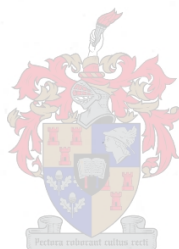


NOTES ON THE FLORA AND VEGETATION
OF THE Omuverume Plateau-Mountain,
Waterberg, South West Africa.

by

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ABSTRACT

A short account is given of the vegetation and flora of a 32 square kilometer area which is characterized firstly by being a meeting-ground for the major floras of the north-eastern "Tree savanna and woodland" and the central "Thornbush savanna" vegetation types of S.W.A. and secondly by containing several topographically-correlated local floristic areas which here form a buffer zone between the two major floras.

A table of 310 vascular plant species collected and observed in the floristic areas present, is given.

The relict nature of the extreme south-western geographical limits of the flora of the "Tree savanna and woodland" vegetation type is also indicated.

OPSOMMING

'n Kort verslag van die plantegroei en flora van 'n 32 vierkant kilometer area is gegee. Hierdie area word eerstens gekenmerk deurdat dit 'n gebied is waar die groot floras van die noordoostelike „Boomsavanna en Droë Woud" en die sentrale „Doringbossavanna" plantegroei tipes van S.W.A. bymekaarkom en tweedens deurdat 'n paar topografies-gekorreleerde lokale floristiese areas wat 'n buffer sone tussen die twee groot floras vorm, teenwoordig is.

'n Tabel van 310 vaatplantsoorte wat versamel en opgemerk is in die floristiese areas wat teenwoordig is, is gegee.

Die relik-geaardheid van die heel suidwestelike geografiese grens van die flora van die „Boomsavanna en Droë Woud" plantegroei tipe, is ook aangetoon.

ZUSAMMENFASSUNG

Ein kurzer Bericht wird über die Vegetation und Flora des 32 Quadratkilometer großen Arealen gegeben. Kennzeichnend für dieses Gebiet ist erstens das Zusammentreffen der großen Floreengebiete des nordöstlichen „Baumsavanne und Trockenwald"- und des zentralen „Dornbuschsavannen"-Vegetationstypus von Südwestafrika und zweitens das Vorhandensein einiger topographisch bedingter, lokalen, floristischen Areale, welche als Pufferzonen zwischen den beiden großen Florenformen angetroffen werden.

In einer Tabelle werden die gesammelten und beobachteten 310 Gefäßpflanzen der einzelnen floristischen Gebiete aufgeführt.

Die relikartige Form dieser extrem südwestlichen geographischen Grenze der Flora des „Baumsavannen und Trockenwald"-Vegetationstypus wird ebenfalls aufgezeigt.

I. INTRODUCTION

1. General

In 1970 and 1971, an intensive study was made of various structural and functional ecological aspects of the savanna vegetation on a small area of the Omuverume Mountain Plateau in South West Africa. The results of this study are due to be published later. In conjunction with this main study, notes were also made on floristic and vegetational aspects of the area, surrounding the main study area. This surrounding area constitutes the Omuverume Plateau-mountain, most parts of which were inspected at least once during the course of the study. The present paper concerns only a general description of the flora and vegetation of the various parts of this mountain as a whole.

2. Geography

The Omuverume Plateau-mountain is a somewhat attenuated triangular shaped plateau-mountain centered on $20^{\circ}35\frac{1}{2}'S$ and $17^{\circ}07'E$ and forms the south-western end of the Great Waterberg Plateau in the north-eastern part of the Otjiwarongo district of S.W.A. (Fig. 26). The mountain is separated from the remainder of the Great Waterberg by a high saddle-break with the summits of the two parts about half a kilometer apart. The Omuverume Plateau is about 325 to 415 metres above the surrounding plains and 1885 metres above sea level at the highest point. The plan area of the mountain is approximately 32 square kilometers.

3. Geology

The plateau-mountain is made up of the Etjo beds which have been correlated with the Triassic Stormberg Series of the Karoo System (Gevers, 1937). The mountain is capped by more or less unbedded, vertically jointed, uniformly textured, deep pink aeolian sandstone which forms a line of cliff completely circumscribing the mountain at its summit. The centre of the summit area has a continuous, approximately three metre deep, reddish sand layer while the summit perimeter area contains much exposed sandstone. Below the line of cliff runs a parallel almost continuous terrace with a fairly even slope running down from the terrace to the base of the mountain. The rock beds below the summit sandstone are made up of sedimentary layers of red shales and clayey sandstones interspersed with layers of arkoses (Gevers, 1937). The surface of all the slope areas below the summit sandstone is however almost totally covered by sandstone rocks weathered from the summit.

4. Climate

The mountain is situated in a summer rainfall region. Data from the two rain measuring stations nearest the mountain (roughly 5 and 8 kilometers distant) indicates the average annual rainfall of the plateau to be in the region of a few millimetres above 500 mm with about 97% of the average total falling between the 1st of October and the 30th of April and about 23% in the month of February. Rain in the winter months of June, July and August occurs very rarely.

The mean annual temperature of the Waterberg area is somewhat higher than the means of much of the rest of Southern Africa (south of 17°30'S). Schulze (1965) indicates the Waterberg area to lie roughly between the mean annual real isotherms of 20.0° and 22.5°C and to have an annual range of mean monthly temperature of less than 10°C. No long term temperature data is available for the Omuverume mountain itself but short term measurements indicate that when the minimum temperatures of the year occur on winter nights, temperatures below 0°C are experienced several times on the terraces and base of the mountain while this occurs more rarely every few years on the summit of the mountain.

5. General Method

The mountain was initially divided into 21 geographical units. Data on the general structure of the vegetation and on aspects of the distribution and relative abundance of the plant species was recorded at several places in each of the 21 areas. This data was condensed for each area and then, using mainly species composition and to a lesser extent the estimated abundance of the species, the resultant data was compared to give the degree of similarity between the areas. The flora of the mountain was found to form a floristic gradient that alters along a line running from the centre of the summit area to the base of the mountain. Within this gradient however, floristic concentrations of distribution occur in parts corresponding to five distinct topographical belts encircling the mountain. For this reason, the 21 geographical areas were finally compounded into five different floristic zones. The present state of knowledge of the mountain does not appear to justify the subdivision of these five floristic zones at this stage although distinct variations of floristic composition do exist within these zones.

Two subsequent visits to the mountain in June and July 1972 indicate that impressions of abundance, individual plant size and phenological phases of certain herbaceous species can change from one year to the next in some areas. Here this is probably due to a below average rainfall season preceding the above two visits which is in contrast with the above average rainfall season of the study period of 1970-71.

II. OBSERVATIONS

Descriptions of the vegetation and flora of the five topographical belts encircling the plateau-mountain are given commencing with the middle of the summit area and thereupon radiating outwards down to the base of the mountain (Figs. 1 and 2). Where more than one species is mentioned at a time, these are generally placed in order of importance.

1. The central summit sand (Figs. 3 and 4)

The central portion of the plateau comprises an almost flat approximately 1,75 square kilometer sand area without surface rock. In this area, a relatively uniform deciduous woodland-savanna occurs. The vegetation structure is simple —

consisting of a tree canopy layer with tops usually from about 3 to 7 metres high and an herbaceous layer with some grass culms up to about 2,5 metres high. Only one species of shrub is common and this in the lower part of the herbaceous layer. Several 3 to 4 metre high tree-thickets occasionally occur within the sand area and are usually positioned on low mounds of darker soil.

The flora of this area belongs to the same basic flora of the north-eastern "Tree-savanna and woodland" or "Northern Kalahari" vegetation type of Giess (1971). The dominant trees belong to the species *Burkea africana*, *Terminalia sericea* and *Combretum psidioides* subsp. *dinteri* followed by the very common *Ochna pulchra* — which is however seldom found growing above three metres high — and by the less common *Combretum collinum* and *Securidaca longepedunculata*. The only common shrub species present is the approximately half metre high *Grewia avellana* while *Grewia deserticola* is the only larger shrub species that is at least infrequently scattered in the area. *Combretum collinum* generally forms thickets usually positioned on low mounds which are irregularly scattered in the area. Apart from this latter species and a few common species of the summit sand area — notably *Digitaria polevansii* and *Andropogon gayanus* — almost all the other species found on the mounds are more typically found in the summit perimeter belt, cliff and terrace zones of the mountain but within the central sand plateau area, these species are almost all totally restricted to the mounds. Examples of these species include *Cenchrus ciliaris*, *Dombeya rotundifolia*, *Hibiscus fleckii* and *Gloriosa virescens* (see table 1).

The dominant herbs are the grass species *Digitaria polevansii* and *Brachiaria nigropedata* followed by *Andropogon gayanus* and *Andropogon schirensis*. In the north-east of S.W.A., dominance of these grass species is generally considered to approach a vegetational climax community stage. On the Omuverume Plateau this state is probably due in part to the strict protection of the area from larger grazing mammals by means of the barrier formed by the encircling cliffs of the plateau.

2. The summit perimeter belt (Figs. 4, 5 and 6)

A perimeter belt, 150 to 600 metres wide with an approximate area of 6,3 square kilometers, runs around the mountain above the line of cliff enclosing the central sand area. The entire summit areas of the north-western, south-western and eastern points of the plateau are included in this area. The perimeter belt area is generally rocky varying from rather restricted sand flats intruded by rock in several places, to large boulder areas with narrow passages of sand between the boulders. The area contains a great variety of habitats yet not always clearly differentiated from one another. The following five habitats are however recognised:

i) Sandy flats between rock

On these localised sand flats, the flora has a fair degree in common with the flora of the central sand area. This is especially true in the case of the larger sand flats which are generally situated nearer to the central sand area as well as within the three point areas of the plateau. The trees are however often dwarfed to about one half the height of that of the same species on

the adjacent central sand area. Larger shrubs are common.

Common woody species here include *Burkea africana*, *Croton gratissimus*, *Lonchocarpus nelsii*, *Mundulea sericea* and *Terminalia sericea*. In places *Securidaca longepedunculata* and *Combretum apiculatum* subsp. *leutweinii* are also common. Slightly taller than the general tree height of the area are *Peltophorum africanum* individuals and these are very locally distributed mainly within each of the three point areas of the plateau. Common grass species include *Digitaria polevansii*, *Andropogon gayanus*, *Andropogon schirensis*, *Cymbopogon plurinodis* and *Brachiaria nigropedata*. Both the above *Andropogon* species sometimes form very dense stands at the edges of the flats alongside rocks.

ii) Narrow sand passages between large rocks

These areas are found more often nearer the edge of the plateau. Here the vegetation is generally relatively dense and the trees present are often 6 to 7 metres high.

The most frequent tree species here is *Lonchocarpus nelsii*. Other woody species include *Mundulea sericea*, *Dombeya rotundifolia*, *Vangueria cyanescens*, *Osyris lanceolata*, *Maytenus heterophylla*, *Pavetta assimilis* and others. The overwhelmingly dominant grass species is *Loudetia ramosa* while *Eragrostis scopelophila* is dominant in occasional isolated patches. Other occasional herbaceous species include *Kentrosiphon saccatus*, *Hibiscus mutatus*, *Moraea polystachya* and *Walafrida alopecuroides*.

iii) Crevices in bare rock

Almost all the rock boulders present are easily weathered and form crevices and small depressions which provide habitats for several species the most common being *Sutera acutiloba* and the scrambling *Ficus guerichiana*. Other frequent species include *Anisopappus pinnatifidus*, *Rhus tenuinervis*, *Chrysocoma tenuifolia* and *Loudetia ramosa*. In places *Aeolanthus canescens*, *Helichrysum fleckii* and the scrambling *Sarcostemma viminale* are common.

iv) Seasonal summer rock pools

At several places within the perimeter area water pools are formed in rock depressions in the summer months and usually endure until early autumn. The pools generally have a rocky bottom and vary from a few centimetres to almost half a metre deep.

Common species include the aquatic *Chamaegigas intrepidus* as well as *Eragrostis rotifer* and to a lesser extent *Crassula transvaalensis*, the latter being restricted to the pool edges. The much rarer aquatic *Aponogeton desertorum* is found in the deepest pools. It may be noted that many of the pools which are formed appear to be barren of angiosperm species.

v) Shallow-soil pan areas

These open areas appear to be seasonal pools in different stages of silting up. Some of these areas become more or less waterlogged during the height of the rainy season. Here small sedges are common, examples being *Cyperus amabilis*, *Mariscus aristatus*, *Bulbostylis mucronata*, *Fimbristylis exilis* and *Pycnus pumilus* subsp. *patens*. *Oldenlandia herbacea* can also be common

in places. Other pan areas are more sandy and appear to have some degree of drainage. It is in these areas that *Eragrostis stapfii* is characteristically dominant with *Eragrostis viscosa* and *Anthospermum ericoideum* occasionally present.

It should be noted that several of the above habitat types together with their typically associated plant communities, intergrade the one type into the other indicating a possible line of very slow successional change from a rock pool stage through wetter and then dryer pan area stages to a sand flat stage. The vegetation of the perimeter belt zone can thus in this view be seen as forming an irregular mosaic of different successional stages. This postulated line of succession however, appears to abort in many places at an early stage due to the rock pool eroding away leaving bare rock again. The communities of the rock crevices and narrow sand passages would appear to be for the most part independent of the above line of succession.

