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THE OXFORD SURVEY
OF THE BRITISH EMPIRE

VOLUME III



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AFRICA — BATHY-OROGRAPHICAL.

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THE OXFORD SURVEY OF THE BRITISH EMPIRE

A F R I C A

INCLUDING SOUTH AFRICA, RHODESIA, NYASALAND, BRITISH EAST AFRICA, UGANDA, SOMALILAND, ANGLO-EGYPTIAN SUDAN & EGYPT, GAMBIA, SIERRA LEONE, GOLD COAST, NIGERIA, WOLFISH BAY, WITH MAURITIUS AND OTHER ISLANDS IN THE INDIAN AND ATLANTIC OCEANS

With 47 Photographs, 5 Coloured Maps, and 20 Figures in text

Edited by

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PREFACE

THE object of this series is to furnish a survey of the British Empire and its constituent parts in their geographical and allied aspects, together with their economic, administrative, and social conditions, at the present time. History has not been included as an integral part of the scheme, except for the inclusion of a general historical summary in the General Volume; for the rest, historical references have been included only in so far as they were found desirable for the explanation of existing conditions. The history of the Empire has been brought under review elsewhere, notably in the Oxford *Historical Geography* edited by Sir Charles Lucas.

The series is in six volumes, and the subject-matter is thus distributed :

- I. The British Isles and Mediterranean territories (Gibraltar, Malta, Cyprus).
- II. Asiatic territories.
- III. African territories (with adjacent islands, Mauritius, &c., St. Helena, Ascension, and Tristan da Cunha).
- IV. American territories (with the Falkland Islands and dependencies).
- V. Australasian territories (including islands in the Pacific Ocean and the British sector in Antarctica).
- VI. General.



The Editors have been in close consultation throughout as to the general plan and details of the work. They have shared between them the arrangements with the contributors, for whose collaboration they express their thanks. They wish in particular to record the generous assistance afforded by the late High Commissioner for South Africa, Sir Richard Solomon ; the special interest which he showed in the section on South Africa only adds to their regret that he did not live to see the work completed.

Professor Herbertson has undertaken the major part of the work connected with the maps ; Mr. Howarth has carried out the greater part of the editorial work in its later stages, has dealt with the illustrations (in the five topographical volumes), and has seen the volumes through the press.

It is desired to acknowledge Mrs. Howarth's collaboration in the work of indexing, and Mr. O. Brilliant's assistance in the compilation of the gazetteer references in the topographical volumes.

Notes in the text enclosed in square brackets are editorial.



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The names of the authorities or individuals who have supplied photographs are stated on each plate. The editors desire to express their indebtedness, for the loan of photographs, to the late Sir Richard Solomon, High Commissioner for the Union of South Africa, the Visual Instruction Committee of the Colonial Office, the Crown Agents for the Colonies, Sir Harry H. Johnston, Mr. M. S. Thompson, Mr. T. J. Alldridge, and Professor J. Stanley Gardiner. They have also to thank Sir Charles Lucas for valuable advice, and Major A. J. N. Tremearne for assistance.



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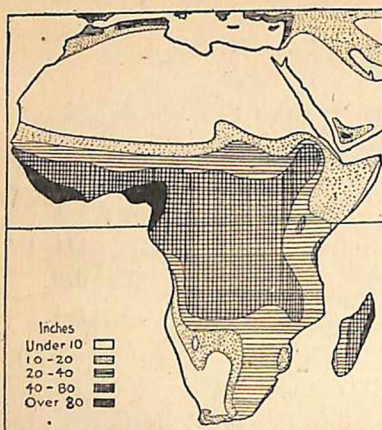


FIG. 1. Mean Annual Rainfall of Africa.

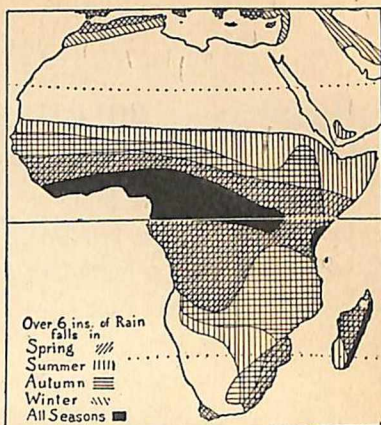


FIG. 2. Rainy Seasons in Africa.

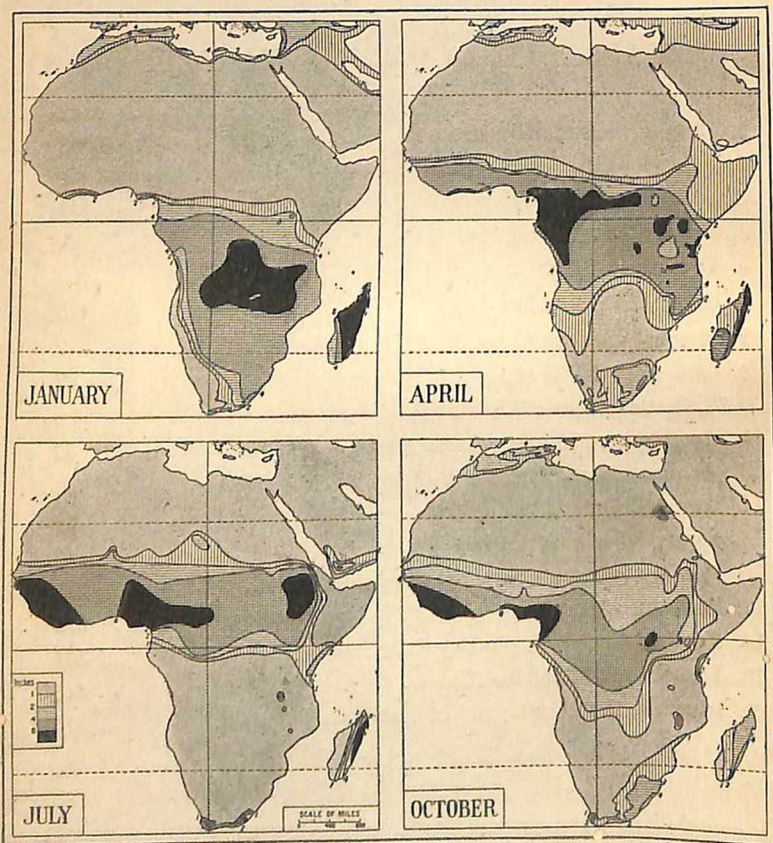


FIG. 3. Seasonal Rainfall.

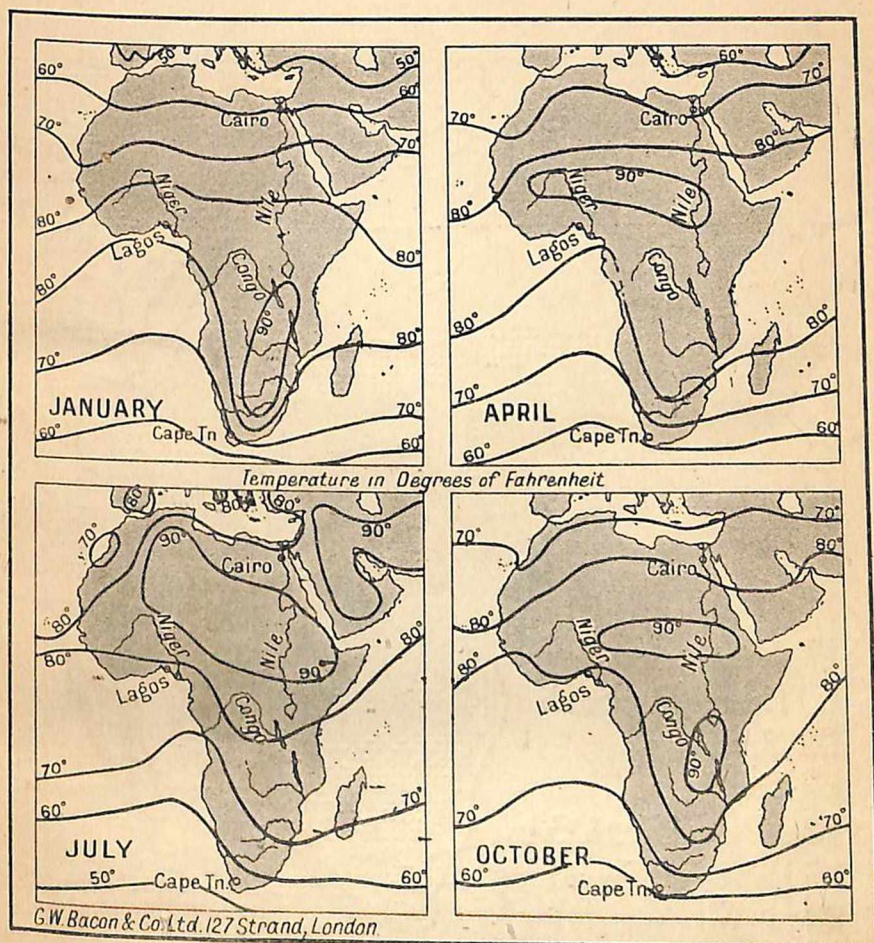


Fig. 4. Temperature. (Maps showing pressure over the African continent will be found on page 328.)

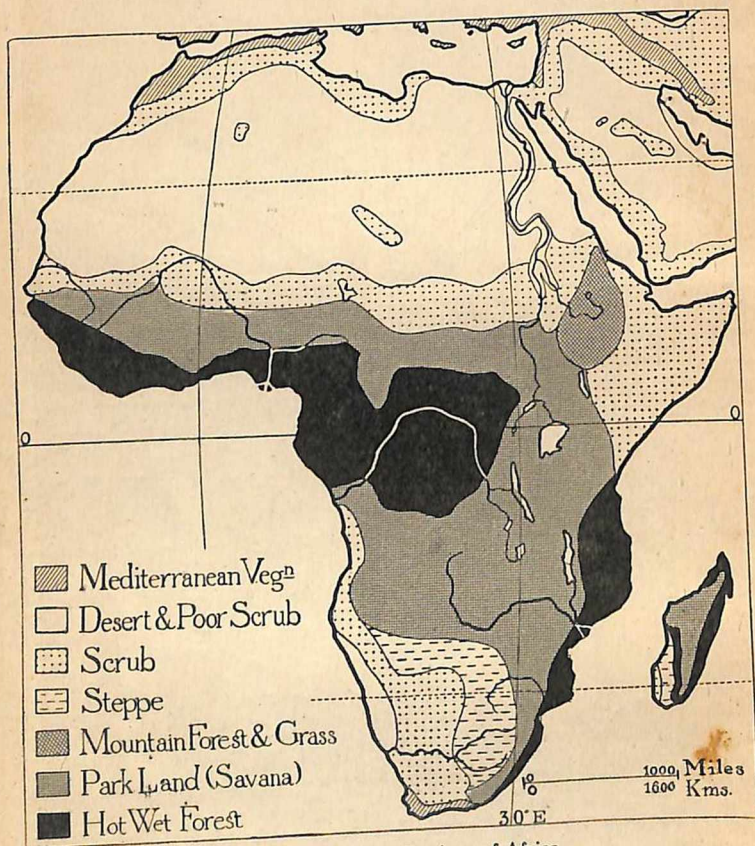


FIG. 5. Vegetation Regions of Africa.



BRITISH SOUTH AFRICA — POLITICAL.





SOUTH AFRICA

INTRODUCTION

THE term 'South Africa', so far as concerns British Africa territory, is used in more than one connexion, and with south of Lake Tanganyika. more than one connotation, and as, in the chapters which follow, one or another of these connotations has been adopted according to the requirements of the particular subject under discussion, it is well at the outset briefly to explain the political division of the whole of British African territory southward of Lake Tanganyika.

To that territory the name of British South Africa may be applied in a proper geographical sense, and it is so applied, for physical reasons which will be obvious, in the following survey of the physical geography and geology (chapter I). Its area approximates to 1,205,000 square miles, and it lies between latitudes 8° and 35° S. It marches on the north with German East Africa and Belgian Congo, on the east with Portuguese East Africa, and on the west with Angola (Portuguese territory) and German South-west Africa. Bordering it on the north-east, but not geographically reckoned with it, is the Protectorate of Nyasaland (formerly called the British Central Africa Protectorate). Only from latitude 27° S. southward does British South Africa possess a seaboard, extending from the Atlantic to the Indian Ocean: it therefore resembles a vast wedge driven inland into the continent from the south.

In a limited, still physical, sense, South Africa is frequently reckoned as that part of the continent which lies south of the river Zambezi, and it is so regarded for the purposes of the study of climate in chapter II. But this division conflicts with the political, for the British South Africa Chartered Company's territory of Rhodesia, which forms the northern third (or rather more) of British South Africa in its widest sense, strikes athwart the great South of rivers Zambezi and Limpopo.



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river, which divides it into Northern and Southern Divisions. South of Rhodesia and the Limpopo River lie that congeries of colonies which are now united as the Union of South Africa—Transvaal, the Orange Free State, Natal, and the Cape of Good Hope. In addition there are certain territories which lie outside the Union but within the jurisdiction of the High Commissioner for South Africa; these are the Bechuanaland Protectorate, Basutoland, and Swaziland. To these three territories separate chapters have not been devoted; their names find natural though incidental places alongside those of the divisions of the Union: for Rhodesia, however, in spite of its inclusion in the physical survey of the sub-continent, separate treatment is clearly essential (chapter IX).



CHAPTER I

PHYSICAL GEOGRAPHY AND GEOLOGY

BY A. W. ROGERS

BRITISH SOUTH AFRICA stretches through 27° of latitude from the Cape to the southern end of Lake Tanganyika. It is a high-lying country, for only narrow belts along the coast are under 1,500 feet in altitude, yet there are no great mountain ranges in it. The highest points are in the south-east, on the Drakensberg, where the edge of the eastern escarpment reaches 10,600 feet in places. The only mountains of the folded type which attain a height of 7,000 feet are the southern ranges of the Cape Province.

General
physical
features.

The most important feature of the sub-continent is the interior plateau; very extensive areas on it are flat or are diversified only by the worn remnants of hills which rise more or less abruptly from its surface. The northern part of the plateau includes Rhodesia and Nyasaland, made of Archaean rocks covered in part by deposits of continental origin correlated with some portion of the Karroo system; in the north-east this plateau was broken up in late geological times by the remarkable faults which gave rise to the troughs in which Tanganyika and Nyasa lie, and the formation of which was accompanied by volcanic activity that still persists further north.

Interior
plateau.

The Archaean rocks of the great Central African plateau extend southwards into the Union, where they become covered by thicker and thicker deposits of sedimentary rocks towards the south, but the surface maintains its tableland character over the newer rocks.

A very important feature in the great tract of country thus briefly described is the Kalahari, a sand-covered region of little relief, and in part of internal drainage, which extends from the Congo-Zambezi watershed to the Orange River. The Zambezi drains its northern portion,

Kalahari.



and formerly that river received tributaries from a part at least of the middle Kalahari, and the Orange River used to receive water from the southern Kalahari, but at the present time no water leaves the middle or southern Kalahari except by evaporation.

The political boundaries have for the most part been drawn without reference to the physical features; for some 400 miles the slightly marked Congo-Zambezi watershed is the limit of Northern Rhodesia, but the Luapula and lower course of the Orange are the only other definite features which have become international boundaries south of Nyasa. Within British South Africa the escarpment of the southern Drakensberg, and the Molopo, Vaal, Orange, and Limpopo Rivers are the chief features which serve as territorial limits.

The South African Plateau: Its Escarpment and Rivers

The southern end of the African plateau, on which the Bechuanaland Protectorate and by far the greater part of the Union lie, rises gradually to the north and south from the valley of the Orange River. On the east, west, and south the plateau is bounded by a great curved escarpment. Both on the east and west (as far south as Van Rhyn's Dorp) the escarpment is separated from the ocean by a terraced country or by slopes of a more uniform grade, but in the south the Great Karroo and long ranges of fold-mountains intervene between the escarpment and the coast.

The
eastern
escarp-
ment.

The eastern escarpment is, on the average, higher than the western by some 3,000 feet. It commences as a definite feature as far south as the Strydpoort range (6,000 feet) near Potgietersrust, while the western escarpment is continued north of the Orange River through German territory into Angola. This difference is to be explained partly by the structure of the two areas, but chiefly by the contrast in climate, the great development of the eastern river system of the Limpopo being due to the heavier rainfall on that side of the continent.

The escarpment of the Strydpoort range at first trends

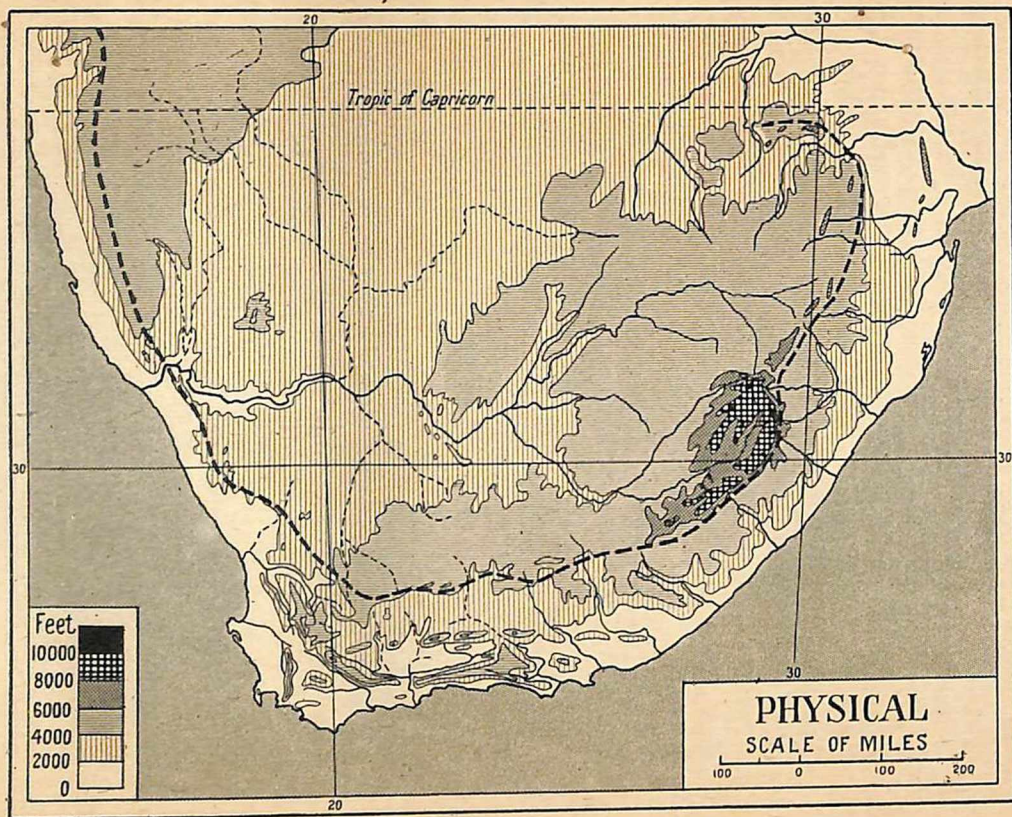


FIG. 6. South Africa, map of surface-relief.



eastwards, but turns south-east at Wolkberg (6,890 feet) and then south to the west of Leydsdorp, where it is called the Drakensberg; the highest point in the Transvaal, Mount Anderson (7,790 feet), stands near its edge. Southwards the Drakensberg of the Transvaal is separated from the Natal Drakensberg by a tract of country between Carolina and Vryheid in which the descent to the low country is more gradual. This change in the nature of the slope takes place where the geological structure of the country alters. The Transvaal Drakensberg is characterized by great cliffs due to the resistant quartzitic beds of the Black Reef series, but as that formation thins southwards the cliffs become lower, and the Archaean gneisses and schists below the Black Reef form the greater part of the slope down to the low country; west of Swaziland the base of the Karroo system, which overlaps the Transvaal formation in that region and comes to lie directly on the Archaean, appears at the top of the escarpment, and the higher beds of the Karroo system take a continually increasing part in the face of the escarpment as it is followed southwards. In this quarter, also, the conditions are complicated by a gentle monoclinical fold affecting the Karroo beds, by which the latter are carried down below the Cretaceous rocks of the coast belt. Further north the greater part of the flexure which connected the sea-ward dipping Karroo beds of the Lebombo range with similar strata on the High Veld has been removed by denudation.

The escarpment becomes more and more marked in northern Natal, and the beds of which it is made belong to the higher subdivisions of the Karroo system, so that for about 280 miles—from the sources of the Tugela south-westwards to the mountains south-west of Barkly East, where the Drakensberg ceases—the highest parts are made of the uppermost (Drakensberg or volcanic) group of the Karroo system; the height of the steep slopes and precipices in this region may amount to 6,000 feet.

From the south-western end of the Drakensberg, the escarpment, somewhat diminished in height, has

The
southern
escarp-
ment.

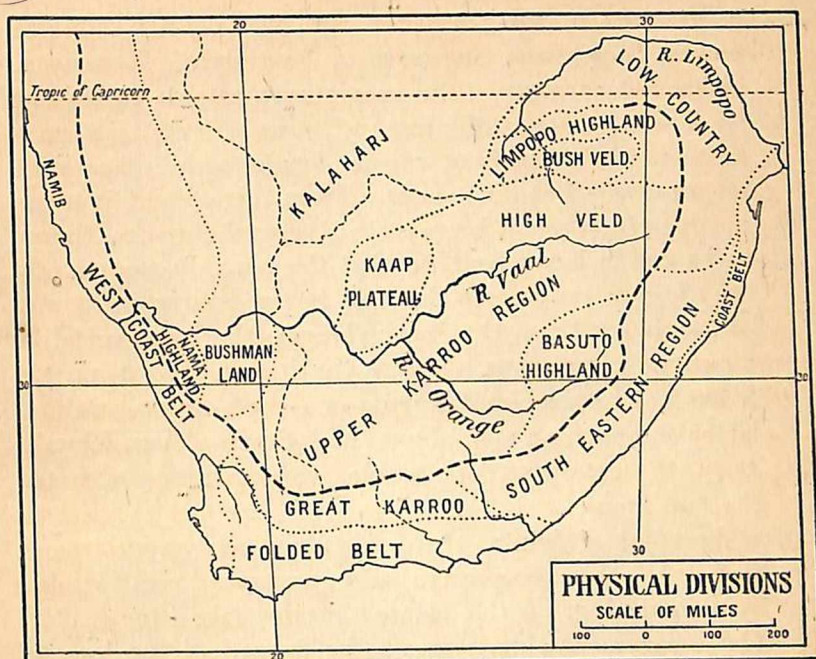


FIG. 7. Physical Divisions of Africa south of the Limpopo.

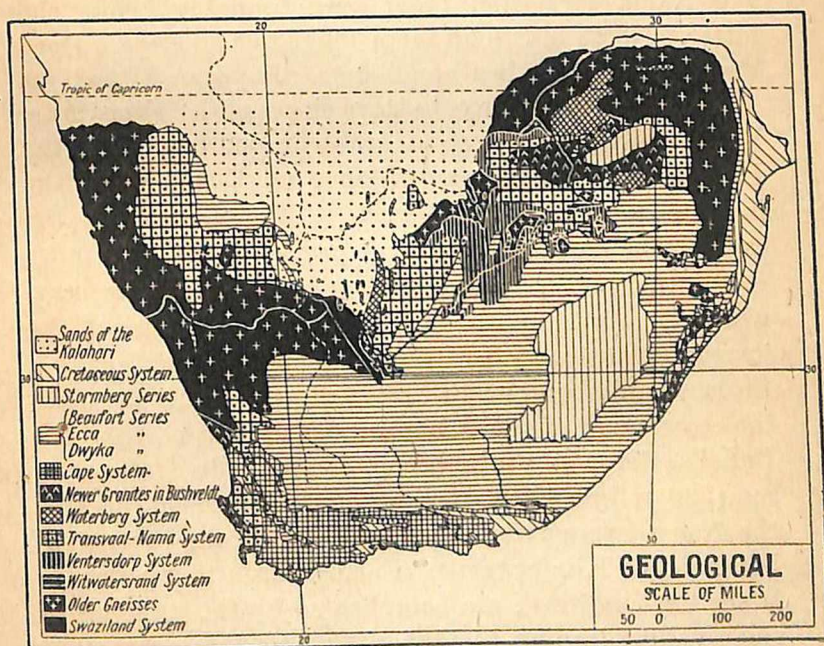


FIG. 8. Geology.



a westerly course for some 400 miles under different names, Stormberg, Sneeuwberg, Nieuweveld, Komsberg, in successive parts. The escarpment in this portion of its course is cut out of lower and lower beds of the Karroo system, the Komsberg region consisting of the lower stages of the Beaufort series. From this district it turns north-west, where it bounds the Roggeveld, and continues to be cut in lower beds, so that the basal Beaufort beds only form a capping to the Ecra in the escarpment south of Calvinia. From the Sneeuwberg to the Roggeveld the escarpment presents a front varying in height up to 3,500 feet to the Great Karroo or Gouph, and where the latter comes to an end, about the latitude of Van Rhyn's Dorp, the escarpment is double, with a terrace between the two steps.

The
western
escarp-
ment.

West of Calvinia there is again only one step, owing to the progressive disappearance northwards, by denudation, of the strata forming the Roggeveld. The escarpment thus comes to be formed of the lowest Karroo beds (Dwyka), part of the Cape system, and the Nama formation lying unconformably below the latter. North of Stinkfontein Poort in Van Rhyn's Dorp the Cape system has completely disappeared, and for some miles the Dwyka caps steep slopes of the Nama beds, but the latter give place to Archaean gneiss south of the Langeberg, a Dwyka-capped spur on the edge of the interior plateau. North-west of the Langeberg the escarpment consists entirely of gneiss for some 60 miles round the southern and western sides of Kamiesberg, which is a western, highly dissected projection of the interior plateau (called Bushmanland in this region). From Kamiesberg north-westwards for some 90 miles the escarpment of gneiss is much cut up, but north of the Buffel's River it again becomes a definite feature for some 30 miles, where the quartzitic basement beds of the Nama system form its summit. From the neighbourhood of Klipfontein north-westwards to the Orange River the conditions are complicated by the presence of steep valleys leading to that river, and the escarpment

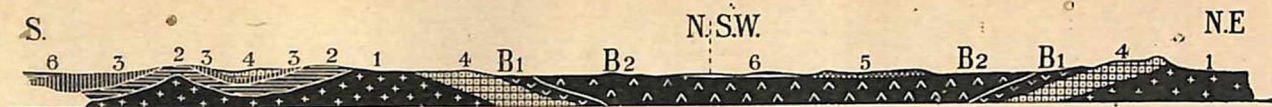


FIG. 9. Section from S. to N. through northern Orange Free State and the Rand, thence N.E. through Transvaal.

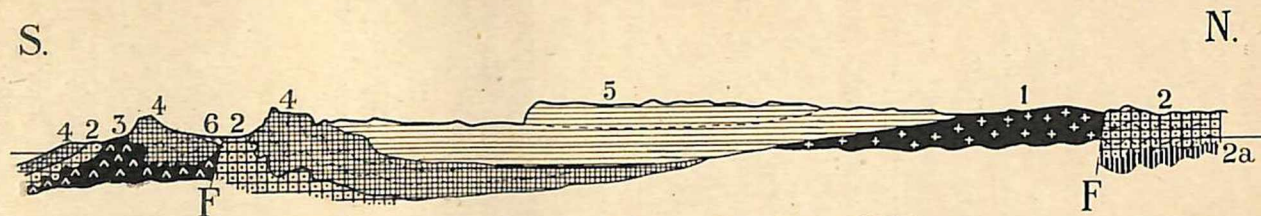


FIG. 10. Section from S. to N. approximately on 20° E. long.



FIG. 11. Section through Cape, Karroo, and Swaziland systems.



almost disappears as a definite feature, but in German territory it again becomes important in the structure of the country.

The whole
escarp-
ment.

It is noteworthy that the escarpment becomes more precipitous where thick horizontal beds of resistant rock co-exist with softer beds, as in the Transvaal Drakensberg (Black Reef), Natal Drakensberg (volcanic series and Cave sandstones), Nieuweveld and Roggeveld (intrusive sills of dolerite), and the Bokkeveld Mountain (Table Mountain sandstone); and that where it is cut in more homogeneous rocks, such as the gneiss of Kamiesberg, it is deeply and irregularly dissected.

Though there are still uncertainties about the structure of parts of this curved escarpment, the length of which within the Union is over 1,300 miles, it is one of the great features of the country, and its geological structure is broadly symmetrical; on each side of the continent the northern portion is capped by the correlated Transvaal and Nama beds; to the south, on each side, come intervals of more broken country of Archaean rocks, and further south the Karroo formation appears and forms an increasing part of the escarpment and eventually the whole of it. The chief defects in symmetry are due to the absence of the Cape system from the escarpment in the east and the great development of the Karroo formation on the same side, and also to the north-western extension of the Great Karroo. A corresponding asymmetry is found in the structure of the coast belt, which will be described later.

The main
divide.

For some 650 miles, from the neighbourhood of Carolina to the Komsberg, the main watershed of the country, between rivers flowing to the Indian Ocean and those going to the Atlantic, lies on the escarpment. Near Carolina the watershed leaves the escarpment and takes a westerly course over the High Veld and the Witwatersrand, then turns north-west, passing between Zeerust and Mafeking into the Protectorate. From the Komsberg it runs south-west across the Klein Roggeveld and the Great Karroo to the Bokkeveld and the Cape peninsula.



The Limpopo receives the drainage of the northern and middle Transvaal either by gorges cut back through the escarpment, as in the case of its tributary the Oliphant's River, or, higher up its course, by the Magalakwin, Crocodile, and other rivers which flow northwards from the country west of the Strydpoort range where the escarpment comes to an end. Between Potgietersrust and Haenertsburg the rivers rise on the Archaean rocks north (i.e. below the face) of the escarpment, pass through it by great 'poorts' such as those of the Clunie's and Malip's Rivers, and after traversing the highly dissected country enclosed by its north-eastern bend, in which they join to form the Olifant's River, again break through the escarpment on their way to the low country. Instances have been described of the capture of the head-waters of these streams by the rivers with steeper grades and more direct courses to the Limpopo; these facts, in conjunction with the geological structure of the country, prove that the escarpment formerly extended far to the north of its present position.

