A PRELIMINARY STUDY OF THE VEGETATION OF PIKETBERG MOUNTAIN, CAPE PROVINCE.

by

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ABSTRACT

A vegetation survey of the Piketberg has been undertaken, with the aim of laying the basis for a more detailed survey. The mountain ranges from 300 m to 1500 m and lies near the north-western edge of the Cape Fynbos.

The vegetation was classified using the phytosociological methods of the Zürich - Montpellier school. Vegetation forms were described with particular attention to the vegetation continua within the groups.

Extensive data were collected on climatic and edaphic factors, and these were correlated to the vegetation forms and continua. This, it is hoped, will create the framework for the study of the ecological and evolutionary dynamics of the system.

A check-list was compiled, and the flora analysed and compared to other known floras.

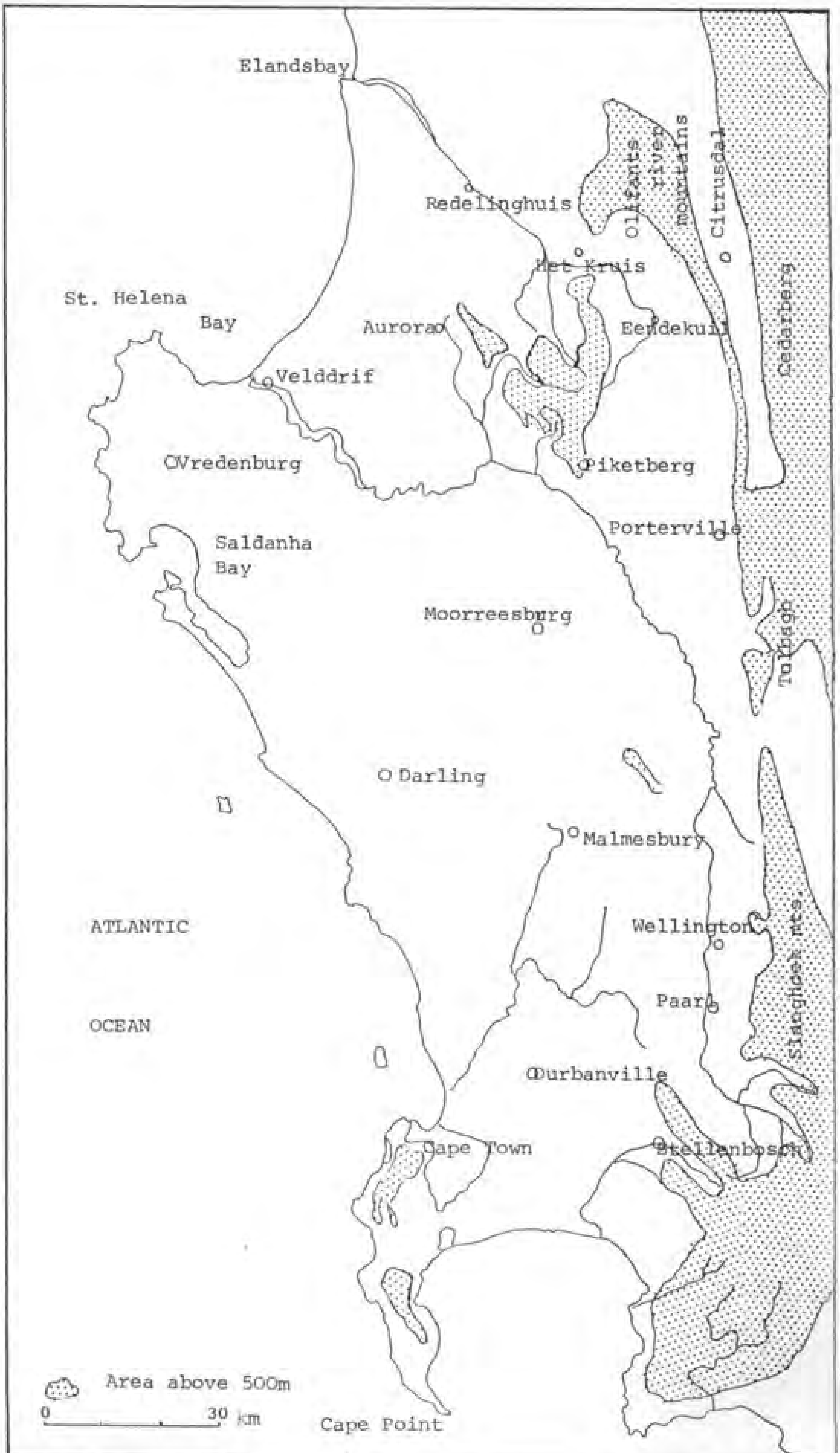
INTRODUCTION

The Piketberg forms an isolated mountain complex, which lies between the main fold mountain range (the Porterville-Cold Bokkeveld mountains), and the sea. It is separated from the main ranges by the Piketberg flats, which are some 25 km wide. At the northern end it is separated from the Olifants River Mountains by the Kruismans River.

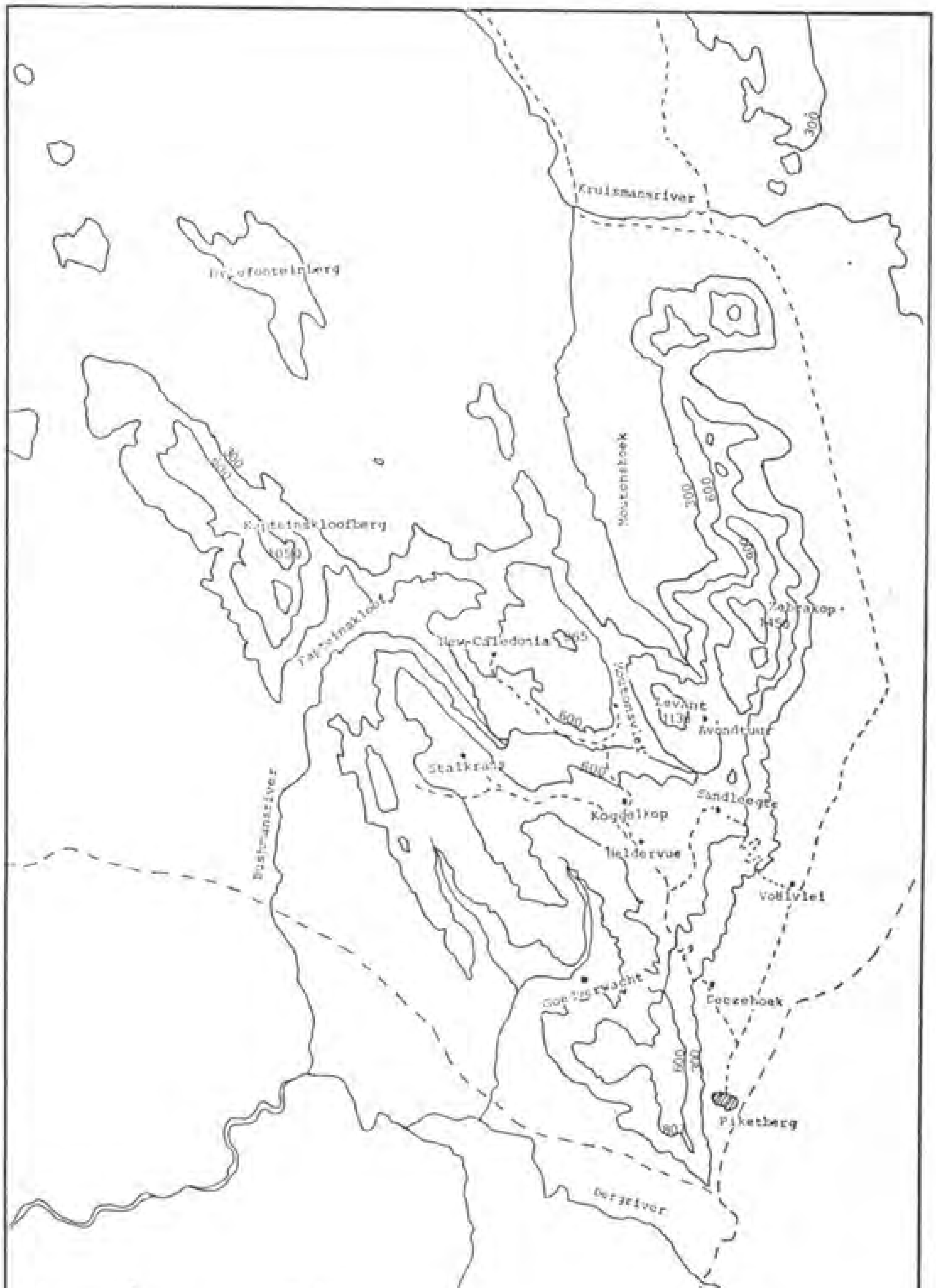
The mountain lies 32° 45′ south, and 18° 45′ east, and covers an area of roughly 225 sq. km (Map 1). In altitude the mountain ranges from 300 m to 1458 m (Zebrakop). The major part of the mountain forms a plateau which ranges from 500 m to 800 m, most of which is cultivated.

Climatically, the area falls in the winter rainfall region of the Cape. Foristically, it is part of the Cape floral Kingdom (Good, 1964; Takhtajan, 1969). Vegetatively, it falls into veldtype 69 (Macchia) (Acocks, 1953).

Botanically, the mountain has not been studied in any detail. Probably the first collections on the Piketberg were made by Drège (1830 - 1840). Towards the end of the last century Harry Bolus (1895) and Rudolf Schlechter (1894) botanized on the mountain. They probably ascended the mountain at Sandleegte. During this century, several botanists have visited the Piketberg, including T.P. Stokoe, E. Esterhuysen and J.P. Rourke. The most important collector, Map 1. Location of the study area.



Map 3. Topography of the Piketberg mountain.



however, was N S. Pillans, who made an exhaustive collection in 1936. He was apparently based at Moutonsvlei, and visited Zebrakop, Gruyskop and Stawelklip. From his collections he compiled a checklist of 373 species. This unpublished list is in the Bolus Herbarium.

The present survey is of the reconnaissance type (Westhoff, 1973), and was initiated to prepare the ground for a more comprehensive study. Work was started on a checklist in 1973, as the availability of a reasonably complete checklist is a necessity for any survey based on floristic composition.

As a more detailed survey should pay particular attention to ecological dynamics and plant-environment interactions (for management planning) and to evolutionary dynamics (for conservation planning), an attempt was made in this study to isolate the main areas of interaction between the vegetation and the environment. The vegetation has to be classified to provide a consistent terminology with which to work. But continua within these vegetation units, which can be correlated to environmental gradients, provide the key by which plant - environment interactions can be analysed. An attempt is, therefore, made to accommodate both a classification and a description of continua in one format.

This survey has no claim to being comprehensive. Only those aspects which appeared to be significant as controlling factors in the vegetation were studied. Because of their complexity, biological interactions were not studied at all. The vegetation survey was mostly restricted to the main plateau, between Zebrakop, Stalkrans and the top of the Versfeld Pass. The entire area south of the Versveld Pass was devastated by a wild fire in January, 1976, and could, therefore, not be included in the survey.

It is hoped to continue the survey, and to extend it into those areas which have not been studied to date.

HUMAN INFLUENCE

The earliest human occupation of the mountain was probably by the Bushman. Evidence of their presence is found in Bushmans Hollow, where some Bushman paintings still exist.

Initially, the white settlers, who reached the area in the early 19th century, (Burger, 1975), grazed their horses on the mountain. Access up the mountain was mainly up Burgerskloof from Goedverwacht, and from Moutonshoek to Moutonsvlei.

The earliest settlement was probably at Langeberg. Towards the end of the 19th century, J. Versveld started farming on the mountain, and in 1889 he constructed the first pass for ox-wagons from Voëlvlei to Sandleegte. Fruit farming and settlement expanded rapidly, and now nearly all arable land is being utilized. In 1943 the new pass was finished from Deezehoek up the mountain.

The following effects have probably resulted from the settlement of the mountain:

(a) The frequency of fires has probably greatly increased. Veld is burned to provide grazing (this is still being practised). For this purpose, the veld is usually fired in the early winter, a couple of hours before the rain starts. This results in small burnt patches. Much more damaging was burning for buchu (Agathosma betulina). As the growth of buchu is stimulated by fire, the buchu producing areas (mainly between Levant and Zebrakop) were fired in late summer. A single fire would then sweep through the whole area. This practice is now illegal, and hopefully the low price of buchu will prevent these fires in the future.

(b) Grazing by horses, sheep and goats used to be widespread, but it is now infrequent. Cattle are still grazed on the plateau east of Levant, and sheep on the plateau south of Zebrakop. The effects of this grazing are difficult to estimate. The most damaging effect is probably the nitrate enrichment resulting from the dung, which could allow the invasion of alien species, which cannot survive the present low nutrient status of the soil.

(c) Dam-building has accelerated greatly in the last decade as the rainfall decreased rapidly, and all streams are now dammed, some by several dams. Beside the obvious effect of wiping out the vegetation on the rich alluvial floodplains, they affect the flow patterns of the streams. The riverine vegetation is sensitive to these patterns, and species like Osmunda regalis, Disa acaulis and Erica caffra might well be affected. The effects of changing the silt and sand contents of the streams are not known, but it is likely to affect the stream fauna.

(d) Spraying for pests could have disastrous affects if insect pollinators are affected, and this could also affect the predator-prey balance. It is not known to what extent this would affect the fynbos.

(e) The introduction of alien vegetation has not yet had any disastrous effects. However, Pinus planted as windbreaker, is starting to spread into the virgin bush, and could well prove to be a problem in the future. The Australian acacias do not seem to be particularly virulent in the dry sandstone conditions, and no species of Hakea have as yet appeared.

The effects of the settlement of the mountain still need careful evaluation. To date, the effects on the natural vegetation do not appear to be disastrous.

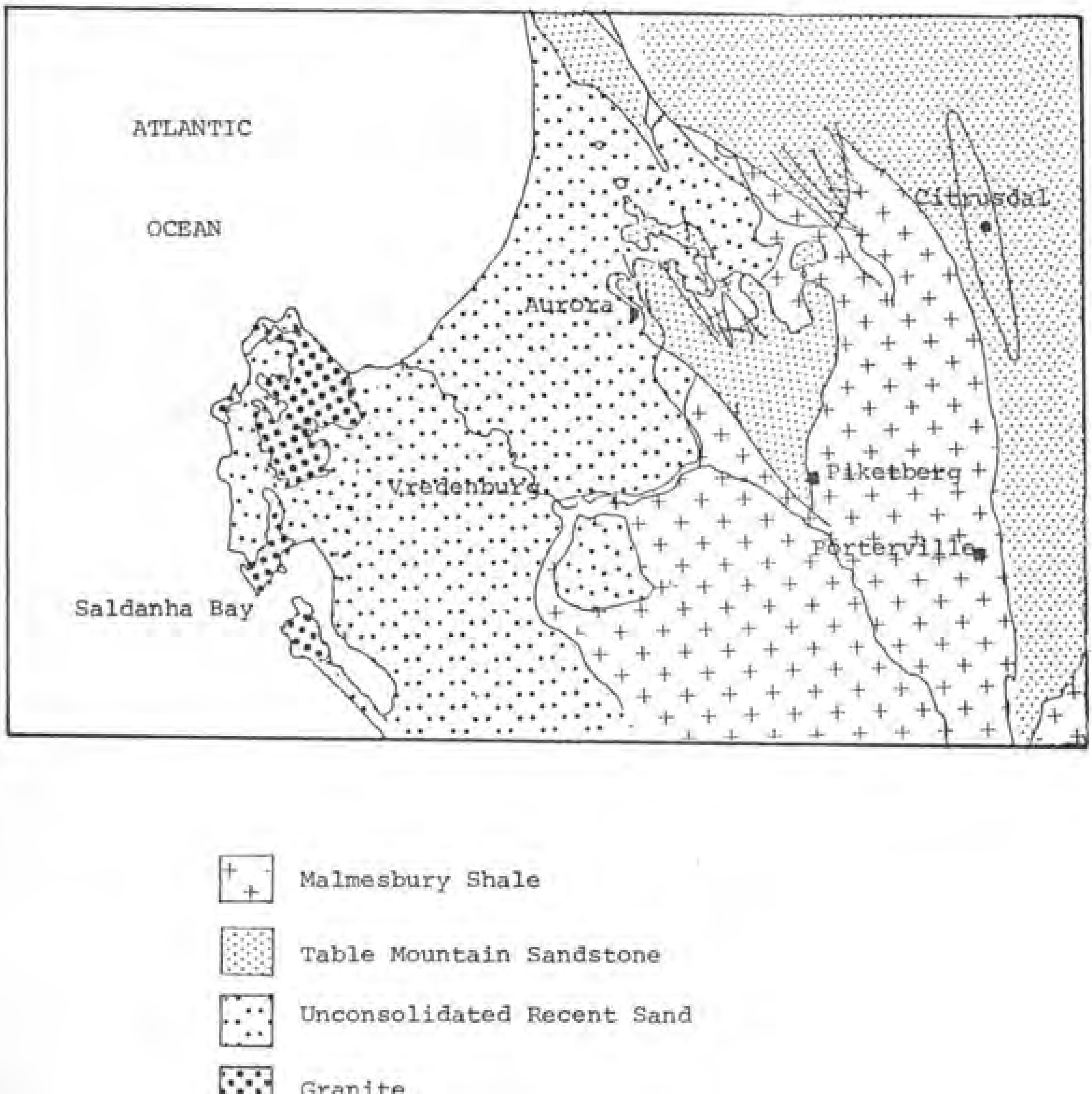
GEOLOGY AND PEDOLOGY

The Piketberg has not yet been studied geologically in any detail. It forms part of the Cape System. Typically, this consists of a thick layer of sandstone resting on Malmesbury shale. The sandstone layer is divided into upper and basal sandstones by a narrow shaleband (100 - 15 m thick) (Du Toit, 1954; Haughton, 1969). The system is generally poor in minerals, but manganese extrusions occur occasionally.

The Western Cape mountains were formed by extensive folding of this system. Consequently the flatlands are usually of Malmesbury shales, and the mountains of Table Mountain Sandstone. As the sandstone does not weather easily, the mountains tend to be precipitous.

The Piketberg consists of Table Mountain Sandstone. The complex arrangement of the fold lines (Map 2) resulted in the triangular shape of the mountain, with the main drainage lines being along the folds. Towards the east, the flats consist of Malmesbury shales, and towards the west, of Recent Sand, which forms the Sandveld. Generally, the

Map 2. Geology of the Piketberg Area.



transition occurs at about 300 m. Along the eastern escarpment, the shale - sandstone margin runs obliquely from Deezehoek (300 m) to the top of the old pass at Sandleegte (600 m). There is no trace of the upper shale band.

The soils on the mountain have never been studied. Preliminary investigations revealed that the Glenrosa form is widespread on slopes. This form consists of a coarse sand with 5 - 10% silt and clay, and a pH which varies from 4,5 to 6,0. The organic content of the A-horizon varies from 2 - 6%. The A-horizon is 10 - 30 cm deep. The B-horizon consists of unconsolidated weathering stone, with soil in between the stones. Generally, the stones make up 50 - 90% of the weight of the solum in the B-horizon.

In flat areas the Fernwood form commonly occurs. This consists of deep undifferentiated sand. pH and organics are basically the same as for the Glenrosa form. These soils are widely used for orchards and other cultivation. Occasionally, a 10 - 50 cm deep layer of clay is found suspended in the solum, or resting on the bedrock. This clay is also found on slopes, and is much sought after for the construction of dams.

In swamps a very organic soil is found (Champagne form), but it is rare. It also occurs in permanent seepages, and is noted for its coarse sand and high organic level (more than 30%).

The rich black alluvial soils in the larger river valleys (Moutonsvlei, Stawelklip, Bushmans Hollow and Agtervlei) have not been investigated, as they are mostly under cultivation.

All these soils are derived from Table Mountain Sandstone, and the parent material is therefore a coarse sand. These soils do not retain water, and are very poor in nutrients. They are usually very well leached (Cole, 1949).

This discussion is still tentative, as insufficient samples were analysed to give a good impression of the soils on the mountain.

CLIMATIC CONDITIONS

1. Introduction

A Mediterranean climate is broadly defined as: "a climate with the concentration of rainfall in winter and with a period of drought lasting from a minimum of one month (in summer) to a maximum of 12 months" (Di Castri, 1973). This description applies to the climate of the Piketberg. One would then expect to find long hot summers, and cold wet winters. A closer analysis of the climate on the Piketberg reveals that this picture is a gross simplification.

Unless otherwise indicated, the data presented were collected at the farm Heldervue.

2. Rainfall

The average rainfall at 800 m, over a thirty year period (1940 - 1970), is approximately 750 mm per annum, with 69% of the rain falling between May and September (Fig. 1). The village of Piketberg (altitude 300 m) receives an average of approximately 400 mm, with a strikingly similar distribution to the mountain (Figures 2, 3). By extrapolation, it could be expected that the higher parts of the mountain (above 1000 m) would receive on average up to 1000 mm of rain per annum. The slope of the average rainfall curve indicates that most of the rain falls at the beginning and the end of winter, with July being somewhat drier.

