parts of the excavation. For the final presentation of results, all the units belonging to one layer were added together.

3.2.3.3 Accumulations of plant material

The surface layer of loose, ashy material on top of the dung floor contained the best preserved plant remains. Twigs as long as 20 cm were found, some of them with bark, thorns and leaves.

Below the surface the bulk of the material consisted of fragments of wood, bark, twig and grass less than 5 cm long. A few leaves are preserved but they are brittle and larger ones are usually fragmented. !Nara seed coats were interspersed throughout the deposit. Occasionally seed coats mixed with other vegetable material, usually a matted pad of grass, would be concentrated over small areas 5–7 cm in extent. Ricinus seeds were found in more distinctive accumulations in the vegetation-rich layer (plate 14 a, b). Two grinding stones and the tip of a large granite stone were embedded in one such a concentration. Whilst no grass or other plant matter was found amongst the ricinus seeds, around them there was matted, grassy material, charred along the edges.

A thin layer of charcoal and grass was also found on top of another concentration of ricinus seeds,

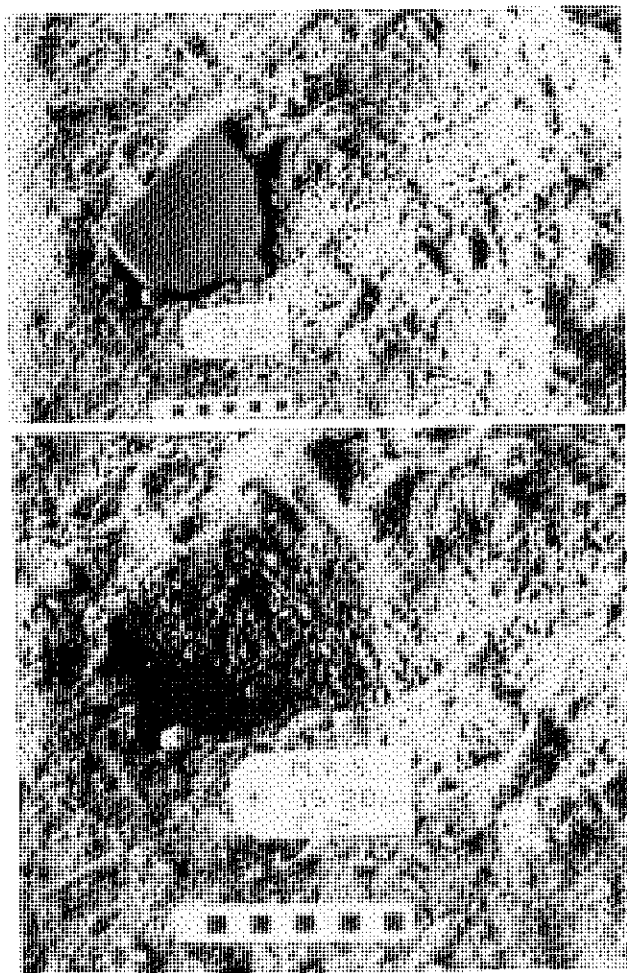


Plate 14: Ricinus seeds in the vegetation-rich layer (upper) a grinding stone, lower) seeds found below it

here mingled with seashells. This accumulation was found immediately below the lowest dung floor. Three other concentrations of vegetable matter occurred in association with small pits or hollows. These combinations were found only in the vegetation-rich layer, one of them extending down into the sandy layer. This had a conical shape and dipped down to a depth of approximately 12 cm (plate 15). It must have been lined or filled with some material which gave its earthen wall a harder texture than that of the surrounding deposit. It could be effectively swept out with a paint brush, but could not be lifted. Consequently it was raised by means of a supporting cast of plaster of Paris. A concentration of rodent bone, ash and grassy vegetable matter inside this pit contrasted with the material in the surrounding deposit.

Immediately below the dung floor layer, extensive concentrations of plant material were found. In one of these, a nest or basket-like structure with a diameter of approximately 10 cm was found. It consisted of plant material cemented together with fine earth and could be picked up out of its surrounding matrix of less firmly matted plant matter. The concentration of vegetable matter extended, almost like a column, deeper into the deposit, and into another nest-like depression or pit of the same

shape and size as the one just described, but without plant matter incorporated into its wall. Its inside surface and the surface on its well-defined, convex edge resembled the conical pit mentioned earlier on. This lower pit was approximately 10 cm to the side of the basket-like one above it. It was also taken out within a plaster cast.

In the central sandy layer only *Inara* seeds were found in slightly denser concentrations. The remainder of the plant fragments, consisting of isolated fragments of twigs, wood, bark, leaves and grass in an excellent state of preservation, were distributed fairly evenly throughout the layer.

The small amount of organic material recovered from the dark grey layer was in a poor state of preservation, charcoal constituting the bulk of this material.

Near the front of the shelter there was a thick layer of well-preserved pieces of charcoal. The concentration was arc-shaped, approximately 80 cm thick at the broadest point and continuing into the unexcavated section of the deposit. This charcoal does not look like the residue of a hearth or cooking fire but suggests rather that a structure of twigs and branches was burnt down. A brushwood enclosure comes to mind, but further excavation would be needed to establish this. In both the grid square over which this accumulation extended, the charcoal fragments stuck to the bottom of the second dung floor. The edge of the third and lowest dung floor was charred and may be associated with the burning, although the charcoal layer extended through the vegetation-rich layer into the sandy layer, but did not, however, make contact with the dark grey layer.

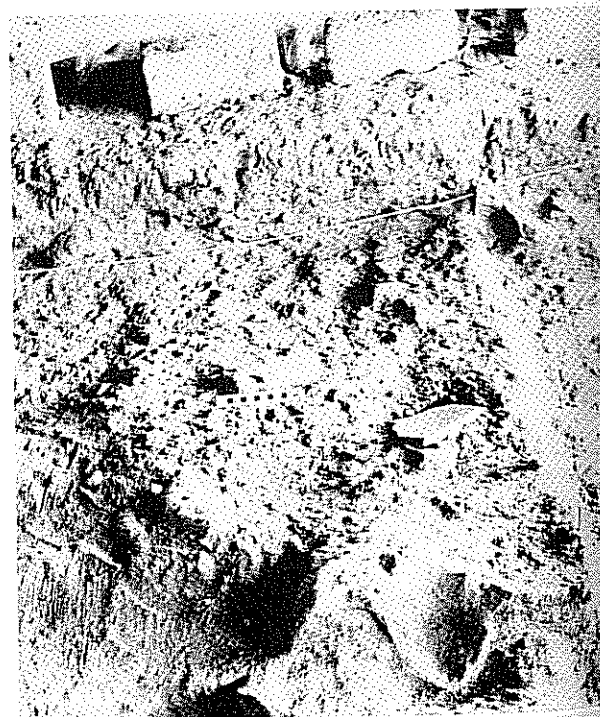


Plate 15: A small pit which could have been used for storing seeds

3.2.3.4 Quantitative analysis

In the laboratory, the contents of every excavation unit were spread out on a tray and sorted into categories of twigs, bark, wood, grass, seeds, leaves and charcoal. Each of these was weighed. As leaves and grass occurred in such small quantities, it was decided that they should be excluded from the summary of mass presented in the table (fig. 3). The variable amount of plant remains found in the different layers corresponds to the volume of the layer as well as to the conditions of preservation. The high percentage of charcoal in the vegetation-rich layer and in the sandy layer obscures the relative occurrence of the other materials. Since most of this charcoal was part of what is thought to be the burnt down structure, the high amount of charcoal creates a false impression. It was therefore decided that the different categories of material should be represented separately as well. The charcoal found in the dark grey layer does, however, represent a significant constituent in the data and must be considered independently. Since unburnt material may have decayed, the charcoal might represent only a part of the total plant material. If the surface layer were taken to represent an average ratio of charcoal to other plant materials, it is possible that the dark grey layer contained a great deal more plant material than any other layer, and

much more than is represented by the volume recovered during excavation.

The highest concentration of bark was found in the vegetation layer. Less than half of that amount was found in the sandy layer. The dung floor contained about 5% less bark, and only 21% of the total bark was found in the surface layer, even though preservation was good. The negligible amount of bark recovered from the dark grey layer probably results from poor conditions of preservation. Almost half of all the wood remains came from the dung floor. Ten per cent less wood was found in the vegetation layer, but as such it still contained almost four times as much wood as found in the sandy layer. Again the amount of wood from the dark grey layer was small. The surface layer contained less wood than the dung floor and the vegetation layer, but more than twice as much as the sandy layer.

The amount of twigs recovered from the dung floor and the vegetation layer considerably exceeds the amount from the sandy layer. It also exceeds the amount from the surface layer, though to a lesser extent. There are hardly any twigs preserved in the dark grey layer. The mass for the caches of ricinus seeds in the vegetation layer were not included in the total mass for seeds. The bulk of the remaining seeds, in contrast to the other plant matter, was found in the sandy layer. Slightly fewer seeds

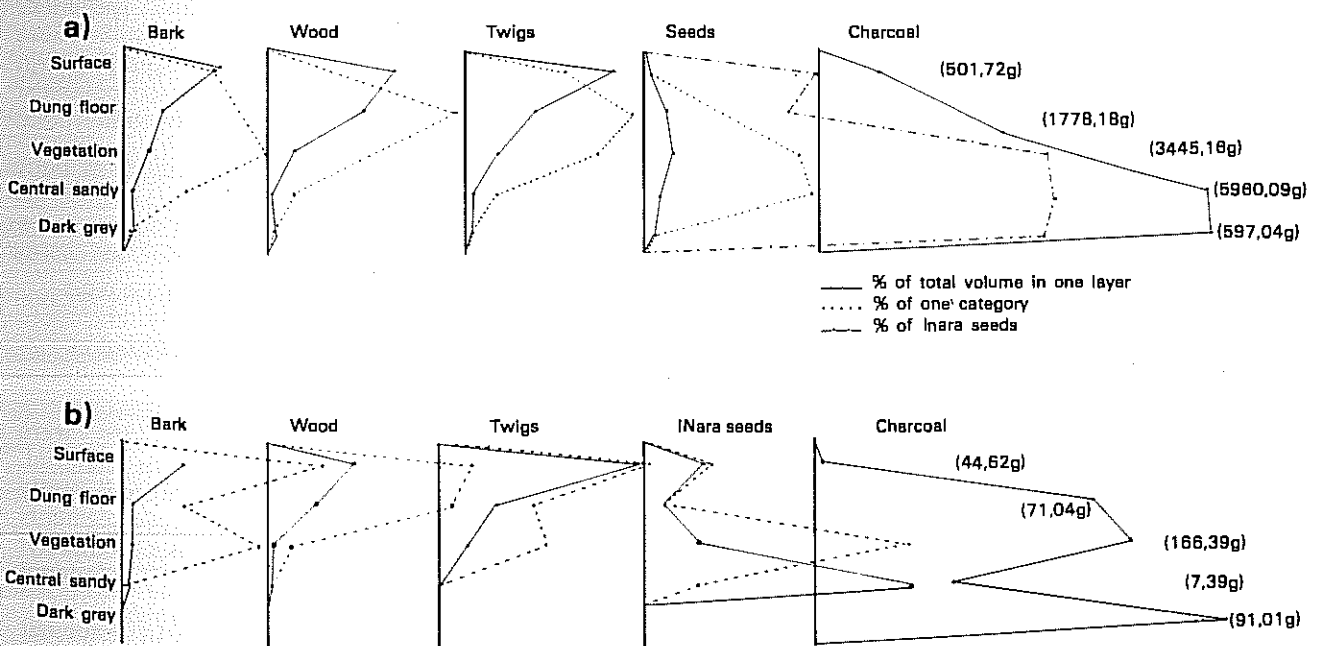


Figure 3: a) Plant remains in each layer
 b) Plant remains from 1 unit per layer

occurred in the vegetation-rich layer, with decreasing amounts occurring in the dung floor, the surface and the dark grey layer. !Nara seeds constituted the bulk of all the seeds (fig. 3). They were separated from the other seeds, showing an interesting ratio to them: in the dung floor only 35,40 % of all the seeds were !nara seeds, whereas they represented 99,44% of all seeds in the sandy layer. A similarly high concentration of !nara seeds (98,22%) was found in the vegetation layer and they constituted 42,0% of the seeds in the surface layer. The amount of 97,98% found in the dark grey layer may once more have to be considered in terms of the means of preservation. It is possible that !nara seeds preserve better than other seeds. Considering the variable thickness of the layers, it was decided to compare the percentage of total plant remains found in a single excavation unit from each layer. The frequency of plant material in the six different layers is presented in a table (fig. 3). There is a high concentration of plant remains in the vegetation-rich and the dark grey layers (43,76% and 23,88% respectively). The surface layer contained only 11,7% and the sandy layer shows up as a remarkable contrast with only 1,94%. The dung floor contained 18,72 %. The dark grey layer is represented exclusively by charcoal, but as such comprised 23,88% of the plant remains collected in the six distinct depositional units. No organic material was found in the deposit of red sand filling hollows in the bed-rock beneath the dark grey layer.

The units used in this comparison were chosen subjectively so as to represent the average or most common situation in each layer. In the vegetation layer, a unit was chosen which did not contain part of a seed cache. In the sandy layer, accumulations of the well-preserved charcoal were avoided. The material representing the dark grey layer comes from the central part of a thick band of the layer.

3.2.3.5 Qualitative analysis

In southern Africa no use has so far been made of archaeo-botanical evidence other than pollen in the interpretation of palaeo-climatic data (Sandelowsky 1976). In most areas the conditions are such that it is not standard practice to collect all the plant remains and flotation methods (Higgs and Vita-Finzi 1968) are seldom applied. It is difficult to have materials identified. At the Botanical Research Institute, where an identification service is officially available, there is a ten year backlog of work. There are not many people with specialised knowledge of the Namib Desert flora, and only 20% of a sample of material submitted for morphological identification at the Botanical Research Institute could be identified. Consequently an attempt was made at identification on the basis of anatomical characteristics.

From the material which had been sorted in preparation for weighing, five units from distinctive

strata in the deposit were chosen. Specimens from these units were prepared for micro-analysis. The weighed collections of twigs and woody fragments were scrutinised with the aid of a microscope and sorted into sub-groups according to such characteristics as small hairs or fissures in the outer surface. From every unit a few pieces of charcoal as well as two or three specimens from every sub-group of twigs and wood were selected for anatomical identification. Although leaves and grass bases were also prepared, with the aim of testing their suitability for the process, only cross-sections through stems and wood were used for this stage of identification.

The method used for microscopic identification was suggested by Roger Ellis of the Botanical Research Institute in Pretoria. He has also provided the following description of the process which led to the identification of the archaeo-botanical material from the excavation at Mirabib.

3.2.3.5.1 Choice of reference material

Woody species found growing under present-day conditions within a 30 km radius of the Mirabib Hill Shelter, were chosen for use as reference material for anatomical comparison with the woody plant remains excavated from the shelter. The most important woody species in the plant communities falling within this area were extracted from a phytosociological survey of the Namib Desert Park by Robinson (1977, this volume). Representative material of the ± 40 species thus chosen was removed from authenticated herbarium specimens collected from as near as possible to Mirabib. These reference twigs and thin stems were prepared in exactly the same way as the archaeo-botanical material, and used to facilitate identification (plate 16).

3.2.3.5.2 Preparation of reference and archaeo-botanical material for microscopic examination

Normal plant microtechnique procedures were employed for the preparation of all the material. Segments about 1–2 cm long were cut and gently boiled in water for about one hour. These segments were dehydrated in the following series — methyl cellosolve, 100% ethanol, n-propanol and u-butanol — 12 hours in each solvent at 0°C. The material was then impregnated and embedded in tissue-mat (M. Pt. 56,5°C). Each wax block was trimmed, one end of the embedded segment exposed and then soaked in Mollifax for one to three weeks to soften the tissues. This softened material was then cross-sectioned in a transverse plane with a rotary micro-

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tome, double-stained with saffranin and fast green, and mounted with Permount under a coverslip on a glass slide.

3.2.3.5.3 Identification of prepared material

The transverse sections of the reference species were photographed at various magnifications. As twigs with little secondary xylem pre-dominated in the excavated material, conventional wood structure was of little assistance and thus characters as seen in tangential and radial longitudinal section were not used.

The photomicrographs of the voucher species were grouped according to shared anatomical characters. It was found that vessel distribution and parenchyma ray structure was sufficient to place the 42 species into small, manageable groups for final visual comparison with the voucher specimen photographs (plate 16). Thus, eight species displayed radial chains of vessel, such differences as whether the parenchyma rays were multi-, bi- or uniseriate, the length of the chains of vessels, vessel size and bark structure, especially the presence of mucilage canals, were sufficient to distinguish the individual species in this group. (*Moringa ovalifolia*, *Monechma genistifolia*, *Hermannia affinis*, *H. stricta*, *Ficus cordata*, *Euphorbia guerichiana*, *Maerua schinzii* and *Boscia foetida*). A further 12 species possessed only solitary vessels and were further distinguished by vessel size and structure, ray structure, pith size and characteristics of the primary xylem groups. (*Dichrostachy cinerea*, *Barleria merxmuelleri*, *Dicoma capensis*, *Grewia flavescens*, *Croton gratissimus*, *Montinia carophyllacea*, *Hibiscus elliottiae* and the *Acacia* species — *albida*, *erubescens*, *erioloba*, *mellifera* and *reficiens*). A further category showed variable vessel arrangement — either in short radial groups or solitary. Thus, *Rhus marlothii* has wide vessels, either single or small radial groups and with uniseriate rays, the cells of which are filled with crystals and tannin. *Cordia*

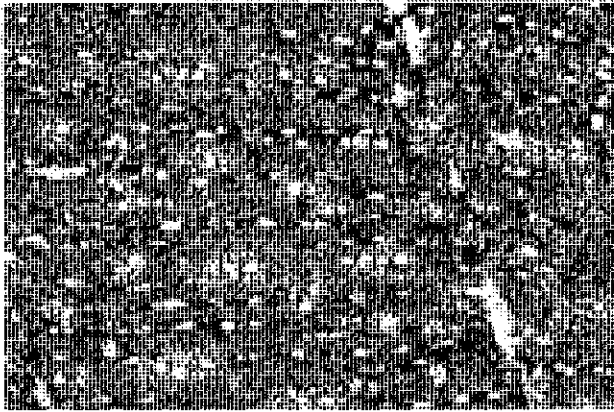
ovalis is similar but with biseriate rays. The *Cornmiphora* species — *saxicola*, *glaucescens* and *virgata* — have vessels of variable size and arrangement, but can easily be distinguished by characteristic canals in the bark. *Parkinsonia africana* has narrow vessels in radial groups or singly with very few parenchyma rays and with dense, homogenous, fibrous ground tissue. *Hermannia modesta* and *H. elliottiana* are both much like *H. stricta*, but their vessels are either solitary or in shorter radial rows of only two to four vessels. Both *Euclea undulata* and *E. pseudebenus* have narrow vessels, either solitary or in short radial groups, without parenchyma rays, but they can be distinguished by the radial chains of protoxylem vessels.

In *Galenia africana* the vessels are in short radial rows, with conspicuous growth rings each separated by a continuous band of unligified parenchyma. *Salvadora persica* and *Tephrosia monophylla* both fall into this group but have very little secondary xylem and wide piths. Certain species either have no vessels or the vessels are very narrow and not typical vessels at all. Thus, *Ruellia diversifolia* and *Zygophyllum simplex* have long chains of narrow vessels extending into the pith. They both lack radial rays. *Catophractes alexandri* and *Phaeoptilum spinosum* both lack obvious vessels but have numerous well-developed radial parenchyma rays. *Petalidium lanatum*, *P. setosum* and *Maytenus heterophylla* have numerous, very narrow, solitary vessels. *Kissenia capensis* and *Tribulus zeyheri* possess no secondary xylem.

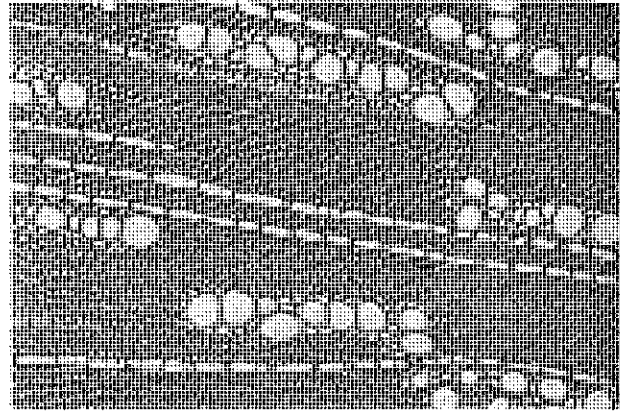
The results of the anatomical identifications are summarised in the following table. The sample here represented is largely a product of the degree to which material from different layers was preserved, and of the effectiveness of laboratory techniques applied in the course of processing the material. The sample is not statistically representative, consequently no attempt will be made to interpret this table. The following comments are made to explain the origin of the identified material.

The sample from grid square E 34 5—10 cm represents material just beyond the edge of the dung floor. It is likely to be contemporaneous with the dung floor.