South of the Witwatersrand the whole country enclosed by the escarpment, with the exception of a small area in Calvinia and Namaqualand, is the drainage basin of the Orange River. The main stream of that river and the southern tributaries of the Vaal rise in the Basuto Highlands, where they have cut deep valleys in the uppermost strata of the Karroo system. The Vaal River has a more varied course than the corresponding part of the Orange, because it traverses the hilly country made of pre-Karoo rocks round Parys and Venterskroon while the Orange River leaves the Karroo beds first near Hopetown, and only reaches hilly country made of the older rocks at Prieska. The chief northern affluent of the Vaal is the Hart's River, which is joined by the Dry Hart's at Taungs. The Dry Hart's, Hart's, Vaal, and Orange Rivers, over a distance of 230 miles from Vryburg to Prieska, occupy the course of an ancient pre-Karoo valley, to which the name Kaap valley has been given on account of its relation to the escarpment of the Kaap plateau to



the east. The Dry Hart's and the Hart's valleys have a peculiar feature in that they are much less steeply graded for many miles above their junctions with the larger Hart's and Vaal respectively than the valleys of the latter; this is due to the circumstance that the tributaries are on the comparatively soft Karroo beds which filled the Kaap valley, while the large rivers, above the junctions, are on the hard pre-Karroo rocks on the left side of the Kaap valley. The old Kaap valley pursued a southerly course east of Prieska and is lost to sight under the Karroo formation, but the Orange River leaves this ancient valley and turns north-west for some 120 miles and then flows westwards to the Atlantic. From Prieska to the confluence of the Hartebeest River, the valley of the Orange is alternately very steep-sided and narrow and more open, but even in the open portions the river itself is some 20 or 30 feet below the ground near it, except in times of great flood, as is also the case in the higher part of its course. There are only very narrow strips of alluvium along the river. Below the junction of the Hartebeest, the Orange River, which in that region is much divided by islands, drops more than 400 feet over the Ougrabies Falls, and for many miles below them it flows in a deep gorge with precipitous walls. Near its mouth the river makes a sharp curve, convex to the north, through the mountainous country of the Richtersveld, and enters the Atlantic after a short course through the coastal sand-veld and over a sand bar. From the confluence of the Orange and Vaal to the Atlantic, a distance of over 800 miles, there are only two tributaries of considerable length by which water occasionally reaches the main stream; they are the Brak and Hartebeest Rivers, which together drain some 56,000 square miles of the extreme southern part of the South African plateau. The tributary from the north, the Hygap, formed by the junction of the Nossob, Molopo, and Kuruman Rivers, drains over 60,000 square miles in Bechuanaland and German territory, but its course is blocked by sand dunes, and the small quantity of water



occasionally carried by it comes from the country a few miles above its mouth.

The Hartbeest River is the largest tributary from the south ; it is formed by the junction of the Fish, Zak, and Olifant's Vley Rivers some 70 miles above its mouth, draining the Roggeveld, Nieuweveld, and Karreeberg regions. This group of rivers presents the peculiar feature of a more steeply graded lower course (the Hartbeest) and a very flat middle course. The change takes place where the rivers leave the flat-bedded and comparatively soft Karroo beds and flow over the hard gneiss and schists of Kenhardt. They have evidently widened their valleys in the softer strata behind the more resistant Archaean rocks, in which the valley is narrow. The Hartbeest is a periodical river with less frequent floods than the Orange, which controls the level of the mouth of the Hartbeest, so that the latter is maintained in a favourable condition for cutting down its bed. The tributaries of the Hartbeest for many miles above the Archaean outcrops have lengths of very flat valleys on soft rocks between shorter, narrower, and more steeply graded courses over hard dolerites. In the flat stretches there is often no definite bed, and the water in flood-time spreads over the valley floor for some miles on either side of the middle of the depression. These sheets of water are only a few inches deep, but the flats take up so much of the water that the Hartbeest rarely receives any from the Zak River.

The sub-regions of the South African Plateau

The interior plateau can be divided into nine sub-regions, each of which, with the possible exception of the Kalahari and Bushmanland, presents features that distinguish it from the others, though there are of course transitional belts from one to another. The sub-regions are the Kalahari, the Kaap Plateau, the Limpopo Highlands, the Bushveld, Highveld of the Transvaal, the Basuto Highlands, the Upper Karroo, Bushmanland, and the Namaqua Highlands.



The
Kalahari.

The portion of the Kalahari which comes within the scope of this chapter includes the Bechuanaland Protectorate, the Gordonia district, and parts of Kuruman and Hay. It lies between 2,700 and 5,000 feet above sea-level. Its chief characteristic is the almost universal covering of reddish sand, which is for the most part arranged in long dunes lying generally west-north-west, joining each other at intervals. The dunes are rarely in a condition to move under present circumstances, for the sand supports a fairly thick growth of grass, and occasionally bush. It is a mistake to call the country a desert, for it has very little in common with such regions as the Libyan Desert or the deserts of Tibet. Over large areas dunes cannot be distinguished, and the sand forms an undulating surface. Along the rivers the sand-dunes lie parallel to the beds, and they are often conspicuously developed on the south and east sides of pans; in these cases the dunes are usually almost devoid of vegetation, and they are pale yellow or almost white owing to the removal of the usual ferruginous coating of the sand grains when lying in the occasionally wet pans and river beds before the wind carries them on to the banks.

No water leaves this region by the surface of the river channels. The rain is quickly absorbed by the sand, and the evaporation from the pans and occasional sheets of water in the rivers is intense. There is a general underground flow of water below the surface of the dry river beds, as shown by the results of well-digging in them; and below pans there is often a water-supply that can be got by means of wells; in the Kalahari generally the rainfall appears to be sufficient only to moisten a layer of sand of varying thickness, but not to saturate it so that water can collect in wells. In the south-western corner, from Rietfontein to the Orange River, the covering of sand is less general than usual, and in this hard-veld there are many water-yielding wells.

Pans, usually slight depressions in the surface with floors of sandy mud, tufaceous limestone, or the bed-rock



of the neighbourhood, are especially abundant in the south-western part of the region. The largest, Haak-schien Vley, has an area of about 80 square miles and a flat floor of hard sandy mud with occasional flat patches of the underlying rock. In the eastern part of the region, especially where the Kalahari conditions encroach on the limestone country of the Kaap plateau, the pan-floors are of calcareous tufa, and to the east of the Heuning Vley ridge the upper part of the calcareous tufa is more or less silicified. Limestone pans are very numerous in the middle Kalahari. Though the wind is certainly the agent by which the sand is removed from these depressions, much evidence has been put forward to prove that certain pans which are small and steep-sided, and depressions within many other pans, have been enlarged, possibly also initiated, by the large game which formerly resorted to them to drink or wallow.

There are few hills in the Kalahari ; the largest are those in the extreme south, such as Scheur Berg and Inkruij. They are all of the 'Inselberg' type, rising very steeply from the undulating sand-veld.

Over a very large area of the southern Kalahari the sand appears, from the evidence of wells, to lie directly upon the Dwyka series, but to the west the older rocks of the Nama system and Archaean gneiss are laid bare in places ; on the east the Matsap series forms the ranges on the borders of the Kalahari and the Kaap plateau, and the Kheis rocks (quartzites and schists) appear in the Scheur Berg.

This region lies between the Kalahari on the west and the eastern escarpment (Campbell Rand), overlooking the long valley (the old Kaap valley) now occupied by the Dry Hart's, Hart's, Vaal, and Orange Rivers. The main features in it are the wide limestone plain in the east, which rises from 4,000 feet on the top of the escarpment to 5,000 in the country between Kuruman and Daniel's Kuil, and the mountain ranges on the borders of the Kalahari, which rise to a height of 6,010 feet (Langeberg Beacon). The country east of the Asbestos Hills is drained

The Kaap plateau.

eastwards into the Vaal and Orange Rivers north of Prieska, the western and northern parts directly into the Orange River west of Prieska or into the Kalahari ; the rivers very rarely have water at the surface, though there is an underground flow in many cases. The eastern plateau is at the most 80 miles wide, between Taungs and Kuruman ; it becomes narrower to the north and south. Though the rivers on this plateau are dry there is a comparatively abundant water-supply in springs and holes ; the Kuruman spring (4,000,000 to 5,000,000 gallons a day) is one of the largest springs in South Africa. Deep clefts and small caves, empty or filled with débris, are numerous on this limestone plain. In the long range of the Asbestos-Kuruman-Heuning Vley Hills the westward-dipping Griquatown beds form an escarpment which rises to 6,090 feet between Kuruman and Daniel's Kuil. Towards the north they disappear under the sand of the Kalahari ; in the south, across the Orange River, they are continued as the Doornbergen in Prieska. The trend at the south end is towards the north-east, but it turns northwards at Daniel's Kuil, north-westwards near Kuruman, and northwards again where the Kuruman River passes through the range. A similar but less marked curve is followed by the Langeberg range to the west, and the Korannabergen form a north-south range further west. The Korannabergen and Langeberg are the smooth-topped remnants of a strongly folded mountain region made almost entirely of the Matsap series. They are steep-sided and rise abruptly from flat sand-covered country of the Kalahari type. Between the Langeberg and the Asbestos-Kuruman Hills there is undulating country, hard-velled in the south but covered with sand in the west and north. The major portion of the denudation which shaped the Langeberg district, the Asbestos-Kuruman Hills and the Campbell Rand, is of Dwyka or pre-Dwyka date, for outliers of the flat-lying Dwyka are found in the southern and eastern parts where the surface-relief of the pre-Karoo rocks is greatest.



The Limpopo Highveld is the rather elevated, much dissected country between the Bushveld and the Limpopo valley. It is traversed by the rivers from the central Transvaal, the Steelpoort, Olifant's, Magalakwin, Marico, and the upper part of the Limpopo itself. Its eastern portion is the northern section of the Transvaal Drakensberg, described in a previous paragraph, and the country behind the escarpment; the middle part is the Palala plateau in the Waterberg district, a rugged tableland made of flat-lying quartzitic beds of the Waterberg system; the western part, like the eastern, is largely made of southerly inclined beds of the Transvaal system, but here there is no marked escarpment at the northern limit of the formation. The Zoutpansbergen can be regarded as a detached portion of this region; they rise on the southern flank of the Limpopo valley and consist of three parallel ranges of Waterberg beds with escarpments due to strike faults along which the beds are thrown down to the south.

The
Limpopo
Highveld.

The Bushveld is an undulating, sandy country covered with grass and bush, lying between 3,300 and 4,000 feet above sea-level in the middle of the Transvaal. It is for the most part directly underlain by rocks of the Bushveld Plutonic Complex, the interior of a great laccolite laid bare by denudation; but there are many outliers of the Karroo formation on its surface, the largest being that which stretches from near Pienaar's River station for some 100 miles to the east-north-east, forming remarkably flat country called the Springbok Flats. These outliers consist of shales and sandstones, occasionally coal-bearing but of uncertain horizon, at the base, overlain by the massive Bushveld sandstone, the northern equivalent of the Cave sandstone, which is in its turn covered by volcanic rocks of basaltic type correlated with the Drakensberg lavas. At a few places, such as Buiskop near Warm Baths, the Bushveld sandstone makes outcrops which remind one of the Cave sandstone of Basutoland and Griqualand East. The hilly country of the Magaliesberg and Pretoria forms a transition belt from the Bush-

The
Bushveld.



veld to the Transvaal Highveld. It is chiefly made of the Pretoria series dipping northwards under the Bushveld laccolite, of which that series apparently forms the floor. Towards the west the outcrop of the Pretoria series sweeps round northwards through Zeerust and Marico into the Limpopo Highveld.

The
Transvaal
Highveld.

The Transvaal Highveld includes the Witwatersrand and the whole of the Southern Transvaal. It ranges from 4,000 to over 6,000 feet in height, and is the most populous and important part of the province. The surface is undulating, with occasional ridges of moderate height, such as the Witwatersrand, Gats Rand, and Zuikerbosch Rand. On the east the surface is occupied by beds belonging to the lower part of the Karroo formation as developed in the Transvaal; they lie horizontally and contain the chief coal beds in the province. To the west of the Karroo area there is an anticline of the Transvaal formation trending east and west, flanked both to north and south by synclines. Where the Transvaal formation has been denuded away, the older rocks exposed are the volcanic rocks of the Ventersdorp system underlain by the beds containing the gold-bearing conglomerates on which the prosperity of the Union chiefly rests at the present time. The Archaean gneisses appear beneath the Witwatersrand beds and form the floor on which the latter were deposited in this region. West of Potchefstroom the anticline widens rapidly and becomes lost in a very low, flat, dome-like structure, the interior of which forms the country between Klerksdorp, Vryburg, Lichtenburg and the Vaal River, and is made of the Ventersdorp beds lying on Archaean gneiss. On the south-east the horizontal Karroo beds cover the older rocks; to the north-west lies the Protectorate of which the structure is not yet known; the Transvaal formation dips gently to the west to form the Kaap plateau, and to the south-west is the old Kaap valley, still partly filled with Karroo rocks. In the Bloemhof and Wolmaranstad districts there are extensive plains bordering the Vaal River and cut, to a great extent at least, in the lavas of



the Ventersdorp system. In this region, as is also the case further down the Vaal River in Barkly West, there are wide deposits of gravel at various heights above the river which yield diamonds, and are the site of the 'River Diggings'.

The Basuto Highlands stretch from the south-eastern corner of the Orange Free State to the Barkly East district, and include the whole of Basutoland. The country ranges from 5,000 to over 10,000 feet above sea-level, and it is the most mountainous part of South Africa, though the rocks lie almost flat. The mountainous character of the country is due to the ranges of very steep-sided hills left standing between the valleys leading to the Indian Ocean and those draining into the Orange River; the escarpment ranges are called the Drakensbergen, and the great spurs running west and south between the larger head-streams of the Orange River system are known as the Malutis. The whole country is carved out of the uppermost or Stormberg series of the Karroo system, and the mountains are made of the two highest subdivisions of that series, the massive, pale-coloured Cave sandstone below and the dark volcanic beds above. These two groups, so different in colour, give a characteristic appearance to the deep valleys between the ridges and tablelands, and the whole area offers a strange contrast to the very flat portion of the Transvaal Bushveld, the Springbok Flats, made of the same two groups of rock. Though the volcanic beds are probably much thicker in Basutoland, where they attain a thickness of 4,000 feet or more, than in the Bushveld, the striking difference in the scenery is due to the conditions in the two areas. In the Bushveld the rivers have to pass through the hard rocks of the Limpopo Highlands before reaching lower country, and are not able to cut down their valleys sufficiently quickly to dissect the Stormberg beds of the Springbok Flats, but the rivers which drain the Basuto Highlands have very steep grades. The actual difference in level between the base of the volcanic beds in Basutoland and the same horizon in the Bushveld is probably

not more than 2,000 feet on the average, but how much of this difference is due to a subsequent uplift of the Basutoland area, and how much to an original difference in altitude at the time of the outpouring of the lavas is not known. The Basuto Highlands are a very healthy grass country for farm stock. The rainfall is fairly high (34 inches) and is little subject to the violent fluctuations which are the trouble in the lower country to the north and west. The lower valleys are largely under cultivation.

The
Upper
Karoo
or High
Veld.

The Upper Karroo includes almost the whole of the Orange Free State, the south-eastern part of Griqualand West, and that part of the Cape Province which lies between the escarpment, the Orange River, and Bushmanland. With the exception of those parts of Kenhardt and Prieska districts which are on the Archaean rocks, this sub-region has a very uniform type of scenery. Wide plains broken by table-shaped hills and 'spitz-kops' (pointed conical hills) are the usual features. Towards the main watershed the valleys become narrower and the tablelands increase in area. The country is made of flat-lying shales and sandstones penetrated by dykes and sheets of dolerites; the dolerites and sandstones are the more resistant rocks, and their outcrops give rise to the outstanding features in the landscape. The dolerite sheets, like the sandstones, form prominent cliffs on the steep slopes and protect the rock below them; they are the cause of most of the precipices on the face of the great escarpment west of the Drakensberg, and also of many of the table-mountains and spitz-kops in the country behind it. The dolerite has a further effect in hardening the shales in contact with it, and there are many instances of these hardened, vertically jointed shales forming precipices on the escarpment and other steep slopes. The thick dykes of dolerite often make conspicuous lines of rough kopjes rising from flat ground. Curious forms are produced by the great ring-shaped inclined dykes (or inclined sheets) which are characteristic of parts of the country. The dolerites have a great effect



on the surface features in the upper parts of the great valleys; in the flat country from Kimberley south-westwards to Calvinia the shales and hard dolerites are often cut to an almost level surface on which there is a deposit of tufaceous limestone; in these cases the dolerites are deeply weathered. These remarkably flat surfaces have been cut in several distinct formations, the Archaean on the north-west, the Dwyka series in the middle, and the Eccia further south. The Archaean floor of the Dwyka series in this region was worn flat in Dwyka times or earlier, and is now again being exposed by denudation, but the flat character of the whole area must be due to conditions which have existed for a long time past and are still in force. The chief factor seems to be the presence of the hard Archaean rocks athwart the courses of the rivers and in front of the region of soft shales and sandstones of the Eccia and Dwyka series. The rivers have very low grades in this area, and the action of the wind must be important in removing sand, possibly also in eroding outcrops; the wind has a retarding influence on the tendency of the streams to accentuate irregularities due to the presence of hard and soft rocks. Then again the formation of calcareous tufa in low-lying tracts tends to protect them and to raise their level. This area has large numbers of small shallow pans on it, especially on the outcrops of the Dwyka series and on the Archaean rocks bordering that belt; away from the Dwyka outcrops the pans rapidly decrease in number. The chief range of hills far from the watershed in this region is the Karreeberg, a flat-topped range of horizontal shales and sandstones, with dolerite sheets stretching through the Carnarvon and Fraserburg divisions. To the north, in the Prieska and Kenhardt divisions, there are prominent flat-topped ranges; the Doornbergen on the east with north-west trend, the shorter Ezel Rand with north-east trend, and the rough ranges, which have no name, on the borders of the Kenhardt and Prieska in the west, with north-westerly and northerly trends; these are all made of pre-Karoo beds and are the continuation

of the Asbestos, Langeberg, and other hills in Griqualand West and Gordonias, from which they are separated by the Orange River.

The region of the Upper Karroo ranges in height from 3,000 to 7,000 feet, and it is a country of small bush of markedly xerophytic character, and grass. The northern portion, the Orange Free State and the eastern side of Griqualand West, is mainly a grass country from which the thorn trees that were formerly scattered more or less thickly over it have been removed by man, either purposely or through grass-burning. Towards the south the grass diminishes in importance with the rainfall, but in the high country near the escarpment, where the rainfall increases again, the grass returns in abundance. With the exception of the Kimberley mining area, and a few other diamond mines, this region is a farming country, and in certain parts of it irrigation is being carried out on an increasing scale.

Bushman-
land.

No definite limit can be drawn between the Upper Karroo and Bushmanland, and, on the other hand, the latter region presents points of similarity to the Kalahari, from which it is separated by the valley of the Orange River. The chief characteristics of Bushmanland are its flat surface with a general covering of sand, the want of definite river channels, the abundance of shallow pans, scarcity of water, and the occasional steep hills of the 'Inselberg' type. On the south the surface is on the Dwyka series, and in the north on the Archaean gneiss and schists, but the details of its geology are not known. The water in wells and pans (except immediately after rain) is brackish. The vegetation is grass and small xerophytic bush. There are very few permanent habitations in the country, but farmers trek there with sheep and cattle when water is obtainable. The height of the country above sea-level rises from 2,000 feet or less near the Orange River to almost 3,400 in the southern part, but the hills reach 3,886 feet in Koeberg.

The
Namaqua
Highlands.

The Namaqua Highlands are on the north-western edge of the interior plateau. They are a rugged country of



gneiss with intercalated schists, partly covered in the west by nearly horizontal beds of the Nama system. The surface of Bushmanland rises westwards and becomes more and more deeply dissected by streams which enter the Atlantic either directly by the Green and Buffel's Rivers or by way of tributaries of the Olifant's River on the south or the Orange River on the north. For some two, or three miles the head-streams in the Kamiesberg, which rises to 5,510 feet, and is the highest ground in Namaqualand, often have water in them during several months in the year, but the middle and lower portions only occasionally carry water in winter, and for many miles from the coast the Green and Buffel's Rivers are dry for years together. The division between the regions of summer and winter rains is very sharply marked in this quarter; Bushmanland depends on the summer thunderstorms for its water, and it remains dry while the winter rains fall on the country between the Richtersveld and Kamiesberg. A small area in the Kamiesberg is a comparatively well-watered country, but the rainfall decreases to 8 inches or less northwards. The extremely rugged and very dry country, partly enclosed by the bend of the Orange River, 60 miles from the sea, is called the Richtersveld. This tract of some 1,700 miles presents features of great geological interest; in the eastern part are great outliers of the Nama beds in a slightly disturbed state, and in the west what are probably the same beds are highly sheared and folded, and there is a large mass of granite intrusion into both these folded beds and the older gneiss on which they rest.

Between the southern part of the great escarpment and the Cape ranges there is a tract of comparatively low-lying country with a very dry climate; this is the Great Karroo. Its height ranges from little over 1,000 feet in the valleys of the Gamka and Dwyka Rivers, just behind the mountains, to over 4,000 feet in the Klein Roggeveld. The region has a thin soil and an abundance of rock fragments on its surface, except in the immediate neighbourhood of the larger rivers where there are narrow

strips of thick alluvium. The vegetation consists of xerophytic bush sparsely scattered; trees only occur along the river beds. The form of the surface varies greatly with the disposition of the shales and sandstones which underlie it; in the south, in the belt bordering on the Cape ranges, where the strata are thrown into east and west folds which gradually decrease in amplitude northwards, there are hills trending east and west; to the north this hilly country gives place to wide plains on which there are low but sharp steps marking the outcrops of the harder or thicker sandstones; the Klein Roggeveld is a tableland with terraced declivities due to the outcrop of the harder layers in the horizontally bedded shales and sandstones. In the west, where the Cape ranges are represented by one great anticline, there are no hills east of the eastern limit of the Cedarberg anticline, and the featureless Tanqua (Ceres) Karroo alone lies between this anticline and the Roggeveld. In the southern part of Calvinia the Tanqua Karroo rises northwards and becomes merged in the country on the top of the escarpment.

The river system of the Great Karroo is of special interest, for the usually dry river beds, after a long course over ground with an altitude of from 1,000 to 3,000 feet, traverse the Cape ranges to the south and west by great 'poorts'. Another noteworthy feature is the extensive development of gravel terraces on the northern flank of the Cape ranges, and the outlying remnants to the north in the form of gravel-capped tablelands of small extent. Towards the east the Great Karroo grades into the terraced south-eastern region, the change being dependent on an increase in rainfall. The region is chiefly a sheep and goat-farming country and is, generally speaking, unsuited for agriculture.

South-
eastern
region.

The south-eastern region consists of the seaward slope from the great escarpment east of the neighbourhood of Graaff-Reinet. On the west it is fronted by the extreme eastern end of the Cape ranges, but further east only a narrow coastal belt intervenes between it and the ocean. It thus includes the eastern province of the Cape, and



the greater part of the Transkei, Pondoland, and Natal. The characteristic features of this region are the terraced form of the surface and the deeply cut river-channels. The climate varies considerably, the north-eastern portion having more rain and higher temperature than the south-western. The country rises from the coastal belt to the foot of the great escarpment, some 5,000 feet above, and the rivers have steeply graded beds, often broken by falls or rapids over the outcrops of the harder rocks. The whole region is made of nearly flat-lying Karroo beds, with more or less abundant intrusions of dolerite, often in the form of slightly inclined sheets; thus, owing to the resistance offered by the thick sandstones and dolerite sheets to the agents of denudation, there is a tendency to the production of flat terraces bounded by escarpments, and of deeply sunk valleys along the larger streams.

The vegetation is mainly grass, but patches of forest occur in protected areas, chiefly on the face of steep escarpments and in the smaller head-valleys.

The Transvaal low country lies to the north of the south-eastern region and includes the district between the escarpment and the Lebombo range, the Limpopo Highlands, and the Limpopo River. It is an undulating country, from 500 to 4,000 feet above sea-level. The chief range in it, the Zoutpansberg, is an outlying portion of the Limpopo Highlands; the minor ranges and hills of the 'Inselberg' type are due to belts of schists and resistant granitic rocks. The Lebombo range runs north and south, and is made of Karroo beds dipping east; it is the limb of a gentle monoclinal fold which brings those beds down from the Transvaal Highveld to below sea-level in Portuguese territory and Zululand.

The Cape Ranges or Folded Belt

Between the Van Rhyn's Dorp district in the west and the east shore of False Bay there lies a mountainous tract roughly parallel to the coast; between Ceres and False Bay other ranges abut against these and can be followed eastwards for some 450 miles. They are cut off obliquely

by the coast between Agulhas and the Peddie district. The mountains are rough and bare-looking, though even where the veld is frequently burnt there is much vegetation between the rocks, and where protected from fire the less precipitous parts become covered with thick bush. The valleys in this region are the richest and most populous agricultural districts in the Cape province, owing to the nature of the soil and the facilities for irrigation. The valleys lie between 200 and 2,000 feet above sea-level, and the mountains rise to 7,382 feet in Matroosberg near the Hex River, and to 7,628 feet in the Seven Weeks' Poort Mountain ; many peaks exceed 6,000 feet.

By far the greater part of the region is made of the Cape system, but it is edged on the north by the lower portion of the Karroo system, of which there are also important outliers in the Worcester district ; the Uitenhage (Neocomian) beds occupy parts of the valleys. The Karroo strata are involved in the folds which gave rise to the mountains, but the Uitenhage beds are not, though they are thrown down along faults parallel to the axes of the folds in the older rocks.

In the north-west the mountains start in Van Rhyn's Dorp, where the thick sandstones of the Table Mountain series, which lie nearly horizontally, first show flexures ; these flexures, of which the axes run a few degrees east of south, become more and more pronounced towards the south, and near Clanwilliam the amplitude of the Cedarberg fold is over 6,000 feet.

Near Ceres, where the east-west folds meet the Cedarberg group, the arrangement becomes more complicated, and diagonal ranges are developed. East of Ceres overfolds are found, especially in the Zwartberg and Langeberg ranges. There are several axes of folding roughly parallel to each other, but any one anticlinal axis is found to die out, and perhaps to be replaced by another on nearly the same line further on. In most cases a distinct arc, concave to the coast, is formed by each axis. The amplitude of the folds is probably greatest in the Zwart-



PLATE I. ZWARTBERG PASS, PRINCE ALBERT
 (High Commissioner for South Africa)



PLATE II. CAMPS BAY
(High Commissioner for South Africa)



berg range, and it diminishes eastwards ; there is also a slight inclination of the axes towards the east, so that beyond Port Elizabeth the Table Mountain series no longer appears at the surface in the folded belt. There is no counterpart in the east to the meeting of the two great sets of folds in the west, for the coast cuts diagonally across the folds and reaches the terraced region made of flat Karroo beds in East London and the Transkei. Where the Cape formation appears again in Pondoland and Natal it lies nearly flat, as in Van Rhyn's Dorp, though there is the curious horst of St. John's, a relatively raised block of Table Mountain sandstone, surrounded by faults, which is like nothing in the north-west. What lies concealed under the ocean off that coast is of course not known.

The lower level of the Cape formation there, and the consequent lack of symmetry in the structure of the country bordering the south coast of the continent may be connected in origin with the asymmetry in the structure of the escarpment due to the great development of the upper part of the Karroo formation in the south-east.

The rivers of the folded belt run east or west in the synclines (north in the Cedarberg region), or over the Uitenhage beds, till they meet one of the large transverse valleys which cut through the ranges on their way from the Karroo. Hence the main drainage lines of the region lie athwart the axes of folding. Where the rivers pass through the larger anticlines, as at the poorts of the Gamka, Buffel's, Gouritz, and Doorn Rivers, the valley sides rise precipitously several hundred feet from the river beds.

The Coast Belt

On the coast side of the folded belt there is usually a more or less dissected terrace sloping gently to the sea, with an average height of 700–1,000 feet (Uplands terrace or plateau). This plateau resembles those found between the ranges, and it is bounded by cliffs (Mossel Bay, George) or by a narrow strip of low country along the coast. Similarly the south-eastern region terminates

in low cliffs or has a strip of sand-covered lowland in front of it. On the west coast and in the north of Natal and Zululand the low country on the coast is much wider and rises gradually towards the interior. In the north-west the coast belt has very little rain (two inches), but heavy fogs support a thick growth of bush behind the sand-dunes. North of Natal the coast belt is a series of swamps in the rains.

The South African coast is remarkable for its regular form and poverty in headlands and bays. The west coast is almost straight between the Orange River mouth and St. Helena Bay, and the east coast is also remarkably even between Algoa Bay and St. Lucia Bay. Between St. Helena and Algoa Bays the coastline is more indented, first by Saldanha Bay, which is the only good natural harbour in South Africa, then by the bays on either side of the Peninsula, and further east by the slightly marked bays, open to the south-east, found where the shore cuts obliquely across successive belts of the resistant rocks of the Table Mountain series. The straightness of the east and west coasts has given rise to some discussion ; on the one hand it is thought that the existence of faults with downthrow on the ocean side must be assumed in order to account for the facts ; and on the other, seeing that faults strictly parallel to the coast and with downthrow towards the ocean are unknown on the land, it has been suggested that flexuring about a nearly horizontal axis has determined the position of the coast.

An advantage of the latter hypothesis is that it accounts for the existence of depressed and raised areas in close proximity, according to the position of the axis just above or below sea-level at each place. The evidence of depression is found in the over-deepened river channels now filled with sand or mud and the characters of the lagoons at the mouths of several rivers ; the evidence for upheaval is got from raised beaches and terraces.

The continental platform bounded by the 100 fathom contour round South Africa is very narrow on the east coast, widens out to over 100 miles in the south, where



it is called the Agulhas Bank, and narrows again on the west coast. The depth increases rapidly to the east and west of that contour, less quickly to the south, and it may represent approximately the position of the coast at some former time.

A curious feature in the south-west is found in the Cape Flats, a low sand-covered tract connecting the island-like peninsula with the mainland. It looks as if it must have been under the sea, and has been so described by several writers, but no trace of marine deposits has been found under it. Beds of lignite and peat are intercalated with the sand, and they are found below high-water level near the sea as well as far from it. The Flats are probably, therefore, due to stream erosion, and their average level is being raised by sand blown in from Table and False Bays.

GEOLOGICAL HISTORY OF SOUTH AFRICA

It is an unfortunate fact that up to the present time no determinable fossils have been found in South African rocks older than the Bokkeveld (Lower Devonian), so that all correlation of the older beds within the country depends entirely upon lithological characters and structure. Another consequence is that no horizon can be determined as of Cambrian age, and, therefore, local terms alone can be used in describing the stratigraphy of the formations older than the Devonian. An exception is made in the case of the very ancient rocks referred to in this chapter as the Archaean, because the use of the several local terms applied to them in different parts of the country would only be confusing.

These Archaean rocks consist of sedimentary and volcanic beds which have been more or less altered by the intrusion of granite or gneiss and also by shearing. The dip is usually high, and the true order of succession is in many cases uncertain. The volcanic rocks have often undergone great alteration, being represented by schists and granulites, the original nature of which is recognized by tracing their connexion with less altered beds or by



SOUTH AFRICA

CSL

the presence of amygdaloids. An interesting feature, the meaning of which is not fully understood, is the repeated occurrence of banded magnetic cherts, which are found in the Archaean as well as in the Witwatersrand and Transvaal systems. The limestones are accompanied by lime-silicate rocks. In the North-eastern Transvaal, Bechuanaland, Prieska, and Kenhardt these Archaean beds form the worn-down remnants of considerable ranges with various trends, about east-north-east in the Transvaal, and between north and north-west in the Cape Province. These beds were invaded by the granitic rocks referred to here as the Archaean gneiss, but whether there was more than one great intrusion is not yet known. In the North-eastern Transvaal the granite of the Palabora Hills has been proved to be a later intrusion than the Archaean gneiss surrounding it, but it is very probably older than the Transvaal system.

Witwaters-
rand
system.

