The flora that matched the fauna

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ABSTRACT

An attempt is made to reconstruct the vegetation of the plains, plateaux, mountains and rivers of the semi-arid to arid western half of the Republic of South Africa as it was before it came under the influence of any type of man other than the Bushman and the Hottentot. Species of plants that were likely to have been important are listed, even if they are rare today. Particular attention is paid to the riverine vegetation. Features of the vegetation and topography that might have influenced the fauna are noted.

INTRODUCTION

To conserve and manage our fauna and vegetation successfully, it is desirable to know what the vegetation was like before the White man appeared on the scene some 200-300 years ago. In short, a reconstruction of the original vegetation is required. The area under consideration is the western half of the Republic, i.e. roughly west of longitude 26 °E, where the vegetation has suffered the greatest changes and where the indigenous animal population has all but disappeared. Only by a process of deduction will it be possible to determine what the state of vegetation was when the Hottentots, Bushmen and game had the veld all to themselves. By the time the scientific description of flora and vegetation first became possible, much of the vegetation and soil had been damaged or was well on its way to being damaged. The vague descriptions and references to grass and the absence of grass that we have at our disposal help very little and tend rather to be confusing. Burchell's (1822-1824) attempt to list the flora in Griqualand West shows how little was known in 1810, at a time when the White and Coloured pastoralists had already penetrated to all parts of this western half except the far north, and there the Black man had long been established.

Because of the topography, some of the vegetation types tend to occur in continuous belts, extending over hundreds of kilometres even if very narrow, rather than in isolated patches. Evidence of seasonal migration of game must be sought where these belts extend across the boundary between summer- and winter-rainfall regions. If the belts also extend from cold high altitudes to warm low altitudes, the probability of migration is increased. On the other hand, greater swampiness along the rivers, or denser gallery forests and thickets, may well have hampered the movements of some species.

Hunters and gatherers are no longer a factor in the environment, but in the eastern half of the country we can still see how the vegetation reacts to Man advanced beyond the hunting and gathering stage. One does not have to be a botanist to notice, for instance, that in a few decades the purple-pink winter colour of a climax Themeda-veld can change to the white of a pioneer Eragrostis-veld to the mottled green and white of a Chrysocoma-Aristida—bare-ground—desert type of false karoo. One will also note that, physiognomically, the end result in an area receiving 600 or 750 mm of rain a year will hardly differ from that in an area annually receiving 175 or 200 mm hundreds of kilometres away to the west or south, except that there will perhaps be no dongas in the latter because no soil remains.

A second great change that inevitably follows thinning or destruction of a grass cover is the erosion of the soil by water and wind. This erosion is not so obvious on the flats until one notices that some of the longer-lived bushes, like Lycium, Pteronia and Rhigozum, are standing on 30 cm stilts. Where the soil is deep, for example on apron slopes of the mountains and along the valleys, this is particularly noticeable. The capacity of the country to support the animals through the dry season is reduced by the disappearance of swamps and river flats formerly too wet for use in the rainy season. Much of the scanty and erratic rainfall, particularly the heavy rain which does not fall very often, is also lost down the dongas. For this reason, one hears the farmers complaining about “dry rain”. Donga erosion is the biggest obstacle to restoring the vegetation, mainly because the uneven surface cannot hold the rain long enough for it to soak into the soil, and thus to promote the growth of plants.

A third great change that anyone can observe is the whittling away of forest for cultivation, road-building and so on, and by veld-burning. On a small scale, perhaps, because western South Africa had only a small area of forest then and a very small area now. Forest is nevertheless a vegetation type that must be added and some types of thicket, too, for instance Spekboomveld, which is being nibbled away by goats.

A fourth noticeable change is conversion of grassveld (grassland) and grassy woodland into thorny thickets, either by invasion or by thickening up of local species such as Acacia karroo, A. mellifera subsp. detinens and Rhigozum trichotomum. Another aspect of this is invasion of karroo and fynbos by exotics such as species of Prosopis, Pinus, Hakea and Acacia. Therefore thickets of the wrong type and occurring in wrong places, also forest if it is artificial, should be removed from the vegetation picture before we can arrive at the original condition of the vegetation.

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A fifth important and universal change, but not always obvious and often difficult to assess, is change in species composition even where there is not change in vegetation type. This can be caused by selective overgrazing, by too frequent burning, or by selective use for timber, firewood, medicine, etc., some species tending to disappear and others tending to increase by taking their place.

A very serious problem arises in those regions where forest, fynbos and grassveld meet, because neither fynbos nor grassveld can survive under a forest canopy even if it is only a scrub-forest, nor can grassveld survive in a fully developed fynbos. The difficulty is that in any particular area many of the fynbos species, in particular, are endemic and so cannot be replaced from outside that area. The only solution appears to be to invoke a "rotating climax", depending on fire at appropriate intervals under a climate of such a nature as to prevent the forest from advancing beyond a scrub-forest or thicket stage that becomes inflammable in a severe drought. The rotation would be: scrub-forest—fire—grassveld—fynbos—scrub-forest. For several reasons, fire as an environmental factor can hardly be eliminated. For, however long or short a period fire-using man has been around, it is difficult to visualize a climate without lightning, nor can spontaneous combustion be ruled out in a mixture of animal droppings and damp grass.

TOPOGRAPHICAL REGIONS AND THEIR VEGETATION

The country under consideration consists topographically of the following regions (see Fig. 1):

(a) a coastal plain on the west side;
(b) a low coastal plateau on the south side, with little coastal plain;
(c) mountain ranges running north and south on the western side (Kamiesberg, Cedarberg, etc.), east and west on the south side (Langeberg, etc.) near the coast;
(d) an inland mountain range (Swartberg) running east and west parallel with the coastal range of the south coast;
(e) the Great Escarpment of the upper plateau, running more or less parallel with the Swartberg and Cedarberg;
(f) a series of basins between or within the mountain ranges:
   (i) the Worcester—Robertson Karoo.
   (ii) the Little Karoo
   (iii) the Great Karoo
   (iv) the Ceres—Tanqua Karoo
   (v) the Warm Bokkeveld; and
   (vi) the Cold Bokkeveld;

(g) the upper plateau.

In this account, the number of species mentioned in parentheses after the veld type number is the veld type.

The veld type that shows signs of the most grassiness is what is now Coastal Renosterbosveld 46.1 (c. 900 species, 205 m) on clayey soils. This would have been a fairly dense Themeda-dominated grassveld for a few years after a fire until a thick sprinkling of small shrubs of many species grew out again; the grassiness would, however, have been permanent and the renosterbos not yet dominant. Ploughing has been so thorough that all that is left of this veld is on hills too steep to be ploughed and on outcrops of hard rock.

The grasses included:

- Cymbopogon marginatus
- Cynodon dactylon
- Ehrharta calycina
- E. capensis
- E. mespilus
- E. villosa
- Eragrostis curvula
- Festuca scabra
- Hemarthria altissima
- Hyparrhenia hirta
- Karroochloa curva
- Koeleria cristata
- Lasiochloa longifolia
- Merxmuelleria arundinacea
- M. rufa
- M. rufula
- Pennisetum macraurum
- Pentaschistis curvifolia
- P. thunbergii etc.
- Phragmites australis
- Plagiocloa uniolae
- Sporobolus virginicus
- Stipagrostis capensis
- Themeda triandra

The shrubs and small trees of stream-banks, rocky places and "heuweltjies" included:

- Diospyros glabra
- Dodonaea viscosa var. angustifolia
- Euclea tomentosa
- Lycium fruticosum
- Maytenus heterophylla
- M. oleoides
- Mentostachys caryophyllacea
- Olea africana
- O. capensis
- Printzia polifolia
- Rhus angustifolia
- R. incisa
- R. laevigata
- R. rosarinfolia
- Salvia africanca-caerulea
- Solanum guineense
- Solanum spinosum
- Wiborgia mucronata

Of these, Olea africana was dominant, while representative bushes, forbs and geophytes of the Western Coastal Renosterbosveld were the following:

- Agathosma cerefolium
- Aizoocarpus sagittatus
- Albuca altissima
- Anthospermum aethiopicum
- A. capensis
- A. fruticosum
- A. uniflorus
- A. viridiflora
- A. xilostachyum
- Apinis parviflora
- Apinis gracilis
- Asparagus spp.
- Berkeyha armata
- Castalis nudicaulis
- Cliftonia juniperina etc.
- Corymbia villosa
- Crassula subulata etc.
- Cyanella capensis
- Cyphilla digitata etc.
- Diosma hirsuta
- Eichiaischys spicatus
- Euphorbia genistoides
- Ficinia bracteata etc.
- Galenia fruticosa
- Helichrysum revolutum etc.
- Herzogia arisifolia etc.
- Indigofera procumbens etc.
- Lachenalupernum etricides
- Lapeirousia corymbosa
- Lessertia rigidica
- Lobostemon fruticosus etc.
- Lotononis prostrata etc.
- Mohria caffrorum
- Monosopia speciosa
- Morea villosa etc.
- Muralia heisteria
- Nenax hirta
- Ornithogalum thyrsoides etc.
- Oxalis obtusa etc.
- Pelargonium raacemum etc.
- Peulaelia auriculata
- Peucedanum capillaceum etc.
- Phyllica rigida etc.
- Polygala aetherina
- Pteronia hirsuta etc.
- Restio cuspidatus
- Scirpus maritimus
- Seneio hastatus etc.
- Tetragonisia spicata
- Trachycyphus spp.
- Typha laevigata subsp. capensis
- Ursinia chrysanthemoides
- Zantedeschia aethiopica
- Zygocephium sessilifolium

The other veld types in this coast belt are on sandy soils. They are the Strandveld 34 (1 038 species, 58 m), the West Coastal Fynbos 47.1 (1 374 species, 74 m) and northwards on firmer red sandy soil the Succulent Karoo 31.1 (600 species, 183 m). These veld types were more suitable for the browsers in
PHYSIOGRAPHIC MAP of WESTERN SOUTH AFRICA

Natural features mentioned in the text but not named on the map:
1. Richtersveld
2. Langeveld
3. Kubiskow Mountain
4. Cedarberg
5. Bokkeveld Escarpment
6. Cold Bokkeveld
7. Warm Bokkeveld
8. Langeberg
9. Outeniqua Mountains
10. Swartberg
11. Komsberg
12. Onder Sneeuberg
13. Camdeboo Mountains
14. Kikvorsberg
15. Suurberg
16. Bamboesberg
17. Theekloof
18. Rooiberg
19. Sandberg
20. Klein Roggeveld
21. Langkloof
22. Swart se Kolk se Vloer
23. Baviaanskloof
24. Buchuberg
25. Kathu

Positions of modern towns mentioned in the text:

1:2,500,000
that they were essentially shrubby. They would only locally, however, have been too dense for a good deal of grass, including species peculiar to sand, e.g. Ehrharta villosa, Erargrostis spinosa, Pentaschistis involuta, Sporobolus virginicus, Tricholaena arenaria, Chaetobromus dregeanus and Erargrostis cyperoides.

To the south, Restionaceae were important, e.g. Wildenowia striata and, in wet hollows, species of Chondropetalum and Thamnochortus.

High forest cannot have existed in this semi-arid region, but there was a little short forest in the shape of gallery forest along the permanent streams, not to mention the curious “Lilliputian forest” of the coastal dunes and the short thorny thickets on limestone in the Saldanha Bay area. In the gallery forest, species included:

- Olea africana
- Podocarpus elongatus
- Pterocelestrus tricuspidatus

Colpoon compressum
Maytenus heterophylla
Acacia karroo (northwards)

The “Lilliputian forest” and the limestone thicket of the Strandveld included:

- Cassine eucleaefornis
- Euclcea racemosa
- Pteronia tricuspidata
- Rhus glauca
- Chrysanthemoides monilifera

Away from the coast, the Strandveld is of Fynbos form, but includes more of the bushy succulents like Cotyledon paniculata, Euphorbia burmannii, Ruschia cymosa, R. utilis, Othonna floribunda, Pelargonium fulgidum, P. gibbosum and Zygophyllum morgsana.

Also present are some shrubs not found in the Fynbos, such as Pteronia onobromoides, Jasminum glaucum, Erioccephalus racemosus, Justicia orchioides, Lebeckia multiflora and L. sericea, but it lacks Protea, Leucadendron, Leucospermum and Serruria of the Coastal Fynbos.

In the West Coast Fynbos, the grasses included the following:

- Chaetobromus dregeanus
- Cymbopogon marginatus
- Cynodon dactylon

Diplachne fusca
Ehrharta calycina
E. villosa

Eragrostis curvula
E. sarmentosa
Hemarthria altissima
Imperata cylindrica
Lasiochloa longifolia
Pentaschistis curvifolia
P. thunbergii
Plagiochloa uniolea

The shrubs of the West Coast Fynbos included:

- Berzelia abrotanoides
- Diospyros austro-africana
- var. rugosa
- D. glabra
- Euclcea racemosa
- E. tomentosa
- Leucadendron salignum
- L. imbricatum
- L. pubescens etc.
- Leucospermum rodotentum
- Lycium afrum
- L. ferocissimum

The bushes of the West Coast Fynbos included the following:

- Agathosma capensis etc.
- Anthospermum aethiopicum
- Aspalathus quinquexcifolia subsp. virgata
- A. ternata etc.
- Cliftonia spp.
- Diosma oppositionifolia etc.
- E. tomentosa
- Euphorbia burmannii
- Colpoon compressum
- Zygophyllum morgsana
- Limonium perigrinum

The shrubs of the West Coast Fynbos included:

- Passerina glomerata
- Pharacnum incanum
- Phyllica cephalantha
- P. rigidifolia
- P. stipularis etc.
- Polygala gurannii
- Priestleya sericea
- Protea scolymocephala
- Rafnia spp.
- Serruria spp.
- Solanum guineense
- Stasiia radiata
- Stoebe fusca etc.
- Tetragonia fruticosa
- Thesium scabrum etc.
- Viscum capense
- Zygophyllum spinosum

Forbs and geophytes of the West Coast Fynbos included:

- Aizocon paniculatum
- Antholza rings
- Argyrolobium velutinum
- Asparagus asparagusoides
- Babiana spp.
- Caesia dregeana
- Chlorophyllum viscosum
- Chondropetalum tectorum
- Cyanella capensis
- Cynanchum africanum
- Euphorbia tuberosa
- Ficinia bulbosa etc.
- Gladiolus alatus
- G. carinatus etc.
- Helichrysum spp.
- Lachenalia bulbifera etc.
- Lapeirousia fabricii etc.
- Lebeckia carnosa etc.
- Limonium longifolium
- Lobelia coronopifolia
- Melapherula ramosa
- Microloma sagittatum
- Moraea fugax etc.
Ornithogalum thyrsoides etc.
Osteospermum imbricatum etc.
Othonna perfoliata etc.
Oxalis purpurea etc.
Pelargonium triste etc.
Pelalcte coronata
Restio filiformis etc.
Romulea rosea etc.
Rumex cordatus

One may suppose that the pastoral Hottentots made free use of fire in order to take advantage of the ability of a high proportion of the shrubs to coppice from the crown. This new growth of nearly all species of bush and Restiads is palatable to cattle (and to bontebok at least of the wild animals, as can be seen in the Bontebok Park), even though the old growth of nearly all species now present is unpalatable.

Change in species composition in apparently unaltered veld is difficult to assess in this part, because little grazing is now done to give one an idea of which species are likely to have been reduced by overgrazing in the past. One has to suppose that in important genera like Aspalathus, Erica and Cliftonia there were many species that were palatable to the wild animals, but one can feel sure that the species which are now dominant, as a result of selective grazing by domestic livestock, were not the original dominants.