An analysis of the monthly distribution of rain shows a striking irregularity. Most of the rain is received in one or two months (varying from May to August); these months usually have precipitations of 250 to 350 mm, as opposed to the maximum average monthly precipitation of 140 mm. (Fig. 4). These large totals are the result of heavy rains, which usually result in large runoffs. The concept of the winter rains being in the form of gentle drizzles is manifestly false. The magnitude of these runoffs is illustrated by the speed

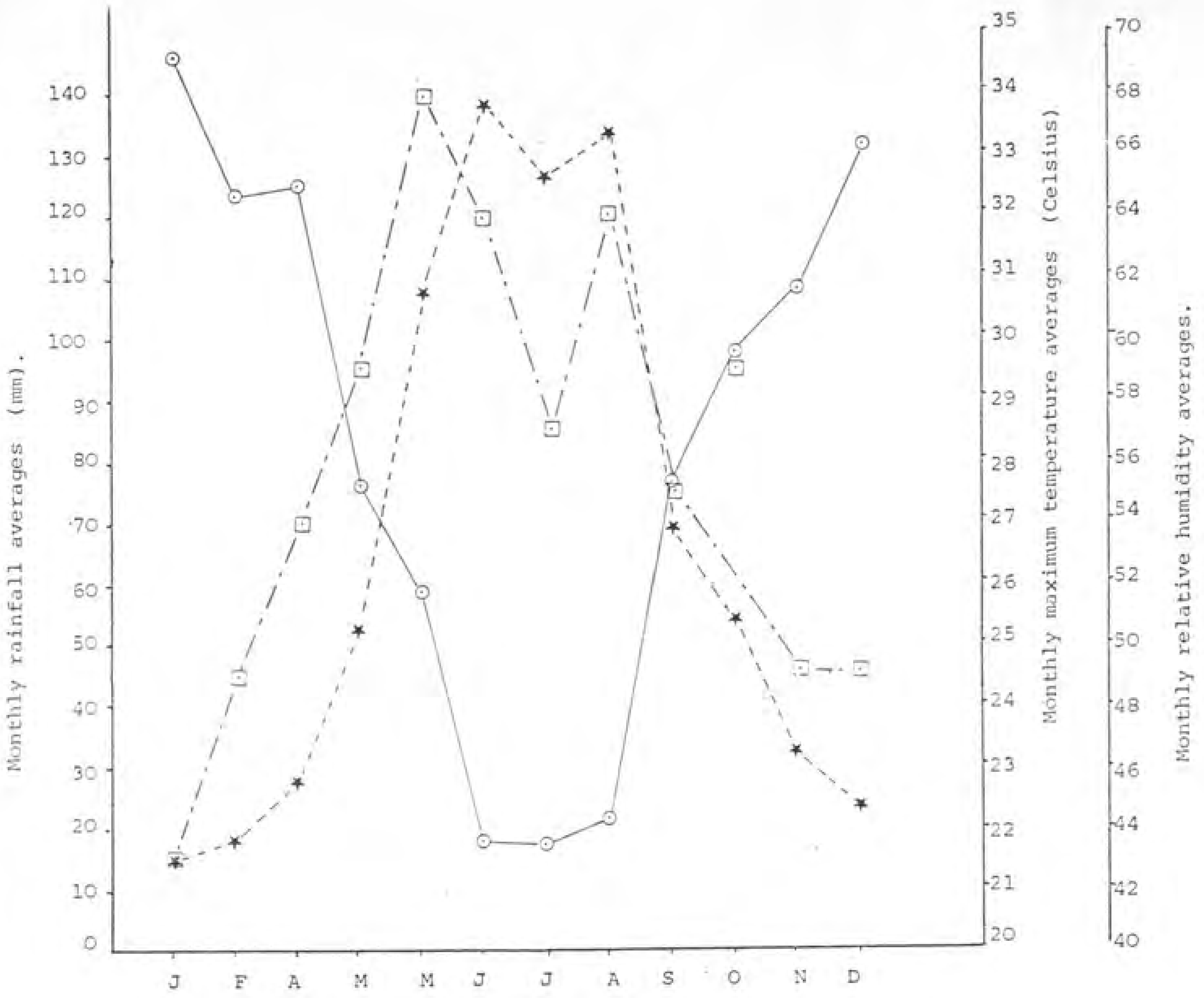


Fig. 1 Climatic diagram for Heldervue, based on the averages of figures available.
Rainfall. ★-----★ Temperature. ⊙——⊙ Humidity. ⊡—·—⊡

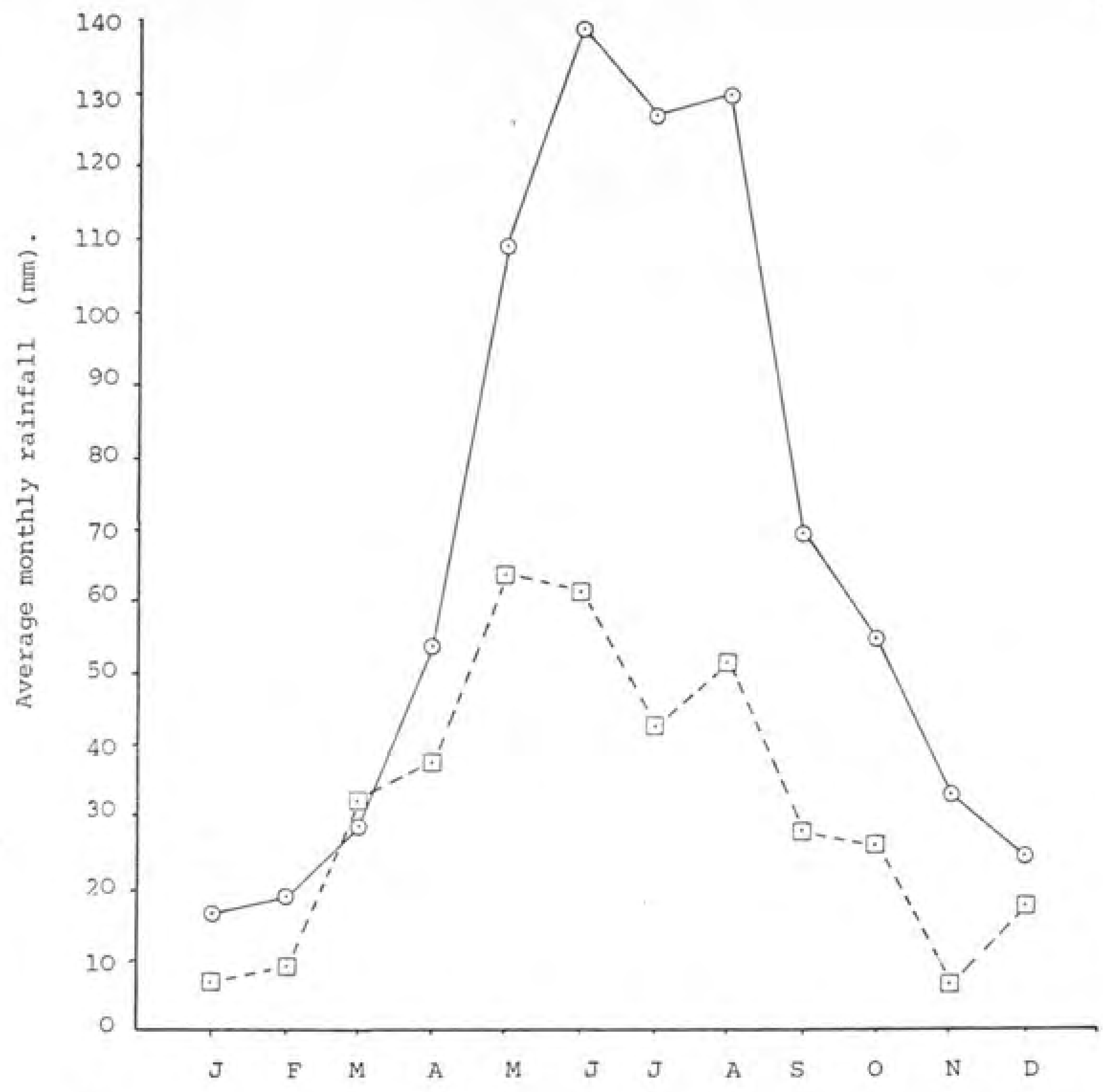


Fig. 2 Comparison of the average rainfall at Piketberg and Heldervue.

Piketberg. ⊡——⊡ Heldervue. ⊙——⊙

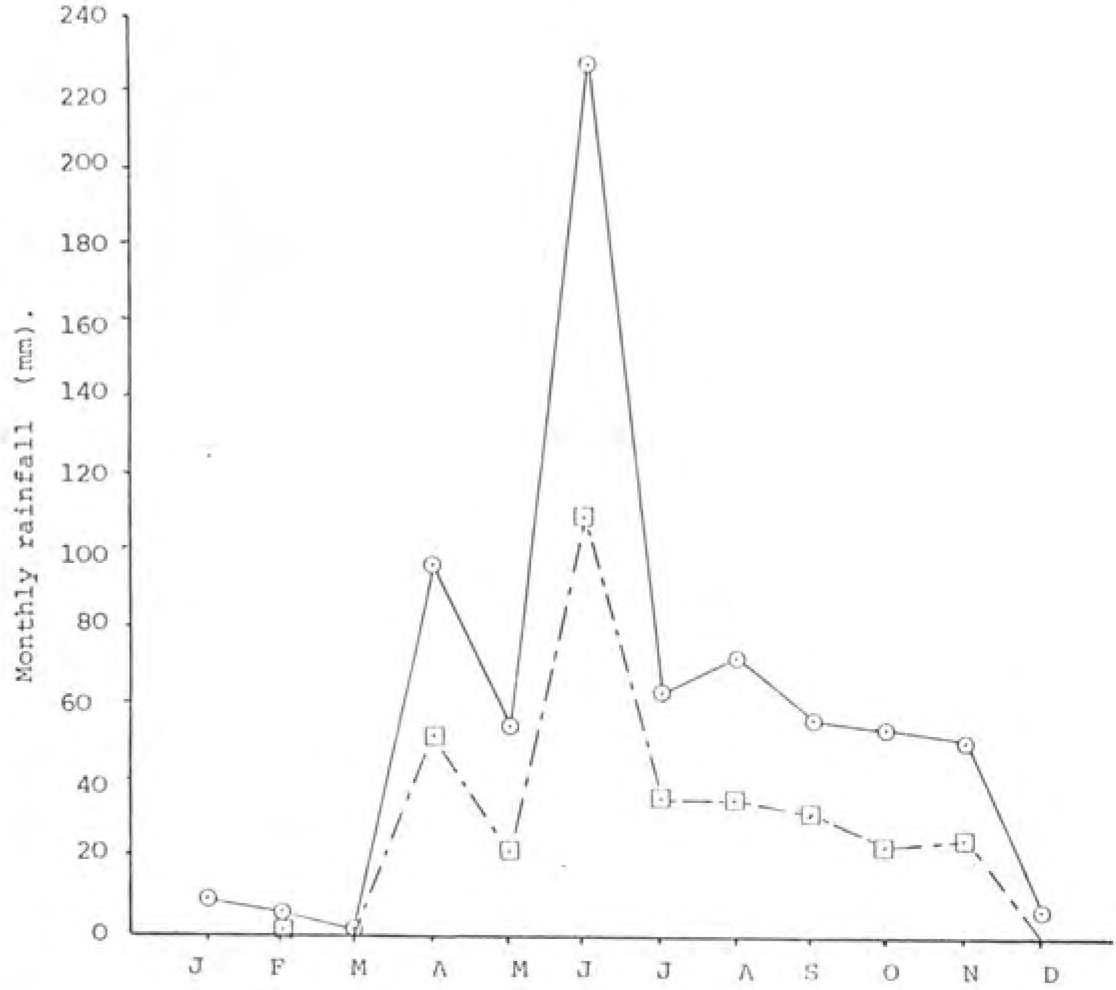


Fig. 3 Comparison of rainfall for 1967 at Piketberg and at Heldervue.

⊡- — -⊡ Piketberg.

⊙——⊙ Heldervue.

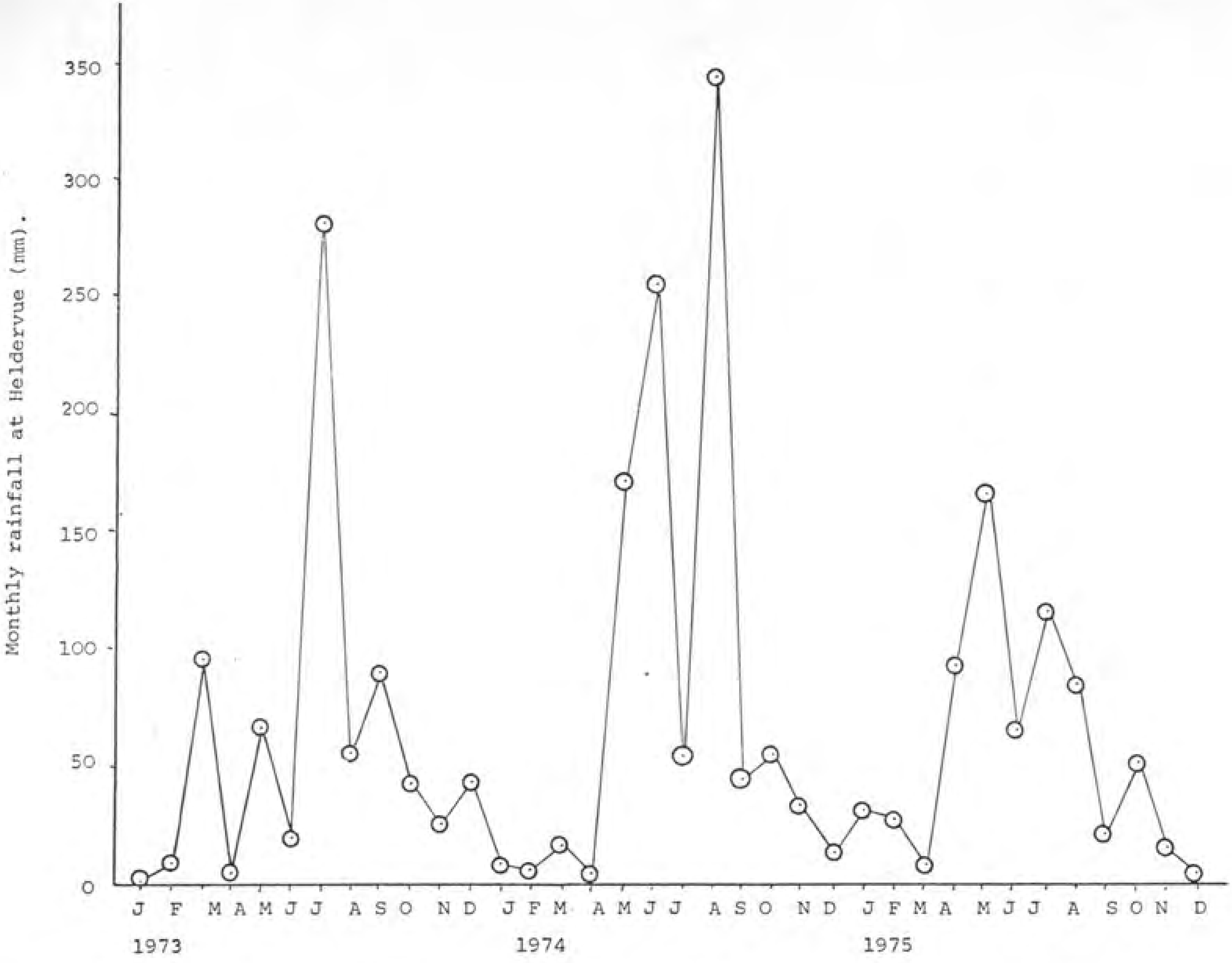


Fig. 4 Monthly rainfall figures for 1973 to 1975 at Heldervue.

with which storage dams fill up. The monthly distribution of rainfall varies strongly from year to year. This indicates that the distribution of average rainfall is a gross oversimplification.

Annual comparisons of rainfall show a difference of up to 50% (Fig. 5). Occasionally, consecutive years receive a similar amount of precipitation, but fluctuations can range from 1100 mm (1957) to 600 mm (1958). This again indicates that averages are misleading, as an expectation of 750 mm could be grossly misleading.

Since 1940, rainfall has declined significantly (Fig. 5). Interannual fluctuations tend to conceal this tendency. This raises two possibilities: the area is undergoing secular desiccation, or there are longterm cycles in the precipitation pattern. Ladurie (1971) showed that Europe underwent such cycles, which operated on timespans of a centry or more. However, it is also known that the Cape used to have a wetter climate (Van Zinderen Bakker 1969), which supports the thesis that the desiccation is part of a longterm process. However, the rate of the desiccation is so high that a longterm cycle hypothesis is preferred. This would indicate that average rainfall data are false, as they are influenced by past climatic conditions. Only a power curve fit could give a valid average.

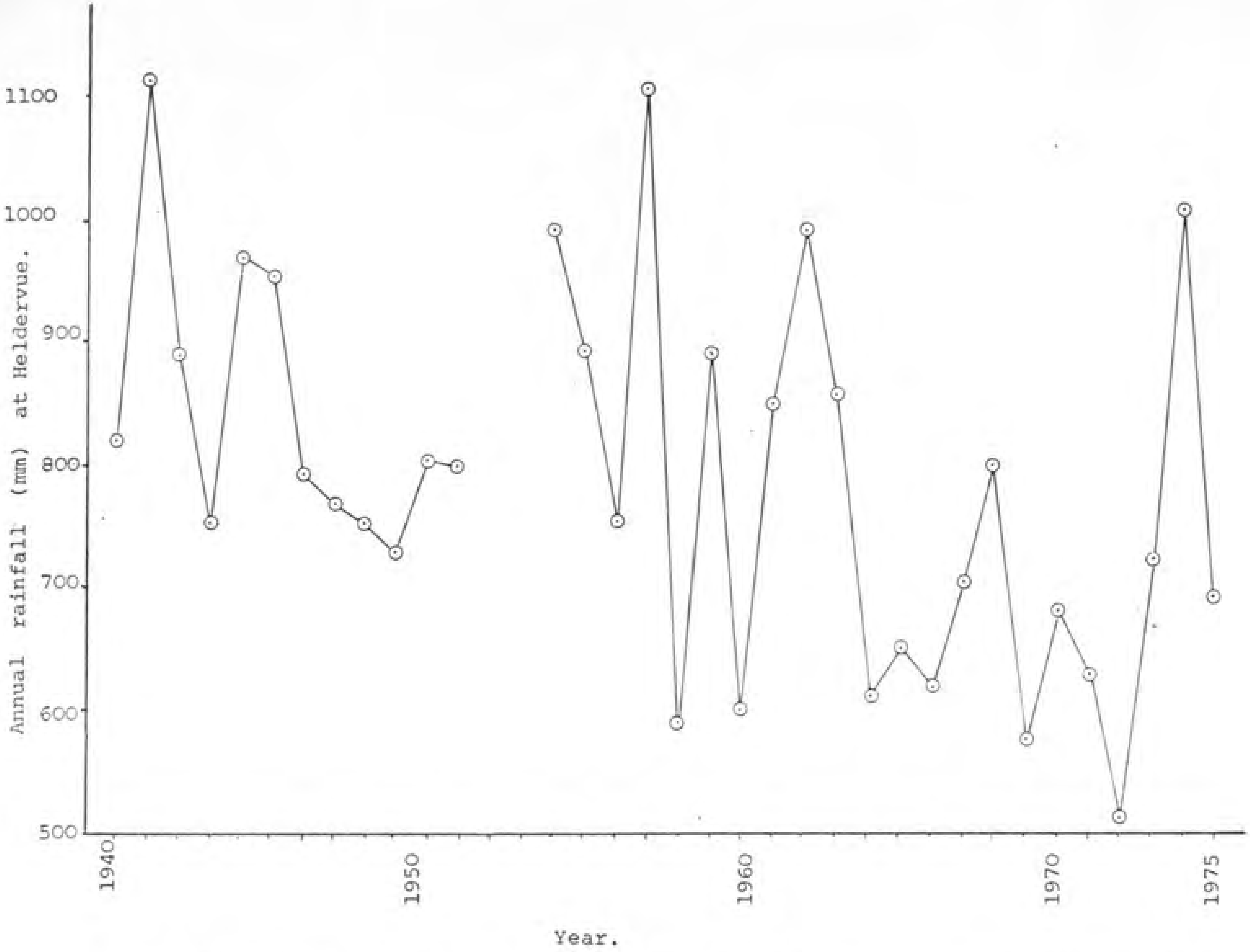


Fig. 5 Fluctuations in the total annual rainfall at Heldervue between 1940 and 1975.

Rainfall figures collected from farms at various localities on the mountain show significant differences. Farms on the northern escarpment (New Caledonia, 700 m, and Moutonsvlei, 500 m) have the highest rainfall. Farms on the central plateau have an intermediate rainfall (Koggelkop, 800 m, and Heldervue, 800 m), while farms on the eastern escarpment (Sandleegte, 800 m) have the lowest rainfall (Fig. 6). It must be noted that only the data from Heldervue are fully reliable, as the others were collected in a casual way. However, this could only result in an underestimation of the rainfall. There is, therefore, on the mountain a strong variation in rainfall, independent of altitude. This has also been noted for Cape Town (Knox, 1911).