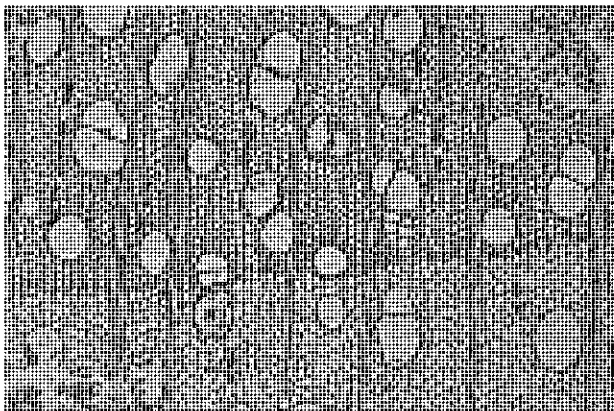
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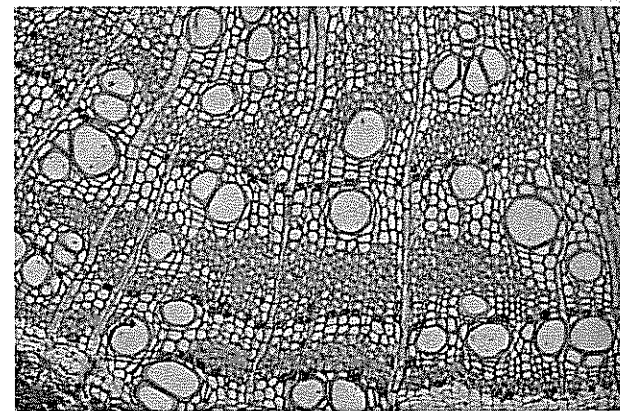
a) Charcoal from vegetation-rich layers identified as *Boscia foetida* (1:16)



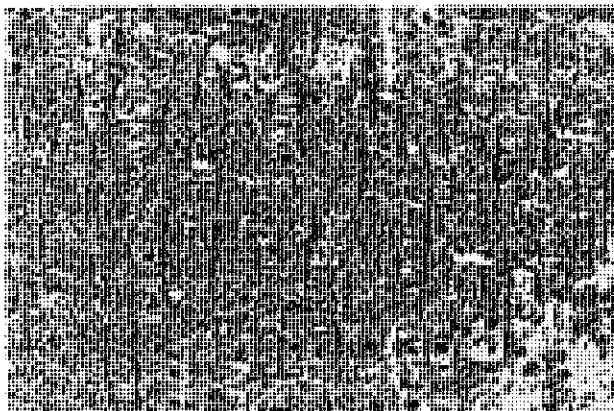
b) Key specimen: *Boscia foetida* (1:18)



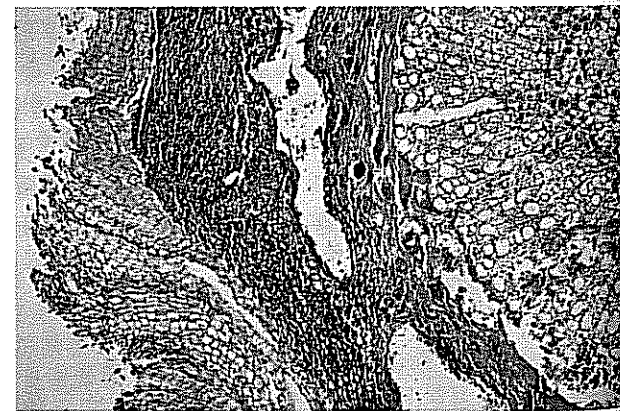
c) Wood fragment from vegetation-rich layer identified as *Acacia erioloba* (1:18)



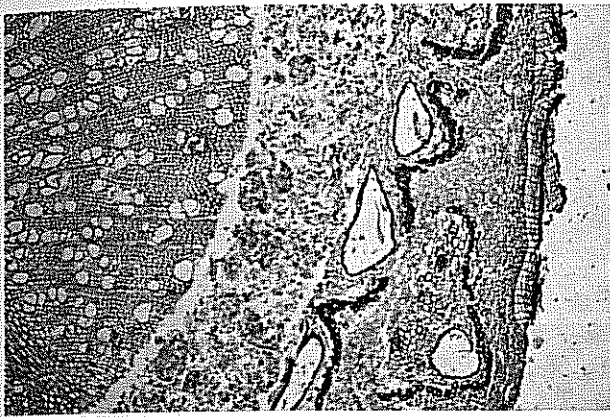
d) Key specimen: *Acacia erioloba* (1:18)



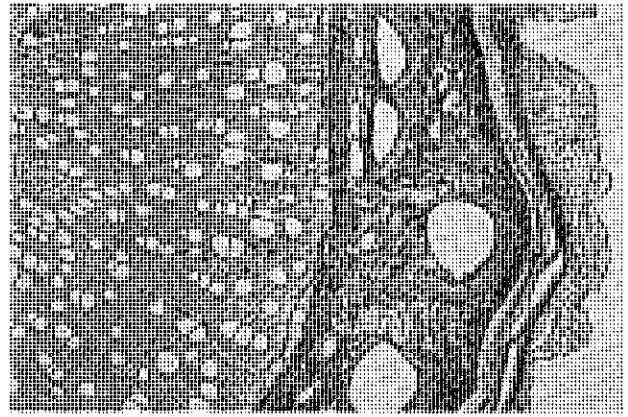
e) Wood fragment from central sandy layer identified as *Acacia erioloba* (1:16)



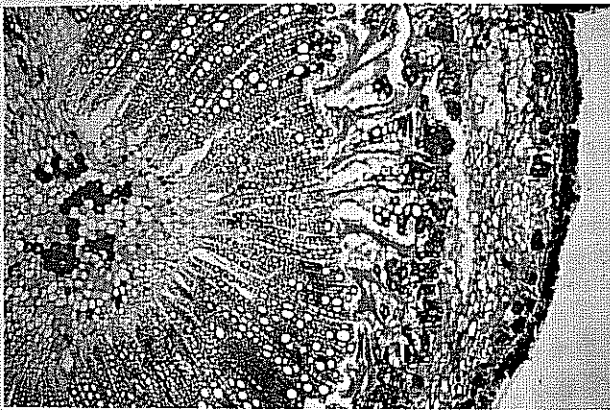
f) Stem fragment from dung floor layer identified as *Commiphora saxicola* (1:13)



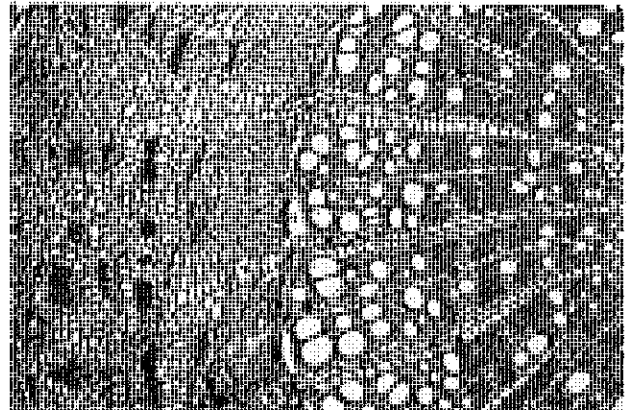
g) Stem fragment from vegetation-rich layer identified as *Commiphora saxicola* (1:12)



h) Key specimen: *Commiphora saxicola* (1:12)



i) Stem fragment from dung floor identified as *Cordia ovalis* (1:12)



j) Key specimen: *Cordia ovalis* (1:18)

TABLE 3: Summary of anatomical identifications

Plant species	excavation units				
	E34 5–10 cm	D34 10–15 cm	C34 25–30 cm	E34 25–30 cm	E34 45–50 cm
<i>Acacia erubescens</i>			1	1	
<i>A. erioloba</i>	1		4	10	6
<i>A. erioloba</i> charcoal	1	6		1	
<i>A. reficiens</i>		3	2		
<i>Boscia foetida</i>	1	3			
<i>Boscia foetida</i> charcoal		2		1	
<i>Catophractes alexandrii</i>			1		
<i>Commiphora glaucescens</i>				1	
<i>C. saxicola</i>			2	3	
<i>Cordia ovalis</i>	3		2		
<i>Croton gratissimus</i>	1			2	
<i>Dicoma capensis</i>	1			2	
<i>Ficus cordata</i>		1			
<i>Hermannia affinis</i>	1				
<i>H. stricta</i>				1	
<i>Hibiscus elliotiae</i>		1			
<i>Kissenia capensis</i>	1			1	
<i>Maerua schinzii</i>		1			
<i>Montinia caryophallacea</i>		1			
<i>Parkinsonia africana</i>			1	1	
<i>Petalidium setosum</i>	1				
<i>Phaeopitulum spinosum</i>		1		1	1
<i>Rhus marlothii</i>		3	2	3	
unknown but identifiable	7	8	8	2	2
unidentifiable	3	4	1	5	2

fied as

The material from grid square D 34 10—15 cm belongs to the base of the vegetable-rich layer beneath the dung floor.

The sample from C 34 25—30 cm comes from the central sandy layer.

The sample from E 34 25—30 cm represents the lower part of the sandy layer, whilst E 34 45—50 cm constitutes part of the dark grey layer.

A number of plants found in the excavation do not appear on the list of species found in the Mirabib area today. This raises a number of questions to be investigated. How far away from Mirabib do these species occur today? Do they share any characteristics? What can they tell us about conditions in the past?

3.2.3.6 Ethno-botanical study of the !nara

The !nara plays an important role in the economy of the Topnaar people who live in small villages on the northern bank of the Kuiseb River. A separate study was initiated to investigate and describe the utilisation of this plant (Dentlinger 1977).

3.2.3.6.1 The !nara

The most obvious and readily identifiable plant remains in all the layers at Mirabib were the seeds of an endemic cucurbit, the !nara (*Acanthosicyos horrida*). According to Professor C. H. Bornman of the University of Pretoria "the seeds make up approximately one third of the volume of the fruit, and when fully ripe contain 20% water. In terms of food value they are by far the richest component of the fruit:

	%
protein (kjeldal nitrogen x 6,25)	25
fat	29
fibre	38
ash	4
undetermined sugars	4

Trace elements such as zinc, copper and manganese are present, as are macro-elements such as calcium and iron".

The !nara is a highly adapted, endemic plant, growing in loose dune sand (Herre 1975). It can survive extremely dry conditions but requires a little rain for germination. The bushes cover sandy hummocks on the side of dunes. Leaves have turned into thorns and photosynthesis takes place directly through the stems.

3.2.3.6.2 Preservation

The stems, thorns and fruit coats do not preserve well, presumably because they are eaten by animals and are of no use to people. Seeds and seed-coats, however, were found in the excavation and near the Topnaar settlements.

A test on the breakage patterns of the seed-coats was designed to ascertain whether the remains of the !nara in the Mirabib Hill Shelter were the result of human agency.

Remains of !nara seeds from three different locations were studied:

- material found in the excavation
- remains of !nara seeds collected from the surface near a house in Soutrivier village by three people independently (a toddler, an older woman living at Soutrivier and myself). The collections were checked against each other to make sure there was no preferential selection of certain types of fragments. Similar proportions of breakage patterns were found in all three lots, and it is therefore assumed that the entire collection is a representative sample
- remains of !nara seeds collected from the edge of a large !nara bush in the Kuiseb River valley, with melons at all stages of ripeness.

A preliminary study of different collections indicated three phenomena:

- different patterns of breakage which were distinguished from one another on the basis of shape and size of the seed-coat
- different degrees of decay, best described as a flaking away of the seed-coat surface. This latter phenomenon was particularly noticeable in the remains from the various levels of the excavation
- in some cases where !nara melons were deliberately positioned for study, animals consumed the entire fruit.

3.6.3.6.3 Breakage patterns

In freshly broken seeds two types of edges were distinguished:

- one showing a straight fracture, very often coinciding with the seam of the seed
- sometimes the fracture is a rather wide zig-zag, at angles to the seam
- the other is a jagged edge such as could be brought about by the teeth of a small gnawing animal
- an effect similar to (c) along otherwise straight fractures of very decayed seeds. Under a microscope (10 x magnification), however, the flaking of decay can be distinguished from the gnawing marks of small teeth.

Sizes

Three different sizes of fragment were observed:

- a) seeds broken into two halves along the seam of the seed-coat
- b) seed-coats not broken along the seam but constituting more than 50% of a half-seed
- c) fragments of seed-coats representing less than 25% of the original seed-coat surface.

3.6.3.6.4 Findings

In the material from Soutrivier and from the excavation, breakage pattern a) and b) accompanied size classes a) and b).

Breakage pattern c) accompanied size class c) in the material from the edge of the !nara bush in the river valley.

It is therefore concluded that human utilisation of !nara seeds is indicated by the following criteria:

- a) preservation of seed remains — usually just the seed-coats — occasionally a complete seed
- b) 25%—50% of the entire seed-coat surface usually preserved, the most common occurrence being half-seeds, split along the seam
- c) the edge of the broken seed-coat characterised by a straight line of fracture, very often along the seam
- d) under a microscope, the difference between gnawed and decayed edges can be distinguished.

In contrast the following features are typical of non-human utilisation of !nara seeds:

- a) Seeds and seed-coat disappear completely
- b) Where remains of the seed-coat do occur they are minute i.e. less than 25% of the entire seed-coat surface
- c) Edges of the broken seed-coat are characterised by gnawing marks in irregular jagged lines. Breakages along the seam are rare.

3.2.3.7 Conclusion

The work on the archaeo-botanical material has led to the development of methodological technique, and has provided information on the variable distribution of plant remains in six distinctive depositional units spanning more than 8 000 years.

For recovering plant remains from such a site as Mirabib, the process described proved practical. Even the material submerged in water did not suffer and could be handled well in the process of further

work in the laboratory as long as two years after excavation. The bulk of the material was worked on in the Namib Desert and never left that dry climate.

Although the results of the quantitative analysis have been approached in three different ways, they show a distinct pattern of change.

In relation to equal parts of volume 43,76% of the plant remains recovered from the six distinct sediments are concentrated in the vegetation-rich layer. Assuming that charcoal indicates the availability or presence of plant material, it is suggested that a similar, if not greater concentration of vegetable matter occurred in the dark grey layer. As it is, charcoal, the only plant material preserved in this layer, constitutes 23,88% of the vegetable remains.

Fairly similar quantities of botanical material are found in the dung floor layer and in the surface layer (18,72% and 11,7% respectively).

By comparison, plant remains are conspicuously rare in the central sandy layer (1,94%) and completely absent in the deposit of red sand occurring in rocky hollows beneath the dark grey layer; it is suggested that this reflects the relative frequency of vegetation in the vicinity of the shelter.

The distribution of seeds in the Mirabib deposit supports the impression of alternating dry and moist conditions.

The poor preservation in the dark grey layer does not indicate accurately to what extent !nara are represented in that layer. In all the overlying layers, however, !nara seeds are an important feature (fig. 3). In the dung floor all seeds decrease, comprising only 6% of all the plant remains, and of these only 33% are !nara seeds. This could well be related to the introduction of sheep when meat became more abundant in the diet, accounting for a decrease in !nara. In the central sandy layer !nara comprise 99,44% of the seeds which in turn constituted 64% of all the plant remains. Similar frequencies were found in the vegetation-rich layer. In the surface layer !nara seeds are once more an important item. Ethnographically the !nara still plays a role in the economy of the stock-owning Topnaar people (Dentlinger 1977).

The data from the quantitative analysis should soon be enhanced by additional qualitative evidence. Experiments in the qualitative approach have demonstrated that the method of micro-identification can be applied to archaeo-botanical material. Considering the wealth of sites in the Namib Desert alone this technique has considerable potential and can subsequently be applied in botanically more complex areas.

Very little is known about the !nara plant, its conditions of growth and distribution. It is a food plant of considerable nutritional value growing in areas where few other plants survive. A closer study of this plant is certain to provide significant ethnobotanical information.

3.2.4 Stone artefacts and other cultural material

The bulk of the artefactual material consists of microlithic implements made of quartz. Larger stones were used for grinding and hammering. A few fragments of worked wood and knotted grass may be a poor indication of the position of these in the material culture of the inhabitants of Mirabib. Bone and hide were probably of similar importance and are represented by a few leather fragments and pieces of worked bone. Isolated fragments of metal and pottery were found close to the surface only (plate 17d, 18c).

On the surface of each of three granite grinding stones there was a red stain, probably from grinding ochre. A similar colour was noticed on ostrich egg-shell fragments, beads, pieces of bone and marine shell. Strands of tightly curled human hair were encrusted with ochre-coloured paste (plate 18a). In one case an ostrich egg-shell bead was attached to the end of a strand of hair. Red colour and in some cases human hair, also adhered to sharp-edged chips of quartz (fig. 4 e, h). These stone fragments were neither well-shaped flakes nor did they show signs of secondary working.

Nodules of haematite or iron ore were found in all the layers. Some of these are soft and can be rubbed to make a reddish colouring matter. Others are too hard. It is possible to melt them, but in the absence of any other signs of metal working in the area, it is unlikely that this was done. Pellets of ochred paste, often with hair, were found at all levels.

3.2.4.1 Sampling

During the process of excavation, the cultural material found in the deposit was put through the first selection and rough sorting. The artefacts were either exposed during the brushing away of the surrounding deposit or picked up when the material

was sieved. More careful cleaning and sorting took place in the laboratory. All the non-lithic material was recorded (table 6).

From the huge quantity of lithic material, a sample of almost 4000 artefacts (3922), flakes, cores and retouched implements was chosen for detailed analysis (table 4). This sample represents the four central grid squares of the excavated area, where the deposit reaches its maximum thickness. All of the six sedimentologically distinct layers are represented here.

All recordings were kept separate according to the excavation units. Since the dung floor was the only clearly defined layer, the remaining deposit was removed in 5 cm spits per grid square. The materials from the different units in each layer were compared, and when an internal consistency was observed it was grouped with the other material from each of the six general layers.

3.2.4.2 Stone

3.2.4.2.1 Raw material

Some of the lithic material showed no signs of chipping, grinding or colouration, but was material which would not have occurred naturally in the shelter. Large slabs of muscovite and biotite probably attracted the attention of prehistoric collectors, just as they attract people's attention today. A number of these pieces show signs of attempted perforation, but none could be described as well made pendants or as having been fashioned into any specific design. A piece of limestone had been bored like a pendant (plate 17 e).

Chert nodules, agate, jasper and unworked pieces of fine-grained quartz must have been carried into the shelter and were probably intended as tools. These raw materials, worked and unworked, occurred in all the layers, except in the basal red sand.

TABLE 4: Frequencies of stone artefacts in the four central grid squares of the excavation

Layers	Cores		Flakes		Retouched edge-damaged, coloured, stained		Total	
	Actual numbers	% Within layers	Actual numbers	% Within layers	Actual numbers	% Within layers	Actual numbers	%
Surface	—	—	11	58,1%	8	42,1%	19	
% of total type found	0%		0,39%		1,2%			0,5%
Dung floor	38	10,1%	282	74,6%	58	15,3%	378	
% of total type found	9,2%		9,9%		8,7%			9,6%
Vegetation	133	9,1%	1 115	75,9%	221	15,0%	1 469	
% of total type found	32,2%		39,2%		33,1%			37,4%
Central sandy	187	11,9%	1 073	68,6%	305	19,5%	1 565	
% of total type found	45,3%		37,8%		45,7%			39,9%
Dark grey	53	11,5%	331	72,8%	72	15,6%	456	
% of total type found	12,8%		11,6%		10,8%			11,7%
Red sand	2	5,7%	30	85,7%	3	8,5%	35	
% of total type found	0,5%		1,1%		0,5%			0,9%
Total	413	10,5%	2 842	72,%	667	17,0%	3 922	100%

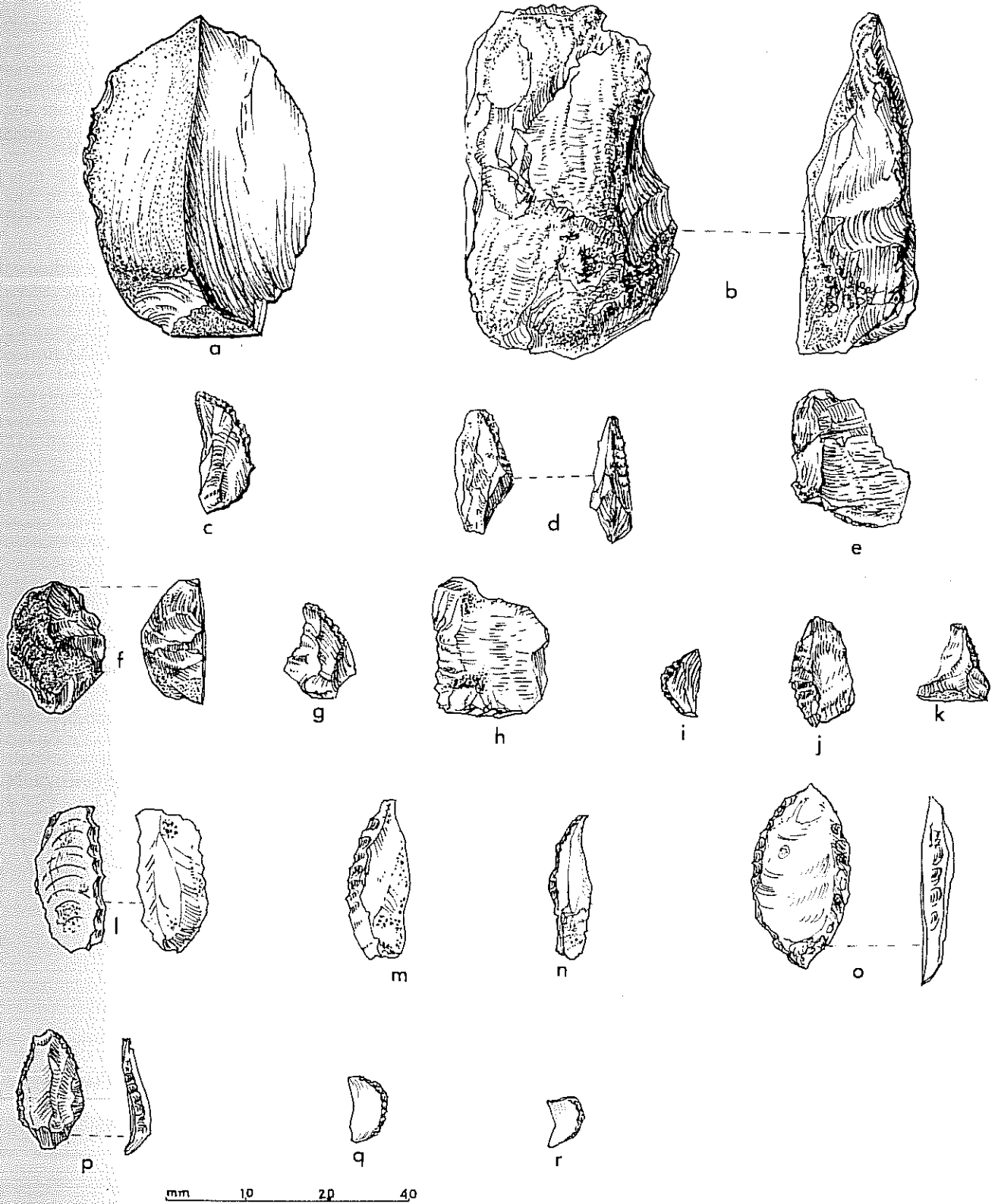


Figure 4: Dung floor: a) edge-damaged flake of indurated shale, b) medium-sized scraper of quartz, c) convex scraper of clear quartz, d) broken convex scraper of moss agate, e) flake with traces of ochre made of clear quartz. Dark grey: f) high-backed core scraper on river pebble of clear quartz, g) convex scraper of clear quartz, h) flake with traces of ochre made of clear quartz. Surface: i) micro-side scraper of clear quartz, j) convex scraper of clear quartz, k) irregularly shaped flake with retouch, made of clear quartz. Central sandy: l) flake of indurated shale, retouched from the ventral side and showing traces of dark colour, possibly residue of hafting, m) obliquely convex scraper of clear quartz with traces of dark colour, n) distally retouched flake of clear quartz, o) double crescent of agate, p) convex scraper of jasper, q) crescent of clear quartz, r) crescent of clear quartz.

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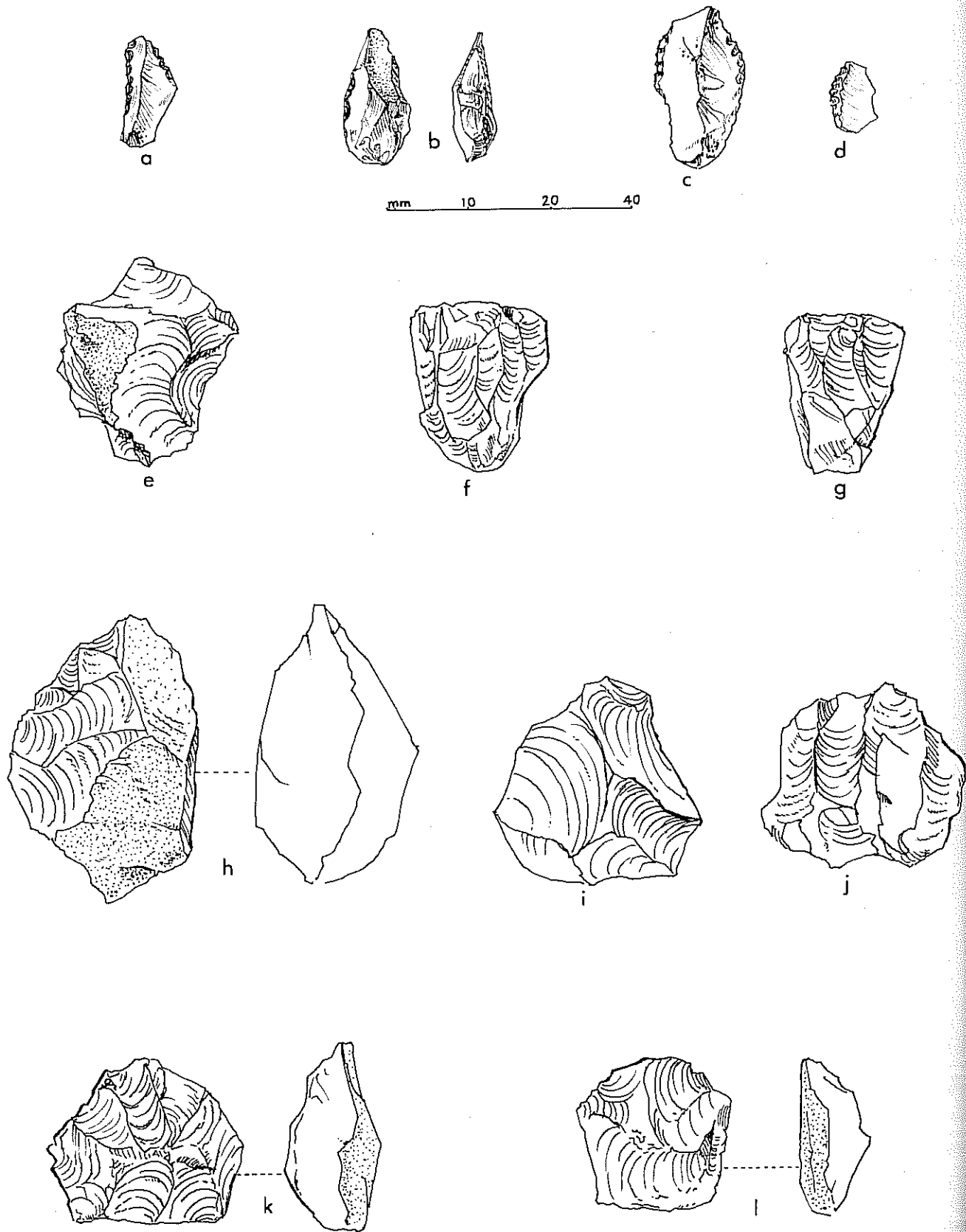


Figure 5: Vegetation: a) borer of clear quartz, b) irregularly shaped fragment of indurated shale with retouch and edge-damage, c) convex scraper of clear quartz retouched and edge-damaged, d) backed crescent of clear quartz. Central sandy: e) core of chert, f) blade core of milky quartz on river pebble. Vegetation: g) blade core of clear quartz, h) core of vein quartz with semi-circular platform. Dung floor: i) core of milky quartz with circular platform, j) blade core on clear quartz river pebble. Dark grey: k) discoid core of vein quartz, l) discoid core of white quartz.