Northwards beyond the Olifants River, the country is very arid and in summer more suited to the animals that do not need to drink, except perhaps near the mountains and near the coast. The high proportion of succulents in the Succulent Karoo would be a help, assuming they were palatable. Here again, the dominants of today were not the original dominants, while the proportion of non-succulent shrubs and grasses was higher than it is now. More widespread species in the Succulent Karoo are now:

- Adromischus mamillaris
- Amphiglossa tomentosa
- Aridaria noctiflora
- Sphiemanthus tetrameria
- Asparagus capensis
- Berkleya fruticosa
- Cotyledon reticulata
- C. wallichii
- Drosanthemum frutescens
- Euphorbia burmanni
- Senecio glabriusfolius etc.
- Staberoha distachya
- Tetrarognia portulacoides
- Thamnochortus dichotomus
- Trachyandra scabra etc.
- Ursinia chrysanthemoides
- Wachendorfia paniculata
- Watsonia coocinea
- Willdenowia arersens
- W. striata
- Zantedeschia aethiopica
- Osteospermum sinuatum
- Psilocaulon utile
- Pteronia heterocarpa
- Ruschia caroli
- R. cymosa
- R. frutescens
- Osteospermum sinuatum
- Psilocaulon utile
- Pteronia heterocarpa
- Ruschia caroli
- R. cymosa
- R. frutescens
- Adromischus mammilaris
- Othonna perfoliata
- Oxalis purpurea etc.
- Aspalathus, Erica and Cliftonia
- Ursinia chrysanthemoides
- Wachendorfia paniculata
- Watsonia coocinea
- Willdenowia arersens
- W. striata
- Zantedeschia aethiopica
- Osteospermum sinuatum
- Psilocaulon utile
- Pteronia heterocarpa
- Ruschia caroli
- R. cymosa
- R. frutescens

Grassiness is sometimes conspicuous, but today it is mainly annual, consisting of an annual form of Ehrharta calycina, with Stipa capensis (particularly on the “heuweltjies”), Bromus japonicus, Lasiochloa echinata, Pentaschistis capillacea and others. Besides these annuals, perennial grasses included Ehrharta calycina, E. barbinodis, Chaetobromus dregeanus, Tricholaena arenaria and Stipa capensis and would formerly have been more plentiful.

Soil erosion would have been of little importance here because of the generally soft nature of the rainfall. Winds are strong from the north-west and south-east, but as they blow along the coast rather than inland, their effect is less than might be expected.

It should be noted that the rounded mountains of the Escarpment in Namaqualand do not constitute the barrier to eastward migration that the mountains do southwards, and the gap between the Kamiesberg and the Langeberg provides an open passage to the grassy Bushmanland plateau. There is, moreover, considerable drainage from the Kamiesberg in a southerly and south-easterly direction into this gap.

A feature of the west-coast belt is an immense geophyte flora. Bulbs, corms, tubers and rhizomes often give the impression of being more plentiful than soil in the top few centimetres. Another feature is the occurrence, both in clayey and sandy parts, of the low mounds known as “heuweltjies”, which may or may not have been termitaria. Bush-clumps are associated with them in parts that are not too thoroughly denuded.

The picture one can form of the vegetation is thus a grassy shrubland up to two or three metres tall, open and densely grassy only in the southeastern portion which is now (or was until ploughed up) Renosterbosveld. Intersecting it would be belts of short forest and thicket along the major drainage channels, another type of shorter thicket occurring all along the coast, while bush-clumps were dotted around too. The lower courses of some of the rivers which arise in the mountains were possibly deep...
or swampy enough to constitute barriers to movement of most kinds of game. As the whole area received a winter rainfall there was little climatic variation.

South of the Olifants River, movement of game would probably have been restricted to concentration in summer around places where there was permanent water and enough moisture in the soil to permit growth of grass in particular, perhaps on the mountain sides too, with game dispersed in winter. In the arid part north of the Olifants River, movement of animals, especially those not dependent on drinking water, was more or less unrestricted because of easy access to the upper plateau.

One can safely say that there was a place for all kinds of animals except those of high forest.

(b) **Coastal plateau**

The plateau of the south coast is similar in general characteristics, but is less arid and receives a proportion of summer rainfall sufficient to support a more vigorous growth of grass, large shrubs and small trees. There is no material climatic variation.

Topography is more broken, with the main rivers, which rise in the mountains, sunk in deep gorges for much of their courses. Even the minor streams arising locally often have deep, narrow channels. The underlying rock being either tilted shale or clayey soils and Fynbos in a proportion of summer rainfall sufficient to support a more vigorous growth of grass, large shrubs and small trees. There is no material climatic variation.

This sort of short forest rotated with tall *Protea* Fynbos and *Themeda*-dominated grassveld, but could not have been a permanent climax because of the large number of fynbos endemics. The grassveld phase may have been shorter-lived than in the Renosterbosveld, but it should be noted that *Themeda* here is capable of becoming a scrambler, with leafy stems up to 1½ metres long. It has the same shrub-(and restiad-) smothering ability as *Ehrharta barbinodis* in Namaqualand. General sandiness notwithstanding, in places one finds a suggestion of a black humus soil and a open limestone, held in position now by the thinly twiggy but strongly rhizomatous *Ehrharta rehmannii*.

**Besides Themeda and Ehrharta rehmannii**, the grasses of the Duineveld included the following:

- *Andropogon appendiculatus*
- *Aristida diffusa var. burkei*
- *Cymbopogon marginatus*
- *C. plurinodis*
- *Cynodon dactylon*
- *Diplachne fusca*
- *Ehrharta calycina*
- *E. villosa*
- *Eragrostis curvula*
- *Eustachys mutica*
- *Festuca scabra*
- *Hemarthria altissima*
- *Koeleria cristata*

**Besides the trees and shrubs of the short forest**, the shrubs and lianas of the Duineveld included:

- *Amphithalea ericaefolia*
- *Clutia ericoides*
- *Chascanum cernuum*
- *Asparagus rubicundus*
- *A. nigra*
- *A. calcarea*
- *Euclea racemosa (as a tree)*
- *Eucalyptus globulus*
- *Eucalyptus gunnii*
- *E. coccinea*
- *E. muirii*
- *E. villosa*
Myrsine africana
Nenax hirta
Nylandia spinosa
Pasperina galpinii
P. glomerata
Pelerangium betulinum etc.
Pentzia sp. = A 23142, 23959
Phytolacca incanum
Phyllica dodii etc.
P. parviflora etc.
Polygala bracteata
P. peduncularis etc.

The forbs and geophytes include:
Albuca cooperi
Antizoma capensis
Arctopus echinatus
Argyrolobium lanceolatum
Artaca africana
Babiana nana etc.
Berkheya coriacea
Brassavagia orientalis
Cassytha ciliolata
Castalas nudicaulis
Centella difforsis
Chironia tetragona
Chondropetalum microcarpum
Corymbium glabrum
Crassula subulata var. subulata etc.
Euphorbia silenifolia
E. villosa
E. polyphylla etc.
E. microcarpa
E. crassiflora
E. buxifolia
E. melicoides
E. tubularis
E. purpurea
E. matrella
E. melicoides
E. capensis
E. ecklonii
E. villosa
E. ecklonii
E. crassiflora
E. capensis
E. torta
E. pusilla
E. arganier
E. heringii
E. cheiranthus
E. kollmannii
E. arganier
E. heringii
E. cheiranthus

The Valley Bushveld has become open and clumpy and much invaded by Elytrarpopus rhinocerotis. It is probable that the deep little valleys of streams running north into the Riversonderend and south into the Breede River were filled with reedswamp, the main rivers being filled with Priorium Swamps.

The likely migration route out of the coast belt for most of the animals would seem to be into the Breede River valley past Swellendam. The Knysea forest barred them in the east, mountains barred them in the north and west and the Riversonderend made access to the upper Breede River valley, via the Villersdorp gap, difficult.

There was a place for all kinds of animals except those of the desert.

(c) Coastal mountain ranges

These ranges consist of sandstone and quartzite with a poor sandy soil, except in Namaqualand and near Cape Town where granite and shale occur. Very little soil remains today, but presumably when fires were less frequent these ranges were better wooded and could carry a denser vegetation, but at best they are precipitous and rugged.

Where rainfall is sufficient, southern lower slopes and kloofs were clothed with a rich forest of Knysea type. It occurred on Table Mountain, on the mountains around Stellenbosch, and perhaps Fransch Hoek, and was probably continuous from the Riversonderend Mountains to George except for short gaps in the valley of the Breede River and the gorge of the Gouritz River. On the drier west side and on the lower mountains of Caledon and Bredasdorp, shorter forest is found, but it is difficult to say how extensive it might have been. Today it is confined to stenches except for a few relics like the Ulkraal forest near De Kelders. It is true forest rather than thicket, so if it did cover the south slopes, at least of the mountains of Caledon and Bredasdorp it would have been a permanent climax.
such forest on the south coast mountains in a narrow belt above the Knysna-type forest and extending to the Couga Mountains.

On the west coast ranges the rainfall comes in winter with snow, but in summer only the upper slopes receive a certain amount of moisture from mists. On the south coast ranges rainfall also comes in summer, increasing eastwards, in addition to winter rainfall and snow.

The vegetation throughout, apart from the forest, is Mountain Fynbos, varying greatly in species composition from place to place, but always having such a variety of species of grasses, sedges, restiads, ericoid shrubs, forbs and sedges, that the vegetation is renosterbosveld with relics of their flora as well as extensive swamps, which include the following:

- **Aloe dichotoma**
- **Pennisetum macrourum**

The botanist finds it difficult to visualize a fauna of the mountains (klipspringer, vaal rhebok, quagga perhaps?), but in these valleys a numerous and abundant fauna seems more possible. Thanks to the presence of a multitude of small species of grasses, sedges, restiads, ericoid shrubs, forbs and sedges, as to provide for any kind of animal that is prepared to climb. However, there is little place for pure grassveld. The Mountain Fynbos has not been studied in the same way as the Coastal Fynbos and other veld types.

The only reasonably level country within the mountains comprises the Warm Bokkeveld of Ceres, f (v), and a maze of valleys in the Cold Bokkeveld, f (vi), at a higher level to the north. Neither is karoo so they are best considered here. In the flat, open Warm Bokkeveld, shale outcrops have resulted in a vegetation of renosterbosveld with relics of Themeda Veld surviving. The Cold Bokkeveld is mainly sandy and thus fynbos. Both are well watered, with extensive swamps, which include *Prionium serratum* in their flora as well as *Cladium jamaicense*, *Anthoxanthum dregeanum* and *Pennisetum macrourum*.

The rounded granite mountains of Namaqualand, which form a coastal range but are actually on the edge of the central plateau, have a different vegetation. Only on the 1 300 to 1 400 m Kamiesberg Plateau is there a patch of fynbos, renosterbosveld and non-succulent karoo, with narrow belts of renosterbosveld and karoo at lower levels where shale occurs. For the rest, the vegetation, the Namaqualand Broken Veld 33 (1 044 species, 600 m) is physiognomically similar to the luxuriant variation of the Karroid Broken Veld on rocky hillsides in the Little Karoo (pp. 686–688).

The characteristic plant is *Aloe dichotoma*, but today, at least, it is of erratic occurrence. As befits a “broken” veld, all life forms of plants are present. Besides *Aloe dichotoma*, notable plants of more regular occurrence in the Namaqualand Broken Veld include the following:

- **Acacia karroo**
- **Antizoma miersiana**
- **Asparagus retrofractus etc.**
- **Berkeaana frutescens**
- **Cotyledon paniculata**
- **C. wallichii etc.**
- **Dedleta spinosum**
- **Euclea tomentosa**
- **Euphorbia decussata**
- **E. mauritanica**
- **Lebeckia sericea**
- **Meliandus pectinatus**
- **Othonna arbuscula**
- **Osteoperum oppositifolium**
- **Ozoroa color**
- **Pteronia dichotoma var.**
- **Rhus undulata var.**
- **P. divaricata**
- **R. horrida**
- **R. populifolia**
- **Acacia karroo**
- **Dodonea viscosa var.**
- **E. villosa**
- **E. scoparius**
- **Enneapogon scaber**
- **Ehrharta calycina**
- **E. frutescens etc.**
- **Montinia caryophyllacea**
- **Maytenus oleoides**
- **Salvia dentata**
- **Euclea undulata**
- **Eryngiumundulata**
- **Ficus cordata** and **F. ilicinac** occur on rock faces.

On the lower slopes, the taller plants fade out, leaving Succulent Karoo.

On the whole, it is country more suited to the browsers than to the grazers.

**Second mountain range**

The second mountain range, the Swartberg, is higher, up to 2 200 m, and is continuous rather than broken up into separate peaks like the coastal range. It receives less rainfall, some of it in summer, and snow in winter. It consists mostly of quartzite and sandstone, very rugged, and the vegetation is fynbos of drier types, especially on the north side. Here the lower slopes and the north sides of parallel foothills both north and south of the main range, are occupied by Spekboomveld 25.3 (724 species, 612 m), an extension of the semi-succulent bushveld of the Eastern Cape. Much of this Spekboomveld has been grazed out, but it must originally have been continuous, past Willowmore, with that of Aberdeen, Graaff-Reinet, Jansenville, Steytlerville and Uitenhage. One might say we are now in good kudu country.

The Spekboomveld today is usually a dense mixture of succulence and thorniness up to a height of 3 m, but in its original state was presumably more grassy and open and less thorny. If it is found on particularly rugged slopes, it is probably only because it could not survive elsewhere.

In the western variation, 25.3, the following grasses are present:

- **Agrostis semiverticillata**
- **Aristida difusa var. burkei**
- **Arundinella nepalensis**
- **Cenchus ciliaris**
- **Cymobopogon prolixus**
- **Cynodon dactylon**
- **C. incompletus**
- **Digitaria argyrograpa**
- **D. glauca**
- **Digitaria fusca**
- **Ehrharta calycina**
- **E. ramosa var. aphylla**
- **Enneapogon scaber**
- **E. scoparius**
The trees and shrubs of the western Spekboomveld include the following:

- Acacia karroo
- Aloe ferox
- Cadaba aphylla
- Carissa haematocarpa
- Cussonia spicata
- Diospyros lycioides
- Dodonaea viscosa var. angustifolia
- Euclea undulata
- Grewia robusta
- Heteromorpha arborescens
- Kiggelaria africana
- Lycium oxyccarpum
- Maytenus acuminata
- M. heterophylla
- M. polyacantha
- M. oleoides

Among the bushes and forbs are:

- Adromischus maculatus
- Alhagi sociabilis
- Asparagus striatus et al.
- Berkheya obovata et al.
- Cotyledon caucalisoides
- Crassula portulacoides
- C. cultata
- C. rupestris etc.
- Dioscorea hemerocrypta
- Euphorbia heptagona et al.
- Garuleum bipinnatum
- Helichrysum zeyheri
- Hermannia linifolia etc.
- Hippocrium alienatum
- Indigofera polystachya
- Limeum sutherlandianum
- Melianthus comosus
- Monechma pseudopatulum
- Pachypodium succulentum

Apart from the gallery forests in the deep gorges of the rivers which penetrate the range from north to south, there is no forest on the Swartberg, but along the flanks of this mountain range, thus, there is a direct connection with the south-eastern Cape. Only in the east near Aberdeen with the Onder-Sneeuberg and Camdeboo Mountains. One branch continues eastwards into the Amatolas, with only minor gaps, or rather indentations, at Graaff-Reinet (Sundays River), Somerset East (Swaershoek Valley) and Coquhouse (Great Fish River). This branch trends north-eastwards via the Sneeuwberg, Kikvorsberg, Suurburg, Bamboeberg and Stormberg towards the Drakensberg.

The gallery forest to be passable, but, on the other hand, it is possible that the rocks were covered with soil held in place by a denser and more vigorous growth of Prionium serratum than there is now. If so, the rivers would have had more water because of the damming effect of Prionium beds and the hippo, if present, would have had no difficulty in moving along them through the gorges. If hippo really did occur at Zeekoeqat on the upper Traka River, they must indeed have done so.

(e) Great Escarpment

Apart from the Namaqualand mountains, already discussed, the third mountain range lies along the edge of the Great Escarpment. It starts with the isolated Langeveld, Kubiskow Mountain and Hantamberg, and just south of Calvinia becomes the continuous Roggeveld–Komsberg–Nuweveld Range to some 40 km north-east of Beaufort West, with one small gap at Oukloof Pass. It resumes 90 km to the east near Aberdeen with the Onder-Sneeuberg and Camdeboo Mountains. One branch continues eastwards into the Amatolas, with only minor gaps, or rather indentations, at Graaff-Reinet (Sundays River), Somerset East (Swaershoek Valley) and Coquhouse (Great Fish River). This branch trends north-eastwards via the Sneeuwberg, Kikvorsberg, Suurburg, Bamboeberg and Stormberg towards the Drakensberg.

The western part lies in arid country, half receiving winter rainfall, the other half receiving late-summer rainfall, and all receiving winter snow. The eastern part is less arid, the climate in the Aberdeen area being already wet enough to support gallery forest of Celtis africana in kloofs and to support spekboomveld at Graaff-Reinet. From there it becomes progressively wetter to Somerset East, where the subtropical forest starts on the south slopes and the Dohne Sourveld on the summit of the Bosberg. The main rainy season is still late summer and snow regularly falls in winter.