These Archaean rocks had long been exposed to denudation before the sediments of the Witwatersrand system were deposited. The latter consist of quartzites with pebble beds, ferruginous and siliceous rocks and hard shales; volcanic rocks are represented by some intercalated sheets of amygdaloidal diabase. Some of the quartzitic conglomerates, locally called blanket-reefs, contain the gold on which the chief mineral industry of the Union is based. The Witwatersrand formation, the lower group of which is estimated to be over 12,000 feet thick, bears little evidence of deposition under marine conditions, and it belongs to a class of sediments, widely developed in Africa during several different geological periods, called 'continental deposits', a term which includes rocks formed in river basins, lakes, or deserts, in fact under any circumstances except under sea-water. These beds have only been definitely recognized in the Southern Transvaal and the extreme northern part of the Orange Free State. They were thrown into folds before, or during, as well as after, the great volcanic outbursts which characterized the period represented by the succeeding Ventersdorp system.



The Ventersdorp beds are found in the Southern Transvaal, the northern part of the Orange Free State, Bechuanaland, Griqualand West, Hopetown, and Prieska, and they are perhaps represented by the Koras series, chiefly of volcanic rocks, of Kenhardt and Gordonia. They are divided into three groups by unconformities, which indicate repeated earth-movements over a large part of South Africa during a prolonged period of volcanic activity and the formation of various sedimentary rocks. So far as is known the earliest (Zoetlief) rocks of this formation are the quartzites and conglomerates in the Vryburg and Kimberley districts, and round Beer Vley south of the Orange River. These sediments are followed by devitrified rhyolitic lavas; the greatest observed thickness of sediments and acid lavas together is 1,300 feet, in the Kimberley mine. In Prieska and Hopetown, the Kuip series, a group of felspathic sandstones, flagstones, limestones, cherts, and andesitic lavas overlie the Zoetlief beds, and are in their turn covered unconformably by sediments (conglomerates, quartzites, flagstones, and calcareous beds) and lavas of intermediate and acid composition; these rocks are known as the Pniel series, and they are the most widely distributed group of the Ventersdorp system; they cover large areas in the valley of the Vaal River in the South-eastern Transvaal and in Griqualand West. That they underwent a considerable amount of erosion in several areas before the Black Reef series began to be laid down is proved by the unconformity between the two formations, yet lavas of the Pniel type occur in the Black Reef series, and just above it, in the Vryburg district. The Black Reef series forms a very well-defined horizon over a large region which stretches from the North-western Transvaal to the Prieska district, and it is adopted as the lower limit of the important group of rocks called the Transvaal system, but in the Vryburg district the unconformity at the base is of the same order as those within the Ventersdorp system, and is of much less significance, as a structural feature, than the unconformities at the bases of the

underlying Witwatersrand formation and the overlying Waterberg formation.

Transvaal
system.

The Transvaal system consists of the mainly arenaceous Black Reef series, the great dolomitic limestone and chert group called the Campbell Rand series, and the arenaceous and shaly Pretoria series, with which lavas are interbedded. The Black Reef series is thickest in the North-western Transvaal, but it maintains its characteristic features throughout its range as far as the Prieska district, and the Campbell Rand beds are also remarkably constant in character over an equally large area; the sedimentary rocks of the Pretoria series, on the other hand, undergo considerable changes in lithological nature towards the west. In the Eastern and Southern Transvaal they consist of hard shales and several persistent bands of quartzite, with a volcanic group underlain by conglomerate in the middle of the series; in Griqualand West and Prieska, quartzites are unusual, shales of a normal kind only appear over small areas, and the characteristic rocks are siliceous beds, cherts, and jaspers, more or less rich in magnetite, haematite, or limonite. Another remarkable feature in Griqualand West is the widespread occurrence of a soda-amphibole, crocidolite, in these ferruginous rocks, either distributed at random through them or arranged in layers parallel to the bedding planes. Thin limestones are found near the top of the lowest of the three subdivisions into which the series has been divided in Griqualand West; at the top of this subdivision and just below the volcanic (or Ongeluk) beds there is a very well-marked glacial conglomerate, the oldest of the three groups of glacial beds hitherto found in South Africa; the area enclosed by the outcrops of this conglomerate is some 3,000 square miles. The Ongeluk volcanic beds consist of andesitic lavas, tuffs, and breccias, occasionally with beds of jasper. The lavas are identical in character with those on the same, or nearly the same, horizon in the Transvaal. The Pretoria series is much thicker in the Transvaal than in the Cape Province, but this difference is due, in part at least, to the upper bed having been



removed by denudation to a greater extent in the west than in the east before the rocks of the Waterberg system were formed.

It appears very probable that the Nama system, which plays an important part in the structure of the western part of South Africa, from Damaraland down to the Peninsula, is the western correlation of the Transvaal system. The grounds for this identification are lithological resemblance and the structure of the country, but, as much of the evidence comes from German territory, full details cannot be given here. In the Cape Province the Nama system consists of three members, a group of felspathic sandstones, quartzites, and hard shales, the Nieuwerust series, succeeded conformably by the Malmesbury series, shales, limestones, and quartzites, which in many areas are unconformably overlain by a thick group of shales, conglomerates, and arenaceous beds called the Ibiquas series. The Nama formation was invaded by great masses of granite in the south-west and west-coast regions of the Cape Province before the deposition of the Table Mountain series, and in the same districts it was thrown into great folds, so that the dips are very high over wide areas, but in the north of Van Rhyn's Dorp and a belt of country running northwards through the middle of Namaqualand, these beds are comparatively slightly disturbed and lie at low angles; in that region they are not penetrated by granite.

We now come to a point upon which opinions differ widely. In the Transvaal, Bechuanaland, Griqualand West, and Prieska there is an important formation called the Waterberg and Matsap group in the east and west respectively. These two groups have not been traced continuously from one area to the other, yet there are close resemblances between them and they will here be considered as parts of one system. There are very strong reasons, based on the structure of the Cape Province, for regarding the Matsap beds as older than the Table Mountain series. On the other hand, the Waterberg system is considered by some geologists to be the northern

representative of the Table Mountain series. There is no evidence obtainable from fossils, and a discussion of the question would involve too much detail for this place. The writer can only follow his opinion that the Matsap and Waterberg are one system, which is older than the Table Mountain series.

The Waterberg system consists, in the Transvaal, of a lower and an upper group with an unconformity between them. The lower group, best developed in the north-western part of the country, is chiefly a series of felsitic lavas with interbedded shales, while the upper division is made of conglomerates in which felsite boulders are often abundant, sandstones, grits, and shales, of red, purplish, or brown colours. These rocks form a large area of rough country in the Waterberg district, the Zoutpansbergen to the north-east, and a smaller tract east of Pretoria.

The Matsap beds form the long series of ranges which commence in the Ezel Rand of Prieska, and are continued northwards in the Langeberg and the Korannabergen of Bechuanaland; they appear at intervals from beneath the sands of the Kalahari in the Molopo valley and in the Protectorate. They consist of purplish quartzitic grits, quartzites, conglomerates, hard shales, and a thick volcanic group (andesitic lavas and tuffs); the volcanic beds lie in the middle of the Matsap series. From the Prieska district northwards the base of the Matsap beds lies upon younger and younger members of the older series, from the Ventersdorp volcanics to the highest-known beds of the Griquatown series. The earth movements which produced overfolds and small thrusts in the Ventersdorp, Transvaal, and Matsap beds in western Prieska and Griqualand were of post-Matsap age and gave rise to mountain ranges which were exposed to denudation in Dwyka times; outliers of the Dwyka occupy the bottoms of old valleys in those ranges, and are themselves free from the effects of earth movements. A similar relationship between the Dwyka and the Waterberg system obtains in the Transvaal, but in that



province there are no considerable mountain ranges formed of folded Waterberg rocks.

After the deposition of the Waterberg system great intrusions of igneous rocks took place in the Transvaal, forming what is perhaps the most interesting feature in the geology of that province. So far as it is exposed, the main body of igneous rock extends over an area 280 miles long from east to west and 160 wide from north to south. In the Waterberg district it is still partly covered by the Waterberg formation, and in the Springbok Flats, as well as in many other smaller areas, Karroo beds lie unconformably on it. The intrusions made their way along the base of the Waterberg formation; thus they lie between those beds and whatever the latter happened to rest upon, generally the Pretoria beds or some lower stage of the Transvaal system. The form of the great mass of igneous rock is that of a laccolite, but, owing perhaps to depression consequent on the withdrawal of so large a body of magma from below the area, the floor sank, and the dip of the beds forming its exposed edges is towards the interior of the laccolite. The rocks of the laccolite range in composition from ultra-basic to ultra-acid, and they are known collectively as the Bushveld Igneous Complex. The greatest bulk at the surface consists of a granite rather rich in soda, called the red or newer granite to distinguish it from the Archaean or older granite of the Transvaal, but towards the base of the laccolite, and therefore exposed round a large part of the periphery of the main body of the complex, the rocks are norite and diabase. That these basic portions in certain localities consolidated first is proved by intrusions of the red granite in them, but in some places there is a gradual passage from one rock to the other. The ultra-basic (peridotites, pyroxenites, and magnetite rocks) and ultra-acid rocks (quartz rocks and greisen) occur in much smaller volume traversing the other varieties, lying between them or cutting the surrounding or overlying beds of the Transvaal and Waterberg systems. The abundant sheets and dykes of diabase in the rocks surrounding the

Bushveld Complex are regarded as offshoots from it. In the Pilandsberg, near Pretoria, and at a few other places, there are some remarkable soda-rich rocks of the nepheline-syenite and related types. In the former locality a volcanic group of post-Waterberg age is accompanied by intrusions of the nepheline-syenite family.

The intrusions of the norite and granite had very marked effects on the surrounding rocks, especially on the Pretoria beds, the metamorphism of which has been closely studied. The chief result is the production of rocks rich in cordierite, biotite, andalusite, and other metamorphic minerals; but in several localities the altered rocks contain pyroxene and amphiboles probably formed from material transferred from the intrusive magma to the sedimentary beds.

So far as is known there are no intrusions in the Cape Province analogous to the Bushveld Complex, unless the comparatively unimportant diabase sheets and dykes of Griqualand West and the Prieska syenite can be regarded as such.

Cape
formation,
&c.

In the south and west of the Union, according to the views adopted here, there is no formation that can be attributed to the Waterberg system, but the beds of the Nama (Transvaal) system were plicated, invaded by great masses of granite, and subjected to prolonged denudation before the deposition of the Cape formation. This important system is divided into three groups on lithological grounds; the Table Mountain series at the base consists chiefly of quartzitic grits and sandstones with subordinate pebbly beds; arenaceous shales are occasionally found, and near the top there is a group of argillaceous beds which include, in the Cedarberg region, a glacial conglomerate. The quartzitic sandstones of this series give characteristic features to the long southern ranges of the Cape. The series is followed conformably by the Bokkeveld beds, shales, and argillaceous and calcareous sandstones, the lower part of which contain the earliest fauna yet discovered in South Africa, the remains of marine animals of Lower Devonian affinities. The



Bokkeveld beds are succeeded conformably by the Witteberg beds, pale quartzites and dark shales, which have only yielded a few casts of plants and fragments of an eurypterid. The Table Mountain series maintains its characteristic features throughout its range from Van Rhyn's Dorp in the west through the southern ranges of the Cape to Port Elizabeth, where it disappears under the sea, but it reappears with similar characters in Pondoland and Natal. It is a typical 'continental' deposit, and there is no evidence that any part of it was laid down under the sea, and the same may be said of the upper part of the Bokkeveld and the whole of the Witteberg series. The Bokkeveld and Witteberg beds become more argillaceous as they are followed southwards from the country on the borders of the Great Karroo towards the coast.

How far north these beds once extended is not known; both in the west and east of South Africa they are unconformably overlapped by the Dwyka series, which in the country south of lat. 33° appears to follow them conformably. This supposed conformity is based on the fact that a similar succession from the Table Mountain series up to the Karroo beds has been found not only along the 450 miles of outcrop between the Cold Bokkeveld in the west and Grahamstown district in the east, but also in the Worcester district on the south side of the Cape ranges and in the folded outliers within the ranges; nowhere in that region has the Dwyka been found resting on lower beds than the Witteberg.

The total thickness of the Cape formation is about 10,000 feet, and there must have been more or less continuous depression of the southern end of the continent during its deposition; but at some time during that period subsidence ceased in the country north of lat. 33° , and a gradual uplift exposed the newly deposited beds to erosion. South of that latitude the depression continued far into Karroo times.

The early part of the Karroo period was marked by the prevalence of glacial conditions over the South African

Glacial
beds.



as in other portions of the southern continent called Gondwanaland, which stretched during Carboniferous, Permian, and Triassic times from South America across Africa to the Indian peninsula and Australia. Within the Union traces of glaciation have been found as far north as S. lat. $22\frac{1}{2}^{\circ}$, but the recent discovery of glacial beds, which are correlated with the Dwyka, in S. lat. 10° in the Congo State, extends the range enormously. Up to the present time no satisfactory explanation of the former existence of glacial conditions over so wide an area in tropical and temperate regions has been found. The movements of the ice, as shown by the direction of the striae on the floor beneath the conglomerate and by the distribution of boulders, was southerly. The thickness of the hard boulder-clay or tillite varies from a foot to 1,000 feet. The great thicknesses are found especially in the south of the Karroo, where there is a conformable passage from the underlying beds. It is worth noting that such great thicknesses of boulder-clay spread over wide areas are unknown amongst the products of the Pleistocene Ice Age in the northern hemisphere.

The glacial beds are overlain by shales, cherts, and thin limestones south of the Vaal River. To the north of the Vaal, and probably also for some miles to the south, the sequence differs from that found within the Cape Province; there is an unconformity in the north above the glacial beds, and the smooth-pebble conglomerates, sandstones, shales, and coal beds found above them are probably representatives of beds which lie far above the conglomerates in the south. Different opinions are held on this matter, and the evidence from fossils is at present insufficient to decide the question. The only fossils yet found in the Dwyka tillite and the Upper Dwyka shales within the Union are *Gangamopteris* and *Mesosaurus*, but near Keetmanshoop, in German territory, the marine forms *Conularia* and *Eurydesma* occur in beds that lie just above the tillite.

Karoo
system.

The Karroo system is much more fully developed in the south-east of the Cape Province and the neighbouring



part of Natal than in the Transvaal. In the former regions it consists of some 16,000 feet of shales, mudstone, and sandstones, with a capping of 4,000 feet of volcanic beds, but in the Transvaal it is perhaps not much more than a tenth of that thickness. At present the explanation of the difference is imperfectly understood, but it seems that the Dwyka, Ecca, and Beaufort series, and the Molteno beds of the Stormberg series thin northwards, while the higher divisions of the Stormberg are also less fully developed in the Transvaal.

The Ecca and Beaufort series are very much alike lithologically, though in each the development of thick sandstones characterizes certain horizons traceable through considerable distances. The Ecca beds are more arenaceous in the south than in the north and north-west of the Karroo. The Beaufort beds are the source of many reptilian fossils, some with mammalian characters, and forms with generalized structure. The lowest (Molteno) group of the Stormberg series consists of pebbly and coarse sandstones and shales, and is the coal-bearing formation of the Cape Province. The fossils in these beds are almost entirely plants; the succeeding Red beds and Cave sandstone are mainly arenaceous strata; they have yielded dinosaurians, a few fish, a crocodile, and a mammal, *Tritylodon*.

The conditions under which the Karroo sedimentary rocks were deposited are but little understood. The fact that some 15,000 feet of non-marine beds with an extremely small proportion of conglomerates or gravels were formed over part of the district can only be explained by the assumption of long-continued subsidence in an area to which a river system brought down much mud and sand. Possibly some of the thick sandstones of the upper portion may represent sand-dunes, but for the greater part of the formation deposition on land cannot be accepted. It may be that the area was somewhat of the nature of the great Indo-Gangetic plains, but further from the source of the sediments, so that pebble beds were limited in extent and were only formed during

Deposition of Karroo sedimentary rocks.



short periods (part of the time represented by the Molteno beds). It is probable that the surface of deposition was kept at a level near that of the ocean. There is no evidence, in the form of salt beds, gypsum, or tufaceous limestones, that the area was ever one of internal drainage from which water escaped only by evaporation. The existence of a lake for so prolonged a period (Carboniferous to Jurassic times) is almost impossible to believe.

At some period during the deposition of the Karroo beds, probably just before the Molteno beds were laid down, earth-movements of the mountain-building kind made themselves felt in the south and west; the chief result was the production of anticlines in which all the beds from the Beaufort series downwards were involved. There are two large groups of these anticlines, the symmetrical folds of the Cedarbergen on the west with axes trending north-north-west, and the Zwartberg folds on the south with east and west trend. The axes of the fold are not quite straight, for they are wide arcs concave towards the ocean. The overfolding is towards the interior of the country, and so are the thrusts in cases where certain strata are pushed over younger beds. Where these two groups of folds meet there are diagonally placed folds and faults.

Jurassic
igneous
period.

The great volcanic outbursts which brought the Karroo period to a close affected a very large area in Basutoland, the central and eastern Transvaal and Rhodesia; whether these isolated districts are parts of a once continuous volcanic region is not known, but the intrusive phase of the igneous activity, of which the volcanic phase is represented in those five areas, affected a much greater area, almost the whole of British South Africa as well as part of German South-West Africa. The evidence is in the form of dykes and sheets of dolerite. The only important region where these intrusions are not found is the folded belt of the west and south, though where the folding became insignificant, as in the Cape Peninsula, Pondoland, and Van Rhyns Dorp, the dolerite intrusions are again met with.



Since this (Jurassic) period of igneous activity the whole interior region appears to have remained well above sea-level and to have suffered continuous denudation. In Lower Cretaceous times the southern folded belt became partly buried under torrential and river deposits, represented by the conglomerates, sands, and clays of the Uitenhage series; towards the east the valleys in which these deposits were laid down were open to the sea, for beds with marine fossils are there found intercalated with, and lying upon, the non-marine deposits. How far west of Knysna the sea encroached upon the folded belt is not known. After these Lower Cretaceous rocks were formed, they were let down to the south along faults parallel to, and on the south side of, the east and west anticlines. No similar events are known to have happened in the western (Cedarberg) region.

Lower
Creta-
ceous and
later
periods.

The Lower Cretaceous beds (Neocomian) are covered unconformably over a small area in Alexandria by what are possibly Upper Cretaceous (Danian) shallow-water marine limestones, and these latter beds overlap the Uitenhage and are found lying on Karroo beds to the north-east near East London. During the interval between the Neocomian and Danian, the Cretaceous sea encroached upon what is now the east coast; in Pondoland and Southern Natal the strata then laid down are represented by very narrow strips above high-water mark, and consist of Senonian beds resting upon Karroo or older rocks; but in Zululand, where the Cretaceous area becomes very much wider, Cenomanian beds come in below. Thus after a short advance and retreat of the ocean in Lower Cretaceous times, it advanced south-westward on the African coast at a later date, but it never seems to have covered a considerable part of the country below the great escarpment.

Cainozoic marine deposits are represented by certain shelly limestones in the Alexandria, Uitenhage, and Bredasdorp districts, and also in Zululand, but little is known of them as yet.

At some period since Uitenhage times a curious form

of igneous activity broke out sporadically over practically the whole of South Africa, and resulted in the formation of 'pipes' and fissures filled with ultra-basic igneous rocks and various breccias. The best known of these are the pipes in which diamonds are found scattered through a peridotite-breccia (Kimberlite); but there are connecting links between these breccias and the similarly-shaped bodies of melilite-basalt and nepheline-basalt. The youngest rocks known to be pierced by the peridotite breccias are the Stormberg beds and the dolerite intrusions, but melilite-basalt pierces Uitenhage beds in the Riversdale district.

Whether any of these fissures or pipes, which simulate volcanic necks, actually reached the surface and gave rise to tuff-cones or lava-flows is not known. They are distributed irregularly; the chief groups are those of the Kimberley and the Orange Free State, Pretoria district, Sutherland district, and western Bushmanland, but considerable numbers occur elsewhere from German South-West and Rhodesia down to East Griqualand. Their arrangement has no obvious relation to any structural feature in the continent.

Origin of
 present
 main
 water-
 shed.

The existing main watershed appears to have been derived from the shape of the land at the close of the Karroo period. It no doubt lay nearer the present position of the coast line and has since retreated north-westwards, away from the steeper slope of the country. There are remains of high-level terraces on both sides of the watershed. On the Atlantic side the most important are those of the Kaap-Stormberg plain, rising from 4,000 to 6,000 feet above sea-level, and on the Indian Ocean slope the chief remnants are those of the Uplands (700-1,000 feet) and the De Vlught terraces; though there are no marine beds found on them except where the Uplands plain merges into the raised-beach deposits of shelly limestone quite near the coast. It is probable that these old plains and terraces were formed when the sub-continent stood at low levels during long periods, possibly also the climate was drier then than now. The great plains of the Kalahari have probably been subject to a drier climate than the

present during part of the long period since the Karroo rocks were laid down there, but at some time the rivers from the north and west were able to cut deep channels through the region; and at the present day the sand-dunes formed under a more rigorous climate are fixed by vegetation.

The history of the southern slope can be made out in part from the relation of the river system to the geological structure of the region. The rivers join to pass through the southern and western mountains by deep poorts, and they receive important tributaries from the longitudinal valleys within the folded belt. They pass over the Uitenhage beds without deflections, and were evidently initiated at a time when the Uitenhage beds filled the great longitudinal valleys and the surface had a general southerly slope. There is no evidence that the present transverse valleys have resulted from the capture of rivers flowing eastwards in longitudinal valleys in the direction of slope of the main axes of the Zwartberg folds.

[For Geology, the *Reports* published annually by the Geological Commission of the Cape of Good Hope (Cape Town) should be consulted. Those for 1901 and 1902 may be indicated particularly as dealing with extensive areas—the region west of the High Veld; while that for 1908 is concerned with parts of Prieska, Hay, Britstown, Carnarvon, and Victoria West. Reports are also published by the government geologists of the Transvaal and Natal. See also articles in *Science in South Africa*, Cape Town, 1905, for the geology of all divisions of South Africa; *The Geology of the Transvaal and the Orange River Colony* (British Association Handbook), Cape Town, 1905; F. H. Hatch and G. Corstorphine, *Geology of South Africa*, London, 1909; C. H. Stott, *Geology of South Africa*, Cape Town, 1909; E. H. L. Schwarz, *South African Geology*, London, 1912; and on particular areas, A. W. Rogers, *Introduction to the Geology of Cape Colony*, London, 1904; J. P. Johnson, *Geological and Archaeological Notes on Oranania*, London, 1910; A. L. Hall, *Geology of the Murchison Range and District*, Pretoria, 1912. Among works of a more general character, which include topographical description: Somerset Playne, *Cape Province*, London, 1912; A. H. Tatlow, *Natal Province* (Official Guide), London, 1912; T. G. Trevor, 'Physical Features of the Transvaal', in *Geographical Journal*, July, 1906.

Surveys by the Geographical Section of the General Staff cover the Orange Free State and Basutoland, about 100,000 square miles in Cape Colony, and a small area in Transvaal, but publication is not complete. There are also various series of farm surveys. A very notable geodetic survey has been made: see Sir D. Gill, *Report on the Geodetic Survey of South Africa*, Cape Town, 1896–1905.] Mapping.



Archaean

Cannot be correlated with foreign rocks

Swaziland system

Relative ages and correlations unknown

- Abel's Kop beds ; schists, limestone, banded ferruginous cherts.
- Kheis series { Wilgenhout Drift beds ; sedimentary and volcanic rocks.
- Kaaieen beds ; quartzites and schists.
- Marydale beds ; sedimentary and volcanic rocks.
- Kraaipan series ; schists, ferruginous cherts, and volcanic rocks.
- Moodie's series ; ferruginous cherts, schists, and conglomerates.
- Schists of sedimentary and volcanic origin in Namaqualand.

Witwatersrand system

- Quartzites, ferruginous shales and cherts, conglomerates, also a few lava flows ; developed in the Southern Transvaal ; not known elsewhere.

Ventersdorp system

- Pniel series ; lavas of basic, intermediate and acid composition, tuffs, quartzites, and conglomerates.
- Kuip series ; basic lavas, arkose, limestone, chert, sandstones.
- Zoetlief series ; acid lavas, shales, quartzites, and conglomerates.

Transvaal system

- Pretoria series ; shales, quartzites, andesitic lavas (Ongeluk beds), ferruginous cherts.
- Campbell Rand series ; dolomitic limestones and cherts.
- Black Reef series ; quartzites, conglomerates and shales.

Probably equivalents of Nama system in West

- Ibiquas series ; shales and sandstones.
- Malmesbury series ; shales and limestones.
- Nieuwerust series ; arkose and quartzites.

Waterberg system

- Sandstones, shales, and conglomerates (Upper Waterberg) rest upon felsitic lavas and shales of Lower Waterberg in the Transvaal ; quartzites, conglomerates, and andesitic lavas (Matsap beds) of Griqualand West.

Intrusion of younger granites of Namaqualand and south and south-west of Cape Province.

Minor intrusions of basic and intermediate composition.

Intrusion of Palabora granite.
Intrusion of old gneisses of Transvaal and north and west of Cape Province.

Mountain-building in south and west of Cape Province ; emergence in north.
Long-continued depression in north, west, and south.

Minor uplifts in Griqualand West and Bechuanaland.
Uplift over Witwatersrand.

Mountain-building in north and west ; followed by great denudation.





SYNOPSIS OF GEOLOGICAL FORMATIONS IN THE UNION OF SOUTH AFRICA

CSL

Stratified Formations.

Igneous Intrusions.

Earth Movements.

Depression of coastal region.
Uplifts of whole of South Africa.

Uplifts.

Encroachment of sea in south-east.
Subsidence along faults in south and south-east regions; downthrow on ocean side; emergence of the south-east and south from Uitenhage sea and estuaries, and uplift of interior.

Encroachment of sea in south over area partly buried under débris from the exposed southern ranges.

Emergence of land over Karroo region, and formation of main watershed. Narrowing of area of deposition in Karroo region due to rise of southern ranges within that region.

Mountain-building in south and south-west of Cape, producing east-west and north-south ranges, preceded by long-continued subsidence (Cape Karroo times) over south and south-eastern regions; the subsidence was interrupted by uplift north of lat. 33°.

Uplift of the northern region.
Mountain-building produced north-south ranges in Griqualand West, &c.

'Volcanic' pipes and fissures filled with nepheline- and melilitite-basalt, and peridotite-breccia (Kimberlite). Dykes of monchiquite and bostonite (?).

The lava flows were accompanied and followed by intrusions of dolerite and cognate rocks in form of dykes and sheets; the basic plutonic masses of Insizwa, &c., are cut by dolerite dykes.

Intrusion of alkali-syenites into the Pilandsberg lavas (phonolites and trachytes) of post-Waterberg age. Later limit of age unknown. Intrusion of the Bushveld Plutonic Complex.

Cainozoic

Cretaceous system

Recent and sub-recent sands, alluvium, gravels, limestone-tufa, ironstone, quartzites; raised beaches.
Fossiliferous marine in-shore beds of Alexandria, Addo, Bredasdorp, and Zululand; high-level gravels of inland terraces; lignites and sands of Knysna.
Need's Camp series (Danian); shelly marine limestone.
Umzamba series (Senonian); Pondoland, Natal, and Zululand; shelly limestones and conglomerates.
False Bay and Manuan Creek series, Zululand (Cenomanian); clayey limestones.

Uitenhage series (Neocomian).

Sunday River beds; marine clay and limestones.
Wood beds; sands and clays.
Enon beds; sands, clays, and conglomerates.

Stormberg series (Rhaetic and higher).

Drakensberg or volcanic beds; basaltic and andesitic lavas and ash, of Drakensberg, Springbok Flats, and Lebombo range.

Cave sandstones of Drakensberg and Bushveld.

Red beds; sandstones and shales.
Molteno beds; sandstones, shales, conglomerates, and coal beds (in Cape Province).

Beaufort series (Permian-Triassic).

Burghersdorp beds; shales and sandstones.

Middle Beaufort beds; sandstones and shales.

Lower Beaufort beds; shales and sandstones.

Ecca series (Permian).

Shales in the north and east; shales and sandstones in the south.

Dwyka series (Carboniferous-Permian).

Upper shales.
Tillite, glacial beds, mudstones, &c.
Lower shales.

Witteberg series; shales and sandstones (quartzites).
Bokkeveld series; shales and sandstones, marine fossils (Devonian) in lower half.

Table Mountain series; sandstones, shales, few conglomerates, glacial conglomerate in Cedarberg.

Mesozoic

Karoo system

Palaeozoic

Cape system (only known in Cape and Natal).



CHAPTER II

CLIMATE AND WEATHER

BY C. STEWART

Physical
features.

THE term South Africa is taken here as referring to that portion of the African continent extending from the valley of the Zambezi, in about latitude 15° S., southwards to Cape Agulhas in approximately 35° S., and lying between 12° and 36° E. longitude. This area includes the British possessions of the Cape of Good Hope, Orange Free State, Transvaal, and Natal, constituting the Union of South Africa, together with Basutoland, Bechuanaland, and Rhodesia.

Topographically considered, South Africa consists essentially of four elevated plains or plateaus, separated from each other by steep escarpments rising to a considerable elevation above the tablelands and appearing, when viewed from the coast, as a series of high mountain ranges running roughly parallel with the coast. This division into plateaus is most distinctly seen in traversing the country from south to north, but is not so well defined in the west where the slopes are more gradual, nor in the east where the plateaus sink in terraces. These plateaus may be described as follows :

1. The coast plateau or coast flats, having an average elevation of 500–600 feet, and varying considerably in width, from about 30 miles in German South-West Africa to 3 or 4 miles or even less in the south-east of the Cape Colony.

2. The Southern or Little Karroo, a narrow tableland about 15 to 20 miles in width and of an average elevation of 1,500 feet.