Quartz was the most commonly found raw material, varying in appearance from a clear crystal-like variety and a fine-grained, milky type to semi-transparent vein quartz and a dense white quartz. For the purpose of description the following three categories were set up: 'clear quartz' comprises the crystal-like type and the fine-grained milky pieces; 'vein quartz' is less fine-grained, semi-transparent and prone to uneven fracturing; 'white quartz' is fine-grained and with an even texture, but not transparent.

Grinding surfaces were found on garnet-hornblend-schist, granite and sand-stone slabs (plate 22 a, b). Most of those larger stones blackened by fire and probably used as hearth stones were slabs of granite. A number of smaller, flatter granite spalls were found. These had only one blackened side, and probably exfoliated from the roof of the shelter, which is covered by a black deposit, probably soot. The bulk of microlithic material consisted of chips, chunks and flake fragments, ranging from minute pieces to angular fragments with dimensions of 3–5 cm. Unbroken flakes, cores, retouched pieces and those with obvious modification of the edge or surface are described in detail.

3.2.4.2.2 Cores

On the surface only a few microliths were found and all of the cores were broken. In the other layers the numbers of cores varied in relation to the quantities of other stone implements. In the vegetation layer 32,2% (133) of all the cores were found. Most cores came from the central sandy layer (187

= 45,3%), while 53 or 12,8% were found in the dark grey layer and only two (0,5%) well-defined cores occurred in the red sand at the base of the excavation although three of the scrapers are made on cores as well. Most of the cores are made of vein quartz and clear quartz (fig. 6 a; fig. 5 e–l; fig. 12 b, d, e).

The size of the cores was recorded by marking the greatest length/breadth measurements on graph paper. Most of the cores were of a medium size with lengths and breadths falling between 20–30 mm. Those recorded as being smaller or larger than this are in low numbers and are neither excessively small nor very large but should be seen as forming the two ends of a continuum which has a mode of 25 mm (fig. 6 b).

Flake release scars were counted. The quality of the quartz, which shatters and fractures unevenly, made it impossible to assess the total number of flake scars accurately in every case, but it could be established that the greater percentage of cores had more than five flake scars. Well-worked cores made from small clear quartz river pebbles indicate a good control of this hard raw material (fig. 7 a).

That percentage of the core's surface covered by cortex was estimated and recorded in the following four categories: none, 50% cortex covering and more or less than that. This was thought to indicate a degree of workmanship, but it was observed that clear quartz river pebbles which were well worked would often retain as much as 50% of cortex on the surface.

Consequently it was considered more useful to note the number of cores made on river pebbles (fig. 7 a), most of which were found in the vegetation-

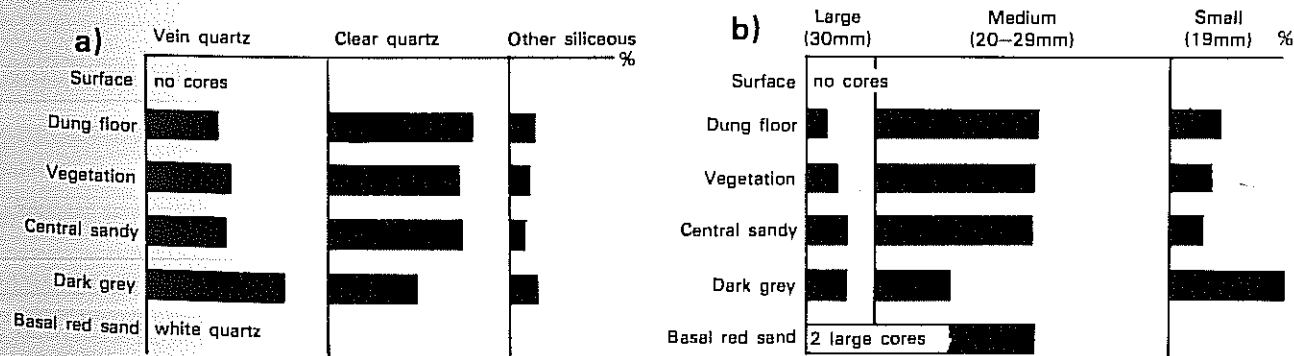


Figure 6: Cores: a) raw material, b) size of cores.

damage,

rich layer. In the dark grey layer there is a slight increase of well-worked cores without cortex. The shapes of negative flake scars on cores are not always clearly discernible because scars superimpose upon one another. Long, narrow blade scars are the most diagnostic ones, usually occurring on cores with two opposing platforms (fig. 7 b). These characteristic scars were observed in similar quantities on all the cores, and relate to the frequencies of blades (fig. 9 a) and retouched tools made on blades. The direction from which flakes were struck off a core was also recorded and from this the number of platforms on a core can be deduced. The most common pattern was that of a single platform core. Often one or two flakes had been removed to create the platform from which subsequent flakes were struck. Cores with two platforms approximately at right angles to each other occurred fairly frequently and merged with discoidal and chopper-like cores with flakes removed from a circular platform (fig. 5 e-1).

There is a striking similarity in the cores from the three central layers i.e. the dung floor, the vegetation-rich layer and the central sandy layer, while those from the dark grey layer deviate slightly from the pattern as regards size and choice of raw material. Although no complete cores were found on the surface, the core fragments and the other stone artefacts resemble those found in the three central layers. The material from the basal red sand provides an obvious contrast.

3.2.4.2.3 Flakes

Flakes constitute 72,5% of all stone implements analysed. The ratio of flakes to cores and modified pieces was very similar in the five main layers (table 4).

Clear quartz and vein quartz are the most commonly used raw materials. There are only isolated specimens in quartzite, while fine-grained siliceous materials occur in small numbers (fig. 8 a).

The size of the flakes was also assessed in terms of large, medium and small, relating to flakes with a length/breadth dimension of larger than 30 mm, between 20 mm and 29 mm and smaller than 20 mm. Like the cores, most flakes are of medium size and there is a continuum of sizes rather than three distinct categories (fig. 8 b).

Four different types of platforms were recorded, the most common being an irregularly end-struck flake. The numbers of side-struck flakes were smaller, but exceeded those of blades. Corner-struck flakes were an exception (fig. 9 a).

Platforms were mostly plain or were represented by the natural surface of the stone. Facets on the platform were very rare (fig. 9 b). In accordance with the plain and the natural platforms, many flakes showed cortex on the dorsal surface. On more than half of the flakes there were two, three or four scars, which were usually struck from the direction of the platform (fig. 4 c, d, fig. 9 c). Most of the scars were parallel or converging.

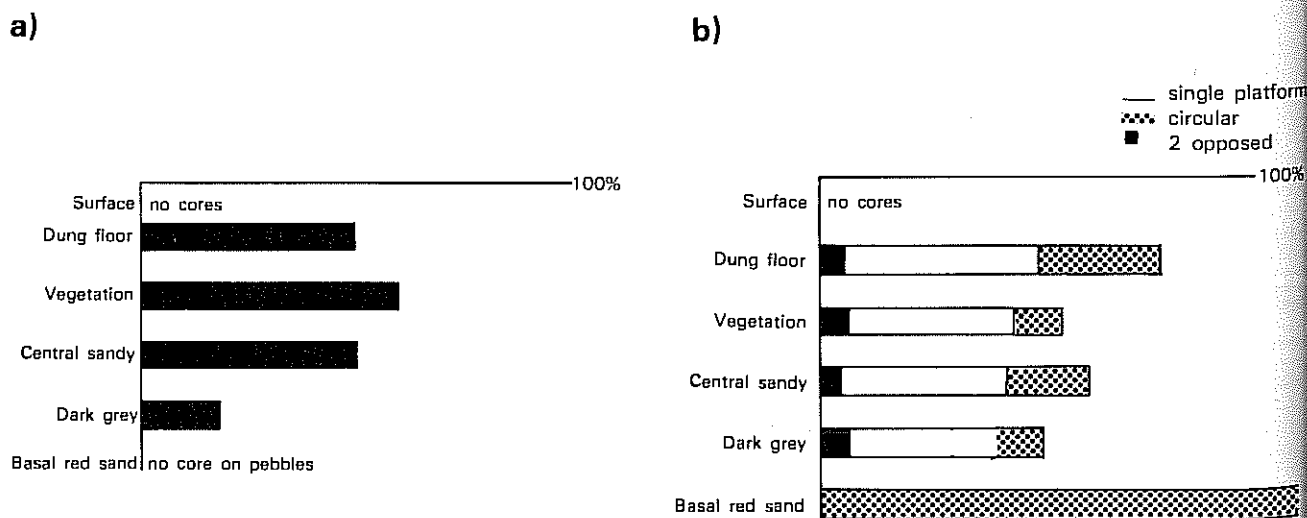


Figure 7: Cores: a) frequencies of cores worked on river pebbles, b) platforms.

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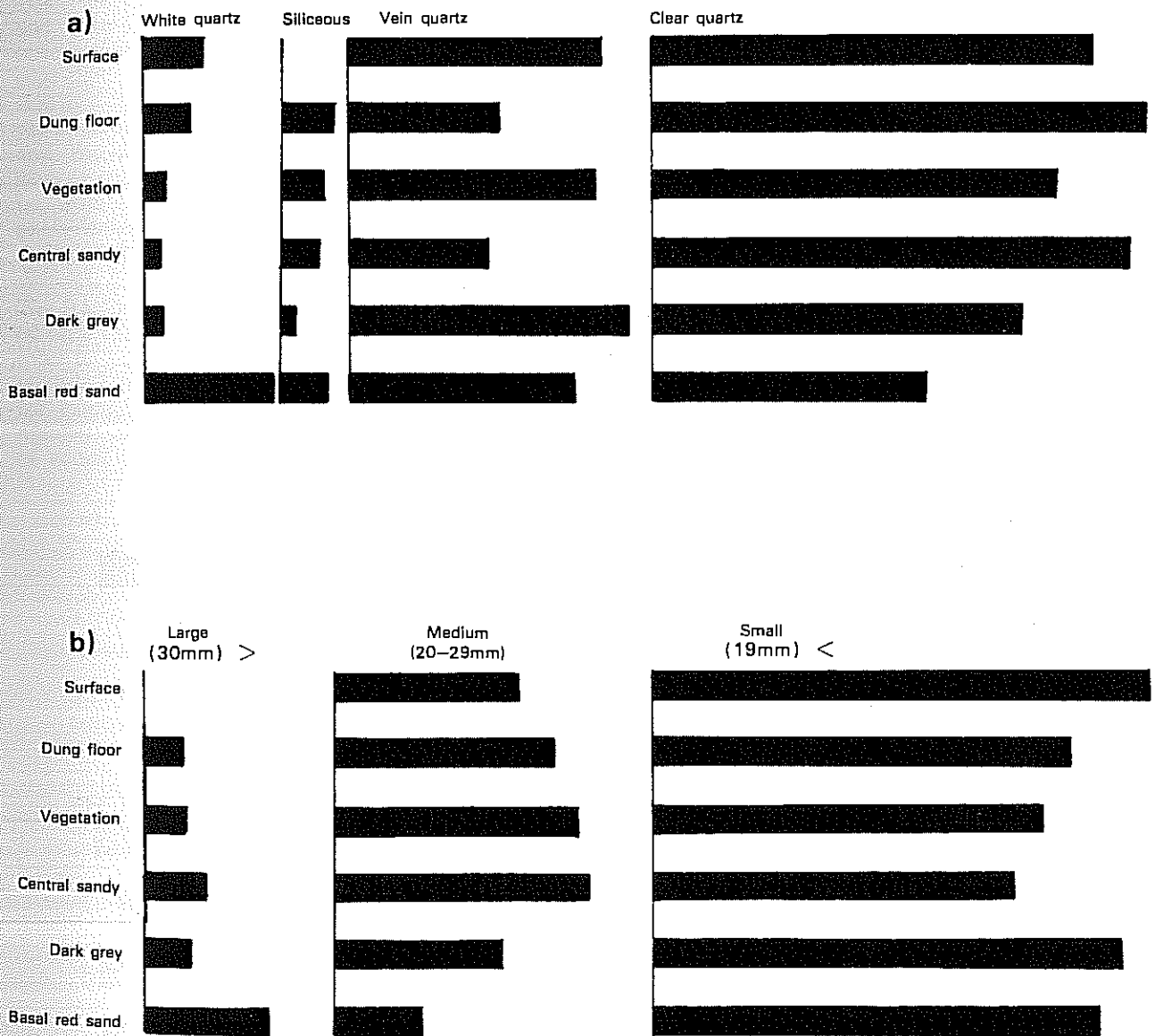


Figure 8: Flakes: a) raw material, b) size of flakes.

3.2.4.2.4 Tools

Many microlithic flakes and fragments show modification of the edges, either blunted by backing, retouched or utilized in such a way that secondary scars or chips can be observed with the naked eye. The small secondary scar patterns show a range from even-sized, small or large, contiguous scars extending over at least half the length of the worked edge, to pairs or even isolated scars occurring intermittently on an edge. Some pieces had one edge very evenly worked and only a few scars along another edge.

These characteristics were recorded, as were the exact length, breadth and thickness of retouched and edge-damaged implements (fig. 11). Further observations concerned the position of retouch and edge-damage on the tool (i.e. whether along the side or sides (lateral and bilateral), at the end of the platform (the basal end), or at the opposite distal end, the shape of the worked edge (straight, concave or convex), and the continuity of the working, i.e. whether it continues evenly all along the side or is intermittent. From these observations, five main attributes emerged: backing, retouch, edge-damage, hafting traces and ochre stains.

The frequencies of these characteristics are presented on a table (fig. 10 a, c). The numbers for totals refer to actual implements, but the attributes were recorded independently. Since one implement might for example, have both backing and retouch, the number, in attribute classes may exceed the totals of actual specimens. The most obvious contrast is

the low incidence of tools in the basal red sand and the surface layer. Since this relates to the occurrence of flakes and cores, it is in itself significant and, although the samples are so small, the absence of backing, hafting and ochreous stain in the basal red sand agrees with the general character of the implements found in this stratum, which is very different from the layers overlying it. By comparison, the stone tools on the surface seem to represent a qualitative continuity, but there seems to have been no need for that kind of tool in the greater numbers that were required earlier on. Since the volume of the deposit is an obvious variable in a comparison of this kind, the frequencies were also tested by working out an average occurrence per excavation unit in each layer (fig. 10 b).

The pattern of characteristics remains more or less the same, with a remarkable decrease of stone tools in the dung floor layer and the surface. By far the greatest concentration of lithic material is found in the central sandy layer, with only about half as many tools occurring in the vegetation rich layer, whereas only half of the latter quantity were recovered from the dark grey layer. The very small numbers of implements in the basal red sand are seen in perspective with the lack of ash, charcoal and other artefactual material in that layer of the deposit.

In the four central layers (dung floor, vegetation, central sandy and dark grey) where the samples are of a reasonable size, the ratio in which the different types of modification occur is similar.

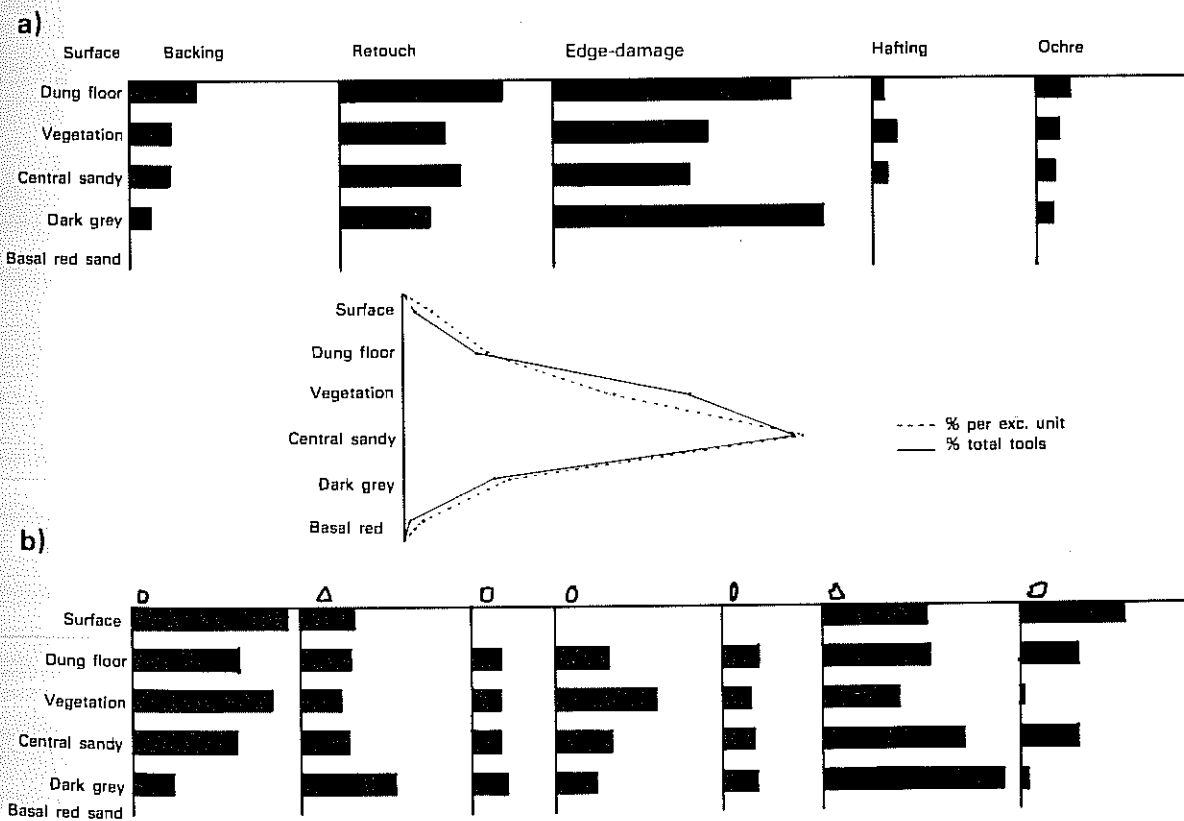


Figure 10: Retouched and edge-damaged tools: a) frequencies of formal tools, b) shapes of modified pieces.

The shapes of the retouched pieces are remarkably similar in the bulk of the deposit. The obvious contrast occurs in the basal red sand, indicating the absence of the microlithic element (fig. 12). Three segment-shaped pieces, of which two are retouched and one is backed, were found on the surface, in addition to five irregularly-shaped pieces with various signs of edge modification. These characteristics resemble those found in the underlying material, although they occur in much greater frequency in the material from the layers below the surface (fig. 4, i-k, p, q, r).

The dimensions of length, breadth and thickness are remarkably uniform in the four main layers (fig. 11), the mode for the whole sample being length: 15,0-19,9 mm × breadth: 5,0-9,9 mm × thickness: 1,0-3,3 mm.

As before, material from the surface and the basal red sand represents a striking deviation from this pattern. In all the layers a convex edge was most commonly worked or used. Less than half of the worked edges were straight, and only a small percentage of these edges was concave (fig. 4, l-o). In most cases the modified edge was situated on one side of the implement. Though much lower, the incidence of bilateral retouch was not uncommon. A similar percentage of tools in each of the four central layers had been retouched on the distal end.

In every layer with a microlithic component, there were a few specimens which had been worked on the platform. Signs of breakage or usage on the dorsal and ventral surfaces were observed on only a few isolated pieces (fig. 5 c).

The majority of the microliths in the central layer were flakes or flake fragments with scraper retouch on a convex edge. The most striking tool types were a minute segment and the double crescent (fig. 4 o, r; fig. 5 d).

A large and two smaller quartz scrapers and discolored cores, reminiscent of bola stones, were the diagnostic tools found in the basal red sand (fig. 12 a-e).

3.2.4.2.4.1 Formal tools

Wendt devised a classification for stone tools found in South West Africa in 1972 (Wendt 1972: 28-32). Placing the material from Mirabib in his categories shows a fairly wide variety of forms (table 5). The most common type is the segment-shaped scraper. Small geometric, backed blades and pointed curved flakes represent the other characteristic tools of the assemblage. A few *outils écaillés*, scrapers and battered chunks would be classed as medium sized tools. The only macrolithic tools were found in the basal red sand.