The vegetation almost throughout was grassveld with very little woody vegetation. In the winter-rainfall area, as far east as Theekloof, it was dominated by Secale africanum, Ehhrharta spp., Helicotrichon namaquense and such grasses to form the Namaqualand variation 43.1 (613 species, 1 430 m) and the Roggeveld variation 43.2 (803 species, 1 430 m) of what is now the Mountain Renosterbosveld 43. In the late-summer rainfall area eastwards from Theekloof, it was dominated by Themeda triandra, Tetrachne dregae, Penisetum sphacelatum, P. thumbergii, and their associates to form what has become the Karroid Merxmuellera Mountain Veld 60 (1 166 species, 1 710 m). This veld merged eastwards into the Dohne Sourveld 44.2 and, via the Stormberg Plateau Sweetveld 59, into the mountain veld of the Drakensberg.

It is a feature of this vegetation that it has a high proportion of temperate winter-green grasses, even eastwards where tropical grasses are dominant and at lower, warmer levels, for instance as follows:

- Ehhrharta calycina
- E. capensis
- E. melicoideae
- Helicotrichon spp.
- Festuca caprina
- F. scabra
- Poa binata
- Brachypodium bulbosum
- Bromus leptoedrus
- Schismus barbatus

On the mountain tops, this grassveld was replaced by Merxmuellera-dominated grassveld: Merxmuellera dura in the winter-rainfall area in the Mountain Renosterbosveld and M. disticha eastwards in the country to the north, if the few gorges through the mountains were then as they are now. One might think that they were too rocky and too choked with gallery forest to be passable, but, on the other hand, it is possible that the rocks were covered with soil held in place by a denser and more vigorous growth of Prionium serratum than there is now. If so, the rivers would have had more water because of the damming effect of Prionium beds and the hippo, if present, would have had no difficulty in moving along them through the gorges. If hippo really did occur at Zeekoeqat on the upper Traka River, they must indeed have done so.
Karroid *Merxmuellera* Mountain Veld, and this in turn has been invaded and partially suppressed by renosterbosveld. The latter includes shrubs like *Elytropappus rhinocerotis*, *Euryops* spp., *Pentzia cooperi*, *Helichrysum hamulosum*, *Passerina montana*, *Chrysocoma tenuifolia*, *Euphorbia dregeana* and *Walafrida articulata*.

Although a few species of fynbos genera (besides *Passerina*) occur as rareties (*Cliffortia, Muraltia, Leptocarpus, Ficinia, Lobostemon, Agathosma, Erica*), there is, surprisingly, nothing that can be called fynbos until one reaches the Katberg and the Drakensberg.

There is, however, a type of thicket, or perhaps originally short forest, peculiar to the western part of the range. It consists of *Cliffortia arborea* (sterboom), a small tree resembling *Leucosidea sericea* of the eastern parts rather than *Cliffortia* of the fynbos. Remnants of it occur on scree below the krantzes of the mountains, e.g. at Calvinia and Sutherland.

The renosterbosveld in the winter-rainfall area at lower altitudes around Touwsrivier, 43.3 (715 species, 976 m), and in the year-round rainfall area eastwards, 43.4 (1,034 species, 700 m), is found on the lower slopes of the mountains, between the karoo and the fynbos. At these lower levels it became dominated by *Elytropappus rhinocerotis*, almost singly, retaining a very rich flora, but through little of its original grassiness. Locally, *Eriocephalus africanus* or *Pteronia incana* may be co-dominant or even dominant.

On the upper plateau the Karroid *Merxmuellera* Mountain Veld extended a varying distance into the plains (further than shown in the Veld Type map) and has there been converted into Karoo 42 (642 species, 1,463 m) rather than renosterbosveld. As the mountains are mostly not precipitous or rugged on the inland side, there would thus have been a fairly easy passage through this type of grassveld almost across the country from the Drakensberg and Katberg through to the Onder-Sneeuberg near Aberdeen and again from Beaufort West through to Calvinia. Climate ranges from high summer rainfall to low late-summer rainfall and from low late-summer rainfall to low winter rainfall, with altitude remaining high all through. At lower altitudes there was a complex of grassy passages around the Little Karoo under a low year-round rainfall and into the Bokkeveld under a somewhat higher winter rainfall at a higher altitude, in this case provided by what is now the Mountain Renosterbosveld.

At the eastern end of the Escarpment, one can still see the black humus topsoil disappearing and form some idea of the luxuriance, quality and carrying capacity of the original veld; elsewhere there is only subsoil and an occasional handful of topsoil left to indicate that there was such a soil and such a vegetation.

On the south side of the Escarpment above Aberdeen and towards Pearson, the climate is more humid and the vegetation, particularly on high plateaux, was a mountain form of the Eastern Province Grassveld, a very dense *Themeda* Veld, of which relics survive on the original topsoil. It is, however, much cut up by precipitous gorges. It is breaking down to *Euryops* spp., and a form of *Eragrostis curvula* rather than to *Elytropappus* and *Merxmuellera*.

(i) The Worcester–Robertson Karoo.—This area lies in the middle valley of the Breede River, open to the coastal plateau at the south-eastern end, but hemmed in by mountains and the Riviersonderend elsewhere. The rainfall is low (below 300 mm), but run-off from the mountains is plentiful along many streams. The river itself and its major tributaries, the Riviersonderend and the Hex Rivers, are permanent and would have been deep and slow running, much impeded by *Prionium*, *Typha* and *Phragmites*. They would have had a well-developed gallery forest, more extensive and more continuous than that of today, including such species as:

- *Eucalyptus longatus*
- *Brabeium stellatifolium*
- *Kigelia africana*
- *Freylinia lanceolata*
- *Melianthus major*
- *Lachnostylis hirta*
- *Salix capensis*
- *Podocarpus undulata*, *Carissa haematocarpa*, *Zygophyllum foetidum*, *Putterlickia pyracantha*, *Euphorbia marnianca* and *Cotyledon paniculata* thinning out along the less arid foot-slopes of the mountains into the grassy veld, now renosterbosveld, which is transitional to the fynbos of the mountains. It appears that the rainfall in the rain shadow of this valley was insufficient to support high forest. Relics of forest in kloofs are similar to the gallery forest with some additions, like *Metrosideros angustiloba*, *Cunonia capensis*, *Myrtus acuminata* and *Rhus lancea*.

So it seems that although this valley had some open grassy country for the grazers, it was better suited to hippos and browsers.

(ii) Little Karoo.—Lying between the coast range and the Swartberg, the Little Karoo is drier than the Breede River valley with a rainfall of under 200 mm, dispersed throughout the year. On the other hand, it is not affected by the desert north-west wind of the upper plateau therefore humidity is not so low, conditions which favour the succulents.

The Sandberg, the Rooiberg and the deep gorges of the Gouritz and Groote Rivers divide it into two basins. The western one, the Ladismith Karoo, is a maze of little shaly hills from which all soil has disappeared, and is cut up by outliers of the main ranges. The Touws and the Groote Rivers traverse it from west to east, receiving many tributaries from the mountain ranges on either side and their outliers. It is thus likely that stock waters were generally available, as was riverine veld, even though the
rainfall over most of the area is under 127 mm per year. This meant that in the early days of settlement there was no need to trek away in search of water and grazing. In consequence, no rest would have been given to the relatively scanty hill vegetation, while the riverine vegetation was being "tamed", until soil erosion set in and eliminated the original vegetation. Only remnants of the gallery forest, that survives in the mountain gorges, still occur along the major streams, with such species as *Acacia karroo*, *Rhus lancea*, *R. pyroides*, *Buddleja saligna*, *Salix capensis*, *Clematis brachiata*, *Zygophyllum foetidum*, *Chrysanthemoïdes monilifera* subsp. *subcanescens* and *Phragmites australis*.

However, a farm name like Roode Els Bosch between the Rooiberg and the Sandberg suggests that such forest was not confined to places like Seven Weeks Poort.

The vegetation in general is Karroid Broken Veld 26.1 (778 species, 518 m) including all plant forms from small trees to stone plants, window plants and geophytes, with the Mesembs particularly prominent today. It is an open woodland, the main species including the following:

- *Acacia karroo*
- *Cadaba aphylla*
- *Carissa haematocarpa*
- *Diospyros austro-africana*
- *D. lycioides*
- *Euclea undulata*
- *Grewia robusta*
- *Lycium oxyacarpum*

On rocky hillsides, as distinct from the usual stony ones, it is taller and denser, dominated by:

- *Cotyledon orbiculata*
- *C. paniculata*
- *C. wallchii*
- *Crassula ovata*
- *Euclea undulata*
- *Euphorbia mauritiana*
- *Maytenus heterophylla*

- *Nymania capensis*
- *Pappea capensis*
- *Putterlickia pyracantha*
- *Rhigozum obovatum*
- *Schotia afra*
- *Wiborgia sp.*
- *Zygophyllum morgsana*
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It has been mentioned how the less arid foothills of the mountain ranges have spekboomveld on the north aspects, providing a link with the semi-succulent bushveld of the south-eastern Cape, and renosterbosveld on the south aspects. It was westwards that these originally grassy renosterbosveld belts provided access to the country north of the Swartberg via Touwsrivier, Matjiesfontein and the Klein Roggeveld to the Roggeveld and northwards towards Namaqualand, as well as eastwards along the Great Escarpment.

This denser veld of the rocky hillsides provides another link with Namaqualand. It reaches the Matjiesfontein area via the Buffels River gorge. From there it extends rather intermittently along the lower middle slopes of the Klein Roggeveld and Roggeveld escarpment e.g. at Ganaga Pass and Bloukrans Pass, until it joins the Namaqualand Broken Veld in the Hantam River valley to the north-west of Calvinia. From where this valley debouches onto the coastal plain, remnants again occur southwards, on the lower middle slopes of the Bokkeveld escarpment and the Cedarberg into the Doorn River valley and the Olifants River valley to the Clanwilliam neighbourhood. One may perhaps wonder whether the rhino, with its reputation as a thorneater, in this area regarded Hoplohyllum spinosum and Eragrostis spinosa as delicacies.

If one can thus visualize the vegetation before it was broken down, it ceases to be surprising or questionable that animals of active disposition but of rather-specialized habitat requirements and of large size, such as kudu, elephant, rhinoceros and hippopotamus, could have lived all through this arid country.

Grassiness is difficult to visualize under such a low rainfall, but when woody and fiercely armed shrubs like Carissa haematocarpa and Maytenus heterophylla are driven to take shelter in bonsai form in rock crevices along with soft grasses like Ehrharta calycina and Digitaria argyrograpta, it may be asked whether the distribution of grasses is limited by the eating habits of goats and donkeys rather than by rainfall. Grassiness there certainly is even now. Besides the two perennial species just mentioned, Aristida diffusa var. burkei, Cenchrus ciliaris, Cynodon dactylon, Eragrostis truncata, Hyparrhenia hirta and Sporobolus fimbriatus, are still to be found, usually
in rock crevices. Their presence is so surprising as to suggest that this, and the western part of the Great Karoo, are places where there really has been a major decline in the rainfall. Short-lived grasses with the ability to regenerate very rapidly from seed, such as Stipagrostis obtusa, S. ciliata, S. anomala, Fingerringhia africana and Enneapogon scaber, are more common and less surprising.

The more one studies this veld, the more one suspects that there is also an almost-lost flora of non-succulent grazable bushes. Examples are as follows:

- Dicoma fruticosa
- D. picta
- D. rethanioides
- Felicia lasticarpa
- F. macrorrhiza
- Limonium amoenum

In addition, the following are still relatively widespread:

- Antizoma capensis
- Berkheya cuneata
- B. spinosa
- Cotyledon orbiculata
- Crassula rupestris
- Cyphia digitata
- Dicoma spinosa
- Drosanthemum luteum
- Erioccephalus ericoides
- Euphorbia sp. cf. E. rhombifolia
- Felicia filifolia forma
- F. ovata
- Galenia fruticosa
- Garuleum bipinnatum
- Hermannia desertorum
- H. linifolia
- H. pulverata
- Hirsipicium alienatum
- Indigofera patens
- Kochia pubescens
- Limneum aethiopicum
- Monechma pseudopatulum
- Ornithoglossum viride
- Osteospermum scariosum
- O. sinuatum
- Penzia sp. = A 14409
- Polygala seminuda
- Pieronia glauca
- P. sordida
- Salvia aphylla
- S. tuberculata
- Sarcocaulon spp.
- Sarcostemma viminale
- Scelentium rigidum
- Schizobasis intricata
- Senecio longiflorus
- Sericocoma avolans
- Sutera atropurpurea
- Sutherlandia frutescens
- Tetragonia arbuscula
- T. robusta
- Theasum linearum
- Trichodiadema barbatum
- Viscum capense
- V. rotundifolium
- Zygophyllum flexuosum
- Z. spinosum

One must, moreover, suppose that there were many species of Mesembs as well that were too palatable to goats and donkeys to have survived at all.

The distribution of Portulacaria afra (spekboom) is of interest. When it is plentiful on one side of a fence and absent from the other, one may assume a long-standing difference in grazing management, or the position of watering points relative to the fence. When it covers the north side of a steep, knife-edged ridge but stops short at the crest even though there is no fence, one may assume a micro-climatic difference. However, its survival in some places and total disappearance from other places, when no such considerations apply, is a curious phenomenon that is less easily explained. The farmer is inclined to think that there is a "sour" form of spekboom that is ungrazeable even though it looks the same as the normal "sweet" form. My own view is that the spekboom is not a balanced feed, so that when the grasses and non-succulent shrubs have been virtually eradicated it can no longer be fully utilized. This is the reason why it sometimes increases to the point where its tangled overgrown thickets become impenetrable. Where the other plants are in excess, on the other hand, it is in danger of being browsed to extinction, even its thick, soft trunks being eaten by goats.

In the light of this, the presence of a solitary patch of dense spekboom high on a bare white quartzite mountain side at the western end of the Klein Swartberg, becomes intelligible as an indicator of the original vegetation of that mountain side and of others like it that lack even the spekboom.

Comparison of bare mountain sides with the vegetation outlined on p. 683 helps one to understand how arid regions can be turned into deserts, and how little time it may take. If the vegetation of steep mountain sides can be thus destroyed, what hope of survival had that of the level and easily accessible valleys and flats? If the mountain sides could carry vegetation of that calibre, what could the valleys not have carried? There was no-one interested in recording what they carried, all being too busy destroying it because it was too coarse or was occupying ground that could be ploughed. Nor was there fencing even if there had been any thought of preserving enough to prevent erosion.

The eastern half of the Little Karoo, centred on Oudtshoorn, has a similar climate but is slightly less arid, and is more open, the hills occurring as chains close to, and parallel with, the mountains to north and south. Well-developed Spekboomveld covers warm aspects as well as parts of the south aspects.
and of the flats, with renosterbosveld on cool aspects and plateaux just below the main ranges. Karroid Broken Veld is less extensive.

The perennial Olifants River traverses the area from east to west, with many tributaries coming out of the mountains to north and south. Under the somewhat less arid conditions, gallery forest and swampiness must have been well developed. Relics of subtropical grasses like *Hemarthria altissima*, *Stipa dregeana* var. *elongata*, *Arundinella nepalensis* and *Digitaria glauca* make it easier to visualize a good deal of luxuriance of vegetation of river banks and shady slopes.

Eastwards via the renosterbosveld there was access to the Baviaanskloof and to the Langkloof, leading right down to forest country in Humansdorp Division. There was less easy access to the Karroid Broken Veld of the Great Karoo and Steytlerville Karoo near Willowmore.

So the Little Karoo, too, is likely to have been able to provide for all kinds of animals, except those of high forest, even if in limited numbers, but it was particularly suited to the browsers.

(iii) Great Karoo.—This karoo type, lying between the Swartberg and the Great Escarpment, is open country, unobstructed by mountains, deep rivers or forests. Triangular in shape, it extends some 320 km east and west and 160 km north and south, but across the 90 km gap in the Escarpment it is open to the upper plateau. Here would appear to be scope for large herds and large-scale migrations of animals.