It is likely that the area between Levant and Zebrakop receives a higher rainfall than the rest of the mountain. From the data in Table 1 it appears as though the plateau to the east of Levant receives 1,24 times more rain than Moutonsvlei. This data is likely to be an underestimation, as the gauge was at the lowest point of the plateau at the eastern base of Levant.

The topography of the area (it forms the highest ridge of the mountain, and is an extension of the N.W. escarpment) would also indicate a relatively high rainfall.

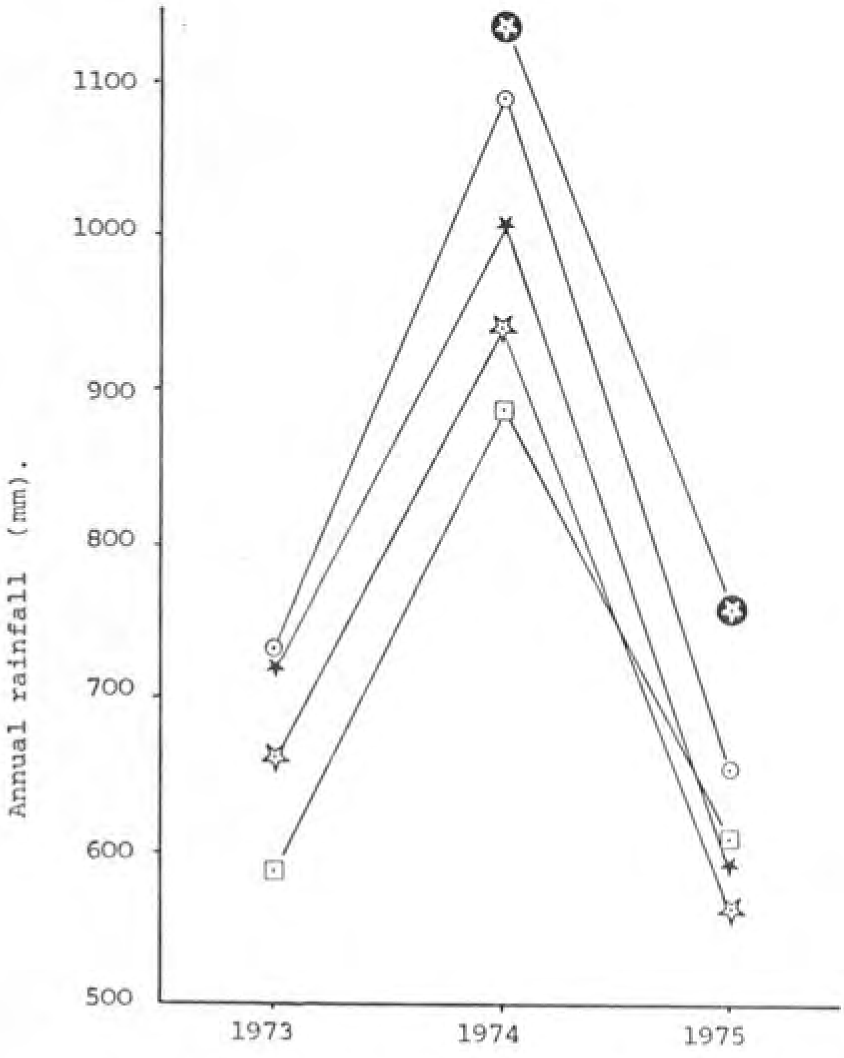


Fig. 6 Comparison of rainfall from various parts of the mountain.

○——○ Moutonsvlei
★——★ Koggelkop
□——□ Sandleegte
☆——☆ Heldervue
✪——✪ New Caledonia

Table 1: RAINFALL FOR MOUTONSVLEI AND AVONDTUUR FOR 1973.

Month	Moutonsvlei	Avondtuur
January	-	-
February	-	-
March	98	-
April	-	-
May	83	-
June	19	-
July	240	-
August	129	155
September	67	82
October	37	48
November	15	16
December	44	60

3. Temperature

Temperature data are only available for Heldervue, and that not for a sufficiently long period to detect longterm cycles.

The highest maximum temperature recorded was 38°C, with the hottest months being January and February. The lowest temperatures are recorded between June and August, when minima occasionally reach -6°C. Usually, the lowest temperatures are around zero (Fig. 7). Noteworthy is that the four summer months have a very similar temperature, and temperatures then drop very rapidly to the winter levels, where they stabilize for a few months before they rise just as rapidly to the summer levels. Periods of intermediate temperature are therefore rare.

Generally, snow occurs annually above 900 m, and can persist in patches for up to a week on Zebrakop (1500 m). This indicates that winter temperatures are substantially lower at higher altitudes. Performance of fruit trees requiring freezing temperatures varies at the same altitude over the mountain indicating that topography also plays a role in the determination of temperature. However, no recorded data are available to substantiate these observations.

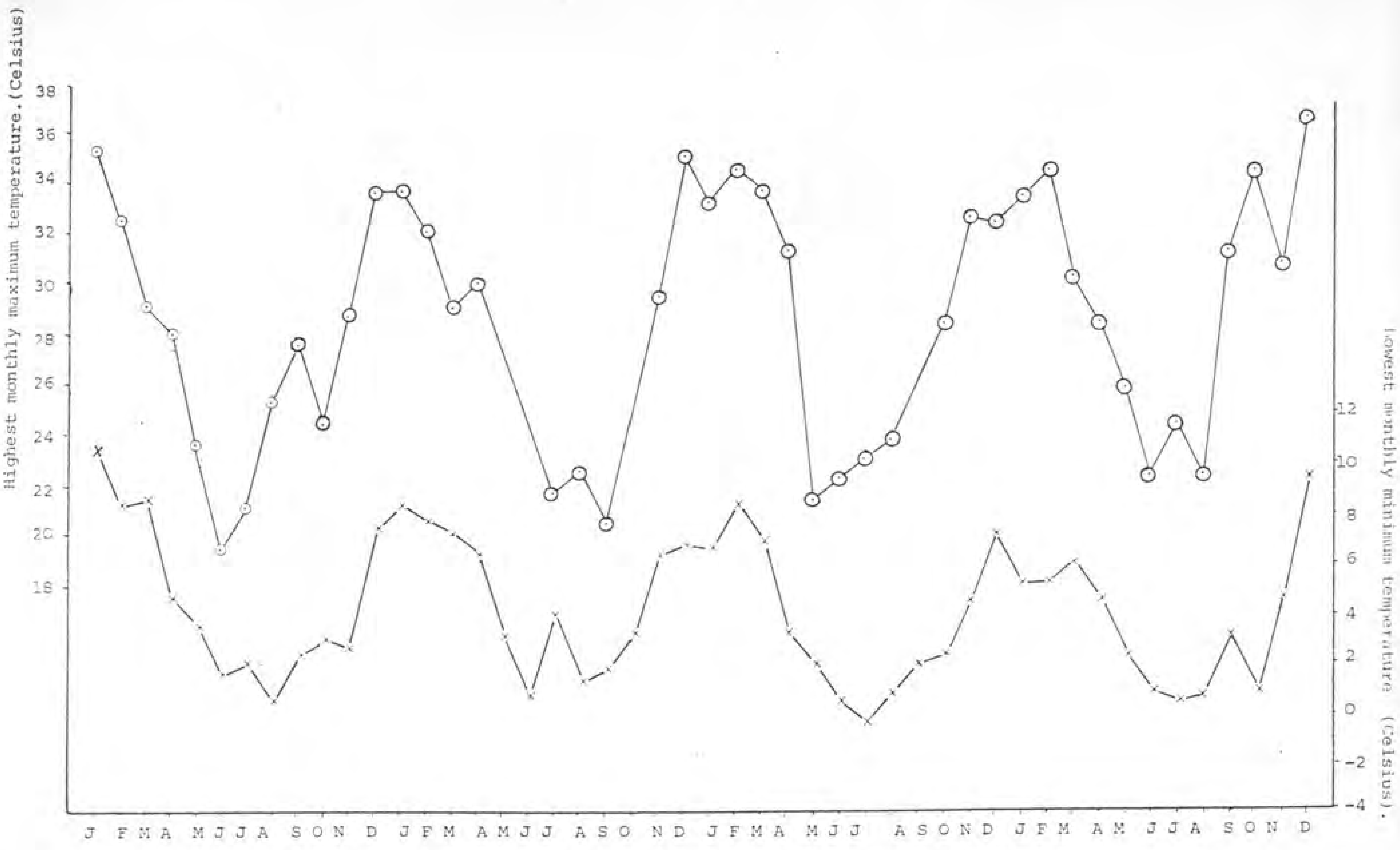


Fig. 7. Maximum and minimum temperatures between 1957 and 1960 at Heldervue.

O——O Maximum temperature.

X——X Minimum temperature.

Unfortunately, there are no data available for temperatures at the base of the mountain. Thunder and hail occur occasionally, but not on a regular annual basis.

4. Humidity:

Average monthly humidity figures have been calculated from readings taken at 1400 hours (Fig. 1). These range from 40% relative humidity in January to 70% in May. These averages have only been based on three years observations and might show abnormal irregularities.

Fog occurs throughout the year at Heldervue, with a very high rate of occurrence during winter (10 - 20 days per month). The plateau is generally above the base of the winter rainclouds. In summer, fog occurs on between two and ten days per month (Fig. 8). These figures are expected to be substantially higher at higher altitudes. Data has not been analysed for a sufficiently long enough period to calculate averages, but for the three years for which data is available, fot occurred on 27,5% of the days. It is not known how often the fog is associated with rain.

It has been demonstrated that fog can contribute significantly of the total precipitation (Marloth, 1903, 1905; Kerfoot, 1968), and this appears to be dependant on the

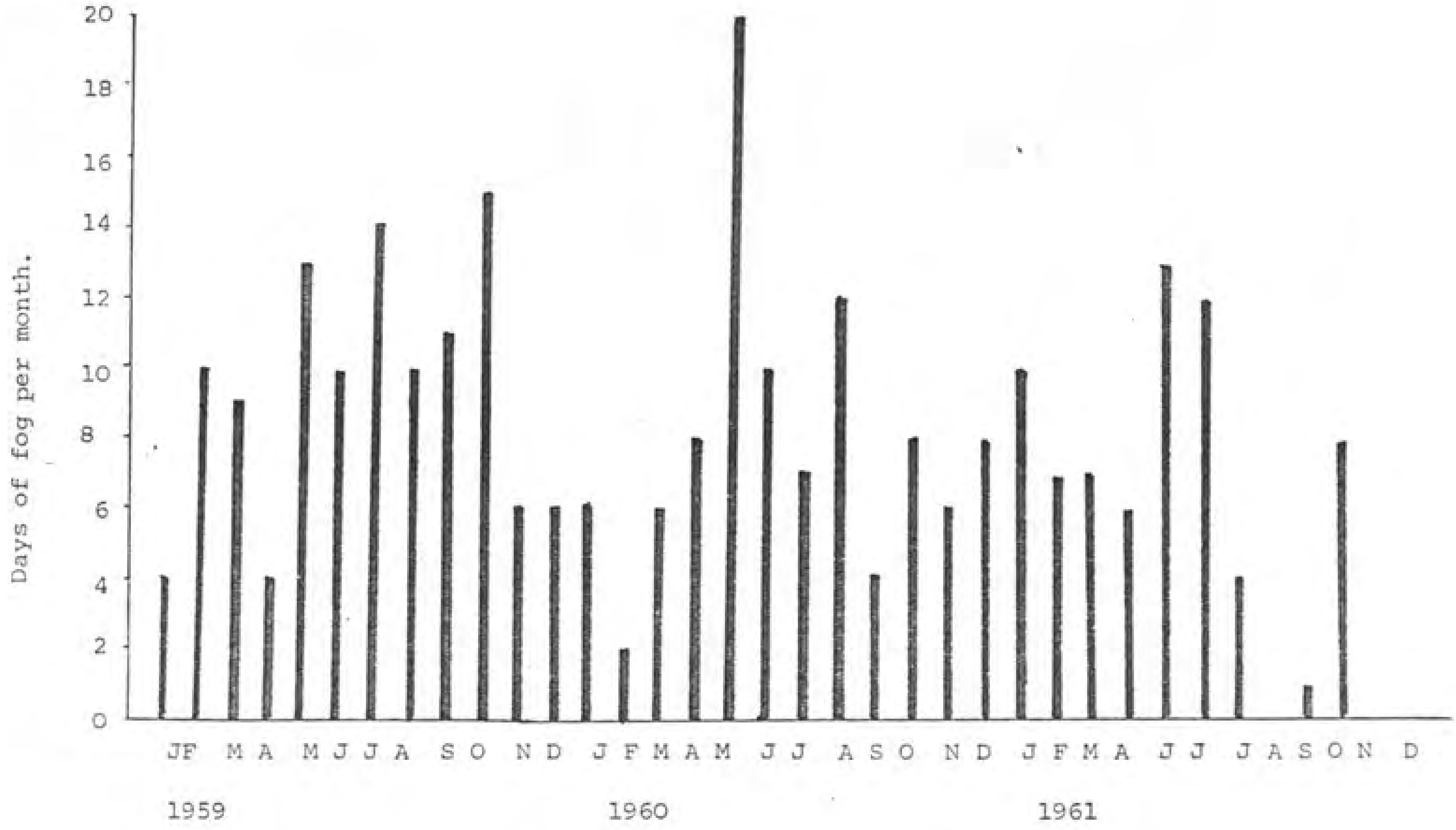


Fig. 8. Days of fog at Heldervue.

droplet size of the fog. However, no data is available on this.

5. Wind

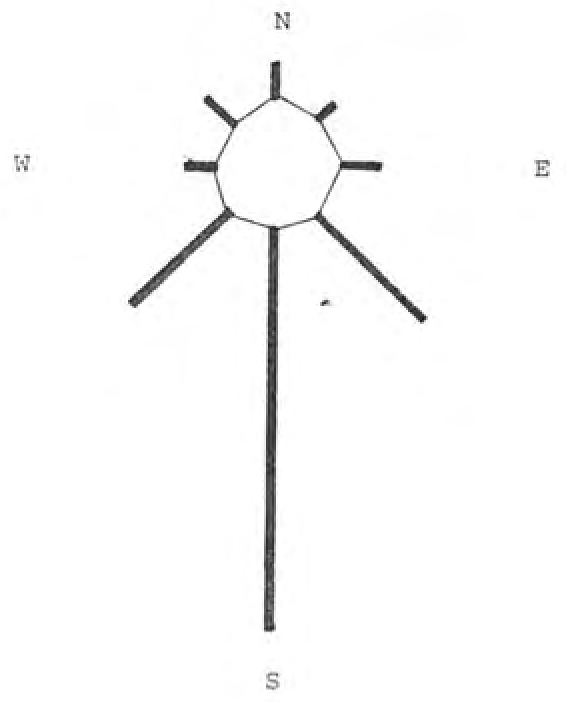
The two dominant winds are the northwest winds in winter, and the south winds in summer (Fig. 9). The wind data for one year are given in Table 2.

The northwest winds bring in the rain. The southerly winds occur throughout the year. In summer the south wind is the dominant wind, and in winter it is generally a bitter cold wind that induces snow-falls at higher altitudes. Easterly winds in summer are usually "bergwinds" (Knox, 1911) which are hot and dry.

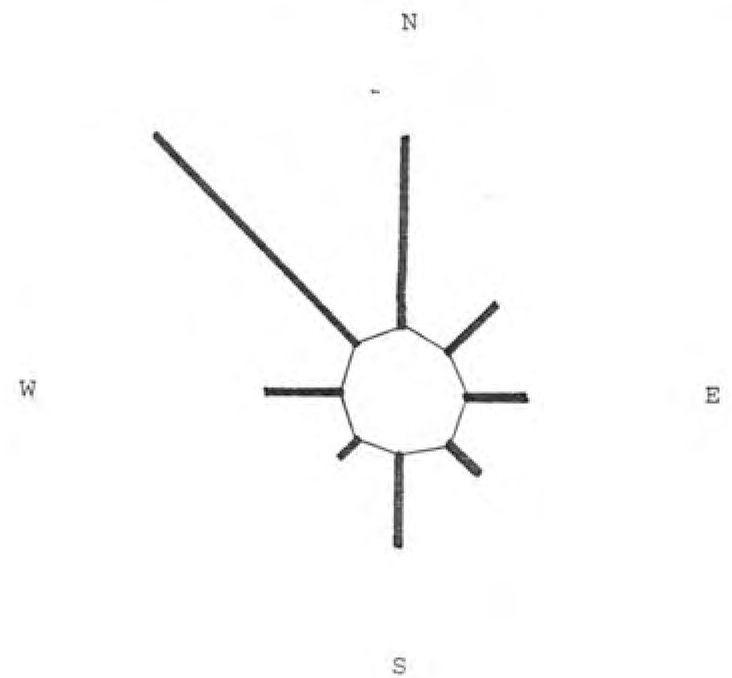
Even though no data are available for the windspeeds, these can be considerable, and have forced the planting of windbreaks to protect the orchards. Boucher (1972) recorded similar conditions from the Kogelberg.

6. Biological Significance

The biological significance of a particular climatic régime is usually assessed by placing the precipitation and the temperature on one graph (Di Castri, 1973). However, we have seen that precipitation averages for



January



June

Fig. 9 Windroses based on average wind directions for January and June.

Table 2: WIND DIRECTIONS AT HELDERVUE IN 1959.

Month	N	NE	E	SE	S	SW	W	NW	Calm
January	4	3	4	5	24	8	4	3	7
February	3	1	3	5	28	3	2	2	8
March	11	8	4	2	19	3	3	3	8
April	12	3	5	2	15	4	3	8	7
May	11	6	1	3	4	3	4	28	1
June	22	5	4	3	9	1	2	10	4
July	14	7	4	4	9	0	2	16	5
August	16	2	6	4	12	3	2	14	1
September	11	8	2	4	14	5	2	8	6
October	9	6	5	7	16	3	5	9	1
November	2	4	4	12	26	2	0	5	1
December	0	5	4	10	25	6	0	5	1

the Piketberg are very misleading. A similar state may exist for temperature averages. Such a climatograph could, therefore, be misleading.

To survive, plants have to be able to survive the harshest conditions which occur, even if these occur only rarely. Consequently, extremes are of more significance than averages. Di Castri (1973) noted that interannual variability of precipitation is probably the most critical factor in Mediterranean areas.

Rainfall on Piketberg is erratic, and the biologically significant figure is, therefore, the 500 mm rainfall which occurs occasionally. The erratic distribution of rainfall within the year further diminishes the value of the actual rainfall. Most of the rain falls in a short time, and is lost as runoff. However, this situation is ameliorated to an unknown extent by the frequent occurrence of fog, even in the summer months. Marloth (1903, 1905) postulated that this is a significant factor in determining the vegetation on the Cape mountains.

These two factors greatly complicate the precipitation parameter. Spatial distribution of precipitation régimes is further complicated by influence of the topography on the rainfall. A generalization could be made, and it could be said that the area between 500 and 1000 m has one régime, the area above 1000 m another, and the slopes below 600 m a third. Within each area a myriad of micropatterns probably exist, which affect the vegetation to a greater or a lesser extent.

METHODS

1. Sampling

Sampling the vegetation presented severe problems:

(a) The study area is very large, and includes rugged and inaccessible terrain.

(b) Three main vegetation types are involved: forest, montane fynbos and rhenosterveld.

(c) The fynbos especially shows a high B-diversity, and on the steeper rocky slopes no homogeneous communities exist.

(d) The vegetation on the whole is in various stages of a fire succession, so that the successional time factor plays a very important role. Determination of the age of the vegetation after the last burn was not always possible.

Under these circumstances, random sampling would have necessitated the collection of an impractical number of relevés (Whittaker, 1973). As each vegetation form had to be typified by a minimum number of samples, sample sites were selected subjectively after an exhaustive investigation of the area.

For types without clear margins (the majority of types), the vegetation was sampled using 10 x 5 m plots. This size was found to be optimal, as larger sizes frequently included much heterogeneous vegetation, and smaller sizes did not accurately reflect the vegetation at a broad scale. In clearly defined communities (such as scree forests of riverine vegetation) the largest homogeneous area was taken as a sample. Effectively, the whole community was thus treated as a plot. It was assumed that this compensated for the small number of samples which could be taken.

The vegetation was sampled using plots, as advocated by the Zürich - Montpellier School. This method was selected in preference to plotless sampling or line transects, (Shimwell, 1971; Kershaw, 1973) as it is much more versatile, and the most rapid method (Mueller-Dombois, 1974).

All vascular plants within the plots were recorded. In some cases, species had to be ignored because it was impossible to identify them. The importance and numbers of species within the plot was assessed on a scale modified from Braun-Blanquet (1932):

(+)	Present outside the plot.
+	0 - 1% of the area, plants few.
1	1 - 5% of the area, or more if there are a few large plants
2	5 - 12% of the area.
3	12 - 25% of the area.
4	25 - 50% of the area.
5	50 - 75% of the area.
6	75 - 100% of the area.

This scale was found to be more satisfactory, as the majority of the higher density species have cover of between 5% and 25%.

2. Classification of the Vegetation

The vegetation samples were grouped by tabular comparison methods (Mueller-Dombois, 1974; Shimwell, 1971). Werger et al (1972) showed that such methods are feasible in the Cape fynbos, despite the high floristic diversity. From the raw table, a partial table was produced. This was finally developed as a differential table. As so few relevés were available from each vegetation type, and the full variation of the type was not recorded, a Roman or constancy table was not produced.