3. The cliff zone (Figs. 7 and 8)

A line of 15 to 60 metres high vertically fissured sandstone cliff completely circumscribes the summit of the mountain. Included under this heading is a fairly steep, narrow zone immediately below the cliff. This area comprises old fallen rock with darkish soil between the rock. In only a very few places — mainly at the south-western point of the plateau — are fresh falls of rock apparent. The cliff zone contains two very diverse forms of vegetation corresponding to the two different zones mentioned above:

- i) On the vertical cliff face itself, several straggling trees and smaller shrubs and herbs occur although never covering much area of the rock face. On generally shaded faces however, crustose, foliose and fruticose lichens can cover large areas. The common straggling tree species are *Boscia albitrunca*, *Ficus cordata* and the scrambling *Ficus guerichiana*. In the few deeper clefts and narrow ravines in the cliff *Pavetta assimilis*, *Croton gratissimus*, *Rhus tenuinervis* and *Euclea undulata* are frequent, the latter species being more common in the largest ravines. The more common smaller individuals on ledges and in crevices on the cliff face are for the most part the species *Hibiscus engleri*, *Sutera acutiloba* and *Cineraria canescens* while *Pentatrachia avasmontana* is common in a few localised areas.
- ii) On the short slope immediately below the cliff face and above the terraces, patches of trees, bushy areas and grassy slopes occur. The most common tree species is *Acacia karroo* with *Ficus cordata* trees occasionally present. Common in the more bushy areas are *Croton gratissimus*, *Dombeya rotundifolia* and *Abutilon pycnodon*. Throughout this slope area and forming pure stands in many places, is the grass species *Loudetia ramosa* followed by *Pennisetum foermeranum* which is dominant in places. In a few areas below the cliff there are patches of rock scree without surface soil. Here *Obetia carruthersiana* is common and local patches of *Ricinus communis*, *Senecio cinerascens* and *Steganotaenia araliacea* sometimes occur. Infrequently distributed throughout this zone below the cliff are the climber species *Clematis brachiata*, *Asparagus africanus* and *Cyphostemma cirrho-*

sum subsp. *transvaalense*. Several fern species including *Pellaea calomelanos* as well as the herbaceous species *Sutera hereroensis* and *Sutera hyperoides* are frequently sheltered under rocks throughout the zone.

It is appropriate to note here that those species which are found in the south of Southern Africa and find their northern-most distribution in the vicinity of the Waterberg latitudes appear, where present on the Omuverume Plateau-mountain, to be well represented in the cliff zone of the mountain which is relatively more shady, moist and cooler than the other zones of the mountain. Examples of these species are *Senecio cinerascens*, *Acacia karroo* and *Melianthus comosus*.

4. The terraces (Figs. 9 to 15)

A generally level and often sandy 50 to 150 metre wide terrace with relatively little rock runs around the plateau at between 80 and 140 metres below the cliff top. The terrace however falls away at the three points of the mountain thus forming three separate terraces. On the south-eastern terrace three spring areas are situated but only one of these produces above ground free flowing water. In these spring areas the organic content of the soil is higher. Range (1930) gives an organic content of 8,3% with 88,2% sand and 3,5% ash for the soil of the "Gehängemoore am Waterberg".

The vegetation of the terraces varies from a simple structured savanna, consisting almost entirely of tree and herbaceous layers, through shrubby areas to open grass flats with a few larger shrubs. In the vicinity of the spring areas, tree and larger shrub forms predominate together with an herbaceous layer which can comprise dominants of non-grass species.

Of the tree species of the terraces, *Terminalia sericea* is the most widely spread and is the main tree species of the terrace savanna areas. Other very frequent tree species are *Lonchocarpus nelsii*, *Acacia hereroensis*, *Acacia erubescens* and to a much lesser extent *Combretum imberbe* and *Ziziphus mucronata*. The most common grass species include *Sporobolus fimbriatus*, *Digitaria eriantha*, *Cenchrus ciliaris*, *Heteropogon contortus* as well as *Brachiaria nigropedata*, *Pogomarthria squarrosa* and the less frequent *Enneapogon cenchroides*. Some grass species such as *Eustachys paspaloides* and *Anthephora pubescens* are generally found in patches at very infrequent intervals along the terraces. Very few herbaceous species other than grass species appear to be widespread and common on all the terraces. Larger shrub species occasionally present throughout the area include *Grewia bicolor*, *Croton gratissimus*, *Dombeya rotundifolia* and *Dichrostachys cinerea*.

A few species which are common on the summit sand area are, where present on the terraces, quite often found in close association with one another. These species, which are rare in this area, include *Andropogon gayanus*, *Triraphis schinzii*, *Rhynchelytrum repens*, *Digitaria polevansii* and sometimes *Grewia avellana*. *Brachiaria nigropedata* can also be present in these associations "spilt over" from the central summit sand area, but is by no means restricted to them. Apart from these species and *Terminalia sericea*, other species common on the central sand plateau are, if present on the terraces, usually found here as a few isolated individuals.

In the spring areas of the south-eastern terrace the following trees are dominant, some attaining a maximum height of 15 to 16 metres: *Ficus sycomorus*, *Ficus cordata*, *Acacia karroo*, *Rhus lancea*, *Ziziphus mucronata*, and the more shrubby tree species *Euclea undulata*. Only the first mentioned species appears to be restricted to the free flowing spring area. The most common herbs are the species *Achyranthes aspera*, *Dicliptera eonii* and *Plectranthus hereroensis*. In an above average rainfall season, *Setaria verticillata* can be very abundant in some areas around the springs. This state is evidently assisted by herds of kudu (*Tragelaphus strepsiceros*) transporting the disseminules externally on their bodies especially into the free flowing spring area. In or just adjacent to the running water of this spring are the grass species *Hyparrhenia hirta*, *Imperata cylindrica*, *Agrostis lachnantha* and *Diandrochloa namaquensis*.

5. The slopes (Figs. 16 to 20)

An approximate 15° to 30° slope runs down a height difference of about 200 to mostly 270 metres from the edge of the terraces to the base of the mountain. The area is covered by generally small weathered sandstone rocks with some larger sandstone blocks on slight ridge formations.

The slopes support a very variable vegetation and it is especially important that in this area mention be made of the difference between the vegetation of the southerly to easterly facing slopes and the slopes that face in a northerly to westerly direction. On the south-eastern slopes more tree forms are present averaging 3 to 5 metres high in places while on the north-western and western slopes the number of tree forms are far fewer and the general height of the shrubs present is about 2 metres especially on the upper slopes. Some species which are more or less restricted to the lower slopes on the south-eastern side extend to the upper slopes on the north-western side of the plateau.

The most common tree species present on the slopes are *Acacia erubescens*, *Combretum apiculatum* subsp. *apiculatum*, *Terminalia prunioides*, *Commiphora mollis* and the more shrubby *Croton gratissimus*, *Mundulea sericea* and occasional *Grewia* species including *G. bicolor* and *G. flavescens*. *Tarchonanthus camphoratus* can be dominant over large areas mainly on the north-western slopes. Common in some areas are *Kirkia acuminata*, *Albizia anthelmintica*, *Dichrostachys cinerea* subsp. *africana*, *Acacia mellifera* subsp. *detinens* and more isolated *Boscia albitrunca* individuals. Common herbaceous species include *Blepharis obmitrata*, *Calostephane divaricata*, *Crotolaria* and *Justicia* spp. and many grass species often relatively locally distributed. Included here are *Enteropogon macrostachyus*, *Aristida effusa*, *Rhynchelytrum* spp., *Triraphis ramosissima*, *Urochloa brachyura*, *Enneapogon cenchroides*, *Aristida rhiniochloa*, *Eragrostis trichophora*, *Chloris virgata*, *Setaria verticillata* and others. *Eragrostis scopelophila* is very common on the upper slopes and often forms dominant patches in these areas.

It is noteworthy that the transition between the flora of the slopes and that of the plains at the base of the mountain is usually relatively sudden corresponding to the relatively sudden change from rocky slope to more or less rockless plain.

III. A NOTE ON THE PLATEAU-MOUNTAIN FLORA IN RELATION TO THE FLORA OF THE PLAINS AT THE BASE OF THE MOUNTAIN

The vegetation of the plains at the base of the Omuverume Plateau-Mountain forms part of the "Thornbush savanna" vegetation type (Giess, 1971) which covers much of the central plains of South West Africa.

The dominant tree species of the plains near the mountain is *Acacia mellifera* subsp. *detinens* (Fig. 21). Other more common species here include *Dichrostachys cinerea* subsp. *africana*, *Acacia hebeclada* subsp. *hebeclada*, *Boscia albitrunca*, *Albizia anthelmintica*, *Acacia tortilis* subsp. *heteracantha*, *Grewia* spp., *Eragrostis rigidior*, *Eragrostis trichophora* and *Chloris virgata* while *Lonchocarpus nelsii* and *Combretum imberbe* occur very less frequently. Patches of *Terminalia sericea* occur in sandy pockets farther afield.

When the floras of the mountain slopes and the plains are compared, it becomes evident that more species which are typical of the thornbush-savanna overlap on to the mountain slopes than do typical slope species overlap on to the plains. This is probably related to the presence of more diverse habitats on the slopes than on the plains.

It should also be noted that there is practically no degree of floristic overlap in either direction between the "Tree savanna and woodland" vegetation type of the summit sand plateau and the "Thornbush savanna" vegetation type of the plains below. This almost total dissociation between the floras of these two major vegetation types in this area, although largely determined by edaphic and other factors, may also be partly attributed to the barrier formed between the two by the local floras of the edge and sides of the plateau-mountain. (See table 1 for centres of distribution of *Caesalpiniaceae*, *Rubiaceae*, *Cyperaceae*, *Scrophulariaceae*, *Burseraceae* and others.)

IV. A NOTE ON THE SOUTH-WESTWARD LIMITS OF THE FLORA OF THE "TREE SAVANNA AND WOODLAND" VEGETATION TYPE.

As has been stated before, the vegetation of the central summit sand area of the Omuverume Plateau-Mountain clearly belongs to the north-eastern "Tree savanna and woodland" type of Giess (1971). On a smaller vertical scale, certain aspects of the transition of this vegetation type down through the different topographical belts of the Omuverume Plateau-Mountain to the "Thornbush savanna" vegetation type have been indicated. It is however also of interest to note how on a larger horizontal geographical scale this north-eastern vegetation type comes to an end in the thornbush savanna areas in the south-west.

The "Tree savanna and woodland" vegetation type extends along a decreasing rainfall gradient from the area around the Okavango River on the north-east border of South West Africa in a south-westerly direction on to the Waterberg Plateau which rises gradually out of the eastern sand-veld plains and attains a maximum height in the Omuverume and Klein Waterberg plateaux in the west above the central thornbush savanna plains. The latter plateau is completely separated by several kilometres from the Omuverume part of the Great Waterberg Plateau and the north-eastern vegetation type still flourishes as far as on the summit of this isolated plateau (Fig. 22).

Farther south-westwards, in progressively lower rainfall areas, there are two detached outliers of sandstone plateau of the same geological series as the Waterberg plateau (Fig. 26). The first of these is the small Omboroko Plateau (Fig. 23) which lies about 45 kilometres south-west of the Klein Waterberg Plateau. Here a distinct relict flora of the "Tree savanna and woodland" vegetation type occurs. Many grass species including *Andropogon gayanus* are present and *Securidaca longepedunculata* is a codominant tree species with *Terminalia sericea* and *Lonchocarpus nelsii* (Fig. 24). On the Etjo Plateau, a further 30 kilometres south-westwards and in a distinctly lower rainfall area than the annual 500 mm average of the Waterberg area, very few elements of the vegetation type are present. Although *Terminalia sericea* and *Lonchocarpus nelsii* are common here, no strictly characteristic woody species of the flora appear to be present (Fig. 25). Only a few herbaceous species, the most important being the grass species *Andropogon gayanus*, may indicate a relict status of the area.

The relict status of the summit floras of the Omboroko and Klein Waterberg plateaux appears to be well-founded since the distances between these two plateaux and between the latter and Omuverume plateaux have been probably from the Tertiary period sufficiently great to prevent direct transport of the more heavy wind-dispersed disseminules such as those of *Securidaca longepedunculata* individuals from the one plateau to the other. If one accepts both this and that the above may also apply generally to the plant species of the flora which are not dispersed as above, there remain two main possible considerations of how the distribution came about:

- i) That the present flora (or the immediate forefathers of this flora) was (or were) already in position on those parts which have remained as separate plateaux after the erosion of the rest of the geological formation had taken place up to the present time. The acceptance of this possibility however places an undue strain upon the belief of a flora's ability to survive the many environmental fluctuations that in all probability will have occurred in the very long period from separation up to the present day.
- ii) That conditions along the possible migration routes between the plateaux must have been, for a period of sufficient length, different to present conditions in these areas. A slow migration of the flora across the flats at some time in the Quarternary period appears a more credible basis for the explanation of the present distribution of the flora on the plateaux. These past conditions required in the areas between the plateau for the migration of

the flora from the north-east on to the isolated plateau would probably be mainly: a) more widespread sand than at the present time since the flora concerned is a more or less sand-bound flora; b) somewhat higher minimum temperatures than at present since some members of the flora — e.g. *Securidaca longepedunculata* — are frost-sensitive and indications are that at present, areas below the plateau-summits experience temperatures below 0° C much more frequently than do the summit areas; and possibly c) a somewhat higher rainfall than at present although to what degree lower rainfall is a limiting factor for the flora concerned appears to be uncertain. It appears to be equally uncertain to what degree pluvial periods have occurred in the past in the Pleistocene and more recent times in the area.