The Great Karoo is, however, badly watered as well as arid. In general, the country slopes down from north to south and run-off from the Swartberg goes east or west along the valleys between the parallel foothill ranges and thence south through the gorges of the Buffels, Gamka, Groot and Traka Rivers, to the benefit of the Little Karoo. There is also a pronounced rain shadow below the north side of the Swartberg, accentuated by former overgrazing made possible by the presence of these east- and west-running streams. One has to suppose they were not always as desert-like as they are now.

The mountains of the Escarpment to the north are semi-arid, receiving an average of no more than 370 mm of rain per annum plus some snow, while the country in the gap receives only 200 to 250 mm, so not much run-off is available. The hilly westernmost part, lying in the basin of the upper Buffels River, receives the run-off from the winter rainfall and snowfall of the Klein Roggeveld and the Komsberg, while the run-off from the extreme western parts of the Nuweveld range, mainly in winter, goes down the Dwyka River through the western part of the Great Karoo. The low ridge running south-east through Merweville diverts run-off from the rest of the Escarpment as far as Beaufort West into the Gamka River, leaving a large area, bounded by the Dwyka and Gamka Rivers and a line from a few kilometres north of Merweville to Fraserburg Road, with no water resources other than its own rainfall of less than 127 mm.

Similarly, a ridge running south past Beaufort West over a low plateau of triangular shape diverts the Gamka River to the south-west and diverts run-off from the Escarpment to the north-east of Beaufort West south-eastwards down the Salt River. This leaves the whole triangular central part of the Great Karoo, from Beaufort West to the neighbourhood of Prince Albert and from there east to the neighbourhood of Willowmore, with only its own rainfall of 127 mm to not more than 200 mm. There is another watershed running south from Three Sisters to near Rietbron and a fourth to the south of Aberdeen, with the result that in the whole of the eastern part, from the Salt River to the Sundays River, only the Kariega River carries water from the mountains across the Great Karoo. In this part, the rainfall is still under 200 mm per annum.

One may suppose that before the reed-beds disappeared, all these rivers that arise in the mountains had at least permanent pools. Even along a minor river like the Upper Traka, which rises on the low plateau to the south of Beaufort West, reeds are to be found here and there. For the rest, the only other permanent waters were springs.

There is no place for high forest in the Great Karoo, but short gallery forest consisting mainly of *Acacia karroo*, *Rhus lancea*, *Lycium* spp., *Rhus pyroides*, *Phragmites australis*, *Tamarix usneoides* (westwards) and perhaps *Salix capensis*, existed along the main rivers and even along some of the lesser ones (see p. 696).
The vegetation of the Great Karoo in general was open Karroid Broken Veld in rockier places and Central Lower Karoo elsewhere. Spekboomveld 25.3 (p. 683) occurred on north slopes of the Swartberg and its foothills and on scattered hills and minor mountain ranges in the far eastern part bordering on the Noorsveld 24 (p. 693) and Spekboomveld 25.2 (p. 692) of the south-east Cape. From Aberdeen to Pearson it is likely that a Setaria neglecta-dominated grassveld or open shrubland occurred in a narrow belt at the foot of the Escarpment. Such veld also occurred in the Great Fish River valley up to somewhere near Craddock, and the true Koup and its foothills and on scattered hills and minor mountain ranges in the far eastern part bordering on the Swartberg and its foothills and on scattered hills and minor mountain ranges in the far eastern part bordering on the Swartberg.

One is surprised to find that, at the foot of the Escarpment, much of some luxuriance, most of which is now occurring fairly frequently in crevices of the little Escarpment below Theekloof and eastwards and some one is surprised to find that, at the foot of the Escarpment. Such veld also occurred in the Great Fish River valley up to somewhere near Craddock, and the true Koup and its foothills and on scattered hills and minor mountain ranges in the far eastern part bordering on the Swartberg and its foothills and on scattered hills and minor mountain ranges in the far eastern part bordering on the Swartberg.

In the relics, Themeda Veld of the upper plateau. Here would appear to have been a migration route from high, cold country to low, warm country.

Returning to the karoo proper, in the west in the Upper Buffels River basin, in the country around Laingsburg and in the country between the Escarpment and the Gamka River, as well as in a belt along the northern foot of the Swartberg eastwards, the Karroid Broken Veld 26.2 (715 species, 762 m) and 26.3 (485 species, 671 m) is transitional to that of the Little Karoo, with many succulents. The shrubs include the following:

- *Euclea undulata*
- *Diospyros lyoniodes*
- *Lycium oxyacarpum*
- *L. prunus-spinosa*
- *Maytenus heterophylla*
- *Rhigozum obovatum*

Grasses are again notably varied and common such as the perennials *Aristida diffusa* var. *burkei*, *Heteropogon contortus*, *Tricholaena capensis*, *Cenchrus ciliaris*, *Digitaria argyrograpta* and *Stipagrostis namaquensis*.

Shorter-lived grasses include *Stipagrostis citlata* *S. obtusa*, *S. uniplumis*, *Fingerhuthia africana* and *Enneapogon scaber*.

As one approaches Merweville through the very denuded country along the road from Koukp Station, one is surprised to find *Heteropogon contortus* occurring fairly frequently in crevices of the little shaly ridges—until one remembers that this strip of country is the true Koup and that Koup is said to mean "luxuriant". It is even more surprising to find that, at the foot of the Escarpment below Theekloof and eastwards and some distance into the flats, there are relics of a Themeda Veld of some luxuriance, most of which is now False Karroid Broken Veld 37.4 (643 species, 1,341 m). In the relics, Themeda triandra with *Digitaria eriantha*, *Heteropogon contortus*, *Sporobolus fimbriatus* and *Panicum maximum* grow densely on dolerite outcrops so rugged that apparently only klipspringer would be prepared to go there, but it also occurs sparingly on shale and sandstone where it is accessible to domestic livestock.

These relics show that there is no mistake about the local recollection that in the early years of this century the south face of the Escarpment, at least as far west as Oukloof was Themeda Veld. This is where the trekboeken came down from the Upper Plateau into the Great Karoo. Further to the east such veld still covers some of the rockier mountain sides to the west of Three Sisters. It can be contended that the present distribution of grasses is controlled more effectively by mismanaged domestic livestock than by rainfall.

It may be that this western Themeda Veld (with Themeda-Tetrachne Mountain Veld on the higher-t points, where there is still Merxmuelleria Mountain Veld today) was continuous with the main body of the original Dry Cymbopogon-Themeda Veld. The connection would have been in an irregular and hilly belt along the watershed between the Upper Plateau and the Great Karoo, i.e. between the catchment of the Ongers River to the north and the catchments of the Salt and Buffalo Rivers to the south. This watershed runs north, at a general altitude of 1,300-1,500 m, from the eastern part of the Nuweveld Range towards Melton Wold, east towards Victoria West, south-east to the Horseshoe Mountain and then east-north-east towards Richmond. The Themeda Veld would also have covered the high hills and plateaux scattered across the upper Salt River basin south-west from the Horseshoe Mountain to join that which survives to the west of Three Sisters and on to the Escarpment in the Nelspoort area.

It is thus possible that the mountain grassveld corridor across the country from the Drakensberg to Calvina was not completely blocked by karoo at the gap in the Escarpment.

As in the Little Karoo, there is a good variety of karoo bushes and forbs in this far western and southern part of the Great Karoo, a fact which needs to be emphasized in country where ungrazed succulents tend to monopolize attention. The list of important species is almost the same as for the Little Karoo (p. 689), but a few have to be added, like *Aloe claviflora*, *Asclepias buchenaniana*, *Cucumis africana*, *Helichrysum luciloides*, *Hernammia grandiflora*, *Pentzia sphaerocephala*, *Pteronia scariosa* and *P. viscosa*.

Although the gravelly and sandy flats of the Great Karoo 26.2 and 26.3 are often almost devoid of perennial grasses, they look nearly as bare, really have much more useful vegetation than meets the casual eye, in spite of the rainfall of less than 127 mm a year. They therefore indicate more of the original vegetation than the gravelly and sandy flats. One reason for this is that most species are palatable to livestock and so are kept in reasonable abundance, while the unpalatable species which tend to dominate other types of karoo are scarce here. A second reason is that the nature of the rock provides crevices to protect the crowns and roots of plants. A third reason may be that the crumbly shale surface soaks up small rains while the hilliness sheds any surplus from heavier rains into the many gravel-filled water-courses where it is stored and protected against evaporation. Most of it thus remains available to the vegetation to help it to hold out against *c.v.* grazing.

Wherever such a surface and such a topography occur, more of the palatable species will survive than on plains with a silty or clayey soil where they are protected in a desert pavement of small stones, as in the Great Karoo (p. 689), but a few have to be added, like *Aloe claviflora*, *Asclepias buchenaniana*, *Cucumis africana*, *Helichrysum luciloides*, *Hernammia grandiflora*, *Pentzia sphaerocephala*, *Pteronia scariosa* and *P. viscosa*.

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oleoides and Pappea capensis. The grasses persist, with Sporobolus fimbriatus increasing eastwards and Ehrharta calycina and Digitaria eriantha coming in. Karoo bushes are much more plentiful, but today are mostly those that are unpalatable to domestic livestock.

The Central Lower Karoo 30 (538 species, 802 m) occupies the non-rocky parts. It lacks the shrubs, except sometimes on rocky outcrops and along drainage lines, and has much in common with the Arid Karoo. Karoo bushes and forbs that are likely to have been important include the following:

- Aridaria noctiflora
- Felicia filifolia forma
- F. muricata
- F. ovata
- Drosanthemum lique
- Eriocephalus ericoide
- Euphorbia rhombifolia
- Euryops anthemoides
- Galenia fruticosa
- Hermannia cuneifolia
- H. grandiflora
- H. spinosa
- Kochia pubescens
- Lessertia pauciflora
- Limeum aethiopicum
- Osteospermum sinuatum
- Pentzia spiniscens
- P. pinnatisecta
- Phymaspermum parvifolium
- Plinthus karrooicus
- Polygalas seminuda
- Salsola calluna
- S. tuberculata
- Senecio acutifolius
- Tetragonaria arbuscula
- Trichodiadema barbatum
- T. violaceum
- Zygocephalum flexuosum

Grasses of the Central Lower Karoo include:

- Aristida diffusa var. burkei
- Digitaria argyrograpta
- Enneapogon desvauxii
- Eragrostis lehmanniana
- E. obtusa
- Fingerhuthia africana
- Sipagrostis anomala
- S. ciliata
- Tragus koelerioides
- S. obtusa

Riverine vegetation will be considered with that of the upper plateau under (g) on p. 696.

Most of the Great Karoo, particularly the central part, gives the impression of being inhospitable, even hostile, country, perhaps because of the scarcity of surface waters and the dull uniformity of topography and vegetation, rather than because of lack of feed for grazing and browsing animals. If these parts are regarded as gemsbok country, in the more favourable areas at the west and east ends and the belts joining them along the foot of the Escarpment with the Upper Plateau via the gap in the Escarpment, one might expect there to have been a more varied fauna.

Before leaving the Great Karoo basin, the central variation of the Spekboomveld 25.2 (503 species, 700 m) and the Noorsveld 24 (522 species, 457 m) at the far eastern end of it have still to be considered.
Physiognomically similar, this central variation of the Spekboomveld shows considerable floristic difference from the western variation (p. 683), only partly because no river banks were included in the samples. One has to think of it as having been more open and grassy and less congested with thorny thickets than it is now.

The important grasses included the following:

- Aristida diffusa var. burkei
- Cenchrus ciliaris
- Cymbopogon plurinodis
- Cynodon dactylon
- C. incomplectus
- Digitaria argyrograpta
- D. eriantha
- D. glauca
- Ehrharta calycina
- Enneapogon scaparius
- Eragrostis curvula
- E. lehmanniana

The trees and shrubs of the central Spekboomveld included:

- Acacia karroo
- Allophylus decipiens
- Aloe ferox
- A. speciosa
- Asparagus racemosus etc.
- Azima tetracantha
- Boscia oleoides
- Brachylaena ilicifolia
- Buddleja glomerata
- B. saligna
- Cadaba aphylla
- Carissa haematoarcara
- Cassonia spicata
- Diospyros austro-africana
- D. lycioides
- D. scabrida var. cordata
- Dodonaea viscosa var. angustifolia
- Ehetria rigida
- Encephalartos lehmannii
- Euclea undulata
- Euphorbia coeulescens

The bushes and forbs included:

- Adromischus maculatus
- Aizooid glaucoides
- Aloe comptonii etc.
- Anticy Tina capensis
- Barleria obtusa
- Bulbine frutescens
- Ceratopogion ampliata
- Chasmanum debiscens
- Cyphostemma quinata
- Cotyledon ramosissima etc.
- Euphorbia enopla etc.
- Grewia robusta
- Lycium oxyscarpm etc.
- Maytenus capitata
- M. undata
- Nymania capensis
- Olea africana
- Pappea capensis
- Polygala myrtofila
- Portulacaria afra
- Ratterlickia pyracantha
- Rhizogum obovatum
- Rhoicissus tridentata
- Rhus lancea
- R. longispina
- R. lucida
- Sarco commum viminalae
- Schotia afra
- S. latifolia
- Tarchonanthus
- Zygophyllum foetidum

- Crassula ovata
- C. cultrata
- C. rupestris
- C. tetragona etc., etc.
- Dicoma spinosa
- Dioscorea elephantipes
- Euphorbia mauritanica
- E. rhombifolia etc.
- Felicia ovata
- Haemanthus albiflos
- P. tetragonum
- P. vulgaris
- P. comptonii
- Sansevieria hycinthoides
- Schizobasis citricata
- Selago albida
- Senecio juncace
- S. longifolius
- S. vitais etc.
- Stachys aethiopica
- Sutera halimifolia etc.
- Teucrium africana
- Viscum obscurum
- V. rotundifolium

The Noorsveld 24 is of shorter stature and was probably open and grassy than the Spekboomveld before the suckering noorsdoring (Euphorbia coeulescens) and other thorny shrubs thicken up. Spekboom is present but not so common, just as noorsdoring is present in the Spekboomveld but not so regularly. One thinks of it as a dense, grey thicket of Euphorbia coeulescens with a sprinkling of woody shrubs and small trees and a little grass growing through it, usually obscured by a haze of dust. The open, grassy condition can be found here and there, though it is only secondary as a result of better grazing management, while at the other extreme there are farms from which even the noorsdoring is disappearing. In recent wet seasons, however, the picture has changed in a remarkable manner: the obscuring haze is now a haze of grass seed.

Under a rainfall of only 175 to 200 mm, the nature and vigour of the grassiness would be surprising if one were not already aware of the part played by the goat and the donkey in controlling the distribution of grasses. It is the goat- and donkey-thwarting presence of the densely shrubby and thorny noorsdoring that has maintained the general presence of the grass in a vigorous state, so that plentiful seed is available to take advantage of any lightening of the grazing pressure in good seasons. The growth habit of the noorsdoring keeps the animal out but lets in enough sunlight to allow the grass and other plants, notably Indigofera costata subsp. macra, to flourish.

Fig. 12.—Noorsveld north of Jansenville. Euphorbia coeulescens with Panicum maxi mum and Digitaria eriantha.
In species composition the Noorsveld is very similar to the Central Spekboomveld, although the frequency of occurrence of some species is different, some being more frequent, some less frequent. Of the species listed for the Spekboomveld, only the following have not been found in the Noorsveld samples:

- Merxmuella stricta
- Setaria lindenbergiana
- Polygala myrtifolia
- Rhus lucida
- Passerina obtusifolia
- Senecio vitalis
- Digitaria glauca
- Hyparrhenia hirta
- Allophylus decipiens
- Buddleja glomerata
- Indigofera costata subsp. macra
- Indigofera denudata
- Buddleja glomerata
- Dodonaea viscosa var. angustifolia
- Indigofera costata
- Lotononis sp. (= A 23525)
- Pentzia sphaerocephala

There are a few species of importance in the Noorsveld that were not found in the Spekboomveld, such as Sporobolus nitens, Aloe striata, Asparagus striatus, Gasteria spp., Hydnora africana, Indigofera costata subsp. macra, Lotononis sp. (= A 23525) and Pentzia sphaerocephala.

If the noorsdoring preserved the grass, it has rather helped to destroy the gallery forest, which today consists of little besides Acacia karroo and the scrambling Zygophyllum foetidum. The noorsdoring can have this effect because if a farmer is prepared to go to the trouble of chopping it into small pieces to get rid of the latex, he can keep his animals alive in a drought, without having to trek away to give his veld some sort of rest.