From this data, plant communities were described, and were typified by the floristic composition. Particular attention was paid to the structural and taxonomic characteristics of the communities.

A very wide concept of the plant community was employed, so that continua due to environmental gradients within a vegetation form could be accommodated. The classification was based on the presumed mature stage, and various successional stages were all included within the community.

As it is premature to suggest a formal classification, the major groups were named after the characteristic or a faithful species, followed by a physiognomic epithet. Where these groups were subdivided, the sub-groups were named after a characteristic species, followed by the epithet "form".

3. <u>Soil Samples</u>

Soil samples were taken from most of the more representative plots. The samples were taken from the most typical part of the plot.

A hole was dug, either to the bedrock, or to 1 m deep. The depth of the horizons visible was measured, and described. Two 500 g samples were taken: one from the upper horizon (excluding litter and the aerial parts of plants), and one from the lower horizon. An attempt was made to include a proportionally representative collection of all size fractions.

In the laboratory, the samples were airdried. The fraction of organic material was analysed according to the method outlined by Etherington (1975). Samples were crushed to break up any aggregates and passed through a 2 mm sieve to exclude all litter and roots. Two 10 g samples were then fired at 650^{o}C for 5 or more hours, and reweighed. This method is preferred for its simplicity.

A mechanical analysis was performed by sieving the soil. Ideally, soils should first be fired to remove the organic material (Etherington, 1975), and treated chemically to break up the aggregates (Russel, 1973). However, the facilities and time were not available for these procedures. The samples were merely passed through a series of sieves ranging from a mesh diameter of 50,8 mm through 25,4; 9,52; 2,0; 0,42; 0,25 to 0,074 mm. Russel (1973) remarks that below 0,2 mm sieves become ineffective, and segregation is best carried out by the suspension of the samples in water, and by their differential sedimentation by gravity or centrifuging. The validity of this criticism was noticed with the fine clays, which tended to coagulate and block the pores of the finer sieves.

The segregate which passes through the 2 mm sieve is regarded as "fine soil" (Lyon, 1943), and was treated separately in the calculation of the percentage weight composition. The 2 - 9 mm segregate was treated as a separate group, as this contained most of the soil aggregates. The larger segregates contained the stones.

The determination of the soil reaction was basically as outlined by Etherington (1975): soil was passed through a 2 mm sieve to eliminate stones and litter. 4 g of soil was mixed with 10 ml of distilled water, shaken up, and the pH taken with a Beckman Chemate II pH meter. Two readings were taken from each sample.

Because of the small number of samples available from each vegetation type, no statistical analysis was undertaken. To achieve statistical validity in this study, many more samples will have to be taken into account for the full variability associated with each vegetation form.

CLASSIFICATION OF THE VEGETATION

The vegetation on the Piketberg ranges in structure from forests to heathlands. Floristically, the vegetation can be roughly classified into six groups. Some of these groups are well defined and homogeneous, others contain a wide range of variation, which can in some cases be described as sub-types. Due to insufficient data, no formal classification is proposed.

The vegetation other than the riverine and the forest forms generally has a three-layered structure in its mature form (Adamson, 1938). The main floristic groups in the vegetation can be correlated to the degree to which these various strata were developed.

1. Forest Vegetation

Forest vegetation ranges from 3 m tall scrub-forest on screes to 7 m tall cliff forests. Characteristic species are *Kiggelaria africana*, *Maytenus oleoides*, *M. acuminata* (a constant species), and *Olea africana.* The first three species are faithful to the forest forms. Elements of the Proteaceae, Ericaceae and Restionaceae are typically absent.

1.1 Scree Forest Form:

These scrub forests are found on nearly all scree slopes and on rocky outcrops. They are always associated with huge boulders, and also occur in Jonkershoek (Werger et al, 1972), and at Cape Hangklip (Boucher, 1972). The species composition changes from area to area, but the habitat and structure remain the same. Campbell and Moll (1976) noted that the scree forests of Table Mountain were dominated by Maurocenia frangularia and Olea africana. They suggested that Heeria argentea was eliminated by the higher moisture levels. This appears to be substantiated by the absence of Heeria argentea from scree slopes on the S.E. slopes of Zebrakop (Relevé 14).

Characteristic species are Heeria argentea (the dominant species), Aloe glauca and Adiantum nigrum. The fern flora of this form is very rich, and the moss cover on the boulders high. Othonna lingua and Lampranthus piquetbergensis are frequently associated with these forests.

The soil was sampled at relevé 10. The A-horizon had 24% organics, and a pH of 5,9. The B-horizon, with 12,6% organics, had a pH of 4,5. Boucher (1972) noted that the scree forests showed strong coppicing after a fierce fire. Even though the scree forests are not associated with surface water, the boulders probably assist in keeping the substrate moist.

1.2 Cliff Forest Form:

The cliff forests usually form 5 - 7 m tall stands, with the lower branches clear of the ground. As in the scree forests, the herbaceous layer is virtually absent. Only two patches of cliff forests are known: at Stalkrans and on the S.W. slopes of Zebrakop.

Characteristic species are Podocarpus elongatus (dominant), Halleria lucida, Hartogia capensis and Ilex mitis (rare but faithful). The margins of the forests are formed by Olea africana, Podocarpus elongatus, and if there is surface water, Empleuron semilatum.

The soils were studied at the Stalkrans locality: the A-horizon had 9% organic material, pH 5,1; the B-horizon had 7% organics, was paler, and had a pH of 5,0. There was a 2 cm litter layer. The soil was deeper than 1,5 m. Both patches are moist, and are on the S.E. side of cliffs. The margins are closed.

1.3 Podocarpus Scree Forest Form:

Three patches of Podocarpus elongatus occur at 1000 m on the hill south of Zebrakop. These patches cannot be related either to typical scree forests, or to cliff forests, and they do not have any faithful species.

Characteristic of this vegetation is the dominance of Podocarpus elongatus, with the absence of Heeria argentea, Hartoghia capensis and Halleria lucida. There is also an absence of young P. elongatus plants.

A soil sample was studied from relevé 34. The high clay content and the high pH make this soil unique comparative to the rest of the forest forms (Fig. 10). The habitat is characterised by huge boulders. Isolated P. elongatus trees also occur at similar altitudes (1000 - 1200 m) in deep gullies or among boulders.

2. Riverine Vegetation

The riverine vegetation occurs in narrow strips along the permanent and semi-permanent streams. It is very distinctive, and clearly separated from the other vegetation forms. In structure it ranges from a low forest to a low dense bush.

Characteristic species are Cunonia capensis, Brachylaena neriifolia, Metrosideros angustifolia and Leptocarpus paniculatus. The last three species are faithful. There are no constant species. Werger et al (1972) and Boucher (1972) noted the association of the last three species with riverine or swamp conditions.

The species composition of the vegetation appears to be determined by the size and periodicity of the stream. Empleuron semilatum, Cunonia capensis, Blechnum capense, Brabeium stellatifoliu, Erica caffra and Osmunda regalis are associated with permanent water. Elegia capensis, *Leptocarpus paniculatus*, *Rubus fruticosus* and *Rhus angustifolia* can survive some desiccation, and are more often found in swampy conditions.

The structure of the vegetation appears to be governed by the topography. If the flanks of the stream are protected by steep slopes or cliffs, *Cunonia capensis*, *M. angustifolia* and *B. stellatifolium* can develop into small trees, forming a low forest. Werger et al (1972) also noted this dependancy on the topography in Jonkershoek.

As no clear boundaries between the various structural and floristic forms can be laid down, no attempt is made to subdivide the riverine vegetation into subtypes. It is best regarded as a continuum along a moisture gradient.

3. *Protea Laurifolia Scrub*

This is the most common type of fynbos, and contains a complex of forms and successional stages. In the mature stage, the three layers described by Adamson (1938) are fully developed. At present, this vegetation type is a complex of various successional stages.

Characteristic species are *Protea laurifolia* and *Restio*

Table 3. Differential Table for the Forest and Riverine Vegetation Forms.

Releve number		8	10	14	34	10b	11	12	16	1	2	6
Soil pH, horizon	A				6,9	5,9			5,5			
	B				6,4	4,5						
Stone content	A				15	0			34%			
	B				0	0%						
Clay content	A				17				8%			
	B				20	10%						
Organics	A				9	24,3			7%			
	B				3	13%						
Altitude		800	800	800	1100	800	800	800	800	600	600	800m
Forests												
Kiggelaria africana		3		3	2	2	3	2	1			
Maytenus acuminatus		1	1	3	+	2	3	5				
Maytenus oleoides		3	1	2		2	2	+				
Olea africana		3	+	+	2	2		1				
[illegible] forests												
Adiantum nigrum		+	+	+								
Aloe glauca		+	+									
Searia argentea		5	6			2						
Pellaea pteroides		+	+						+			
Asparagus retroflora		1	1		1		1					
Adiantum sp.		+										
Cynanchum sp.		+										
Colpoon compressum			+									
Ceterach cordatum			+									
Zantedeschia aethiopica			+		+							
Knowltonia capensis				+	+							
Cliff forests. Podocarp scree forest												
Curtisia capensis			1			3	4	2				
Podocarpus elongatus					6	5	5	1				
Halleria lucida				1		1	2	2	+			
Ilex mitis							2	+				
Blechnum undulatum							1	+				
Cunonia capensis							5	5	4	2	1	
Riverine vegetation												
Brachylaena neriifolia									4	2	2	

Table continued.

Releve number	8	10	14	34	10b	11	12	16	1	2	6
Todea barbara								+	1		+
Diplcuron cemilatum								3			
Blechnum capense								1			
Asparagus aethiopicus								+			
Pteridium aquilinum									+	1	2
Metrosideros angustifolius									4	5	3
Leptocarpus paniculatus									+	2	+
Blechnum punctulatum									1		
Osmunda regalis									+		
Pellaea hastata									+		
Asplenium aethiopicum									+		
Erica caffra									1		
Brabeium stellatifolium									3		
Juncus lomatophyllum									1		
Elegia capensis										2	
Blechnum attenuatum										+	
Psoralea pinnata										1	
Stoebe plumosa										2	1
Muraltia heisteriana											+
Anthospermum aethiopicum											2
Indigofera fruticosa											+
Erica curviflora											+
Rubus fruticosa											+
Rhus rosmarinifolia											+
Rhus tomentosa											1
Psoralea aphylla											1
Salvia aurea											+
Asparagus scandens	+					+	+	+	+	+	
Rhus mucronata			1		+						

gaudichaudianus. The former is probably constant in all mature forms. Willdenowia arescens, though uncommon, might be shown by a more detailed survey to be nearly constant.

A attempt was made to subdivide this form, but the groups should be regarded as noda, rather than as discrete communities. This type is to some degree comparable to the two Protea neriifolia communities in Jonkershoek (Werger et al, 1972).

3.1 Protea laurifolia - Stoebe plumosa Form:

Protea laurifolia forms the upper layer in this form (1,5 - 3 m tall). Characteristically, the middle layer is formed by woody shrubs, mainly composites and Cliffortia. The lower layer usually consists of Restionaceae and Cyperaceae.

Characteristic species are Metalasia muricata, Helipterum canescens, Stoebe plumosa and Cliffortia ruscifolia (the last two are constant species). Species such as Willdenowia arescens, Protea repens, Phylica villosa, P. cylindrica, P. stipularis, and numerous geophytes often occur. It is possible that this type could be subdivided into numerous facies. For example, Leucospermum calligerum would separate off that facies found on Langberg and in Kafferskloof, and _Chondropetalum macrocarpum_ the facies from the south end of the mountain to Kleinbegin and Mőreson.

This form is typically found on gentle to medium sloping slopes, irrespective of aspect. Soil pH varies from 5 - 6, organics from 3 - 6%. The soils are generally shallow (A-horizon 0,1 - 0,3 m). The B-horizon is usually 70% or more stone. This form is found on altitudes between 500 and 700 m.

The _Leucadendron rubrum_ form appears to be a precursor to the _Stoebe plumosa_ form. This form lacks the upper stratum, and the middle stratum is strongly dominated by _L. rubrum_ (0,5 - 2 m tall). The lower stratum is variable. Only _L. rubrum_ is characteristic of this form, and is constant but not faithful. Juvenile plants of _P. laurifolia_ usually occur. Species like _Metalasia muricata_ and _Helipterum canescens_ are typically absent. _Stoebe plumosa_ and _Cliffortia ruscifolia_ occur in some relevés, but are absent in others. Habitat conditions are basically similar to that of the mature form: pH ranging from 5,5 to 6,6; soil organic content from 3 - 7%, and clay fraction from 6 to 13% of the soil. This form is found on all aspects. It is not known whether succession can be arrested at this stage. Certainly no community has been found that is older than six years, and all communities have some _P. laurifolia_ juveniles.

Senescent Protea laurifolia scrub is represented by relevés 44 and 43. In this form the middle stratum has become lank and senescent, although P. laurifolia plants (15 - 20 years old by bud counts) still appear viable. This form differs from the mature P. laurifolia scrub by the absence of Metalasia muricata and Helipterum canescens. The soil and habitat conditions appear to be similar to that of mature bush, although organic content and pH are somewhat lower. The variation in this group is not known, due to the relative scarcity of senescent bush.

3.2 Protea laurifolia - Restio sieberi Form:

The upper and basal strata of this type are the same as for 3.1, but the middle stratum is composed mainly of Restionaceae, such as Willdenowia arescens and Chondropetalum macrocarpum. Characteristic species of this from are Willdenowia arescens, Restio sieberi and Chrondropetalum macrocarpum. The first two are constant species, but none are faithful. Characteristic is also the absence of a shrubby middle stratum. Phylica villosa and Protea repens are often associated with this form. This form appears to centre itself in deeper sand than the shrubby form. The pH varies from 5,5 to 6,0, and the organic content of the soil from 2,5 to 3%. The A-horizon is usually of pure sand, without any stones. These conditions occur in hollows, as opposed to the shallow soiled slopes (Fig. 11).

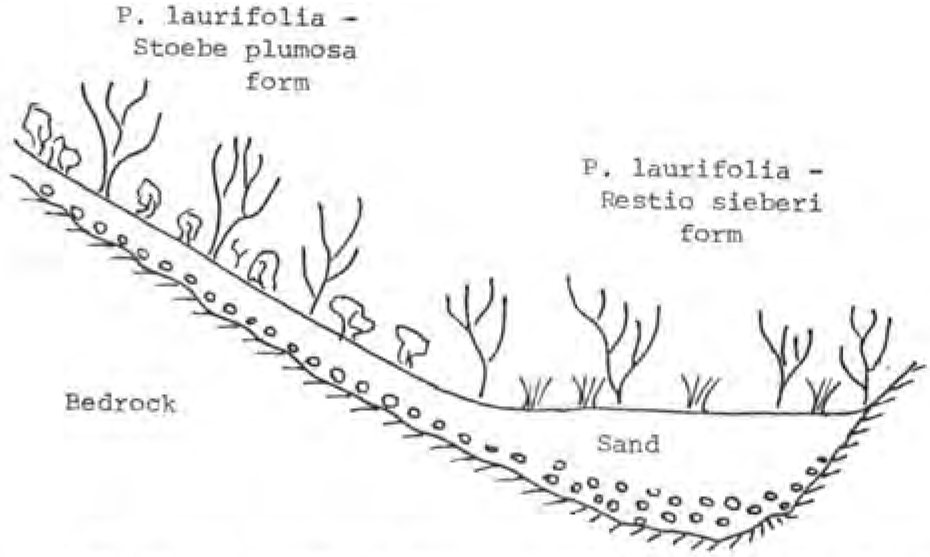


Fig. 11: Schematic Profile Diagram of the edaphic differences between the two forms of P. laurifolia scrub.

4. Leucadendron salignum - Erica parilis Scrub

This vegetation lacks an upper stratum, and the lower stratum is very well developed. It is found in a variety of habitats - high altitudes, deep sand or on slipes with mispah soils. Characteristic species are Leucadendron salignum (constant), Elytropappus scaber (constant) and Erica parilis (faithful). Characteristic is the absence of Protea laurifolia, Phylica villosa and Leucadendron rubrum. The vegetation type is probably comparable to the high altitude restioid, short shrub communities in Jonkershoek (Werger et al. 1972). This broad form can be subdivided into three subtypes: apparently separated by edaphic factors (Fig. 10).

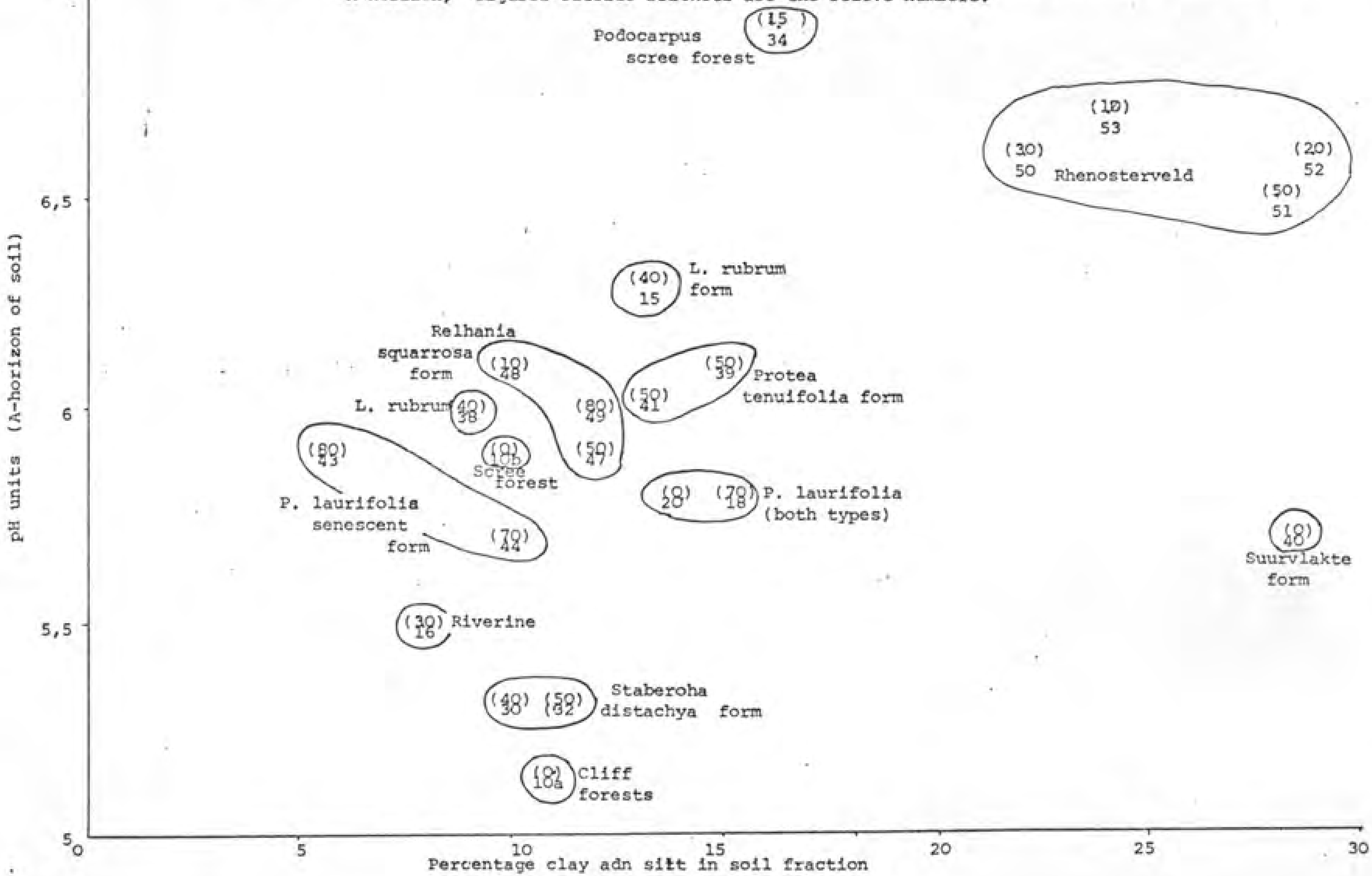
4.1 Protea tenuifolia - Serruria aitonii Form:

This short (up to 0,5 m) and shrubby form which has a fairly high total cover (75 - 85%) and no distinct lower and middle layers is clearly defined. It was found on Langberg and to the east of the top of the Versveld Pass. Characteristic species are Protea tenuifolia (constant and faithful), and Serruria aitonii and Tetraria ustulata (constant). This form apparently occurs on shallow rocky soils (Glenrosa or Mispah forms). The pH for both horizons is high. The organic content is also high. The A-horizon contains about 50% stone, and the B-horizon 80 - 90% stone. The clay fraction of the soils is somewhat higher than usual. Edaphically, therefore, this form is thus distinct (Fig. 10).

4.2 Staberoha distachya Form:

In this form, both the basal stratum and the middle stratum are well developed. The vegetation is 0,5 m tall, and presents a smooth cover. Total cover is between 60 and 80%. This form occurs at an altitude of 100 m. Characteristic species are Staberoha distachya

Fig. 10. Scatter diagram of soil conditions. Figures in brackets are the percentage stone in the A-horizon, figures outside brackets are the releve numbers.