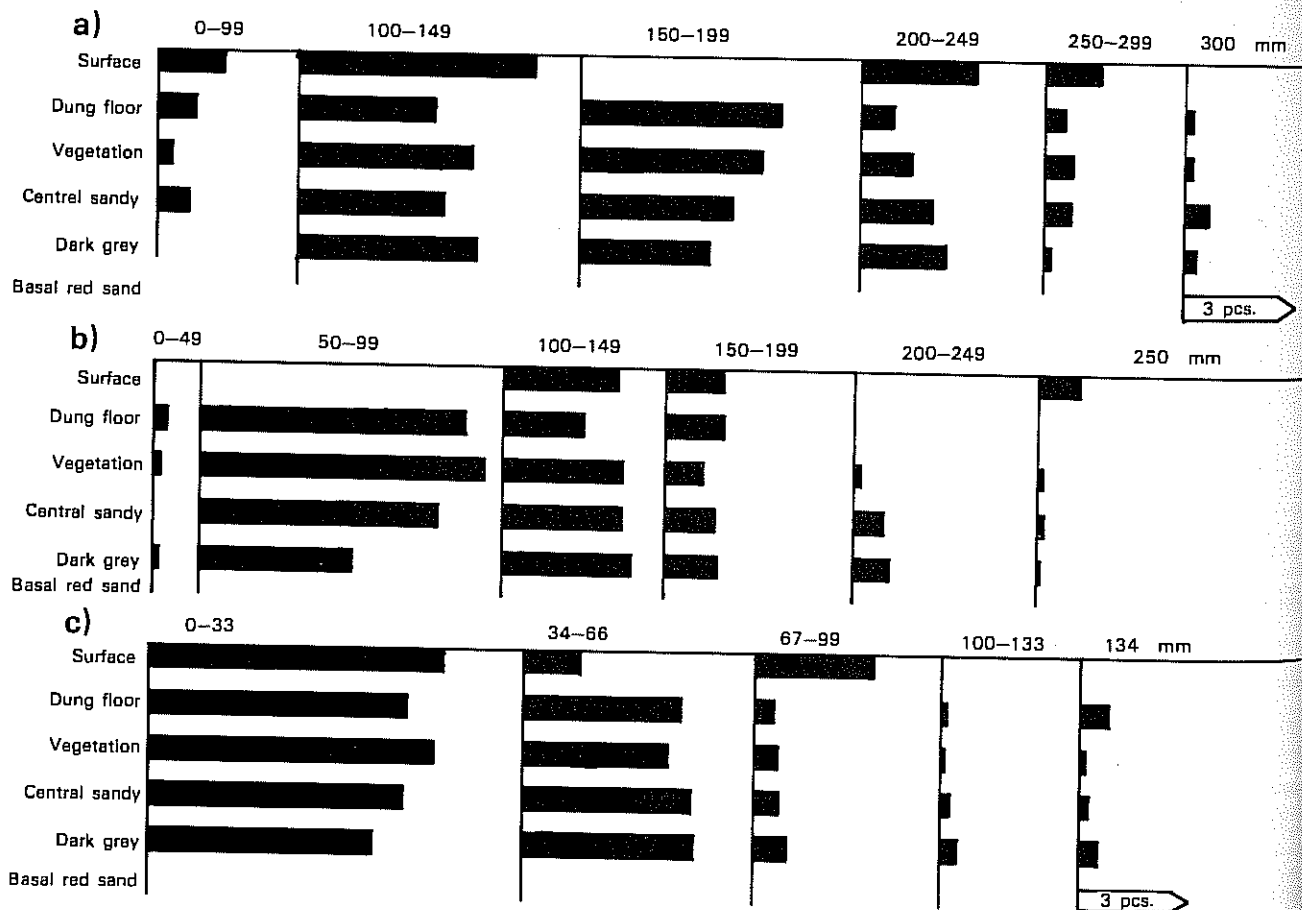


Figure 11: Retouched and edge-damaged tools: a) length, b) breadth, c) thickness.

TABLE 5: Frequencies of formal stone tools (typology taken from Wendt 1972)





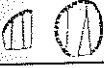



















Microlithic tools		Surface	Dung floor	Vegetation	Central sandy	Dark grey	Basal red sand
Scrapers							
I a/1		—	2	3	11	1	—
I b/1		—	—	1	3	2	—
I b/2		—	—	1	5	3	—
I b/3		—	—	—	2	1	—
I c/d		—	2	6	6	—	—
I e		2	6	42	36	9	—
Terminally retouched and truncated							
II a/c		—	2	8	15	3	—
II f		—	1	5	14	6	—
II g		—	1	—	9	2	—
II d/h		—	—	1	3	—	—
Laterally retouched and backed							
III b/2		—	—	—	2	1	—
III b/3		—	5	14	30	7	—
Crescents							
IV a/1		1	1	13	27	2	—
IV a/2		—	4	8	16	2	—
IV a/3		—	5	6	9	2	—
IV c		—	1	2	10	2	—
IV d		—	4	8	18	1	—

TABLE 5: (cont.)

"Double crescents"							
V a		—	3	9	9	2	—
V b		—	6	10	13	3	—
V c		—	4	3	1	2	—
Borers							
VI a/2		—	—	—	4	—	—
VI e/1		—	2	5	4	—	—
VI e/2		—	1	5	4	2	—
VI c		—	—	3	6	2	—
VII a <i>outils écaillés</i>		—	1	2	7	2	—
VII b notched		2	3	1	10	3	—
VII c miscellaneous		2	3	17	17	6	—
medium-sized scrapers		—	3	2	5	2	—
battered cobbles		—	1	—	—	1	—
macrolithic tools		—	—	—	—	—	5

3.2.4.2.4.2 Grinding stones

When this site was first investigated, the most noticeable feature was the large number of grinding stones lying on the surface of the shelter floor. Forty-five querns were counted, many of them with pestles resting on the grinding surface, while isolated pestles were also found. Four of the grinding stones had two smoothed surfaces. Grinding stones and fragments of grinding stones were also found at lower levels in the excavation (plate 23). The most striking find was two grinding stones and a large, unworked granite slab, enclosing a concentration of ricinus seeds. The sizes of the grinding stones varied. Most of them were flat, with a thickness of 2–10 cm and length/breadth dimension of 15–20 cm. A small grinding stone made of sandstone (plate 23 a) must have been used for preparing small amounts of material.

The fragments of a smoking pipe carved out of soapstone, a well-shaped, oval, grooved stone in the same material, and a perforated stone pendant made of talcic mica schist have been described previously (Sandelowsky 1974).

Red staining on the polished surface of four grinding stones, one of them found in the dark grey layer implies that they were used for grinding ochre. The remains of *Inara* and ricinus seeds near some of the grinding stones suggests other uses made of them. As was mentioned before (Sandelowsky 1974), salt might have been another substance that was ground up, since this is a use made of grinding stones by the Topnaar living along the Kuiseb today. Rounded quartz cobbles, with a diameter of 5–10 cm and with marks of battering or pecking, probably belong to this tool kit as well. With use these might have become smooth pestles.

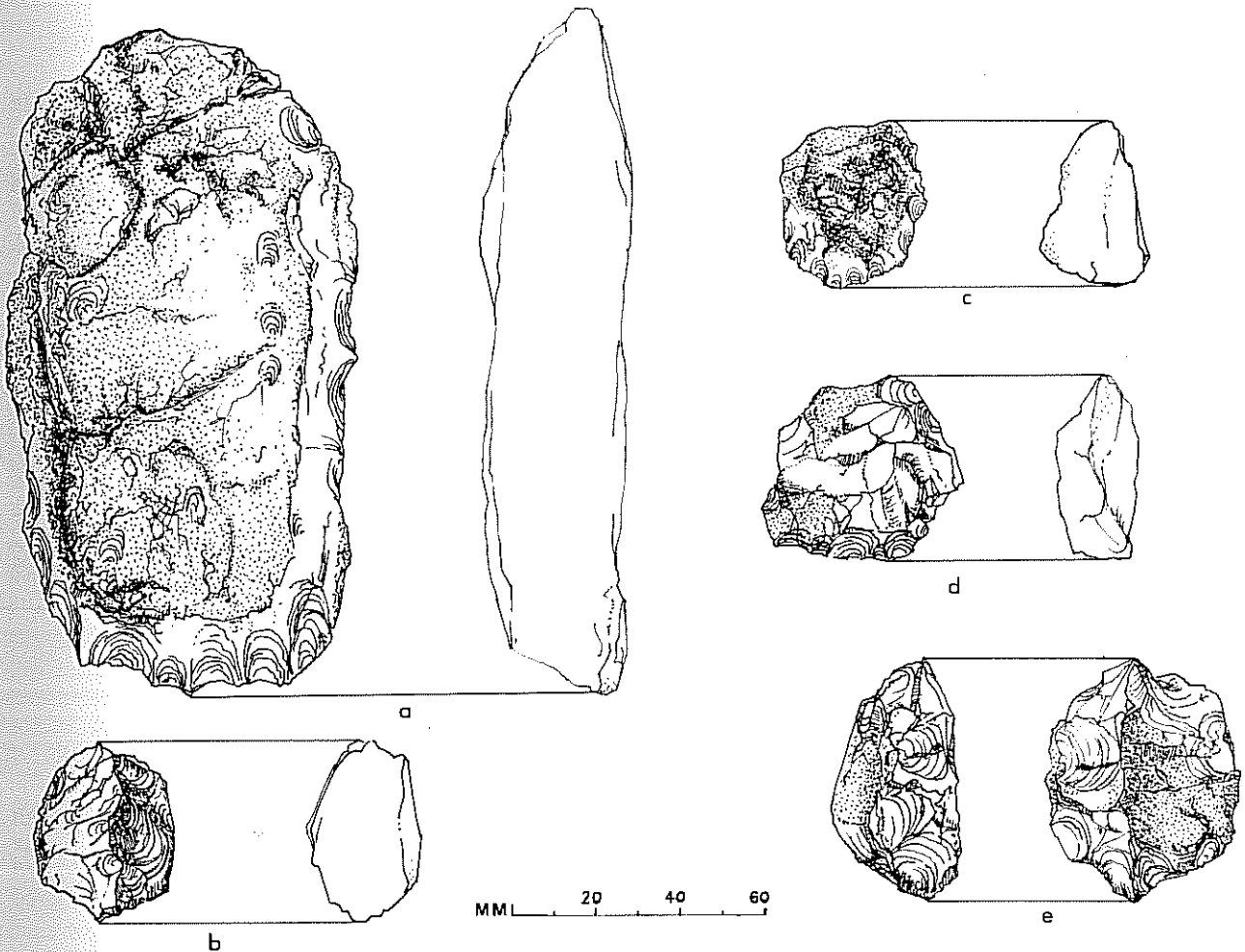


Figure 12: Basal red sand: a) macrolithic scraper of white quartz, b) discoid core of white quartz, c) semicircular scraper of white quartz, d) discoid core of white quartz, e) discoid core of white quartz.

3.2.4.3 Non-lithic artefacts

Non-lithic artefacts occurred in much smaller numbers than did the stone tools. All those found in the excavation were therefore recorded (table 6).

3.2.4.3.1 Pottery

Only seven undecorated body sherds were found inside the shelter. Six were found on or above the dung floor, while one small sherd was beyond the edge of the dung floor and in the vegetation layer. Their paste was dark and fairly fine. Amongst the boulders outside the shelter, were one complete (plate 17) and one broken pot, whose paste was similar to that of the sherds found in the shelter. The broken pot had a well-defined, pointed base, whereas the other one was not quite so pronounced, although it also had the thickening at the centre of the base which is characteristic of these pointed-based pots. Neither of them had lugs or decoration, nor did they have a well-defined neck or rim. The unbroken pot had small holes drilled into its wall near the opening, a feature often found on pots in the Namib. This probably served for the fastening of a handle made of leather or fibre.

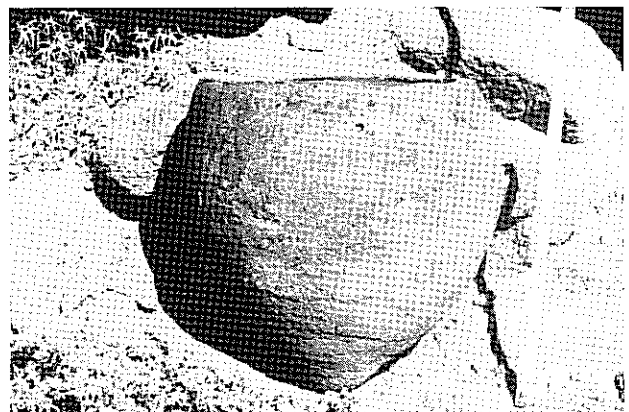


Plate 17: Clay pot found among granite boulders close to Mirabib Hill Shelter

3.2.4.3.2 Metal

Two copper beads, nine fragments of copper and what looks like the blade of a pocket knife were found close to the surface (plate 18 d, 19 c). One of the copper beads is very well preserved and shows a seam on the side. Two scraps of iron are 2,5 mm in diameter.

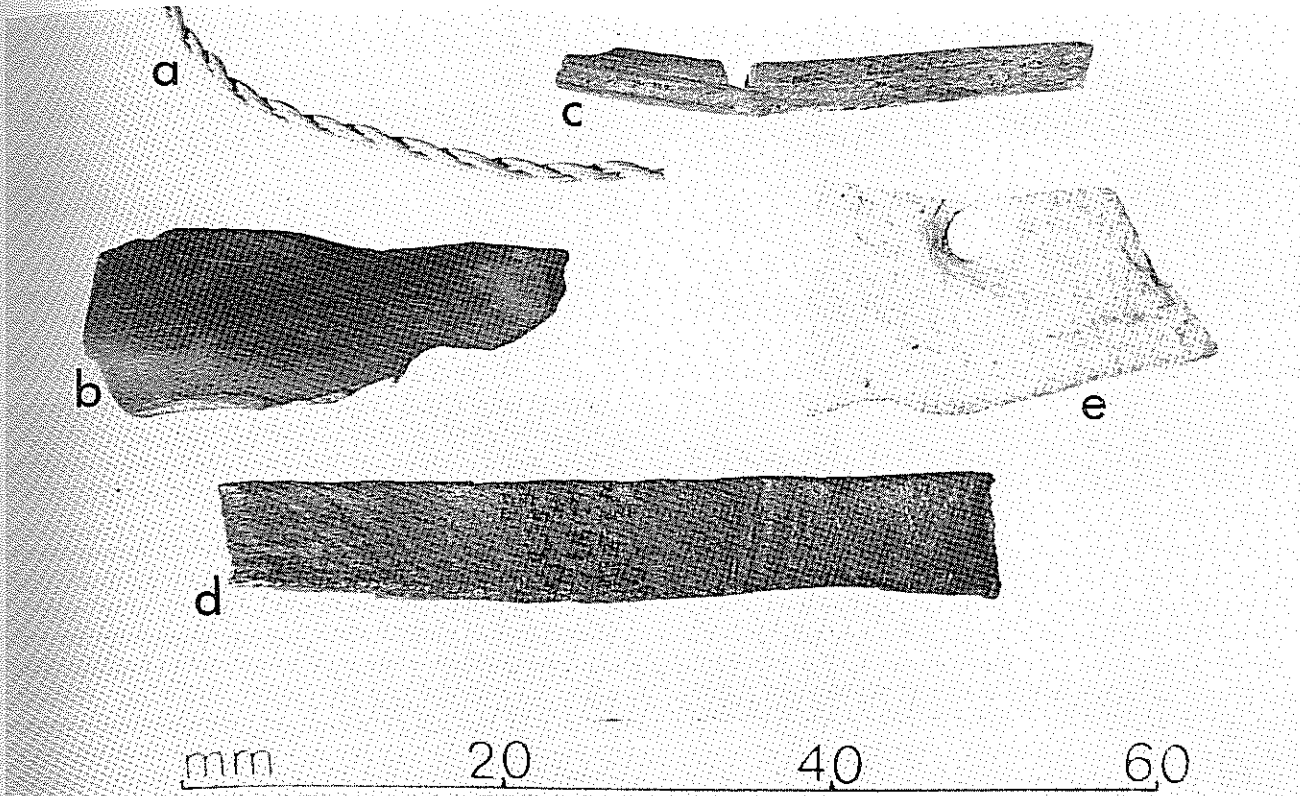


Plate 18: Artefacts found on the surface; a) twine, b) worked bone, c) worked wood, d) metal, e) stone pendant

Photo: G. Komnick

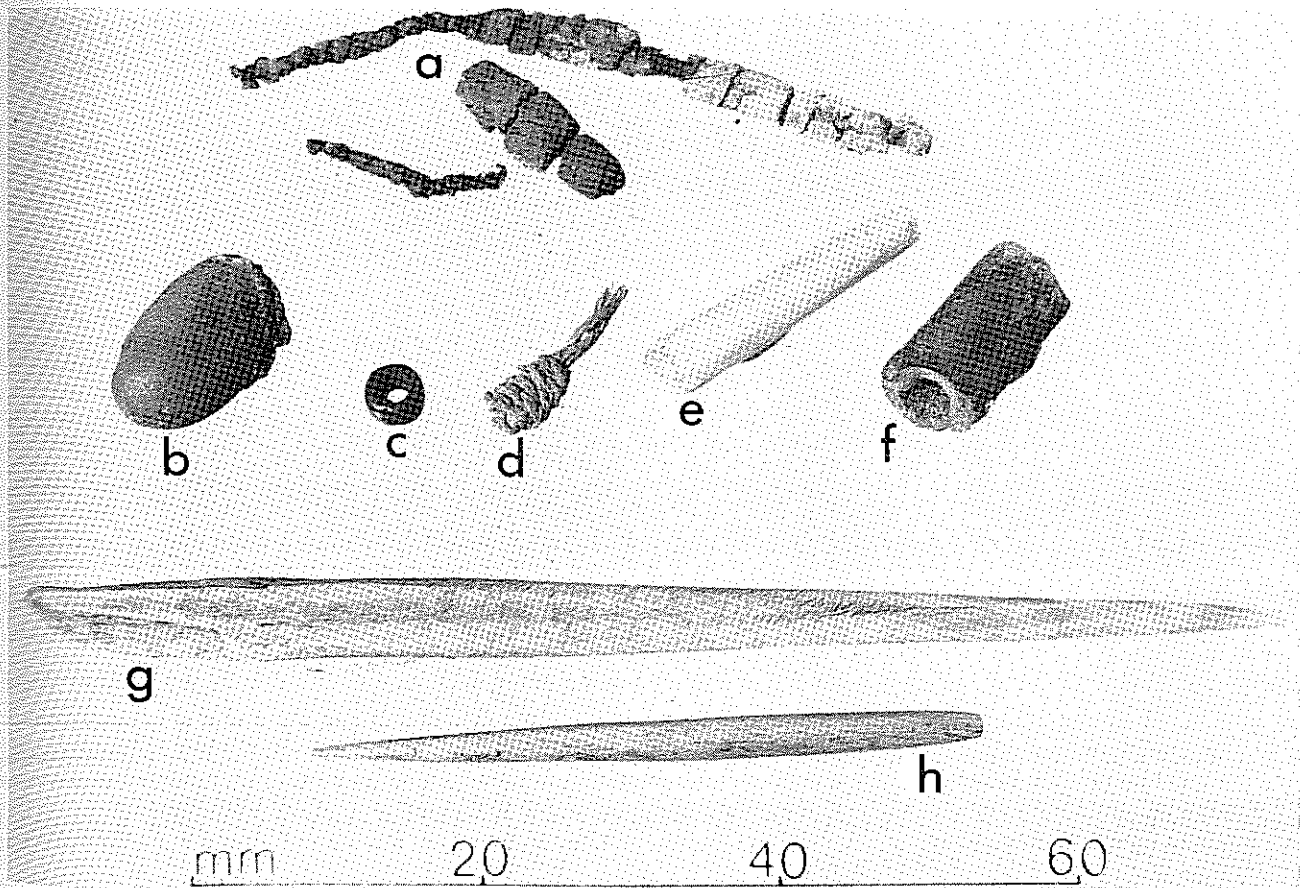


Plate 19: Artefacts found in the dung floors; a) 3 strands of human hair encrusted with ochre, b) ochred inara, c) copper bead, d) twine, e) worked bone, f) wooden bead, g, h) bone points

Photo: G. Komnick

3.2.4.4 Conclusion

The description and analysis of the microlithic assemblage was done to see whether the stone tools in the six layers of the Mirabib deposit differed from one another. The approach was adapted to that used by Wendt (1972). Although the results of a detailed analysis which he is undertaking are not yet published, personal consultation has led to the conclusion that the Later Stone Age collection from Mirabib (i.e. the top five layers) exhibits similar characteristics as material found along the western edge of the escarpment in the Namib. The similarity is illustrated by such diagnostic tools as the very small segment in clear quartz; the larger double crescent often made of jasper or agate; well worked bone, often shaped into tubular beads, ostrich egg-shell pendants and the abundance of grinding stones.

In the four central layers there is a remarkable uniformity of size, shape and attributes of secondary work among the microliths. Accordingly there seems to have been little change in the requirements for workmanship of stone tools for approximately 7000 years. The oldest tools at Mirabib were found in sterile red dune sand underneath a layer dated to over 8000 B.P. These stone implements differ from the Later Stone Age assemblage in shape, size, raw material and frequency. Considering the lack of

organic material in this part of the deposit suggested that the shelter was used infrequently briefly during that time period.

With the introduction of smaller tools in a large variety of raw materials the shelter was also used more intensively. The contrast in the deposit between these two layers is so marked that it is probable that there was a considerable time interval between the two occupational horizons.

Although the floral and faunal evidence indicates moister conditions during the deposition of the dark grey layer, the frequency of stone tools is relatively low. Less intensive use of the shelter or low population density compared to that in the overlying layers are two possible explanations. But it is also possible that more use was made of wood and bone as a raw material and that this has decayed together with the other organic material.

The central sandy layer which may reflect a trend toward conditions drier than those of both the underlying dark grey layer and the overlying vegetation layer, contains the greatest concentration of stone tools per volume of excavated deposit. A high concentration of *!nara* seeds is another important feature of this layer. Together with the seeds found in the vegetation layer 40 *!nara* seeds were either pierced, ochred or both, an indication of the value of this plant. In the dung floor only three

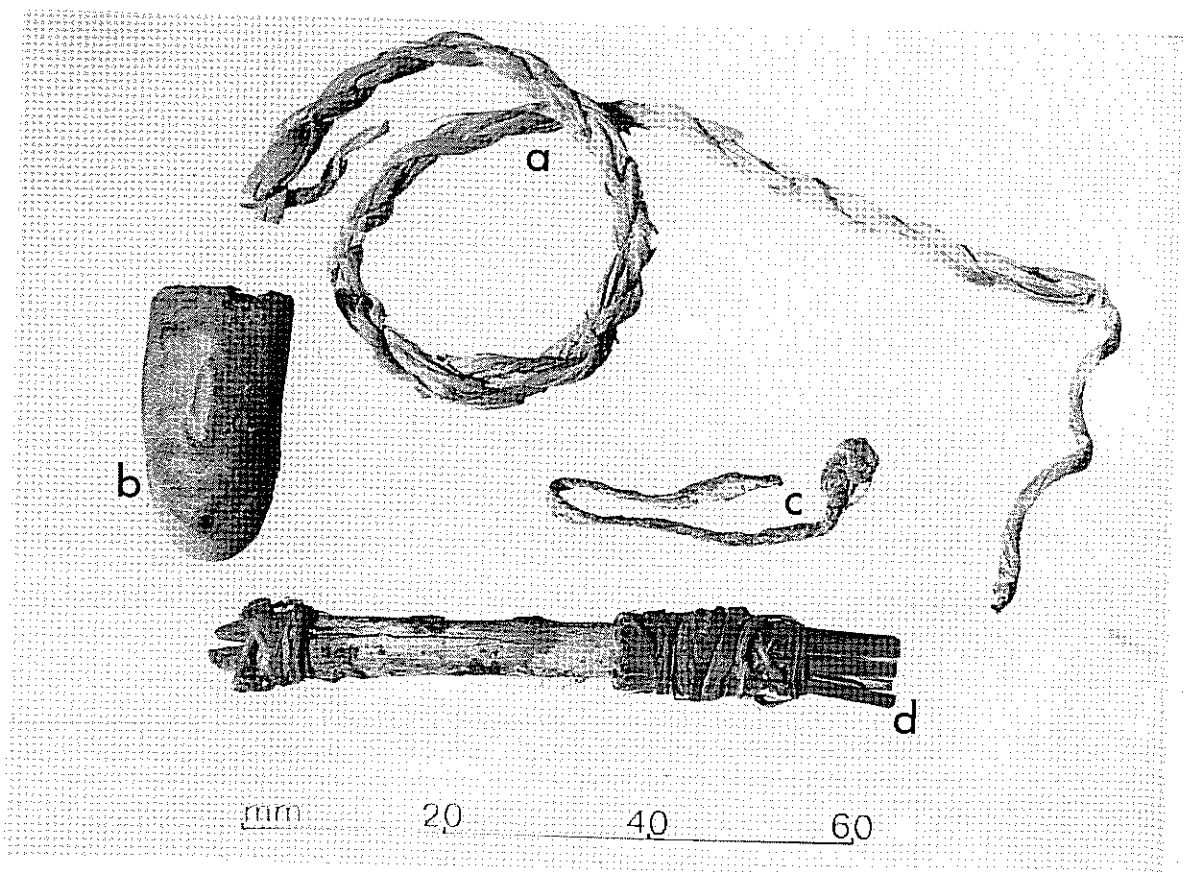


Plate 20: Artefacts found in the dung floors; a) twine, b) rattle, c) leather, d) worked wood

Photo: G. Komnick

these items were found and none in the surface layer. In 1974 Dentlinger noticed a Topnaar woman wearing three !nara seeds around her neck as a cure against a chest cold (Dentlinger 1977, 34).