3. The Central or Great Karroo, having an average altitude of 2,000–3,000 feet.

4. The Northern or Upper Karroo, or High Veld, is the

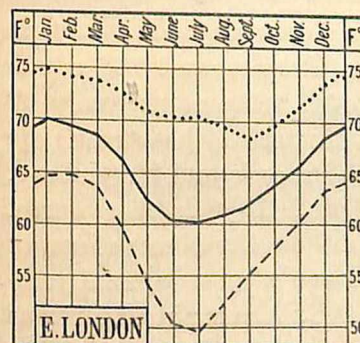
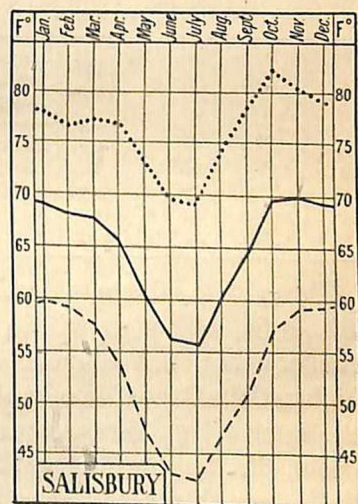
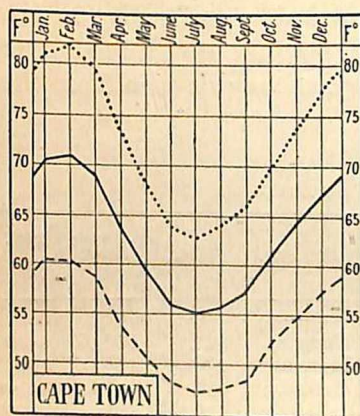
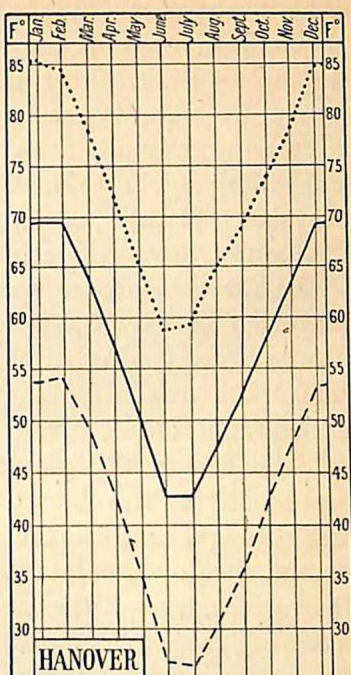
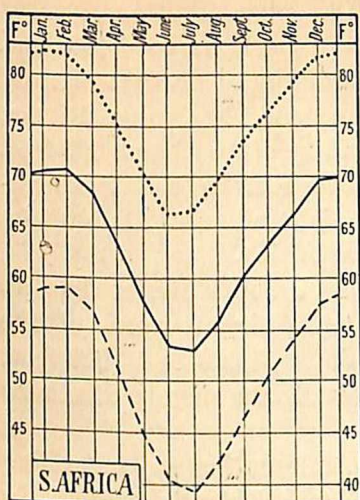


FIG. 12. Monthly Temperatures (maxima, mean, and minima).

innermost plateau, and has an average elevation of about 4,000 feet, rising in the eastern portions to 6,000 feet. From the Drakensberg the land slopes northwards and westwards towards the Limpopo and the Orange Rivers, decreasing gradually to an elevation of less than 3,000 feet, but rising again to over 4,000 feet in the Mashona-Matabele Plateau of Rhodesia and the Damanama Plateau of German South-West Africa.

By far the greater portion of South Africa has an elevation of over 3,000 feet, the highest parts of the Drakensberg having an altitude of 11,000 to 12,000 feet, whilst the area below 1,500 feet forms merely a narrow fringe around the coast.

Tempera-
ture.

The effect of this plateau-configuration in controlling and modifying the climate of South Africa is particularly well brought out by the remarkable uniformity in the annual mean temperatures of stations distributed over the various parts of the country, as may be seen from the following table :

TABLE I
ANNUAL MEAN TEMPERATURES

<i>Stations.</i>	<i>Lat.</i>	<i>Long.</i>	<i>Alti- tude.</i>	<i>Annual mean temp.</i>	<i>Stations.</i>	<i>Lat.</i>	<i>Long.</i>	<i>Alti- tude.</i>	<i>Annual mean temp.</i>
				<i>Fahr.</i>					<i>Fahr.</i>
Cape Town	33° 55'	18° 25'	115	62·6°	Umtata	31° 35'	28° 46'	2400	63·0°
O'okiep	29° 36'	17° 52'	3036	63·0°	Pretoria	25° 45'	28° 11'	4392	63·5°
Mossel Bay	34° 11'	22° 9'	105	63·3°	Pietersburg	23° 56'	29° 24'	4130	63·4°
Graaff-Reinet	32° 16'	24° 32'	2460	63·6°	Salisbury	17° 48'	31° 5'	4800	64·6°

From the above it will be seen that Salisbury in Rhodesia, although within the Tropics and 16° nearer the equator, has a mean annual temperature only 2° higher than Cape Town, whilst Mossel Bay has practically the same annual temperature as Pretoria and Pietersburg, which lie approximately 8½° and 10¼° farther north. Fully two-thirds of the stations on the observations of which this chapter is based have a mean annual temperature between 59° and 64° F., the main exceptions being found along the east coast or in valleys, and a few in Rhodesia. The coldest station is Disa Head (Table



Mountain) in the Cape Peninsula, where, at an altitude of 2,500 feet, the annual mean temperature is 54.7° ; whilst the warmest station is Komati Poort (lat. $25^{\circ} 26' S.$, long. $31^{\circ} 56' E.$) in the Transvaal, on the borders of Portuguese East Africa, where an annual mean temperature of 73.1° is met with at an elevation of only 460 feet and at a distance of 55 miles from the sea. There is therefore a difference of 18.4° in the annual mean temperatures of the coldest and warmest places known in British South Africa. As a result of this uniformity of mean annual temperature, it is evident that the main climatic differences must be sought in the mean daily range or the mean difference between the day and night temperatures, and the mean annual range or the difference between the coldest and warmest months.

Speaking generally, the mean daily range increases from the coast inwards, averaging slightly over $12^{\circ} F.$ at the south coast stations and increasing to over $30^{\circ} F.$ in Basutoland and parts of the High Veld, where, however, it is mostly between 26° and 28° . The extremes vary between $10.4^{\circ} F.$ at Cape Agulhas and $35.2^{\circ} F.$ at Umsinga in Natal. An indication of the differences in climate at the eight stations given in Table I will be gained from a consideration of the annual mean maxima and minima, and the resulting diurnal range for these same places :

TABLE II
ANNUAL MEAN MAXIMUM, ANNUAL MEAN MINIMUM, AND MEAN DAILY RANGES

Stations.	Annual mean max.	Annual mean min.	Mean daily range.	Stations.	Annual mean max.	Annual mean min.	Mean daily range.
Cape Town	71.8°	53.4°	18.4°	Umtata	75.7°	50.2°	25.5°
O'okiep	75.2°	50.8°	24.4°	Pretoria	78.1°	48.8°	29.3°
Mossel Bay	70.2°	56.4°	13.8°	Pietersburg	77.0°	49.8°	27.2°
Graaff-Reinet	78.0°	49.2°	28.8°	Salisbury	76.2°	53.1°	23.1°

The small diurnal range of $13.8^{\circ} F.$ at Mossel Bay is due to the equalizing influence of the sea, whilst the large range of $29.3^{\circ} F.$ at Pretoria is owing to its being built in a valley surrounded on all sides by kopjes, and the consequent undue heating by day and cooling by night.

Over the west and south-west the mean daily range is greater during the warmest month than during the coldest by about 5° , whereas over the rest of the country the reverse holds, the difference being slightly more than 5° in favour of the coldest months. This contrast is evidently due to the blanketing effect of cloud during the winter season in the west and south-west, whilst summer is the rainy period over the rest of the country. The increased range during winter is greatest, 14.8° at Stander-ton in the south of the Transvaal; whilst the summer excess is found to be greatest (9.9°) at Springbokfontein in Namaqualand.

Some of these peculiarities can be seen in the following Table III, which is primarily intended, however, to show the mean annual range of temperature; that is, the difference between the mean coldest and the mean warmest month at each station. This may be regarded in most cases as a measure of the increase of temperature from midwinter to midsummer, and of the variations to which plants and animals are liable to be subjected.

TABLE III
 MEAN ANNUAL RANGES

<i>Station.</i>	<i>Warmest month.</i>	<i>Mean max. temp.</i>	<i>Mean min. temp.</i>	<i>Mean monthly temp.</i>	<i>Coldest month.</i>	<i>Mean max. temp.</i>	<i>Mean min. temp.</i>	<i>Mean monthly temp.</i>	<i>Mean annual range.</i>
Cape Town	Feb.	81.8°	60.3°	71.0°	July	62.6°	47.4°	55.0°	16.0°
O'okiep	Feb.	85.3°	59.1°	72.2°	July	63.4°	43.0°	53.2°	19.0°
Mossel Bay	Jan.	75.7°	63.8°	69.8°	July	66.3°	49.5°	57.9°	11.9°
Graaff-Reinet	Feb.	87.6°	60.5°	74.0°	July	67.9°	36.9°	52.4°	21.6°
Umtata	Feb.	81.2°	60.1°	70.6°	June	70.2°	36.8°	53.5°	17.1°
Pretoria	Jan.	83.8°	59.6°	71.7°	July	68.6°	34.8°	51.7°	20.0°
Pietersburg	Jan.	81.5°	59.9°	70.7°	July	69.0°	36.2°	52.6°	18.1°
Salisbury	Nov.	80.5°	59.3°	69.9°	July	68.9°	42.3°	55.6°	14.3°

The mean annual range shown in the last column has been obtained by subtracting the mean monthly temperature of the coldest from that of the warmest month. This shows that the most equable climate as regards temperature is met with on the coast, whilst stations on the Karroo, like Graaff-Reinet, are subject to much greater variation during the year than even places on the High



Veld. The latter fact may be explained by a relatively small amount of cloud over the Karroo during summer, enabling solar radiation to have a greater effect than over the High Veld, and consequently to raise the day temperatures in the south more than those further north and east. It may be assumed, however, as a general rule, that the greater the mean daily range the greater the mean annual range, other conditions being similar.

The comparatively small land area of this sub-continent enables the moderating influence of the surrounding oceans to be felt over practically the whole country. This, in conjunction with the elevated character of the interior, renders the climate of almost any part of South Africa much more temperate than that of stations in corresponding latitudes in the Northern Hemisphere. Thus the warmest station, Komati Poort, in lat. $25^{\circ} 26' S.$, has a mean annual temperature ($73.1^{\circ} F.$), corresponding with that of Cairo in $30^{\circ} N.$ lat. and practically the same as the mean summer temperature of Madrid; whilst the coolest station, Disa Head, in lat. $34^{\circ} S.$, has an annual temperature ($54.7^{\circ} F.$), similar to those of Pavia and Boulogne.

The mean annual temperature of all stations is $62.6^{\circ} F.$, about the same as that of Barcelona, Toulon, Naples, and the Riviera on the shores of the Mediterranean; slightly lower than the annual temperature of Sydney (New South Wales) and Melbourne, and about the same as the summer months in London.

On drawing the mean annual isotherms, after applying a correction for altitude, it is found that the lines run roughly parallel with the coast, and show an increase of temperature from the sea inland. It is also seen that the west coast is relatively cooler than the east coast, the former being washed by the cold waters of the Benguela current, whilst the warm Mozambique (or Agulhas) current raises the temperature of the east and south coasts as far as Simonstown, where the annual temperature is $64.7^{\circ} F.$ Without any correction for height, there is found to be an increase in temperature from west to

Mean
annual
isotherms.

east along the parallels of latitude of about one degree (1° F.), for each degree of longitude; from north to south along the west coast, there is an increase of slightly more than 1° F. for each degree of latitude; along the south coast, from Cape Agulhas, the increase eastwards is only 0.4° F. per degree of longitude; whilst from East London to Durban the rate northwards is increased to about 1.5° F. for each degree of latitude. The coolest section of the country is found in Basutoland, where the annual mean is 58.7° F., the Orange Free State, the Northern Karroo, and the north-east of the Cape Colony being only a few tenths warmer on the mean of the year; the warmest section of the country is Natal (66.9° F.), Rhodesia coming next with an annual temperature of 66.6° F.

Seasons.

Over the southern hemisphere the seasons are the reverse of those in the northern hemisphere, the three warmest months, December—February, corresponding to the summer season of June—August in countries north of the equator. Considering the general march of temperature throughout the year, it is found that the monthly mean temperature curve (Fig. 12) is at the maximum (70.6° F.) in January and February; it then falls at first slowly in March, but rapidly in April, May, and June, to the minimum (53.0° F.) in July; after which it ascends more slowly to the maximum again. The maximum or day temperatures are highest (82.2° F.) in January, and decrease to the lowest (66.3° F.) in June, after which they rise again to the maximum in January. The minimum or night temperature curve falls from its highest value (59.1° F.) in February to its lowest point (39.4° F.) in July, then rises again till February. It will be noted that whilst the day temperatures are rising in July, the night temperatures are still falling, a state of affairs closely associated with a cold spell which affects the whole country about the middle of the month. Although the three months, December to February, constitute on the average the warmest period of the year, there are certain striking exceptions to this rule. Thus, the Cape Peninsula and



the south-west of the Cape Colony have the highest mean monthly temperatures from January to March, a lag of one month behind the greater part of the country, due mainly to the cool southerly winds decreasing in frequency and strength during March. Again, over Rhodesia the warmest period of the year is from October to December, a circumstance closely associated with the occurrence of the rainy season about the beginning of November. The highest mean monthly temperature there occurs either in October or November, according as the rains are early or late. At most coast stations the mean day temperatures, instead of beginning to rise in July, continue to fall till August or September ; the reason for this is not quite clear.

The equable nature of the climate of South Africa is well indicated by the comparatively small difference between the warmest and coldest months, thus the range is least (5.9°F.) at Port Nolloth on the west coast, and greatest (28.7°F.) at Fraserburg in the Northern Karroo. Generally the annual range increases from the coast inland, being mostly $10^{\circ}\text{--}12^{\circ}\text{F.}$ at the coast and $20^{\circ}\text{--}25^{\circ}\text{F.}$ over the less elevated portions of the High Veld as well as over the Karroo. These values are small compared with stations occupying positions in the European or American Continents, thus in the United States it ranges from $10^{\circ}\text{--}15^{\circ}\text{F.}$ along the Pacific Coast to $55^{\circ}\text{--}65^{\circ}\text{F.}$ over the north-eastern Rocky Mountain slope eastwards to Lake Superior.

Temperatures of 100°F. have been recorded at most stations, with the exception of a few places on the more elevated portions of the High Veld, in Basutoland, &c.; whilst temperatures of $101^{\circ}\text{--}105^{\circ}\text{F.}$ are of fairly common occurrence along the coast belt, being usually noted once or twice a year, and occasionally over the elevated interior. Temperatures of $106^{\circ}\text{--}115^{\circ}\text{F.}$ are much less frequently observed, but do occur from time to time over the lower plateaus and the lowest western portions of the High Veld ; temperature rises to this extent mostly during the prevalence of hot, föhn-like winds

Range of
tempera-
ture.



that are liable to blow at times from the elevated interior down to the lower levels on and near the coast.

Mean shade temperatures of 32° F. and under are of most frequent occurrence during June—August, particularly over the Northern Karroo, the north-east of the Cape Colony, and parts of Natal.

Severe frosts, capable of freezing standing water, are practically unknown along the coast, but are of fairly frequent occurrence in the interior. As a matter of fact, frost is liable to occur at inland stations during any month of the year, but more particularly from May to the middle of September, although killing frosts are apt to occur as early as March and as late as October. The danger of damage to fruit, &c., from this cause will be apparent when it is stated that the first almond blossoms open on the Karroo, on an average, on August 1, the peach on August 25, and the pear three to four weeks later. Hoar-frost, however, is not uncommon over the coastal districts, as from actual observation it has been found to occur, on an average, on seventeen days in the course of the year over the Cape Flats, in the neighbourhood of Cape Town. Over the Great Karroo there are about seventy days per annum on which ground-frost occurs; ninety-six in the north-east of the Cape Province, and sixty-three days at Bloemfontein. A great deal, however, depends on the situation of the station, whether on a hill or slope, or in a valley, as is shown by there being only five days, on an average, with frost at the Union Observatory, Johannesburg, situated on a ridge at an elevation of 5,925 feet; frosts are much more frequent in the adjoining valleys.

The extremes of temperature recorded over South Africa are 125° F. at Main in Tembuland, in January 1903, and 6° F. at Palmietfontein in the north-east of the Cape Colony, in lat. $30^{\circ} 25' S.$, and long. $27^{\circ} 33' E.$, at an altitude of 4,500 feet, after a severe snowstorm in June 1902.

(A table showing the average monthly temperatures of some of the principal towns in South Africa is appended.)

Rainfall.

The average rainfall varies enormously over the country,

AVERAGE MONTHLY TEMPERATURES (Degrees Fahrenheit)

Station.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Salisbury	78.0 Mean max. 59.9 Mean min. 69.0 Monthly mean	76.7 Mean max. 59.2 Mean min. 68.0 Monthly mean	77.3 Mean max. 57.9 Mean min. 67.6 Monthly mean	77.0 Mean max. 53.9 Mean min. 65.4 Monthly mean	73.0 Mean max. 47.3 Mean min. 60.2 Monthly mean	69.6 Mean max. 43.0 Mean min. 56.3 Monthly mean	68.9 Mean max. 42.3 Mean min. 55.6 Monthly mean	73.9 Mean max. 49.9 Mean min. 60.4 Monthly mean	78.3 Mean max. 51.0 Mean min. 64.6 Monthly mean	82.2 Mean max. 57.3 Mean min. 69.6 Monthly mean	80.5 Mean max. 59.3 Mean min. 69.9 Monthly mean	79.0 Mean max. 59.4 Mean min. 69.2 Monthly mean	76.2 Mean max. 53.1 Mean min. 64.6 Monthly mean
Bulawayo	61.3 Mean max. 71.0 Mean min. 71.0 Monthly mean	60.4 Mean max. 70.0 Mean min. 70.0 Monthly mean	58.5 Mean max. 68.5 Mean min. 68.5 Monthly mean	53.6 Mean max. 65.8 Mean min. 65.8 Monthly mean	48.3 Mean max. 61.4 Mean min. 61.4 Monthly mean	44.2 Mean max. 57.2 Mean min. 57.2 Monthly mean	43.8 Mean max. 56.6 Mean min. 56.6 Monthly mean	47.6 Mean max. 61.7 Mean min. 61.7 Monthly mean	52.8 Mean max. 66.3 Mean min. 66.3 Monthly mean	58.2 Mean max. 71.0 Mean min. 71.0 Monthly mean	60.4 Mean max. 71.6 Mean min. 71.6 Monthly mean	60.9 Mean max. 71.6 Mean min. 71.6 Monthly mean	54.2 Mean max. 66.0 Mean min. 66.0 Monthly mean
Pretoria	83.8 Mean max. 59.6 Mean min. 59.6 Monthly mean	82.2 Mean max. 59.1 Mean min. 59.1 Monthly mean	80.1 Mean max. 55.5 Mean min. 55.5 Monthly mean	78.0 Mean max. 54.8 Mean min. 54.8 Monthly mean	72.7 Mean max. 50.6 Mean min. 50.6 Monthly mean	69.6 Mean max. 48.6 Mean min. 48.6 Monthly mean	68.6 Mean max. 47.4 Mean min. 47.4 Monthly mean	73.7 Mean max. 51.7 Mean min. 51.7 Monthly mean	79.4 Mean max. 56.7 Mean min. 56.7 Monthly mean	82.3 Mean max. 63.4 Mean min. 63.4 Monthly mean	82.4 Mean max. 66.2 Mean min. 66.2 Monthly mean	84.0 Mean max. 69.2 Mean min. 69.2 Monthly mean	78.1 Mean max. 63.5 Mean min. 63.5 Monthly mean
Johannesburg	75.1 Mean max. 55.7 Mean min. 55.7 Monthly mean	73.4 Mean max. 55.5 Mean min. 55.5 Monthly mean	71.2 Mean max. 53.5 Mean min. 53.5 Monthly mean	68.2 Mean max. 50.5 Mean min. 50.5 Monthly mean	63.3 Mean max. 45.6 Mean min. 45.6 Monthly mean	59.3 Mean max. 41.4 Mean min. 41.4 Monthly mean	58.8 Mean max. 40.4 Mean min. 40.4 Monthly mean	54.6 Mean max. 38.4 Mean min. 38.4 Monthly mean	48.0 Mean max. 34.8 Mean min. 34.8 Monthly mean	50.4 Mean max. 36.6 Mean min. 36.6 Monthly mean	52.8 Mean max. 39.6 Mean min. 39.6 Monthly mean	54.8 Mean max. 42.4 Mean min. 42.4 Monthly mean	49.3 Mean max. 37.1 Mean min. 37.1 Monthly mean
Komati Poort	91.8 Mean max. 69.2 Mean min. 69.2 Monthly mean	90.6 Mean max. 68.2 Mean min. 68.2 Monthly mean	88.0 Mean max. 65.9 Mean min. 65.9 Monthly mean	85.3 Mean max. 63.6 Mean min. 63.6 Monthly mean	82.6 Mean max. 61.4 Mean min. 61.4 Monthly mean	79.5 Mean max. 58.1 Mean min. 58.1 Monthly mean	79.3 Mean max. 57.2 Mean min. 57.2 Monthly mean	82.4 Mean max. 60.7 Mean min. 60.7 Monthly mean	87.7 Mean max. 65.8 Mean min. 65.8 Monthly mean	89.4 Mean max. 67.6 Mean min. 67.6 Monthly mean	88.6 Mean max. 66.3 Mean min. 66.3 Monthly mean	93.0 Mean max. 70.9 Mean min. 70.9 Monthly mean	86.5 Mean max. 63.3 Mean min. 63.3 Monthly mean
Maritzburg	73.3 Mean max. 61.4 Mean min. 61.4 Monthly mean	73.4 Mean max. 61.5 Mean min. 61.5 Monthly mean	71.4 Mean max. 59.2 Mean min. 59.2 Monthly mean	67.8 Mean max. 55.7 Mean min. 55.7 Monthly mean	61.9 Mean max. 49.8 Mean min. 49.8 Monthly mean	57.6 Mean max. 45.6 Mean min. 45.6 Monthly mean	58.6 Mean max. 46.6 Mean min. 46.6 Monthly mean	62.4 Mean max. 50.6 Mean min. 50.6 Monthly mean	65.2 Mean max. 53.2 Mean min. 53.2 Monthly mean	67.4 Mean max. 55.4 Mean min. 55.4 Monthly mean	69.1 Mean max. 57.1 Mean min. 57.1 Monthly mean	71.8 Mean max. 59.8 Mean min. 59.8 Monthly mean	66.6 Mean max. 54.6 Mean min. 54.6 Monthly mean
Durban	84.9 Mean max. 68.2 Mean min. 68.2 Monthly mean	84.3 Mean max. 68.3 Mean min. 68.3 Monthly mean	81.5 Mean max. 65.8 Mean min. 65.8 Monthly mean	77.5 Mean max. 61.8 Mean min. 61.8 Monthly mean	75.5 Mean max. 59.8 Mean min. 59.8 Monthly mean	75.5 Mean max. 59.8 Mean min. 59.8 Monthly mean	75.3 Mean max. 59.6 Mean min. 59.6 Monthly mean	75.8 Mean max. 60.1 Mean min. 60.1 Monthly mean	78.7 Mean max. 63.0 Mean min. 63.0 Monthly mean	81.2 Mean max. 65.5 Mean min. 65.5 Monthly mean	83.4 Mean max. 67.9 Mean min. 67.9 Monthly mean	86.2 Mean max. 70.7 Mean min. 70.7 Monthly mean	79.9 Mean max. 64.3 Mean min. 64.3 Monthly mean
Kimberley	90.5 Mean max. 61.0 Mean min. 61.0 Monthly mean	89.8 Mean max. 60.6 Mean min. 60.6 Monthly mean	86.6 Mean max. 59.4 Mean min. 59.4 Monthly mean	76.2 Mean max. 51.0 Mean min. 51.0 Monthly mean	68.6 Mean max. 43.0 Mean min. 43.0 Monthly mean	63.6 Mean max. 36.7 Mean min. 36.7 Monthly mean	64.6 Mean max. 36.5 Mean min. 36.5 Monthly mean	70.9 Mean max. 40.1 Mean min. 40.1 Monthly mean	79.6 Mean max. 45.2 Mean min. 45.2 Monthly mean	85.0 Mean max. 51.5 Mean min. 51.5 Monthly mean	90.2 Mean max. 56.2 Mean min. 56.2 Monthly mean	91.9 Mean max. 57.9 Mean min. 57.9 Monthly mean	79.6 Mean max. 50.1 Mean min. 50.1 Monthly mean
Hanover	75.8 Mean max. 53.7 Mean min. 53.7 Monthly mean	75.2 Mean max. 54.2 Mean min. 54.2 Monthly mean	72.0 Mean max. 50.4 Mean min. 50.4 Monthly mean	63.6 Mean max. 42.5 Mean min. 42.5 Monthly mean	55.8 Mean max. 35.1 Mean min. 35.1 Monthly mean	50.2 Mean max. 30.6 Mean min. 30.6 Monthly mean	50.6 Mean max. 30.6 Mean min. 30.6 Monthly mean	64.8 Mean max. 36.2 Mean min. 36.2 Monthly mean	68.6 Mean max. 39.7 Mean min. 39.7 Monthly mean	73.7 Mean max. 42.5 Mean min. 42.5 Monthly mean	78.4 Mean max. 48.2 Mean min. 48.2 Monthly mean	84.9 Mean max. 53.5 Mean min. 53.5 Monthly mean	72.7 Mean max. 41.6 Mean min. 41.6 Monthly mean
Cape Town	69.4 Mean max. 60.1 Mean min. 60.1 Monthly mean	69.4 Mean max. 60.2 Mean min. 60.2 Monthly mean	64.0 Mean max. 58.7 Mean min. 58.7 Monthly mean	57.3 Mean max. 54.4 Mean min. 54.4 Monthly mean	50.0 Mean max. 48.3 Mean min. 48.3 Monthly mean	42.9 Mean max. 42.4 Mean min. 42.4 Monthly mean	42.9 Mean max. 42.4 Mean min. 42.4 Monthly mean	47.7 Mean max. 45.6 Mean min. 45.6 Monthly mean	52.4 Mean max. 50.7 Mean min. 50.7 Monthly mean	58.1 Mean max. 56.6 Mean min. 56.6 Monthly mean	63.3 Mean max. 62.0 Mean min. 62.0 Monthly mean	69.2 Mean max. 67.3 Mean min. 67.3 Monthly mean	57.2 Mean max. 53.6 Mean min. 53.6 Monthly mean
Port Elizabeth	75.4 Mean max. 64.4 Mean min. 64.4 Monthly mean	75.8 Mean max. 63.8 Mean min. 63.8 Monthly mean	75.2 Mean max. 62.8 Mean min. 62.8 Monthly mean	72.4 Mean max. 60.0 Mean min. 60.0 Monthly mean	69.9 Mean max. 57.5 Mean min. 57.5 Monthly mean	67.1 Mean max. 55.5 Mean min. 55.5 Monthly mean	67.4 Mean max. 55.4 Mean min. 55.4 Monthly mean	67.2 Mean max. 55.6 Mean min. 55.6 Monthly mean	66.6 Mean max. 55.0 Mean min. 55.0 Monthly mean	68.3 Mean max. 57.0 Mean min. 57.0 Monthly mean	71.1 Mean max. 60.7 Mean min. 60.7 Monthly mean	73.8 Mean max. 64.2 Mean min. 64.2 Monthly mean	70.8 Mean max. 62.0 Mean min. 62.0 Monthly mean
East London	75.0 Mean max. 64.9 Mean min. 64.9 Monthly mean	74.3 Mean max. 64.8 Mean min. 64.8 Monthly mean	73.9 Mean max. 63.5 Mean min. 63.5 Monthly mean	72.8 Mean max. 62.4 Mean min. 62.4 Monthly mean	70.9 Mean max. 60.2 Mean min. 60.2 Monthly mean	70.3 Mean max. 59.1 Mean min. 59.1 Monthly mean	70.3 Mean max. 58.8 Mean min. 58.8 Monthly mean	69.5 Mean max. 58.3 Mean min. 58.3 Monthly mean	68.6 Mean max. 57.1 Mean min. 57.1 Monthly mean	69.7 Mean max. 58.6 Mean min. 58.6 Monthly mean	71.5 Mean max. 60.2 Mean min. 60.2 Monthly mean	73.8 Mean max. 63.2 Mean min. 63.2 Monthly mean	71.7 Mean max. 61.8 Mean min. 61.8 Monthly mean
Bloemfontein	84.6 Mean max. 60.3 Mean min. 60.3 Monthly mean	82.9 Mean max. 59.5 Mean min. 59.5 Monthly mean	78.3 Mean max. 55.1 Mean min. 55.1 Monthly mean	72.4 Mean max. 49.4 Mean min. 49.4 Monthly mean	65.6 Mean max. 43.3 Mean min. 43.3 Monthly mean	60.7 Mean max. 38.2 Mean min. 38.2 Monthly mean	61.9 Mean max. 39.7 Mean min. 39.7 Monthly mean	66.9 Mean max. 45.0 Mean min. 45.0 Monthly mean	73.2 Mean max. 51.9 Mean min. 51.9 Monthly mean	77.2 Mean max. 55.1 Mean min. 55.1 Monthly mean	81.5 Mean max. 59.9 Mean min. 59.9 Monthly mean	85.3 Mean max. 63.9 Mean min. 63.9 Monthly mean	74.2 Mean max. 54.0 Mean min. 54.0 Monthly mean
	72.5	71.2	66.7	59.9	53.0	47.1	47.6	51.9	59.1	63.3	67.7	71.9	61.0

-ranging from over 200 inches in the mountainous district of the south-west of the Cape Province (Wemmer's Hoek and Berg River areas) to 2.5 inches at Port Nolloth, and 0.3 inches at Walfish Bay. In the east of the Cape Province the wettest station is Evelyn Valley (lat. $32^{\circ} 35' S.$, long. $27^{\circ} 33' E.$), where at an elevation of 4,200 feet the normal annual rainfall is about 62 inches. Over the Transvaal the amounts vary between 82 inches at Woodbush Forest, in the Zoutpansberg District (lat. $23^{\circ} 51' S.$, long. $29^{\circ} 58' E.$), at an elevation of 4,900 feet, to 18.5 inches at Christiana in the extreme south-west of the province. Over the Orange Free State it is much more uniform, varying from 35 inches in the eastern portion to 18 inches at Jacobsdal in the west; over Rhodesia, from 65 inches at Helvetia (Melsetter) in the east in lat. $20^{\circ} 20' S.$, long. $32^{\circ} 40' E.$, to 14 inches at Tuli in the Limpopo Valley at an altitude of 1,750 feet; in Natal (including Zululand) it ranges from 53 inches at Eshowe ($28^{\circ} 49' S.$, $31^{\circ} 29' E.$), and 51 inches at Qudeni (lat. $28^{\circ} 37' S.$, long. $30^{\circ} 40' E.$, approximately) at an elevation of 5,680 feet, to 25.5 inches at Weenen, (2,840 feet) in lat. $28^{\circ} 52' S.$, long. $30^{\circ} 6' E.$ It is therefore obvious that these widely varying quantities combined with the variations in temperature must cause a considerable diversity of climate over the various parts of the country. Not only does the quantity of rainfall vary considerably over widely separated parts of the country, but stations within a few miles of each other show marked contrasts in the amount of rainfall occurring during the year. Thus the Royal Observatory, near Cape Town, has an annual amount of 25.6 inches, and Bishopscourt, about three miles distant, averages 55.2 inches. Again, George, on the south coast, has a normal annual fall of 31 inches, whilst Ezeljagt, about nine miles to the north-east, but on the other (i.e. the north) side of the Outeniqua Mountains, receives only about 13 inches per annum.

Speaking generally, however, the mean annual rainfall decreases from east to west and from south to north.