The flora of the Omuverume Plateau Summit Sand may still be in the very last stages of attaining relict status since a few individuals of a few species may still occasionally filter across the relatively short distance between the Omuverume Plateau and the rest of the Great Waterberg Plateau by route of the high saddle between these two parts or by direct dispersal across the gap.

It may be noted that one common feature of the vegetation of the Waterbergs', Omboroko and Etjo plateau areas is that, although these are all situated in the thornbush savanna plains, they are all largely free of *Acacia* and other thorn tree species. Areas with some *Acacia ataxacantha* are however found on the main portion of the Great Waterberg Plateau especially in the more easterly parts.

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Table 1. TABLE OF THE OCCURRENCE OF VASCULAR PLANT SPECIES IN THE FIVE ZONES OF THE OMUVERUME PLATEAU-MOUNTAIN.

The families are arranged according to Merxmüller, H. 1966 — 70. Prodrömus einer Flora von Südwestafrika.

The following symbols are used:

- not recorded in the zone.
- 0 present in varying abundance in the zone.
- + clearly more abundant relative to the other zones.
- ! more or less restricted to the mounds of the Central Sand Plateau (Applicable only to the first column).

	COLL. NO.	CENTRAL SUMMIT SAND	SUMMIT ROCK-SAND PERIMETER	CLIFF ZONE	TERRACES	SLOPES
<i>SINOPTERIDACEAE</i>						
<i>Doryopteris concolor</i> (Langsd. & Fischer) Kuhn	236	—	—	0	—	—
<i>Notholaena marlothii</i> Hieron.	357	—	—	—	0	—
<i>Pellaea calomelanos</i> (Swartz) Link	116	—	0	0	0	0
<i>P. goudotii</i> G. Kunze ex C. Chr.	130	—	—	0	—	—
<i>ASPLENIACEAE</i>						
<i>Ceterach cordatum</i> (Thunb.) Desv.	117	—	0	0	0	—
<i>MORACEAE</i>						
<i>Ficus cordata</i> Thunb.	138; 311	—	0	+	0	—
<i>F. guerichiana</i> Engler	30	—	+	0	—	—
<i>F. sycomorus</i> L.	173	—	—	—	0	—
<i>URTICACEAE</i>						
<i>Australina acuminata</i> Wedd.	418	—	—	0	—	—
<i>Obetia carruthersiana</i> (Hiern) Rendle	222	—	0	+	0	0
<i>OLACACEAE</i>						
<i>Ximenia americana</i> L. var. <i>microphylla</i> Welw. ex Oliver	235	0	0	—	0	0

	COLL. NO.	CENTRAL SUMMIT SAND	SUMMIT ROCK-SAND PERIMETER	CLIFF ZONE	TERRACES	SLOPES
<i>SANTALACEAE</i>						
<i>Osyris lanceolata</i> Hochst. & Steudel	158;305	—	0	0	0	—
<i>Thesium megalocarpum</i> A. W. Hill	79	—	0	—	—	—
<i>LORANTHACEAE</i>						
<i>Phragmanthera glaucocarpa</i> (Peyr.) S. Balle	2	0	+	0	0	—
<i>Tapinanthus oleifolius</i> (Wendl.) Danser	100;469a	+	0	—	0	—
<i>POLYGONACEAE</i>						
<i>Oxygonum alatum</i> Burch.	340	—	—	—	0	—
<i>NYCTAGINACEAE</i>						
<i>Commicarpus africanus</i> (Lour.) Dandy	377	—	—	—	—	0
<i>MOLLUGINACEAE</i>						
<i>Gisekia africana</i> (Lour.) O. Kuntze	214	—	0	—	0	+
<i>Limeum fenestratum</i> (Fenzl) Heimerl	195;428	+	0	—	—	—
<i>L. viscosum</i> (J. Gay) Fenzl subsp. <i>viscosum</i>	12;105	0	—	—	—	—
<i>Mollugo nudicaulis</i> Lam.	400	—	—	—	—	0
<i>PORTULACACEAE</i>						
<i>Portulaca kermesina</i> N.E.Br.	56;402	—	0	—	—	0
<i>ILLECEBRACEAE</i>						
<i>Pollichia campestris</i> Aiton	315	—	0	—	—	—
<i>CARYOPHYLLACEAE</i>						
<i>Polycarpaea corymbosa</i> (L.) Lam.	455	—	0	—	—	—
<i>P. eriantha</i> Hochst. ex A. Richard	51	—	0	—	—	—
<i>AMARANTHACEAE</i>						
<i>Achyranthes aspera</i> L.	143	—	0	0	0	0
<i>A. sicula</i> (L.) All.	411	—	—	—	0	—
<i>Aerva leucura</i> Moq.	321;490	0	0	—	0	—

	COLL. NO.	CENTRAL SUMMIT SAND	SUMMIT ROCK-SAND PERIMETER	CLIFF ZONE	TERRACES	SLOPES
<i>Amaranthus thunbergii</i> Moq.	159	—	—	—	0	—
<i>Hermbstaedtia odorata</i> (Burch.) T. Cooke	338	—	—	—	0	—
<i>Kyphocarpa angustifolia</i> (Moq.) Lopr.	436	0	—	—	—	—
<i>Leucosphaera bainesii</i> (Hook. f.) Gilg	220	—	—	—	0	0
<i>Nelsia quadrangula</i> (Engler) Schinz	337	—	—	—	0	0
<i>Pupalia lappacea</i> (L.) Juss.	151	—	0	—	0	0
<i>RANUNCULACEAE</i>						
<i>Clematis brachiata</i> Thunb.	137	0!	0	+	0	—
<i>Clematopsis scabiosifolia</i> (DC.) Hutch.	83	0	—	—	—	—
<i>MENISPERMACEAE</i>						
<i>Cissampelos mucronata</i> A. Richard	98	+	0	—	—	—
<i>OCHNACEAE</i>						
<i>Ochna pulchra</i> Hooker subsp. <i>pulchra</i>	197a	+	0	—	0	—
<i>CAPPARACEAE</i>						
<i>Boscia albitrunca</i> (Burch.) Gilg. & Benedict	209	0!	0	+	0	+
<i>Cleome monophylla</i> L.	379	—	—	—	0	0
<i>C. oxyphylla</i> Burch.	136	—	0	0	0	—
<i>Maerua juncea</i> Pax subsp. <i>juncea</i>	198	0!	—	—	—	—
<i>BRASSICACEAE</i>						
<i>Lepidium divaricatum</i> Aiton subsp. <i>divaricatum</i>	135	—	—	0	—	—
<i>MORINGACEAE</i>						
<i>Moringa ovalifolia</i> Dinter & Berger	191	—	—	—	—	0
<i>CRASSULACEAE</i>						
<i>Crassula transvaalensis</i> (O. Kuntze) K. Schum.	63	—	0	—	—	—

	COLL. NO.	CENTRAL SUMMIT SAND	SUMMIT ROCK-SAND PERIMETER	CLIFF ZONE	TERRACES	SLOPES
<i>Kalanchoe brachyloba</i> Welw. ex J. Britten	59	—	0	—	—	—
<i>K. lanceolata</i> (Forsk.) Pers.	391	—	—	—	—	0
<i>K. rotundifolia</i> (Haw.) Haw.	331	—	0	—	—	0
<i>MONTINIACEAE</i>						
<i>Montinia caryophyllacea</i> Thunb.	416	—	—	—	—	0
<i>MIMOSACEAE</i>						
<i>Acacia erubescens</i> Welw. ex Oliver	204	—	—	—	0	+
<i>A. hebeclada</i> DC. subsp. <i>hebeclada</i>	82	—	—	—	0	—
<i>A. hereroensis</i> Engler	147; 479	0!	0	0	+	0
<i>A. karroo</i> Hayne	205	—	0	+	0	—
<i>A. mellifera</i> (Vahl) Bentham subsp. <i>detinens</i> (Burch.) Brenan	210	0!	0	—	0	+
<i>A. tortilis</i> (Forsk.) Hayne subsp. <i>heteracantha</i> (Burch.) Brenan	obs.	—	—	—	—	0
<i>Albizia anthelmintica</i> (A. Richard) Brongn.	obs.	—	—	—	—	0
<i>Dichrostachys cinerea</i> (L.) Wight & Arnott subsp. <i>africana</i> Brenan & Brummitt	176	—	—	—	0	+
<i>Elephantorrhiza elephantina</i> (Burch.) Skeels	99	+	0	—	—	—
<i>CAESALPINIACEAE</i>						
<i>Bauhinia macrantha</i> Oliver	108; 468	0	—	—	—	—
<i>Burkea africana</i> Hooker	196	+	0	—	0	—
<i>Cassia biensis</i> (Steyaert) Mendonça & Torre	367	+	—	—	0	—
<i>C. falcinella</i> Oliver	467	—	0	—	—	0
<i>Peltophorum africanum</i> Sonder	4	—	+	—	0	—
<i>FABACEAE</i>						
<i>Crotolaria kurtii</i> Schinz	304	—	0	—	—	—

	COLL. NO.	CENTRAL SUMMIT SAND	SUMMIT ROCK-SAND PERIMETER	CLIFF ZONE	TERRACES	SLOPES
<i>C. podocarpa</i> DC.	405	—	—	—	—	0
<i>C. steudneri</i> Schweinf.	392	—	—	—	—	0
<i>C. ulbrichiana</i> Harms	398	—	—	—	—	0
<i>Erythrina decora</i> Harms	212	—	+	+	0	—
<i>Indigofera daleoides</i> Bentham ex Harvey	219	+	0	—	0	—
<i>I. filipes</i> Bentham ex Harvey	364	—	—	—	0	—
<i>I. parviflora</i> Heyne ex Wight & Arn.	385	—	—	—	—	0
<i>I. vicioides</i> Jaub. & Spach	407	—	—	—	—	0
<i>Lonchocarpus nelsii</i> (Schinz) Schinz ex Heering subsp. <i>nelsii</i>	90	0	+	—	+	0
<i>Lotononis platycarpa</i> (Viv.) Pic. Ser. var. <i>abyssinica</i> (Hochst. ex A. Rich.) Pic. Ser.	335	0	—	—	0	—
<i>Mundulea sericea</i> (Willd.) A. Chev.	9;478	—	+	—	0	+
<i>Rhynchosia sublobata</i> (Schumacher) Meikle	89	0!	0	—	—	—
<i>R. venulosa</i> (Hiern) K. Schum.	114;448	+	0	—	—	—
<i>Tephrosia cephalantha</i> Welw. ex Baker var. <i>decumbens</i> Welw. ex Baker	431	+	0	—	—	—
<i>T. lupinifolia</i> DC.	35;489	0	0	—	—	—
<i>T. purpurea</i> (L.) Pers. subsp. <i>lepto-</i> <i>stachya</i> (DC.) Brummitt var. <i>pubescens</i> Baker	237	—	0	—	—	—
<i>T. rhodesica</i> Baker f. var. <i>rhodesica</i>	454,9a	—	0	—	—	—
<i>Zornia milneana</i> Mohlenbr.	54	—	0	—	—	—
OXALIDACEAE						
<i>Oxalis purpurascens</i> Salter	163	0!	0	0	0	—
GERANIACEAE						
<i>Monsonia angustifolia</i> E. Meyer ex A. Richard	370	—	—	—	0	—
<i>M. burkeana</i> Planchon ex Harvey	221	—	—	—	0	—

	COLL. NO.	CENTRAL SUMMIT SAND	SUMMIT ROCK SAND PERIMETER	CLIFF ZONE	TERRACES	SLOPES
<i>EUPHORBIACEAE</i>						
<i>Croton gratissimus</i> Burch.	29;442	0!	+	+	0	+
<i>Euphorbia avasmontana</i> Dinter	213	—	0	—	—	—
<i>E. crotonoides</i> Boiss.	363	—	—	—	0	0
<i>Phyllanthus pentandrus</i> Schumacher & Thonning	85;450	0	0	—	0	0
<i>Pterococcus africanus</i> (Sonder) Pax & K. Hoffm.	200	0	—	—	—	—
<i>Ricinus communis</i> L.	133	—	—	+	0	—
<i>Tragia dinteri</i> Pax	493	0	—	—	—	—
<i>SIMAROUBACEAE</i>						
<i>Kirkia acuminata</i> Oliver	186	—	—	0	0	+
<i>BURSERACEAE</i>						
<i>Commiphora africana</i> (A. Richard) Engler	382	—	—	—	—	0
<i>C. mollis</i> (Oliver) Engler	189	—	—	—	—	0
<i>C. pyracanthoides</i> Engler subsp. <i>glandulosa</i> (Schinz) Wild	404	—	—	—	—	0
<i>MALPIGHIACEAE</i>						
<i>Sphedamnocarpus puriens</i> (A. Juss.) Szyszyl.	1;458	+	0	—	—	—
<i>POLYGALACEAE</i>						
<i>Polygala albida</i> Schinz	345	—	—	—	0	—
<i>P. kalaxariensis</i> Schinz	3	0	—	—	—	—
<i>Securidaca longepedunculata</i> Fresen.	7;444	+	0	—	—	—
<i>ANACARDIACEAE</i>						
<i>Ozoroa paniculosa</i> (Sonder) R. & A. Fernandes	481	+	0	—	+	0
<i>Rhus ciliata</i> Licht.	228	0	—	—	—	—
<i>R. lancea</i> L. f.	172	—	—	—	0	—