Changes in the climate and consequently in the environment seem to distinguish the central sandy layer from the vegetation-rich layer since there is no obvious difference in the cultural material from the two layers. In contrast to this the difference between the vegetation-rich layer and the dung floor is marked by a most conspicuous cultural change. The dung floor with hair of sheep as well as five potsherds embedded in it signifies an important historical event in the Namib approximately 1500 years ago. Apparently these features were introduced rather suddenly since nothing, apart from a single potsherd, was found in the preceding layers indicating a gradual acquisition of either sheep or pottery. It is similarly surprising to find no sign of herding and only one potsherd in the layer on top of the dung floor. Nevertheless two complete pots were found very close to the shelter and these had, no doubt, been used by the last inhabitants of the shelter.

Who were these people?

The present day indigenous population consists of various genetic and linguistic elements. Most people living in the villages along the Kuiseb River consider themselves to be Topnaar Hottentots. But both their appearance and such family names as Herero, Fischer and Engelbrecht indicate the

presence of other racial and ethnic elements. The name of one abandoned settlement on the bank of the Kuiseb River is Damaron //hawadi (the place where Damara children died). According to statements of Topnaar informants Dama people were living along the Kuiseb River when the Topnaar came to the area. This would agree with the suggestion made earlier on (see page 237) about Topnaar-Dama relationships. It would also fit in with the results of the skeletal study done by de Villiers suggesting an association of physical characteristics of the Gorob skeleton with the Dama.

The metal fragments found in the surface layer mark the most recent and the most far-reaching change ever to come about in the life of people inhabiting the Namib. This is the arrival of western civilization with all its consequences and by-products. The absence of sheep and the low incidence of pottery in the surface layer raises the question of how the last inhabitants of Mirabib related to the previous occupation, when the shelter had been used for stock. Was this the same cultural group?

The evidence presently available does not answer the question. But the relationship between hunters and herders, resident populations and immigrants, and more in particular the role of the Dama in the history of this country are themes which are currently being investigated by a number of people (Heintze 1972, Wadley 1977, Wendt 1975). The results of all these studies should soon contribute to a coherent picture of our prehistory.

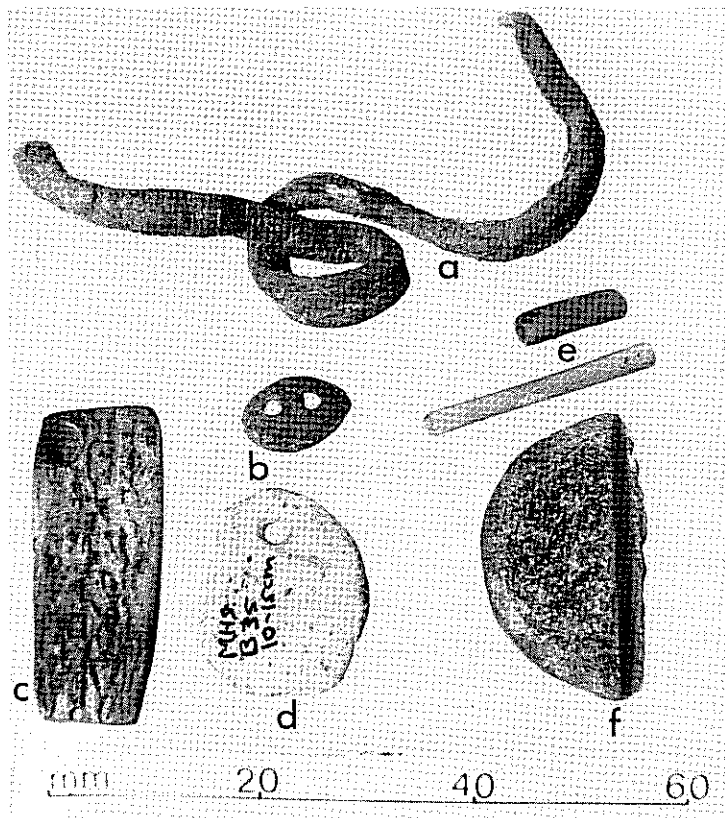


Plate 21: Artefacts found in the vegetation-rich layer; a) leather, b) pierced !nara, c) worked bone, d) ostrich egg-shell pendant, e) 2 bone beads, f) grooved stone

Photo: G. Kornick

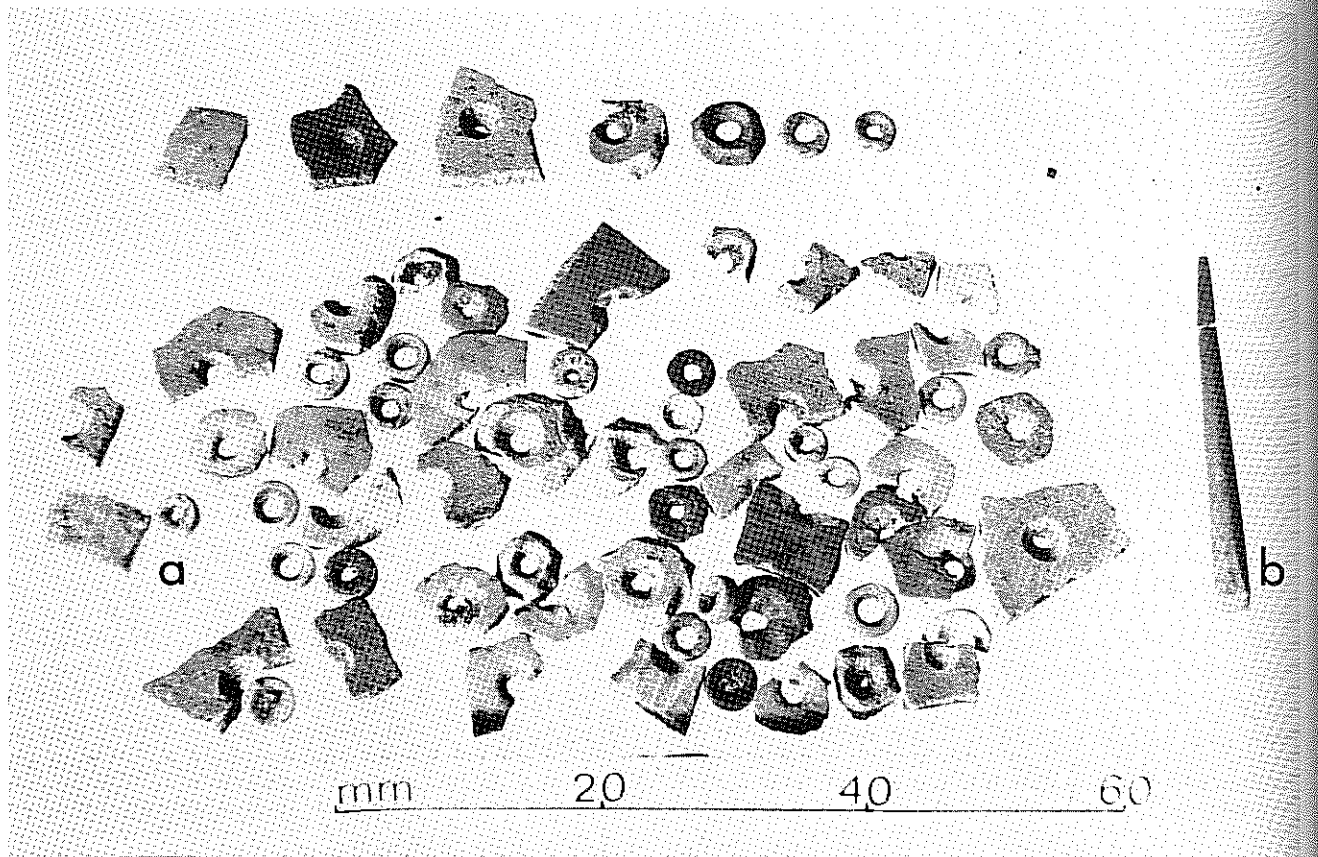


Plate 22: Artefacts from the central sandy layer and the dark grey layer; a) ostrich egg-shell beads, b) bone point

Photo: G. Kornick

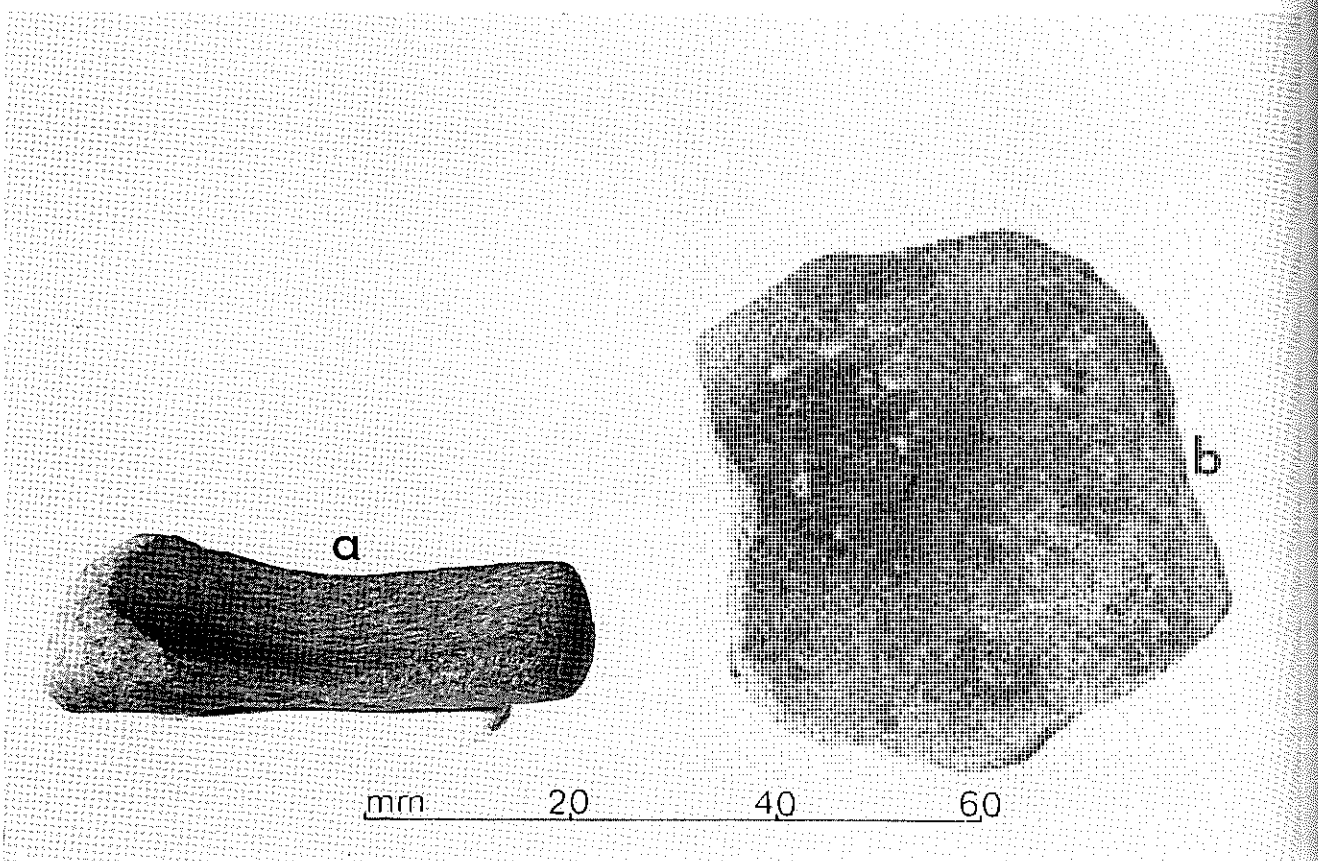


Plate 23: Grinding stones from a) dark grey layer, b) central sandy layer

Photo: G. Kornick

3.2.5 Archaeo-zoology

All faunal remains found in the deposit were collected, mostly by hand from the sieve. There was a considerable amount of dung, generally in the form of turds. Samples were kept.

3.2.5.1 Bone of larger animals

Bones representing food remains at archaeological sites are usually very fragmented and Mirabib was no exception to this rule. Apart from isolated tooth fragments of herbivores which occurred in all the layers no significant identifications could be assigned to any of the fragments found. But the bone found in the dark grey layer differed from that in the other layers. The fragments were extremely brittle and could only be removed with great care and glyptol. Furthermore, they were larger and more numerous than the pieces of bone in the other layers. Most of these fragments were 5 cm or 6 cm long with a diameter of 2–3 cm, probably representing pieces of long bone.

3.2.5.2 Ostrich egg-shell fragments

Apart from eating ostrich eggs, just as other bird eggs would have provided readily available food, ostrich egg-shell was an important raw material. The shells are best known for their use as water containers and for the making of beads and ornaments. Considerable quantities of burnt egg-shell (fig. 13) suggest not only cooking of the eggs but also using the shell as a pot. Some fragments were covered with red ochre. One looked as though it had broken off the edge of a container because apart from red colour on the inside red paint had apparently spilled over the edge and had run down the outside of the shell as well. Specimens were found representing various stages in the making of beads: accumula-

tions of angular fragments, angular fragments with complete and incomplete perforations and rounded discs without holes (plate 41).

3.2.5.3 Feathers and hair

In all layers very small, soft, green-yellow feathers were found. Probably they were parts of owl pellets. Larger feathers were a rare find. They looked as though they had been cut, perhaps to be inserted into the ends of arrows.

Hair which was firmly embedded in the dung floor and therefore in an unambiguous context was submitted to the Forensic Laboratory of the South African Police in Pretoria. Using the Hardy microtome cross sections were made and compared with those of identified material.

Dark hair with medulla was identified as hair of sheep (Krölling and Grau 1960).

3.2.5.4 Marine shell

Sixty-three fragments of marine shell and ten complete specimens of *Patella granularis* (identifications by Brian Kensley, S. Afr. Museum, Cape Town), were found in the excavation at Mirabib. The *Patella* shells were mixed with a concentration of ricinus seeds found in the vegetation-rich layer. The small but consistent occurrence of marine shell in all the layers except the dark grey and red sand layers at the base of the deposit indicate contact with the coast. Possibly people frequenting Mirabib moved to the coast as part of their migratory cycle. Alternately they may have met people who came from the coast.

All the identified species have been found along the coast of the central Namib implying similar coastal environments during the past 6000 years.

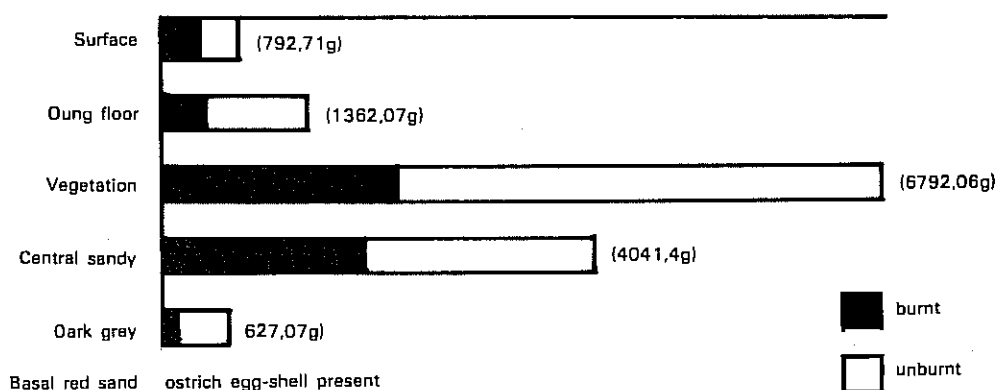


Figure 13: Distribution of ostrich egg-shell fragments.

TABLE 7: Distribution of marine shell

	<i>Perna perna</i>	<i>Donax serra</i>	<i>Patella</i> sp.	<i>Marginella capensis</i>	<i>Argobuccinum argus</i>	Unidentifiable
Surface	7	7	—	1	—	1
Dung floor	3	2	—	1	—	4
Vegetation	8	3	10	1	—	10
Central sandy	4	3	3	—	1	4
Dark grey	no marine shells found					
Basal red sand	no significant amounts of organic material present					

3.2.5.5 Microfauna

A study of the microfaunal remains (Brain and Brain 1977 this volume) contained in owl pellets provided crucially important evidence on environmental changes during the past 6000 years. Unfortunately the older layers contained only such poorly preserved organic remains that they could not be identified or the organic content was altogether negligible.

Apart from documenting climatic changes which are also indicated by other kinds of data from the Mirabib deposit the analysis of the microfauna provided supportive information on the cyclicity of environmental changes suggested by Mörner (1973).

4 DISCUSSION

This report provides information on all the three themes which the Namib palaeo-ecology project was to investigate i.e. the reconstruction of environmental conditions, the history of prehistoric populations in the Namib and man-environment relationships.

Most of the evidence came from an excavation in the Mirabib Hill Shelter where the organic material was very well preserved. One kind of data was used for the reconstruction of the palaeo-environment, whereas other data provided information on the subsistence strategies of the shelter's inhabitants. The microfaunal remains were crucial in that they provided information on changes not governed by human preferences or choices.

4.1 Past environments

The distribution of the different kinds of sites located in the Namib indicates changes in environmental conditions. Middle and Early Stone Age sites which are today situated in the utterly inhospitable dune sea of the central Namib to the exclusion of Later Stone Age sites imply that conditions were less severe here when Middle and Early Stone Age populations inhabited the area. The stone tools found at these sites cannot be dated absolutely but on the basis of comparison with similar tools from dated sites elsewhere (Clark 1970,79) it is inferred that they date back to Pleistocene times.

In contrast to the finds of early tools in the dunes, the sites along the coast belong almost exclusively

to the Later Stone Age. Middle Stone Age tools were found only at Conception Bay, some distance from the shore and on rock outcrops at Noordhoek, several metres above sea level. The dearth of older tools along the coast may be due to the weathering processes on a desert coast or to marine transgressions (Carrington and Kensley 1969).

The distribution of prehistoric settlements along the rivers relates to changes in the natural surroundings as well as to socio-economic factors. Further documentation of these settlements on the basis of archaeological and ethnological records promises additional information on the history of the riverine environment and its inhabitants.

The Mirabib site provided evidence of the Holocene environment with radiometric dates covering the last 8400 years. The oldest tools in the shelter which are not associated with datable material, differ distinctly from those found in the overlying layers, thereby extending our view beyond the 8400 years. These earliest stone tools in the Mirabib deposit are found in pockets of fine red sand filling hollows in the bed-rock. Containing the largest quantity of fine sand and the lowest quantities of cations and organic material, this deposit reflects arid conditions as have not been experienced since. The contrast between the initial deposit in the shelter and the subsequent dark grey layer suggests that the shelter was not used for some time between the depositions of these two layers.

The dark grey layer which rests on bed-rock or on the pockets of the basal red sand contains organic carbon, charcoal, ash and fossilized plant and animal matter. Together with the artefactual assemblage this proves intensive occupation of the shelter. The ratio of organic to mineralogic components in comparison with that of the underlying as well as the overlying layers shows less aeolian material. This could imply denser vegetation and higher rainfall. Age and the influence of fire heat probably account for the brittleness of the organic matter found in this layer.

During the next 2000 years there seems to have been a trend toward drier conditions at Mirabib. This is documented in the central sandy layer by the high content of aeolian sand and the low frequency of plant matter. Cycles of drier and moister conditions seem to have been superimposed on this general trend. They are indicated by phases of more and less intensive habitation evident in concentrations of high organic content, bands and lenses of ash and charcoal within the central sandy layer. Similarly an oscillation of moist and dry

conditions is reflected in the analysis of owl pellet remains (Brain and Brain 1977). The relationship of gerbils and geckos in the owl pellets is a reciprocal one with gerbils relating to more humidity and geckos to greater aridity. This evidence agrees with a model for world-wide climatic cyclicality suggested by Mörner on the basis of land, sea and air data (Mörner 1973). Though drier than during the preceding phase accompanying the deposition of the dark grey layer the conditions during the time of the central sandy layer on the average were more favourable than at present.

Another shift back to moister conditions is signified in the next layer by large quantities of vegetation remains and a decrease in aeolian material. According to Mörner's hypothesis this period falls approximately midway between two peaks of deterioration (ibid. 12). With the central sandy layer representing one of these peaks the other one would be represented by the dry phases within the last 500 years marked by the high frequencies of gecko bones in the owl pellet remains. Presumably such moister conditions would have meant longer wet seasons though not wet enough to seriously affect the conditions of preservation in the shelter. Although concentrations in !nara and ricinus seeds are a special feature in this layer the former do not occur as exclusively as they did in the central sandy layer. The ricinus seeds could imply more water in the drainages which under modern conditions carry surface water for only a few hours during the rainy season.

The dung floor is a striking component in the Mirabib stratigraphy. In spite of an apparent age gap separating it from the previous layer there is no matching sedimentological feature nor an obvious break in the artefactual tradition. In the owl pellet remains the *Dendromurinae* still occur though in much smaller numbers. The remarkable economic innovation of sheep herding probably took place towards the end of the moister phase to which the vegetation-rich layer relates.

The dung floor is covered by a clearly distinguishable layer of loose, ashy material in which no signs of sheep herding are evident. Stone implements were still in use though in much smaller numbers, possibly on account of metal having become available. The owl pellet remains indicate two periods of extremely dry conditions within the most recent depositional phase probably covering the last 500 years.

At its deepest point the Mirabib deposit is less than a metre thick and yet it covers a time period of well over 8000 years. The rate of surface deposition observed over a four year period was slow and unobtrusive in this extremely well protected shelter. These facts and the relatively large area over which the excavation extended, have led to the conclusion that the different layers reflect average conditions. It is unlikely that a phenomenon such as an isolated good rainy season would show up evenly in the form of a vegetation rich layer or in large concentrations of owl pellet remains over a surface as large as the one that was excavated.

In the following diagram (table 8) the palaeo-ecological data from Mirabib is placed into a general scheme for worldwide climatic change postulated by Mörner (1973).

4.2 The history of people living in the Namib

The range of stone tools and archaeological features in the Namib gives a long account of human settlement and behaviour. The deposit at Mirabib covers only a short part of this story.

The bulk of the stone tools recovered from the excavation at this site are typical of the Later Stone Age. But there are two obvious changes, one occurring near the base of the deposit and the other near the surface. Makers of the stone artefacts found in the basal red sand chose other raw materials, sizes and shapes than were selected in subsequent times. Other requirements and conditions probably dictated using the shelter differently than was done later.

A long time may have passed before people under changed environmental conditions began living in the shelter for longer periods of time. How long these periods were and when they occurred probably depended on rainfall. The finds of !nara seeds and the observations of how this food plant is used today suggest that those months when the !nara was ripe were spent at or near the !nara fields. The height of the !nara season also seems to relate to rainfall albeit indirectly by underground water becoming available. Although the seasonality of the !nara is not well known it is apparent that the period when there is no !nara available is relatively short, perhaps two to three months.

The finds of marine shells and ethnographic accounts (Sydow 1973) indicate that the coast presented another station in the seasonal cycle. Since the marine food supply is a fairly stable one it is probable that it was used when other areas offered less. The rainy season probably offered most at Mirabib. Since it is also the only time when water would be readily available it is suggested that that would be the time spent there.

The bulk of stone tools found at Mirabib are microlithic and of remarkable uniformity in size, shape and raw material. Together with other cultural items such as ostrich egg-shell ornaments, ochre and articles made of faunal and floral materials a conservative, well-adapted tradition of hunting and gathering is documented for most of the time that the Mirabib Shelter was occupied.