(constant and faithful) and Restio

The high density of Restionaceae make this form distinct. The pH of the soils is lower than usual (5,3). The soils are stony, the B-horizon being 90% rock. The soils could be described as being Glenrosa. This form occurs on both south and north aspects, on gentle to medium slopes.

4.3 Suurvlakte Form:

This form is variable in its species composition, and is best defined by the absence of shrubby composites. It has a strong ericoid-restioid nature. The strata are very indistinct, and the vegetation is about 0,5 m tall. There are no differential species which could define this form. It is characterised by the absence of Staberoha distachya and Erica parilis. This form, which could probably be subdivided if more data were available, is found on deep sand that often has a clay layer in the B-horizon. Under these conditions the soil is waterlogged in winter and dry in summer.

5. Relhania squarrosa Dry Fynbos

This vegetation form is found on the slopes of the mountain, between 300 and 600 m. Although all three strata are represented, the middle stratum is higher than usual (1 - 2 m), and is well developed. The upper stratum has a low total cover. Compositae form the bulk of the species, with the Restionaceae, Proteaeceae and Ericaceae being rare or absent. This form could also be described as "dry fynbos".

Characteristic species are Euryops speciosissimus, Passerina glomerata (constant), Relhania squarrosa (faithful and constant), Elytropappus rhinocerotis and Protea laurifolia.

Edaphic factors vary only slightly (Fig. 10), and all the relevés were taken down a spur with the same eastern aspect, and the same drainage patterns. The relevés can, therefore, be regarded as a simple altitudinal gradient.

This form albeit distinct, is best understood as a continuum, which has a nodum (relevés 48 and 47). Some species invade from the Protea laurifolia scrub (Table 4, group 1), other from the rhenosterveld on Malmesbury shale at the base of the mountain. (Table 4, group 3).

6. Rhenoster Veld

This vegetation has only two strata, of which the middle stratum is the best developed. Alpha diversity in this

Table 4. Analysis of the <u>Relhania squarrosa</u> dry fynbos.

Releve number		45	48	47	46	49	
pH Horizon	A	6,1	6,3	5,8	6,2	6,0	
	B	6,0	5,9	5,3		5,7	
Clay & silt	A	9,9	13,5	11,9		12,3%	
	B	10,3	14,2	7,6		16,2%	
Stone	A	14	50	50		80%	
	B	0	70	80		60%	
Altitude		600	500	450	450	300 m	
Slope		Med.	Steep	Steep	Steep	Med.	
Protea laurifolia		4	2	+		(+)	Group 1. Species common in Protea laurifolia scrub.
Willdenowia arescens		(+)	1		+		
Restio gaudichaudianus			2	3	+		
Cliffortia ruscifolia		1			+		
Serruria aitonii		(+)	(+)				
Metalasia muricata		1	(+)				
Protea repens		2					
Leucadendron rubrum		1					
Athanasia trifurcata		1					
Chondropetalum macrocarp.		3					
Phylica villosa		1					
Rhus rosmarinifolia		1					
Agathosma latipetala		1					
Agathosma bisulca		(+)					
Phylica cylindrica		+					
Cliffortia tuberculata		(+)					
Euryops speciosissimum		+	2	3	2	+	Group 2. Species faithful to the slopes.
Passerina glomerata		+	3	5	(+)	1	
Relhania squarrosa			1	1	2	1	
Elytropappus rhinocerotis			1	2	4	1	Group 3. Species common in rhenosterveld.
Eriocephalus capitatus			1	1	2	2	
Rhus incisa						2	
Asparagus thunbergianus		(+)		+	1	1	
Felicia hyssoptifolia			(+)	1	(+)	+	Group 4. Widespread species.
Protea arborea			(+)	+			
Dodonaea thunbergiana			(+)	+			
Phylica oleafolium			1			2	

stratum is very low, although it is high for annuals and geophytes. This vegetation is noted for its near absence of Proteaceae, Restionaceae and Ericaceae. It is very uniform over large areas, and can be described as primary rhenosterveld.

Characteristic species are Euryops thunbergianus (constant and faithful) and Merxmuellera sp. Elytropappus rhinocerotis, Asparagus thunbergianus and Euryops speciosissimus are characteristic, but widespread.

This vegetation form is restricted to Malmesbury shales, and changes immediately to dry fynbos if the soil changes to Table Mountain Sandstone. These shale-derived soils are noted for their high pH and clay contents (Fig. 10). Rhenosterveld occurs on shale-soils up to an altitude of 600 m (the upper limit of the shale-soils - fynbos is never found on shales on the Piketberg).

Generally, E. rhinocerotis has 80 - 90% cover in the rhenosterveld. But patches occur where the species is entirely absent, and E. thunbergianus and Merxmuellera share dominance.

DISCUSSION

1. Nature of Vegetation Units

The vegetation found at any particular spot is determined by three factors:

(a) Evolutionary past, which determines what species are available in the area.

(b) Environmental conditions, which determine which of the available species can survive in that particular habitat, and

(c) Ecological time, which is the successional stage in which the vegetation is at that particular time.

This implies that species are distributed individually, and do not form closed communities. As the first factor can be assumed not to play a part within the Piketberg area, patterning of the vegetation should be explainable by the environmental conditions (spatial patterns) and the ecological time (temporal patterns). Mapping of mature vegetation should give the same results as mapping the environmental conditions. Therefore, plant "communities" would result from fairly uniform conditions, and vegetation "continua" should be related to environmental gradients.

This has been borne out by the Piketberg vegetation. Within the broad climatic régime on the plateau, on certain soils, the broad Protea laurifolia vegetation form can be distinguished. Within this community, complex temporal and spatial micro-patterning can be discerned. The complexity of the micropatterning is probably due to the fact that several environmental parameters of equal importance fluctuate independantly of one another.

In areas where one parameter changes so dramatically that it overrides fluctuations in the other parameters, continua exist in the vegetation (for example, the riverine vegetation and the mountain slope vegetation). Ashton (1976) found a similar situation on the slopes of Mount Piper in Australia. Species have been shown to be distributed individually down such a simple gradient (Whittaker, 1973, 1970, 1965).

Where one parameter is very different from the normal, and does not grade into another state, clearly defined vegetation units result. Examples of this type of vegetation unit would be the scree scrub forests and the cliff forests.

From this it is then clear that the individualistic species concept of Gleason (1926) is logically valid. However, in practice vegetation units can be discerned (Greig-Smith, 1964; McIntosh, 1967). On the Piketberg although vegetation units are described, continua and gradients within these units have been recognised.

2. Environmental Parameters

(a) EDAPHIC FACTORS:

Edaphic conditions have been found to be important in determining the vegetation in the Cape (Taylor, 1969; Boucher, 1972). Except for the rhenosterveld, which occurs on Malmesbury shale, all the vegetation types on Piketberg are found on soils derived from Table Mountain Sandstone.

A scatterdiagram of the most important edaphic parameters (pH, stone and clay content) revealed that there is a relationship between the edaphic factors and the vegetation forms (Fig. 10).

The rhenosterveld is very distinct from the rest of the vegetation forms. Edaphically, it separates out mainly by its high pH and clay content. Levyns (1956) noted that E. rhinocerotis prefers fine-grained soils. Thoday (1925) noted that in the Bokkeveld series, fynbos occurred on the Table Mountain Sandstone ledges, and that Passerina glomerata and Elytropappus rhinocerotis were complementary.

Protea laurifolia shrub.																																
Willdenowia arescens	+				+		6	1	2	4	2	2	2	(+)	2	3		1		2					+		1					
Restio gaudichaudianus									1	+		+	1		2	1	1	1			1	1			+	3	2					
Protea laurifolia										5	5	4	+	4	4	4	4	3	5	2	4		3	1		+	2	(+)				
Restio sieberi form.																																
Restio sieberi							+	1		1	4	4	1		2		2				1											
Chondropetalum macrocarpum								(+)	4	3		3	3	3	+																	
Protea repens												2	3	2			3		1	1			+	+								
Stoebe plumosa form.																																
Metalasia muricata												+		1	2	3	2						1				(+)					
Helichrysum canescens							(+)							+	+	+																
Stoebe plumosa												1		1	3	3	2	2	+	3	3	2	1									
Cliffortia ruscifolia			1		1								+	1	3	1	2	2	+	3	3	2			+							
Phylica villosa												1	1	1	2		1	+	+				+									
Leucadendron rubrum									(+)				2	1	+					6	5	2	2	5								
Bolhania squarrosa dry fynbos.																																
Bolhania squarrosa																									2	1	1	1				
Passerina glomerata													+	+											(+)	5	3	1	+			
Felicia																									(+)	1	(+)	+	1			
Protea arborea																									+	+	(+)					
Rhenosterveld.																																
Euryops thunbergianus																													1	3	1	4
Kernmüllera																														(+)	+	4
Rhus incisa																												2	(+)	(+)	+	
Tetraria ustulata	2			(+)	2	+	2	(+)	1	+	2	+			+																	
Rhus rosmarinifolia					+		+	1	1	+	2	1	1	1	+	1		+						1								
Anthospermum aethiopicum						+		+	1	1		1				1	+	+			+	1		+	+	2	+	(+)		(+)	+	
Cliffortia tuberculata		+		+	+					1		1		(+)			2		1	(+)												
Restio cuspidata		+	+				+	2			1													1								
Ficinia scariosa				1					(+)								+	+														
Phylica cylindrica						1		1	2		1		1	+										1								
Brunia nodiflora					(+)		(+)																1									
Ursinia pinnata												1		+																		
Hypodiscus binatus											3	+		1		1																
Cliffortia polygonifolia													1																			
Athanasia crithmifolia													+																			
Athanasia trifurcata							+	(+)				+	+	+										+								
Muraltia heisteriana						+																	2									
Leucospermum vestitum					(+)																		1	+								
Phylica stipularis																			+	+		1										
Leucospermum calligerum																			3					1								
Erica imbricata																	2															
Diospyros glabra																						1										
Anthospermum ecklonii																								+								
Agathosma latifolia																								1								
Euryops speciosissimus														+	1										3	3	2	+		1	(+)	(+)
Asparagus thunbergianus														(+)											1	+		1		+	+	1
Elytropappus rhinocerotis																									4	2	1	1	3	3	5	
Eriocephalus africanus																									2	1	1	2	1	2		
Mohria caffra																									1	+	+	+	1	+	(+)	
Dodonaea thunbergianus																										+	(+)			+		
Clutia alaternoides																										+	(+)				+	
Ceterach cordatum																											+					
Rhus glauca																									(+)							
Polygala bracteata																												+				
Sinocheilus																												1				
Rhus dissecta																												+				
Aspalathus acuminatus																																2
Euphorbia mauritanica																												1	2			
Euphorbia selenifolia																													+			
Olea africana																														+		
Sutera aethiopicum																									1	(+)				(+)	(+)	(+)
Phylica oleafolium																											1	2				

Table 5 Differential table for all releves except Forest and Riverine.

Releve number	40	31	32	30	39	41	28	27	25	20	23	21	26	45	18	9	19	44	43	15	17	5	42	38	46	47	48	49	50	53	52	[illegible]
Soil pH, horizon A	5,7		5,3	5,3	6,1	6,0				5,8				6,1	5,8			5,7		6,3				6,0	6,2	5,8	6,3	6,0	6,7	6,6	6,6	[illegible]
B	5,5		5,5	5,4	6,0	5,8				5,?				6,0				5,7	5,9	6,6				6,2		5,3	5,9	5,7	5,9	6,2	6,5	[illegible]
Stones, A			50	40	45	50				0				14	73			67	83	40				40		51	14	77	10	26	23	[illegible]
B	0		60	90	90	83				63				0	100			95	65	66				89		80	68	64	36	43	15	[illegible]
Clay & Silt A			11	10	15	13				14				10	15			10	5	13				8		12	10	12	24	22	43	[illegible]
B			7	15	14	14				7				10				12	8	9				7		8	14	16	24	40	37	[illegible]
Organics A	1,4		3,4	3,1	5,6	5,5				2,6				2,6	3,9			3,9		3,9				4,0	3,1	6,4	2,6	6,8	4,1	5,9	4,9	[illegible]
B	2,3		3,7	3,2	8,4	9,9				2,5				3,1				3,4	2,2	3,3				5,7		6,7	4,2	9,3	2,9	4,7	4,5	[illegible]
Altitude	800	900	900	900	800	800	600	600	600	600	600	500	650	650	500	700	500	750	700	800	600	800	800	800	450	450	500	300	300	450	400	[illegible]
Leucadendron salignum - Erica parilis																																
Elytropappus scaber	1	1	+	3	1	1	1	(+)	2	1	1	+	1				1	1														
Leucadendron salignum	1	1	1	2	3	+	3	3	2	2	1		1		+					1		3										
Erica parilis		(+)	1	1	2	+	1	2	2																							
Restio	2	+	2	3	2	1																										
Suurvlakte form.																																
Erica sp. (667)	1																															
	1																															
Staberoah distachy form.																																
Restio		2	1	+																												
Staberoah distachya		2	+	+																												
Diosma hirsuta		+		+																												
Protea tenuifolia form.																																
Protea tenuifolia					1	+	+	+																								
Serruria aitonii					1	3	3	(+)		1	+	+		(+)		+						1		1								
Protea acaulis	+		1						1																							
Aulax capitata					(+)			(+)																								
Macrostylis decipiens				+					(+)																							
Protea laurifolia shrub.																																
Willdenowia arescens	+				+		6	1	2	4	2	2	2	(+)	2	3		1		2					+		1					
Restio gaudichaudianus									1	+		+	1		2	1	1	1			1	1			+	3	2					
Protea laurifolia										5	5	4	+	4	4	4	4	3	5	2	4		3	1		+	2	(+)				
Restio sieberi form.																																
Restio sieberi							+	1		1	4	4	1		2		2				1											
Chondropetalum macrocarpum								(+)	4	3		3	3	3	+																	
Protea repens												2	3	2			3		1	1			+	+								
Stoebe plumosa form.																																
Metalasia muricata												+		1	2	3	2						1				(+)					
Helichrysum canescens							(+)							+	+	+																

This hypothesis is clearly supported on the Piketberg - the two vegetation forms are separated only by the change from Malmesbury shale to Table Mountain Sandstone. There is no support for the theory that the dry funbos to rhenosterveld change is related to a moisure gradient as postulated by Levyns (1950). Pure rhenosterveld on shale occurs at 500 m, while fynbos on sandstone occurs at 300 m, on slopes with the same aspect.

The different forest types are clearly separated on edaphic factors. Cliff forests have a very low pH, and the _Podocarpus_ scree forest has a high pH. Scree forests and riparian forests are intermediate.

The bulk of the soil samples do not show much variation, and the various forms of _Protea laurifolia_ shrub, the _Relhania squarrosa_ dry fynbos and the _Protea tenuifolia_ - _Serruria aitonii_ form grow on soils with similar A-horizons. The restioid short vegetation (_Staberoha distachya_ and suurvlakte forms) are separated by harsher conditions (low pH and a clay B-horizon).

The correlation between soil and vegetation is, therefore, strong. However, many more samples would be needed to verify this correlation. Parameters like soil depth and drainage might also reveal correlations. From the data it cannot be postulated what edaphic factor acts as the critical factor, as not all have been investigated.

(b) CLIMATIC FACTORS

As suggested above, the climate of the mountain can be separated into three broad régimes. The vegetation shows some correlation of these régimes:

300 - 600 m	Relhania squarrosa dry fynbos. Rhenosterveld.
600 - 1000 m	Protea laurifolia scrub. Forest form. Protea tenuifolia form. Suurvlakte form.
1000 m +	Staberoha distachya form.

The Relhania squarrosa dry fynbos, which occurs in similar edaphic conditions as the Protea laurifolia shrub, is thus found under different climatic conditions. That climatic conditions can be critical is shown by the continuum in the shrub down an altitudinal gradient. The vegetation above 1000 m has not been extensively sampled, but the local occurrence of many species (Protea recondita, Ixia splendida, Erica phillipsii, et al.), and the absence of common species like Protea laurifolia in the mountains between Levant and Zebrakop indicate different climatic régimes.

(c) WATER AVAILABILITY:

Where water is available (streams, drips and seepages) very distinctive vegetation forms develop. These have all been classed as riverine vegetation. Within the group there is a continuum along the water availability gradient. At the dry end the continuum grades into dry bush.

(d) TOPOGRAPHY:

Aspect is known to play a role in determining the vegetation (Tansley, 1926). This was not revealed in the collected relevés. However, forest forms are always associated with protecting cliffs and boulder screes. Riverine vegetation shows the importance of protection, as the same floristic composition will result in scrubby vegetation when unprotected, and in forest when protected. Topography can protect against fire or against desiccating winds. The former is probably the case for scree forests and riverine forests, while the latter is more likely in the cliff forests.

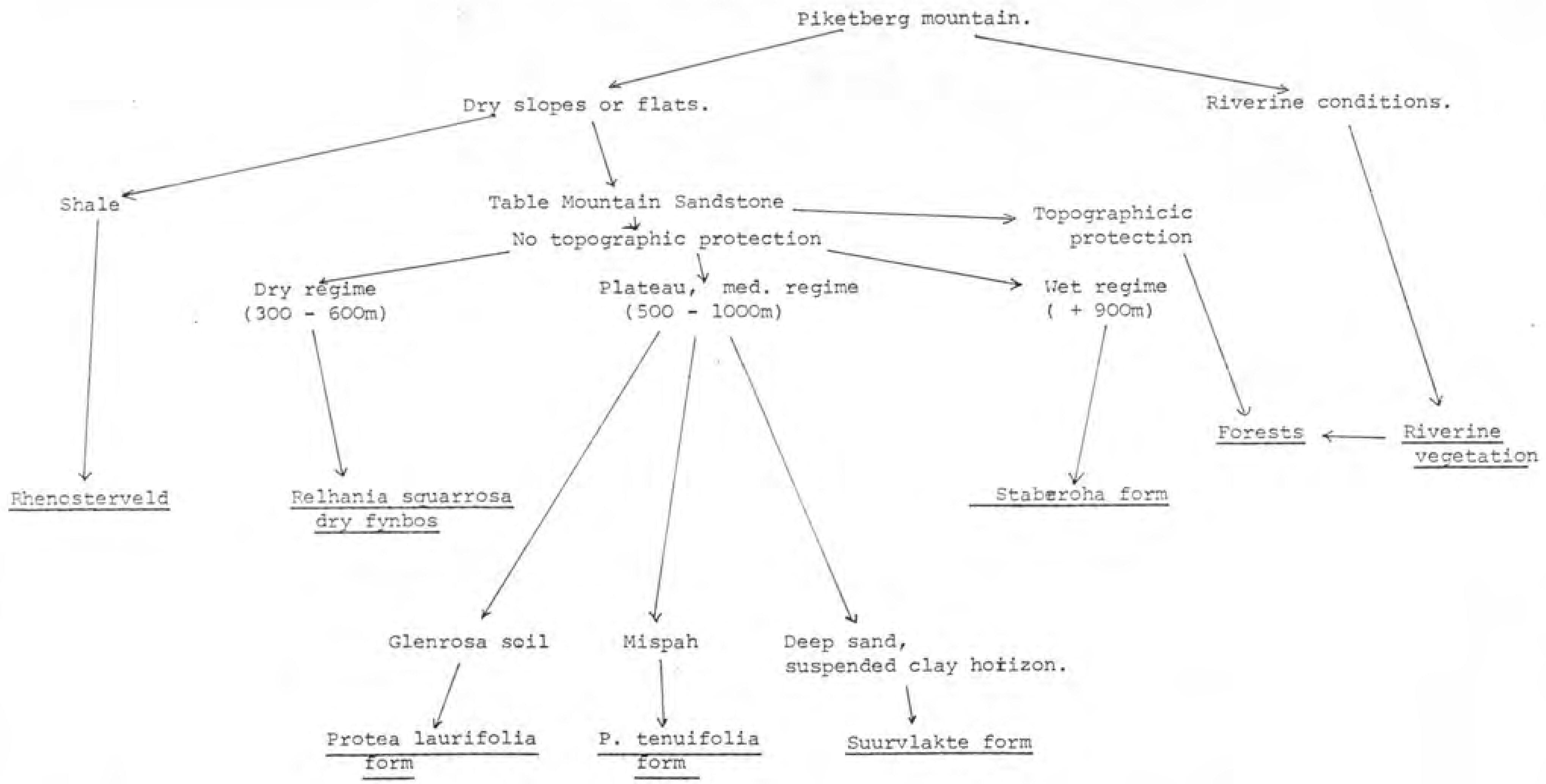
It therefore appears as though there are different critical factors in the various vegetation forms, and that some types have several critical factors, resulting in complex gradients. An attempt is made to show the inter-relationships between environment and vegetation graphically (Fig. 12).

3. Evolutionary relationships

Margalef (1968) defined mature vegetation as the state when there is a balance between the environment and the available species. The species which are available are the result of the accessibility of the area to propagules, both in the present and the past, and on past environmental conditions and ecological relationships.

The Piketberg is isolated from the nearest montane fynbos by 15 - 30 km. That this barrier is reasonably effective, and has been for some time, is indicated by the endemic species of the area. Although the total number of endemic species has not been calculated, some forty are known to date. The case of *Leucospermum profugum* Rourke, which is endemic, and has a vicarious partner on the Porterville mountains, *L. spathulatum* R.Br. (Rourke,

Fig. 12. Tentative vegetation - environment correlation.