(iv) Ceres–Tanqua Karoo.—The Ceres–Tanqua Karoo is today the most desert-like of the karoo basins. Like the Little Karoo, it is well watered by streams from the surrounding mountains, but is even more completely screened from rain by them. It lacks the hilliness of the western Little Karoo and the shaliness, except at the foot of the Escarpment, where it is a little less desert-like. Lacking the big shrubs (except in gallery forest) the vegetation where it survives at all, is Succulent Karoo 31.2 (381 species, 487 m) and the semi-succulent variation of the Western Mountain Karoo 28.2. It has been so far reduced that closer study than has hitherto been made will be necessary before one can attempt a reconstruction.

Whatever the vegetation may have been, there is easy access northwards to the less arid Western Mountain Karoo and the Mountain Renosterbosveld of Nieuwoudtville and Calvinia, and south-eastwards to the Mountain Renosterbosveld of the Klein Roggeveld and Matjiesfontein and the Karroid Broken Veld beyond. It is likely that the game would have fled from the snowy bleakness of the plateau in winter into the warm Karoo, just as the farmer does today.

(g) Upper plateau

Here the whole fauna survived until there were literate persons present to describe the animals, count them, paint pictures of them and make specimens of them. Some of the vegetation has suffered little change, and where it has suffered change, the main reason for attempting a reconstruction will be to find out how it could have carried the enormous numbers of animals which these observers reported.

If in this area, moreover, where relics of the original vegetation still survive, it is found possible to determine the kind and magnitude of the changes that have taken place, it will help one to visualize what is likely to have happened in other areas where no relics survive. This is particularly important in respect of stream-banks, vleis and floodplains that are so bare today and yet must have provided a large part of the original carrying capacity, particularly during winter and droughts. Rainfall has nothing to do with this bareness: there are wide valleys on the eastern edge of our area that are so eroded as to have hardly more vegetation than the “vloere” of Bushmanland. Fortunately, in that eastern part they are the exceptions.

The manner in which the previously dry rivers of the plateau have developed a steady flow once the remnants of soil in the remnants of vleis had become saturated during the past three years of heavy rainfall, gives us a clue to the enormous volume of water that was stored as a buffer against drought when the soil and vegetation of all the rivers and minor water-courses were still undisturbed.

The upper plateau is higher and cooler than the karoo basins and most of it receives a higher rainfall. Whereas the whole of the Great Karoo receives less than 200 mm, the upper plateau receives more than 200 mm from about Carnarvon eastwards to 330 mm at Middelburg to about 500 mm at the eastern edge of the area under consideration. Only west, northwest and north of Carnarvon below the Kareeberg escarp-
ment does the rainfall drop below 220 mm, down to less than 127 mm in Bushmanland. Only there, too, is the run-off from the Great Escarpment mountains confined to a single river, the Sak River. Elsewhere there are many streams draining northwards either from the Escarpment or from hills receiving enough rain for them to feed streams. The gradient from south to north is very slight, so rivers are sluggish, floodplains are wide and pans occur, some of large extent, and surrounded by wide flats.

For riverbanks, vleis and floodplains, we have two useful indicators: *Fingerhuthia sesleriaeformis* for the wetter ones that are not too excessively grazed out, and *Eragrostis bicolor* for the remaining drier ground. *Fingerhuthia* is of regular enough occurrence to indicate that it was the dominant grass of the vleis. This is true at least as far as the western edge of the original grassveld, i.e. of what is now False Central Upper Karoo 36.1c (597 species, 341 m) and 36.2c (505 species, 372 m), to show what its nature was. Even along minor drainage lines, this vegetation was a half-metre deep mass of leaf of *Fingerhuthia sesleriaeformis*, *Pennisetum sphacelatum*, *P. thunbergii*, *Koeleria cristata*, *Carex glomerata*, etc. matted together with *Trifolium angustifolium*, *T. burchellianum* and possibly *Indigofera stipularis*, and with patches of 1–13 m *Miscanthus* spp. at the drier edges was 30–40 cm deep *Tetrachne dregei*, *Themeda triandra* and *Punica stapfianum*, merging into the general *Themeda–Tetrachne–Digitaria etraniha–Sporobolus fimbriatus* Veld.

Add thickets of *Phragmites australis*, *Juncus punctorum* and *Scirpus inani* on the riverbanks and *Typha latifolia* and *Scirpus littoralis* in the water, and it will become clear why the early settlers found the vegetation too luxuriant for their sheep and felt that they had to "tame" it, and why Nature needed to put hippos in the rivers and periodically needed to increase antelope numbers to stampeding levels.

West of the Seacoast River, such luxuriance ceases to survive and it becomes difficult to visualize it. *Eragrostis bicolor* becomes the principal indicator. It covers the wide flats in the Philipstown, De Aar, Britstown and Hanover areas. One occurrence of *Fingerhuthia* is known in the middle of such a flat near De Aar and there are various occurrences of *Themeda* and a few of *Tetrachne*, which is why one supposed these flats to have been *Themeda* Veld. The big herds were here, so the luxuriance must have been here, too, to support them, but if this had not been known, it would have been difficult to appreciate it. The importance of even single relics of climax species becomes evident.

In the genuine karoo types, Central Upper Karoo 27 and False Arid Karoo 35 westwards, *Fingerhuthia sesleriaeformis* has been found at only three places below the Escarpment mountains, but the significant point is that these three occurrences are on streams arising in the karoo itself: two in the catchment of the Ongers River, at Hutchinson in the Brak River and at Pampoenpoort in the Groen River, and one in the catchment of the Sak River about 30 km south of Loxton. The last is in the Slangfontein River, one of whose tributaries rises a few km from the source of the Groen River. The Slangfontein River joins the Sak River some 80 km below where the latter leaves the mountains. With *Fingerhuthia* occurring all along the Escarpment (although very rarely today) to Calvinia, it will be seen that it was present to the upper reaches, at least, of all the rivers westwards to the Sak River and its tributaries right through to the Fish River, i.e. all through the Upper Karoo except Bushmanland. *Eragrostis bicolor* occurs along watercourses even into Bushmanland. In this same area there are a few records of *Tetrachne dregei* in catchments of streams arising in the karoo, as well as on the mountains at Beaufort West.

Burchell (1822–24) found *Tetrachne on* the bank of the Orange River near where Hopetown now stands, almost on the 1 050 m contour. Today the only place where it is known to grow at so low an altitude is the Cypress Grove vlei between Middelburg and Cradock. If the vegetation implied by the presence of *Tetrachne and Fingerhuthia* grew on the extensive floodplains of the Ongers River and its tributaries down to this altitude, i.e. to just below the Smartt Syndicate Dam, it would provide a very different indication of the carrying capacity of this denuded and eroded part of the upper plateau and its ability to support large herds of antelopes.

Grasses which might have replaced *Tetrachne and Fingerhuthia* in the lower courses of the rivers towards the Orange River are *Hemarthria altissima* and *Sorghum verticilliflorum*. Nothing has been found to indicate how far down the Sak River and its tributaries this sort of vegetation extended. The topography is, however, more broken and stony, without extensive floodplains, until one reaches country too hot and arid and perhaps too brackish for it, so it would have been confined to the river-banks.

Therefore in the Central Upper Karoo and the False Arid Karoo, i.e. west of the western boundary of the False Central Upper Karoo, to the Kareeburg and south to Beaufort West, the riverine vegetation can be reconstructed thus (in the wetter parts):

| Carex sp. | "perdegras" | Juncus maritimus  
| C. marginatus | *Phragmites australis*  
| Dipalchne fusca | Polygonum lapathifolium subsp. *kochii*  
| Fingerhuthia sesleriaeformis | *Puccinellia spp.*  
| Gomphostigma virgatum | *Rumex lanceolatus*  
| Hemarthria altissima | *Scirpus inani* (upstream)  
| (downstream) | *Sorghum verticilliflorum* (downstream)  
| Hordeum capense | *Typa latifolia* subsp. capensis  
| Juncellus lavigratus  

In less wet parts at the margin, the following are present:

- *Anchusa riparia*  
- *Atriplex vestita*  
- *Cynodon dactylon*  
- *Cynodon sp., cf. C. transvaalensis*  
- *Helichrysum pentzioides*  
- *Juncus araloides*  
- *Kochia pubescens*  
- *Lycium prunus-spinosa*  
- *Melinthus comosus*  
- *Panicum lanipes* (downstream)  

Restoration of any semblance of luxuriance would depend on the success of *Phragmites australis* and *Stipagrostis namaquensis* in trapping enough silt, sand and rubble to hold the moisture needed to enable the smaller grasses and sedges to re-establish themselves.

Considering that the rivers crossing the Great Karoo also rise in the mountains of the escarpment, or along the watershed in the gap, one might be justified in reconstructing the vegetation of their upper courses, at least, in the same way. It is in their upper courses:
that the most extensive floodplains occur. Grasses and sedges that are still to be found include the following:

- Cenchrus ciliaris
- Panicum maximum
- Cynodon dactylon
- P. stapfianum
- Cyperus longus
- Paspalum paspalodes
- C. marginatus
- Phragmites australis
- Digitaria eriantha
- Puccinellia spp.
- Diplachne fusca
- Sporobolus limbatis
- E. curvula var. conferta
- S. ioclados
- Hordeum capense
- S. tenellus
- Eragrostis bicolor
- Typha latifolia subsp. capensis
- E. curvula var. conferta
- P. stapfianum
- Juncellus laevigatus
- Sporobolus fimbriatus
- Juncus maritimus capensis
- Diplachne fusca
- Fingerhuthia
- Themeda

Fingerhuthia and Themeda were probably important too, but not Tetrachne. Shrubs and trees of the gallery forest include the following:

- Acacia karroo (with Viscum continuum)
- Cadaba aphylla
- Diospyros lycioides
- Lycium oxycarpum
- Maytenus heterophylla
- Rhus lancea
- R. pyroides
- L. salinicolum
- R. undulata var. undulata

In the Arid Karoo, Phragmites australis and Stipagrostis namaquensis will themselves have to work their way downstream and upstream before they can start to restore the riparian vegetation. It seems unlikely that the great deposits of silt in the vloere and along the Sak River could have accumulated without a grass cover to prevent the silt from washing and, more particularly, blowing away as fast as the river brought it down. It must be remembered that much more water reached the lower course of the Sak River, and more regularly, before it was turned out into "saaidamme" all along the way. This meant also that the soil was less brackish than it is now. The presence of Acacia karroo on the river-banks in the neighbourhood of Onderste-doorns and the single big Olea africana (= Olea chrysophylla) at the south-west corner of Verneuk Pan, suggest that the Sak River may once have had a gallery forest, possibly with Phragmites lanipes, Panicum stapfianum and Sporobolus ioclados on the floodplain and Dichanthium papillosum ("D. annulatum"), Panicum lanipes, Cenchrus ciliaris and Stipagrostis namaquensis in sandy and gravelly tributaries. Eragrostis bicolor would be the pioneer. The same may have been true of the Carnarvon Leegte.

It is doubtful if enough water came down the Sak River regularly enough to maintain the great expanse of the Groot Vloer as a reedswamp and almost certain that the Carnarvon Leegte could not have supported reedswamp at Verneuk Pan. In such cases Diplachne fusca may have been the key species, just as it is in the Orange Free State in the pans. There, after a good flooding, it grows densely to the height of a metre. If it grew like that over the great expanse of the vloere it would have provided, even if only at times, for a very large population of grazing animals.

Until the Fish River was diverted into the "saaidamme" of the Sak River near Sak River Station, it did not join the Sak River, but turned west into what is now Swart se Kolk se Vloer to form a permanent lake. It had a depth of as much as 12 m on the west side, which is why, now that it is dry, it is said to be the only sloping vloer. To reach it, the river flowed through two vleis, now vloere, one of them still called Voëlvlei. With Phragmites australis still occurring in this river, Fingerhuthia sesleriae-formis on the Hantamberg where some of its tributaries rise and Typha latifolia subsp. capensis in the old river bed where it enters the vloer, some idea of the vegetation that existed can be formed.

Much attention has been given to the riverine vegetation. Even at the risk of repetition, one cannot overemphasize its importance to a large population of animals, because of its great extent and its value in holding the scanty rainfall and extending its usefulness into the dry season and the droughts that have always occurred. When there was the grassy cover on all the floodplains that is here visualized, the proportion of the rainfall lost in flash floods and by evaporation from bare soil was small. Instead, the bulk of it was used either by the plants through transpiration while making growth, or by seepage through the soil to maintain a steady flow in the main rivers and feed springs. These rivers were not the efficient stormwater drains that they are now, but were so obstructed by the reed-sedge-rush-bulrush vegetation as to call for the hippo to keep a channel open. What is more, the common plants were the ones which the animals could utilize rather than the ones that were too thorny, or resinous or waxy or in other ways so unpalatable as to be useless as feed to the generality of animals.

There is a world of difference between a temporary condition of "no grazing", because the vegetation has been grazed down, but is ready to
grow again when the drought breaks, and today's all-too-common permanent condition of "no grazing", because there is neither vegetation to grow again, nor seed, nor soil fit to support regeneration of vegetation. Considering that soil that is not under a permanent, continuous cover of grass (or similar vegetation) is washed away or blown away, the obvious corollary would appear to be that the presence of soil is proof of a formerly existing vegetation cover, which would usually have been grass.

Looked at in this way, this reconstruction of the vegetation of the arid and semi-arid regions appears reasonable.

As regards the original vegetation of the flats and hills, it appears that the grassveld which is now the False Central Upper Karoo 36.1 (1,081 species, 1,341 m) south of the Orange River consisted mainly of the following grasses:

- Themeda triandra
- Tetrachne dregei
- Digitaria eriantha
- Panicum stapfianum

Of these, Tetrachne and Panicum very rarely grew on the dolerite hills, while Enneapogon scoparius, Hyparrhenia hirta and Eustachys mutica regularly did so. Aristida diffusa var. burkei and Heteropogon contortus were relatively less important than they are now. Vlei vegetation was as described on p. 695.

The following forbs occurred in the grassveld, which is now False Central Upper Karoo, but it is difficult to be positive about it because of karoo invasion:

- Albuca pachychlamys
- Cyperus usitatus
- Felicia ovata
- Helichrysum dregeanum
- Heliophila suavissima
- Lessertia pauciflora
- Limeum aethiopicum
- Nexa microphylla

- Osseopogon scariosus
- Sporobolus fimbriatus
- Eragrostis curvula var. conferta
- Cymbopogon plurinodis

In addition, the dolerite hills have some bushes and forbs of their own, as follows:

- Themeda triandra
- Tetrachne dregei
- Digitaria eriantha
- Panicum stapfianum
- Sporobolus fimbriatus
- Eragrostis curvula var. conferta
- Cymbopogon plurinodis
- Enneapogon scoparius, Hyparrhenia hirta and Eustachys mutica regularly did so.
- Aristida diffusa var. burkei and Heteropogon contortus were relatively less important than they are now. Vlei vegetation was as described on p. 695.

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- Digitaria eriantha
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- Cymbopogon plurinodis
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- Aristida diffusa var. burkei and Heteropogon contortus were relatively less important than they are now. Vlei vegetation was as described on p. 695.

It can be reasonably presumed that a species which is palatable to domestic animals is likely to be a relic of the original flora, because it is unlikely to be an invader.

In addition, the dolerite hills have some bushes and forbs of their own, as follows:

- Aloe broomii
- Anthospermum rigidum
- Argyrolobium collinum
- Asparagus capensis forma
- A. striatus
- Boophane disticha
- Ceterach cordatum
- Chascanum incisum
- Diantus micropetalus
- Hermannia cuneifolia
- subsp. labrecens
- H. filifolia
- H. pulchella
- Lightfootia albens
- Loxospermum laxa
- Chelanthus eckloniana
- Pelargonium ramosissimum
- Pentzia punctata
- P.phaeocerphala
- Pzniaspermum aciculare
- Pollichia campestris
- Polygala seminuda
- Selago albida
- Sutera halimifolia
- Viscum capense
- Maytenus heterophylla
- Rhigozum obovatun
- Rhus erosa
- R. pyroides
- R. undulata var. tricrenata
- Tarchonanthus

Olea africana and Celtis africana also appear to north and east.

North of the Orange River the grassveld, which is now False Central Upper Karoo 36.2 (848 species, 1,372 m), was essentially the same, but with Eragrostis superba replacing Tetrachne dregei westwards and with Olea africana and Rhus ciliata appearing more often on the hills, plus Ziziphus mucronata.