	COLL. NO.	CENTRAL SUMMIT SAND	SUMMIT ROCK-SAND PERIMETER	CLIFF ZONE	TERRACES	SLOPES
<i>R. tenuinervis</i> Engler var. <i>tenuinervis</i> (cf. Merxmüller (1966-70) remark under <i>R. tenuinervis</i>)	70	—	0	0	—	—
<i>MELIANTHACEAE</i>						
<i>Melianthus comosus</i> Vahl	139	—	—	0	—	—
<i>CELASTRACEAE</i>						
<i>Maytenus heterophylla</i> (Ecklon & Zeyher) N. Robson	319; 498	—	+	0	0	—
<i>M. senegalensis</i> (Lam.) Exell	141	—	—	—	0	—
<i>RHAMNACEAE</i>						
<i>Ziziphus mucronata</i> Willd. subsp. <i>mucronata</i>	157	0!	—	—	+	—
<i>VITACEAE</i>						
<i>Cyphostemma cirrhosum</i> (Thunb.) Desc. ex Wild & Drumm. subsp. <i>transvaalense</i> (Szyszyl.) Wild & Drumm.	115	—	+	+	+	0
<i>TILIACEAE</i>						
<i>Corchorus tridens</i> L.	371	—	—	—	0	—
<i>Grewia avellana</i> Hiern	437	+	0	—	0	—
<i>G. bicolor</i> Juss.	obs.	0	0	—	+	+
<i>G. deserticola</i> Ulbr.	473	0	0	—	0	0
<i>G. flavescens</i> Juss.	80; 145	0	0	—	0	+
<i>G. schinzii</i> K. Schum.	167	—	—	0	0	—
<i>G. tenax</i> (Forsk.) Fiori	383	—	—	—	—	0
<i>Triumfetta annua</i> L.	170	—	—	—	0	—
<i>T. delicatula</i> Sprague & Hutch.	233	—	0	—	—	—
<i>MALVACEAE</i>						
<i>Abutilon angulatum</i> (Guill. & Perr.) Mast.	181	—	—	—	+	0

	COLL. NO.	CENTRAL SUMMIT SAND	SUMMIT ROCK-SAND PERIMETER	CLIFF ZONE	TERRACES	SLOPES
<i>A. pycnodon</i> Hochr.	134	—	0	+	0	0
<i>Hibiscus engleri</i> K. Schum.	57;329	—	0	+	0	—
<i>H. fleckii</i> Gürke	103;463	0!	0	—	0	—
<i>H. mutatus</i> N.E.Br.	113	—	+	+	0	0
<i>Pavonia clathrata</i> Mast.	225	0	—	—	—	—
<i>Sida hoepfneri</i> Gürke	343	—	—	—	0	—
<i>STERCULIACEAE</i>						
<i>Dombeya rotundifolia</i> (Hochst.) Planchon	156;459	0!	+	+	0	0
<i>Hermannia mildbraedii</i> Dinter & Engler	162	—	0	—	—	—
<i>H. quartiniana</i> A. Richard	217	—	—	—	0	—
<i>H. tomentosa</i> (Turcz.) Schinz ex Engler	84;492	0	—	—	—	—
<i>Melhania acuminata</i> Mast.	408	0!	—	—	0	0
<i>CUCURBITACEAE</i>						
<i>Corallocarpus welwitschii</i> (Naudin) Hooker f.	120	—	—	0	—	—
<i>Zehneria marlothii</i> (Cogn.) R. & A. Fernandes	387	—	—	—	—	0
<i>LYTHRACEAE</i>						
<i>Ammannia baccifera</i> L.	348	—	—	—	0	—
<i>Nesaea</i> sp. cf. <i>N. cordata</i> Hiern	48	—	0	—	—	—
<i>COMBRETACEAE</i>						
<i>Combretum apiculatum</i> Sonder subsp. <i>apiculatum</i>	491	—	—	—	0	+
subsp. <i>leutweinii</i> (Schinz) Excell	317	0	+	—	0	—
<i>C. collinum</i> Fresen.	11;472	+!	0	—	—	—
<i>C. imberbe</i> Wawra	obs.	—	—	—	0	—
<i>C. psidioides</i> Welw. subsp. <i>dinteri</i> (Schinz) Excell	40;441	+	0	—	0	—

	COLL. NO.	CENTRAL SUMMIT SAND	SUMMIT ROCK-SAND PERIMETER	CLIFF ZONE	TERRACES	SLOPES
<i>Terminalia prunioides</i> Lawson	232	—	—	—	0	+
<i>T. sericea</i> Burch. ex DC.	499	+	0	—	0	—
<i>APIACEAE</i>						
<i>Heteromorpha trifoliata</i> (Wendl.) Ecklon & Zeyher	356	—	—	—	0	—
<i>Lefebvrea upingtoniae</i> Schinz	175	—	—	—	0	—
<i>Steganotaenia araliacea</i> Hochst.	192	—	—	0	+	0
<i>PLUMBAGINACEAE</i>						
<i>Plumbago zeylanica</i> L.	410	—	—	—	0	—
<i>EBENACEAE</i>						
<i>Euclea undulata</i> Thunb.	122	—	0	+	+	0
<i>APOCYNACEAE</i>						
<i>Strophanthus amboensis</i> (Schinz) Engler & Pax	230	—	0	—	—	—
<i>PERIPLOCACEAE</i>						
<i>Raphionacme burkei</i> N.E.Br.	446	0	—	—	—	—
<i>ASCLEPIADACEAE</i>						
<i>Caralluma</i> sp. cf. <i>C. lugardii</i> N.E.Br.	197	—	0	—	0	0
<i>Gomphocarpus tomentosus</i> Burch.	216	—	0	—	—	—
<i>Pentarrhinum abyssinicum</i> Decne	88	0!	—	—	—	—
<i>P. insipidum</i> E. Meyer	165	—	—	—	0	—
<i>Sarcostemma viminale</i> (L.) B.Br.	8	—	0	—	—	—
<i>RUBIACEAE</i>						
<i>Ancylanthos bainesii</i> Hiern	6	+	0	—	—	—
<i>Anthospermum ericoideum</i> Krause	58; 308	0	+	—	—	—
<i>Kohautia azurea</i> (Dinter & Krause) Bremek.	49	—	0	—	—	—
<i>Oldenlandia herbacea</i> (L.) Roxb.	16; 325; 465	—	+	—	—	0

	COLL. NO.	CENTRAL SUMMIT SAND	SUMMIT ROCK-SAND PERIMETER	CLIFF ZONE	TERRACES	SLOPES
<i>Pavetta assimilis</i> Sonder	120	—	+	+	0	—
<i>Pygmaëothamnus zeyheri</i> (Sonder) Robyns	102	+	0	—	—	—
<i>Vangueria cyanescens</i> Robyns	129	—	+	0	—	—
<i>V. infausta</i> Burch.	60;62	—	0	—	—	—
CONVOLVULACEAE						
<i>Convolvulus ocellatus</i> Hooker f.	346	—	—	—	0	—
<i>Evolvulus alsinoides</i> (L.) L.	355	—	—	—	0	—
<i>Ipomoea arachnosperma</i> Welw.	369	—	—	—	—	0
<i>I. hochstetteri</i> House	341	—	—	—	0	—
<i>I. plebeia</i> R. Br. subsp. <i>africana</i> Meeuse	378	—	—	—	—	0
<i>I. sinensis</i> (Desr.) Choisy subsp. <i>blepharosepala</i> (Hochst. ex A. Rich.) Verdc. ex Meeuse.	354	—	—	—	0	—
<i>I. verbascoidea</i> Choisy	333	—	0	—	—	—
<i>Merremia tridentata</i> (L.) Hall. f. subsp. <i>angustifolia</i> (Jacq.) Ooststr.	334	0	—	—	—	—
<i>Turbina oblongata</i> (E. Meyer ex Choisy) Meeuse	234	0	—	—	—	—
VERBENACEAE						
<i>Lantana angolensis</i> Moldenke	301	—	0	—	0	—
LAMIACEAE						
<i>Acrotome fleckii</i> (Gürke) Launert	380	—	—	—	0	0
<i>A. inflata</i> Bentham	339	—	—	—	0	—
<i>Aeolanthus canescens</i> Gürke	206	—	0	0	—	—
<i>Hemizygia petrensis</i> (Hiern) Ashby	27;307	—	0	—	—	—
<i>Leonotis dysophylla</i> Bentham	37	0	0	—	—	—
<i>Leucas pechuelii</i> (O. Kuntze) Gürke	403	—	—	—	—	0
<i>Ocimum canum</i> Sims	223	—	—	—	—	0
<i>Plectranthus hereroensis</i> Engler	164;414	—	0	+	+	0

	COLL. NO.	CENTRAL SUMMIT SAND	SUMMIT ROCK-SAND PERIMETER	CLIFF ZONE	TERRACES	SLOPES
<i>SOLANACEAE</i>						
<i>Lycium oxycarpum</i> Dunal	396	—	—	—	—	0
<i>Solanum delagoense</i> Dunal	153	0!	—	—	+	0
<i>S. multiglandulosum</i> Bitter	323	—	+	—	0	—
<i>S. nigrum</i> L.	112; 419	—	0	0	0	—
<i>S. sp. cf. S. rigescens</i> Jacq.	140	—	—	0	—	—
<i>Withania somnifera</i> (L.) Dunal	131; 310	—	0	0	0	—
<i>SCROPHULARIACEAE</i>						
<i>Alectra parvifolia</i> Schinz	362	—	—	—	0	—
<i>Buchnera hispida</i> Buch.-Ham.	44; 324	—	0	—	—	—
<i>Chamaegigas intrepidus</i> Dinter ex Heil	obs.	—	0	—	—	—
<i>Lindernia parviflora</i> (Roxb.) Haines	50	—	0	—	—	—
<i>Nemesia sp. cf. N. fruticans</i> (Thunb.) Bentham	199	—	—	0	—	—
<i>Sutera acutiloba</i> (Pilger) Overkott ex Roessler	125	—	+	+	0	—
<i>S. atropurpurea</i> (Bentham) Hiern	42	—	0	—	—	—
<i>S. hereroensis</i> (Engler) Skan	314	—	0	+	—	—
<i>S. lyperioides</i> (Engler) Engler ex Range	313	—	0	+	—	—
<i>SELAGINACEAE</i>						
<i>Walafrida alopecuroides</i> (Rolfe) Rolfe	303	—	0	—	—	—
<i>BIGNONIACEAE</i>						
<i>Rhigozum brevispinosum</i> O. Kuntze	5	0	0	—	0	0
<i>ACANTHACEAE</i>						
<i>Barleria jubata</i> S. Moore	352	—	—	—	0	0
<i>B. lancifolia</i> T. Anderson	386	—	—	—	—	0
<i>Blepharis maderaspatensis</i> (L.) Heyne ex Roth	109; 342	+	—	—	0	—
<i>B. obmitrata</i> C. B. Clarke	208	—	0	—	—	+

	COLL. NO.	CENTRAL SUMMIT SAND	SUMMIT ROCK-SAND PERIMETER	TERRACES	CLIFF ZONE	SLOPES
<i>Dicliptera eonii</i> S. Moore	413;435	0	0	0	0	0
<i>Justicia dinteri</i> S. Moore	388;409	—	—	—	—	0
<i>J. matammensis</i> (Schweinf.) Oliver	353;349	—	—	—	—	0
<i>J. odora</i> (Forsk.) Vahl	375	—	—	—	—	0
<i>J. protracta</i> (Nees) T. Anderson	330	—	+	—	0	—
<i>Monechma divaricatum</i> (Nees) C. B. Clarke	406	—	—	—	—	0
<i>PEDALIACEAE</i>						
<i>Sesamum</i> sp. cf. <i>S. triphyllum</i> Welw. ex Ascherson var. <i>triphyllum</i>	347	—	—	—	+	0
<i>ASTERACEAE</i>						
<i>Anisopappus pinnatifidus</i> (Klatt) O. Hoffm. ex Hutch.	22	—	+	0	0	—
<i>Bidens biternata</i> (Lour.) Merr. & Scherff	65	0!	—	—	+	+
<i>Calostephane divaricata</i> Bentham	401	—	—	—	0	+
<i>Chrysocoma tenuifolia</i> Berg.	24	—	+	0	—	—
<i>Cineraria canescens</i> Wendl. ex Link	202	—	0	+	—	—
<i>Crassocephalum coeruleum</i> (O. Hoffm.) R.E.Fr.	368	—	—	—	—	0
<i>Dicoma gerrardii</i> Harvey ex Wilson	86;443	0	0	—	—	—
<i>D. schinzii</i> O. Hoffm.	451	0	—	—	—	—
<i>D. tomentosa</i> Cass.	350	—	—	—	0	0
<i>Felicia muricata</i> (Thunb.) Nees	453	+	0	—	0	—
<i>Geigeria ornativa</i> O. Hoffm.	372	—	—	—	0	—
<i>Gongrothamnus divaricatus</i> Steetz	376	—	—	—	—	0
<i>Helichrysum fleckii</i> S. Moore var. <i>dinteri</i> (S. Moore) Merxm. & Schreiber	52	—	+	0	0	—
<i>Hirpicium gorterioides</i> (Oliver & Hiern) Roessler subsp. <i>gorterioides</i>	61;359	—	0	—	0	0