The 13th century skeleton, found beneath a stone cairn resembling numerous structures of that kind in the area, implies that a population with distinct burial practices frequented the Kuiseb River region. A similar date for a clay pot from Conception Bay (Vogel pers.comm.) indicates that the coast was also exploited at that time. The skeletal characteristics of the Gorob grave skeleton do not resemble those of bones previously associated with

TABLE 8: Data from Mirabib seen in relation to model constructed by Mörner (1973)

Mörner	Yrs B.P. 0	Mirabib
high frequency cycles (230-400 yrs)	1 000	500 dry dry
1 700		1 500 dung floor
deterioration	2 000	
2 750		
deterioration	3 000	
low frequency cycle (550-850 yrs)	4 000	
	5 000	
		5 190 vegetation-rich layer 5 570
	6 000	central sandy layer
high frequency cycle (230-400 yrs)	7 000	6 470 6 500
deterioration	8 000	
amelioration		8 200 dark grey layer 8 400
low frequency cycle (640-1 000 yrs)	9 000	
amelioration	10 000	
high frequency cycles (230-400 yrs)	11 000	
11 500		
	12 000	
		basal red sand?
	13 000	

coastal sites (Sandelowsky and Pendleton 1970, 53). This inland one is more robust and has provisionally been assigned to the Dama (Appendix III). Historically these people, who present puzzles in the ethnography (Knussman 1969, Wadley 1977), have been well documented in this area (Koehler 1969).

According to the age of the skeleton their history here might go back seven to eight centuries. In

this case it is not unlikely that they were also connected with the fifth century phenomenon of sheep herding. Apparently this was introduced rather suddenly into an area where a hunting and gathering way of life had been practiced for some 7000 years. Remains of sheep have also been found at the Big Elephant Shelter in the Erongo Mountains (Wadley 1976) implying a similar situation as at Mirabib: hunter-gatherers coming into contact with

herding. The nature of this relationship will have to be investigated in the course of future archaeological and anthropological work.

The ultimate change in the way of life of the people using the Mirabib Hill Shelter came about with the arrival of western civilization. A few fragments of metal and glass replacing many stone tools were the first signs of this far reaching event. The shelter has been abandoned for some time, certainly since the area was declared a game park. Beer cans, plastic bags and other picnic residue represent the modern epoch at Mirabib . . .

4.3 Man-environment relationships

The evidence at Mirabib shows that prehistoric man survived environmental changes ranging from conditions more arid than today to more humid ones. Rock paintings and various items of material culture indicate not merely survival but a well developed cultural tradition providing for artistic expression and social custom.

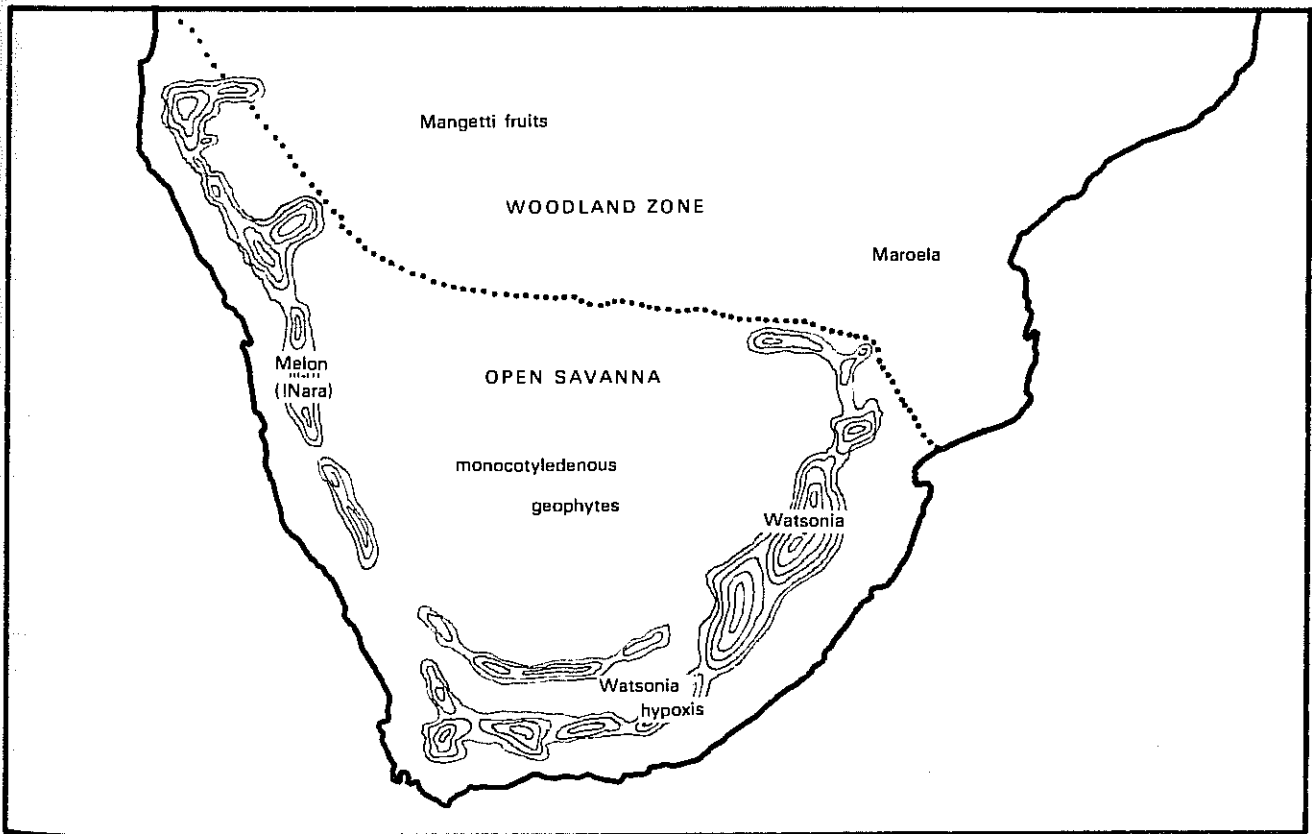
The most successful subsistence strategy seems to have been one in which three or four different areas were systematically exploited. The coast, the river banks (with !nara fields) and the inland rainfall areas would have represented the different ecological niches. Mirabib is situated on the edge of the inland rainfall area and as such would have

been a suitable location from which the riverine and coastal areas as well as the interior could be exploited.

The !nara plant is the best documented staple used for most of the time that Mirabib was inhabited. As such this area fits into a geographical model of sub-Saharan Africa constructed by Deacon (map 2). It suggests that Holocene hunter-gatherer communities exploited one specific plant food adaptively and systematically. They were not, as had previously been suggested, wholly opportunistic.

Considering that the Namib is a desert the question arises why people would live in such a marginal area. Population pressure might be invoked as a reason but it is unlikely that this part of the continent was ever that densely populated (Clark 1970,154). Historic records documenting the Topnaar people where they are living today date from a time when the interior was hardly inhabited (Palgrave 1977). It would therefore seem that people lived here by choice because this area offered more favourable conditions than other areas.

Apart from air, the body's most immediate need is for water, a rare commodity in the desert. But with an intimate knowledge of the surroundings the problem of water can be solved, if the requirements can be assessed accurately and if the water sources are known. Often requirement is dictated more by cultural expectation than by biological need. The water necessary for drinking is a fraction of that needed for washing clothes and body. Although the river courses in the



Map 2: Areas where specific plants were predominant in their significance to man during the Holocene (after Deacon)

Namib are dry on the surface for most of the year there is an abundant store of subterranean water which can be reached by digging one or two metres into the ground. For hunting the absence of water is an advantage because the game will congregate at the isolated water-holes in larger numbers. Animals dangerous to life and health such as infection causing bacteria, disease carrying insects, large snakes and aggressive mammals are rare or absent in the desert. Whereas the number of plant species in the desert is small it is easier to acquire a detailed knowledge of every plant than to do the same with a complex flora. It is suggested that a simple system can be handled more efficiently than a complex one.

The edge of the Namib Desert is seen as a fairly ideal living situation and it is suggested that the crucial factor for groups inhabiting this area was a control over population density. In other words time and space permitting, withdrawal into one or other of the zones in use, this habitat can and has been successfully exploited over thousands of years without having been destroyed for future use. Changes in the economy such as the introduction of sheep must have had an effect on the environment but even that event was negligible compared to what is happening now. Recent developments are fences, gates, water pipelines, canals, tourist camps, and subsequent dumping of rubbish. The store of underground water is tapped in vast quantities for the first time. Mining activities involving drilling, air prospecting, telephone structures, trenches scarring the surface as well as the concomitant increase in human activity must be having an unprecedented effect on all the populations and will shortly be altering the total Namib environment.

A model designed by Horace Quick, a geographer from the University of Colorado, U.S.A., is presented here to illustrate possible developments in the Namib. The model has been simplified. It is based on the assumption that an environment (E) can exist without a population (P). But any organic population requires an environment and the two factors will affect each other. Once there is a human population there will be culture (C) representing a third factor which could form an equilibrium with the other two. Such a balance has been maintained at Mirabib for over 8000 years.

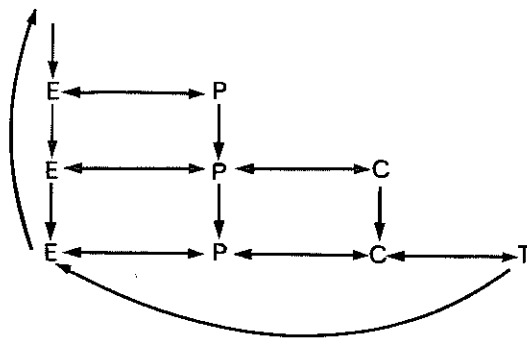


Fig. 14: Model adopted from Quick (pers. comm.)

Technology (T) which covers industrialization, has such effects as pollution and over-exploitation of natural resources which are threatening the natural surrounding in many parts of the world and may reduce environments to a state unfit for human population.

The reason for presenting this model is to raise the question of whether the novel utilization of the Namib Desert Park is to the best interest of everyone concerned. A panel of experts from all fields should investigate this question with the aim of retarding if not preventing the process by which this area is being turned from an inhabitable area into an uninhabitable one.

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APPENDIX I: Temperatures and precipitation

I thank Mr and Mrs Maree of the Weather Bureau in Windhoek for these data.

TABLE 1: Annual averages for the ten years 1965—1975

Weather Station	Longitude	Latitude	Rain	Fog	Max. Temp.	Min. Temp.
Pelican Point	14°26'E	22°53'S	9,9mm	147 days	18,4°C	12,6°C
Gobabeb	15°03'E	23°34'S	12,7mm	95 days	29,9°C	12,8°C
Klein Aub	16°40'E	23°49'S	266mm	2 days	27,1°C	10,4°

APPENDIX II: Soil profiles

by H. Scholz, P.B. 13134, Windhoek.

Soil profile A (table 1)

Locality:	2,5 km west of Mirabib Hill Shelter.
Height above sea level:	550 m.
Average rainfall p.a.:	below 50 mm.
Average annual temperature:	unknown.
Flora:	<i>Stipagrostis ciliata</i> : at the time 15—20 cm high; 30 % coverage.
Substrate:	calcareous calcrete, aeolian sand, granite.
Depth:	shallow.
Topography:	penplain with a shallow gradient dissected by a few erosion gullies.
General description:	calcrete soil of the desert.

- 1) 0— 5 cm: light brown, gritty fine sand with a poorly coherent structure and a more or less dense surface cover of loose grit and stones; calcareous, little root content. Beneath the loose surface layer and on top of the coherent soil material, there is a layer of silty material with little vesicles 1—2 mm in diameter.
- 2) 5—12 cm: very stony, light brown sand; few roots: very calcareous. The stones consist mainly of calcareous rubble.
- 3) 12—30 cm: with depth the calcareous crust becomes more compact, with few roots. In the upper reaches this layer consists of more angular rubble.

Soil profile B (table 1)

Locality:	1,5 km north of the Mirabib Hill Shelter.
Height above sea level:	550 m.
Average rainfall p.a.:	below 50 mm.
Average annual temperature:	unknown.
Flora:	<i>Petalidium setosum</i> community.
Substrate:	colluvium of weathered granite rubble and aeolian sand.
Depth:	shallow to medium; occasionally deep.
Topography:	Penplain dissected by valleys and erosion gullies.

General description:

In the vicinity of Mirabib the most typical valley system of this area is found between the Inselberg Mirabib and Mirabib Hill. It is an erosion gully no more than 50 cm deep and between 50 and 100 m wide, filled with loose, locally weathered material. Resembling other water deposits, the sediments of these valleys are heterogeneous. In some places large stones have accumulated; in others there are more, fine-grained deposits.

Since this is a relatively young system, no obvious formation of calcrete has taken place along the banks. This is characteristic of other drainages in this area. Not only has lateral sorting taken place in these valley sediments, but a horizontal sorting of the material is even more noticeable. However, a soil formation in the pedological sense could not yet take place because the material is too young.

- 1) 0–7 cm: gritty sand with single grain structure and a few stones; very poorly weathered; occasionally calcareous; few roots.
- 2) 7–17 cm: stony grit; single grain structure; few roots. The grit consists mainly of quartz, feldspar, mica and granitic rubble which has not yet disintegrated into individual minerals.
- 3) 17–22 cm: fine sand with single grain structure and a high content of biotite. This sand probably represents aeolian material in a secondary deposit. In comparison to the overlying material this layer appears to have more roots, although these are represented mostly by fine root hairs.
- 4) 22–50 cm: essentially similar to horizon 2 but with more roots; approximately as in horizon 3;
- 5) 50+ cm: poorly weathered granite rock.

A loose layer of grit, consisting mostly of quartz and feldspar, covers the surface of the soil profile B. The entire section of this profile is free of calcrete. This indicates a young soil where little chemical weathering has taken place. This is therefore, essentially an accumulation of physically-weathered rubble. Nevertheless, considering local conditions, this provides a favourable location for plant growth in the area.

TABLE 1: Analysis of soil samples
(done by R. F. Loxton, Hunting & Associates, Johannesburg.)

Sample	A/1	A/2	B/1	B/2	B/3	C/1
Depth in cm	0–5	5–12	0–7	7–17	17–22	0–12
Particle size distribution (%)						
fine earth (<2mm)	77	64	84	42	97	77
c. sand (2.0–0.5mm)	10	8	29	42	3	14
m. sand (0.5–0.2mm)	12	12	34	26	30	16
f. sand (0.2–0.02mm)	65	64	30	23	56	51
Silt (0.02–0.002 mm)	3	4	1	1	0	7
Clay (<0.002mm)	10	12	6	8	11	12
Net extractable cations (me/100g)						
Na	0,25	0,20	0,20	0,20	0,20	0,20
K	0,40	0,45	0,15	0,10	0,10	0,55
Ca	3,00	3,15	1,60	1,95	1,75	2,30
Mg	0,75	0,85	0,35	0,30	0,40	0,55
S. value	4,40	4,65	2,30	2,55	2,45	3,55
C.E.C.	5,55	5,55	3,50	3,25	3,60	4,60
S. value/100g clay	44	38	38	32	22	30
C.E.C. clay	56,00	46,00	58,00	41,00	33,00	58,00
Ph.H ₂ O	7,9	8,1	7,5	7,7	7,8	7,5
Ohmns R 60°F	3000	4000	3800	5200	3900	3000
% CaCO ₃	4,10	5,20	3,05	7,55	3,20	11,95
% CaSO ₄	—	—	—	—	—	—
% NaCL	0,04	0,04	0,02	0,02	0,04	0,04

Soil profile C (table 1)

- Locality: 2,0 km north of Mirabib.
- Height above sea level: 550 m.
- Average rainfall p.a.: below 50 mm.
- Average annual temperature: unknown.
- Flora: *Stipagrostis ciliata*
- Substrate: calcrete and decomposed granite.
- Depth: shallow.
- Topography: Pediplain dissected by drainages.
- General description: This is an example of an older soil on the pediplain.
- 1) 0–12 cm: Light to ochre-brown; calcareous, stony, gritty, sand; poorly coherent structure with silty, vesicular layer on the surface; a fairly dense cover of grit and stones as well as some plant remains; local concentrations of roots.
 - 2) 12–20 cm: as above, but more stony with depth; merging with weathered granite rock.

Approximately 10 m from where soil profile C is situated, there is a shallow syrosem of the pediplain, accounted for by the surface structure. Whereas profile C has a higher elevation, the site of the syrosem is a gully-like depression. Here the water collects and runs off, thereby preventing soil formation as it could take place at the site of profile C.

APPENDIX III: Report on human skeletal remains from a grave (Gorob) in the Central Namib Desert by H. de Villiers, Department of General Anatomy, University of the Witwatersrand, Johannesburg.

The human remains comprise:

- Cranium** although fractured, crushed and distorted is virtually complete.
- Mandible** is complete but for the left coronoid process, the antero-superior border of the right coronoid process and the lateral border of the left condyle.
- Teeth** *Maxillary*: the medial incisor and canine teeth are missing, although from the sockets there is evidence that the canine and right medial incisor were present at the time of death. The loss of the left medial incisor appears to have occurred sometime ante mortem as indicated by resorption of the socket. *Mandibular*: all mandibular teeth are present.

All teeth, except the third molars, show wear with dentine exposure.

Post cranial 23 vertebrae and fragments thereof, including six cervical vertebrae and fragments of the sacrum.

Fragments of the scapulae and innominate bones.

The first left rib and rib fragments.

Left ulna.

Left femur and head greater trochanter of right.

Right and left tibia.

Right fibula and shaft of left.

Left talus, navicular and cuneiform bones.

Two metatarsal bones.

The remains are those of a fully adult individual, probably in the third decade. Owing to the fragmentary nature of the pelvic bones, it is not possible to assess the sex of the individual with any degree of accuracy. However, the rather robust cranial vault bones, mandible and post cranial bones suggest that these remains are those of a male rather than those of a female.

The estimated maximum living stature of the individual based on Trotter and Gleser's (1958) regression formula for American Negro males is 169,23 cm. However, as Trotter and Gleser point out it is possible that different equations may be needed even for the same racial group in successive generations.

The cranial vault has been crushed in the right frontal region and the individual vault bones have been distorted — in particular the frontal, right parietal and occipital bones. The sagittal suture has been obliterated, it would appear prematurely. The orbital and nasal regions have also been fractured and distorted. Owing to the crushing and distortion no reliable measurements of the cranial dimensions could be made. The cranial vault appears to have been ovoid in shape, short, of moderate

breadth and height. The temporal squame appears to have been moderately expanded, the parietotemporal suture rising above the level of pterion. The occipital curve appears not to have been pronounced. The right mastoid process is undamaged and is of medium size (31,2 mm). The posterior root of the zygoma and the supramastoid crest show a moderate degree of development. The tympanic plate of the temporal bone is moderately thickened. The maxillary sinuses are large and expanded laterally; the hard palate is deep (estimated palatal depth 16 mm); and sloping anteriorly the dental arcade is horseshoe shaped. The subnasal portion of the maxilla is deep and apparently prognathous. The mandible is wide in relation to its length (Table 1).

TABLE 1: Mandibular measurements (in mm)

Character	Gorob grave	S.A. Negro male mean
cyl	21,0	19,9
rl	55,0	57,6
rb	36,4	35,2
m2p1	31,5	30,0
cpl	81,0	80,9
m2h	30,0	26,5
h1	42,1	34,0
gogo	92,7	91,3
zz	41,8	46,0
ml	111,0	107,5
Rameal index	66,1	61,4
ML	138,0	120,6

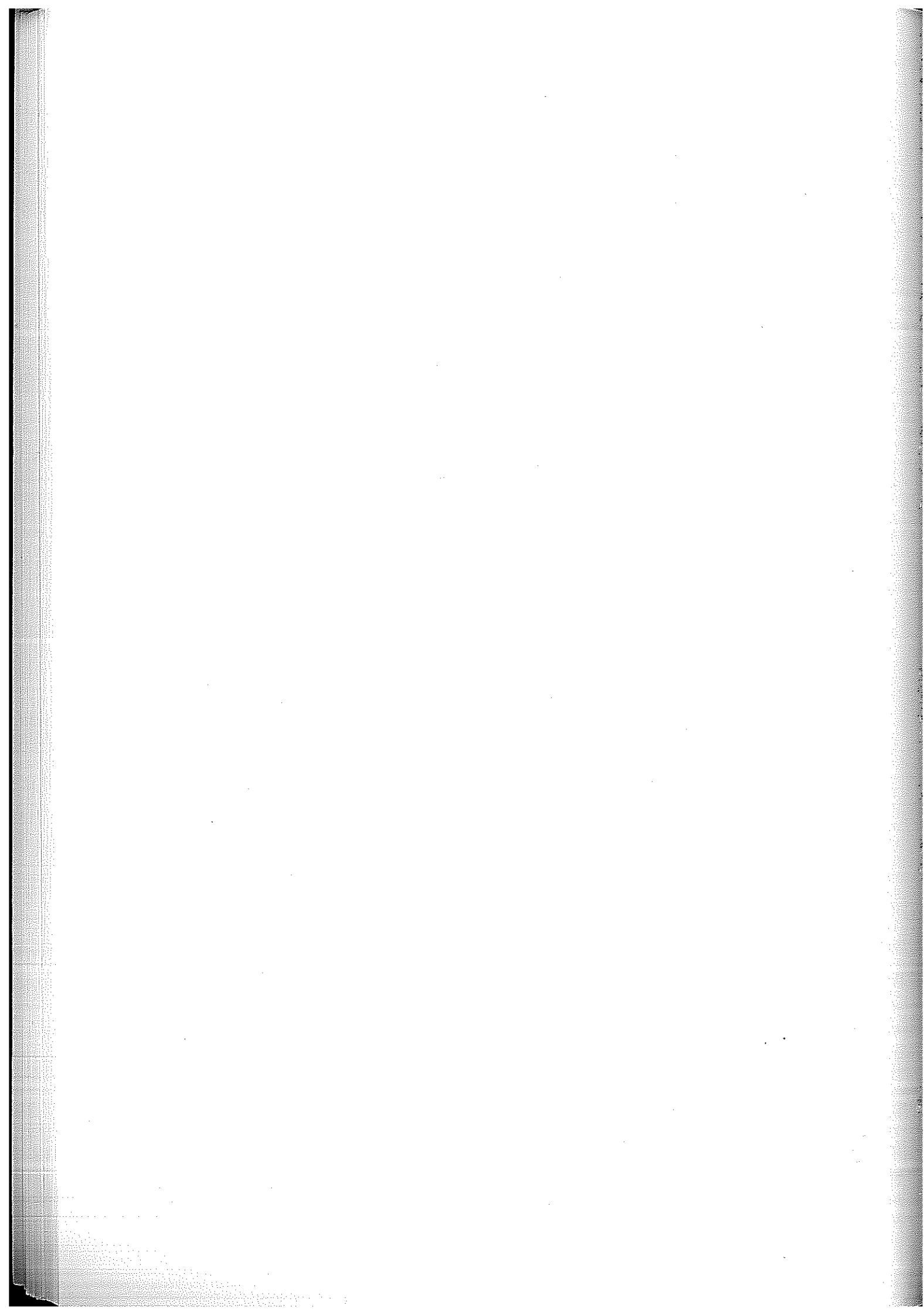
The corpus mandibulae is high (m2h 31,5 mm and h1 42,1 mm); the lateral surface tapers antero-posteriorly and is marked by a single postero-superiorly directed mental foramen which lies below the apex of the second premolar nearer the lower margin of the corpus than the upper. The ramus is relatively broad (rameal index 66,1 %). The chin region is prominent, the mental protuberance is well developed, the resultant chin shape is pointed. There are two superior genial tubercles and a single median inferior tubercle. A mylohyoid bridge has converted the mylohyoid groove into a canal. The dental arcade is divergent U-shaped and the angles of the mandible are everted.