Desiccation of the vleis of the False Central Upper Karoo through erosion and the disappearance of an adequately dense and vigorous grass cover, probably explains why Acacia karroo, Rhus pyroides, Diospyros lycioides and Lycium spp. are invading the vleis and tending to form impenetrable thickets. True gallery forest is represented today by remnants of Salix capensis in the lower kloofs of the Escarpment mountains and along the more permanent rivers like the Seekoei River and of Acacia karroo and Rhus lancea along the lower courses of tributaries of the Orange River. The Orange River itself has a well-developed gallery forest consisting mainly of Salix capensis, Ziziphus mucronata, Acacia karroo, Rhus

Fig. 15.—View to west along southern edge of Orange River valley, 18 km north-northeast of Colesberg. Eragrostis tehmanniana with Rhus ciliata, R. undulata var. tricrenata, R. erosa and Rhigozum obovatun.
THE FLORA THAT MATCHED THE FAUNA

lancea, Lycium hirsutum, Phragmites australis and, as far down as the Colesberg neighbourhood, Celtis africana.

The Pan Turf Veld 51 of the western Orange Free State has almost disappeared, but relics show it to have been a very dense Themeda Veld with a rich flora and it must have had a high carrying capacity, both on the flats and in and around the innumerable pans. The False Karoo 41 (493 species, 1 220 m), which has replaced it, still has almost five hundred species. It was the pans, with the springs and extensive seepages on the slopes around them, that had the greatest luxuriance of vegetation. Some, such as the biggest of them i.e. the nameless one near Koffiefontein, are remembered to have been reedswamps, while some still periodically become covered with a dense metre-deep growth of Diplachne fusca in seasons wet enough to flood them. Species still to be found include:

- Anthephora pubescens
- Cymbopogon plurinodis
- Cyperus longus
- C. marginatus
- Digitaria eriantha
- Diplachne fusca
- Echinochloa holubii
- Eragrostis superba
- Hemarthria altissima
- Imperata cylindrica
- Lobelia thermalis
- Mariscus capensis
- Panicum coloratum
- P. stapfianum
- Paspalum paspalodes
- Phragmites australis
- Platycarpha parvifolia
- Scirpus littoralis
- Setaria woodii
- Sporobolus fimbristylus
- Themeda triandra
- Trifolium burchellianum

Even the cover still provided on parts of the slopes and edges of pans by pioneer species, such as Cynodon dactylon, Eragrostis bicolor, E. truncata, Sporobolus acinifolius, S. ioclados, S. ludwigii, S. tenellus, Tragus koelerioides and the prostrate mat-forming Salsoa humifusa, is of lawn-like density. Single trees and groups of Rhus lancea on slopes to some of the pans were probably much more plentiful formerly. Acacia karroo, A. hebeclada and Acacia tortilis var. heteracantha are likely to be invaders from the Kalahari Thornveld to the west.

Taking the Central Upper Karoo 27 (719 species, 1 310 m) and the False Arid Karoo 35 (740 species) together, the north-eastern part from Victoria West and Carnarvon north-eastwards, is topographically similar to the False Central Upper Karoo in having wide plains and scattered hills. The southern and western parts are more broken, to the south resembling the western part of the Great Karoo, so that the environment was not so favourable for the big herds. The Kareeberg region to the north-east of Carnarvon and west to the Williston neighbourhood is particularly hilly. What is regarded in “Veld Types of South Africa” (Acocks, 1975) as Variation 3 of the Arid Karoo is now regarded as Variation 1 of the False Arid Karoo, the original veld having been closer to the Central Upper Karoo than to the Arid Karoo. In the high country south of the western Kareeberg closer to Saafontein on the Sak River, it probably was Central Upper Karoo, only becoming transitional westwards.

On the northern foothills of the western Kareeberg are to be found outliers of the Orange River Broken Veld, with Aloe dichotoma.

The possibility that there might have been an extension to the Nuweveld of the original Themeda Veld on the hills and plateaux along the watershed at the southern edge of the Central Upper Karoo has been considered on p. 691.

In the Central Upper Karoo, in the north-eastern part of the False Arid Karoo 35.3 (443 species, 1 130 m) and in the high central part of the False Arid Karoo 35.2 (400 species, 1 310 m) there is no difficulty about reconstructing the vegetation of the hills. Its grassy constituent did not greatly differ from that of the grassland flats, excluding Tetrachne dregei, but its flora lacked Rhus eosa (which has the same distribution as Tetrachne) and had a great variety of karoo bushes, resulting in a rich flora.

The grasses of the hills included the following:

- Aristida diffusa var. burkei
- Cenchrus ciliaris
- Digitaria eriantha
- Ehrharta calycina
- Enneapogon scaber
- E. scoparius (central)
- Eragrostis curvula var. conferta (not in north-east)
- E. lehmanniana
- E. obtusa
- E. nindensis
- Fingerhuthia africana
- Heteropogon contortus
- Panicum lanipes (not central)
- Schismus barbatus
- Sporobolus fimbristylus
- Stipagrostis namaquensis
- Themeda triandra
- Tricholaena capensis (central)

![Fig. 16.—Cenchrus ciliaris on dolerite ridge, 64 km west-northwest of Carnarvon.](image-url)
The shrubs of the hills of this part of the Central Upper Karoo and False Arid Karoo included the following:

Asparagus retroflectus
Boscia albitrunca
Cadaba abyssa
Diospyros austro-africana
Euphorbia capensis var.
E. trunciata
E. nindensis
Tragus koelerioides
D. lycioides
Lycium oxyccarpum

Melianthus comosus (not north-eastern False Arid Karoo)
Phaeoepitium spinosum
Rhus lanca
Rhus undulata var. tricrenata

Rhus lancea remains plentiful in some of the kloofs of the Kareeburg.

In addition to the bushes and forbs of the flats, the shrubs of this part of the Central Upper Karoo and False Arid Karoo have some of their own such as:

Aloe broomii (not in the north-east)
A. claviflora (especially north-eastern False Arid Karoo)
Anthaxia capensis
Asparagus striatus
Ceratocordatum (not in the north-east)

Dianthus spp.

The bushes and forbs of the Central Upper Karoo and False Arid Karoo in general include the following:

Aptosium marlothii
A. spinosus
Aridaria noctiflora
Boophane disticha (not in the north-east)
Dicoma capensis
E. pauperrimus
E. spinescens
Felicia filifolia forma
F. maccorrhiza (not in the north-east)
F. muricata
Helichrysum luciolides
Hermania cuneifolia var. cuneifolia (not in the north-east)
H. cuneifolia var. glabrescens
H. grandiflora (not in the north-east)
H. spinosa

Of the shrubs, only Lycium spp., Rhigozum trichotomy (northwards) and Phaeoepitium spinosum are usual on the flats.

In the Central Upper Karoo and False Arid Karoo it is the grasses of the flats that are the problem. The only grasses that are important now (apart from Digitaria eriantha, Sporobolus fimicola and False Arid Karoo) are E. pauperrimus, E. obtusa, E. capensis, E. melicoides, E. lanca, E. capensis var. congerfa, Fingeruthia africana.

Bushes and forbs that were probably important include the following:

Argyrolobium collinum
Berkheya spinosa
B. onabromoides
Carex sp. "perdegras"
Castalas trigaus
Chrysoma oblongifolia
Cyphia digitata
Dianthus campisutos
Eriogonum spp.
E. filifolia forma
F. lacioperca
F. maccorrhiza
F. ovata
F. scabrida
Foekoe sinuata
Galenia frutescens
Gratiosa arbuscula
T. robusta

The karoo of the far south-western, winter-rainfall part of the upper plateau is the Western Mountain Karoo 28.1 (1,076 species, 1,097 m) denser and taller than other karoo types and dominated in its present state by Eriogonum spp., with grass inconspicuous and scarce. It is well watered by streams from the Escarpment mountains.

The grasses are largely the same as those of the Mountain Renosterbosveld:

Aristida diffusa var. burkei
A. vestita
Chasmodromus dregeanus
Digitaria eriantha
Ehrhartia calycina
E. capensis
E. melicoides
Ergogrus curvula var. congerfa
Fingeruthia africana

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Castalas trigaus
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E. filifolia forma
F. lacioperca
F. maccorrhiza
F. ovata
F. scabrida
Foekoe sinuata
Galenia frutescens
Gratiosa arbuscula
T. robusta

Also present is a large geophyte and annual flora still persisting in places where the soil has not been eroded down to the rock. As in the Coastal Renosterbosveld, bulbs, corms, tubers and rhizomes appear to be more abundant in the top few centimetres than soil. Only a few Oxalis spp. have contractile roots strong enough to drag their bulbs along a zig-zag course through the crevices of the shale itself to a safe depth of 10 to 15 centimetres. So rich a flora as this, at its best in spring, may well have attracted the animals from the east on the many occasions when the spring rains failed there.

The drier phase of the Western Mountain Karoo 28.2 (685 species, 802 m), bordering on the Arid Karoo and the Succulent Karoo, is sparser and shorter with a higher proportion of succulents.

The last of the karoo types of the upper plateau are the Arid Karoo 29 (524 species, 976 m) and the False Succulent Karoo 39. The Arid Karoo shows considerable variation with soil type and amount annual Enneapogon desvauxii may also have been important by virtue of its ability to act like a perennial. Cleistogamous seeds which lie embedded in a small, dense tuft that remains firmly rooted when dead, enable it to do this. The Ouvlak type of vegetation which has developed on such flats in the former grassveld on the western side of Middelburg Division and the eastern side of adjacent Richmond Division, is known to be a favourite haunt of springbok. This sort of veld is also of importance to the brown locust.
and distribution of rainfall, but there are two main variations: Blomkoolgannaveld (Salsola tuberculata) on more or less sand-covered calcareous tufa, and Driedoringveld (Rhigozum trichotomum) on other soils. The former is mainly in the northern half on the granite and the latter in the south on Dwyka and Ecca shales and sandstones. The southern variation of the Arid Karoo of "Veld Types of South Africa" (Acocks, 1975) is now regarded as a variation of False Arid Karoo.

The main species, however, occur all through and it appears that the variations are chiefly varying reactions to overgrazing. A division into a western variation, west of the Sak and Hartebees Rivers, which is Bushmanland, and an eastern variation, east of the rivers, will be best for present purposes. The southern half of Bushmanland is a region of internal drainage, so level that its altitude varies perhaps as much as 20 m on either side of 914 m. The northern half is slightly higher, with ranges of low hills along the edge of the Orange River valley, and drains northwards. Rainfall is less than 127 mm per annum, the distribution of which is neatly summed up by the local saying that "there is plenty of rain in Bushmanland, only it takes five years to work round to one's farm". There used to be the permanent lake on the south side where the Fish River emptied into what is now Swart se Kolk se Vloer. One can imagine the bird life on this lake and the two vleis, one still known as Voëlvlei, both now vloere, through which the river flowed to reach it (see p. 696). There are permanent streams, or seepages, in the south-western corner from the Kamiesberg, but no other water is received from outside, so permanent habitation is possible at few places.

The eastern part has an undulating topography, has a little more rainfall and is crossed by many drainage lines from the Kareeberge, which receive 175 to 200 mm of rain and perhaps more on the high western portion of the range. There are many extensive pans in Bushmanland and extensive pans and floodplains in the eastern part, all equally bare now and of the nature of vloere, a "vloer" being originally a threshing floor.

The striking feature of the Arid Karoo was, and once more is, its grassiness, provided by the silvery plumose species of Stipagrostis—the Bushman grasses (S. ciliata and S. obtusa) twagraas or dgaagras (S. brevifolia), gemsbokgras (S. uniplumis), klipboesman-gras (S. anomala, not plumose), as well as S. fastigiata and S. hochstetterana which are now very scarce. S. brevifolia and S. fastigiata are very permanent and, while the others may die in a prolonged drought they remain rooted and remain palatable for years. Seedlings grow rapidly and come into flower and seed in a matter of weeks. Seed may work itself vertically into the sand in such abundance as to silver the ground with its plumes when seen against the late afternoon or early morning sun.

Together with a variety of karoo bushes, some semi-succulent, and succulents, it appears that this veld, while always available to animals like gemsbok, would become an immediately available reserve of grazing for the others as soon as rain provided drinking water, without waiting for growth to take place.

The grasses included the following:

- Cenchrus ciliaris (east)
- Dichanthium papillosum ("D. annulatum")
- Diplachne fusca
- Dregeochloa calvinensis (west)
- Enneapogon desvauxii
- E. scaber
- Ergrostris bicolor
- E. lehmanniana
- E. nindensis
- Fingerhuthia africana
- Oropetium capense
- Panicum lanipes
- Sporobolus ioclados
- S. lampranthus
- Stipagrostis anomalana
- S. brevifolia (west)
- S. ciliata
- S. fastigiata (west)
- S. hochstetterana (west)
- S. namaquensis
- S. obtusa
- Tricholaena capensis

The shrub Rhigozum trichotomum (driedoring) is almost universal, ranging from 30 cm to 2 m in height and from rare to absent in the Blomkoolgannaveld to almost impenetrable in the Driedoringveld, being more common and often dominant in the latter, as the name implies. This condition of dominance is, however, certainly artificial, resulting from elimination of effective competition from the grasses. Lycium spp. and Phaewiptilium spinosum are fairly regularly present in smaller numbers, while Xerocladia viridiramis is of local occurrence.

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- E. lehmanniana
- E. nindensis
- Fingerhuthia africana
- Oropetium capense
- Panicum lanipes
- Sporobolus ioclados
- S. lampranthus
- Stipagrostis anomalana
- S. brevifolia (west)
- S. ciliata
- S. fastigiata (west)
- S. hochstetterana (west)
- S. namaquensis
- S. obtusa
- Tricholaena capensis

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Fig. 18.—Arid Karoo. Sheet erosion is indicated by the "stilts" of old bushes. Partial recovery is indicated by the number of young bushes not on "stilts", but *Rhigozum trichotomum* continues to invade in the background and the grass has not returned.

Fig. 19.—"Cushions" of *Psilocaulon ciliatum* replacing karoo bushes in marginal Western Mountain Karoo: the development of False Succulent Karoo, about 39 km east-northeast of Loeriesfontein.

Fig. 20.—Orange River Broken Veld about 12 km south-east of Riemvasmaak Mission.
The bushes of the Arid Karoo include:

- Aizoon burchellii
- Aptosimum spinosum
- Aridaria noctiflora
- Eriosepalus pauperrimus
- E. spinosum
- Felicia filifolia forma
- F. macrorrhiza
- Hermandia grandiflora
- Hoodia gordonii
- Lebeckia linearifolia
- L. spinosum
- Lessertia pauciflora
- Lineum aesthiopicum
- Monocha desertorum
- Osteospermum spinosum
- O. spinosum
- Of these, Salsola tuberculata (blomkoolganna) was probably the most important.

The False Succulent Karoo, in its original condition probably did not differ greatly from the Arid Karoo. Bordering on the winter rainfall area, however, its minimal rainfall of less than 127 mm is likely to be dispersed through the year, a condition which favours the succulents rather than the non-succulent karoo bushes. What little study has been made shows that the karoo bushes are present, as well as the grasses, even if scarce today.

The Namaqualand Broken Veld of the Veld Type Map (Acocks, 1975) which occupies the Orange River valley from the Kakamas neighbourhood down to Vioolsdrif is now regarded as being typical Orange River Broken Veld 32.1 (640 species, 802 m) while the Orange River Broken Veld 32.2 (363 species, 1 067 m) of Griqualand West is now regarded as transitional to the Vryburg Shrub Bushveld. Below Kakamas it is all very arid, with a rainfall of under 127 mm, and (apart from the Orange River itself) it receives no run-off from wetter regions outside.

It is open country, sloping gently down towards the Orange River from the edge of the plateau on the south side, but in most parts dropping abruptly to the river on the north side. The soil is mostly coarse granite sand with dunes in places. The country becomes rocky near the river and very broken upstream towards Kakamas. Elsewhere, widely scattered rocky hills and short ranges of hills occur.

It is on the hills and in the rocky parts that the distinctive broken veld is best developed, the open country resembling the Arid Karoo plus a sprinkling of small trees and big shrubs and other elements of the Namib and subtropical savanna floras. The grassiness of the Arid Karoo is retained; indeed, in sandier parts the efficient seed-dispersal mechanism of the Stipagrostis spp. and their speed of growth have resulted in a Desert False Grassveld 33c in places from which the bushes have disappeared. This is the only case in the drier regions where change in the vegetation has favoured the grazers at the expense of the browsers.