	COLL. NO.	CENTRAL SUMMIT SAND	SUMMIT ROCK-SAND PERIMETER	CLIFF ZONE	TERRACES	SLOPES
<i>Nidorella resedifolia</i> DC. subsp. <i>resedifolia</i> var. <i>rapunculoides</i> (DC.)						
Harvey	13;447	0	—	—	—	—
<i>Pentatrachia avasmontana</i> Merxm.	497	—	—	0	—	—
<i>Philyrophyllum schinzii</i> O. Hoffm.	415	—	0	—	0	0
<i>Senecio cinerascens</i> Aiton	229	—	0	+	—	—
<i>Tarchonanthus camphoratus</i> L.	231	0	0	—	0	+
<i>Vernonia poskeana</i> Vatke & Hildebr.	425	0	0	—	0	—
<i>APONOGETONACEAE</i>						
<i>Aponogeton desertorum</i> Zeyher ex Sprengel f.						
	obs.	—	0	—	—	—
<i>LILIACEAE</i>						
<i>Asparagus africanus</i> Lam.						
	207	0!	—	+	—	—
<i>Gloriosa virescens</i> Lindley						
	215	0!	0	0	0	0
<i>Ornithogalum pulchrum</i> Schinz						
	224	—	0	—	0	—
<i>Pseudogaltonia clavata</i> (Mast. ex Baker) Phillips						
	obs.	—	—	—	0	—
<i>VELLOZIACEAE</i>						
<i>Xerophyta humilis</i> (Baker) Dur. & Schinz						
	78	—	0	—	0	—
<i>IRIDACEAE</i>						
<i>Ferraria glutinosa</i> (Baker) Rendle						
	160	—	—	—	0	0
<i>Kentrosiphon saccatus</i> (Klatt) N.E.Br. subsp. <i>steingroeveri</i> (Pax) Oberm.						
	421	—	+	0	0	—
<i>Moraea polystachya</i> (Thunb.) Ker-Gawler						
	322	—	+	0	0	—
<i>Pentamenes zambesiacus</i> (Baker) N.E.Br.						
	226	0	—	—	—	—

	COLL. NO.	CENTRAL SUMMIT SAND	SUMMIT ROCK-SAND PERIMETER	CLIFF ZONE	TERRACES	SLOPES
<i>COMMELINACEAE</i>						
<i>Commelina africana</i> L.	475	+	0	—	0	—
<i>C. benghalensis</i> L.	146;306;474a	0!	0	—	0	0
<i>C. livingstonii</i> C.B.Cl.	397	—	—	—	—	0
<i>C. subulata</i> Roth	47;327	—	0	—	—	—
<i>GRAMINEAE</i>						
<i>Agrostis lachnantha</i> Nees	201	—	—	—	0	—
<i>Andropogon gayanus</i> Kunth	73;439	+	+	—	0	0
<i>A. schinzii</i> Hackel	366	—	—	—	+	0
<i>A. schirensis</i> Hochst. ex A. Richard	10;96;423	0	0	—	—	—
<i>Antheplora pubescens</i> Nees	obs.	—	—	—	0	—
<i>Aristida congesta</i> Roemer & Schultes	104;432	+	0	—	0	—
<i>A. effusa</i> Henrard	184;384	—	—	—	—	0
<i>A. meridionalis</i> Henrard	107;438	+	—	—	0	—
<i>A. rhiniochloa</i> Hochst.	390	—	—	—	—	0
<i>A. stipitata</i> Hackel	93;426	0	—	—	—	—
<i>Brachiaria nigropedata</i> (Munro ex Ficalho & Hiern) Stapf	430	+	0	—	0	0
<i>B. poaeoides</i> Stapf	179	—	—	—	0	—
<i>Cenchrus ciliaris</i> L.	457	0!	—	0	+	0
<i>Chloris virgata</i> Swartz	149	—	—	—	0	+
<i>Cymbopogon plurinodis</i> (Stapf) Stapf ex Burt Davy	76	—	+	—	0	—
<i>Diandrochloa namaquensis</i> (Nees) De Winter	203	—	—	—	0	—
<i>Digitaria eriantha</i> Steudel	152;381	0	—	—	+	0
<i>D. polevansii</i> Stent	316	+	0	—	0	—
<i>Enneapogon cenchroides</i> (Roemer & Schultes) C.E. Hubbard	177	—	—	—	0	+
<i>Enteropogon macrostachyus</i> (Hochst. ex A. Richard) Munro ex Bentham	171	—	—	—	0	+

	COLL. NO.	CENTRAL SUMMIT SAND	SUMMIT ROCK-SAND PERIMETER	CLIFF ZONE	TERRACES	SLOPES
<i>Eragrostis biflora</i> Hackel	328	—	0	—	—	—
<i>E. cilianensis</i> (All.) Vignolo-Lutati	161;183	—	—	—	0	0
<i>E. curvula</i> (Schrader) Nees	119	—	0	—	—	—
<i>E. dinteri</i> Stapf	487	—	—	—	0	—
<i>E. jeffreysii</i> Hackel	488	+	0	—	—	—
<i>E. nindensis</i> Fic. & Hiern	19;469	0	—	—	—	—
<i>E. pallens</i> Hackel	110;427	+	0	—	—	—
<i>E. porosa</i> Nees	150;178	—	0	—	0	—
<i>E. rigidior</i> Pilger	434;494	0!	0	—	+	0
<i>E. rotifer</i> Rendle	68;395	—	0	—	—	0
<i>E. scopelophila</i> Pilger	211	0!	0	0	0	+
<i>E. stapfii</i> De Winter apud Chippindall	20;452	0	+	—	—	—
<i>E. superba</i> Peyr.	obs.	—	—	—	0	—
<i>E. trichophora</i> Coss. & Dur.	393	—	—	—	—	0
<i>E. viscosa</i> Trin.	45;71	—	0	—	—	—
<i>Eustachys paspaloides</i> (Vahl) Lanza & Mattei	106;482	0	0	—	+	—
<i>Fingerhuthia africana</i> Nees	374	—	—	—	—	0
<i>Heteropogon contortus</i> (L.) Beauv. ex Roemer & Schultes	25	0!	0	—	+	—
<i>Hyparrhenia hirta</i> (L.) Stapf	412	—	—	—	0	—
<i>Imperata cylindrica</i> (L.) Beauv.	218	—	—	—	0	—
<i>Loudetia ramosa</i> (Stapf) C.E.Hubbard	69;142	—	+	+	0	—
<i>Microchloa</i> sp. cf. <i>M. caffra</i> Nees	18	—	0	—	—	—
<i>Panicum kalaharensis</i> Mez	87	0	—	—	—	—
<i>P. maximum</i> Jacq.	126;429	0!	—	0	0	0
<i>Pennisetum foermeranum</i> Leeke	144	—	+	+	0	0
<i>Pogonarthria fleckii</i> (Hackel) Hackel	227	—	0	—	—	—
<i>P. squarrosa</i> (Licht. ex Roemer & Schultes) Pilger	344;456	0	0	—	+	0

	COLL. NO.	CENTRAL SUMMIT SAND	SUMMIT ROCK-SAND PERIMETER	CLIFF ZONE	TERRACES	SLOPES
<i>Rhynchelytrum brevipilum</i> (Hackel) Chiov.	361	—	—	—	0	0
<i>R. repens</i> (Willd.) C. E. Hubbard	95;318	+	0	—	0	0
<i>R. villosum</i> (Parl. ex Hooker) Chiov.	182;445	0	0	—	0	0
<i>Schmidtia pappophoroides</i> Steudel	461	0	—	—	+	—
<i>Setaria pallide-fusca</i> (Schumacher) Stapf & C. E. Hubbard	326	—	0	—	0	0
<i>S. verticillata</i> (L.) Beauv.	187	—	—	0	+	+
<i>Sporobolus festivus</i> Hochst. ex A. Richard	32	—	0	—	—	—
<i>S. fimbriatus</i> (Trin.) Nees	123;154	—	0	—	+	—
<i>Stipagrostis uniplumis</i> (Licht. ex Roemer & Schultes) De Winter	193;433	+	0	—	0	—
<i>Triraphis ramosissima</i> Hackel	399	—	—	—	0	+
<i>T. schinzii</i> Hackel	424	+	0	—	0	—
<i>Urochloa brachyura</i> (Hackel) Stapf	185	—	—	—	0	+
<i>CYPERACEAE</i>						
<i>Bulbostylis mucronata</i> C. B. Clarke	26	—	0	—	—	—
<i>Cyperus amabilis</i> Vahl	483	—	0	—	—	—
<i>C. bellus</i> Kunth	17	—	0	—	—	—
<i>C. margaritaceus</i> Vahl	449	+	0	—	—	—
<i>C. remotiflorus</i> Kükenthal	36	—	0	—	—	—
<i>Fimbristylis exilis</i> (Humb., Bonpl. & Kunth) Roemer & Schultes	65;148;476	0	+	—	0	—
<i>Kyllinga alba</i> Nees	43	—	0	—	—	—
<i>Mariscus aristatus</i> (Rottb.) Chermeson	28;46	—	0	—	—	—
<i>M. indecorus</i> (Kunth) Podl.	168	—	—	—	0	—
<i>M. laxiflorus</i> Turrill	34;127;464	+	0	—	—	—
<i>Pycreus pumilus</i> (L.) Domin subsp. <i>patens</i> (Vahl) Podl.	14;81	—	0	—	—	—