The features of the cranium and mandible described are essentially Negroid in character. The individual represented by these remains may have been a member of a Bergdamara population.

The cranium and mandible, as far as could be ascertained exhibit none of the morphological and metrical features generally associated with Khoisan skulls. On the other hand, the range of variation shown by Khoisan skulls is not well known.

REFERENCE

- 1958 TROTTER, M. and GLESER, G. C.
A re-evaluation of estimation of stature. *Amer. J. Phys. Anthropol.*, 16: 79.



Microfaunal remains from Mirabib: some evidence of palaeo-ecological changes in the Namib

by

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ABSTRACT

Microfaunal remains, derived from disintegrated owl pellets, from stratified dateable remains in the Mirabib shelter, were used to determine palaeo-ecological changes in the Namib. It was estimated that a minimum of 2308 individual animals, of which 87% were found to be either gerbils or geckos, contributed to the remains studied. The evidence suggests that dune sand was not present within the owl-hunting range of Mirabib during the 6000 years for which faunal evidence was available. The overall indications for the last 6000 years suggest that a more favourable habitat was present during the accumulation of these sediments than is the case today.

1 INTRODUCTION (by C. K. B.)

The Mirabib shelter, intensively studied by Dr Sandelowsky, contains evidence of human occupation over more than 8000 years. It also contains a wealth of microfaunal remains from the regurgitated pellets of owls—owls which used the shelter as a roost or breeding site. The remains are preserved in stratified, dateable layers and therefore represent an extremely valuable record of small animal life available to the owls in the immediate vicinity of the Mirabib Hills over thousands of years.

The faunal composition of owl pellet remains can provide useful information about the habitat in which the animals lived. The potential of the Mirabib area from this point of view was recently explored (Brain 1974) when two collections of owl pellets, one from Mirabib and the other from Homeb on the Kuiseb River 30 km to the south east were analysed. It was found that differences in the faunal composition of the two collections reflected differences in habitat between the two locations. The Homeb owl roost provided access to the dune sand areas south of the Kuiseb River as well as to rocky, gravelly and river bed situations. Owls hunting from the Mirabib roost would not have access to the dune sand environment and so would have hunted animals living on gravel plain and rocky substrates only. The most striking difference in the faunal composition of the two prey samples centred round the incidence of the golden mole, *Eremitalpa granti namibensis*. This species is widespread in the arid west of southern Africa but the subspecies *namibensis* is restricted to the dune areas of the central Namib (Coetzee 1969). The preferred substrate is loose dune sand, in which the golden mole "swims", although penetration into the silts of the Kuiseb River bed has also been noted (Holm 1969). *Eremitalpa* individuals constituted 15 % of the animals in the Homeb prey sample, but were entirely absent from the Mirabib collection.

It seems reasonable to assume therefore that the presence of *Eremitalpa* in a prey sample indicates

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TABLE 1: Minimum numbers of individuals for each of the taxa in the various squares and levels

Level	Rodents										Insectivores				Birds		Reptiles			Invertebrates		Totals			
	Gerbillinae		Dendromurinae		Petromys sp		Other rodents		Macroscelidae		Soricidae		Chrysochloridae		Aves indet		Gekkonidae		Chamaeleo sp	Solifugae		Insecta indet			
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
Square B 35	89	59,3	0	0	0	0	0	0	10	6,7	0	0	0	0	11	7,3	34	22,7	0	0	6	4,0	X	150	100,0
Surface—datum	59	43,4	2	1,4	0	0	0	0	2	1,5	0	0	0	0	3	2,2	69	50,7	0	0	1	0,7	X	136	99,9
0—5 cm	41	56,9	1	1,4	0	0	0	0	6	8,3	2	2,8	0	0	1	1,4	21	29,2	0	0	0	0	X	72	100,0
5—10 cm	72	38,5	0	0	3	1,6	0	0	10	5,3	0	0	0	0	4	2,1	98	52,4	0	0	0	0	X	187	99,9
10—15 cm	52	80,0	1	1,5	0	0	0	0	1	1,5	0	0	0	0	2	1,5	10	15,4	0	0	0	0	X	65	99,9
15—20 cm	60	56,1	4	3,7	0	0	0	0	6	5,6	0	0	0	0	1	0,7	35	32,7	0	0	0	0	X	107	100,0
20—25 cm	19	43,2	2	4,5	0	0	0	0	2	4,5	0	0	0	0	3	6,8	18	40,9	0	0	0	0	X	44	99,9
25—30 cm	3	37,5	0	0	0	0	0	0	0	0	0	0	0	3	37,5	2	25,0	0	0	0	0	0	8	100,0	
30—35 cm	1	33,3	0	0	0	0	0	0	0	0	0	0	0	1	33,3	1	33,3	0	0	0	0	0	3	100,0	
35—40 cm	1	50,0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	50,0	0	0	0	0	0	2	100,0
40—45 cm	1	50,0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	50,0	0	0	0	0	0	2	100,0
	397	51,3	10		3		0		37		2		0		29		289		0		7		X	774	
Square C 35	30	58,8	0	0	1	7,7	0	0	1	2,0	0	0	0	0	1	2,0	19	37,3	0	0	0	0	X	51	100,1
Surface—datum	10	76,9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	15,4	0	0	0	0	X	13	100,0
0—5 cm	31	81,6	1	2,6	0	0	0	0	0	0	0	0	0	1	2,6	5	13,2	0	0	0	0	0	X	38	100,0
5—10 cm	64	56,1	16	14,0	0	0	1	0,9	1	0,9	0	0	0	0	1	0,9	31	27,2	0	0	0	0	0	114	100,0
10—15 cm	100	69,0	7	4,8	0	0	1	0,7	1	0,7	0	0	0	0	3	2,1	33	22,8	0	0	0	0	X	145	100,1
15—20 cm	148	73,3	33	16,3	0	0	1	0,5	2	1,0	0	0	1	0,5	2	1,0	15	7,4	0	0	0	0	X	202	100,0
20—25 cm	41	65,1	8	12,7	0	0	3	4,8	1	1,6	0	0	0	0	2	3,2	8	12,7	0	0	0	0	0	63	100,1
25—30 cm	35	74,5	5	10,6	0	0	1	2,1	1	2,1	0	0	0	0	2	4,2	3	6,4	0	0	0	0	0	47	99,9
30—35 cm	9	81,8	1	9,1	0	0	0	0	0	0	0	0	0	0	0	0	1	9,1	0	0	0	0	0	11	100,0
35—40 cm	3	50,0	0	0	0	0	0	0	0	0	0	0	0	1	16,7	2	33,3	0	0	0	0	0	6	100,0	
40—45 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100,0	0	0	0	0	0	0	0	1	100,0	
45—50 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50—55 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55—60 cm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60—65 cm	2	66,7	1	33,3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	100,0
	473	68,2	72		1		7		7		0		1		14		119		0		0		0	694	
Square D 35	1	16,7	0	0	0	0	0	0	1	16,7	0	0	0	0	0	0	4	66,7	0	0	0	0	0	6	100,1
Surface—datum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	100,0	0	0	0	0	0	1	100,0
0—5 cm	6	40,0	0	0	0	0	0	0	2	1,5	0	0	0	0	1	6,7	8	53,3	0	0	0	0	0	15	100,0
5—10 cm	24	58,5	0	0	0	0	0	0	1	2,4	0	0	0	0	1	2,4	15	36,6	0	0	0	0	0	41	99,9
10—15 cm	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
15—20 cm	27	62,8	3	7,0	0	0	0	0	1	2,3	0	0	0	0	2	4,6	9	20,9	1	2,3	0	0	0	43	99,9
20—25 cm	72	55,8	14	10,8	0	0	1	0,8	2	1,5	0	0	0	0	0	0	41	31,5	0	0	0	0	0	130	100,0
25—30 cm	57	70,4	7	8,6	0	0	2	2,4	2	2,5	0	0	0	0	0	0	13	16,1	0	0	0	0	0	81	100,0
30—35 cm	65	66,3	10	10,2	1	1,0	2	2,0	2	2,0	0	0	0	1	1,0	17	17,3	0	0	0	0	0	98	99,8	
35—40 cm	42	85,7	1	2,0	0	0	0	0	1	2,0	0	0	0	0	0	0	5	10,2	0	0	0	0	0	49	99,9
40—45 cm	13	59,1	3	13,6	0	0	2	9,0	1	4,5	0	0	0	0	0	0	3	13,6	0	0	0	0	0	22	99,8
45—50 cm	1	50,0	0	0	0	0	1	50,0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	100,0
50—55 cm	3	75,0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	25,0	0	0	0	0	0	4	100,0
55—60 cm	3	75,0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	25,0	0	0	0	0	0	4	100,0
	311		38		1		8		11		0		0		5		117		1		0		0	492	

TABLE 1 (continued)

Level	Rodents										Birds			Reptiles		Invertebrates		Totals						
	Gerbillinae		Dendromurinae		Petromys sp		Other rodents		Macroscelidae		Insectivores		Aves indet		Gekkonidae		Chamaeleo sp		Solifugae		Insecta indet			
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n		%	n	%	n	%	n
Square E 35	6	46,2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surface-datum	1	25,0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0-5 cm	14	40,0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-10 cm	21	61,8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-15 cm	28	59,6	1	2,1	1	2,1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-20 cm	24	63,2	1	2,6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-25 cm	25	73,5	1	2,9	1	2,9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-30 cm	21	65,6	1	3,1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-35 cm	42	68,9	5	8,2	1	1,6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35-40 cm	26	66,7	5	12,8	1	2,6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40-45 cm	5	62,5	1	12,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45-50 cm	1	33,3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50-55 cm	214	15	5	4	4	13	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55-bedrock	1395	135	10	19	68	68	3	3	1	1	56	56	613	613	1	1	7	7	0	0	0	0	0	0
Overall Totals	1395	135	10	19	68	68	3	3	1	1	56	56	613	613	1	1	7	7	0	0	0	0	0	0

TABLE 2: Summary

Level	Rodents										Birds			Reptiles		Invertebrates		Totals						
	Gerbillinae		Dendromurinae		Petromys sp		Other rodents		Macroscelidae		Insectivores		Aves indet		Gekkonidae		Chamaeleo sp		Solifugae		Insecta indet			
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n		%	n	%	n	%	n
Combined squares 35 B-E	120	58,3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surface-datum	75	46,0	2	1,2	1	0,6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0-5 cm	79	61,3	2	1,6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-10 cm	174	46,5	16	4,3	4	1,1	1	0,3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-15 cm	173	70,0	8	3,2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-20 cm	263	65,9	41	10,3	1	0,3	2	0,5	1	0,3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-25 cm	156	56,7	25	9,1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-30 cm	120	70,6	13	7,7	1	0,6	3	1,8	4	2,4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-35 cm	96	66,7	12	8,3	1	0,7	3	2,1	3	2,1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35-40 cm	88	74,0	6	5,0	1	0,8	0	0	2	1,7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40-45 cm	39	62,9	8	12,9	1	1,6	2	3,2	2	3,2	1	1,6	0	0	0	0	0	0	0	0	0	0	0	0
45-50 cm	6	60,0	1	10,0	0	0	1	10,0	1	10,0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50-55 cm	6	60,0	1	10,0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55-60 cm	1395	135	10	19	68	68	3	3	1	1	56	56	613	613	1	1	7	7	0	0	0	0	0	0
Overall Totals	1395	135	10	19	68	68	3	3	1	1	56	56	613	613	1	1	7	7	0	0	0	0	0	0

the presence of an aeolean sand habitat within the hunting range of the owls. It is unfortunate that we do not know what the typical limits of a barn owl's hunting range are. Presumably the range would be larger in situations where prey is scarce. All that can be said at present is that owls using the Mirabib roost do not fly the 25 km to the nearest dune sand in order to catch their prey.

In the light of the *Eremitalpa* considerations, it was immediately apparent that the stratified, dateable remains in the Mirabib shelter could tell us whether the dunes, currently restricted to the area south of the Kuiseb, had at any stage in the timespan involved crossed the river and spread to the north. The Kuiseb River forms a very spectacular dividing line between the duneland to the south and gravel plains to the north; it would be of great interest to know whether this barrier has been of long standing. Evaluation of other faunal elements in the sample could also perhaps throw light on the nature of the Mirabib habitat as it existed in the past.

2 THE MICROFAUNAL SAMPLE AND ITS ANALYSIS (by V.B.)

The excavation of the Mirabib shelter has been described in detail (Sandelowsky 1974, and this volume). A horizontal grid was laid out and 14 square metres have been excavated by Dr Sandelowsky. The datum level conformed to the natural surface over part of the area involved but dipped to 10 cms below the surface in some squares. Excavation of the loose deposit was undertaken with great care in 5 cm spits, all sediment being screened so that cultural, plant and faunal material could be removed by hand from the screens. The microfaunal material was placed in paper packets marked according to square and level.

For the purpose of the present analysis, four squares, designated 35 B—E were selected. These formed part of the original trial trench orientated approximately at right angles to the trend of the back wall of the shelter, and situated immediately below the ledges used as owl roosts and breeding sites over a considerable period of time.

Microfaunal remains, derived from disintegrated owl pellets, occurred in all levels to a depth of 55—60 cms, but were absent in the lowest levels of the profile; they were less numerous below 40 cms than above it. Likewise, remains were most numerous in the square closest to the owl roost, i.e. square 35 B. The abundance of bones declined progressively in the sequence of squares 35 B—E. Samples from every 5 cm spit in each of the four squares were sorted and analysed separately. Sorting was done under an illuminated magnifier, the aim being to remove all parts which could be used in the compilation of a table reflecting the minimum numbers of individual animals which had contributed to the sample.

The method used in compiling a list of the minimum numbers of individual animals consisted of isolating and counting diagnostic parts of the animals involved. The individual count for each taxon would be based on that part of the skeleton which occurred most abundantly. The remains tended to be very fragmentary, doubtless due to trampling by men and animals within the shelter. Complete skulls were invariably absent.

In the case of rodents and insectivores, all maxillary and mandibular pieces were sorted out. These were then separated taxonomically and re-sorted into left and right maxillary or mandibular pieces. Minimum numbers for each taxon per level were then determined. It was found that many elements in a golden mole skeleton are easily recognisable and all these would have been removed, had they occurred. The same is true of bird bones — the count of birds was based on a wide variety of cranial and post-cranial parts.

Reptile numbers were based on counts of left and right maxillary and mandibular pieces, while numbers of sun spiders (Solifugae) were estimated on the occurrence of characteristic mouthparts. No attempt was made to estimate the numbers of individual insects per level or square. Presence or absence of insect remains was simply noted.

It was estimated that a minimum of 2308 individual animals had contributed to the remains in the four squares studied. Of these, 774 occurred in square 35 B (closest to the owl roost), 694 in C, 492 in D and 348 in E (furthest from the roost). Details of the minimum numbers of individuals for each of the taxa in the various squares and levels are given in Table 1.

It will be seen that 2008, or 87 %, of all the individual animals represented in the whole sample were found to be either gerbils or geckos: these creatures have formed the staple diet of Mirabib owls for thousands of years. Nevertheless, a variety of other animals is also represented. Some comments on the various taxa are now provided.

2.1 Subfamily Gerbillinae: the gerbils.

Gerbils comprise by far the largest faunal component. They apparently consist mostly of *Gerbillurus vullinus* individuals though *G. paeba* is likely to be represented as well. Definite separation of the fragmentary material is difficult. *Desmodillus auricularis* is also likely to be present in small numbers; separation of these from *Gerbillurus* specimens is possible if the alveoli of the first molars are counted. According to Coetzee (1972), *Desmodillus* first molars have three alveoli, *Gerbillurus* have four. Unfortunately, the diagnostic tympanic bullae of the gerbil skulls are never preserved in the Mirabib material.

2.2 Subfamily Dendromurinae

Fragmentary remains of dendromurines may be recognised by the well-developed "masseter knobs" present on the maxillae (Coetzee 1972). In his checklist of mammals of the Mirabib area, Stuart (1976) does not record the presence of dendromurines, but it is known that the long-eared desert mouse, *Malacothrix typica* is difficult to trap (Smithers 1971).

All the dendromurine remains from Mirabib are provisionally assigned to *Malacothrix typica*, though further study on a larger sample is desirable.

Petromys sp. remains are likely to belong to the extant species *P. typicus*, the dassie rat, known from the area.

2.3 Other rodents

Remains of rodent taxa other than those already referred to are rare, but do occur. Further study is warranted, preferably on a larger sample including remains from other grid squares.

Genera represented include *Rhabdomys*, *Aethomys* and *Petromyscus*.

2.4 Macroscelidae

Three different form of elephant shrew are known from the Mirabib area: *Macroscelides proboscideus*, *Elephantulus rupestris* and *E. intufi*. All are likely to be represented in the remains although separation into the species has not yet been made.

2.5 Soricidae

Remains of only three individual shrews were found. They are provisionally referred to *Crocidura sp.* *C. cyanea* is known to occur at Gobabeb.

2.6 Chrysochloridae

The golden mole *Eremitalpa granti namibensis* is present in the dune area south of the Kuiseb River. The single humerus found is referred to this species.

2.7 Aves

The bird remains have not yet been studied in detail. All come from small birds of approximately lark-size.

2.8 Gekkonidae

Most of the geckos represented in the sample are comparatively large ones and are thought to come

from *Pachydactylus bibroni*, a common species on the rocky outcrops. Other forms may also be represented, such as *Chondrodactylus* and the smaller *Ptenopus*.

2.9 Chamaeleo sp.

The mandible of a single Namaqua chameleon, *Chamaeleo namaquensis* was found.

2.10 Solifugae

Sun spiders, as yet undetermined specifically, are regularly preyed upon by contemporary barn owls at Mirabib. Their remains are found in the upper levels of the cave deposit.

2.11 Insecta

The presence of beetles, largely Tenebrionids, was noted in many of the layers, as reflected in Table 1. No attempt was made to estimate numbers of individuals or to identify species present.

3 INTERPRETATION OF THE RESULTS (by C.K.B.)

The purpose of this study is to establish what animals are represented in each level of the cave sediment and to draw conclusions, if possible, from these remains concerning past environmental conditions. In particular answers were sought to two specific questions:

1. Did the dunes cross the Kuiseb River at any stage during the time spanned by the remains?
2. Is there evidence of rainfall or habitat change during the period?

The major features apparent in the composition of the sample as a whole are:

- (a) The spectrum of prey animals is dominated by gerbils and geckos.
- (b) The long-eared desert mouse, *Malacothrix typica*, was well-represented in the past but declines towards the top of the sequence and is absent in the uppermost layer.
- (c) Rodents, other than gerbils and dendromurines, occur at very low frequency.
- (d) Elephant shrews (Macroscelids) are represented throughout the deposit in small numbers.
- (e) Shrews (Soricids) and golden moles (Chrysochlorids) are virtually absent.
- (f) Birds, as yet unidentified, are a consistent but small component of the owls' prey.

- (g) The only reptile, other than geckos, represented in the remains was a Namaqua chameleon, *Chamaeleo namaquensis*.
- (h) Parts of sun spiders (Solifugae) are found in the uppermost levels only. It is possible that their chitinous mouthparts have decomposed in the lower layers, if they had been present there.
- (i) Tenebrionid beetle remains occur in small numbers at various depths.

Some evidence bearing on the two questions posed earlier will now be considered.

1. *Did the dunes cross the Kuiseb at any stage during the time-span of the remains?*

As mentioned earlier in this paper, the golden mole *Eremitalpa granti namibensis* is a common inhabitant of the dune sand areas to the south of the Kuiseb River. Pellets collected from a barn owl roost at Homeb on the Kuiseb River contained a 15 % *Eremitalpa* component among its prey items (Brain 1974). Those from the gravel plain/rock habitat of Mirabib itself contained no *Eremitalpa* remains. It therefore seems reasonable to assume that, had the dunes advanced to the vicinity of Mirabib in the past, the associated *Eremitalpa* populations would have moved with them. The remains from all levels of the Mirabib excavation were carefully examined for traces of *Eremitalpa*; a single humerus was found in the 20–25 cms sample and is probably 3000–4000 years old. Apart from the presence of this single individual, the presence of which is difficult to explain, the Mirabib prey sample is devoid of golden mole remains.

The evidence suggests that dune sand was not present within the owl-hunting range of Mirabib during the 6000 years or so for which we have faunal evidence. It is very likely that the Kuiseb River served as an effective barrier to northward dune migration over this period.

2. *Is there evidence of rainfall or habitat change during the period?*

There is indeed some information to be gained on past environmental conditions from

- (a) the occurrence of *Malacothrix*
- (b) an evaluation of the gerbil/gecko relationship.

(a) *Malacothrix typica*, the long-eared desert mouse is widely distributed in the arid areas of southern Africa. Coetsee (1972) states that this species "prefers soil rich in lime content" and that, in South West Africa, it is found in the eastern areas and Ovamboland as well as in his survey of mammals of Botswana, Smithers (1971) found *Malacothrix* to be widespread in the Kalahari and states: "the species is particularly associated with short grass on hard ground, occurring on the fringes of pans

with a cover of karroid bush, or on hard calcareous ground".

As is apparent in Figure 1, *Malacothrix* remains occur throughout the Mirabib profile, with the exception of the uppermost layer. It is quite possible that a small *Malacothrix* population exists in the Mirabib area today but its presence has not been recorded due to difficulties in trapping this species. As shown in Figure 1, the highest percentage abundances of *Malacothrix* are associated with the "vegetation-rich" and "sandy" layers, suggesting that a more favourable habitat was present during the accumulation of these sediments than is the case today.

(b) *The gerbil/gecko relationship*

An interesting aspect of the percentage abundance figures given in Table 2 is that, in all layers where the samples are sufficiently large to be meaningful (ie. from surface to 40 cms), a remarkable relationship exists between the percentage abundance of gerbils and that of geckos. The results are presented in Figure 2 where it is visually apparent that the relationship in each layer is a reciprocal one — where the percentage abundance of gerbils increases, that of geckos declines.

Gerbils and geckos constitute the major component in the prey of owls at Mirabib. A study of contemporary owl pellets, collected at regular intervals in the Mirabib Hills, is being made (Stuart and Brain, in preparation). This study has provided a key to the understanding of the gerbil/gecko ratios in the prey of the owls. 1974 and 1975 were exceptionally wet years in the Namib Park resulting in more luxuriant growth of grass round Mirabib than had been seen for many years. In response to the more favourable conditions, the gerbil populations on the grass-covered plains increased dramatically; occupied burrows could be observed in far greater abundance than had been the case before.

It appears from the owl pellet study that barn owls favour gerbils as prey when these are readily available, but fall back on geckos as a stop-gap when rodents are more difficult to obtain. The sample of pellets collected at Mirabib in August 1972, before local conditions improved as a result of the exceptional rains, contained 60 % gerbils and 21 % geckos (Brain 1974). It seems likely that the remains came largely from rock-living *Pachydactylus* individuals.