The Orange River has its gallery forest, the only luxuriant vegetation in this arid region. Species found between Vioolsdrif and Havenga Bridge near Luckhoff, and up the Vaal River to Warrenton, total 547 in the samples studied. The trees, shrubs and grasses where the rivers flow through the Orange River Broken Veld and False Orange River Broken Veld include:

- Acacia erioloba
- A. karroo
- A. mellifera subsp. detinens
- A. tortilis subsp. heterantha
- Boscia albitrunca
- Bothriochloa glabra
- Cadaba aphylla
- Cenchrus ciliaris
- Combretum erythrophyllum
- Dichanthium papillosum ("D. annulatum")
- Diospyros lycioides
- Echinochloa holubii
- Ehretia rigida
- Euclaea pseudebenus
- Ficus cordata
- Grewia flava
- Hemarthria altissima
- Lycium sp., cf. L. cinereum aggr.
- L. hirsutum
- Maerua gilgii
- M. schinzii
- Maytenus linearis
- Phragmites australis
- Rhus lancea
- R. undulata var. tricrenata
- R. viminalis
- Salix capensis
- Schotia afra
- Scirpus inanis
- Sisyndite spartea
- Sorghum verticilliflorum
- Stipagrostis namaquensis
- Tamarix usneoides
- Ziziphus mucronata

This is a richer flora than that of the frosty upper reaches of the rivers.

The widely scattered shrubs and small trees that mark the change from Arid Karoo to Orange River Broken Veld 32.3a (434 species, 976 m), which extends as far as Prieska Division, are Acacia erioloba (watercourses), A. mellifera subsp. detinens, Boscia albitrunca, B. foetida, Cadaba aphylla (watercourses), Lycium oxyccarpum, and Parkinsonia africana.

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**Fig. 21.**—The normally dry Hartebees River in spate, with gallery forest of Tamarix usneoides, Acacia karroo and A. erioloba near Kakamas.
To the bushes and forbs of the Arid Karoo (p. 702) can be added the following species:

Aloe claviflora
Aptosimum albomargi-natum
Barleria rigid a
Cucumis hookeri
Hermannia abrotonoides

Grasses were the same as in the Arid Karoo.

The distinctive plant of the rocky parts is Aloe dichotoma even if it is not always present. Although it rarely occurs in non-rocky places, there are two extensive groves of it to the north and north-east of Pofadder in sandy valleys. Sandy valleys are more usually dotted with C. aethiopica to the north and north-east of the Asbestos Hills and the river, mostly calcareous tufa, and was probably an open, grassy broken veld and, south of the river, Tarchonanthus-Olea detinens have assumed dominance and appear again and we are once more in kudu country.

Whether part of the original fauna, or introduced from somewhere else, it appears in the list of important species in the Griqualand West Orange River Broken Veld list that are marked with an asterisk appear to be absent while others come in, so that the list for Griqualand West becomes:

Antephora pubescens
Aristida diffusa var. burkei
A. engleri
Cenchrus ciliaris
Digitaria eriantha
Enneapogon scaliger
E. lehmanniana
Eustachys mutica

In Griqualand West on the right bank of the Orange River from Buchuberg to Prieska and in Prieska Division on the left bank from near Koegas towards Prieska and along the Dronberg, this is steep, rugged country.

The fourth variation of the Orange River Broken Veld 32.3b (413 species, 1,037 m) is the Swart-haakveld, mainly between Prieska and Douglas, and not so arid as 32.3a. It occurs on stony flats between the Asbestos Hills and the river, mostly calcareous tufa, and was probably an open, grassy broken veld, transitional from the third variation of Orange River Broken Veld of the plains to the Central Upper Karoo and the Vryburg Shrub Bushveld, with the following species:

Acacia mellifera subsp. detinens
Boszia altibrunca
Cadaba aphylla
Chascanum pinnatifidum
Codon royenii
Dianthus scaber
Dyerophyton africana
Erythra rigida
Euclea undulata
Euphorbia avasmontana
E. flavescens
Grewia flava
Hoodia gordoni
Indigofera sessiliflora
Justice thymifolia
Kissenia capensis
Lantana rugosa
Lasiocretis capensis
Limeum aethiopicum
Lycium oxyccarpum
Maytenus ilicica
Monechma divaricatum
M. incanum
Nymania capensis
Parkinsonia africana
Phaeoptilum spinosum
Plinthus karooicus
Policchia campestris
Pupalia lappacea
Rhigozum trichotomum
R. rhus dregeana
R. undulata var. tricrenata
Rhysochus totta
Salsola grahamensis
Sansevieria aethiopica
Sarcostemma vimineale
Senecio longiflorus
Sarcococca avulans
S. schinzii
S. uniplumis
Tricholaena capensis
Tetragonia arbuscula
Thesium lineatum
Ziziphus muconara

The above species are scattered less thinly than in 32.3a, or possibly group into thickets in depressions around pans and in kloofs leading down to the Orange River. Grasses like Themeda and Cymbogogon appear again and we are once more in kudu country. Whether part of the original fauna, or introduced from elsewhere, forty years ago the kudu was certainly present in these wooded kloofs.

Acacia mellifera subsp. detinens (swarthaad) and Rhigozum richotomum have assumed dominance and have advanced upcast into what was Thermeda-Tarchonanthus-Olea Veld and, south of the river, into what was open karoo, to form the False Orange River Broken Veld 40a (540 species, 1,130 m).
The Orange River Broken Veld and False Orange River Broken Veld are the last of the genuine karroid types. Eastwards and northwards, any karoo bushes were subordinate to the grasses, while their present types. Eastwards and northwards, any karoo bushes glimpses is rather startling. Still, it was what was extending west of the escarpment of the Kaap Plateau remaining veld types are variations of the Kalahari veld. Thornveld becomes so open as to be virtually grass-thickets, thereby maintaining the ability of the veld to support the whole fauna.

The first division to be made is into Kalahari Thornveld proper and Vryburg Shrub Bushveld of which 16.1 and 17.1 occur on sand and 16.2 and 17.2 occur in rocky places. Today there are extensive areas of grassland on firmer soils northwards, viz. 16.2d (i) (292 species, 1 280 m), but this may be artificial. In the drier south and west, the Kalahari Thornveld becomes so open as to be virtually grass-veld. Accacia tortilis subsp. heteracantha did not west of the escarpment of the Kaap Plateau nor south of the Orange River, while Accacia mellifera subsp. detinens was probably not present at all.

The Kalahari Thornveld or Kameeldoringveld is normally an open woodland of Acacia erioloba (=A. giraffae) locally accompanied by, or replaced by Accacia haematoxylon, especially in the drier southern part. It varies from almost closed, as in the Kathu Forest, to almost grassveld. In the less arid eastern part, the grassveld constituent is transitional to the Dry Cymbopogon-Themeda Veld and, northwards, to the Bankenveld. There were few karoo bushes to provide winter feed for the browsers, their place being taken by forbs, which mostly die down in winter, and evergreen shrubs were few. On the other hand, surface waters were more plentiful in pans that held their water longer than they have done during the last seventy years or more. How long they will hold their water after the excessive rains of the last three years remains to be seen.

Most of the trees and shrubs of the less arid eastern part, viz. 16.1, were possibly associated with Acacia erioloba in small bush clumps rather than scattered, such as:

- Acacia erioloba
- A. hebeclada
- A. karroo
- A. tortilis subsp. heteracantha (mainly southwards)
- Asparagus africanus
- Boscia albitrunca
- Dichrostachys cinerea subsp. africana (northwards)
- Diospyros lyciodes
- Ehretia rigida

In the eastern part, the grasses of the Kalahari Thornveld included:

- Anthophora argentea
- A. pubescens
- Aristida meridionalis
- Brachiaria nigropedata (northwards)
- Cenchrus ciliaris
- Cymbopogon plurinodis
- Cydonon dactylon
- Heteropogon contortus (northwards)
- Panicum kalaharense (northwards)
- P. maximum
- Schmidia pappophoroides
- Sporobolus fimbriatus
- Stipagrostis amabilis
- S. uniplumis
- Themeda triandra (northwards)
- Tricholaena monachne
- Triraphis andropogonoides

Excluding the karoo species that occur today, the forms of the Kalahari Thornveld included:

- Acanthosicyos naudinianus
- Anthospermum rigidum
- Anzotiza angustifolia
- Bolumia capensis
- Boophane disticha
- Cassia biennis
- C. italic subsp. arachoides
- Chascanum pinnatifidum
- Coccinia sessilifolia
- Commelina africana etc.
- Convolvulus ocellatus var. Dicoma schinzii
- Elephantorrhiza elephantina
- Geigeria brevifolia
- Harpagophyrtum procumbens
- Heliotropium citatum
- Hypoxis rooperi
- Indigora daleoides
- I. velutina
- Ipomoea omannyeyi
- Lanata rugosa
- L. hirsutum

The drier western part of the Kalahari Thornveld 17.1 (562 species, 1 172 m) that has been studied by the author, is only the eastern fringe of the Kalahari, southern part of the Kalahari Thornveld described by Leistner (1967) and by Leistner & Werger (1973). Both parts include the karoo on limestone outcrops, differing greatly in flora. Except near the Langeberg and other ranges and along rivers, trees were few and far between. Acacia tortilis subsp. heteracantha was absent, whereas A. haematoxylon was of more regular occurrence than farther east. The trees and shrubs were:

- Acacia erioloba
- A. haematoxylon
- Asparagus africanus
- Boscia albitrunca
- Crotalaria virgultalis

The grasses of the drier western part of the Kalahari Thornveld included:

- Anthophora argentea
- A. pubescens
- Aristida meridionalis
- Asthenantherum glaucum
- Bracharia dura var. pilosa
- Digiaria sp.
- Erargrostis lehmanniana
- E. pallens
- Eragrostis lehmanniana
- E. pallens
- E. hirsutum
- Euphorbia caffrum
- Grewia flava
- Lycium hirsutum
- Rhigozum trichotomum
- Ziziphus mucronata

The forbs of this drier western phase of the Kalahari Thornveld included:

- Acanthosicyos naudinianus
- Adenia repanda
- Anthozima angustifolia
- Boophane disticha
- Cassia italic subsp. arachoides
- Convolvulus ocellatus var. ornatus
- Dicoma schinzii
- Euphorbia maculata
- Geigeria brevifolia
- Harpagophyrtum procumbens
- Heliotropium citatum
- Hermannia brachypetala
- Hoffmannseggia burchellii
- Jatropha erythropoda
- Monachea incana
- Pergularia daemia
- Plinthus cryptocarpus
- P. sericeus
- Polichlaena monachne
- Pollichlaena monachne
- Tephrosia lupinifolia
- Tylosme esculentum
- Ziziphus mucronata

The Vryburg Shrub Bushveld 16.2 (888 species) and 17.2 (788 species) has many variations, of which the typical one is taken to be the Tarchonanthus Veld
The calcareous tufa parts of the Kaap Plateau are very flat with many small shallow pans and wide shallow valleys, all normally dry and bare now, but with rare traces of a formerly luxuriant vegetation. It was here, when the author was going from farm to farm collecting information about the vermeerbos problem, that he repeatedly heard the expression “maktrap”, meaning that the early settlers had considered that they had to trample down and “tame” the too-luxuriant vegetation to make it suitable for their sheep. That was forty years ago and by then success was already complete except on certain farms that could not be permanently occupied because of lack of water.

That the plateau was generally well watered, presumably with a fauna to match, is confirmed by the ubiquity of Bushman implements and the traces of their “factories” at so many places that look as though they were formerly springs. The excessive rains of the past three years have more than restored this well-watered condition, but the absence of the rains of the past three years have more than restored

16.2a (i) (560 species, 1 341 m) and 17.2a (i) (273 species, 1 372 m) of the calcareous tufa flats of the Kaap Plateau in Griqualand West and in Vryburg 16.2a (iii) (323 species, 1 250 m) with outliers 17.2a (ii) (359 species, 1 160 m) below the Plateau. In pre-Kimberley days these outliers were more extensive. Veld Type 17.2 is the Vryburg Shrub Bushveld invaded by karoo, so for present purposes it has to be combined with 16.2 with elimination of the invading karoo species.

small bush clumps with the *Tarchonanthus* “spp.” *Maytenus heterophylla*, *Cadaba aphylla*, a tall form of *Rhus dregeana* and others. The names *Tarchonanthus camphoratus* var. *likakunensis* and *T. minor* continue to used because the cattle do not agree with the taxonomists that the plants are indistinguishable, ignoring the former and eating the latter to the verge of extinction.

The rainfall is lower at the south end of the plateau, but not sufficiently so as to alter the nature of the veld.

In this typical form of the Vryburg Shrub Bushveld 16.2a (i) and 17.2a (i), the principal trees and shrubs are likely to have been the following:

- *Acacia karroo*  
- *A. tortilis* subsp. *heterantha*  
- *Asparagus africanus*  
- *A. larcinicus*  
- *Boscia albitrunca*  
- *Diospyros astro-africana*  
- *D. lycoideas*  
- *Ehretia rigida*  
- *Euclia crispa* var. *ovata*  
- *Grewia flava*  

Buses and forbs of the *Tarchonanthus Veld* would have included:

- *Achyranthes aspera*  
- *Aerva leucura*  
- *Aptosimum albomarginatum*  
- *Barleria bechuanensis* var. *espinulosa*  
- *Chascanum pinnatifidum*  
- *Coccinia sessiliflora*  
- *Commelina africana*  
- *Dianthus sp.*  
- *Geigeria filifolia*  
- *Hermannia comosa*  
- *H. linnaeoides*  
- *H. pulverata*  
- *Hibiscus marlothianus*  
- *Kalanchoe pyramidalis*  
- *Lantana rugosa*  
- *Lasiocorys capensis*  
- *Lessertia pauciflora*  
- *Lineum aethiopicum*  
- *Lippia scaberrima* (northwards)  
- *Melhania rupestris*  
- *Menodora africana*  
- *Ornithoglossum viride*  
- *Pavonia patens*  
- *Pentarrhinum insipidum*  
- *Phyllanthus maderaspatensis*  
- *Pollichia campestris*  
- *Polygala asbestina*  
- *Pupalia lappacea*  
- *Rhychosia totta* (northwards)  
- *Ruschia cananotata*  
- *R. griquensis*  
- *Salvia stenophylla*  
- *Sansevieria aethiopica*  
- *Seneocio intricus tus*  
- *S. longiflorus*  
- *Solanum supinum*  
- *Stachys spathulata*  
- *Sutera atropurpurea*  
- *Telinum caffrum*  
- *Viscum spathulatum*  
- *Vulcanum rotundifolium*  
- *Zygophyllum pubescens*
The grasses of the *Tarchonanthus* Veld included:

Chrysoptogon serrulatus  
Cymbopogon plurinodis  
Cynodon dactylon  
Digitaria argyrograpta  
D. eriantha  
D. polyphylla  
Eliosorus muticus  
Enneapogon scoparius  
Eragrostis lehmanniana  
E. superba

Where the dolomite is not covered with calcareous tufa or sand, the surface is rugged, especially along the escarpment of the Kaap Plateau 16.2c (423 species, 1 310 m) and 17.2c (349 species, 1 310 m). The following species may be added to the flora of the escarpment of the Kaap Plateau.