1972), is indicative that isolation has been long enough to allow speciation to occur. However, on the Piketberg itself, no sections can be considered to be isolated from any other sections.

Comparison of vegetation units on the Piketberg with structurally and environmentally similar units in Jonkershoek show that although some species are common to both, the majority are not. Werger et al (1972) observed that the small distributions typical of the Cape flora would make such comparisons difficult.

There is some evidence that the climate was considerably wetter in the past (Van Zinderen Bakker, 1969). Rainfall data from Heldervue on Piketberg show a consistent decrease over the last 30 years. Fossil trees on the Cape Flats (Adamson & Curry, 1951) indicate the existence of a yellowwood forest some 30 000 years ago. On the Piketberg, two old individuals of Ilex mitis still stand: dumb witnesses to a past wetter era, when they were more numerous? Relevé 34 is of a Podocarpus scree forest, which occurs at 1000 m, in very different soil conditions from the other forests. The stand has no juvenile trees. Could this patch be a relic from a once much more extensive montane Podocarpus forest?

All this indicates that there have been climatic changes in the last few centuries, and these must have caused some changes in the vegetation. Such changes will effect the vegetation by leaving relic patches, and by the present flora not being very well adapted to the present conditions.

ANALYSIS OF THE FLORA:

Introduction

A check-list has been compiled for the Piketberg mountain, and its slopes to the start of the cultivated land (at approximately 300 m). The check-list is based on my own collections, on material in the Bolus Herbarium and on distribution records in recent revisions. Due to the large area (225 sq. km), the short period of collecting (1973 - 1976), and the distance from Cape Town, the list is not complete. It is hoped that it will indicate which areas and taxa are as yet under-collected. Some families like the Graminae, Aizoaceae and Crassulaceae are not well represented, because they were poorly collected.

The Pteridophyta are arranged according to Schelpe (1969). The Gymnosperms and Angiosperms are arranged according to Phillips (1926). The species are arranged alphabetically within each genus.

The genera are numbered according to the de Dalla Torre system as modified by Phillips. The only departures are in the Tubiflorae, where the arrangement of Adamson and Salter (1950) is followed. For each species a voucher specimen is quoted, either from my own collection, or from the Bolus Herbarium. Where the voucher specimen is in another herbarium, this is indicated. Where available, information on the locality and habitat of the species is given.

Analysis of the flora

The composition of the flora is shown in Table 6.

Table 6: COMPOSITION OF THE FLORA

	Families		Genera		Species	
	No.	Percentage	No.	Percentage	No.	Percentage
Pteridophyta	7	10,30	11	4,38	15	2,42
Gymnospermia	1	1,47	1	0,40	1	0,16
Monocotyledon	9	13,22	76	30,29	182	29,40
Dicotyledonae	51	75,00	163	64,94	421	68,01

By composition, the Piketberg flora tends to be intermediate between the flora of Cape Hangklip (Boucher, 1976) and the flora of Natal (Ross, 1973). It is more similar to the Cape Hangklip flora. The main difference between the floras is the importance of the monocots.

The ten most important families on the Piketberg are given in Table 7.

Table 7: <u>THE TEN MOST IMPORTANT FAMILIES ON PIKETBERG</u>

Family	% of the total species	% of the genera
Compositae	16,6	16,73
Iridaceae	10,6	8,36
Leguminosae	7,7	5,18
Orchidaceae	6,3	5,18
Ericaceae	5,2	1,59
Liliaceae	4,4	5,98
Proteaceae	4,2	2,79
Restionaceae	3,1	3,19
Scrophulariaceae	2,9	3,98
Cyperaceae	2,4	2,00

The most important families from Cape Hangklip (Boucher, 1976), the Cape Peninsula (Bolus & MacOwan, 1904) and Natal

(Ross, 1973), are shown in Table 8.

Table 8: IMPORTANT FAMILIES FROM CAPE HANGKLIP, CAPE PENINSULA AND NATAL

Cape Hangklip	%	Cape Peninsula	%	Natal	%
Compositae	10,8	Compositae	12,0	Compositae	11,37
Ericaceae	8,5	Leguminosae	7,4	Leguminosae	8,7
Leguminosae	7,3	Iridaceae	5,63	Poaceae	8,57
Iridaceae	7,0	Orchidaceae	5,5	Liliaceae	4,8
Restionaceae	7,0	Cyperaceae	5,4	Asclepiadaceae	4,3
Cyperaceae	5,0	Ericaceae	5,2	Orchidaceae	4,3
Graminae	4,5	Graminae	4,5	Cyperaceae	3,6
Proteaceae	4,4	Aizoaceae	4,3	Euphorbiaceae	3,0
Orchidaceae	3,9	Restionaceae	4,2	Rubiaceae	2,7
Campanulaceae	3,1	Liliaceae	3,9	Scrophulariaceae	2,6
Liliaceae	3,1	Geraniaceae	3,1	Lamiaceae	2,4
Scrophulariaceae	1,8	Scrophulariaceae	2,8	Acanthaceae	2,2

The Cape floras are clearly related. Features in common are the importance of the Ericaceae, Iridaceae, Restionaceae and Proteaceae, and the low importance of the Graminae. These are the features by which the Cape flora is defined (Good, 1964).

The Cape Hangklip flora is rather unique in the importance of the Ericaceae on the Restionaceae, and the relatively low importance of the Orchidaceae. The importance of the Compositae, Iridaceae and the Liliaceae increases from Cape Hangklip, to the Peninsula, to Piketberg. This is also a gradient of decreasing rainfall, which supports the hypothesis that these taxa are relatively more important in the drier parts of the Cape Flora.

Table 9 shows the ratio of genera to species, and the number of species per square kilometer.

Table 9: RATIO OF GENERA TO SPECIES, AND THE NUMBER OF SPECIES PER SQUARE KILOMETER, FOR THE AREAS STUDIED.

Area	Area (sq. km)	No. of spp. per sq. km.	Ratio of gen. to spp.
Piketberg	225	2,79	2,46
Hangklip	240	5,9	3,24
Peninsula	471	5,6	3,73
Natal	91 385	0,1	3,89

The number of species per genus appear to increase with an increase in area. This is to be expected, as genera are more likely to be ubiquitous within the area of a floral kingdom, and species to be endemic to a section of that area. Comparison of this ratio is, therefore, only valid if it is computed for the whole area of the floral kingdom. The figure for the Piketberg is very low, indicating that most genera are very small.

The number of species per square kilometer shows the high diversity characteristic of the Cape flora. But it is lower than the Cape Peninsula or Cape Hangklip. However, the Piketberg flora is relatively under-collected, and the figure is likely to increase significantly.

It is clear that check-lists of biogeographic areas are information rich, and would provide the most valid criteria for the definition and description of the areas.

CONCLUSIONS

The check-list, though still incomplete, shows that the Piketberg vegetation does belong to the Cape Floristic Kingdom. Families like the Compositae, Iridaceae and Liliaceae appear to be more important in the drier parts of the Kingdom. The absence or low presence of the typical Cape families in the forest and rhenosterveld vegetation indicates that these forms are probably not part of the Cape Floral Kingdom.

The more common vegetation forms are described, showing that the method of the Zürich-Montpellier School can be applied to show continua in vegetation forms. Protea laurifolia shrub is the most common vegetation form on the mountain.

Vegetation forms can be correlated to edaphic, climatic, topographical and moisture availability gradients. When these parameters form a gradient the vegetation is best described as a simple continuum. When they vary independantly, and no single parameter can be isolated as the critical factor, a complex multidimensional continuum results. As there are distinct environmental régimes, in which a certain set of environmental conditions occur, vegetation "communities" can be described.

Fire succession introduces an important disruptive factor, and more research will be needed to show all the successional phases of each vegetation form.

There is some indication of a secular desiccation on the mountain, and possibly of longterm climatic cycles. This raises the possibility of dramatic changes in the vegetation.

The effects of the settlement of the mountain cannot be termed disastrous, althoug the long-term effects of some practices (e.g. introduction of alien vegetation and spraying of insecticides) cannot be gauged.

The Piketberg, being an isolated mountain, provides ideal conditions for the study of an evolutionary and ecologically dynamic

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Appendix. Preliminary checklist of the flowering plants and ferns of Piketberg mountain.

PTERIDOPHYTA

OSMUNDACEAE.

Osmunda regalis L. Linder 594

Single plant in the Bushmans River.

Todea barbara (L.) Moore Linder 592

Common along streams and at springs, semipermanent water.

SCHIZEAECEAE.

Mohria caffrorum (L.) Desv. Linder 521

Common on the drier exposed slopes.

GLEICHENIACEAE.

Gleichenia polypodioides (L.) Sm. Linder 613

Common on rock ledges and in shallow caves on Zebrakop.

DENNSTAEDTIACEAE.

Pteridium aquilinum (L.) Kuhn

Common in moist places, especially after disturbance.

Histiopteris incisa (Thunb.) Sm. Linder 614

Rare on the S.E. slopes of the hill S. of Zebrakop.

ADIANTACEAE.

Cheilanthes hirta Sw. Linder 606

On cliff ledges on Levant.

C. multifida Sw. Linder 604

On cliffs on Levant.

Pellaea hastata (Thunb.) Prantl Linder 596

Along Bushmans River, shaded.

P. pteroides (L.) Prantl Linder 548

Common, especially on ledges and in scree forests.

ASPLENIACEAE.

Asplenium aethiopicum Bech. Linder 593

Common in scree forests.

Ceterach cordatum (Thunb.) Desv. Linder 605

In scree forests and on open slopes.

BLECHNACEAE.

Blechnum attenuatum (Sw.) Mett. Linder 599

Along streams, in moist and shaded conditions.

B. capense (L.) Schl. Linder 618

S.E. slopes of hill S. of Zebrakop, wet, rare.

B. punctulatum Sw. Linder 520

Common along streams and in scree forests.

GYMNOSPERMEA.

PODOCARPACEAE.

13 Podocarpus elongatus L'Her ex Pers. Linder 209

Widespread from Kafferskloof to Zebrakop, needs moisture.

MONOCOTYLEDONAE.

GRAMINAE.

134g Cymbopogon sp. Linder 550

Platberg, next to cultivated land. Weedy?

201 Ehrhartia longiflora Sm. Pillans 7288

Hills south of Moutonsvlei.

280 Merxmuellera sp. Linder 689

Shale rhenosterveld, Old Pass.

280b Pentaschistis airoides Stapf Pillans 7292

Hills south of Moutonsvlei.

P. thunbergii Stapf Pillans 7109

Bottom of the old Pass.

371 Lasiochloa longifolia Kunth Pillans 7113

CYPERACEAE.

459 *Cyperus longus* L. Linder 509

Weed in orchard at Stawelklip.

465 *Ficinia bracteata* Boeck Linder 566

Common, widespread between Avondtuur and Zebraskop.

F. capitella Nees Linder 450

Plateau east of Levant.

F. filiformis Schrad. Linder 419

F. indica (Lam.) Pfeiffer Linder 570

Common south of Zebraskop.

F. radiata Kunth Pillans 7572

On plateau east of Levant, in seepages.

F. scariosa Nees Linder 333

Common and widespread in *P. laurifolia* bush.

468 *Scirpus chlorostachyus* Levyns Linder 387

S. diabolicus Steud. Linder 335

Suurvlakte east of Levant.

477a *Epischoenus gracilis* Levyns Linder 621

Widespread.

494 *Tetraria cuspidata* C.B.Cl. Linder 332

Dry proteoid slopes on Platberg.

T. involucrata (Rottb.) C.B.Cl. Linder 571

Frequent in hills south of Zebrakop.

T. picta C.B.Cl. Linder 330

Suurvlakte east of Levant.

T. ustulata C.B.Cl. Linder 533

Widespread on dry slopes.

RESTIONACEAE.

804 *Restio cuspidatus* Thunb. Linder 452

Suurvlakte.

R. gaudichaudianus Kunth Pillans 7319

Widespread on dry proteoid slopes.

R. gossypinus Mast. Linder 552

Platberg.

R. macer Kunth Pillans 7604

Hills south of Zebrakop.

R. ocreatus Kunth Linder 542

Platberg.

R. pedicellatus Mast. Pillans 7547

Hills N.W. of Moutonsvlei.

R. sieberi Kunth Pillans 4575

Widespread on dry proteoid slopes.

R. virgeus Mast. Linder 354

Grootberg.

805 Chondropetalum macrocarpum Pillans Linder 608

Widespread in drier areas, not on steep slopes.

807 Elegia asperiflora Kunth Pillans 7548

Pomona and plateau east of Levant.

E. capensis (Burm.f.) Schelpe Linder 620

Tierkloof and Bushmans River, local in wet areas, rare.

E. parviflora Kunth Linder 622

Suurvlakte east of Levant.

808 Leptocarpus paniculatus Mast. Linder 528

Platberg, in permanent seepages.

L. vimineus Pillans Pillans 7523

Hills N.W. of Moutonsvlei.

813 Thamnochortus fruticosus Berg. Linder 410

Suurvlakte east of Levant.

814 Staberoha distachya Kunth Pillans 7573

Suurvlakte east of Levant.

816 Hypodiscus aristatus (Thunb.) Nees Linder 558

Common south of the Versfeld Pass.

H. binatus Mast. Linder 334

Suurvlakte east of Levant.

818 Willdenowia arescens Kunth Pillans 7429

Common on dry proteoid slopes.

JUNCACEAE.

936 Juncus lomatophyllus Sprg. Linder 176

Widespread in permanent streams.

LILIACEAE.

969 Androcymbium sp. Linder 644

Dry proteoid slopes, Langberg, after a fire.

972 Wurmbea spicata (Burm.) Dur. & Schinz Linder 3

Clay at the E. base of mountains, Deezehoek.

973 Ornithoglossum viride (L.f.) Ait. Linder 56

E. slopes below Aasvoelkop, after fire.

984 Bulbinella gracilis Kunth Linder 329

South of Versfeld Pass.

B. peronata Kunth Linder 8

Central plateau around Pomona.

971 Dipidax punctata (L.) Hutch. Linder 22

Suurvlakte east of Levant.

985a Trachyandra hirsutiflora Adamson Linder 33

Sandleegte, on sand. Uncommon.

T. muricata L.f. Linder 146

Suurvlakte, on sand, uncommon.

T. patens Mauve Linder 11

Rare south of Versfeld Pass.

985b Bulbine asphodelioides Roem & sch. Linder 42

B. filifolia Baker Linder 150

990 Chlorophytum undulatum Oberm. Linder 49

Drier parts of mountain, on rock ledges.

1024 Kniphofia uvaria (L.) Hook f. Linder 163

Eastern upper slopes in seepages.

1026 Aloe glauca Mill var. muricata Pillans 17743
(Schult) Bak. On rocks, widespread.

1047 Tulbaghia alliaceae L.f.
Widespread, especially on the lower slopes.

1080 Urginea filifolia (Jacq.) Steinh. Linder 70
Hills south of Zebrakop in valleys.

1089 Ornithogalum distans L. Bol. Linder 119
South of Versfeld Pass.

1098 Lachenalia hirta Thunb. Linder s.n.
L. pusilla Jacq. Linder 619
Platberg, on rack ledge in organic soil, rare.

L. tricolour Thunb. Matthews 1153
Southern part of mountain, among stones.

L. unicolour Jacq. Linder s.n.
L. vanzyliae Barker m.s. Linder s.n.
Widespread in shaded places.

1113 Asparagus aethiopicus L. Linder 350
Grootberg.

A. compactus Salter Linder 173
Widespread at higher altitudes.

A. muricata (L.f.) Kunth Linder 146
East of Levant in sand.

A.ramossissimus Baker Linder 338
Versfeld Pass, rare.

A. scandens Thunb. Linder 597
Along streams and in scree forests,

A. thunbergianus Sch. Linder 172
Common on dry proteoid slopes.

HAEMODORACEAE.

1160 Dilatris ixiodes Lam. Linder 144

Suurvlakte east of Levant, common after fire.

1162 Wachendorffia paniculata Burm. Linder 126

Widespread, from Aasvoelkop to Zebrakop.

AMARYLLIDACEAE.

1167 Haemanthus rotundifolius Gaul. Linder s.n.

Common on loose organic soil: scree forests and boulders.

1175 Nerine humilis Herb. Linder 589

Widespread on S. facing rock ledges.

N. sarniensis (L.) Herb. Linder 630

Zebrakop and Grootberg areas, on dry stony soil.

1233 Cyanella capensis L. Linder 149

South of Versfeld Pass, in shale at base of mountain.

1230a Spiloxene ovata (L.f.) Garside Linder 585

Moist sandy places.

S. schlechterii Bol. Linder 379

Plateau east of Levant.

Periphnes cinnamomea (L'Her) Leighton Linder 579

Sandy places on plateau, flower only after fire.

IRIDACEAE.

1261 Romulea cruciata (Jacq.) Bak. Linder 21

var. intermedia (Berg.) De Vos

R. flava (Lam.) De Vos var. flava Linder 13

Platberg, sandy soil.

R. hirsuta (Eckl. ex Klatt) Boek Linder 14

R. triflora (Burm.f.)N.E.Br. Linder 51

Zebrakop, common.

1262 Galaxia sp. Linder 370

Plateau east of Levant.

1265 Moraea ciliata Ker. Linder 564

Top of Versfeld Pass.

M. fugax (De la Roche) Jacq. Linder 638

Moutonsvlei.

M. papilionaceae (L.f.) Ker Linder 637

M. tripetala (L.f.) Ker Linder 414

Widespread, usually on sandy soil.

M. unguiculata Ker Linder 636

Zebrakop, moist semiseepage areas.

M. villosa Ker Linder 634

Common between Levant and Zebrakop on stony soil.

1272 Ferraria undulata L. Linder 15

Mountain south of Versfeld Pass.

1284 Bobartia rufa Strid. Pillans 7150

1295 Aristea capitata Ker Linder 155

Suurvlakte east of Levant.

A. coerula (Thunb.) Vahl. Linder 92

Plateau east of Levant.

A. cuspidata Schinz Linder 164

Plateau east of Levant.

A. zeyherii Baker Linder 134

Plateau east ofLevant.

1300a Engysiphon brevitubus Lewis Linder 401

Widespread on dry proteoid slopes.

1300b Geissorhiza aspera (Berg.) Ker Linder 40

Widespread, common in sandy areas.

G. bolusii Baker Pillans 7400

Rock ledges on S. facing slopes, common.

G. imbricata (De la Roche) Ker Linder 71

Grootberg area.

G. juncea (Link) A. Dietr. Linder 46

Along the eastern ridge of the mountain, 1301 Hesperantha falcata Ker Linder 29

Widespread below 600m.

H. radiata Ker Linder 37

Common on Zebrakop and Aasvoelkop.

sp. nov. Linder 82

Rare in the Zebrakop area.

1302 Ixia capillaris L.f. Linder 20

Widespread on dry slopes, especially around Pomona.

I.conferta Foster var. ochroleuca Linder 18

(Ker) Lewis. Shale at E. base on mountain,

I. dubia Vent. Linder 91

Sandleegte, common on dry stony slopes.

I. odorata Ker Linder 112

Zebrakop.

I. paniculata De la Roche Linder 138

vTierkloof and Suurvlakte in swampy ground.

I. scillaris (L.) Bak. var. scillaris Linder 97

South of Versfeld Pass, widespread.

I. scillaris (L.) Bak. var. subundulata Linder 36

Versfeld Pass.

I. splendida Lewis Linder 103

S.E. slopes of Zebrakop, common, endemic.

1305 Melasphaerula ramosa (L.) N.E.Br. Linder 425

Widespread, usually in shaded conditions under trees.

1306 Tritonia cooperii Klatt Linder 63

Aasvoelkop, S. facing ledges.

T. cooperii var. pectinata X T. crispa

Aasvoelkop and Levant, S. facing slopes. Linder 107

T. crispa (Thunb.) Ker Linder 96

South of Versfeld Pass.

1306a Tritoniopsis parviflora (Jacq.) Lewis Linder 188

1309 Synnotia villosa (Burm.) N.E.Br. Linder 49

Common south of the Versfeld Pass, in sand.

1310 Babiana disticha Eckl. Linder 453

Widespread.

1311a Homoglossum priorii N.E.Br. Linder 44

Shales at the base of the mountain at Waboom.

H. watsonianum N.E.Br. Linder 35

Widespread on the mountain, rarely common.

1311b Gladiolus alatus L. Linder 69

Widespread in sandy soils.

G. angustus L. Linder 161

S.E. slopes of Zebrakop.

G. brevifolius Jacq. Linder 216

Widespread on stony dry soil north of the Versfeld Pass.

G. carinatus Ait. ssp. carinatus Linder 50

Widespread, growing in sandy soil.

G. caryophyllaceus (Burm.f.) Poir Schlechter 5791

Sandleegte, now extinct in area due to cultivation.

G. hyalinus Jacq. Linder 52

Widespread on dry sandy or stony soils.

G. liliaceus Houtt. Linder 137

Zebrakop and Levant in moist sand, not seepages.

G. stokoei Lewis Linder 190

Zebrakop and Levant on Moist slopes, common after fire.

G. tenella Jacq. Linder 45

Stony and dry soils.