With the improvement of conditions at Mirabib, the new pellets were found to contain gerbils to the almost total exclusion of other prey; the representation of geckos became insignificant. One may confidently predict however that, as the grass cover at Mirabib

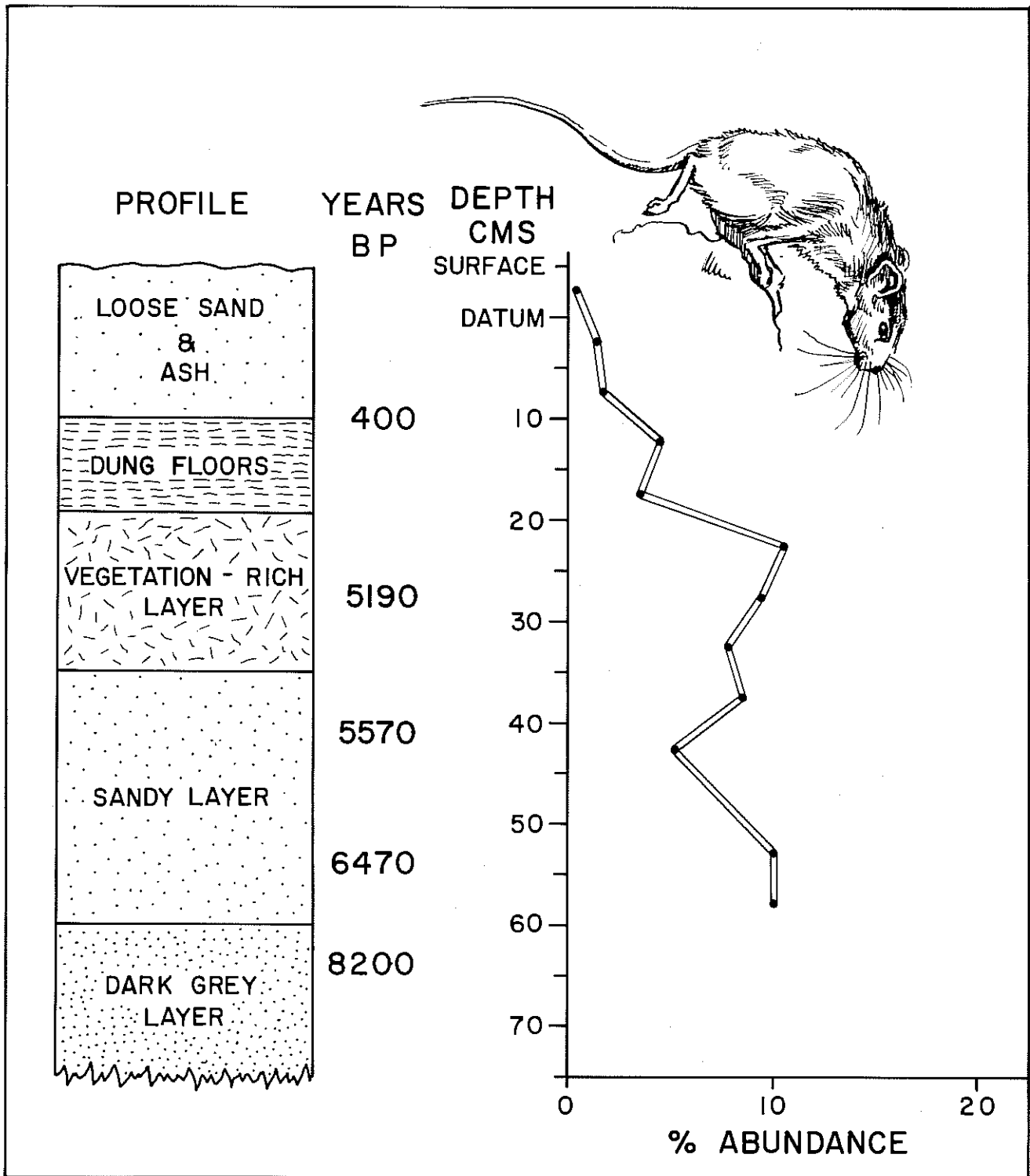


Figure 1: Occurrence of *Malacothrix* remains in the Mirabib profile.

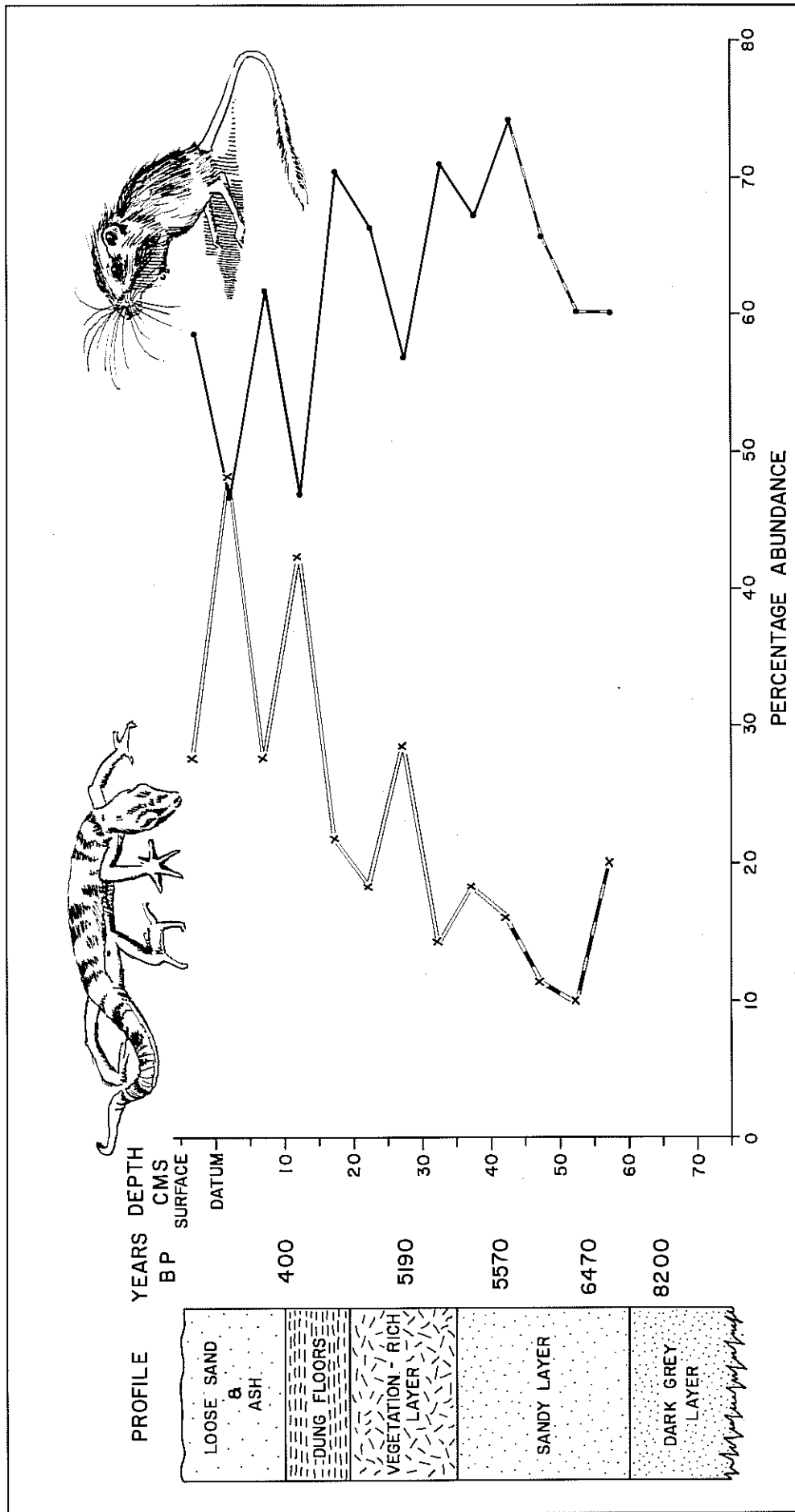


Figure 2. Percentage abundance of gerbils and geckos

gradually deteriorates again, the abundance of gerbils will decrease and geckos will once again figure more prominently in the prey samples.

It would be very valuable if data could be collected on the response of gerbil and gecko populations to the periodic and dramatic changes in rainfall which occur in the Namib. It seems unlikely that the geckos would be able to increase their numbers as rapidly in response to better conditions as is the case with gerbils. The rock-living geckos probably represent a fairly stable, standing resource which can be preyed upon at any time.

On the basis of this reasoning, the graphs for percentage abundance of gerbils and geckos in the various Mirabib layers (Fig. 2.) may be interpreted. Layers showing high gerbil percentages, with associated low gecko ones, suggest times of higher rainfall, more luxuriant vegetation and larger gerbil populations. Conversely, layers with lower gerbil percentages, but higher gecko ones, suggest drier times when the owls relied more heavily on the gecko resource.

Referring to the graphs in Figure two, layers suggest conditions drier than those of today by "today" is meant recent years prior to the exceptional seasons of 1974-6). These are the 0-5 cms and 10-15 cms levels, both of which probably accumulated somewhere within the last 500 years. Level 25-30 cms, dated at approximately 5200 years B.P., suggests conditions very like those of today, while all the rest appear to reflect wetter conditions.

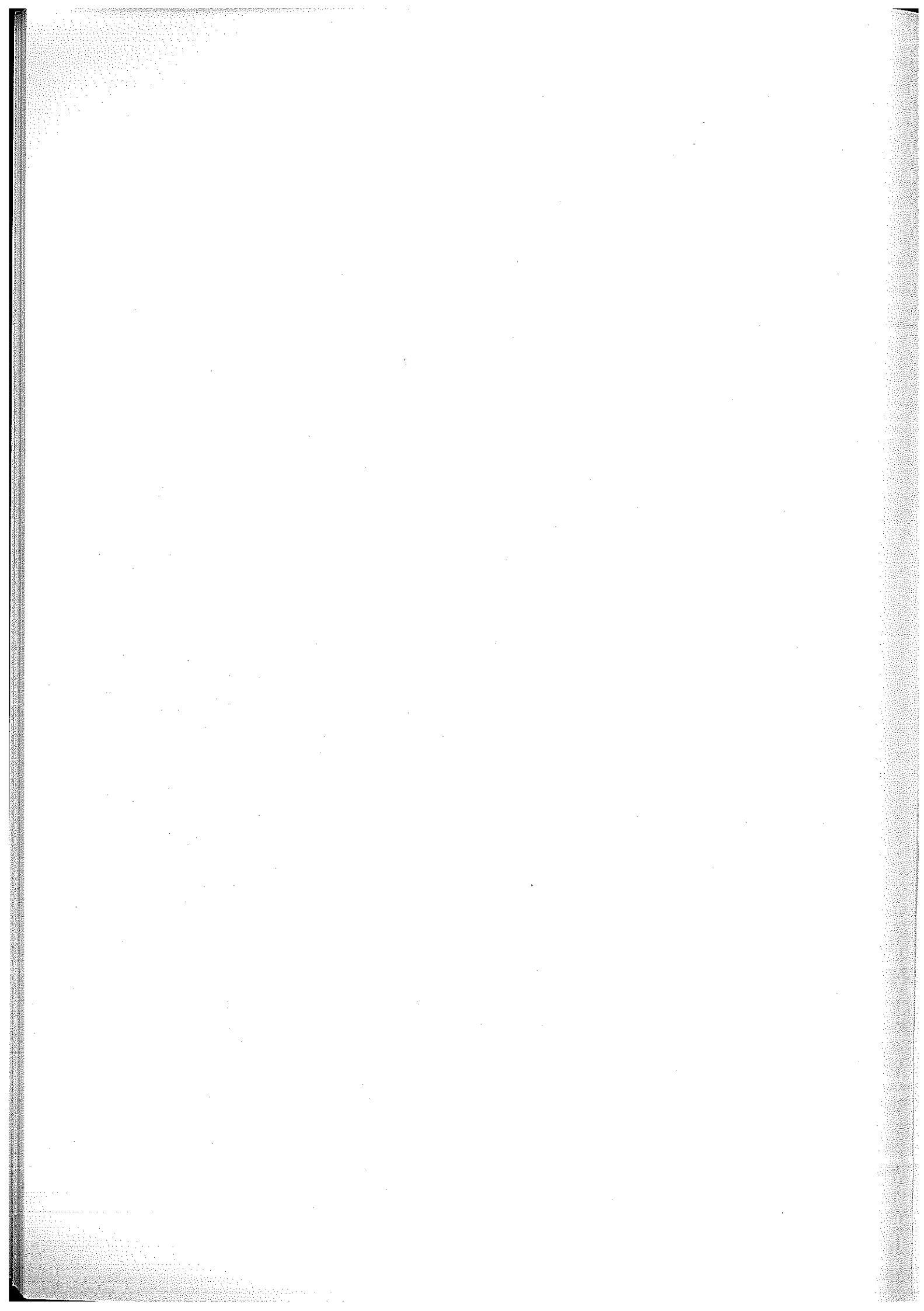
The overall indication for the last 6000 years is that conditions were consistently more favourable than they are at present, with the exception of two dry periods within the last 500 years.

4 ACKNOWLEDGEMENTS

Our particular thanks are due to Dr B. H. Sandelowsky for providing us with the microfauna from her Mirabib excavation and for her enthusiasm; to Dr M. K. Seely for her continued interest in the project and for placing the facilities of the Desert Ecological Research Unit at our disposal; to the C.S.I.R. for its support of the Mirabib project; to Mr C. T. Stuart for help with the collection and study of the owl pellet remains.

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SHORT NOTE

List of plant species from the
Mirabib Hill Area

by

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Plants recorded for the Mirabib outcrops and the adjacent plains are listed below. The plant communities which can be recognised are listed, but the vegetation of the rock outcrops is a mixture, being a combination of communities of washes, the rock outcrops of the pro-Namib, and the grasslands, whose constituent species occupy the micro-habitats provided by outcrops of rock. In many respects this series of hills is ecotonal (that is, a tension zone between) to the pro-Namib hills (such as Tumasberg, "Boulder Beacon" and the broken country leading to the Kuiseb Canyon) and the arid grasslands.

PLANT COMMUNITIES

Stipagrostis obtusa and *Stipagrostis ciliata* sub-communities.

These are the grassland communities of the plains. Structurally and floristically simple, these consist of a single vegetation stratum of grasses and forbs. In more favourable microhabitats such as old animal wallows, the nominate grasses will be accompanied by species such as *Eragrostis annulata*, *Hermannia modesta*, *Triraphis pumilio*, *Indigofera auricoma*, *Geigeria ornativa* and *Tephrosia dregeana*. In other places *Zygophyllum simplex* forms extensive mats.

The *Sesuvium sesuvioides* — *Stipagrostis obtusa* community.

Physiognomically very similar to the above mentioned communities, this is an assemblage of forbs (*Sesuvium sesuvioides*, *Cleome diandra*, *Euphorbia phylloclada* etc.) and grasses. It occupies rocky slopes with shallow soils, particularly over granite.

Monechma genistifolia community. A rather ill-defined community of rocky areas, especially on schistose rocks. Structurally this is a more complex community than the foregoing ones, consisting as it does of a dwarf shrub and a herb stratum. Apart from the nominate species, *Stipagrostis uniplumis*, *Osteospermum microcarpum*, *Adenia pechuelii*, *Talinum arnotii* and *Curroria decidua* are common components. Occasionally the tree *Maerua schinzii* occurs.

Petalidium setosum community. Another two-strata community which is best developed in shallow drainage lines on the plains. It is characterised by the presence of the dwarf shrub *Petalidium setosum** (*indicates species found in archaeo-botanical remains) with *Tephrosia dregeana* ("vetch") and the forbs *Monechma desertorum*, *Trianthema triquetra*, *Indigofera auricoma* and *Cleome luederitziana*. There might be three species of grass present. This community often occurs in shallow soils or calcrete.

Asclepias buchenaviana community. This community is only encountered on the plains NNW of Mirabib. It consists of a tall dwarf shrub (*Asclepias buchenaviana*) with a very sparse herb stratum of *Stipagrostis ciliata*. It is of little significance except for the fact that the *Asclepias* seems to provide a niche for a number of insects (spiders, flies, wasps

and bees), frequently having shallow soil overlying schist rocks.

Adenolobus — *Acacia reficiens* community. Typically consisting of three strata (shrub, dwarf shrub and ground layers) this community occurs in the washes around Mirabib and also comprises the "gutter" community at the foot of the hills. Prominent species are *Acacia reficiens**, *Parkinsonia africana**, *Adenolobus pechuelii*, *Kissenia capensis** and *Asthenatherum glaucum*. Following rains lilies such as *Hexacrytis dickiana*, *Ornithogalum stapfii*, *Dipcadi bakeranum*, *Ornithoglossum viride* and the very striking *Ammocharis tinneana* (a member of the family *Amaryllidaceae*) appear. A common grass in favourable seasons is *Stipagrostis hochstetterana*. In the Mirabib area washes supporting this community are also occupied by *Boscia foetida**, *Moringa ovalifolia* and *Crotolaria podocarpa*. The substrate is generally sand or gravel, which may be of considerable depth.

Acacia erioloba community. Although only poorly developed, examples of this wash community occur in some of the sandy basins in the hills. In these basins are found a rich assemblage of plants, often from a number of the communities.

Typical rock outcrop communities. As mentioned above, the Mirabib Hills provide niches for some of the species of the *Petalidium variabile* and *Commiphora glaucescens* — *Antheophora pubescens* communities of the pro-Namib mountains, but neither community has developed fully. Species which have affinities with these communities are *Pegolettia senegalensis*, *Eragrostis nindensis*, *Euphorbia avasmontana*, *Gisekia africana*, *Trichodesma africana* and others.

LIST OF SPECIES

Although many species have pronounced habitat preferences these are dealt with elsewhere (Robinson 1976). The list given here is moderately comprehensive, but not exhaustive, and any additions will be welcome. Species are arranged alphabetically according to the major growth-forms, following the systems given by Whittaker (1970). The relevant classes are:

Trees (larger woody plants)

- Deciduous
- Broad-leaved evergreen (moderate sized leaves)
- Evergreen-sclerophyll (small, tough leaves)
- Thorn trees (armed with spines)

Lianas — here referring only to climbers

Shrubs (smaller woody plants, here usually between 0,5 and 3 m in height)

- Deciduous
- Evergreen-sclerophyll
- Stem succulents

Thorn-shrubs

Dwarf-shrubs (low shrubs spreading near the ground surface, less than 50 cm tall).

Herbs — (plants without perennial above-ground woody stems)

- Graminoids (grasses etc.)
- Forbs (herbs other than ferns or grasses)

Thallophytes — lichens, mosses and liverworts and fungi.

Trees — Deciduous

Moringa ovalifolia

— Broad-leaved evergreen

*Maerua schinzii**

Cordia gharaf — strictly, this should be classed as a shrub.

— Evergreen-sclerophyll

*Boscia foetida** (may also be an evergreen-sclerophyll shrub)

— Thorn-trees

*Acacia erioloba**

*Acacia reficiens**

*Parkinsonia africana**

— Climbers

Corollocarpus welwitschii

Cumumis sagittatus

Shrubs — Deciduous

Asclepias buchenaviana

*Commiphora saxicola** (?) — more of a dwarf-shrub

Polygala guerichiana (?) — more of a dwarf-shrub

Sarcocaulon mossambidense (?) — more of a dwarf-shrub

— Evergreen-sclerophyll

*Rhus marlothii** — leaves are moderately large

*Montinia caryophyllaceae** — leaves are moderately large

— Stem succulents

Euphorbia avasmontana

— Thorn shrubs

*Catophractes alexandrii**

*Phaeoptilum spinosum**

— Dwarf shrubs

Adenia pechuelii

Adenolobus pechuelii

Aptosimum angustifolium

Asparagus denudatus

Barleria merxmulleri

Blepharis obmitrata

Calicorema capitata

Chascanum garipense

Commicarpus squarrosus

Curroria decida

Dyerophytum africanum

Hermannia abrotanoides

Hermannia modesta

Hoodia currori

*Kissenia capensis**

Kohautia ramosissima
Kohautia virgata
Marcellioopsis denudata
Monechma arenicola
Monechma genistifolium
Nolletia garipense
Orthanthera albida
*Petalidium setosum**
Ruellia diversifolia
Salsola tuberculata
Senecio alliariifolius
Solanum rigescentoides
Sutera maxii
Tephrosia dregeana
Zygophyllum cylindrifolium
Zygophyllum stapfii

Herbs — Graminoids

Aristida adscencionis
Aristida parvula
Asthenatherum glaucum
Brachiaria glomerata
Enneapogon brachystachyus
Enneapogon scaber
Eragrostis annulata
Eragrostis nindensis
Schmidtia kalahariensis
Sporobolus nebulosus
Stipagrostis ciliata
S. hirtigluma
S. hochstetterana
S. subacaulis
S. obtusa
S. uniplumis
Triraphis pumilio

— Forbs (other than lilies)

Aizoanthemum dinteri
Amaranthus thunbergii
Anticharis inflata
Blepharis grossa
Calostephane marlothii
Celosia argenteiformis
Cleome luederitziana
C. diandra
Crotolaria podocarpa
Dicoma capensis
Euphorbia inaequilatera
E. glanduligera
E. phylloclada
Forsskaolea candida
Geigeria alata
G. ornativa
Gisekia africana
Helichrysum leptolepis
H. roseo-niveum
Indigofera auricomma
I. dregeana

Kohautia lasiocarpa
Launaea intybacea
Limeum argute-coronatum
L. sulcatum
Lotononis platycarpha
Mollugo cerviana
Monechma desertorum
Monsonia senegalensis
M. umbellata
Osteospermum microcarpum ssp. *septentrionale*
Pegolettia senegalensis
Pentzia schinziana
Raphionacme (S-R 10)
Senecio flavus
S. marlothianus
Sesamum capense
Sesuvium sesuvioides
Sutera fragilis
Talinum arnottii
Tribulus terrestris
T. zeyheri
Trichodesma africana
Trianthema triquetra ssp. *parvifolia*
Zygophyllum simplex

"Lilies"

Ammocharis tinneana
Eriospermum roseum
Hexacyrtis dickiana
Ornithoglossum viride
Dipcadi bakeranum
Eriospermum tortuosum
Ornithogalum stapfii

Thallophytes

Lichens — The Mirabib Hills area is outside the fog zone, thus only a few species of crustose lichens occur.

Liverworts — One species of liverwort has been collected from a rock-pool in the Mirabib Hills, but has not been identified.

Fungi — Following rains in 1972, 1973 and 1974 two species of *Basidiomycetes* (sub-class *Homobasidiomycetes*, order *Agaricales* or mushrooms) have been recorded.

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1. MADOQUA publishes papers on original, basic and applied research concerning nature conservation and the deserts in South West Africa.
2. Papers submitted for publication should be sent to the:
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1. Papers submitted should be ready for the press.
2. The manuscript should be typed in double spacing throughout, on one side of A4-size (297×210 mm) paper, with a left-hand margin of 4 cm. The beginning of each paragraph should be inset.
3. The original and two copies of the manuscript should be submitted.
4. Title page should contain:
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5. An abstract should be given of not more than 100 words.
6. A list of CONTENTS should give the headings of individual sections and if appropriate also sub-sections.
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 - Results
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1953 *Southern African mammals: A reclassification*. London. Trustees British Museum (Nat. Hist.)

HANKS, J.

1972 Aspects of dentition of the African elephant, *Loxodonta africana*. *Arnoldia* (Rhod.), (36): 1–8.

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1955 Observations on the reproductive activities, measurements, and growth rate of the dikdik (*Rhynchotragus kirki thomasi* Neumann). *Proc. zool. Soc. London*, 124: 751–784.

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1931 Field notes on two little known antelopes: The Damaraland dikdik (*Rhynchotragus damarensis*) and the Angolan impala (*Aepyceros petersi*). *S. Afr. J. Sci.* 28: 412–417.

1934 *The mammals of South West Africa*. 2 Vols. London: Heinemann.

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Plates and text-figures

1. Glossy photographs not less than 14 × 20 cm in size, and line drawings in black (waterproof) india ink on white paper must be submitted together with the manuscript. The line drawings should be about the size of reproduction. An indication should be given of the proposed size of reproduction i.e. full page or one column.
2. The reverse side of illustrations should be marked lightly in pencil with the title of the illustration, author's name and title of article.
3. Scales could be drawn in or photographed so that they form part of the illustration.

Short notes

1. No headings if possible.
2. Text immediately follows the title.
3. References should be cited as with long manuscript – see 14 above.

Proof

1. Galley proofs will be sent to the author, who accepts final responsibility for their complete correction, and should be returned promptly.
2. 75 reprints are sent gratis to the author(s).
3. The size of the printing surface of the pages is 24.7 cm × 16.8 cm.

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