Thus, a rainfall of over 40 inches occurs over a narrow

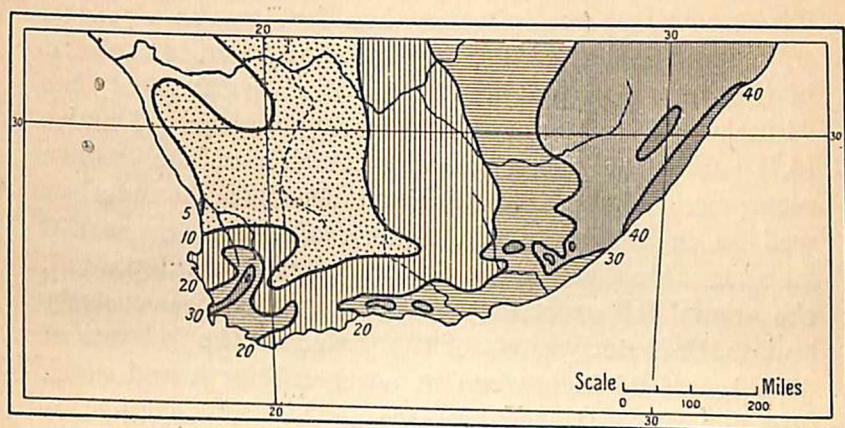


FIG. 13. Mean Annual Rainfall.

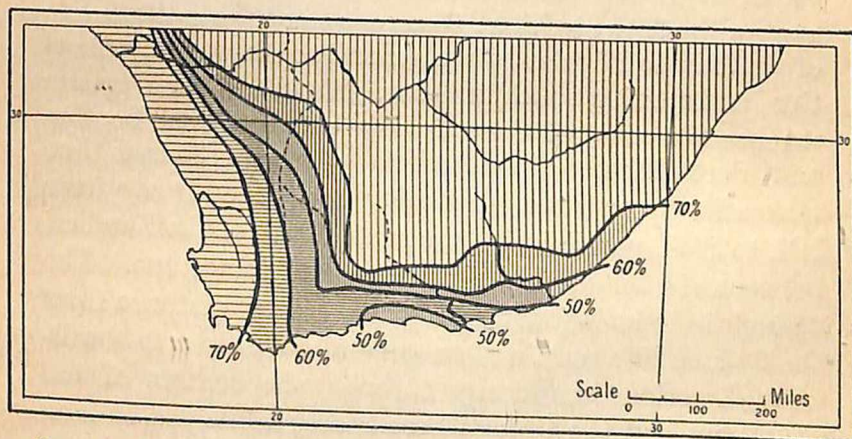


FIG. 14. Proportions of rainfall in summer (perpendicular lines) and winter (horizontal lines).

strip of country along the east coast belt between Port St. John's and Durban, and portions of Zululand and Swaziland have average annual amounts of about 50 inches. The amount of precipitation then decreases in a general way inland to the Drakensberg and the eastern escarpment of the innermost plateau; thus, Durban (260 feet) has 41 inches; New Hanover (2,590 feet), 36 inches; Dundee (4,100 feet), 31 inches. Along the top of the eastern escarpment of the Transvaal and Rhodesia, however, as well as in the mountain regions of Natal, a marked increase takes place in the amount of moisture deposited, the annual fall exceeding 45 inches in the north-easterly and south-easterly parts of the plateau: the isohyets of 45, 40, and 35 inches run in a general north and south direction along the eastern side of the plateau, and are closely crowded together.

Position of
isohyets.

The 30-inch line in Rhodesia starts in about 16° S. lat. and 33° E. long., and at first sweeps in a west-south-westerly direction to the neighbourhood of Sinoia, then turns in a general south-easterly direction to 21° S. lat. and 33° E. long.; over the Transvaal this line oscillates east and west of the 30th meridian, then runs along the western side of the Basuto Highlands in a general south-westerly direction, and turning south in the neighbourhood of Wepener reaches the coast of Cape Colony between East London and Port Alfred. In Rhodesia a second 30-inch line makes its appearance, stretching in a general way from NE. to SW., parallel with the south bank of the Zambezi between the longitudes of Zumbo and Livingstone. The 25-inch isohyet is found at a much greater distance from the 30-inch line running in a general north-east to south-west direction, practically through the centres of the Transvaal and the Orange Free State; while the 20-inch isohyet lies a little to the east of the western boundaries of these two provinces, running south to the neighbourhood of Port Elizabeth. The isohyet of 25 inches in Rhodesia extends at first in a general north-east to south-west direction, roughly parallel with and equidistant from the two 30-inch lines, but forms a wide loop in the south-



west, where it runs a short distance to the south of Bula-wayo and turns north-east to the neighbourhood of Gwelo, whence it extends south-eastwards along the valley of the Nuanetsi, a tributary of the Limpopo. The 15-inch line of equal rainfall in Rhodesia stretches westwards along the northern side of the Macloutsie and Limpopo Rivers from Macloutsie to 31° E. long. This line, which may be considered as roughly separating the semi-arid from the more favoured regions, may be approximately indicated as starting on the 20th meridian in about $23\frac{1}{2}^{\circ}$ S., and sweeping in a general south-easterly direction to the neighbourhood of Campbell (west of Kimberley); thence in a south-south-easterly direction to the neighbourhood of the Fish River to the north of Grahamstown; thence westwards through the Lange Kloof on the north side of the first mountain range parallel with the south coast to the neighbourhood of Worcester; thence up the Hex River Valley to the foot of the Matroosberg; then northwards parallel with the Cedarberg to the neighbourhood of Clanwilliam and afterwards southwards west of Piquetberg to practically the northern shores of Table Bay. To the north and west of this line agriculture requires to be carried on with the assistance of irrigation and the methods of so-called 'dry-land farming'. The most arid part of the country is that part of the Cape Colony west of the Karree and Kamies Bergen between the Olifant and Orange Rivers, and including Great Bushmanland, to the east of the Namaqualand Plateau; here the annual rainfall is less than 5 inches, whilst on the plateau it rises to about 7-8 inches. Another exceptionally dry area is that known as 'The Ghoup' in the west of the Great Karroo, where the rainfall is reduced to about 5 inches.

The wettest portions are the Cape Peninsula, with an average of about 38 inches; and the south-west, which includes the mountainous areas of the Berg River and Wemmer's Hock, already mentioned as having the largest rainfall of all South Africa. In the Cape Peninsula the east side is found to be much wetter than the west or north,

although the excessive precipitation does not extend very far from the neighbourhood of the Table Mountain Range; the rainfall varies considerably over even this limited area, being 87 inches at Maclear's Beacon near the top of Table Mountain, and falling to less than 20 inches at Green Point on the south shore of Table Bay. The driest portion of the south coast is the comparatively flat area between Cape Agulhas and Mossel Bay, where the rainfall is less than 20 inches per annum. East of Mossel Bay, however, the annual fall is much heavier along the coast-belt, exceeding 25 inches at most stations and rising in parts of the Knysna district to over 40 inches.

Seasonal
rainfall.

A composite curve of the average monthly rainfall over South Africa shows that precipitation is at its maximum during March, after which it falls to the minimum in July, rising again to a secondary maximum in November, about three-fifths falling during the six warmest months, October—March. The seasonal distribution varies considerably, however, over different parts of the country, a comparatively small area in the west and south having the major proportion of its total precipitation during the winter months, whilst a still smaller area, along the south coast between Mossel Bay and Cape St. Francis and stretching inland to Uniondale in the Southern Karroo, has a regular or all-the-year-round rainfall; the greater part of the country therefore comes under the influence of a summer rainfall. The 50-per-cent. line separating the summer and winter rainfall areas starts on the west coast about 25° S. lat. and runs in a general south-south-easterly direction to the neighbourhood of Ladismith (lat. $33^{\circ} 29'$ S., long. $21^{\circ} 17'$ E.), after which it turns in a general easterly direction practically parallel with the coast, reaching the coast about Port Alfred (lat. $33^{\circ} 34'$ S., long. $26^{\circ} 54'$ E.).

Examples of these three types of seasonal distribution are given in the table on the next page.

Thunder-
storms.

The summer rainfall area derives the greater part of its precipitation from thunderstorms due to convectional action consequent on intense solar radiation. These storms attain their maximum frequency in February and



reach a minimum in June, there being a secondary maximum in October. It will be noted that the thunderstorm-frequency curve is throughout a month in advance of the rainfall curve, thus indicating that there must be some other cause giving rise to the heavy rainfall in March and November, or at least reinforcing the precipitation caused by thunderstorms. The frequency and intensity of these storms increases from west to east and inland from south to north; thus at the Royal Observatory in the Cape Peninsula there is an average of 13 days per annum on which lightning occurs; at Blaauwkrantz, near the south coast in the Knysna district, there is an average of 16 days; at Colonies Plaats in the Great Karroo, 27 days; and at Johannesburg, 111 days; at

Type.	Place.	Total Yearly rainfall.	Summer rainfall.	Winter rainfall.	Percentage of total in summer.	Percentage of total in winter.
		<i>in.</i>	<i>in.</i>	<i>in.</i>		
Winter rainfall	Royal Observa- tory (Cape Town)	25·65	5·95	19·70	23	77
All the year round	Knysna	28·09	14·62	13·47	52	48
Summer rainfall	East London	34·97	21·67	13·30	62	38
" "	Bloemfontein	22·44	17·20	5·24	77	23
" "	Pretoria	29·44	26·38	3·06	90	10
" "	Durban	40·83	28·61	12·22	70	30
" "	Salisbury	32·78	30·77	2·01	94	6

Durban the average is 23 days, and at Ixopo, further inland, 34 days. Lightning is much more vivid and destructive than in England, several people or cattle being occasionally killed by one flash, while patches of grass are sometimes set on fire from this cause. In the Transvaal alone four years' returns show an average of fifty-three people killed by lightning, twelve being of European and forty-one of native origin.

Precipitation during these storms frequently assumes the form of hail. This occurs mostly in the form of graupel, or soft hail, along the coastal districts; but 'true hail' is of common occurrence in the interior, destroying crops and fruit, even piercing galvanized iron roofs and occasionally killing sheep. The stones are sometimes of considerable size, some having been found to weigh $5\frac{1}{2}$ oz.,

Hail-
storms.

while one actually measured $4\frac{1}{2} \times 3\frac{1}{2} \times 1\frac{1}{8}$ inches. Hail has been observed to lie to a depth of as much as 3 feet in places where it has drifted, and may last a week before being melted.

Destructive hailstorms are of most frequent occurrence in the middle districts of Natal, rendering fruit-growing a very precarious pursuit, in the south-east of the Transvaal and in Kaffraria; in parts of the last area it is usual to protect windows of houses from destruction by means of wire-netting.

Snow.

Snow is liable to occur three or four times in the course of the year at places exceeding 3,000 feet, although it is much more frequently seen on the mountains. Only on very rare occasions is snow to be met with on the flats along the coast, although the coastal mountain ranges are frequently covered during winter. Snow may be seen on the mountain-tops from the end of March to the end of September, but has been noted as late as the last week in December. Although usually occurring over very limited areas, there are occasions on which a large extent of country is affected, as in 1853, 1881, 1902, and 1909, chiefly over the eastern portions of the High Veld, in the neighbourhood of the Drakensberg, extending at times to the Damnamana plateau in German South-West Africa, as in June of 1902. As indicating the comparatively infrequent occurrence of this form of precipitation over the High Veld, in only eleven years in fifty-seven has snow been noted in the Transvaal; whilst on only seven occasions in forty-three years has snow been seen on the face of Table Mountain in the Cape Peninsula.

Winds,
Relief,
and
Rainfall.

Most of the leading features of the distribution of rainfall over South Africa may be readily understood from a consideration of the relation of the principal moisture-bearing winds to the topography of the country, particularly the mountain ranges or steep escarpments of the plateaus; the distance of any station from the sea; and its nearness to the usual paths of barometric depressions; while convectional activity contributes largely to the precipitation over the summer rainfall

area. Thus, in the west the chief rain-bringing winds are from the north-west (the prevailing direction, however, being southerly throughout the year); at Port Elizabeth, from the south-west; at East London, from north-east and south-west, but chiefly the latter, as is also the case at Durban; at Bulawayo the main directions appear to be east, south-east, and south. Over the winter rainfall area the north-westerly winds pass from warmer to colder latitudes, and are further compelled to part with the greater part of their moisture by the elevated ground forming the western boundary of the internal plateaus. They thus pass over the greater part of the country as dry winds, as owing to their originating in the coldest part of the Atlantic, they are unable to absorb any great quantity of moisture or to continue as rain-bearing winds for any great distance inland; hence the small area affected by winter rains.

The area of 'constant rains' is watered chiefly by the south-westerly winds in the rear of the depressions which mainly affect this part of the coast, coming in from the south-west and passing off to the north-east. These winds being deprived of the greater part of their moisture by the first coast range of mountains are unable to cause any heavy precipitation over the Karroos. Moreover, as they are advancing from cooler to warmer latitudes, they themselves become warmer and hence relatively drier, so that they can part with some of the remainder of their moisture only on rising over the mountain ranges or escarpments further inland. Hence it is to be expected that the southern edges of the plateaus will receive a heavier precipitation than the plains further inland. These winds constitute the main precipitating agent of the moisture along the south-east and east coasts.

The greater part of the interior of the area of 'summer rains' owes its rainfall principally to the north-easterly and easterly winds, which coming from the warm, moist latitudes of the Indian Ocean and passing to higher and cooler latitudes, are able to carry their moisture further south and further inland than the south-westerly

winds. Whenever these winds are forced to ascend, as in passing from a lower to a higher plateau, either precipitation will take place in the form of rain or a mist-belt along the edge will be formed, as occurs in Natal and over the eastern slopes of the High Veld. As these winds must be gradually cooled on advancing southwards, they ought to be fairly moist even on reaching the ocean again after crossing the interior. It may be necessary for them to be further cooled by expansion during ascension in such secondary disturbances as give rise to thunderstorms, &c., before they can deposit moisture in the more inland and more southerly parts of the country, a condition possibly largely contributed to by the cool, dry, south-westerly winds. This rainfall is still further increased by occasional deposits from south-east winds and thunderstorms from the north-west. It is therefore evident that along the outer edges of the various plateaus there ought to be a comparatively heavy rainfall, rapidly decreasing inland until the effect of the 'uplift' is lost, when the rainfall is more uniformly distributed; whilst any deep valleys cut by rivers in the plateaus and escarpments will receive but little moisture directly from the winds, but are dependent on convectional action giving rise to thunderstorms. Hence such valleys are apt to be hot in summer and dry, as is the case at Weenen in Natal, where the mean annual rainfall is only 25.5 inches. Port Nolloth, notwithstanding its coastal position, owes its exceptionally small rainfall to the presence of a permanent anticyclone, to westward, close to the coast, the winds from which are dry, whilst this high pressure area prevents depressions passing on to the land, so that Port Nolloth lies out of the track of the disturbances which affect the southern and eastern parts of the country. As showing the dry character of the winds over Namaland, it may be stated that although there is a rise of 1,234 feet in 6 miles between Anenous (1,770 feet) at the base of the plateau and Klipfontein (3,004 feet) near the top, the increase in precipitation is very small, Anenous having 5 inches and Klipfontein 7.9 inches.



Again, during the winter season, the centre of South Africa is occupied by a relatively weak anticyclone, the winds from which blow outwards towards the coast, causing the dry season over the interior and reducing the precipitation in the east. On the other hand, during summer, pressure is lowest over the interior, so that the moist winds from the Indian and Southern Oceans are able to penetrate to the interior. It can therefore be readily understood how these easterly winds over the summer rainfall area ought to be regarded as the moisture-introducing winds, and the cold south-westerly winds as a precipitating agent. 'The Ghoup' owes its small rainfall to both the north-westerly and south-westerly winds having been deprived of their moisture before arriving there by the mountains surrounding it on the north, west, and south sides.

The weather of South Africa, more particularly in the south, is largely due to a series of moving anticyclones passing from west to east, with their associated inverted V-shaped depressions, and to 'secondaries'. Some of the heaviest rains (and occasionally snow) in Natal are derived from Indian Ocean cyclones coming in from the north-east and recurving about the latitude of Durban. Practically the whole of the south and east coast belts are subject to occasional heavy floods, due either to rains of comparatively short duration but of great intensity (4 inches or over per hour), or more prolonged rains totalling 10-17 inches at times in twenty-four hours, both in the Cape Colony and Natal. Heavy falls of short duration occur over practically the whole of South Africa, the intensity at times reaching 10 inches per hour for ten minutes or more.

Unfortunately the greater part of the interior is subject to drought from time to time, should the spring rains fail, a state of affairs liable to be accentuated by a shortage of precipitation during the preceding autumn, as was the case in the recent drought of 1912.

Evaporation from free water surfaces is very large over the whole country, being on the average in the ratio

of about 2·5 inches of evaporation to one inch of rainfall, as compared with an approximate ratio in England of 1·5 inch of rainfall to 1 inch of evaporation.

Föhn winds.

Hot, dry, föhn-like winds blow all along the coast belt from Walfish Bay to Durban, particularly during the winter months in the west and south and at the latter end of winter and spring in Natal, raising the temperature to over 100° and causing a practical inversion of the seasons at times at Port Nolloth.

Dust-storms.

The most disagreeable feature of the South African climate is undoubtedly to be found in the frequent dust-storms which are met with all over the country from about the end of winter, when the anticyclone is beginning to break up, during spring and summer to the beginning of autumn. Fortunately they do not last long and are usually succeeded—over the higher plateaus at least—by rain, mostly from thunderstorms.

Cloud and sunshine.

The mean annual amount of cloud is comparatively low, approximately 38 per cent. for the whole country, being at the maximum in October and the minimum in July. It is cloudiest along the south coast, where it averages 48 per cent., and the skies are clearest over the northern border of the Cape Colony, where the mean amount is only 24 per cent. Generally speaking, July is both the clearest and the driest month of the year. The chief exceptions to this broad statement are the occurrence of the minimum of cloud and of rainfall in January along the west coast, in February over the Cape Peninsula, and in June at Durban; whilst at Johannesburg the clearest days are in August and the least rainfall in June. The mean daily duration of sunshine throughout the year is greatest over the High Veld, amounting to 9·4 hours per day at Kimberley and 8·7 at Johannesburg, being 78 and 72 per cent. respectively of the optima; over the Cape Peninsula the average is 7·5 hours per day or 65 per cent. of the total possible, whilst at Stutterheim in the south-east of the Cape Colony it falls to 6·6 hours per diem. The highest percentage of sunshine over the Cape Peninsula (79 per cent.) occurs in December,



PLATE III (a). UMUNDUSI RIVER, PIETERMARITZBURG



PLATE III (b). CHAPMAN'S PEAK, HOUT BAY (CLOUDS OVER MOUNTAINS)

(High Commissioner for South Africa)

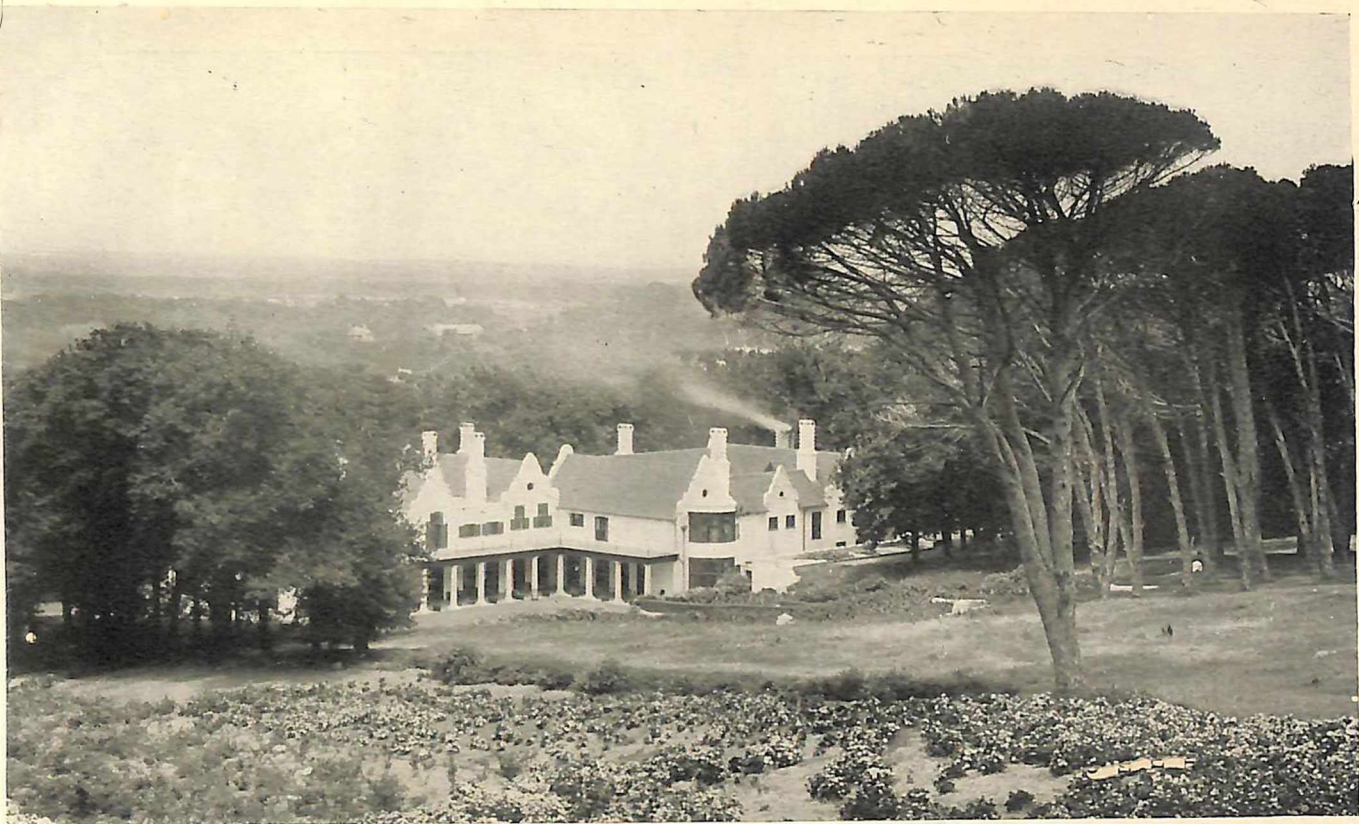


PLATE IV. GROOT SCHUUR
(High Commissioner for South Africa)



and the lowest (51 per cent.) in June and July ; whereas in Johannesburg, the corresponding values are 89 per cent. in August and 58 per cent. in January and February ; and at Kimberley the largest proportion of duration of possible sunshine is 85 per cent. in June and 70 per cent. in February. The sunshine curve is practically the inverse of the cloud curve at these stations. At Johannesburg there is an average of only six sunless days in the course of the year, and at Kimberley this is reduced to less than three. It will therefore be seen that the country is well entitled to the description of 'sunny' South Africa.

[See Alexander Knox, *The Climate of the Continent of Africa*, Cambridge, 1911 ; A. G. Howard, 'The Rainfall of South Africa,' in *Trans. R. S. South Africa*, 1910, pp. 363-90, and other papers ; *Science in South Africa*, Cape Town, 1905 ; A. Buchan, *Rainfall of South Africa*, Cape Town, 1897.]

CHAPTER III

VEGETATION

BY PROFESSOR R. H. YAPP

It is well known that the character of the natural vegetation of any region, and also to a considerable extent the crops which can be cultivated, are largely determined by climate. Soil usually plays a subordinate, but none the less an important part. Speaking broadly, the main types of vegetation (forest, desert, &c.) are dependent on climatic factors, soil factors being more frequently responsible for local differences or developments. Topography is important chiefly by reason of its effect on climate. Of all the factors summed up in the term climate, rainfall has probably the greatest influence on vegetation. Nowhere is this more strikingly seen than in South Africa.

A considerable portion of the rainfall in South Africa is intercepted by the high mountains, which fringe the central table-land, and this tends to increase the general dryness of the climate, especially in the interior. Not only does the mean annual amount of the rainfall vary considerably

Climatic
control.



(as from 86.8 inches on Table Mountain to 0.3 inches at Walfish Bay), but also its distribution throughout the year. In some parts, e.g. the west and south-west, the bulk of the rain falls during the winter months ; in others, e.g. the centre and east, during the summer. Long periodic droughts are frequent, and these, especially when they occur in summer, effectually prevent the development of a luxuriant type of vegetation, even in districts where the total annual rainfall is considerable. Briefly, South Africa is for the most part a country in which, though there are many varieties of climate, the vegetation has to contend, at least periodically, with a scarcity of water. The severity of the climate in this respect impresses itself on the vegetation, which not only lacks luxuriance, but consists largely of 'xerophytes', i.e. plants possessing structural or other peculiarities which enable them to conserve their water-supply. Some of these peculiarities will be referred to later ; they include innumerable devices which facilitate both the obtaining and also the retaining of water by the plant. It is not too much to say that the question of water-supply is the most serious problem which the native plants of South Africa have to encounter.

The vegetation, however, is by no means uniform over the whole of British South Africa, but varies in different parts with every variation of climate and soil. Here we find a true desert, supporting only the scantiest of vegetation ; there wide stretches of grassy steppe, or of country reminiscent of English park scenery ; while only in a few favoured spots do we find any approach to a luxuriant forest vegetation. During the greater part of the year the prevalent hues of the vegetation are dull greyish-greens, greys, and even browns, rather than the vivid greens familiar to dwellers in more favoured climes.

Though South Africa still presents an enormous and attractive field for botanical research, the labours of numerous botanists have resulted in the accumulation of much valuable knowledge of its vegetation, mainly as yet from the systematic and geographical points of view.

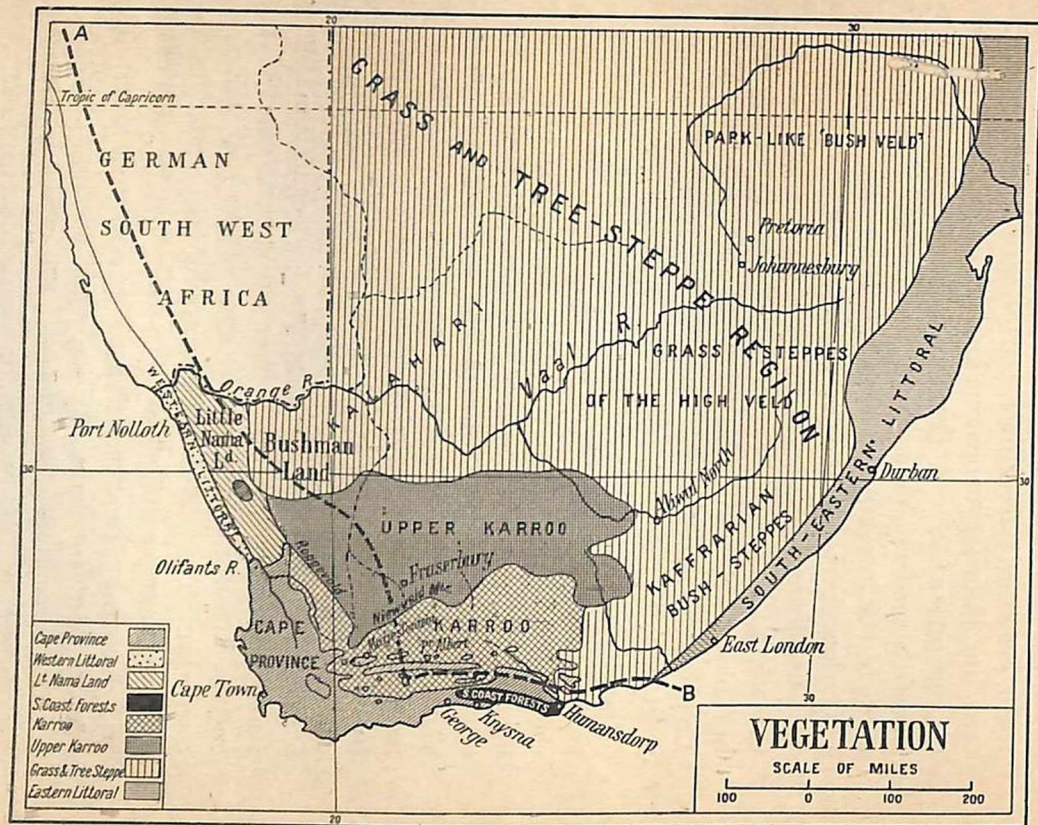


FIG. 15. Vegetation of South Africa.



As a result of the botanical explorations hitherto carried out, it is possible to divide the country into more or less definite floral regions or phyto-geographical provinces. Each possesses as a rule a fairly distinct climate of its own, and in consequence one or more characteristic types of vegetation. These floral regions may now be considered separately,¹ the coastal provinces first, afterwards those of the interior.

The Cape Province.

The south-west corner of Cape Colony,² including the area northwards as far as the Bokkeveld Mountains, and eastwards along the south coast to Humansdorp, is botanically very different from the rest of South Africa. Its flora is also the best known, so it affords a good starting-point.

The total annual rainfall is by no means deficient, the average for the district being about 29.6 inches, though it varies greatly according to locality. But most of the rain falls during the winter (May to October), when the temperature, though mild, is still relatively low. The summer is the dry season, and long droughts regularly recur. Thus the vegetative growing season is compelled to be coincident with the cooler winter months. These climatic conditions have resulted in the production of a peculiar and characteristic type of vegetation. This may be termed 'macchia', from its general resemblance to the macchia of Corsica and other Mediterranean countries. The dominant plants of the macchia are evergreen shrubs some 3 to 6 feet high, usually with small, stiff, leathery leaves. These leaves are essentially 'xerophytic' in character, i.e. they are constructed in such a way as to prevent excessive loss of water. Between the shrubs are many smaller plants, large numbers of which possess bulbs, tubers, or other subterranean organs which store up quantities of water and food substances. On the approach of the dry season the aerial parts wither

¹ The classification adopted here is that proposed by Dr. Marloth in his important work, *Die Kapflora*.

² [The political Cape Province may for present purposes be thus distinguished from the botanical.]



and die, the plants surviving by means of their underground parts. Others have evergreen, fleshy, water-storing leaves or stems above ground ; but though such succulent plants are frequent, they do not form as marked a feature of the vegetation as elsewhere in South Africa.

These features—the generally xerophytic nature of the vegetation ; the dominance of stiff-leaved evergreen shrubs ; the frequency of bulbous, tuberous, and to a less extent of succulent plants—are characteristic also of other parts of the world where the climate is similar. Such are the Mediterranean region and parts of California, Chile, and South Australia, all of which have more or less mild, rainy winters and dry summers. The macchia is widely spread in the south-west of Cape Colony, being especially well developed on the kopjes and foot-hills. But though dominant, it is not the only kind of natural vegetation occurring in the Cape Province. The sandy plains support a dwarf, heath-like vegetation, while marshy hollows, stream margins, mountain ravines, mountain summits, &c., all possess their own peculiar vegetation.

It is an interesting fact that though the macchia of South Africa closely resembles in appearance that of climatically similar areas in other parts of the world, the plants composing it are totally different. Probably not a single native species is common, for instance, to the macchia of South Africa and that of the Mediterranean region. Even the families of plants are largely different. The Cape Province in fact has a highly peculiar flora which, so far as family relationships are concerned, finds its nearest allies in the flora of South-West Australia. As regards the dominant families of plants, there is far greater affinity between the Cape Province and South-West Australia than between the former and the other floral provinces of South Africa. This serves to emphasize the fact that while climate and soil determine the type of vegetation, the actual systematic composition of the flora represented in the vegetation is dependent on quite different causes. Such causes are the power which plants



possess, in varying degrees, of migration (usually when in the seed condition), and of establishing themselves in new areas. Frequently the plants become modified in form, &c., subsequently to migration.