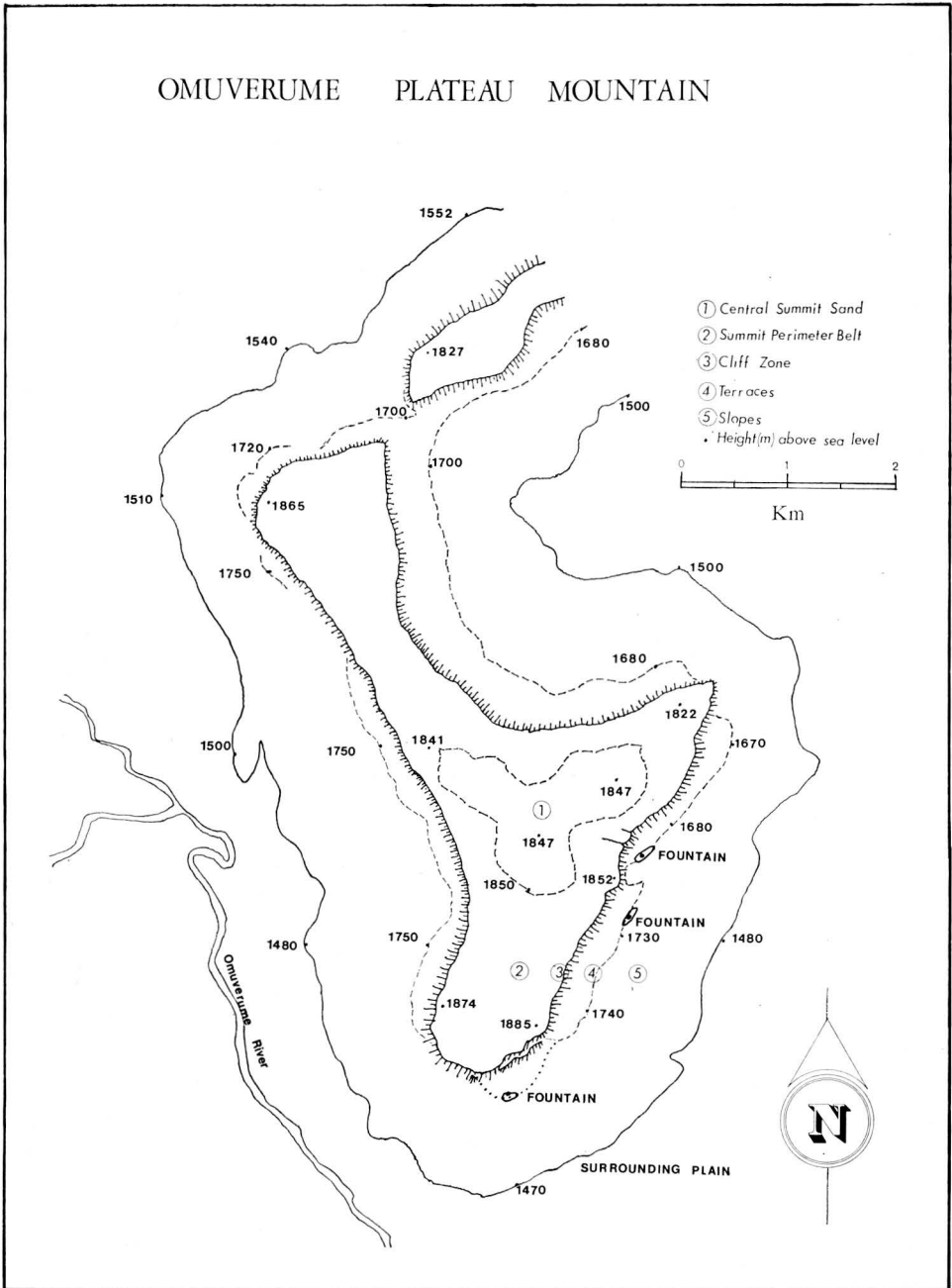


Fig. 1. Map of the Omuverume Plateau-Mountain

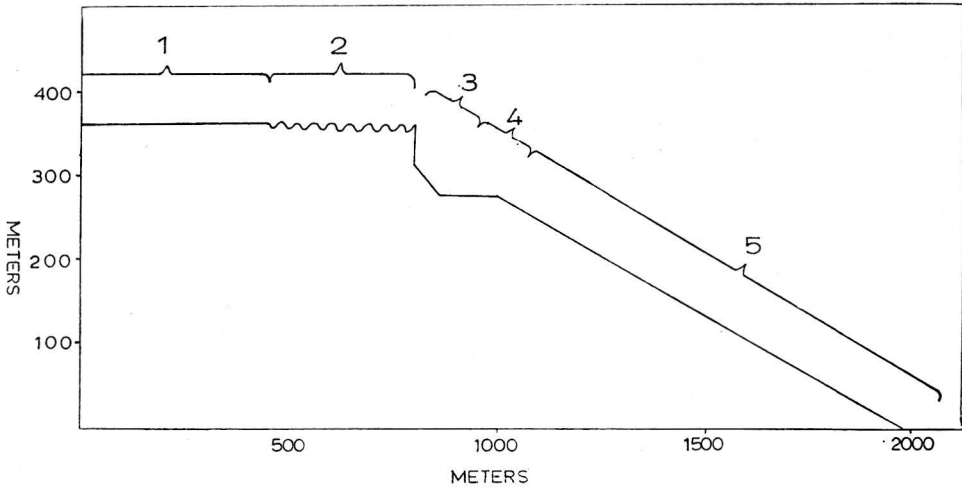


Fig. 2. Schematic cross-section of one side of the Omuverume Plateau-Mountain showing five topographical zones: 1, Central Summit Sand; 2, Summit Perimeter Belt; 3, Cliff Zone; 4, Terrace; 5, Slope.



Fig. 3. *Burkea-Digitaria* woodland-savanna on the Central Summit Sand area.

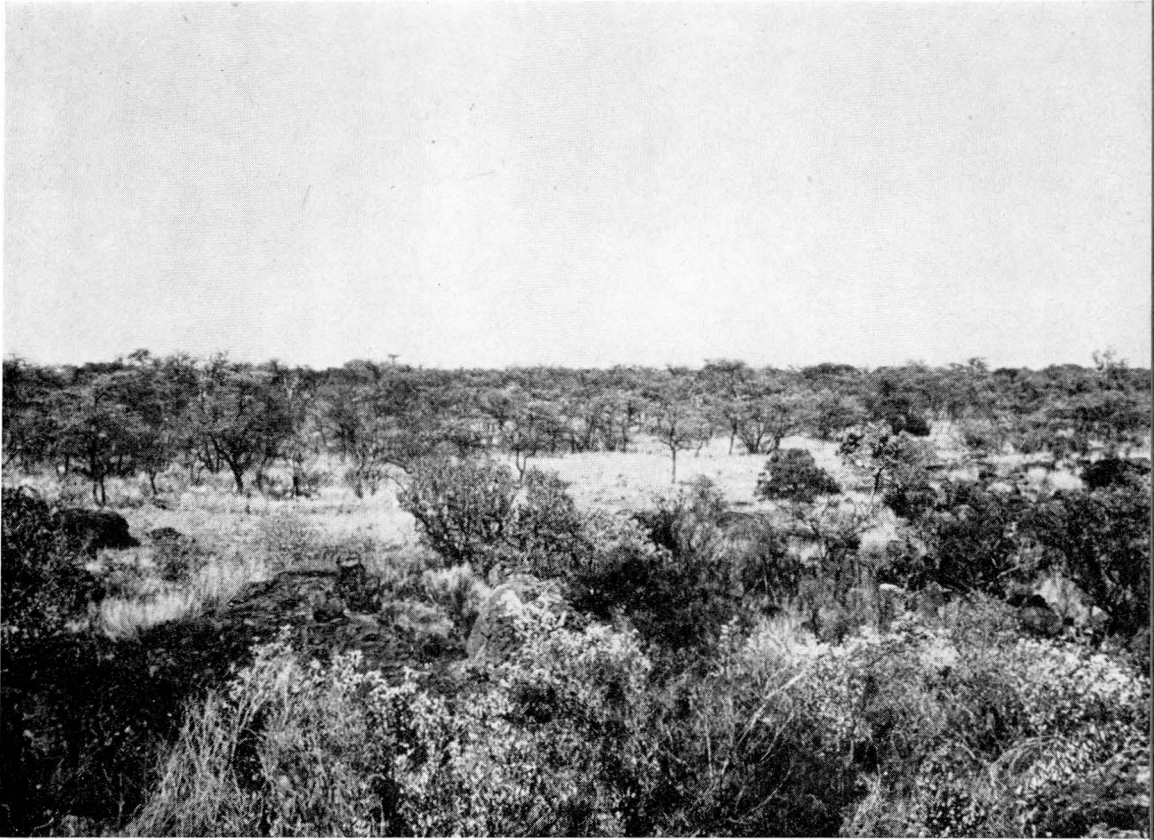


Fig. 4. Transition of the Central Summit Sand area (here predominantly *Terminalia sericea* woodland) in the background to a rocky part of the Summit Perimeter Belt area in the foreground.



Fig. 5. North-eastward view of the Summit Perimeter Belt showing the generally rocky nature of this zone. The remainder of the Great Waterberg Plateau recedes into the distance across the thornbush plains below.

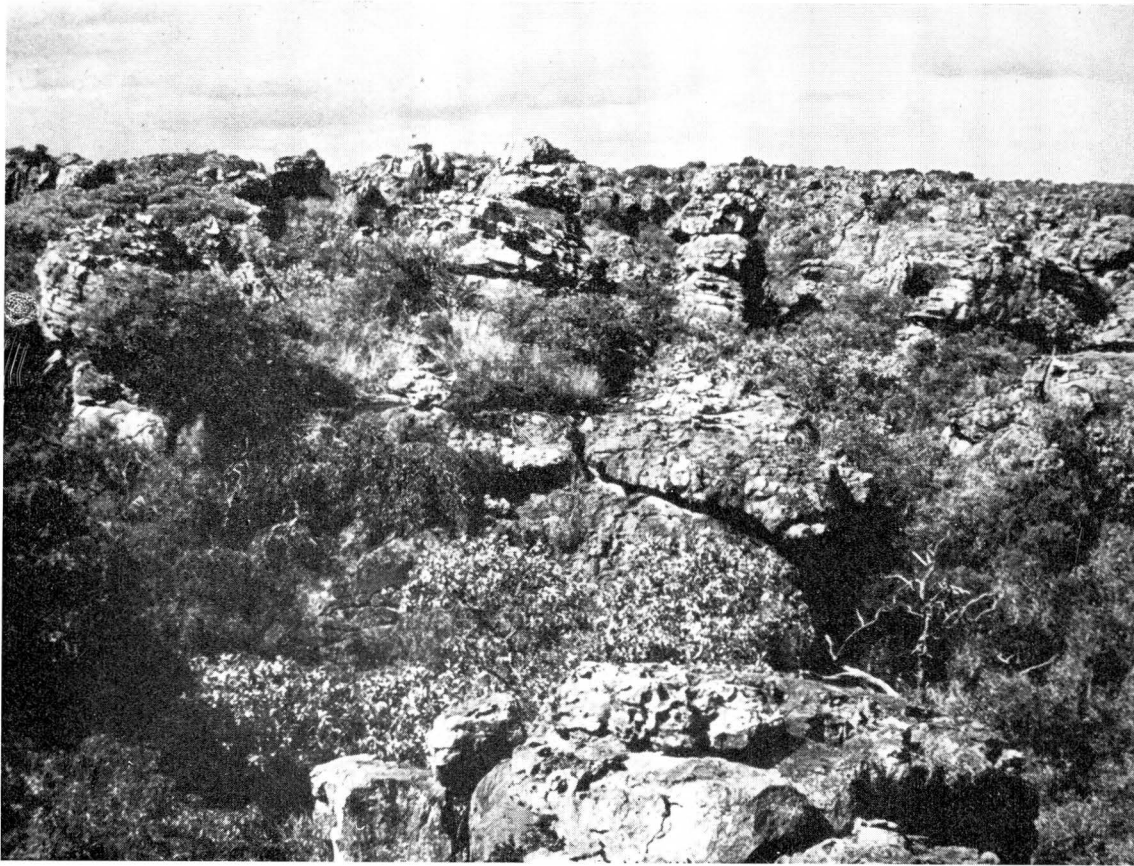


Fig. 6. Part of the Summit Perimeter Belt in an area with some deeper sand passages between large rocks. Visible over the nearest rock is the top of the crown of a *Lonchocarpus nelsii* tree. *Ficus guerichiana* and *Loudetia ramosa* individuals can be seen on the rocks at the middle-left.

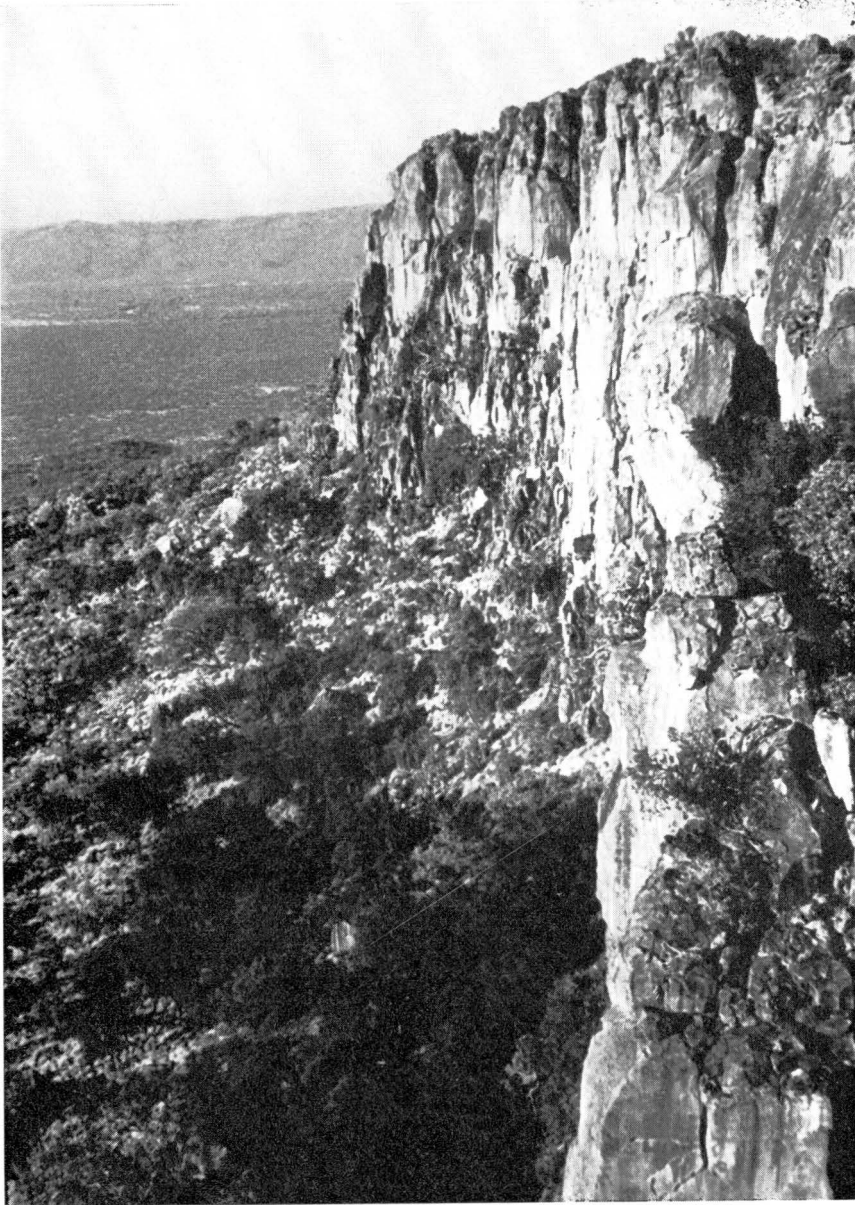


Fig. 7. Part of the south-eastern Cliff Zone showing a large group of *Acacia karroo* trees on the slope immediately below the cliff.



Fig. 8. View of the south-east Cliff Zone near a larger ravine off to the left showing a particularly wooded slope of *Acacia karroo*, *Croton gratissimus* and *Ficus cordata* below the cliff. Largest scramblers on the cliff are *Boscia albitrunca* (with a rounded appearance here) and *Ficus guerichiana*.