G. triste L. var. tristis Linder 174

Upper part of the Bushmans River, Zebrakop. Moist seepages.

G. undulatus L. Linder 90

Sandy soil between Levant and Zebrakop.

1312b <u>Anapalina longituba</u> Fourc. Linder 211
Suurvlakte in cracks of boulders.

<u>A. nervosa</u> (Thunb.) Lewis Linder 129
Widespread on dry stony soils.

<u>A. triticea</u> N.E.Br. Linder 632
Common on dry stony slopes between Levant and Zebrakop.

1313a <u>Thereianthus bracteolatus</u> (Lam.) Lewis
Common on plateau E. of Levant after fire. Linder 187

1313b <u>Micranthus junceus</u> (Bak.) N.E.Br. Linder 193
Widespread and common.

<u>M. plantagineus</u> Eckl. Limder 128
Rare. Seepage near Avondtuur.

1314 <u>Lapeirousia anceps</u> (L.f.) Ker Pillans 7275
Hills W. of Moutonsvlei.

<u>L. fabricii</u> 'De la Roche) Ker Pillans 7718
Shale around base of mountain.

<u>L. jacquinii</u> N.E.Br. Linder 32
Widespread on sand.

<u>L. micrantha</u> (Mey. ex Klatt) Bak. Linder 93
Sandleegte.

1315 <u>Watsonia marginatat</u> Ker Linder 157
Plateau east of Levant.

<u>W. splendida</u> Schinz Linder 2
Perdekop and Langberg on dry stony soil.

<u>W. stokoei</u> L.Bol. Linder 192
Between Levant and Zebrakop, common along streams.

<u>W. vanderspuyae</u> L.Bol. Pillaes 7276
Hills south of Zebrakop.

<u>W. verfsfeldii</u> Matth. & Bol. Linder 156
Zebrakop, among boulders on slopes.

<u>W. vittata</u> Matth. & L.Bol. Linder 191

ORCHIDACEAE.

1408 *Holothrix lithophila* Schlechter Linder 208
Plateau east of Levant.

H. squamulosa Lindl. Linder 84
Plateau east of Levant, common on sand after fire.

H. villosa Lindl. Linder 99
Widespread in cracks on boulders and cliffs.

1416 *Bartholina burmanniana* (L.) Ker Linder 12
Widespread on dry soil.

1430 *Satyrium bicallosum* Thunb. Linder 87
Sandy areas between Levant and Zebrakop.

S. bicorne (L.) Thunb. Linder 1

S. candidum Lindl. Linder 135
Zebrakop and Avondtuur, moist to wet areas.

S. erectum Schwartz Linder 77
Widespread in shaded conditions, even under *Pinus* sp.

S. lupulinum Lindl. Linder 76
Rare. At Sandleegte and Perdekop.

S. retusum Lindl. Linder 86
S. facing cliffs on Zebrakop, shaded conditions.

S. striatum Thunb. Linder 75
Along stream east of Levant, rare.

1430b *Aviceps pumilum* Lindl. Linder 464
Platberg, and mountains between Levant and Zebrakop.

1432 *Schizodium bifidum* (Thunb.) Pillans 7303
Reichb.f. var. *bifidum* Zebrakop.

Var. *rigidum* (Lindl.) Linder Pillans 7835
Kapteinskloof mountain.

S. longipetalum Lindl. Schlechter 5248
Very rare, seen once. Dry stony soils near Dassieklip.

1434 Disa caulescens Lindl. Linder 136

Along upper part of the Bushmans River, common.

D. draconis (L.f.) Schwartz Linder 142

Widespread between Dassiklip and Zebrakop in sand.

D. longifolia Lindl.

Zebrakop, S.W. slopes, very rare, at permanent water.

D. maculata L.f. (white form) Pillans 7347

In cliff crevasses, S. facing, on Platberg and Zebrakop.

D. uncinata Bolus Linder 85

Common in semi-permanent drips on Zebrakop.

D. uniflora Berg. Linder 195

Rare in permanent water on Zebrakop.

D. vaginata Harv. Linder 118

Very rare - one plant found in hills S. of Zebrakop.

1435 Herschelia charpentiariana Kraenzl. Linder 148

Plateau east of Levant.

H. spathulata Sw. Linder s.n.

Plateau E. of Levant, only one plant found.

1436 Monadenia micrantha Lindl. Linder 132

Widespread and common on the plateau east of Levant.

M. physodes (Sch.) Reichb.f. Linder 74

Rare in a seepage on plateau east of Levant.

1437 Disperis bolusiana Schlechter Linder 26

On shale on the old Pass.

D. capensis (L.f.) Schwartz Linder 28

Both green and red forms widespread and common, the green form oftener on the moister E. slopes.

D. circumflexa (L.) Dur. & Schl. Linder 73

Widespread.

D. cucullata Schwartz Linder 27

Widespread but rare on mountain.

Widespread and common on sand.

1438 Pterigodium acutifolium Lindl. Linder 116

In moist sand between Levant and Zebrakop.

P.alatum (Thunb.) Swhtz. Linder 64

South of Versfeld Pass on shaded S. slopes with sand.

P.caffrum (Thunb.) Schwartz Linder 72

Kafferskloof, sand.

P. catholicum (L.) Schartz Linder 5

Widespread and common.

P. platypetalum Lindl. Linder 25

Widespread, not common, usually in moist places, sand.

P. volucris (L.f.) Sw. Linder 19

South of Versfeld Pass, also on shale at Voelvlei.

1439 Ceratandra atrata (L.) Dur. & Schlt. Linder 117

Along streams between Levant and Zebrakop.

1440 Corycium orobanchioides (L.f.) Schutz. Linder 39

Common in drier areas, south of Versfeld Pass.

DICOTYLEDONAE.

MORACEAE.

1961 Ficus cordata Thunb. Pillans 7217

Bushmanskop, among boulders.

URTICACEAE.

2014 Australina procumbens N.E.Br. Linder 427

In scree forests in shade.

PROTEAECEAE.

2024 Brabeium stellatifolium L. Linder 515

Along permanent streams.

2028 Sorocephalus capitatus Rourke Pillans 7341

Between Levant and Zebrakop.

S. imbricatus (Thunb.) R.Br. Bolus 13639

Suurvlakte south of Zebrakop.

S. aitonii R. Br. Linder 685

Common below 800m, often in dry proteoid vegetation.

2035 Protea acaulus Thunb. Pillans 7480

Widespread on stony and shallow soil.

P. arborea Houtt.

Widespread, usually on steep slopes.

P. cynaroides L.

Common on peaks among boulders.

P. laurifolia Thunb.

Widespread and common on dry mountain slopes.

P.recondita Buck

On the peak of Zebrakop, above 1200m.

P. repens Thunb.

Widespread, seldom dominant, usually on deeper soils.

P. tenuifolia R. Br. Linder 204

Widespread in drier conditions, never common.

2036 Leucospermum calligerum (Salisb. Linder 666
ex Knight) Rourke Langberg to Kafferskloof.

L. catherinae Compton Pillans 7431

Voorstevlei and Platberg. Not found.

L.profugum Rourke Edwards s.n.

S. of Versfeld Pass, endemic.

L. rodolentum (Salisb. ex Knight) Rourke

Dry sandy conditions at W. base of mountain. Williams 1361

L. vestitum (Lam.) Rourke Linder 687

Langberg, Perdekop, Môreson. Dry slopes.

2037 Leucadendron discolor Phillips & Hutch.

South of Versfeld Pass, endemic. Pillans 8055

L.glaberrimum (Schlt.) Compton Linder 568

ssp. erubescens Williams. Widespread.

Deezehoek, on shale soils.

L. rubrum Burm.f. Linder 573

Widespread and common between 400 and 800m.

L. salignum Berg. Linder 544

Widespread and common, especially on deep sand.

L. spissifolium (Salisb. ex Knight) Williams ssp. spissifolium Levant Hill.

2038 Aulax cancellata L. Linder 198

Common between Levant and Zebrakop.

LORANTHACEAE.

2093 Viscum sp. Linder 554

Parasites on Rhus on Aasvoelkop.

SANTALACEAE.

2108 Colpoon compressum Berg. Linder 475

Widespread, never very common.

2118 Thesium aggregatum Hill Pillans 7311

Hills N.W. of Moutonsvlei.

T. ericaefolium D.C. Linder s.n.

Shale, old Pass.

T. macrostachyum D.C. Pillans 7428

Hills N.W. of Moutonsvlei.

T. stricta Berg. Pillans 7140

Plateau east of Levant.

T. subnudum Sond. Pillans 7234

Zebrakop.

T. virgatum Lam. Linder 643

Langberg.

CHENOPODIACEAE.

2223 Chenopodium album L. Linder 513

Weed in orchards.

AIZOACEAE.

2401 <u>Aizoon paniculatum</u> L. Linder 444

Common south of the Versfeld Pass.

2403 <u>Tetragonia spicata</u> L.f. Linder s.n.

2405 <u>Erepsia ramosa</u> L.Bol. Esterhuysen 14470

Widespread.

<u>Ruschia filiformis</u> Linder 569

Pomona.

<u>R. microphylla</u> (Harv.) Schwalis Linder s.n.

Deezehoek, dry fynbos.

<u>Lampranthus stipulaceus</u>

Deezehoek.

<u>L. rubroluteus</u> Pillans

Kapteinskloof.

<u>L. acrosepalus</u> Pillans

Between Moutonsvlei and Zebrakop.

<u>L. gracilipes</u> L.Bol. Bolus 13552

<u>L. piquetbergensis</u> Pillans

Endemic and widespread on rock outcrops.

<u>L. aurantiacus</u> Du Plessis 142

Kapteinskloof.

CARYOPHYLLACEAE.

2490 <u>Silene undulata</u> Ait. Pillans 7459

Hills N.W. of Moutonsvlei.

RANUNCULACEAE.

2541 <u>Anemone capensis</u> L.

S.W. slopes of Zebrakop, next to old Pass.

2541a <u>Knowltonia capensis</u> (L.) Hutch. Linder s.n.

Rare in scree forests.

PAPAVERACEAE.

2858a Phacocapnos cracca (Cham. & Schl.) Berm. Linder 429

Koggelkop.

CRUCIFERAE.

2875 Heliophila scoparia Burch. ex D.C. Stokoe 4787

2877 Brachycarpaea juncea (Berg.) Marais Linder 492

South of Zebrakop.

2946 Diplotaxis muralis (L.) D.C. Linder 445

Koggelkop, disturbed sand.

DROCERACEAE.

3136 Drosera pauciflora Banks Linder 404

Widespread, common on seepages.

CRASSULACEAE.

3168 Crassula fascicularis Lam. Pillans 8040

Near Gruyskop.

C. muscosa L. Linder 327

Aasvoelkop, dry fynbos.

C. scabra L. Linder 168

Dry shallow soiled hill north of Sandleegte.

C. strigosa L. Linder 422

Koggelkop, cracks in boulders.

SAXIFRAGACEAE.

3238 Montinia caryophyllaceae Thunb. Linder 402

Widespread over mountain.

CUNONIACEAE.

3275 Cunonia capensis L. Linder 485

Common along permanent water.

BRUNIACEAE.

3285 Tittmannia laxa Presl Bolus 13549

Probably very rare, only collected once in 1895.

3295 Brunia nodiflora L. Pillans 7343

Widespread in moister places on slopes.

3294 Berzelia lanuginosa Brogn. Linder 403

Plateau east of Levant, moist places.

ROSACEAE.

3353 Rubus fruticosus L. Linder 336

Top end of Bushmans River, along stream.

3388 Cliffortia dodecandra Weim. Esterhuysen 14475

C. polygonifolia L. Linder 559

South of Versfeld Pass.

C.propingua E. & Z. Linder 615

Hills south of Zebrakop.

C. strobilifera L. Linder 508

Along permanent streams.

C. tuberculata (Harv.) Weim. Linder 642

Top of Versfeld Pass, dry proteoid slope.

LEGUMINOSAE.

3446 Acacia longifolia Willd, Linder 672

Alien. Rare, only at Stalkrans.

A. saligna (Labill) Wendl.

Alien, widespread, especially around Bushmans Hollow.

3621 Podalyria biflora Lam. Linder 395

Widespread, especially at lower altitudes in drier areas.

3643 Priestleya sericea (L.) E.Mey. Linder 647

Langberg, on dry proteoid slopes.

P. umbellifera D.C. Pillans 7189

Margins of streams of hills south of Zebrakop.

3654 Rafnia triflora Thunb. Linder 466

Zebrakop.

3660 Lebeckia simsiana E.&Z. Pillans 7462

Hills N.W. of Moutonsvlei.

3662 Aspalathus acidota Garab. Pillans 7442

Hills N.W. of Moutonsvlei.

A. altissima Dahlgr.

A. acuminata Lam. ssp pungens (Thunb.) Dahlgr.

Common over whole mountain. Linder 640

A. acuminatus ssp. acuminatus Van Niekerk 627

Common pioneer shrub.

A. arida E.Mey. ssp. procumbens (E.Mey.) Dahlgr.

Near top of Versfeld Pass Dahlgren 990 (LD)

A. aristifolia Dahlgr. Dahlgr. 3864 (NBG)

Near top of Versfeld Pass.

A. bracteata Thunb. Pillans 7513

Widespread.

A. chrysantha Dahlgr. Schlechter 5252

Top of old pass, Sandleegte.

A. complicata (Benth.) Dahlgr. Pillans 7142

Bottom of old pass, Voelvlei.

A. cordata (L.) Dahlgr. Bolus 13534

A. cymbiformis D.C. Guthrie

A. divaricata Thunb. ssp. divaricata Pillans 7232

A. flexuosa Thunb. Pillans 7116

Versveld Pass and Moutonsvlei.

A. glossoides Dahlgr. Johnson 288 (NBG)

Between Stawelklip and Kafferskloof.

A. heterophylla L.f. ssp. heterophylla

Widespread. Pillans 7552

A. hispida Thunb. ssp. hispida Pillans 7226

<u>A. lanata</u> E.Mey. Dahlgr. 984 (LD)

Near Stawelklip.

<u>A. latifolius</u> Bol. Linder 656

Zebrakop, dry slopes near a seepage, endemic, rare.

<u>A. juniperina</u> Thunb. ssp. <u>juniperina</u>

Near top of Versfeld Pass. Dahlbr. 3870 (LD)

<u>A. muraltioides</u> E.&Z. Bolus 7520

<u>A. pendula</u> Dahlgr.

Widespread from Versfeld Pass to Moutonsvlei.

<u>A. perfoliata</u> (Lam.)Dahlgr. Pillans 7394

ssp.<u>phillipsii</u>.

<u>A. pinguis</u> Thunb. ssp. <u>longissima</u> Dahlbr.

Slopes of mountain. Bolus 8436

<u>A. quinquefolia</u> L. ssp <u>virgata</u> Schlechter 5198

Hills south of Zebrakop.

<u>A. retroflora</u> L. Linder 228

Langberg.

<u>A. spicata</u> Thunb. ssp. <u>spicata</u> Pillans 7460

<u>A. tridentata</u> L. ssp. <u>tridentata</u> Pillans 7170

Moutonsvlei.

<u>A. tridentata</u> L. ssp <u>staurantha</u>

<u>A. uniflora</u> L. ssp. <u>uniflora</u> Pillans 7117

Botton of old pass, Voelvlei.

<u>A. varians</u> E.&Z.ssp. <u>varians</u> Dahlgr. 905 (LD)

E. base of Zebrakop.

3673 <u>Argyrolobium lanceolata</u> E.&Z. Pillans 7463

Hills W. of Moutonsvlei.

3702 <u>Indigofera frutescens</u> L.f. Linder 607

Common along streams.

<u>I. incana</u> Thunb. Linder 674

Shale, old pass.

<u>I. procumbens</u> L. Linder 438

Widespread and Common.

3703 Psoralea aphylla L. Linder 215

Zebrakop.

P. obliqua E.Mey. Pillans 7244

Gruyskop.

P.pinnata L. Linder 600

Along streams and seepages.

P. stachydis L.f. Pillans 7810

Around base of Piketberg.

3754 Sutherlandia frutescens (L.) R.Br. Linder 358

Widespread but uncommon.

3756 Lessertia pappeana Harv. Pillans 7294

S.E. slopes of Zebrakop.

L. rigida E.Mey. Linder 663

Sand on Langberg.

3852 Vicia sativa L. Linder 398

South of Versfeld Pass.

3910 Dolichos gibbosus Thunb. Pillans 7370

S.E. ledges of Zebrakop, moist and shaded.

GERANIACEAE.

3925 Monsonia lobata Montin Linder 416

Dry slopes, well drained. Widespread, uncommon.

3928 Pelargonium barbatum Jacq. Linder 228

Widespread and common.

P. longifolium Jacq. Linder 127

Plateau east of Levant.

P. multiradiatus Vent. Linder 152

Plateau east of Levant.

P. myrtifolium (L.) Ait. Linder 133

Plateau east of Levant.

P.revolutum (Andre) Pers. Linder 167

Plateau east of Levant.

P. saniculaefolium Willd. Pillans 7188

Plateau east of Levant.

P. scabrum Ait. Pillans 7334

Widespread and common as an indicator of disturbance.

P. tabularis (L.) L'Her Linder 159

P. triste (L.) Ait. Linder 217

Hills south of Zebrakop.

OXALIDACEAE.

3936 Oxalis lateriflora Jacq. Linder 587

Top of Versfeld Pass, sand, after fire.

O. commutata Sond. Linder 539

Platberg.

O. ebracteata Savign. Esterhuysen 20145

Rocky lower slopes of mountain.

O. glabra Thunb. Pillans 7493

Between Levant and Zebrakop.

O. heterophylla D.C. Linder 540

Zebrakop and Platberg.

O. hirta L. Linder 323

Plateau east of Levant.

O.luteola Jacq. Schlechter 4914

Moutonsvlei.

O. pes caprae L. Linder 436

Weedy, widespread and common.

O.purpurea L. Pillans 7492

Plateau east of Levant.

O. obtusa Jacq. Pillans 7243

Between Moutonsvlei and Gruyskop.

O. versicolour L. Linder 583

Top of Versfeld Pass, sandy, after fire.

O. sp. Londer 582

LINACEAE.

3945 Linum thesiodes Bartl. Pillans 7357

Pomona.

ZYGOPHYLLACEAE.

3965 Zygophyllum fulvum L. Linder 670

Old versfeld pass, rare, on shale.

Z. spinosum L. Linder 407

Common and Widespread.

RUTACEAE.

4037 Agathosma betulina Pillans Linder 360

Widespread, mostly on south aspect slopes.

A. bifida (Jacq.) Bartl. & Vent. Linder 122

South of Versfeld Pass.

A. bisulca B.&H. Pillans

Gruyskop and top of Versfeld Pass.

A. capensis Duemmer Pillans 7328

Widespread.

A. cedrimontana Duemmer Linder 681

North end of Burgerskloof.

A. latifolia Sond. Linder 665

Dry proteoid slopes, Langberg and top of Versfeld Pass.

A. latipetala Sond. Linder 373

Widespread, especially south of the Versfeld Pass.

A. marifolia E.&Z. Edwards 195

Moutonsvlei.

A. serpyllaceae (Roem. & Schl.) Licht. Linder 372

South of Versfeld Pass.

4038 Adenandra marginata (L.f.) Roem. ssp. marginata

South of Versfeld Pass, usually among boulders. linder 380

4041 Diosma hirsuta L. Linder 154

Widespread on deep sand.

South of Versfeld Pass.

4044 Macrostylis decipiens E.Mey. Linder 498

Widespread in drier areas: Platberg and S. of Versfeld Pass.

4046 Empleuron serrulatum Ait. Linder 610

At permanent water: forest margin or precursor.

POLYGALACEAE.

4273 Polygala affinis D.C. Linder 675

Deezehoek, dry fynbos.

P. bracteolata L. Linder 655

Hill south of Zebrakop, western slopes.

P. ludwigiana E.&Z. Van Niekerk 623

Plateau east of Levant.

P. pappeana E.&Z. Linder 648

Widespread, straggling in bushes in dry conditions.

4278 Muraltia alopeuroides (L.) D.C. Linder 220

Common in proteoid bush.

M. heisteriana D.C. Pillans 7154

Widespread pioneer species.

EUPHORBIACEAE.

4448 Clutia alaternoides L. Linder 678

Widespread in proteoid bush.

C. pubescens Thunb. Linder 555

Aasvoelkop.

C. sp. nov. Linder 679

Shale, old pass at Voelvlei.

4498 Euphorbia mauritanica L. Linder 418

South of Versfeld Pass.

E. silenifolia Sweet Linder 584

Top of Versfeld Pass in sand.

E. tuberosa L. Linder 669"

Shale, old Pass.

ANACARDIACEAE.

4589 Heeria argenteum E. Mey. Linder 258

Widespread on rock outcrops at all altitudes.

4594 Rhus angustifolia L. Linder 519

Widespread, usually associated with moisture.

R. dissecta Thunb. Linder 557

Common on the drier lower slopes.

R. glauca Desf. Pillans 7342

Widespread, but not common.

R. incana Mill Linder 518

Platberg.

R. incisa L.f. Linder 686

On shale soils at E. base of mountain.

R. mucronata Thunb. Linder 502

Widespread.

R. rosmarinifolium Vahl. Pillans 7231

Widespread, common on dry stony slopes, often in proteoid.