Of the peculiar families especially characteristic of the Cape Province only a few need be mentioned. The Proteaceae, to which belong many of the evergreen shrubs of the Cape macchia, are represented by 262 species. Among them are the well-known silver tree (*Leucadendron argenteum*) of the Cape Peninsula, the sugar bush (*Protea mellifera*), and others. The Restionaceae, a family of grass-like plants which largely take the place of true grasses in this region, though many of the latter occur as well. Most of the known species of these two families are found either in the Cape Province or in South-west Australia. The Ericaceae (heath family) are very numerous and often strikingly beautiful. Of the genus *Erica* alone there are 456 species. Others are the Bruniaceae, Rutaceae, and Iridaceae. The latter are monocotyledones with underground storage organs. South Africa as a whole is extraordinarily rich in tuberous and bulbous monocotyledones, many of which have beautiful flowers. Large numbers are grown as ornamental plants in European gardens.

The
western
littoral.

An arid strip of sandy desert—the only true desert in South Africa—constitutes the western littoral, lying between the sea and the western edge of the central tableland. It extends from Olifant's River northwards into German South-west Africa. The mean annual rainfall is very small, e.g. 0·3 inches at Walfish Bay, and 2·5 inches at Port Nolloth. The result of this deficiency of rainfall is a very scanty, intensely xerophytic vegetation. The plants are stunted and dwarfed, and nowhere form a continuous covering to the earth. Here and there considerable areas are practically devoid of vegetation. The plants include various desert grasses and succulents: the naras (*Acanthosicyos horrida*), a leafless plant with edible fruit, belonging to the gourd family; the inflammable candle bush (*Sarcocaulon Burmanni*), and in one or two spots the most remarkable of all, the unique



gymnosperm, *Welwitschia mirabilis*, which during a long lifetime only produces two pairs of leaves.

The western littoral and the greater part of the Cape Province lie within the area of winter rains. Towards the eastern extension of the latter, however, the rainfall becomes more equally distributed throughout the year, and the summer droughts decrease in severity. As the climate along the south coast thus gradually changes, the bush increases in height and size, culminating in a small tract of luxuriant woodland vegetation in the Knysna district. The forests are developed for the most part on the southern slopes of the Outeniqua and Zitzikamma Mountains and the lands immediately adjoining them, between George and Humansdorp. The climate is here fairly uniform throughout the year. The temperature is mild, the rainfall considerable (e.g. 35.4 inches at George), and both summer and winter are moist. For South Africa the conditions are unusually favourable to plant life, hence the formation of this small area of 'temperate rain forest'. The tallest trees are the two yellow-woods, *Podocarpus elongata* and *P. Thunbergii*. The former sometimes reaches a height of 130 feet. Both of these, and also the stinkwood (*Ocotea bullata*) furnish valuable timber. The black ironwood (*Olea laurifolia*) is the commonest tree; its wood is used for wagon-making, but is excessively hard. Under the trees is a profusion of ferns and other shade-loving plants, while numbers of orchids and ferns are found growing on the trunks and branches of the trees themselves. Climbers (especially *Cissus Capensis*) are also abundant.

The south-eastern littoral is a narrow strip of low-lying land beginning at East London, and occupying the south-east coast of Cape Colony and the east coast of Natal. The climate is subtropical, and more than 60 per cent. of the total rainfall occurs during the summer months. The vegetation is more tropical in character than that previously considered. Mangrove swamps occur in some of the river estuaries, two species of palms are found, and nine species of cycads. The families so characteristic of the



Cape Province (Proteaceae, &c.) are but poorly represented, while the Rubiaceae, Asclepiadaceae, and others more typical of the African and Indian tropics, are abundant. Many tropical economic plants, too, such as the sugarcane, tea, banana, pine-apple, and mango, are cultivated with success. This province is probably to a large extent a southern and maritime extension of the great tropical African region.

The
interior
provinces.

So far the coastal provinces have been briefly considered. We must now turn to those which occupy the more elevated interior of British South Africa. These are two in number, and constitute a vast upland area of steppe country of varied nature, known to colonists as 'the Veld'. Here again rainfall plays the part of a master factor in determining the character of the vegetation. Broadly speaking, the line separating these two provinces may be drawn from Little Bushman Land in the north-west nearly to Aliwal North in the east, thence south to Humansdorp. We have then (a) the central region, to the west and south of the line, a semi-desert area of dwarf shrub- and succulent-steppe. It includes the Karroo and allied areas; and (b) to the north and east of the line an extensive area of grass- or tree-steppe, extending far northwards into the tropics.

The
central
province.

The central province comprises the Karroo, most of which lies to the south of the Roggeveld and Nieuweveld Mountains; the Upper Karroo (mostly above 4,000 feet) to the north of these ranges, and Little Nama Land as an extension to the north-west. The whole province is situated in Cape Colony. Though less arid than the western littoral, the central province is everywhere a region of low rainfall. Thus Beaufort West has about 9.7 inches, Prince Albert 11.4 inches, and some parts even less. The rains too are very uncertain, and occasionally even a whole year may pass without rain. In the Upper Karroo snow falls abundantly in the mountains, and ice is frequently formed even on the plains. It is thus no matter for wonder that the vegetation should be everywhere of a semi-desert character, or



that plants other than pronounced xerophytes should be unable to establish themselves. Small trees, such as the thorny *Acacia horrida*, and a few others, fringe the mostly dry river beds of the Karroo, elsewhere they are practically absent. The greater part of the country supports only a sparse and incomplete covering of stunted, skeleton-like bushes (about 1-3 feet high) or smaller plants, coloured grey or brown like the stones. Thorny plants, succulents, bulbous, and tuberous plants abound. On the advent of the rains innumerable tiny annuals spring up everywhere. Within a few weeks they have grown to maturity and have produced flowers, fruits, and seeds. As the effect of the rain passes off, these ephemeral plants wither and die, their seeds alone persisting through the ensuing drought. Here, as everywhere, Nature is never tired of exhibiting her versatility and fertility of resource. Every variety of device for obtaining and conserving water may be observed. Some plants, especially the shrubs, have deep root-systems which can obtain supplies of subterranean water. Others have their roots scarcely buried in the earth, and so can make use of light showers and even of the dew. Many have tiny, reduced leaves, of varied structure, but always such as to lessen the output of water. Others again store up large supplies of water in fleshy, succulent stems or leaves, or even in underground tubers or bulbs. Finally, we have the delicate desert ephemerals, whose active life does not extend beyond the brief rainy season. Thus the native plants of this region form silent, but none the less eloquent, witnesses to the severity of the climate. That drought and not a want of fertility of the soil is responsible for the prevailing paucity of vegetation, is evidenced by the fact that where irrigation is possible, rich crops may be cultivated.

The succulent plants are worth further consideration. Many of these are well-known in European cactus houses, where they are popularly but erroneously known as 'cacti'. The mistake is not unnatural, as some of the South African succulents (e.g. stapelias and euphorbias) bear extremely close resemblance in form to the quite



unrelated true cacti. The latter (family Cactaceae) are almost confined to the climatically similar regions of Mexico and other parts of the New World.¹ This again illustrates the principle that similar life-forms are called forth by similar climatic conditions, even though these occur in centres geographically remote from each other. Among the succulents, too, occur a number of highly interesting plants, which closely resemble in form and colour the stones and rocks among which they grow. Dr. Marloth suggests that these plants may derive in this way some protection from herbivorous animals. One of the most striking is *Mesembrianthemum calcareum*. The leaves of this plant are set with projecting knobs, and both the plant and the limestone on which it grows are of a whitish colour sprinkled with dark brown. So complete is the deception, says Dr. Marloth, that no artist could imitate the stones more perfectly. The colonists call these remarkable plants 'flowering stones'.

In some parts of the country succulent plants predominate, and it is possible to speak of a 'succulent-steppe'. In others we find a 'dwarf shrub-steppe', with but few succulents. But in most parts of the area the various plant-forms grow intermingled in varying proportions; always, however, with intervals of unoccupied bare ground.

As regards the dominant plant families of the central province, the Compositae come first, and this is especially true of the Upper Karroo. Leguminosae, Ficoideae (genus *Mesembrianthemum*), Liliaceae, Crassulaceae, &c., are all abundant, and contain many highly peculiar forms. Grasses (Gramineae) are frequent, but nowhere form the dominant feature of the vegetation, as they do on the grass-steppes.

The grass-
and tree-
steppe
region.

By far the largest of the phyto-geographical provinces is the grass- and tree-steppe region, which occupies part of the east of Cape Colony, most of Natal, the Orange Free

¹ The prickly pear (*Opuntia*), which is widely spread over the drier parts of Africa, belongs to this family, but has been introduced into the Old World by man.



State, the Transvaal, Bechuanaland, and a large part of Rhodesia. The eastern part of the province (including the Orange Free State and most of the Transvaal) forms a great elevated plateau, 4,000 feet or more above sea-level. This plateau has an average rainfall of between 20 and 30 inches. Towards the west (the Kalahari) the elevation is considerably less, and the climate is drier. At Upington, for example, the annual rainfall is only 8.7 inches. Most of the province lies within the area of summer rains, the winter being a season of drought. As regards temperature, part of the region is actually within the tropics. In the eastern parts, however, the effect of an approach towards the tropics is largely neutralized by increasing altitude. Thus over much of the Transvaal the warm summers permit of the cultivation of tropical annuals, such as tobacco, &c., but tropical perennials, e.g. bananas, pine-apples, &c., are injured or even killed by the low winter temperatures.

In general it may be said that the vegetation of the grass- and tree-steppe region differs from that of the central province less in any radical change in the plant-forms present, than in the relative abundance of the various types. Thus trees, shrubs, grasses, succulents, bulbous and tuberous plants occur in both provinces, but the numerical importance of these respective forms varies greatly. In the central province dwarf shrubs and succulents are the dominant plant-forms. Grasses are present but play a subordinate rôle, while trees are practically absent except along the water-courses of the Karroo. On the other hand, grasses and trees are the dominant plant-forms in the region now under consideration. Many succulents occur, however, especially on the stony kopjes. Bulbs and tubers are abundant in both. The long winter droughts impose on the plants a necessity for a generally xerophytic character, and even on the grassy steppes there are often patches of bare soil between the individual plants. The trees mostly shed their leaves during the dry winter season, thus contrasting with the ever-green 'macchia' of the Cape Province. The great

grass- and tree-steppe province may be subdivided as follows :

(a) *The Kaffrarian district*, to the east of the Karroo, including Eastern Cape Colony and the middle terraces of Natal. Considerable areas are occupied by a grass- and bush-steppe, while in many parts arborescent aloes and other succulents are common, especially on the rocky kopjes. *Anthistiria imberbis* is one of the commonest grasses, and acacias, especially *A. horrida*, the dominant trees.

(b) *The High Veld* of the Southern Transvaal, the Orange Free State, and the upper terraces of Natal. In this district, trees (*Rhus viminalis*, acacias, &c.) fringe the water-courses, shrubs occur on the kopjes, but the greater part of the country is covered by a treeless steppe. Grasses (*Anthistiria*, &c.) are here the dominant plants, though many other small herbs occur between them.

(c) *The Kalahari* in the west, comprising Bushman-land and a great part of Bechuanaland.¹ This area is much drier than the eastern portions of the province : it is, however, not a true desert, though often loosely referred to as such. For the most part it consists of a tree- or bush-steppe, with numerous grasses ; succulents (e. g. *Aloe dichotoma* and *Euphorbia Dinteri*) abounding wherever there is rocky soil. The Kalahari is closely allied to the Bush and High Veld, differing from them chiefly in the scantier vegetation, and the absence of species dependent on a more ample water-supply.

(d) *The Bush Veld*, which occupies much of the Northern Transvaal, Southern Rhodesia, and parts of Bechuanaland. For the most part the country presents a park-like appearance, being covered by a grassy vegetation, rising above which are trees with spreading crowns. Sometimes the trees are few and scattered, at others they are more abundant, and forest of an open character results. Such is the so-called ' teak forest ' of Rhodesia. This vegetation is closely allied, both as regards its general character and

¹ Some phyto-geographers have used the term Kalahari in a wider sense than that employed here.



also the actual plants which occur, to the steppe regions of Central Africa. Some Central African trees (e.g. *Dombeya densiflora*) occur even as far south as Johannesburg. An interesting local development of luxuriant evergreen rain forest is found immediately around the Victoria Falls of the Zambezi, under the influence of the ever-present mist and spray.

The natural vegetation described above has been much modified by human agencies. Directly by axe, fire, and plough, and indirectly by the introduction of herds of grazing animals, man has altered the extent, and in some cases even the character of the native vegetation. The macchia of the Cape Province and the forests of the Knysna district are undoubtedly less extensive than formerly. Veld-burning, universally practised, probably from time immemorial, by the natives all over South Africa, must profoundly affect the vegetation. Trees and other exposed plants suffer severely from these veld fires. Others, e.g. bulbs and tubers, are not adversely affected at all, as the fires usually occur during the dry season, when such plants are resting beneath the surface of the earth. There is little doubt that by discouraging other plant-forms, the frequent veld fires are at least partly responsible for the enormous number of individuals of this type of plant in South Africa. But in spite of human interference, the greater part of British South Africa is still covered by vegetation which is largely natural.

The influence of man.

[In addition to Marloth's work above quoted, see G. Henslow, *South African Flowering Plants*, London, 1903; Sir W. T. Thistleton-Dyer, *Flora Capensis*, London, 1896-1900; D. E. Hutchins, *Transvaal Forest Report*, Pretoria, 1904; B. Stoneman, *Plants and their Ways in South Africa*, Cape Town, 1906; T. R. Sim, *Forests and Forest Flora of the Cape of Good Hope*, Aberdeen, 1907; J. M. Wood, *Handbook to the Floral of Natal*, Durban, 1907; J. W. Bews, *The Vegetation of Natal*, Pietermaritzburg, 1912.]



CHAPTER IV

FAUNA

BY W. L. SCLATER

Zoo-geo-
graphical
relations.

SOUTH AFRICA forms a portion of the Ethiopian region, one of the six primary regions into which the land areas of the world have been divided for the study of the distribution and the interrelations of the higher forms of animal life. The Ethiopian region includes within its limits the whole of Africa south of the Tropic of Capricorn, the corresponding portion of Arabia, and Madagascar with its dependent island groups. There has been some difference of opinion in regard to the division of the Ethiopian region into sub-regions, but there can be no doubt that Madagascar and its islands, and the West African forest region, form two distinct faunal areas, while there is a good deal of uniformity in the fauna of the rest of the country from the Cape to Somaliland and thence to Senegambia. We may, therefore, for the present purpose consider South Africa to form a portion of the great East African sub-region of the Ethiopian region.

As regards the past history of the Ethiopian region as a whole, the recent discovery, in deposits of Eocene age in the Fayum of Upper Egypt, of the remains of a number of extinct forms of mammalian life, has introduced into the problem of the origin of the African fauna a new set of data. Up to that time what may be called the Huxleyan theory of radiation had held sway. According to this theory, the Ethiopian region had been colonized by two great immigrations; an earlier one in Eocene or early Miocene times, while Madagascar still formed part of the continent, brought in the lemurs and other primitive forms which make up the present fauna of that island, of which age only a few scattered remnants have survived in Africa proper; while a later immigration, which took place in Pliocene times, introduced the antelopes, hippo-



potamus, rhinoceros, zebras, ostriches, apes, and higher carnivora, which now form so conspicuous a feature of the fauna of Africa, and have still living or recently living representatives in Southern Asia.

Most of the ancestors of these forms have been traced back to the earlier Tertiary deposits of the northern hemisphere, but hitherto no ancestral forms of the Proboscidea (elephant group) have been met with of earlier date than the mastodons of the Miocene and Pliocene times, and these have been found in America as well as in the Old World. Recent exploration in the Fayum district in Egypt, by Mr. Andrews of the British Museum, has resulted in the discovery of a number of interesting Eocene types which throw a fresh light on the earlier evolutionary stages of several mammalian orders. Perhaps the most remarkable form is one named by him *Moeritherium*, a very generalized type of Proboscidian, with a full series of front teeth and an almost complete set of molars all in use at the same time, thus differing widely from the modern living forms. Nevertheless, the modern type is foreshadowed not only in the shape and structure of the teeth, but also in the enlargement of the second pair of incisors in each jaw ; an enlargement which continues to be more and more marked in geologically succeeding types until it culminates in the tusks of the modern elephant. From these facts and many others it appears probable that although some components of the Ethiopian fauna may have been evolved in the northern continents and have reached Africa by migration, other groups, such as the Proboscidea, have more probably originated in Africa itself.

The first settlement of the Cape dates from 1652, when van Riebeck landed and took possession of the country in the name of the Dutch East India Company. His journal, which has recently been republished in English, contains many references to the larger animals which then abounded in the immediate neighbourhood of the little fort which subsequently became known as Cape Town. Hippopotami wallowed in the swamps, and herds of eland, harte-

History of
zoological
discovery
in South
Africa.

beest, and kudu ranged over the wooded slopes of Table Mountain. Lions were numerous and gave much trouble to the early settlers, while there is a well-known story that when the governor, the elder Van der Stel, was making a journey of exploration northwards in 1685, his coach was upset by a charging rhinoceros, and he himself had a narrow escape.

Zoological exploration, however, did not really begin till the end of the eighteenth century, when two Swedish travellers, Sparrman and Thunberg, pupils of the great Linnaeus, went to South Africa for the special purpose of collecting specimens of the fauna and flora. Their travels, as well as those of the eccentric Frenchman Le Vaillant, who devoted himself chiefly to birds, are among the classics of early zoological exploration. In 1795, with the advent of the English, a fresh stimulus was given to investigation, both geographical and zoological, and with this period the names of John Barrow and Burchell must always be associated. The latter, who landed at Cape Town in 1810, penetrated into the interior as far north as Kuruman in Bechuanaland, and made very extensive collections of animals as well as plants. The accounts of his journeys and explorations appeared in 1822-4 in two large quarto volumes, and are a monument of his exact and methodical observations. In the second and third decades of the nineteenth century our knowledge of the South African fauna was much advanced by the researches of Sir Arthur Smith, who occupied a position in the Army Medical Service. His travels extended as far north as Kurrichane, the capital of the Zulu chieftain Mozelekatze, near the head-waters of the Limpopo, and eastward to Durban, which was founded about that time. His collections were described and illustrated in four large quarto volumes, published in 1849, dealing with mammals, birds, reptiles, and fishes respectively. A new incentive was given to the study of South African zoology by the founding of the South African Museum in 1855, and the appointment of Mr. E. L. Layard as curator. He devoted himself chiefly to the study of ornithology, and in 1867



published the first complete work on South African birds. His successor, Mr. Roland Trimen, chiefly occupied himself with the Lepidoptera and made many interesting researches in regard to the questions of mimicry, dimorphism, and seasonal variation, and their relation to questions of evolution and natural selection. Of recent years, perhaps, the most fruitful of investigations has been that which was undertaken for the benefit of the British Museum at the expense of Mr. C. D. Rudd and under the direction of Mr. Oldfield Thomas. The work of collecting was entrusted to Mr. Claude Grant, who spent nearly five years (1903-7) at various selected localities in South Africa, ranging from Namaqualand to the Zambezi. The collections resulting have been described in the *Proceedings of the Zoological Society* and in the *Ibis*.

Africa is without question the chief home of the larger Mammalia forms of animal life. No other continent possesses such an assemblage of the larger herbivores as is formed by the elephant, rhinoceros, giraffe, buffalo, hippopotamus, and the various genera of the larger antelopes. On the other hand, the deer family (Cervidae), with their deciduous antlers, are conspicuously absent from the Ethiopian region. It is difficult to find a satisfactory explanation of this, but the deer certainly appear to have originated at a somewhat later period than the antelopes, and were perhaps hardly sufficiently highly-organized to take part in the great Pliocene immigration which peopled the Ethiopian region with most of its larger and more conspicuous types.

In South Africa to-day, although the numbers of individuals are undoubtedly much reduced since the settlement of the interior during the last hundred years, there are still to be found representatives of all the larger characteristic Ethiopian animals. We can easily realize how the plains of the interior of South Africa appeared to the eyes of Gordon Cumming and Cornwallis Harris in the 'forties and 'fifties by comparing their narratives with the appearance of the Athi plains of British East Africa at the present day. Even in Cape Province, however,

beest, and kudu ranged over the wooded slopes of Table Mountain. Lions were numerous and gave much trouble to the early settlers, while there is a well-known story that when the governor, the elder Van der Stel, was making a journey of exploration northwards in 1685, his coach was upset by a charging rhinoceros, and he himself had a narrow escape.

Zoological exploration, however, did not really begin till the end of the eighteenth century, when two Swedish travellers, Sparrman and Thunberg, pupils of the great Linnaeus, went to South Africa for the special purpose of collecting specimens of the fauna and flora. Their travels, as well as those of the eccentric Frenchman Le Vaillant, who devoted himself chiefly to birds, are among the classics of early zoological exploration. In 1795, with the advent of the English, a fresh stimulus was given to investigation, both geographical and zoological, and with this period the names of John Barrow and Burchell must always be associated. The latter, who landed at Cape Town in 1810, penetrated into the interior as far north as Kuruman in Bechuanaland, and made very extensive collections of animals as well as plants. The accounts of his journeys and explorations appeared in 1822-4 in two large quarto volumes, and are a monument of his exact and methodical observations. In the second and third decades of the nineteenth century our knowledge of the South African fauna was much advanced by the researches of Sir Arthur Smith, who occupied a position in the Army Medical Service. His travels extended as far north as Kurrichane, the capital of the Zulu chieftain Mozelekatze, near the head-waters of the Limpopo, and eastward to Durban, which was founded about that time. His collections were described and illustrated in four large quarto volumes, published in 1849, dealing with mammals, birds, reptiles, and fishes respectively. A new incentive was given to the study of South African zoology by the founding of the South African Museum in 1855, and the appointment of Mr. E. L. Layard as curator. He devoted himself chiefly to the study of ornithology, and in 1867



published the first complete work on South African birds. His successor, Mr. Roland Trimen, chiefly occupied himself with the Lepidoptera and made many interesting researches in regard to the questions of mimicry, dimorphism, and seasonal variation, and their relation to questions of evolution and natural selection. Of recent years, perhaps, the most fruitful of investigations has been that which was undertaken for the benefit of the British Museum at the expense of Mr. C. D. Rudd and under the direction of Mr. Oldfield Thomas. The work of collecting was entrusted to Mr. Claude Grant, who spent nearly five years (1903-7) at various selected localities in South Africa, ranging from Namaqualand to the Zambezi. The collections resulting have been described in the *Proceedings of the Zoological Society* and in the *Ibis*.

Africa is without question the chief home of the larger Mammalia forms of animal life. No other continent possesses such an assemblage of the larger herbivores as is formed by the elephant, rhinoceros, giraffe, buffalo, hippopotamus, and the various genera of the larger antelopes. On the other hand, the deer family (Cervidae), with their deciduous antlers, are conspicuously absent from the Ethiopian region. It is difficult to find a satisfactory explanation of this, but the deer certainly appear to have originated at a somewhat later period than the antelopes, and were perhaps hardly sufficiently highly-organized to take part in the great Pliocene immigration which peopled the Ethiopian region with most of its larger and more conspicuous types.

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SOUTH AFRICA

there are still two herds of wild elephants, one in the Knysna forest, the other in the Addo bush near Port Elizabeth, while there are also a fair number to be found in the wilder parts of Rhodesia. Both the species of rhinoceros found in South Africa belong to the Atelodine group of the genus, distinguished by their single horns, comparatively smooth skins, and by the absence of canine and incisor teeth in the adults. The larger species, generally called the white, but better the square-lipped rhinoceros, is, after the elephant, the bulkiest of land animals now living. It was formerly abundant all over the grass country to the north of the Orange River ; now it is on the verge of extinction, and only a few examples are known to survive in Zululand. It was formerly thought to be confined to Africa south of the Zambezi, but has been recently met with in the upper White Nile districts near Lado. The common or black rhinoceros is a smaller species, and can at once be distinguished by its prehensile upper lip, which is produced into a short proboscis. It is still fairly common in the more remote parts of South Africa.

The African antelopes number about 150 species, and of these about 35 have been found in South Africa: an unrivalled assemblage, ranging from the lordly eland to the tiny bluebuck. The spread of settlement and increase of population, and perhaps even more the keen hunting instinct of the South African Dutchman, have sadly diminished the numbers of these beautiful creatures, but notwithstanding this, only one species has entirely died out. This is the blaawbok of Swellendam, which was closely allied to the roan antelope of Rhodesia and East Africa. It appears to have always had a limited range in the south-west corner of Cape Province, and to have become extinct at the beginning of the nineteenth century. On the other hand, several species, such as the bontebok and the wildebeest or white-tailed gnu, have only survived through the efforts of individual enthusiasts who have fenced in large reserves on farms for their preservation. Of late years several government reserves have



been formed where no shooting is allowed, or at all events the killing of larger animals is carefully controlled. The largest of these, in the eastern part of the Transvaal, is known as the Sabi reserve, extends from the Crocodile River to the borders of Rhodesia, and has been in existence since 1892.

It is impossible here to mention the various species of antelopes. Perhaps one of the most characteristic is the springbok (*Antidorcas euchore*). The genus contains only the single species and is confined to South Africa. It is distinguished by a curious fan of long hairs down the middle of the back which the animal can raise or depress. It lives in vast herds, which are subject to periodical migrations or treks, the causes of which are obscure, though probably due to climatic conditions.

The buffalo, the giraffe, and the hippopotamus are still to be met with in the more remote parts of South Africa ; the last named is far from uncommon on the Zambezi near the Victoria Falls, and has been the cause of many accidents to the canoes and boats of tourists visiting the Falls.

The South African carnivora are numerous both in individuals and species, and out of eleven families usually recognized there are representatives of seven. Curiously enough the bears (*Ursidae*) are entirely absent from the African fauna. The lion was formerly abundant over the whole of South Africa, and in the earlier days of the settlement at the Cape was a constant source of annoyance and danger. It is now found only in the remoter districts of Rhodesia and the Transvaal. The leopard, called *tijger* by the Boers, is far more plentiful. It inhabits the rocky hills and kopjes, and only comes out at night to prey on the sheep of the farmer, and to this it owes its survival even in the neighbourhood of Cape Town. Among the smaller carnivora are the wild cats, cheetah, civet, genet, meerkat, hyena, ratal, and many others.

The group of monkeys is not very numerously represented in South Africa ; this is easily accounted for by the scarcity of forest country. The best-known form is

undoubtedly the baboon or bavian (*Papio porcarius*), often called in Europe the chacma, a name unknown in South Africa, though said to have been derived from its original Hottentot appellation. Baboons are found in open country and especially among the rocky hills which form so prominent a feature of South African scenery ; here they live in troops, issuing forth at earliest dawn to rob the farmer's orchards and gardens, for which they are universally execrated. The other monkeys belong to the genus *Cercopithecus* and are confined to wooded districts of the south and east coasts. The lemurs, whose head-quarters are in Madagascar, are represented by several species of galago found in the more wooded districts of Natal, the Transvaal, and Rhodesia. The Rodentia are represented by numerous species of rats and mice, a few squirrels, the rodent moles, a porcupine, and several species of hares ; the Insectivora by the golden moles, whose fur has a beautiful metallic sheen, and the elephant shrews, which sit up on their hind quarters like a kangaroo and have a long tapering snout from which they derive their name. Finally, among the Edentata the aardvark (*Orycteropus*), with its congener from North-East Africa, constitutes a family so distinct from the others of the order as in the opinion of many to require separate ordinal accommodation. The most remarkable feature of these creatures is in the structure of their molar teeth—they have no others—these are made up of a number of columns of dentine, each with its separate pulp cavity packed together to form a solid tooth. No other mammal has teeth in any way comparable to the aardvark, nor have we as yet any clue to its ancestral history.

Birds.

With the possible exception of the butterflies, the birds form the most closely studied and best known components of the South African fauna. A recently published checklist by Messrs. Gunning and Haagner enumerates 920 species as occurring in Africa south of the Zambezi. While it is improbable that many actual new forms of bird life remain to be discovered in South Africa, our knowledge of the life history and distribution of many



of the species is imperfect, and there remains for the field ornithologist plenty of scope for the observation of the migratory phenomena, food habits, and nesting habits of the South African birds.

As regards migration we have in South Africa two very distinct groups of migratory birds. On one hand there are the birds which breed in Europe in the summer of the northern hemisphere, and come as far south as South Africa during the northern winter. Most conspicuous among these is the common barn swallow, the lesser grey shrike, the white stork, and the cuckoo. These reach South Africa about October and stay till March, and with one or two exceptions are not known to nest in South Africa, although this is the breeding season of most of the South African birds. There is another group of migratory birds such as the stripe-breasted swallow and some of the cuckoos (*Cuculus gularis* and *C. solitarius*) which arrive apparently from the north about the same time as the European migrants and breed. During the winter season—April to September—they are absent and presumably wintering in Central Africa. There are also many birds which are resident throughout the year, or are only subject to local movements of which we are at present woefully ignorant.

Among the birds peculiar to South Africa are the long-tailed sugar birds (*Promerops*). They appear to have been specially modified for existence and to be conterminous in their distribution with the plants of the natural order Proteaceae, which form so characteristic a feature of South African plant life. Other groups, such as the bush shrikes, the plantain-eaters (*Muscophagidae*), and the colies (*Coliidae*), are equally characteristic though found elsewhere in the Ethiopian region.

South Africa possesses many birds remarkable in their sexual and breeding relations. The great-tail widow bird (*Coliuspasser procne*), commonly called the Sekabuli by the Kaffirs and the colonists, is one of these. It is one of the only polygamous passerine birds. It lives on the open grassy plains, and in spring each male, accompanied by



ten or twelve females, selects a suitable spot for nesting in the long grass. Here each hen builds a separate nest, while the cock watches the proceedings from some vantage spot ready to warn the hens of approaching danger and to drive off intruders. The breeding habits of the hornbills are even more remarkable. In this case the male plasters up the breeding hole into which he has introduced his mate, so that only a very small aperture is left through which the bill of the female is protruded. Here she remains a prisoner for some six weeks until the eggs are hatched and the young are feathered, while the male brings food for her and the young birds. Still more interesting are the honey-guides (*Indicatoridae*). Of dull plumage and appearance, they are remarkable for the fact that they will lead the traveller to the situation of a wild bees' nest in the hope of sharing with him some of the spoil in the shape of wax or honey. In addition to this they are undoubtedly, like cuckoos, parasitic in their breeding habits, and deposit their eggs in the nests of other birds.

Finally South Africa contains a representative of the *Ratitae* or wingless birds, all of which are now confined to the southern hemisphere. This is the southern ostrich (*Struthio australis*), restricted to Africa south of the Zambezi. It has become a domesticated bird throughout the greater part of Cape Province and is bred and kept for the sake of its plumes, which are annually pulled or cut.

Reptiles
and
batrachians.

In a list of South African reptiles and batrachians drawn up by the present writer some time ago, about 290 species were included; to these a certain number of additional species must now be added.

Of the crocodiles only one species has been met with; this is the same species as is found in the Nile and in other parts of tropical Africa. It is confined to the rivers flowing into the Indian Ocean from the Zambezi to Pondoland, and is unknown in the western streams. It probably seldom exceeds a length of more than 15 feet.