The terms “flats” and “sand” mean that a large area (of the bushveld) has been almost entirely covered by sand. The dolomite is the most common type of limestone flats 16.2d (i) would have been as follows:

<table>
<thead>
<tr>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthephora pubescens</td>
</tr>
<tr>
<td>Cadaba aphylla</td>
</tr>
<tr>
<td>Cenchrus ciliaris (mainly southern)</td>
</tr>
<tr>
<td>Ceterach cordatum</td>
</tr>
<tr>
<td>Celtis africana (mainly southern)</td>
</tr>
<tr>
<td>Corallocarpus welwitschii</td>
</tr>
<tr>
<td>Cypholepis yemenica</td>
</tr>
<tr>
<td><strong>Only Aiptosimum albomarginatum and Hermannia pulverata need to be removed from the above to give a list of the main species of the dolomite.</strong></td>
</tr>
</tbody>
</table>

On the red sandy loam flats in the northern part of the Kaap Plateau 16.2d (i) (292 species, 1 280 m) the woodland is very open, the only thorn tree found in as many as half the samples, for instance, being *Acacia karroo*. Rainfall increases northwards, so that sourer grasses come in, or become more plentiful than they were southwards, so on

<table>
<thead>
<tr>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andropogon amplexcaps</td>
</tr>
<tr>
<td>A. schreinser</td>
</tr>
<tr>
<td>Brachiaria nigropedata</td>
</tr>
<tr>
<td>B. serrata</td>
</tr>
<tr>
<td>Cymbopogon excavatus</td>
</tr>
<tr>
<td>Eliosorus muticus</td>
</tr>
</tbody>
</table>

Forbs belonging to the Transvaal Bushveld begin to appear, while others, particularly those of the limestone, become scarce to absent, so that the list of the bushes and forbs of the northern sandy loam flats 16.2d (i) would have been as follows:

<table>
<thead>
<tr>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achryanthus aspera</td>
</tr>
<tr>
<td>Aerva leucura</td>
</tr>
<tr>
<td>Anthospermum rigidum</td>
</tr>
<tr>
<td>Barleria macrostegia</td>
</tr>
</tbody>
</table>

**Fig. 23.—Kimberley Hardeveld**

24 km north-west of Christia with *Acacia erioloba*, *A. tortilis* subsp. *heterantha*, *A. hebeclada* and *A. karroo*.

Crabbea angustifolia  
Dicona macrocephala  
Elephantorrhiza elephantina  
Hibiscus marlothianum  
Lantana rugosa  
Menadora africana  
Orhantbera jasminiflora  
Osteospermum scariosum  
Oxygonum alatum  
Pavonia patens  
Phyllanthus maderas-patensis  
Pollichia campestris  
Rhynchosia adenodes  
Ruschia griquensis  
Sida cordifolia  
S. dregci  
Solanum supinum  
Vernonia oliocephala  
Zornia tetraphylla

Further south, on hard red sandy loam around Warrenton, Barkly West and Kimberley is a mixed Thornveld, the Kimberley Hardeveld 16.2b (301 species, 1 130 m) and 17.2b (417 species, 1 220 m) ranging from dense to open, and including all the local *Acacia* species except *A. haematoxyylon*. It is, however, almost certainly the result of invasion of grassveld by the bushveld species and in the case of 17.2b, of karoo species as well. This veld must thus be considered to have been *Themeda* Veld.

There are three more major variations of the Vryburg Shrub Bushveld: (a) on the Asbestos Hills 16.2d (ii) (541 species, 1 500 m) and on the drier southern and western parts of these hills that are invaded by karoo 17.2d (ii) (383 species, 1 372 m); (b) on the Langeberg and its foothills 16.2e (462 species, 1 310 m); and (c) on the koppies around Kimberley, where karoo invasion has taken place 17.2f (394 species, 1 160 m). For present purposes, as already pointed out, the invading karoo species have to be ignored.

The Asbestos Hills are stony rather than rocky and generally not steep, so that they are more easily accessible to the hoofed animal than the rocky koppies and the excessively rocky and steep Langeberg. If the stoniness ever was covered by soil, no trace of it has been found. The acid nature of the banded ironstone favours the sour grasses, mainly northwards where the rainfall is higher, so that the list of grasses would have been as follows:

<table>
<thead>
<tr>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andropogon schreinser</td>
</tr>
<tr>
<td>A. schinzi (northwards)</td>
</tr>
<tr>
<td>Anthephora pubescens</td>
</tr>
<tr>
<td>Aristida diffusa var. burkei</td>
</tr>
<tr>
<td>A. meridionalis (northwards)</td>
</tr>
<tr>
<td>Brachiaria nigropedata</td>
</tr>
<tr>
<td>B. serrata (northwards)</td>
</tr>
<tr>
<td>Cymbopogon excavatus (northwards)</td>
</tr>
<tr>
<td>C. plurinodis</td>
</tr>
<tr>
<td>Cypholepis yemenica (northwards)</td>
</tr>
<tr>
<td>Digitaria eriantha</td>
</tr>
<tr>
<td>D. polyphylla</td>
</tr>
</tbody>
</table>

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**Fig. 23.—Kimberley Hardeveld**

24 km north-west of Christia with *Acacia erioloba*, *A. tortilis* subsp. *heterantha*, *A. hebeclada* and *A. karroo*.

Crabbea angustifolia  
Dicona macrocephala  
Elephantorrhiza elephantina  
Hibiscus marlothianum  
Lantana rugosa  
Menadora africana  
Orhantbera jasminiflora  
Osteospermum scariosum  
Oxygonum alatum  
Pavonia patens  
Phyllanthus maderas-patensis  
Pollichia campestris  
Rhynchosia adenodes  
Ruschia griquensis  
Sida cordifolia  
S. dregci  
Solanum supinum  
Vernonia oliocephala  
Zornia tetraphylla

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</tr>
<tr>
<td>Aristida diffusa var. burkei</td>
</tr>
<tr>
<td>A. meridionalis (northwards)</td>
</tr>
<tr>
<td>Brachiaria nigropedata</td>
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<tr>
<td>B. serrata (northwards)</td>
</tr>
<tr>
<td>Cymbopogon excavatus (northwards)</td>
</tr>
<tr>
<td>C. plurinodis</td>
</tr>
<tr>
<td>Cypholepis yemenica (northwards)</td>
</tr>
<tr>
<td>Digitaria eriantha</td>
</tr>
<tr>
<td>D. polyphylla</td>
</tr>
</tbody>
</table>
Diheteropogon amplexent
Ellionurus muticus
Enneapogon scoparius
Eragrostis curvula
E. nindensis
Eustachys mutica
Fingerhuthia africana
Heteropogon contortus
Hyrapphira hirta
Panicum coloratum
P. stapfianum
Rhynechlytum setifolium
Schizachyrium sanguineum
Schmidia pappophoroides
Sporobolus fruticosus
Stipagrostis uniplumis
Themeda triandra
Tragus koelerioides
Trichoneura grandiglumis
Triraphis andropogonoides
Urelytrum squarrosum
(northwards)
(northwards)
(northwards)
(northwards)
(northwards)
(northwards)
(northwards)
(northwards)
(northwards)

Of these trees and shrubs of the Kaap Plateau Tarchonanthus Veld (p. 702) all except Acacia tortilis subsp. heteranca can occur on the Asbestos Hills, with Acacia erioloba (sandy valleys), Cadaba aphylla, Euclea undulata, Lebeckia macrantha, Nymania capensis, Rhigozum obovatum, and Rhus undulata var. tricrenata becoming sparse towards the south. Of the widespread bushes and forbs of the Tarchonanthus Veld, only Aerva leucura, Hermannia linnaeoides and Lippia scaberrima fail to appear on the Asbestos Hills, while 21 have to be added, although a few of them do occur, but as rarities, on the Kaap Plateau. These are the following:

Anthospermum rigidum
Bobophane disticha
Ceterach cordatum
Dimorphotheca cuneata
*Euphorbia gariepina
E. rhombifolia
Garuleum schinzii
*Glossochilus burchellii
*Helinus spartioides (rare to the north)
*Hermannia abrotanoides
Justicia thymifolia
Osteospermum microphyllum
*O. scariosum
Pachypodium succulentum
Pellas hastata
Sida dregi
Stachys burchellii
Sutherlandia frutescens
Thesium lineatum
*Triapsis hypericoides

In the southern half of the Langeberg 16.2e that has been studied, few of the sour grasses occur, but it is along this range and the Asbestos Hills that the sour grasses make their deepest penetration into the arid regions. The list of grasses becomes as follows:

Anthophora pubescens
Aristida diffusa var. burkei
Bracharia nigropedata
Cenchrus ciliaris
Cenchrus plumifolius
Digiteria eriantha
Digitaria eriantha var. burkei
Echinochloa colona
E. nindensis
E. lehmanniana
E. nindensis
E. superba
Eustachys mutica

Running almost north and south, the Langeberg has a marked aspect difference. The west side is covered with Crotton gratissimus with Euphorbia avasmontana scattered through it. In rocky kloofs on the east side there is much Buddleja saligna, while Acacia erioloba is regularly found in sandy kloofs below. Although Acacia melifera subsp. detinens is present all through today, it is not regarded as a member of the original flora of any of these Kalahari types. Otherwise the tree and shrub flora of the Langeberg is similar to that of the Asbestos Hills, but with Diospyros astro-africana, Lebeckia macrantha, Maytenus heterophylla and Rhus pyroides failing to appear. Tarchonanthus camphoratus "var. litakunensis" is almost entirely replaced by Tarchonanthus "minor" and Ficus cordata, Maytenus undulata (= M. ilicin), Nymania capensis, Phaeothamnus spinosum and Putterlickia pyracantha coming in or becoming more frequent, in addition to Acacia erioloba, Crotton gratissimus, Euphorbia avasmontana and Buddleja saligna.

The bush and forb flora of the Langeberg shows considerable difference from that of the Asbestos Hills, with a number of species failing to appear, (those marked with an asterisk in the list on pp. 705 and 706), and a number, some of them from the Orange River Broken Veld, coming in as regular constituents:

Acanthosicyos naudinianus
Adenia repanda
Aloe hereroensis
Corallorcarpus welwitschii
Cotyledon decussata
Dipacida glaucum
Hibiscus eliatiae
H. fleckii
Lopholaena crenefoliifia
Psidia punctulata
Sarcostemma viminalis
Sutera crassicaulis
Sytila biflora

With permanent water at Witsand a few kilometres to the west and springs in the kloofs, one might regard this rugged mountain as a stronghold of such animals as the klipspringer and vaal rhebok, and as a reserve of grazing for others when the need arose to climb.

The Kimberley Koppies 16.2f (309 species, 1,160 m) and 17.2f (394 species, 1,160 m) look similar to those of the False Karoo, but their vegetation shows considerable differences. Their grasses included:

Antheophora pubescens
Aristida diffusa var. burkei
Bracharia nigropedata
Cenchrus ciliaris
Chrysopogon serrulatus
Cymbopogon plurinodis
Digiteria eriantha
Dheteropogon amplexent
Enneapogon scoparius
Eragrostis curvula
E. nindensis
E. superba
Eustachys mutica
Fingerhuthia africana
Heteropogon contortus
Hyparrhenia hirta (northwards)
Panicum coloratum
P. maximun
Rhynchelytrum sp., cf. R. willosum
Sporobolus pappophoroides
Sporobolus fruticosus
Themeda triandra
Tragos koelerioides
Trichoneura grandiglumis

The shrubs and trees of the Kimberley koppies included the following:

Acacia tortilis subsp. heteranca
Boscia albitrunca
Cadaba aphylla
Diospyros betoides
Ehretia rigid
Euclea crispa var. ovata
Grewia flav
Maytenus heterophylla
(northwards)
Olea africana (southwards)
Rhigozum obovatum
Rhus ciliar
R. lancea (northwards)
Tarchonanthus camphoratus "var. litakunensis"
Ziziphus mucronata

The bushes and forbs of the Kimberley koppies included:

Abutilon astro-africana
Achyranthes aspera
Antizoma angustifolia
Argyrolobium rupestre
Asclepias burchellii
Barleria rigid
Bobophane disticha
Ceterach cordatum
Chascanum pinnatifidum
Coccinia rehmannii
Commelina africana
Corellaucarpus welwitschii
Corbichonia decumbens
Crotalaria griesens
Dicauma capensis
Dipacida viride
Euphorbia sp., cf. E. recti-rana
Elionurus muticus
E. nindensis
E. superba
Eustachys mutica
Hibiscus atromarginatus
H. marlothianus
Kalanchoe paniculata
Lantana rugosa
Lasiocorys capensis
Limeum aethiopicum
Melhania prostrata
Osteospermum microphyllum
Pachypodium succulentum
Pavia patens
Pellas hastata
Pollichia carpestris
Pupalia lappacea
Rhynchosia tota
Schizobasis intricata
Senecio longiflorus
Solanum supinum
Sutera crassicaulis
S. halimifolia
Telminium caffrum
Viscum rotundifolium
It is evident that if this reconstruction of the vegetation is correct, the colouring of the landscape would have been different from what it is now. On the whole, the landscape would have been lighter in colour and smoother in contour and texture. The exception, temporarily, is the False Central Upper Karoo, now submerged in a winter-white sea of pioneer *Eragrostis lehmanniana*.

The invading and encroaching bushes, shrubs and trees such as *Chrysocoma tenuifolia*, *Felicia filifolia*, *Dimorphotheca cuneata*, *Elytropappus rhinocerotis*, *Pteronia tricephala*, *Ericocephalus spp.*, *Euryops spp.*, *Rhigozum trichotomum*, *Acacia karroo*, *A. mellifera* subsp. *detinens*, etc., are nearly all dark green or grey. Shadows in their uneven surface help to cause them to show up black at a distance, so their elimination would lighten the colour and smooth the texture of the vegetation.

Because *Themeda*‘s red-brown or orange-brown colour when flowering, or just after the first frosts, closely matches the colour of red soil, restoration of a *Themeda* Veld would sometimes, in denuded and eroded false karoo, make little difference to the colour of the landscape. Young growth, on the other hand, especially if fire or grazing has removed the pale, purple-pink old growth, is pale blue-green; so here and in the Mountain Renosterbosveld and Karroid *Merxmuellera* Mountain Veld, whether coloured light yellow-green by *Merxmuellera* or black by shrubs, restoration of *Themeda* Veld would make a conspicuous difference. Only where the brown dolerite boulders have recently been eroded out of the soil would the change be inconspicuous. While the pale green of *Merxmuellera* is spreading as better management reduces the area under the shrubs, the restoration of the red of *Themeda* is still in the future. Fortunately there is a scattering of relics all through the mountains to give us an idea of what they looked like and how brilliant their colouring must have been. In the parts of the winter-rainfall area outside the range of *Themeda*, the winter colouring was green, the summer colouring white.

Where grasses like *Digitaria*, *Sporobolus*, *Eragrostis*, *Fingerhuthia* and *Tetrachne* were dominant, the green of young growth was less bluish, while the flowering colour was a film of dark grey over the green, and the winter colouring white to cream to light grey. If *Panicum* were dominant, the flowering colour would be purplish. In the arid regions, the flowering colour of the *Stipagrostis* spp. was silvery white, changing to pale blue as the grasses dried off and became matted down into the condition known to the farmer as “bloudak”.

The distinctive yellow-green colour of the spekboom is retained winter and summer and is recognizable at a distance; the only plant that can occasionally cause a little doubt is *Zygophyllum foetidum*. It is not a grass colour, but there is a plant that can perfectly mimic over large areas the pale blue-green colouring of a young *Themeda* Veld; this is the creeping succulent *Hymenocactus luteolus* in the south-eastern Cape in places that used to be spekboomveld. In such cases and where forest has been replaced by grassveld or fynbos, the original colouring was darker than it is now. Where thicket was more open and grassy than it is now that it has closed up and lost its grassiness, its colouring was lighter.

In the karoo, the mixture of grass and small bushes would have produced the same pepper-and-salt effect that it still does, varying with the wetness of the season, the time of year and the degree to which the grasses were grazed down. The difference was that the all-too-common condition of today, which, to amplify the well-known quotation, can be described as “little bushes standing each on its own little mound in its own little desert”, was never reached.

Restoration of the soil would smooth the contour by covering the ledges of hard sandstone that break up the outlines of the shaly slopes and by covering the boulders of igneous koppies and other rocky hills and mountains, besides filling the dongas. More vigorous growth of grass would increase this effect.

To avoid any misunderstanding, it must be emphasized that the present uniform winter-white grassiness of so much of the upper plateau is the effect of three years of excessive rainfall on a vegetation from which practically all the climax grass had disappeared. It is an artificial product which bears little or no resemblance to the original vegetation which this paper has tried to reconstruct and describe.
UITTREKSEL

Daar word gepoog om die oorspronklike plantegroei van die vlaktes, plato’s, berge en riviere van die half-dorre tot dorre westelike helfte van die Republiek van Suid-Afrika voor te stel, alvorens dit onder enige menslike invloed, behalwe die van die Boesmans en Hottentotte, gekom het. Lyste van plantsoorte wat voorheen waarskynlik belangrik was, al is hulle vandag seldsaam, word gegee. Besondere ag word geslaan op die rivieroewerplantegroei. Aandag word ook gegee aan eienskappe van die plantegroei en topografie wat moontlik die dierlewe kon beïnvloed het.

REFERENCES