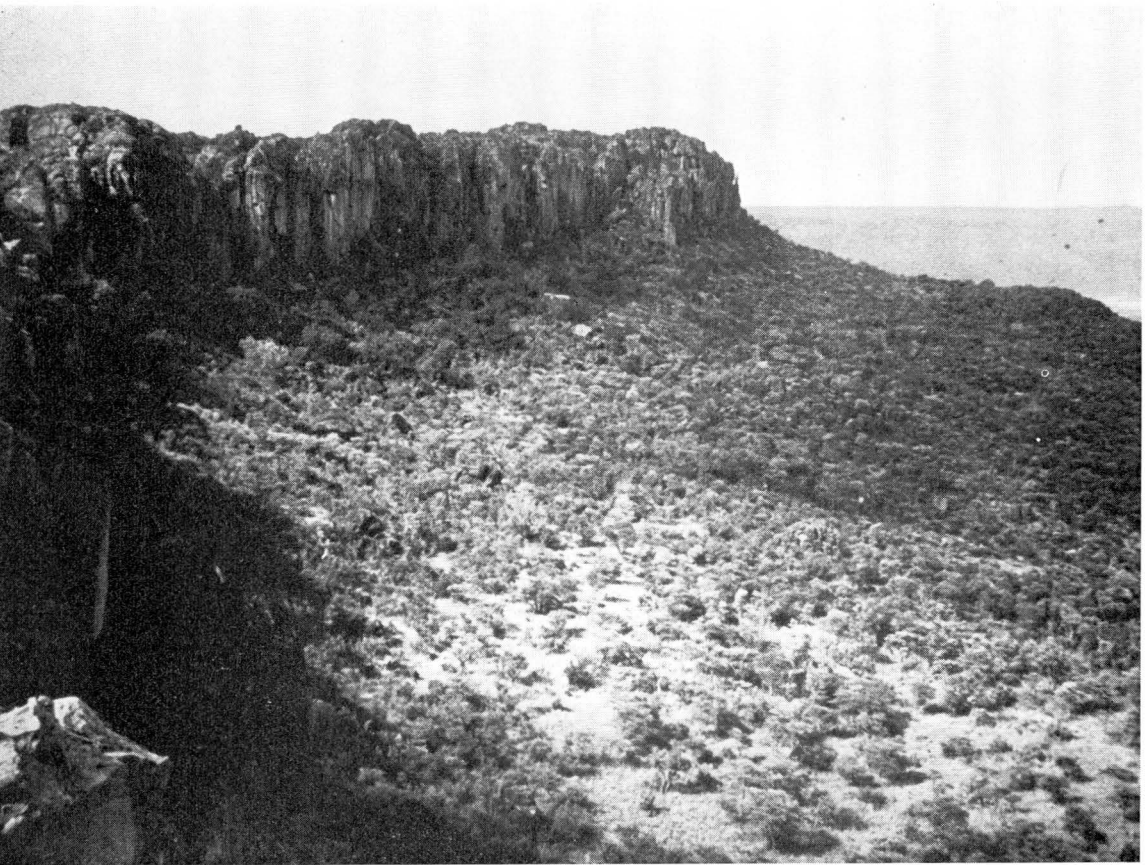


Fig. 9. A broader part of the western terrace showing a predominantly *Terminalia sericea* tree-savanna in the foreground. A portion of the Klein Waterberg Plateau is visible in the distance.



Fig. 10. *Sporobolus fimbriatus*, *Digitaria eriantha*, *Brachiaria nigropedata* and some *Eustachys paspaloides* and *Cenchrus ciliaris* on the western terrace. Tree species visible are *Terminalia sericea*, *Lonchocarpus nelsii*, *Acacia erubescens* and a rare *Combretum psidioides*.

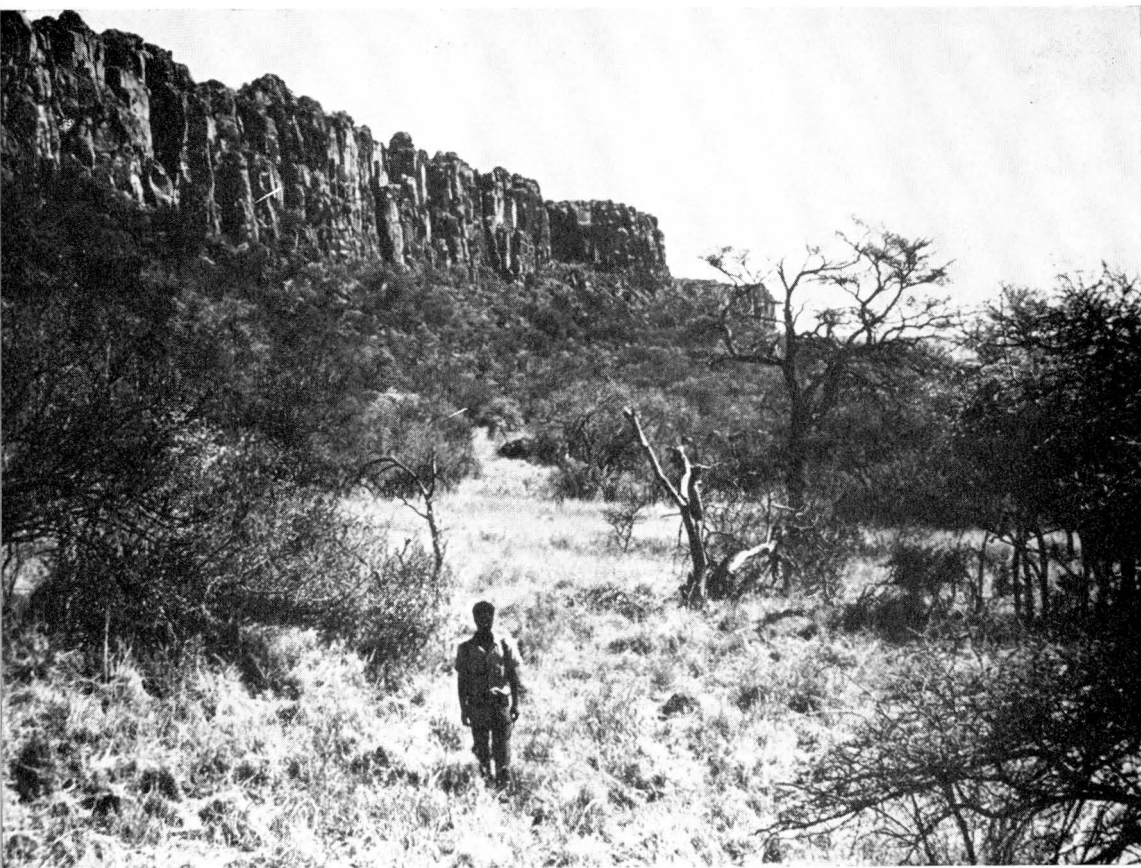


Fig. 11. A part of the south-eastern terrace in late winter. A dense cover of *Brachiaria nigropedata* is visible in the foreground and a *Combretum imberbe* tree at middle-right.

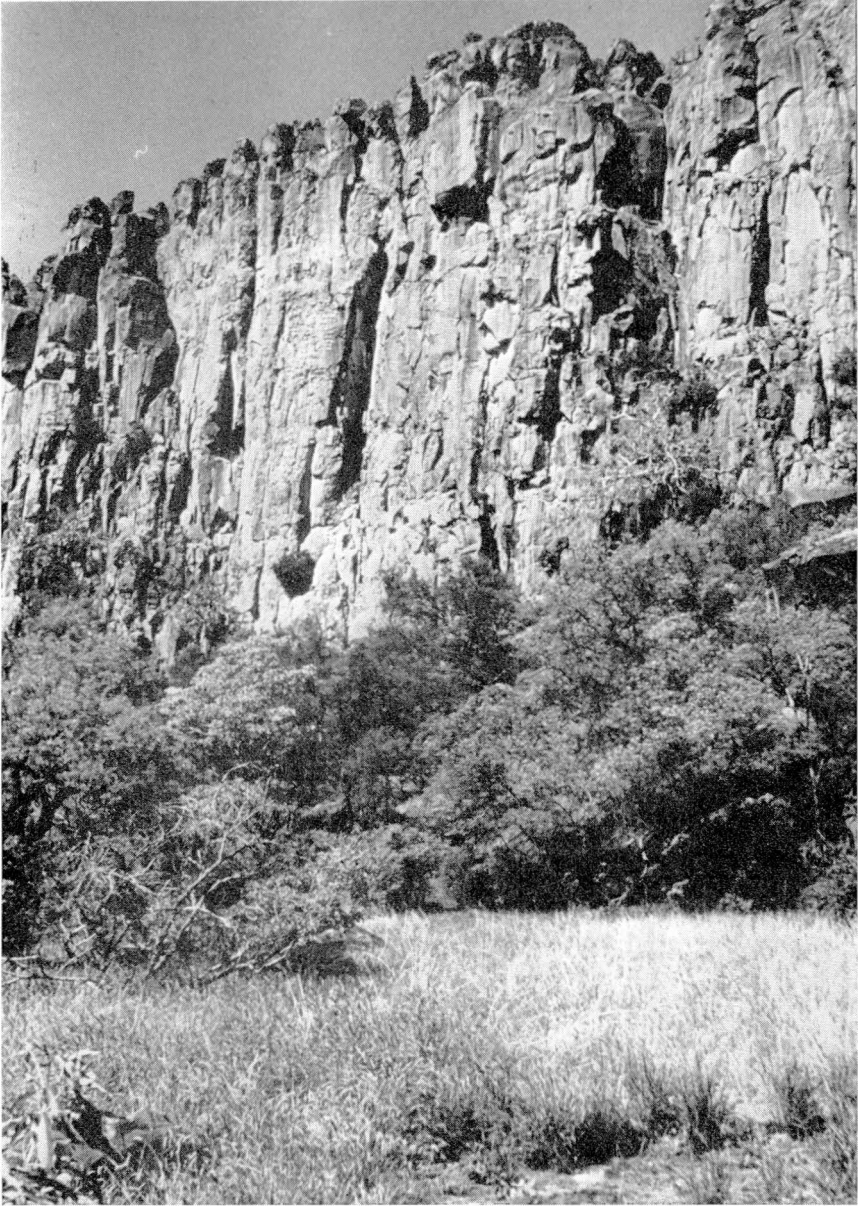


Fig. 12. An open grassy area — dominants are *Sporobolus fimbriatus*, *Digitaria eriantha*, *Cenchrus ciliaris* and *Heteropogon contortus* — flanked by *Acacia hereroensis* trees on an upper part of the south-eastern terrace.



Fig. 13. View from the top of the cliffs showing a more broken part of the southeastern terrace where the free-flowing spring is situated with the larger trees around it.



Fig. 14. Part of the area around the free-flowing spring on the south-eastern terrace. The large tree trunk and branches visible are those of *Ficus sycomorus* while on the ground behind the figure are for the most part the herbaceous species *Achyranthes aspera* and *Dicliptera eonii*.



Fig. 15. The apparently seldom flowering individuals of *Imperata cylindrica* along the flowing water of the south-east spring.

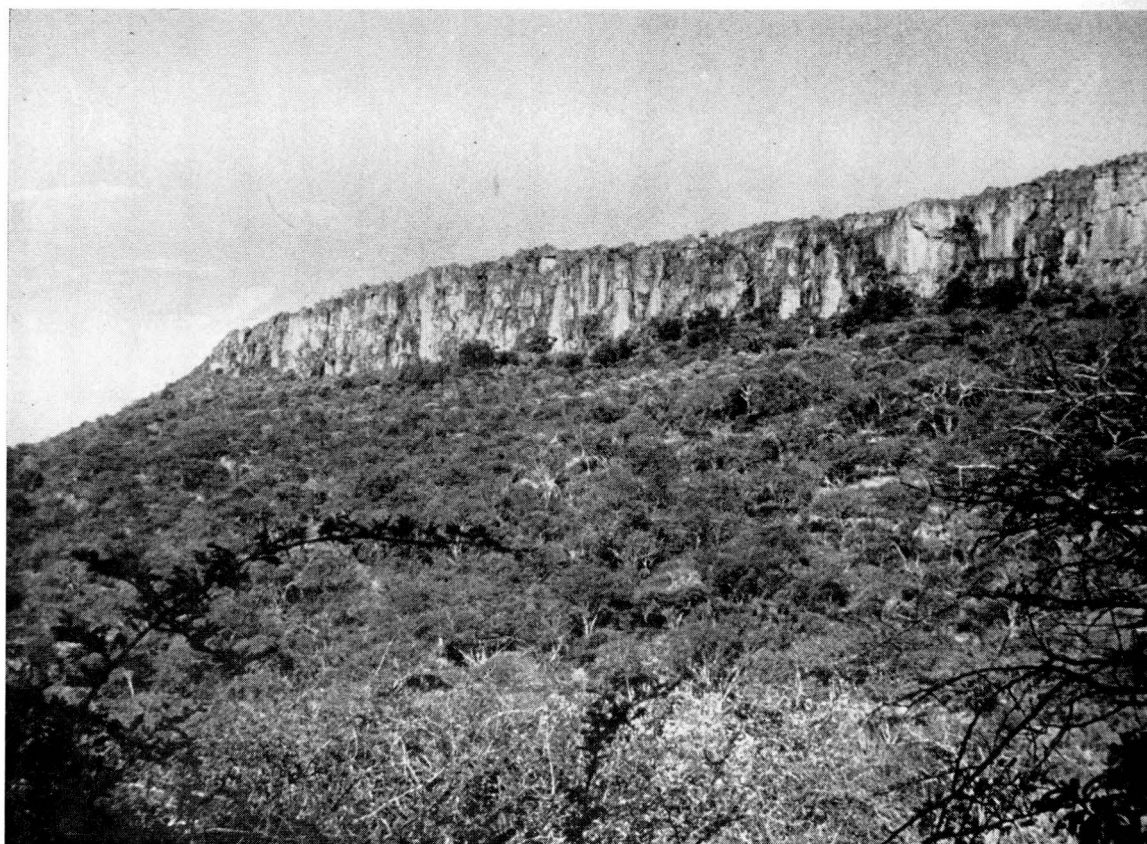


Fig. 16. Part of the upper half of the north-eastern slope. The woody element here consists for the most part of individuals of *Combretum apiculatum* subsp. *apiculatum*, *Dichrostachys cinera* subsp. *africana*, *Commiphora mollis*, *Mundulea sericea* and *Terminalia prunioides*. Due to the angle of view, the slope (no. 5 in fig. 2) appears to run directly on the slope (no. 3 in fig. 2) immediately below the cliff thus concealing the terrace.