Land tortoises and lizards are numerous, but present no specially interesting features. The snakes number

nearly a hundred species, of which about twenty-two are reported to be poisonous. Notwithstanding this, instances of fatalities resulting from snake bites are exceedingly rare, and very few cases came to the knowledge of the writer during twelve years' residence in South Africa. Among the commoner species is *Naia flava*, the yellow cobra, widely distributed through South Africa, and common enough in the neighbourhood of Cape Town. Like the more familiar Indian species, the neck can be flattened out and widened to form the hood, but it can be at once distinguished by the absence of the so-called spectacle marks. The justly dreaded mamba (*Dendraspis*) is only found in Natal and the low country of the east. It is more of a tree snake than the others, and sometimes reaches a length of ten feet. The younger specimens are green, and as they grow older they get darker, but there are no grounds for distinguishing the black and green mambas specifically. Among the viperine snakes the commonest and most dangerous is the puff-adder (*Bitis arietans*), an ugly reptile of yellowish and orange brown. Though seldom reaching a length of more than four feet, it is of great girth. Its habits are inert and sluggish, and it is justly held in great fear on account of its generally fatal bite.

South Africa is not rich in batrachians. Of the three orders only the tailless frog-like Anura are represented. They number some thirty-six species, and are distributed among four families. The largest of the South African frogs is *Rana adspersa*, which often attains a length of eight inches. It is common in the eastern half of the Cape Province and in the Transvaal, and has a very loud croak. An interesting form is *Xenopus laevis*, a very distinct type, with no tongue and with claws to some of the hind toes. It is far more aquatic in its habits than any other frog, and seldom leaves the water.

A few lines must be devoted to the interesting remains of extinct reptiles which have been found in South Africa in various strata of Karroo formation. These probably correspond to the beds of Permian and Triassic age in

Extinct
reptiles.

Europe. The remains of these extinct types are comparatively abundant and well preserved, and are of special interest as it was in these times that the great radiation took place which gave rise to the various orders of reptiles as well as to the more primitive forms of mammals and birds, and it is among these fossils that the clues of the ancestral history of all the higher types of vertebrate life will probably be found. The lowest of the Beaufort beds contains the remains of a number of heavily built land reptiles of which the most prominent and best known form is *Pareisaurus*. This large reptile measured about nine feet in length and stood about three and a half feet in height. The head is broad and flat above, and the temporal region completely roofed over. There are fourteen to sixteen fairly equal flattened teeth with notched edges in each jaw. The limb bones and vertebrae are very massive, and are specially interesting as they resemble the bones of mammals more than of reptiles. *Pareisaurus* was probably a slow-moving animal that lived in the marshes of the great island sea of the time. A nearly complete mounted skeleton is to be seen in the Natural History Museum in London and another in the Museum at Cape Town. *Dicynodon* is another interesting genus of mammal-like reptiles, so called from the large upper canine teeth which form tusks while the rest of the margin of the jaws is covered with horn as with tortoises. Apart from the jaws and teeth, the bones of the skeleton have a striking resemblance to those of mammals. The *Dicynodons* were probably sluggish animals which lived in the marshes and fed like tortoises. A somewhat later form from the uppermost of the Beaufort beds is *Cynognathus*, a large carnivorous creature about the size of a hyena. The skull and most of the bones of the skeleton are almost typically mammalian. The teeth are divided into incisors, canines, premolars, and molars. There is a well-developed secondary palate, and the lower jaw is formed almost entirely by the dentary. The quadrate bone is rudimentary, and though the hinge of the lower jaw is still (as in reptiles) between the quadrate and the



articular, the dentary almost reaches the articulation. The skull is also (as in mammals) supported by condyles.

Our knowledge of these interesting reptiles is derived from the researches of Sir Richard Owen and H. C. Seeley, and at the present time more especially to the work of Dr. R. Broom of Johannesburg, who has published numerous papers in various South African and other journals on the subject.

The paucity of fresh-water fishes in temperate South Africa is remarkable ; it is doubtless caused to a certain extent by the scarcity of permanent rivers and lakes. Many of the rivers, especially in the western and drier half of South Africa, only contain water during the rainy season, or even in some cases for a few hours after a rain-storm, so that most of the fishes have to be able to adapt themselves to these conditions in order to survive.

The family most largely represented in the fresh waters of South Africa is the carp family (Cyprinidae), and most of the species are related to the widely-distributed genus *Barbus* ; all of them are somewhat sluggish forms, and have barbules dependent from the jaws ; Boulenger in his catalogue enumerated thirty-six species from the various rivers of South Africa south of the Zambezi. The only other family of numerical importance is the Siluridae, containing the cat-fishes. One species, first discovered by Burchell and named *Clarias gariensis*, attains a considerable size. It is known as the 'plattekop', and is not uncommon in the deep pools of the Orange and Vaal Rivers, where it lies on the mud. It is of rather forbidding aspect with a scaleless shining body, and a broad flat head bearing eight long barbules. An interesting fish is *Spirobranchus capensis*, not very distantly allied to the perch of English waters. It has a complicated accessory breathing organ, in the cavity of which it retains a little water enabling it to live for some time in the open air or enclosed in dry mud. Finally, mention may be made of a little fish of the genus *Galaxias*, which was first made known from South Africa by Steindachner of Vienna, when describing Holub's collection. It is an

insignificant little fish, seldom exceeding four or five inches in length, and appears to be confined to the south-western districts of Cape Colony. It belongs to a distinct family with rather distant relations to that of the salmon. Its more particular interest is that the members of the genus and family are confined to the fresh waters of the southern hemisphere, the species being distributed in Chile, New Zealand, Tasmania, Australia, and South Africa; and on this account it has been used as an argument for the former connexions of the lands of the southern hemisphere with one another at some remote geological epoch. That some such connexion did once exist seems probable, but most of the arguments seem to point to its having been pre-Tertiary at any rate, and there are but few arguments in favour of any land bridge between the Cape and Patagonia on the one hand, or the Cape and Australia or New Zealand on the other, having been in existence since the appearance and dispersal of the higher terrestrial forms of vertebrate life.

Insects
and other
inverte-
brates.

In the warmer parts of South Africa one of the most remarkable features of the landscape is the large smooth mounds of earth made by the termites or white ants. All the species are not mound-builders, but many of them form an important factor in the economy of many other insects which feed on them. Termites, especially the winged forms which swarm out of the mounds in countless numbers during the early rains, form the greater part of the food of countless insectivorous birds and even mammals, while many other animals find a secure home within the nests themselves.

Butterflies (*Rhopalocera*), though not numerous in species—about 370 are described—are well known chiefly through the investigations of Mr. R. Trimen, but they have formed the basis of some interesting investigations in regard to mimicry and polymorphic forms by Mr. G. A. K. Marshall and others.

The *Diptera* are little known, but among them is the dreaded tsetse (*Glossinia morsitans*), which is the carrier of the blood parasite trypanosome from the wild to

domestic animals, and causes the fatal *nagana* disease, making it impossible to use horses and cattle in the 'fly country'. Recently it has been shown that the same species of *Glossinia* is able to convey the trypanosome of sleeping-sickness equally as well as the other species (*G. palpalis*), but hitherto sleeping sickness is unknown south of the Zambezi.

Mr. Peringuey estimates that the number of species of insects found in South Africa cannot be less than 40,000, and that of these the Coleoptera alone have more than 15,000 representatives. Finally, South Africa is the home of a little animal of extraordinary interest to all zoologists, named *Peripatus*. It is a small caterpillar-like creature which lives under stones and rotten wood along mountain streams, and perishes very quickly when exposed to the dry air. Its special interest lies in the fact that it has structural characters allying it on one hand to the air-breathing Arthropods such as the insects, and on the other hand to the Annelids or worms.

The following is a list of recent general publications on South African zoology: Bibliography.

1. MAMMALS. *The Mammals of South Africa*, by W. L. Sclater; two vols., London, 1900-1. 'A Revised List of the Mammals of South Africa,' by E. C. Chubb, *South African Journal of Science*, vol. vi (1910), pp. 129-42 (contains references to all papers relating to South African mammals since the publication of the previously mentioned work).

2. BIRDS. *The Birds of South Africa*, by A. C. Stark and W. L. Sclater; four vols., London, 1900-6. 'Check List of the Birds of South Africa,' by W. L. Sclater in the *Annals of the South African Museum*, vol. iii, pp. 303-87 (1905). 'A Check List of the Birds of South Africa,' by Dr. J. W. B. Gunning and A. Haagner, in the *Annals of the Transvaal Museum*, vol. ii (1910).

3. REPTILES AND BATRACHIANS. 'List of Reptiles and Batrachians of South Africa,' by W. L. Sclater, in the *Annals of the South African Museum*, vol. i, pp. 95-111 (1898). 'A Revised List of the South African Reptiles and Batrachians, with Synoptic Tables,' by G. A. Boulenger, in the *Annals of the South African Museum*, vol. v, part 9 (1910).

4. FRESH-WATER FISHES. *Catalogue of the Fresh-Water Fishes of Africa* in the British Museum, by G. A. Boulenger; two vols. (incomplete), 1909-11.

5. INSECTS, &c. *South African Butterflies*, by R. Trimen and J. H. Bowker; three vols., London, 1887-9. 'Descriptive Catalogue of the Coleoptera of South Africa,' and many other papers on South African entomology, published in the *Transactions of the South African Philosophical Society*, and in the *Annals of the South African Museum*. Papers on 'South African Spiders and Scorpions', and on *Peripatus*, by H. Purcell, are also in the same journals.



CHAPTER V

AGRICULTURE

BY A. D. HALL

Climate
and agri-
culture.

THE agriculture of South Africa is very largely determined by the distribution and extent of the rainfall; the two distinct climatic conditions which prevail—of summer and winter rains—result in vital differences in the crops that can be grown. As the climate and topography of the region have been dealt with elsewhere, it will be sufficient here to indicate the districts which can be said to have special agricultural characters and the climatic factors to which they are due.

Coast
plateau of
Cape Pro-
vince.

The earliest settled and best known of these districts is that of the coast plateau in the neighbourhood of Cape Town from about Olifant's River on the west coast as far east as Port Elizabeth, the northern boundary being the Zwartbergen Range beyond which begin the plateaus of the Karroos. This region is distinguished from the rest of South Africa by receiving the greater part of its rainfall in winter; the precipitation varies considerably, from Cape Town northwards up the west coast it becomes progressively less until in Namaqualand desert conditions prevail. In the Cape Peninsula itself the rainfall rises to about 40 inches, and this zone extends inland with local variations in the rich valleys by Stellenbosch, the Paarl, Worcester, and Swellendam. Eastwards a drier region succeeds, but from Mossel Bay the higher rainfall again sets in and gives rise to the forest region of the Knysna. Port Elizabeth may be taken as the limit of the winter rains, beyond it the prevailing rainfall occurs in the summer.

Cereals.

It is in this district that agriculture proper of a comparatively advanced order chiefly prevails. The winter rainfall permits of the growth of all the European cereals, wheat, barley, oats, and maize. Where the winter is too



dry to permit of these cereals growing until the spring and the rains, though they then grow with great rapidity owing to the moisture and rising temperatures, they become liable to rust and fail to yield a paying amount of grain. By irrigation alone in regions of summer rain can the plant be established before the winter and carried through the period of drought ; it is then so far advanced as to be little liable to serious damage from rust. The chief wheat-growing areas are Clanwilliam, Malmesbury, and Tulbagh, but a certain amount is also cultivated in the eastern districts.

The most characteristic feature, however, of the agriculture of the coast plateau is the cultivation of the vine and fruit. The vine was introduced by the earliest Dutch settlers in 1653, the government wine farm at Constantia being founded as early as 1680. The best districts are the Cape Peninsula itself, Worcester, Montagu, Ladysmith, and Oudtshoorn. The most valued soil in the Wynberg country is a deep loam derived from granitic rocks, in the other districts a vein of red marl known as the kalksbank. The routine of cultivation followed corresponds closely with that adopted in Europe, and the yield is large, up to 600 gallons per 1,000 vines. At one time Cape wine was extensively exported and possessed some reputation in Europe, but the English market for cheap wines is now mainly supplied from Australia, California, &c., and, since the phylloxera attacked the vines, very little Cape wine is sold as such in this country. The vines have been re-established on phylloxera-proof stocks, but sufficient care has not been taken in the growth and storage of the wine, the quality of which was further reduced by blending and fortification of inferior wines with brandy. Of late years much more attention has been paid to the manufacture of wine, and many are now produced, both Hermitage (claret type) and Drakenstein (hock type), that are fit to export. The price obtained, however, is still very low, and the chief market is in South Africa itself. From the inferior wines a good deal of brandy is distilled. The vine-producing

Wine and fruit.

districts with their winter rainfall are also eminently suited to the growth of European fruits, apples, pears, plums, and peaches, and of late years a considerable export trade has been built up, the fruit being sent over in cold store and sold in England in the early spring months, at a time when little other soft fruit is available. The peach was already widely distributed, having been taken all over South Africa by the Dutch settlers, but this so-called Cape peach is small and of little value for export. Peaches and plums of European origin have generally proved too soft for transit, but the greatest success as far as the export trade goes has been obtained with varieties from California, though the plums have probably their origin in Japan. The peaches are extremely handsome fruit, but most characteristic are the very large and solid plums—Kelsey and Wickson—which are unlike any others reaching the English market. Though the growth of these soft fruits is confined to the districts about Stellenbosch and Worcester and the Hex River valley, nearly the whole of South Africa grows very good oranges, in which an export trade has begun. The old Dutch farm, even far to the north of the Transvaal, always possessed its orange grove and peach orchard. The South African orange or naartje belongs to the mandarin type with an easily detached skin, but climate and soil are suitable to the growth of all types, and many plantations of the larger varieties have recently been established. In Natal and the warmer portions of the Transvaal all varieties of citrus, as for example the grape fruit, grow with great freedom. While dealing with the export trade in fruit we may mention that the warm coast lands of Natal also produce pineapples, small, though of excellent flavour.

Tobacco. An increasing amount of tobacco is grown in the valleys near Oudtshoorn and Swellendam; this is not, however, the typical characteristic Boer tobacco grown in the hill country near Pretoria, nor does it resemble the fine cigarette tobacco grown from Turkish seed in Rhodesia.



PLATE V (a). KEERONSBURG, HEX RIVER VALLEY

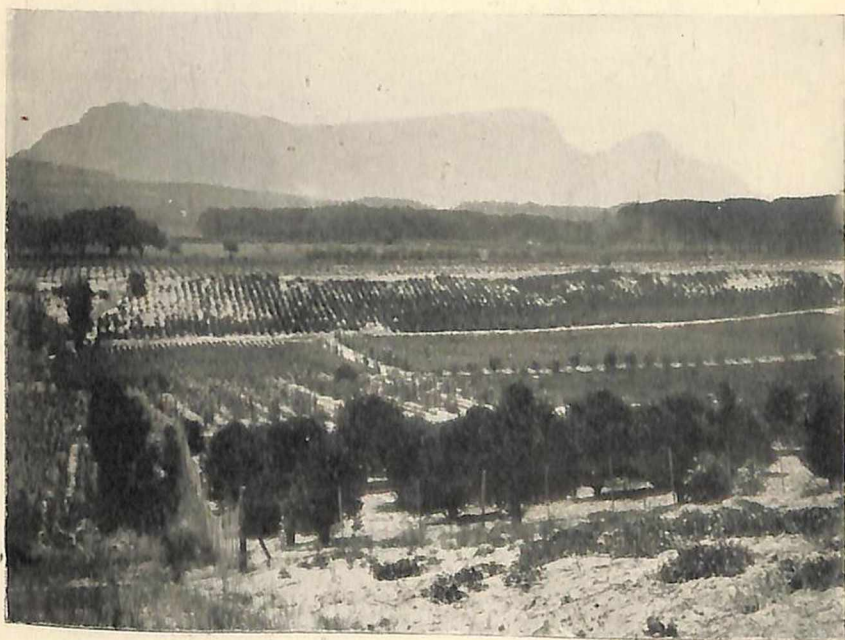


PLATE V (b). FRUIT FARM, CONSTANTIA DISTRICT
 (High Commissioner for South Africa)



CSL



PLATE VI. BIGGARSBERG, HIGH VELD
(High Commissioner for South Africa)



Immediately north of the coast plateau in the Cape Province come the Karroos, dry plateaus, the southern being about 2,500 and the Great Karroo about 4,000 feet above sea-level, which differ entirely in character from the veld, the more elevated plateau which occupies the interior of South Africa as far as the Zambezi. The rainfall is very low, 10 to 15 inches, and the whole area burns up to a desert in the early summer. The vegetation, however, consists in the main of various flowering plants and small bushes, among which species of mimosa and other leguminous plants predominate, and this vegetation, even when in a dry and twig-like condition, affords excellent grazing for stock, provided they can obtain access to a supply of drinking water. Except where one of the rivers can be used for irrigation, under which the Karroo soil proves remarkably fertile, the only agriculture practicable with the limited amount of water which a farmer can store in a dam is sheep and goat farming, and large flocks are still maintained in this district, a merino cross being the usual type of sheep. From 3 to 10 acres per sheep are required unless the farm possesses some irrigated land to serve as a standby in the time of drought. The Karroo is also the true home of the ostrich; though ostrich-farming has extended into many other districts they are still most numerous about Oudtshoorn. Ostriches are allowed to graze in large wired-in camps, each bird requiring about 20 acres, though cattle at the rate of two to every three ostriches may with advantage also occupy the land. An ostrich yields from 1 to 2 lb. of feathers every year, of which the price averages about £2 per lb., not a large return, but the birds require no artificial food except when the drought is prolonged, and little attention except at the breeding time. Attempts have been made to introduce ostrich-farming into other countries, as Australia and California, but with little success; the karroo bush is a much more suitable food than grass and the best feathers are produced where the ostriches roam over a wide area. Recently ostrich-farming has proved

The
Karroos.

remarkably profitable ; the price of feathers has advanced, and the introduction of lucerne as a fodder crop for the birds has greatly extended the capacity of the land to carry ostriches.

Eastern
districts
of Cape
Province.

The eastern districts of the Cape Province share in the winter rainfall of the Cape Town area as far east at least as Port Elizabeth. The climate is dry, however, and though maize, fruit, and in some districts tobacco are grown with success, the agriculture of this region mainly depends upon the production of wool and mohair. The export of wool, however, from the Cape no longer possesses its former importance in the London market. This has been entirely due to the inroads of disease, first of all scab and then the prevalence of redwater and other tick-borne diseases have both reduced the sheep population and deteriorated the quality of the wool. One result of the late war in the central and eastern provinces was a great distribution of cattle diseases of all kinds owing to the breakdown of fences, the intermingling of clean and healthy stock, and the general neglect. Much of the land is unhappily infected with ticks, and these have been proved to be the intermediate hosts of a number of blood parasites of a fatal character. Nothing but the strictest isolation, constant dipping in arsenical washes to keep the animals free from ticks, burning off long grass, and other methods of keeping down ticks, can ever free the country of these diseases. Unfortunately the process is slow, and the individual who takes up the task seriously may find all his labours nullified through the carelessness or apathy of a neighbour, even though the latter may be coerced by government into remedial measures.

Passing eastwards and northwards along the coast towards East London the climate of the coast plateau changes, and though the total rainfall is higher its effect is low because so much of it falls in heavy thunderstorms during the summer months. The vegetation is markedly xerophytic, many of the plants being armed with severe thorns. The agriculture resembles that of the eastern districts, sheep providing the chief sources of revenue,



until towards the Natal border the climate finally becomes too hot for sheep.

Still farther north in the coast belt of Natal we enter a semi-tropical country, though for the tropics the rainfall is comparatively low, little more than 40 inches at Durban. The vegetation still possesses a xerophytic character, but many plants characteristic of the warmer countries now flourish, as for example bananas, guavas, loquats, sugarcane, sweet potatoes, tea, and coffee. There is a considerable local trade in fruit and vegetables, though little is exported, and this industry is tending to fall into the hands of Asiatic emigrants from the Madras coast. There are several sugar factories, but the climate both in heat and humidity does not permit as rapid a growth as is obtained in typical cane-growing countries, and the local produce only maintains itself against the competition of Mauritius sugar through the help of protective duties and differential railway rates. About 6,000 acres are under tea, the centre of the industry being Kearsney, about 40 miles north of Durban; the yield compares favourably with that of India and Ceylon, but with the high cost of labour the product is not available for export. Coffee is not grown commercially in Natal, and cotton has not as yet been successful on a commercial scale, but indigo has been grown for some time and the acreage is now being considerably extended. Inland towards the great escarpment which forms the edge of the central plateau—the high veld—the land rises into an undulating country, somewhat drier and much colder than the coast belt, suitable for most classes of farming but still in the main pastoral. Mealies (maize) and Kafir corn (millet) are the chief crops, but on the foothills one of the most notable agricultural enterprises is the growth of the Black Wattle, introduced from Australia, for its bark, which when dry contains 30–40 per cent. of tannin. Some 50,000 acres are under wattle in the colony; it may be cut after 8–10 years growth, and after barking the timber is sent on to the mines. The very rapid growth of many of the Australian species of

Eucalyptus and Mimosa when introduced into South Africa has been remarkable, even on the driest soils of the veld. Eucalyptus have been known to grow to a height of 80 feet in eight years. The native forests have been supplemented by the plantation of considerable areas of Eucalyptus to supply the railway sleepers and pit wood, for which there is an enormous demand, one that has already denuded the country of most of its indigenous timber of any size. In the neighbourhood of Cape Town, European trees grow freely, oak and elm for example, though the wood ceases to have much value ; the Stone Pine again has become one of the most characteristic features of the Table Mountain landscape.

The High
Veld.

The most distinctive as well as the most extensive agricultural area in South Africa is the Veld, the elevated plateau approached from Cape Province by crossing the Nieuwveld Range to the north of the Great Karroo and bounded on the east by the great eastward-facing escarpment ranging from Griqualand to the borders of Natal, through Zululand and Swaziland to the Zoutspansberg and further north still. The Veld proper is an undulating plateau of gentle slopes increasing in elevation from west to east up to 11,000 feet on the Natal border. The rainfall similarly increases from west to east, from the absolutely desert conditions which prevail in Namaqualand and the Kalahari desert to a rainfall of over 35 inches in Basutoland and the elevated country adjoining the escarpment. The greater part of the rain falls in the summer ; the winter is cloudless ; towards November fall the first 'ploughing' rains, and the precipitation increases in January and February. In the winter night frosts occur, though more than 10° or 12° F. below freezing point are rarely registered. The soil of the veld is mostly a red gritty soil full of small nodules of iron-stone ; sour 'brak' soils containing alkaline salts occur in patches, and 'vleis' are not uncommon, depressions covered with a tenacious black soil rich in organic matter and alkaline in reaction. The veld soils are easy to work and powdery, when they have once been brought under



cultivation, but in their natural state they set with a very hard crust. Chemically speaking, they are deficient in humus and are also short of carbonate of lime. The typical veld is covered with coarse tufted grasses showing the bare earth between ; there is no close matted sward such as is found in Western Europe, and with the closest attention to grazing it is difficult to obtain a real turf. Growth is exceedingly rapid as soon as the rains begin, and a luxuriant vegetation springs up immediately, but during the long drought of the winter the land carries little that affords any nutriment to stock. On the better land the grasses put on a characteristically red aspect, the ' rooi ground '. In the Transvaal the country below 4,000 feet in the basins of the Olifant's and the Limpopo rivers is generally covered by scrub and is known as the Bush Veld, but much of it is not healthy and has not been settled like the High Veld. All over the Veld water is scarce, the smaller streams only run during the rains, and the farmer must depend upon water collected by a dam to carry his stock through the dry season. Only in the neighbourhood of the larger rivers can irrigation be practised, but where the land can be put under water it becomes extremely fertile and large crops can be grown.

Under these conditions the agriculture is very largely of a pastoral character, sheep being more abundant in the Orange Free State and cattle further north, the proportion of cultivated land being comparatively small. The typical Boer farm was of great extent, 2,000–10,000 morgen, over which the cattle ranged at will and were only occasionally rounded up and selected for breaking-in to the ox teams, sale, or slaughter. Close to the homestead the native boys who were allowed a location on the farm cultivated a few acres of mealies (maize), paying over half the crop as rent, and this with the patch of peaches and oranges constituted the only cultivated land on the holding. The farmers' wants were few. Coffee and sugar were purchased on the occasion of the annual trek to the seat of government ; latterly, as native labour grew more scarce, imported condensed milk was also

Pastoral
character
of Veld
agricul-
ture.



purchased because of the difficulties involved in maintaining and milking a herd of cows in enclosed paddocks close at hand. This primitive pastoral farming was rudely shaken by the arrival of the rinderpest in 1896-7, followed by the ravages of the tick-borne diseases, redwater and East African coast fever, which were widely disseminated through the war. The operation of these diseases not only reduced the cattle stock of South Africa to a very low ebb, but made the old method of allowing cattle to run semi-wild over large areas impossible. The cattle had to be confined so as to be able to isolate healthy stock and prevent the transmission of disease from one herd to another; moreover, constant dipping and attention are needed to destroy the ticks which carry so many of the South African cattle diseases.

Dry
farming.

The losses they had suffered and the difficulties attending cattle rearing turned the attention of many of the veld farmers to the raising of crops, and in spite of the deficient rainfall, it has been found that the land can be made very productive by applying the principles of 'dry farming', i.e. continuous cultivation to keep the surface loose but at the same time to consolidate the lower soil after it has once been broken up, so as to render available to the plant whatever water may have been stored in the land. Under this system wheat is beginning to be grown, with some success; on irrigated land oats are grown to be cut for green fodder or for hay, but the staple crop is maize (mealies). Considerable attention has been given to the selection and distribution of improved varieties of maize by the various departments (now consolidated in the Department of Agriculture of the Union of South Africa), with the result that after supplying the local demands, and they are considerable because the chief food of the natives employed in the mining compounds is maize, a valuable export trade with Europe has been built up. The Department of Agriculture puts on sale at all railway stations standard maize bags for export, it grades and inspects the consignments of each farmer, watches over



the transit and conducts the sale in the European markets, where in consequence of the careful inspection South African maize now commands the leading prices. The other cereals grown are various forms of millet or Kafir corn, but none of them command more than a local sale. In the east of the Orange Free State and especially in Basutoland, the increased rainfall and the lower summer temperatures permit of the growth of wheat in the ordinary way, and as varieties suitable to the climatic conditions are evolved, this upland area will become the granary of South Africa.

The chief desideratum for veld farming is a fodder crop ^{Veld fodder crops.} that will remain green during the dry and cold winter; the natural grasses, however nutritive during their spring growth, leave nothing but a harsh tuft of dry grass of low nutritive value during the winter, hence the cattle have either to get through this season in a greatly reduced condition or be hand-fed with maize stores, oats, hay, &c., grown on the cultivated land during the summer. The difficulty of establishing a continuous turf is accentuated by the habit which has long prevailed of burning the veld towards the close of winter before the first rains fall. This practice gets rid of the old weathered tufts and enables the stock to bite the first young shoots; it also helps to reduce the number of ticks, &c., but it tends to kill out the finer grasses and by destroying so much carbonaceous matter and nitrogen compounds which should find their way back to the soil it steadily reduces the fertility of the land. None of the native grasses has proved very amenable to cultivation, nor do any of the European grasses answer well except perhaps Cocksfoot in a few favoured localities, but with careful sowing and after management true pastures providing some winter keep have been established with New Zealand tall Fescue, *Paspalum dilatatum*, and *Phalaris bulbosa*. Lucerne has proved difficult to establish on the dry veld, but where there is some moisture below, and especially on irrigated land, it yields enormous crops of very valuable fodder.

Stock-
farming
and
diseases of
animals.

One of the greatest difficulties from which South African farming suffers is the prevalence of disease among all kinds of domestic animals, diseases which are nearly all kinds of domestic animals, diseases which are nearly always contagious, though they are more generally caused by some blood parasite instead of the bacteria more common in Europe and America. Horse-breeding has long been one of the chief agricultural industries, the country being very suitable for the production of a tough and hard-working pony or cob. The country, however, has been repeatedly ravaged by what is known as horse-sickness (*paard-ziekte*), and in recent years many parts of the country have become uninhabitable by horses owing to this cause. Horses that recover become immune, and a method of immunization has been worked out and is now in widespread operation, but it will be a long time before the country becomes really healthy for horses. In the low-lying and warmer districts, as in parts of Zululand and the bush veld and all over tropical Africa, horses are liable to a trypanosome disease (*nagana*) distributed by the bites of the tsetse-fly, and horse-keeping is practically impossible in the regions where the fly occurs. Mules are also affected by both horse-sickness and *nagana*, though not to the same degree, and donkeys, which are bred to some considerable extent in Bechuanaland, are to all intents and purposes immune. Glanders is another horse disease very prevalent in South Africa, against which again a vaccine has been prepared. It has already been mentioned that cattle have suffered greatly from recurring attacks of rinderpest and other diseases. Of these rinderpest caused the greatest mortality; in some districts it was estimated that 90 per cent. of the cattle died, and the antelopes and other big game suffered equally, so that South Africa was suddenly deprived of the greater part of its meat supply. Rinderpest, however, is a plague that sweeps through a country and does not recur for some time; far greater disaster to the cattle industry is wrought by the diseases for which certain species of grass ticks act as carriers, the so-called redwater and East African coast fever. Cattle



sometimes recover from the former, but the latter is almost invariably fatal. A preventive vaccine has been prepared against redwater, but the stamping out of East Coast fever depends on the preliminary eradication of the tick. Other tick-borne diseases exist, and cattle in South Africa also suffer from anthrax and blackwater; animals freshly imported from Europe are particularly liable to attack, and particular care should be taken to get them through the early months after their arrival by preventive vaccinations and great care to keep them free from ticks. Dipping the animal in some arsenical solution at comparatively short intervals, even every three days, has proved the only way of killing off the ticks before they can inoculate the animal with the disease, and if such a plan were adopted by every one for a few years there is every reason to suppose the diseases conveyed by the tick might be suppressed entirely, because the parasite must die out if the necessary cycle of transmission from insect to animal and back again to insect is broken. Another difficulty with imported cattle arises from the presence in the veld vegetation of various poisonous plants, tulips, which acclimatized cattle have learned to avoid or to eat with impunity. The typical South African cattle belong to the long-horned dun-coloured Afrikaner breed, doubtless in origin a mixed race containing a considerable infusion of oriental blood, one result of which may be seen in the distinct hump they still possess. The Afrikaner stock has been much crossed, most generally with the black and white Frisian or Holstein cattle, but also with various British breeds, and through the necessity of renewing the cattle stock of the country after the war, a number of pure-bred herds of European origin have been established. But for the rougher grazing, and especially in the hotter northern districts, a large proportion of Afrikaner blood is considered desirable. Sheep-farming, which, as mentioned above, forms an important part of the industry of the eastern districts of the Cape Province, is also general in Orange Free State towards the east and in the higher

and cooler districts of the Transvaal. The native Cape sheep is a hairy thick-tailed animal, and doubtless has formed the foundation of many of the colonial flocks, which are now, however, typically Merino in character. Since the war other breeds have been introduced, Shropshires, Suffolks, &c., from Britain, and Persian and other oriental breeds from the hotter parts of Africa. Sheep in South Africa are also subject to a number of diseases besides scab, several of them being transmitted through ticks like the cattle diseases. Goats are numerous in South Africa and will thrive on poor land where sheep cannot exist. They are most numerous in the Karroo, but are also common in the Orange Free State and the Transvaal, a considerable export trade in mohair resulting therefrom. The most valued breed is the Angora.