R. scytophylla E.&Z. Linder 494

Often among stones in proteoid bush.

R. tomentosa L. Linder 337

Along permanent water or in moist places.

AQUIFOLIACEAE.

4614 Ilex mitis (Jacq.) Radlk. Linder 616

Very rare, relic. With permanent water.

CELASTRACEAE.

4627 Maytenus acuminatus (L.f.) Loess Pillans 7400

Widespread in scree and riverine forests, but uncommon.

M. cymosus (Soland.) Exell. Pillans 7179

M. oleoides (Lam.) Loess Linder 342

Widespread on rock outcrops.

4645 Hartoghia capensis Thunb. Linder 507

SAPINDACEAE.

4831 Dodonaea thunbergiana E.&Z. Linder 503

Lower slopes, rare on upper slopes, always on sand.

RHAMNACEAE.

4886 Phylica cryptandroides Sond. Linder

Zebrakop area.

P. cuspidata E.&Z. Linder 351

Langberg and Grootberg among boulders.

P. cylindrica E.&Z. Pillans 7312

Common on dry proteoid slopes.

P. imberbis Berg. Linder 319

South of Versfeld Pass.

P. piquetbergensis Pillans Pillans 7160

Widespread but uncommon on mountain, endemic.

P.olaeafolium Vent. Linder 493

Common on dry lower slopes, usually with boulders.

P. spicata L.f. Linder 474

Aasvoelkop.

P. stipularis L. Stokoe 4579

Common, mostly in higher rainfall areas.

P.strigosa Berg. Linder 325

Plateau east of Levant.

P. strigulosa Sond. Linder 683

South of Versfeld Pass.

P. villosa Thunb. Pillans 7325

Widespread on dry proteoid slopes.

MALVACEAE.

Anisodontia bryoniifolia (L.) Bates Pillans 7993

Kapteinskloof mountain.

STERCULIACEAE.

5056 Hermannia sp. Linder 646

Widespread.

H. sp. Linder 645

Langberg, dry stony slopes.

FLACOURTIACEAE.

5296 Kiggelaria africana L. Linder 611

Uncommon in scree forests.

THYMELAEACEAE.

5435 Gnidia geminiflora E.Mey. Linder 353

Widespread on dry well-drained soils.

G. linoides Wikstr. Pillans 7256

Platberg.

G. oppositifolia L. Linder 214

Along permanent streams.

G. parviflora Meisn. Linder 301

Between Levant and Zebrakop.

G. sericea L. Linder 349

Stalkrans, under pine trees.

5436 Struthiola ciliata (L.) Lam. Peterson 988

Plateau east of Levant.

S. ovata Thunb. Pillans 7374

Between Levant and Zebrakop.

5461 Passerina glomerata Thunb. Pillans 7298

Common in dry fynbos on the slopes below 500m.

MYRTACEAE.

5588 Metrosideros angustifolia Smith Linder 179

Along semi-permanent and permanent streams.

UMBELLIFERAE.

5971 Hermas intermedia C. Norm. Pillans 7373

In crevaces in cliff S. of Zebrakop.

5926 Arctopus monacanthus Carm. Linder 415

At higher altitudes, common north of Levant.

5990 Lichtensteinia interrupta E.Mey. Pillans 7139

Base of old pass, shale soils, Voelvlei.

6020 Chamarea capensis (Thunb.) E.&Z. Linder

South of Vesfeld Pass.

ERICACEAE.

6237 Erica albescens Kl. var erecta G.Br. Pillans 7556

Between Levant and Zebrakop.

E. articularis L.

Common in moist places on the plateau east of Levant.

E. caffra L. Linder 467

Along the Bushmans River, permanent water.

E. calycina Andre Linder 500

Widespread and common north of the Versfeld Pass.

E. cerinthoides L. Linder 169

Common between Levant and Zebrakop, especially on sand.

E. coccinea L. Pillans 7200

Gruyskop.

E. cristiflora Salisb. Pillans 7777

Kapteinskloof mountain.

E. curviflora L. Linder 200

Widespread, moist places or clifffs.

E. curvirostris Salisb. Linder 170

Common on Zebrakop.

E. cyathiformis Salisb. Pillans 7209

W. slopes of the back of Gruyskop.

<u>E. glauca</u> Andr. var. <u>elegans</u> Bol. Pillans 7558

Suurvlakte.

<u>E. guthriei</u> Bolus Pillans 7559

Suurvlakte.

<u>E. imbricata</u> L. Pillans 7202

Widespread on dry soils, in proteiod shrub.

<u>E. inflata</u> Thunb. Esterhuysen 14490

Common along streams between Levant and Zebrakop.

<u>E. parilis</u> Salisb. Linder 197

Widespread in sands at lower altitudes on dry slopes at higher.

<u>E. phillipsii</u> L.Bol. Linder 257

Ledges on S. slopes of Zebrakop.

<u>E. plukenetii</u> L. Linder 565

Central part of mountain, uncommon.

<u>E. leptopus</u> Benth. var. <u>piquetbergensis</u> Bol.

Cool slopes south of Zebrakop. Linder 652

<u>E. lucida</u> Salisb. Pillans 8099

Kapteinskloof mountain.

<u>E. mammosa</u> L. Linder 178

Common between Levant and Zebrakop.

<u>E. nobilis</u> Guthrie Linder 182

Zebrakop.

<u>E. nudiflora</u> L. Linder

Between Levant and Zebrakop, rare.

<u>E. quadrangularis</u> Salisb. Linder 447

Suurvlakte.

<u>E. strigosa</u> Soland. Linder 184

Suurvlakte.

<u>E. tenuis</u> Salisb. Linder 572

Zebrakop, rare.

E. thimifolia Wendl. Linder 186
Zebrakop, rare.

E. triflora L. Pillans 4777
Summit of Zebrakop.

E. verecunda Salisb. Pillans 7204
Gruyskop.

6243 *Eremia totta* Don. Linder 455
Levant Hill.

6244 *Simocheilus klotzschianus* Benth. Stokoe 4782
Very common on the drier lower and southern slopes.

S. piquetbergensis N.E.Br. Pillans 7729
Endemic to the lower slopes of the range.

6245a *Aniserica gracilis* N.E.Br. Pillans 7563
S.W. slopes of Zebrakop.

EBENACEAE.

6404 *Euclea acutifolia* E.Mey. Pillans 7908
Widespread in proteoid bush.

E. tomentosa E.Mey. Pillans 7176
Hills N.W. of Moutonsvlei.

6406 *Diospyros glabra* (L.) De Winter Linder 534
Widespread, often in sand.

OLEACEAE.

6434 *Olea africana* Mill. Linder 433
Widespread, common at lower altitudes in moist places.

GENTIANACEAE.

6418 *Sebaea aurea* (L.f.) Roem.& Schl. Pillans 7229
Hills N.W. of Moutonsvlei.

S. exacoides Schinz Linder 413
Widespread, especially in open vegetation.

S. micrantha Schinz Pillans 7127
N.W. of Moutonsvlei, bottom of old pass.

6503 Chironia baccifera L. Linder 120

Widespread, often growing in half-shade.

C. liniodes L. Linder 166

Suurvlakter east of Levant.

ASCLEPIADACEAE.

6752 Microloma tenuifolium (L.) SchussLinder 420

Around Dassieklip.

6758 Astephanus triflorus R. Br. Linder 671

Shale, old vessfeld pass.

6791 Asclepias crispa Berg. Pillans 7353

Pomona area.

A. fruticosus L. Linder

Widespread, but not common, in disturbed areas.

6860 Secamone alpinii Schultes. Pillans 7545

N.W. of Moutonsvlei.

6884 Caralluma incarnata N.E.Br. Hall 26077

W. slopes of Piketberg, 6m N. of Sauer.

6885 Stapelia immelmaniae Pillans Pillans 7781

W. entrance to Kapteinskloof.

BORAGINACEAE.

7117 Lobostemon argenteus Buek. Pillans 7112

Shale, old pass above Voelvlei.

L. glaucophyllus Buck. Pillans 7457

Widespread and common on the mountain.

LABIATEA.

7281 Stachys aethiopica L. Pillans 7123

Bottom of the old pass in shale.

7290 Salvia africana L. Schlechter 5221 (K)

Base of Piketberg.

S. albicaulis Benth. Pillans 7465

Hills N.W. of Moutonsvlei.

S. aurea L. Pillans 7403

Hills N.W. of Moutonsvlei.

S. chamelaeagnea Berg. Theiler 42 (PRE)

SOLANACEAE

7407 *Solanum nigrum* L. Linder 490

Zebrakop.

7415 *Datura stamonium* L. Linder 511

Along the Bushmans River.

SCROPHULARIACEAE.

7471 *Diasca diffusa* Benth. Linder 440

Widespread.

D. elongata Benth. Linder 396

South of Versfeld Pass.

7476 *Nemesia barbata* (Thunb.) Bens. Linder 392

Widespread at lower altitudes in drier areas.

N. latifrons Grant m.s. Pillans 7464

Zebrakop, often under boulders in sand.

N. versicolor E.Mey. ex Benth. Linder 394

South of Versfeld Pass in dry sand.

7493 *Halleria lucida* L.

In scree and riverine forests.

7494 *Teedia lucida* Rudolphi Linder 461

Sandleegte.

7517 *Manulea leiostachys* Benth. Pillans 7512

Hills N.W. of Moutonsvlei.

M. rubra L.f. var. *turritis* Hiern. Pillans 7512

Hills N.W. of Moutonsvlei.

7519 *Sutera aethiopica* L. Linder 339

Widespread on dry stony soils at all altitudes.

S. annua Hiern. Pillans 7286

Kafferskloof.

S. antirrhinoides Hiern. Linder 660

Langberg, dry stony slopes.

S. foetida Roth. Pillans 7289

Slopes N. from Pomona.

7522 Polycarena qiliodes Benth. Linder 406

Suurvlakte E. of Levant.

P. rariflora Benth. Linder 661

Sandy soil, often on burns.

7523 Zaluzianskya dentata Walp. Linder 465

Often on ledges or open spaces at higher altitudes.

7597 Melasma sessiliflorum Hiern. Linder 536

Platberg.

7627 Harveya capensis Hook. Linder 196

Zebrakop.

SELAGINELLACEAE.

7567 Dischisma ciliatum (Berg.) choisy Linder 405

Common on the plateau east of Levant.

7568 Selago adpressa Choisy Linder 449

Common.

S. fruticosa Rolfe Linder 676

Shale at Deezehoek.

S. quadrangularis Choisy Linder 226

Plateau east of Levant.

S. scabrida Thunb. Pillans 7174

Hills N.W. of Moutonsvlei.

S. spuria L. Pillans 7553

Hills N.W. of Moutonsvlei.

S. tephrodes E.Mey. Pillans 7135

Bottom of old pass in shale.

7569 Microdon cylindricus E.Mey. Pillans 7173

Hills N.W. of Moutonsvlei.

M.lucidus Choisy Pillans 7406

Common.

MYOPORACEAE.

8114 Oftia africana (L.) Bocq. Pillans 7322

Widespread and common, tends to be weedy.

PLANTAGINACEAE.

8116 Plantago lanceolata L. Linder 480

Roadside at top of Versfeld Pass, weedy,

RUBIACEAE.

8438 Anthospermum ciliare L. Pillans 7326

Hills N.W. of Moutonsvlei.

A. ecklonis Sond. Pillans 7317

Widespread.

A. tricostratum Sond. Linder 388

Plateau east of Levant.

A. aethiopicum L. Linder

Very common, especially in proteiod shrub.

8443 Carpacoce vaginellata Salter Linder 451"

Plateau east of Levant.

CAMPANULACEAE.

8663 Prismatocarpus fruticosus L'Her Linder 202

Widespread, especially in deep sand.

8668 Wahlenbergia ecklonii Buek. Pillans 7146

Top of old pass, Sandleegte.

W. exilis D.C. Pillans 7525

Hills N.W. of Moutonsvlei.

8681 Cyphia bulbosa (L.) Berg. Linder 386

Common on suurvlaktes, especially east of Levant.

C. phyteama (L.)W. var. phyteama Linder 468

Zebrakop.

C. volubilis (Thunb.) Willd. Linder400

Widespread, scrambles in bushes, usually dry stony slopes.

8694 Lobelia coronopifolia L. Linder 659

Widespread on sand in open places in bush.

L. spartioides D.C. Pillans 7421

Dassieklip.

8699 Laurentia arabidea D.C. Pillans 7546

Hills N.W. of Moutonsvlei.

L. pygmaea Sond. Pillans 7395

E. slopes of Levant.

COMPOSITAE.

8764 Corymbium enervum Mast. Linder 205

Plateau east of Levant.

C. scabridum Berg. Pillans 7529

Hills N.W. of Moutonsvlei.

C. villosum Less. Pillans 7306

S.W. slopes of Zebrakop.

8862 Pteronia camphorata L. Pillans 7419

Widespread and common.

P. divaricata Less. Bolus 13565

Goedverwacht.

P. hirsuta L.f. Jansen s.n.

Tierkloof

8883 Mairia perezioides Nees Linder 561

Frequent in dry fynbos, south of Langberg.

8919 Felicia amoena (Sch. Bip.)Levyns ssp. amoena

Between Levant and Zebrakop. Pillans 7607

F. bergerana (Sprengl) Hoffm. Guthrie 2619

F. cymbalariae (Ait.)Bol. ssp. cymbalariae
Bolus 27586

F. dubia Cass. Pillans 8633
E. base of the Piketberg mountain.

F. filifolia (Vent.)Burtt Davey Linder 537
Widespread in dry areas.

F. hyssopifolia (Berg.) Nees Linder 366
Widespread in dry areas.

F. tenella (L.)Nees ssp. pusilla (Harv.)Grau
Hills N.W. of Moutonsvlei. Pillans 7412

8926 Conysa ambigua D.C. Linder 524
Grootberg.

8930 Chrysocoma coma-aurea L. Linder 545
Grootberg.

8936 Brachylaena neriifolia R.Br. Linder 201
Common along permanent and semi-permanent streams.

8992 Gnaphalium candidissimum Less. Pillans 7384
Between Levant and Zebrakop.

G. undulatum L. Linder 535
Tierkloof, common, weedy.

9000 Helipterum canescens D.C. Pillans 7995
Widespread on dry stony slopes.

9006 Helichrysum capitellatum Less. Pillans 7542
Hills N.W. of Moutonsvlei.

H. cylindricum Less. Pillans 7111
Bottom of old pass on shale.

H. ericaefolium Less. Linder 482
South of Versfeld Pass, dry conditions.

H. ericoides Less. Pillans 7602
Plateau east of Levant.

<u>H. indicum</u> (L.) Griesum Pillans 7168

Moutonsvlei.

<u>H. odoratissimum</u> Less. Pillans 7458

Hills N.W. of Moutonsvlei.

9008 <u>Leontonyx glomeratus</u> D.C. Linder 470

S.W. slopes of Zebrakop.

<u>L. glomeratus</u> var. <u>stramineus</u> Harv. Linder 457

S.W. slopes of Zebrakop.

9037 <u>Stoebe fusca</u> Thunb. Linder 222

Common on Zebrakop.

<u>S. plumosa</u> (L.) Thunb. Linder 328

Widespread and common, especially in moist areas.

9039 <u>Disparago lasiocarpa</u> Cass. Linder 505

South of Versfeld Pass.

9041 <u>Elytropappus glandulosus</u> Less. Linder

Zebrakop, dry shelterded W. facing gullies.

<u>E. rhinocerotis</u> (L.f.) Less. Pillans 7134

Very common at lower altitudes, dom. on shale.

<u>E. scaber</u> Levyns Linder 523

Very common in dry areas on mountain.

9043 <u>Metalasia muricata</u> (L.) Don. Esterhuysen 20135

Very common, especially in dry proteoid bush.

9050 <u>Relhania genistaefolia</u> L´Her Pillans 8031

At base of Kapteinskloof mountain.

<u>R. squarrosa</u> L´Her Linder 424

Widespread on the lower dry fynbos slopes.

9052 <u>Leyssera gnaphaloides</u> L. Pillans 857

Slopes above De Hoek, Karoo species.

<u>L. incana</u> Thunb. Linder 546

Kafferskloof.

9059 Printzia sp. Linder 691

Old pass, shale, rhenosterveld.

9061 Inula graveolens (L.)Desf. Linder 326

Stawelklip, weed.

9320 Eriocephalus capitellatus D.C. Linder

Common in dry fynbos at lower altitudes.

9322 Eroeda hirta (Thunb.) Levyns Pillans 7824

Kapteinskloof mountain.

9326 Athanasia crithmifolia L. Linder 628

Occasional in dry proteoid veld.

A. parviflora L. Pillans 7433

Hills N.W. of Moutonsvlei.

A. pubescens L. Linder 256

Common.

A. trifurcata L. Pillans 7407

Widespread.

9351a Cenia turbinata (L.) Pers. Pillans 7536

Sand on the Plateau east of Levant.

9357 Hippia frutescens L. Pillans 7591

Between Levant and Zebrakop.

H. pilosa Hutch. Linder 657

Zebrakop, moist places, seepages.

9366 Pentzia suffruticosa Hutch. Pillans 7165

Sandleegte.

9406 Cineraria canescens Wendl. Pillans 7597

S.W. slopes of Zebrakop.

9411a Kleinia crassulaefolium D.C. Pillans 7223

9411 Senecio arenarius Thunb. Pillans 7528

Hills N.W. of Moutonsvlei.

S. cymbalarifolius Less. Pillans 7453

Hills N.W. of Moutonsvlei.

S. diversifolius Harv. Pillans 7138

Bottom of old Pass, shale, rhenosterveld.

S. erosus L.f. Pillans 4700

S.W. slopes of Zebrakop.

S. incertus D.C. Pillans 7374

Between Levant and Zebrakop.

S. leucoglossum Sond. Linder 321

Plateau east of Levant.

S. panduratus Less. Linder 692

Moreson, weedy.

S. paniculatus Berg. Pillans 7381

Between Levant and Zebrakop, mountains.

S. pinifolius (L.) Lam. Linder 586

On deep sand, particularly after fire.

S. pinnatifidus Less. Linder 331

East of Levant.

S. pubigerus L. Linder 525

Common on deep sand.

S. repandus Thunb. Pillans 7144

Sandleegte, edge of escarpment.

S. rigidus Compton Linder 227

Moist places on Zebrakop.

S. rosmarinifolius L.f. Pillans 7359

Hills above Stawelklip.

S. vestitus Berg. Pillans 7454

Moist places, Zebrakop.

9417 *Euryops speciosissimus* D.C. Pillans 7704

Common on the dry fynbos lower slopes.

E. thunbergii Nord. Linder 673

Common on shale at the base of the mountain.

9418 Gymnodiscus capillaris Less. Linder 651

Langberg, in sand after a fire.

9420 Othonna auriculaefolium Licht. Linder 603

Levant, shallow sand.

O. ciliata L.f. Linder 340

South of the Versfeld Pass.

O. digitata Less. Linder 363

Plateau east of Levant.

O. heterophylla L.f. Linder 654

Suurvlakte east of Levant.

O. lingua Less. Linder 357

East of Levant.

O. multicaulis Harv. Esterhuysen 14494

O. pinnata L.f. Linder 649

Langberg, on sand.

O. quercifolium D.C. Linder 633

O. rigens (L.) Levyns Linder 356

East of Levant.

9425a Castalis nudicaulis (L.)Norl. Schlechter 5242

9425 Dimorphotheca montana Norl. Linder 391

Plateau east of Levant.

9427 Osteospermum clandestinum Less. Linder 682

Voelvlei, shaded, on shale. Weedy.

O. pulchrum Norl. Guthrie 2645

O. rigidum Ait. Linder 658

S.W. base of Zebrakop.

9427b Chrysanthemoides monilifera (L.)Norl. Pillans 8023

Common in the moister areas.

9431 Ursinia anthemoides (L.)Poir ssp. anthemoides
Widespread in the drier areas. Linder 378

U. pinnata (Thunb.)Prassl. Linder 547
Widespread over whole area.

U. punctata (Thunb.) N.E.Br. Linder 527
Platberg.

U. rigidula (D.C.)N.E.Br. Linder 641
Langberg and Avondtuur, dry stony soils.

9432 Arctotis aspera L. Pillans 4700
S.W. slopes of Zebrakop.

A. bellidifolia Berg. Pillans 7447
Zebrakop.

A. candida Thunb. Linder 390
Plateau east of Levant.

A. glandulosus Thunb. Esterhuysen 14464
Plateau east of Levant.

A. semipapposum (D.C.) Lewins Linder 612
Hills south of Zebrakop, sprawling in seepages.

A. undularis Jacq. var. acaulis Linder 662
Langberg, sandy areas.

9432d Arctotheca prostrata (Salisb.) Britt. Linder324
Moutonsvlei.

9433 Gorteria personata L. Linder 668
Old pass, in shale, rhenosterveld.

9434 Gazania krebsiana Less. Linder 393
Suurvlakte east of Levant.

9438 Berkheya barbata (L.f.) Pillans 7531
Common among boulders above 900m.

<u>B. viscosa</u> (D.C.) Hutch. Pillans 7262

Between Moutonsvlei and Gruyskop.

9528 <u>Gerbera crocea</u> Ktze. Pillans 7254

Between Moutonsvlei and Gruyskop.