Fig. 17. The vegetation half way up a part of the south-eastern slope. Visible are the lighter *Tarchonanthus camphoratus* at the left, the darker *Terminalia prunioides* at middle-right, *Commiphora mollis* at middle-left background and bushes of *Euclea undulata* and one *Dombeya rotundifolia* in the foreground. Dominant grass species here are *Enteropogon macrostachyus* and *Aristida effusa*.



Fig. 18. The vegetation on a more rocky portion of the south-eastern slope about two thirds of the way up the slope. The larger trees to the right are those of *Commiphora mollis* while individuals of *Grewia flavescens* and *G. bicolor* are visible in the foreground and *Croton gratissimus* in the background.



Fig. 19. *Kirkia acuminata*, typically found on the slope areas, here solitary on the slope immediately below the south-eastern cliff.



Fig. 20. Part of the upper north-western slope viewed from a height of about 2,5 metres above ground. In the middle-foreground are individuals of *Tarcho-nanthus camphoratus* while at middle-left are those of *Dichrostachys cinerea*.



Fig. 21. A view across the thornbush plains towards the north-western side of the Omuverume Plateau. The vast majority of tree-shrub on the plains here belong to the species *Acacia mellifera* subsp. *detinens*.

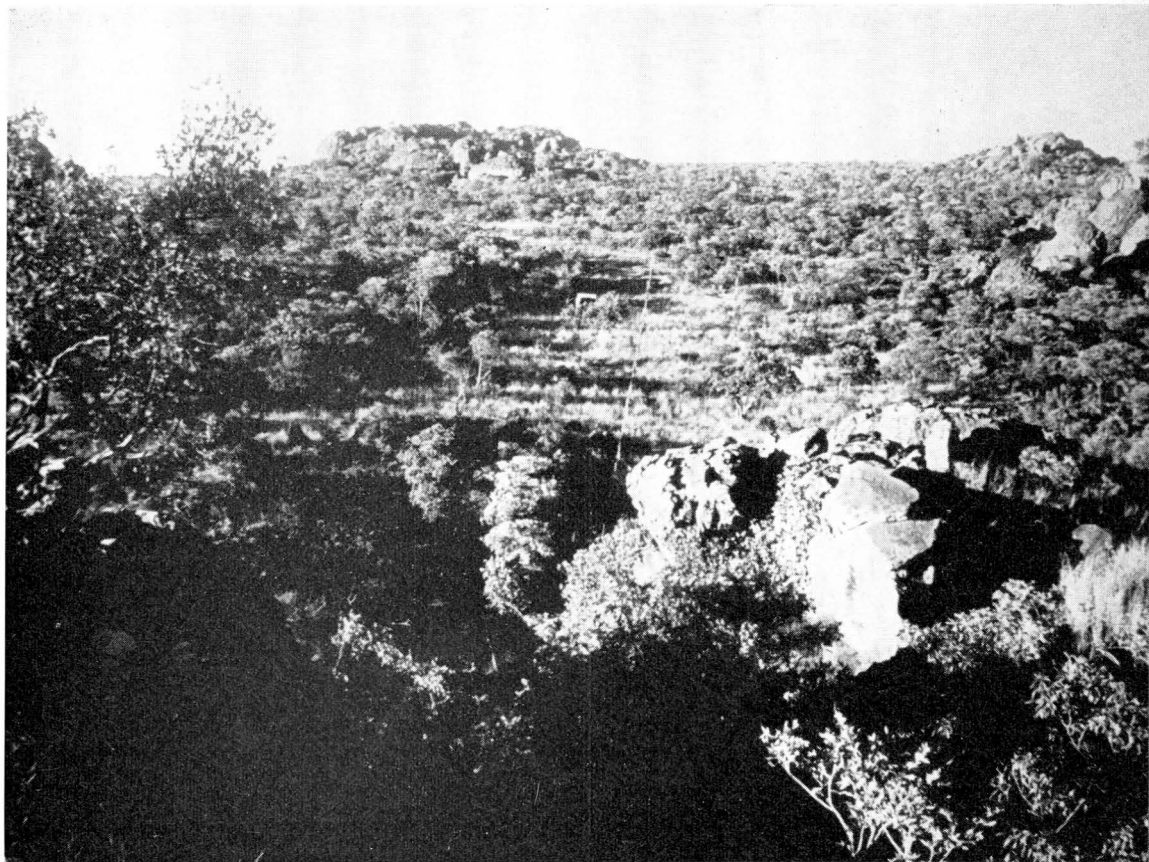


Fig. 22. The wooded plateau of the Klein Waterberg. Most floristic elements of the summit of the Great Waterberg are present here although these are somewhat mixed with rock-associated vegetation containing species such as *Croton gratissimus* and *Dombeya rotundifolia*. This mixing of sand-bound and more rock-associated species is due to the more weathered nature of this mountain's summit.



Fig. 23. Distant view of the Omboroko Plateau-mountain showing the small summit area on which floristic elements of the north-eastern "Tree-savanna and woodland" vegetation type still exist.



Fig. 24. *Securidaca longepedunculata* (with leaves) and *Terminalia sericea* (here leafless) trees on the Omboroko summit Plateau.

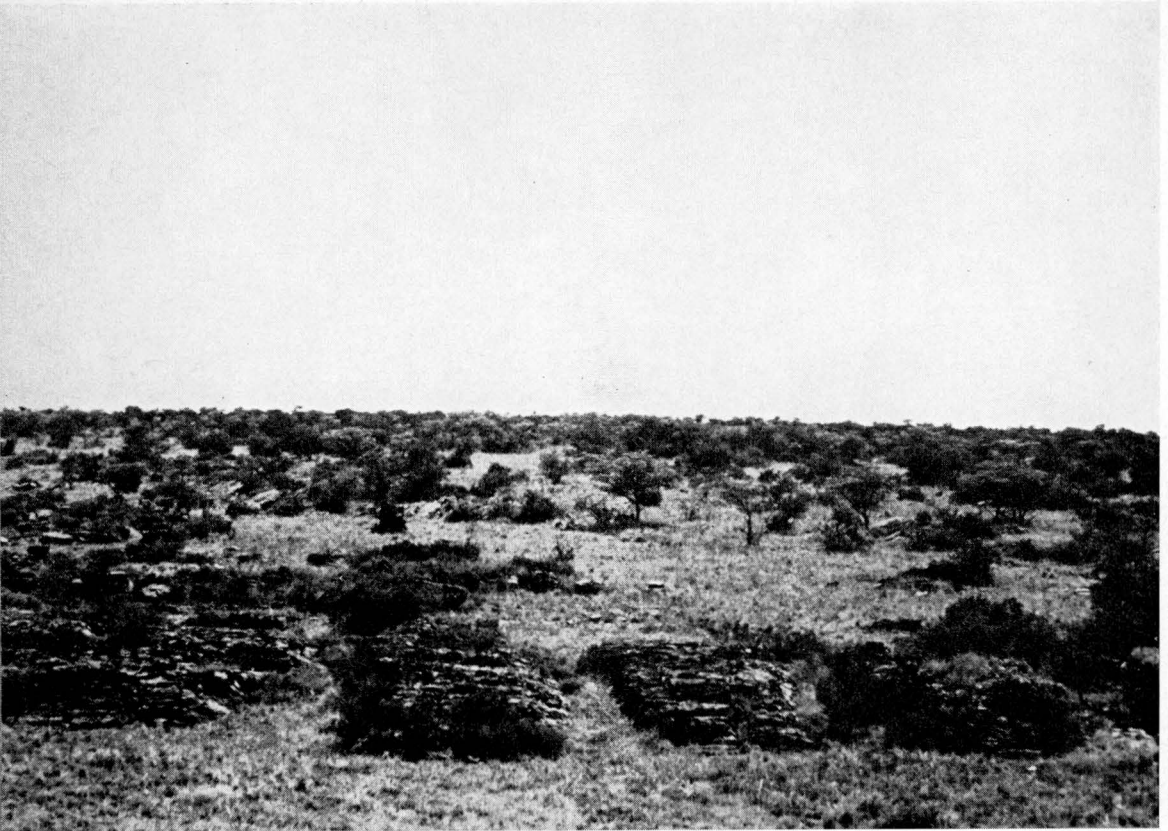


Fig. 25. *Terminalia sericea* — *Lonchocarpus nelsii* — *Combretum apiculatum* subsp. *apiculatum* open savanna on part of the summit area of the Etjo Plateau-mountain.

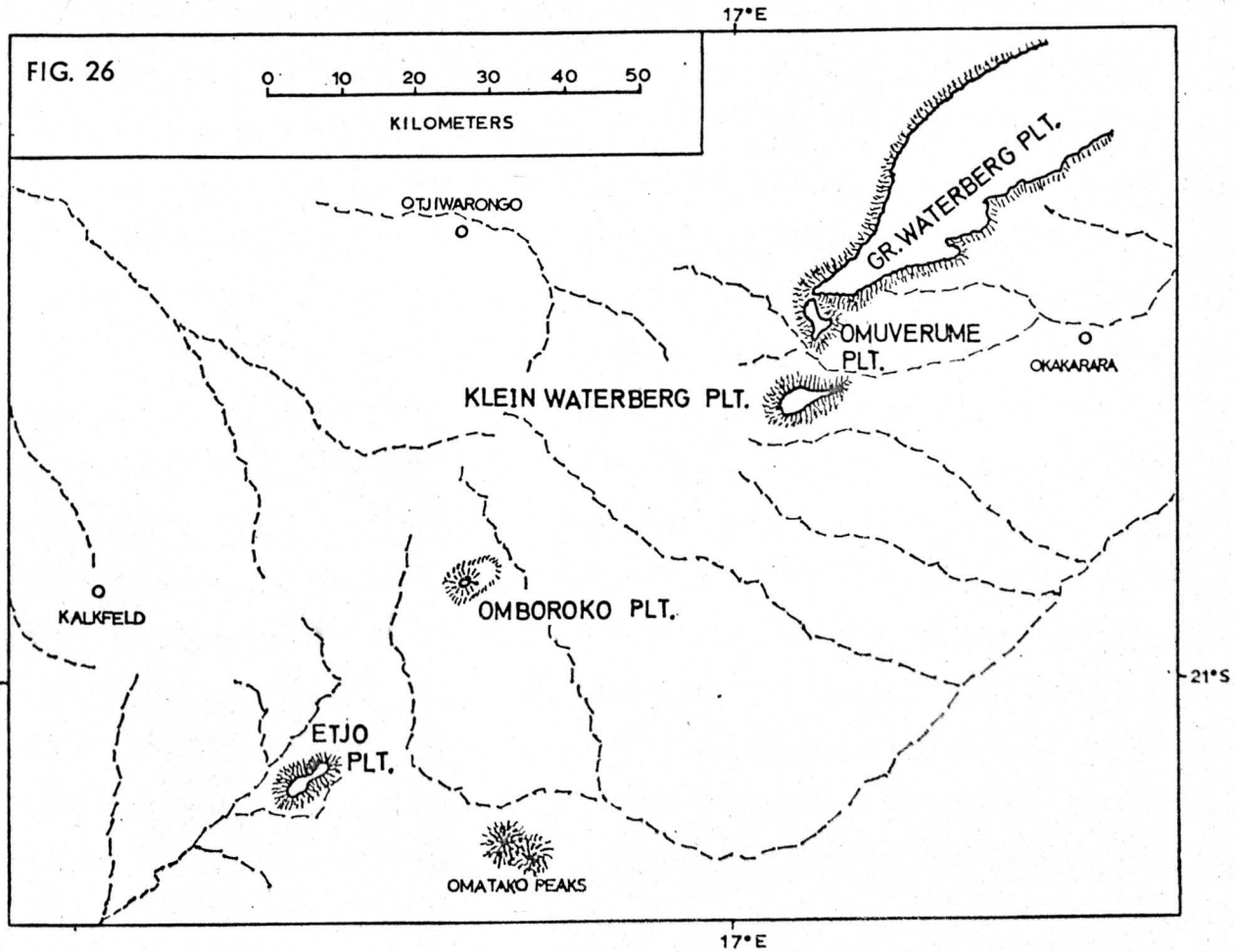


Fig 26.
Map showing
the position
of the sand-
stone pla-
teau of the
Etjo Series
mentioned in
the text.