Agricultural prospects.

It will thus be seen that South Africa as an agricultural country suffers from many disabilities that are not experienced in other parts of the world that are being opened up for settlement. In America, both north and south, in parts of Australia and New Zealand, it has been possible to grow crops of wheat and thus pay immediately for the cost of clearing and bringing the land under cultivation and preparing it for more intensive forms of agriculture. Even when the country was too rough or too dry for wheat-growing, cattle and sheep would thrive when ranging with a minimum of attention, and thus has laid the agricultural foundations of New Zealand, parts of Australia, and North America. Owing to the prevalence of disease in both animals and plants, neither resource has latterly been open to the South African farmer; moreover, the presence of a native population creates a feeling against the white man labouring with his own hands, yet the demand from the mines has raised the price of Kafir labour to a point the farmer finds difficult to pay. The market gardening and *petite culture* in the neighbourhood of large towns like Johannesburg has fallen almost entirely into the hands of poor Portuguese and of Indian immigrants in Natal. No great extension of irrigated land is possible because of the



absence of ranges of mountains furnishing a perennial supply of water. The agricultural ventures which seem to promise most brightly from the point of view of an export trade are the maize-growing of the veld country, orange-growing on all the warmer and better watered lands, the tobacco-growing of the Magaliesberg district in the Transvaal and the Oudtshoorn district in the Cape Province, ostrich-farming in the Karroo, and the fruit-growing of the favoured districts at no great distance from Cape Town.

Further reference to the economic position of agricultural industries will be found in the following chapter.

CHAPTER VI

ECONOMIC CONDITIONS AND COMMUNICATIONS¹

BY THE HON. SIR RICHARD SOLOMON.

SOUTH AFRICAN agriculture² has never received so much attention as is now being paid to it, although judged by the volume of output in relation to the immense possibilities of the country the industry can only yet be regarded as in its infancy. A country with a population of nearly 6,000,000 (black and white), which imports food-stuffs to the extent of £6,500,000 sterling per annum, has still a good deal of leeway to make up before its position as an agricultural country can be said to be at all satisfactory. Nevertheless, despite the peculiar conditions of the Union, such as the difficulties of transport, the unprogressive

Economic position of agricultural industries.

¹ The Editors desire to acknowledge, as well on their own behalf as on that of the late Sir Richard Solomon, the collaboration, in this chapter, of the following authorities: On the agricultural and other industries except that of mining, and on commerce, the Customs Department of the Union; on the mining industry, Mr. Warrington Smyth, Secretary to the Department of Mines; on railways, ports, and harbours, Mr. Hoy, General Manager of the South African Railways; and on posts and telegraphs, Mr. Wilson, Postmaster-General of the Union.

² The distribution of agricultural industries and crops, and a review of the general agricultural conditions, are discussed in the preceding chapter.



methods of much of the rural population, and the deplorable prevalence of animal diseases, development during recent years has been fairly satisfactory. Unfortunately, there are no reliable statistics available regarding the acreage under cultivation prior to union, but there are over 4,250,000 acres under crops of one kind and another, in addition to vineyards, orchards, and vegetable gardens, in extent 12,000 acres. The total area of arable and pasture land actually in commission amounts to more than 180,000,000 acres. Of the cultivated land, there are about 1,000,000 acres under irrigation.

Particular industries, such as the production of sugar, wheat, maize, wool, ostrich feathers, and wattle bark, have in each case during recent years reached their highest level.

Sugar.

In 1907 the output of sugar from the Natal plantations was returned at 35,000 tons; in 1911-12 the crop had increased to 90,000 tons, and with the opening up of the rich alluvial sugar lands of Zululand it is more than possible that the planters will soon not only supply the entire sugar consumption of the Union (which amounts approximately to 130,000 tons), but will have a surplus for which an outlet will have to be sought in the markets of the world.

Ostrich-farming.

An industry which is closely allied to that of agriculture, and ranks high in the order of importance of South African exports, is that of ostrich-farming. Feathers to the value of £2,253,000 sterling were exported during 1911, representing a total weight of 826,992 lb. The number of birds in the Union is approximately 750,000, the greater portion of which are owned in the Oudtshoorn, Albany, and Uitenhage districts of the Cape Province.

Tea.

The tea industry of Natal has had since 1862 a precarious existence. Capital to the extent of £250,000 sterling is invested in the business, and upwards of 6,000 acres, producing from 1,000 to 1,500 tons of tea, are at present in full bearing.

Wine.

The wine industry is almost exclusively confined to the Cape Province, where there are upwards of 4,000 wine



farmers. The annual value of the output is estimated at £250,000 and the value of the wine converted into brandy and spirits at £208,000. The export of Cape wines amounts to little more than £13,000 per annum. It is interesting to note that between the years 1841 and 1850 these wines enjoyed a considerable preference on the English market, with the result that the value imported into Great Britain during that period amounted to about £470,000. For the following ten years the figures had risen to over £800,000, but with the withdrawal of the preference the trade gradually dwindled to the most insignificant proportions. The census figures of 1904 showed a total production of over 5,500,000 gallons. In 1911 the amount had increased to 7,500,000, practically the whole of which, in the form of either wine or spirits, finds a ready sale in the country. There is still considerable room for expansion (apart from an export trade, which at present, however, is more or less out of question), seeing that European wines are also imported to a considerable value.

In regard to maize, for the growth of which South Maize. Africa is peculiarly suited, there has been rapid development on every hand. This has been mainly due to the facilities which have existed since 1907 for export. In that year, by arrangement with the shipping companies, it was made possible for maize to be loaded up at the railway station nearest the farm and carried to Europe at a total cost of approximately £1 per ton. During the first year, 46,000 tons were exported under this arrangement, but the two following years (1909-10) witnessed a very considerable increase, the export reaching as much as 178,000 tons, valued at nearly £700,000. Owing partly to dry seasons and to the more extended use of the grain locally for feeding purposes, the two years following showed a slight falling off in export. The total yield of maize during 1911 was 770,000 tons, compared with 360,000 tons in 1904.

The production of wool and mohair has always been one Wool and of the most promising of South African industries. There mohair.

are nearly 31,000,000 sheep of all classes in the Union, which is double the number disclosed by the census figures of 1904. Goats, a large proportion of which are of the Angora class, number 12,000,000.

Wheat.

In regard to wheat, the Union is barely producing a third of its present requirements, but every year, as in the case of maize, the wheat-growing areas of the Union are being developed, and the recent falling off in the amount imported indicates a gradually increased local production. In 1904 barely 700,000 muids¹ were produced, while the production in 1911 was officially returned at over 1,800,000 muids. There are thousands of acres of fertile soil in the south-west portion of the Cape Province and the grain districts of the Orange Free State which are admirably adapted to the cultivation of wheat. These lands are practically lying dormant, but their value is becoming more and more recognized, and in cases where property of this nature has recently changed hands very high prices have been obtained. In fact, the enhanced value of agricultural land everywhere throughout the Union is perhaps one of the most marked features of its present development.

Develop-
ment of
agricul-
tural
resources.

Everything points to a continued development of the agricultural resources of the country. The former governments of the separate colonies did as much as their means would allow to stimulate interest in this direction, and from the experimental colleges for many years past has gone out a band of young colonists well equipped in every branch of agricultural science, whose example cannot have failed to have the best possible results in those districts in which they have worked. The Union Government has succeeded to the responsibility of fostering agricultural interests, and has fully recognized its duty in this respect. For the year 1912-13, an expenditure of more than £750,000 sterling was allocated under the triple heading of 'Agriculture, Agricultural Education, and Forestry'. This, moreover, takes no account of the large sums which

¹ A muid = 200 lb.



are being spent upon irrigation works, nor of the activities of the Union Land Bank.

The modern history of South Africa may be said to have begun with the discovery of diamonds in 1871 in the neighbourhood of Kimberley. Vigorous development soon followed and Kimberley became the centre of commerce and finance in South Africa and was the goal of all energetic immigrants who intended to carve a career different from the old pastoral life which had been followed by the English and Dutch settlers for two centuries. Kimberley started the development of the north. A year later pioneers in the Eastern Transvaal discovered gold, and with the development of the Barberton and Pilgrims Rest fields gradually pressed on westward¹. In 1884 the conglomerates of the Witwatersrand were discovered, with their high gold-bearing values, and there opened the second chapter, which may be said to have led up to the war and to the Union of the four colonies in 1910.

Mining industries : discovery and development.

As might be expected from their remarkable growth and detached situation in the midst of a vast pastoral country, the mining fields of the Witwatersrand have profoundly affected the history of South Africa and have been concerned in every important social and political problem in the sub-continent, and they must long constitute the commercial centre of the Union, towards which all business tends to gravitate.

Three years after the discovery of the so-called banket Gold beds in the neighbourhood of what is now Johannesburg the gold output amounted to just under £170,000. No regular figures were kept until 1893, when the total tonnage milled was 2,215,413, for a return of 1,221,171 fine oz., valued at £5,187,206. In 1898 the tons milled rose to over 7,000,000 for a return of gold valued at £16,241,134. It was not until 1903 that the industry had sufficiently recovered from the war period to approach previous figures, and the output for that year amounted to a value of £12,628,057. Since that date there has been

¹ See L. V. Praagh, *The Transvaal and its Mines*, Johannesburg, 1906 ; J. P. Johnson, *The Ore Deposits of South Africa*, London, 1909.

a steady increase, and the total output for the Union for the year ended December 31, 1911, amounted to the following : fine oz. 8,251,240, valued at the unprecedented figure of £35,031,041. This output was made up as follows :

	<i>Fine Gold.</i> oz.	<i>Value.</i> £.
Witwatersrand District	7,910,033.981	33,599,689
Heidelberg „	72,095.420	306,242
Klerksdorp „	30,602.066	129,989
Ottoshoop „	1,411.640	5,996
Pretoria „	144.296	613
Barberton „	91,710.113	389,560
Pilgrims Rest „	140,760.871	579,914
Pietersburg „	2,703.031	11,482
Cape	73.052	310
Natal	1,705.880	7,246
Orange Free State	—	—

The most important of the Transvaal mining areas outside the Witwatersrand, as will be gathered from the above table, are those of Pilgrims Rest and Barberton. Mining in the Pilgrims Rest district is chiefly in the interbedded so-called 'flat' reefs which occur in the Dolomite and Black Reef series which lie above the older granites of the Low Country and below the rest of the Transvaal system in the eastern escarpment of the High Veld; while in the Barberton district the mining is generally in steeply inclined quartz reefs formed along zones of sheering, and generally in irregular 'chutes' as regards their gold contents. Both districts offer good opportunities for the small miner or small syndicate running from five to ten stamps. These districts suffered in the past from too much speculation and from over-capitalization of the small mines with but small mineral reserves, and for a long time these districts had only one or two concerns making a successful fight with the local difficulties which are inevitable in mining districts off the main lines of railway. By degrees, however, a good class of miner has opened up and developed the large number of promising small properties, although it is to be regretted that the dangers of over-capitalization and the presence of specu-



lators are still evident, especially in the Pilgrims Rest District.

The gold industry of the Cape Province, Orange Free State, and Natal is negligible, there having been only one mine in Natal dropping stamps during 1911.

More than sixty mines, scattered along the fifty miles of the northern outcrop of the Main Reef series of the Witwatersrand beds, contribute by far the largest portion of the gold output of the Transvaal province. The principal reefs in this series which are most persistent and most definitely defined are the Main Reef, the Main Reef Leader, and the South Reef. Of these the two last are the more important, the South Reef being in most districts the most generally worked. The Main Reef itself, while the largest of the three and generally carrying gold values, is only worked in places where its values are above the average, or where it can be conveniently worked in conjunction with the Main Reef Leader.

The rocks of the Witwatersrand system are older than most of the other Transvaal formations, by which they are overlain, and they rest on the older granite with associated schists and other metamorphic rocks. They are divided generally into two divisions, of which the upper consists almost entirely of quartzites, grits and conglomerates, with small bands of slates or shales. It is these conglomerates, which occur practically throughout the division, which give them their interest to the miner, and of these the most important is the Main Reef Series referred to. The other series of conglomerates of the upper Witwatersrand beds, though frequently auriferous to some extent, are rarely workable over any considerable area, although one or two have been worked at various times under the names of the Battery Reef on the West Rand and the Steyn Estate Reef. In the lower Witwatersrand system conglomerate beds occur on several horizons which are auriferous to some extent and have been worked, or at least prospected, along the lines of the Government and Promise Reefs, though without very satisfactory results. Considerable prospecting has been done in other areas



where the Witwatersrand system occurs, especially about the horizon of the Main Reef Series, but hitherto similar values to those on the Witwatersrand outcrop have not been found.

The comparative regularity and permanence of the values of the Main Reef Series on the Rand are unique of their kind. While, from the point of view of mining, various sections of the reef series are extremely varied in their gold contents, the fact remains that generally the value is well maintained from east to west and on the dip. As a result of the tremendous operations which have been carried on, many of the old outcrop mines are coming to an end of their lives and the depth at which work is carried on is increasing rapidly on all sections of the Rand, the deepest mine, that of the Jupiter Gold Mining Company Ltd., being worked at a depth of 5,000 feet. Promising strikes on the far East Rand have done much to counterbalance some disappointments in depth at points nearer to the Central Rand, and there seems to-day every indication that the place of outcrop mines, the lives of which are generally coming to an end, will be taken by some large producers which will be ready to add to the output, especially east of the East Rand Proprietary Mines and on the dip of the more central portions of the Rand, and it is likely that mining will take place at depths which will considerably exceed 5,000 feet. It is impossible to enter here into the vexed question of the increased costs likely to be caused by mining at greater depths, or into the problems connected with the mining of large blocks of lower grade ores or with the 'big mill' policy, and their effect on the all-important subject of reduction of costs.

Acci-
dents and
disease in
gold-
mining.

The gold output of the Union represents approximately 36 per cent. of the total gold output of the world, while the total gold output from the beginning of operations to the end of 1911 may be placed at £325,128,500, and the total dividends declared from 1887 to the end of 1912 amounted to nearly £90,000,000 sterling.

The disquieting feature about the gold industry in the



Witwatersrand is the very high accident-rate. In this connexion it must be remembered that not only are very large tonnages broken in these mines, but a large percentage of the labour is totally unskilled, and there is too often ignorance of the inherent dangers of mining. Both causes have undoubtedly contributed to the unfortunately high rate of accidents, but a third cause has probably contributed to a measure which has not hitherto been appreciated. Only in recent years has the extent of the ravages of the disease of miners' phthisis, among the workers in the dry mines of the Rand, been appreciated. A medical commission appointed by the Government ascertained, unfortunately without doubt, that the percentage of men affected is far larger than was anticipated. The death-rate from this cause has had a silent but powerful influence on the problems of obtaining skilled miners for underground work.

The disease is caused by inhalation of the fine dust produced in the hard quartzite by blasting and general work in the mine. The dust gradually solidifies the lung, and in the last stages of the silicosis of the lungs tuberculosis frequently intervenes. In the past the incidence of the disease has not been realized, for the reason that men could work, with comparatively little inconvenience, almost to the last. Large numbers of men, therefore, were suffering from the incipient states of the disease without recognizing the fact, and it was extremely difficult to bring home to them the urgent importance of damping down their working places and keeping water jets working on their drills. The stringent regulations which have been introduced with regard to the watering of dry mines underground are, undoubtedly, having a marked effect in the improvement of underground conditions, and it is hoped that, with the co-operation of mine managers and their staffs, the disease will be practically stamped out. The result will be a gain to permanence of employment and efficiency underground, and it is hoped that a marked improvement in the accident-rate will supervene.

The diamond fields of South Africa are situated in the Diamonds.

territory known as Griqualand West, in the northern portion of the Cape Province, in the neighbouring Free State districts of Fauresmith, Boshoff, and Kroonstad, and in the basin of the Vaal River on the north and west of these districts. Since 1902 the Transvaal has entered the list of producers by the discovery and development of the great Premier Mine in the Pretoria district.

The pipes in which the diamonds produced by the above mines are found have pierced the outlying strata and are filled with the unique eruptive material known as 'blue ground' or 'Kimberlite', decomposed near the surface to a yellowish brown and comparatively soft earth. There are, as a rule, abundant inclusions of various types of rock, such as granite, quartzite, quartz porphyry, diabase, shales, and dolerites, which are masses torn from the walls of the pipe during the volcanic outburst. There are also dark heavy rocks, rich in basic mineral rocks, such as olivine, garnet, &c., which are plainly inclusions derived from rocks situated at great depths. The blue ground is a very basic eruptive material, which has suffered considerable alterations through the agency of heated waters, and is now highly serpentinous. Certain minerals are invariably present in the concentrates derived from washing Kimberlite, such as bright green diopside, garnet, flakes of deep brown mica, and lumps of heavy black iron ore, known as 'carbon', with occasional rarer minerals such as zircon, and, economically the most important, the diamond. The distribution of the gem in the blue ground is by no means uniform, and its character in the different pipes is so different that an expert can invariably tell the mine from which any diamond has come.

The pipe is generally somewhat oval in form, though it varies considerably at different levels and is sometimes extremely irregular in plan. Some become elongated with depth, acquiring almost the appearance of a vast fissure, while others narrow inwards considerably, especially at first, but with depth on the whole pipes seem to acquire fairly constant cross sections.

The production for 1911 is taken as illustrating the distribution of the industry :

	<i>Carats.</i>	<i>£</i>	<i>Value per carat.</i>
De Beers Mines (Cape Province)	2,158,610	4,968,436	46s.
Premier Mine, Transvaal . .	1,802,090	1,426,890	15s. 10d.
Orange Free State Mines . .	797,600	1,608,647	40s. 4d

The outstanding point of interest in these figures is the difference in the value of the product of the various mines. In the De Beers mines it will be noticed that an average value of 46s. a carat is reached, the lowest attained being 34s. 7d., and the highest, for Du Toitspan Mine, 72s. No other stones approach in value those of the latter mine, the nearest being the New Jagersfontein, with 60s. 2d. per carat. On the other hand, as is well known to all diamond miners, the alluvial stones found in the valley of the Vaal River, especially in the deeper alluvial deposits, at a depth of 15 feet and upwards, obtain still higher values per carat than even the Du Toitspan stones. Many stones in the Barkly West district, the oldest and still the most flourishing portion of the alluvial fields, obtain 117s. per carat as an average, individual stones of course reaching much higher prices.

The output from the alluvial fields has been recently greatly increased by the discoveries of shallow alluvial diamond gravel in the neighbourhood of Bloemhof, in the Klerksdorp mining district of the Transvaal, along the northern bank of the Vaal River and extending twenty, and probably thirty miles inland. During 1911 and 1912 large numbers of diggers were attracted to this field, and it was estimated that at one time over 5,000 white diggers, with from 10,000 to 20,000 coloured workmen, were congregated in the neighbourhood of Bloemhof, and it spoke well for the orderliness of these workers that violence and crime were almost entirely absent. The tendency during 1912 was towards the breaking up of the bigger mining camps and the scattering of the diggers over the larger area over which the deposit is now found ; while a few have made good sums by finding large stones, the majority

find it hard to pay their way, and many who remain do so because they are unable to leave. The output of these alluvial diggings in 1911 was 41,248 carats, valued at £201,980, a value of about 98s. per carat.

To the visitor to any of the principal mines above mentioned probably the most impressive sight is the immense size and depth of the open-cast workings. That at the old Kimberley mine, practically in the middle of the Kimberley township, is a little over 1,000 feet deep; the immense craters at Du Toitspan and the other mines, owing to their superficial area, offer striking evidence of the value of the diamond in the markets of the world, but the largest of all these open-cast workings is the Premier Mine, which covers an area of not less than 3,482 claims, or 73 acres, and owing to its enormous size it has been suggested that it will be possible to work this mine to a depth of 1,500 feet in the open before it will be necessary to sink a permanent shaft outside the mine and attack it from below by levels, as is now done in all the De Beers mines.

It may be observed here that diamond-mining practice differs in many respects from that of mining for any other mineral; for instance, the miner for baser metal is at fault when he finds that the country rock is described as 'reef', and what he would call a 'horse' of country rock coming into the payable zone is known as 'floating reef' by the diamond miner.

The Premier Mine has departed in many respects from the methods hitherto adopted. Owing to the comparatively lower value of its product, it was essential to the life of the mine that mining operations should be on an enormous scale, and a system of direct treatment has been adopted in lieu of the old flooring methods formerly practised at De Beers and elsewhere. The system, while involving a large expenditure and much ingenuity of a mechanical kind, has been rendered necessary by the increase in the hardness of the blue ground in the deeper levels and the longer period which would have been required for exposure of the blue ground on the old flooring system.



The future of the diamond industry seems assured, as the demand remains steady. A reasonable restriction of output of this article of luxury is the keystone of the whole diamond trade. In this policy the De Beers Company has led the way throughout the history of the development of the diamond industry, and it is largely due to the policy of this firm that the alluvial digger and the other mines of the Union can obtain the prices at present ruling for their products.

The Coal Measures of South Africa have a very wide Coal extent, especially in the Transvaal and Natal, but the productive coal seams are restricted to a comparatively small area of that which is covered by the Coal Measures proper. The Coal Measures belong to what is known as the Karroo system, and especially to what are known as the Upper and Middle Karroo.

The Upper Karroo contains, in what is known as the Stormberg series, the coal of the Indwe district of the Cape and the Komati district in the low country of the Transvaal. The High Veld coal-fields are situated in the Beaufort beds of the Middle Karroo, and, although the extensive shales of the Eccia series of the Lower Karroo have been prospected at great expense in various parts of the country where they are well developed, no payable coal has been obtained from them.

In the Transvaal it is estimated that some 3,000 miles of Coal Measures exist, but the coal seams are found over a much more limited area. The best known coal-field of the Transvaal is that of the Witbank area, from which the greater portion of the best coal is produced in that province. The smaller coal-fields of the Springs-Brakpan area, the South Rand, and Klerksdorp do not contain coal of the same quality as the Witbank area. It was largely, however, from the Springs-Brakpan area, alongside the gold mines of the Witwatersrand, that in the earlier stages of the Rand history the coal supplies necessary for the mines were drawn.

The Coal Measures in the Orange Free State, which are an extension of the smaller southern Transvaal fields,



cover a large area, but the workable coal is limited in extent.

After the Transvaal coal-field that of Natal comes next in importance. The extent of this field is comparatively large, but the doleritic or whin dykes and flows which are met with in every portion of this field have seriously affected the extent of marketable coal which it will be possible to mine in the future. The quality of the coal mined in this field, however, is superior to any other in South Africa.

Tin.

The tin deposits, which are a comparatively recent discovery in the Transvaal, occur either in the red granite or in different strata of the lower division of the Waterberg system, immediately above the old granite, and are, in most cases, situated close to or actually at the line of contact between the two classes of rock. The deposits are found along the belt of country forming the edge of the Waterberg system in the Potgietersrust, Warmbaths, and Rooiberg section of country. In the red granite the cassiterite occurs in the form of roughly cylindrical elongated pipes, or associated with irregular beds of altered granite following definite zones in the granite. They also occur in irregular disseminations in slightly altered granite and as impregnations along well-defined lines of fissure or in pegmatite or quartz veins. In the felsites, shales, and quartzites of the lower Waterberg tin occurs in lodes and more or less defined lines of fissure, and in leaders as well as in irregular patches and pockets.

The geological relations of the deposits tend to give them a more or less defined distribution along the main lines of the geological structure of the country. Further discoveries have been made considerably to the eastward of their known extension in the Warmbaths district. How far these deposits will extend in depth is problematical, but it seems probable that the majority will be found at or near the junction of the red granite and the overlying deposits, and at no great distance from that junction.



The greater portion of the copper in South Africa ^{Copper.} comes from the well-known mines in Namaqualand, which have been worked for half a century by the Cape Copper Company and by the Namaqua Copper Company. During that time the Cape Copper Company alone has paid over £4,000,000 sterling in dividends. The ore reserves of these mines show a steady diminution, but increased prospecting activity in the gneiss rocks of the Namaqua mountains may result in further discoveries. The Messina Transvaal Development Company is the only other copper producer of any importance. The mine, situated on a line of ancient workings near the Limpopo in the Northern Transvaal, promises to become an important producer.

Salt is mostly obtained in pans or lakes by evaporation ^{Miscel-} of the brine, evaporation being done by solar heat. ^{lanea.} The production is entirely for domestic consumption. Each of the provinces yields such products as bricks, granite, sandstone, cement, &c.

In manufacturing industries South Africa has achieved ^{Manufac-} no great results. ^{tures.} From the meagre statistics of production available, it would appear that the approximate value of the output of manufactures is £20,000,000 sterling. This is made up for the most part of the production of a very large number of small scattered factories and workshops, numbering between 2,000 and 3,000. In very few cases does the value of the combined production of any single industry reach £1,000,000 sterling. Such, however, are corn-milling, sugar-refining, manufacture of explosives, bread, biscuit and confectionery works, breweries, and printing; these alone represent a total annual output of over £9,000,000 sterling, leaving the remaining £11,000,000 or £12,000,000 to be divided in varying amounts among a number of minor industries.

If it were profitable (which it is not) to search for the ^{Localiza-} causes which have contributed to this industrial lassitude, ^{tion of} very many valid reasons might be advanced. ^{manufac-} It is ^{turing} perhaps sufficient to state that the total European popula- ^{industries.} tion of the Union, as ascertained at the census in 1911, was only a trifle over 1,250,000. Apart from about a dozen



towns, with populations of 10,000 or upwards, the urban population is made up of small and (in many cases) isolated towns and villages of 500 to 5,000 persons. The native population is omitted from consideration in this connexion, having regard to the fact that their social system is separate from that of the Europeans, and although their spending power is considerable in certain portions of the Union, their numbers are no index of their economic value for purposes of industries. The total European population is about equally divided between urban and rural districts, and in no case (unless we except Johannesburg) has there been that marked concentration of population which in other countries has so materially helped to promote industrial activity.

The chief centres of manufacturing enterprise have hitherto been the seaports, the combined population of which amounts to about 160,000 persons, or about one-fourth of the whole urban population of the Union. Many causes have combined to bring about this particular localization of industry. In the first place, South African industries have been, and still are, almost entirely dependent for their raw material on imports from abroad, and this, coupled with the cheaper labour obtainable at the coast, has resulted in the establishment of the greater proportion of industries on the seaboard. The incidence of railway rates prior to union worked in the same direction, but this last factor will ultimately disappear as through railway rates come to be adjusted.

The lack of population and the vast distances separating the chief markets have undoubtedly had the effect of limiting manufacturing enterprise, and until these conditions are considerably modified it is perhaps too much to expect any very substantial improvement.

Position
and
develop-
ment of
manufac-
tures.

There are abundant indications that, under definite and settled conditions as regards Customs, capital for industrial purposes will flow into the country, and with the gradual growth of population consequent on this development, and the continued extension of the railway system whereby the distant parts of the country will be



linked on to the producing centres, many of the disadvantages under which South African industries have hitherto laboured will be satisfactorily removed. The present circumstances of the country offer exceptional opportunities for the establishment of certain selected industries, the raw material for which is to be found ready to hand. The prejudice against the use of locally-made articles is gradually dying out, and manufacturers themselves are bestowing greater care on the quality of their wares. Municipalities throughout the Union, in their desire for increased population, are offering facilities to those who are desirous of establishing industries. In many cases, factory sites are available at nominal prices, and specially low rates are in most instances quoted for the supply of light, power, and water. To many overseas manufacturers the South African market is much too valuable to be lost, and there are several instances in which the pressure of even the existing comparatively low duties, coupled with increased local production, has led firms to enter within the barrier and to establish themselves as colonial manufacturers. Their enterprise has met with success.

No summary of the industrial situation would be complete without reference to the prevailing labour conditions. Except in the Transvaal, where attempts (more or less successful) are made to exclude all but white labour from skilled and partially-skilled employment, the proportion of coloured labour in factories and other industrial institutions throughout the Union is high. In the Cape Province industries are almost entirely dependent upon coloured or black labour. In Natal and the Orange Free State this tendency is perhaps less pronounced so far as skilled labour is concerned, but production, whether agricultural (as in the case of sugar and tea) or of manufactures (as in the case of soap, jam, creameries, shoe-making, and saddlery, &c.), is in both provinces largely the result of black labour. In this connexion it may be stated that out of the non-European population of 4,700,000, 678,000 are described as mixed and coloured, and these, as experience

Labour.



teaches, are capable of a high degree of efficiency, entirely surpassing the aboriginal native.

Condition
of some
leading
industries.

It is unnecessary to detail at any length the many kinds of industries which have taken root in South Africa, but practically every branch of manufacture natural to a civilized society is represented in some measure, and the position of some of the more important may be summarized here. The total requirements of the country in regard to sugar will shortly be met within the country itself. The breweries are producing the greater part of the beer drunk in the Union. The explosive factories (with over 5,000,000 cases per annum) and the match factories (with a production of more than a million gross) are sufficiently supplying the local demand in their respective lines. The position of the tanning industry is by no means as flourishing as it should be, and owing to the high price of hides and the competition of foreign leather several tanneries have greatly restricted their output. The prospects of expansion in this industry, however, are good. South Africa has plenty of raw material suitable for the finest classes of upper leather, and instead of exporting it to Europe and America, there is no reason why it should not be manufactured in the country where it is produced. Unfortunately, under present circumstances, South Africa has to meet the competition of countries in which the manufacture of leather has been developed on an enormous scale under a policy of high protection. The principal vegetable tanning agents needed in this industry can be obtained in the Union in unlimited quantities. In connexion with the wattle-bark industry of Natal a serious fall in price has taken place. It is estimated that upwards of 200,000 acres of land in Natal have been planted with wattle, and, as there appears to be only a limited market for the bark, the increased production has been met by a corresponding reduction in price, and the future of the industry has been regarded with anxiety. It has been urged by representatives of the tanning industry in Great Britain and Europe that better results would be secured if wattle-growers combined



to export the tannin in the form of extract rather than in that of bark. The whaling industry has assumed large proportions in Natal, and in a lesser degree in the Cape Province. The peculiar type of vehicle characteristic of the country lends itself to local production, and not only is this industry well established in regard to the finer classes of work required for the towns, but practically every village in the Union has one or more carriage and wagon-building establishments. Woollen manufactures are but little developed, but the application of capital to this manufacture, drawing upon the home supply of raw material, offers good prospects. One of the most promising industries, which has advanced rapidly, is that of dairying. Tobacco manufacture is one of the largest industries in the country. The leaf grows well in most parts, and the yield for 1911 was nearly 15,000,000 lb., the Transvaal alone contributing upwards of 8,000,000. The value of tobacco manufactured during 1911 reached a total of more than £750,000 sterling. There will be occasion to refer further to this and certain other local manufacturing industries in the following paragraphs dealing with the commerce of the Union.

In 1908 the total value of imports of merchandise into British South Africa was £24,000,000. In 1909 the figures had increased by 11 per cent., followed by an even larger increase in 1910. In that year the imports reached £39,000,000, and in 1911, £36,000,000. Exports show a similarly satisfactory rate of progress, the total value of South African products (including gold and diamonds) in 1908 being £45,000,000, while in 1911 the figures stood at nearly £58,000,000. The prospects of the country, commercially and industrially, have never been brighter than at the present. For a great number of years mining interests and mining development, vast and important as they undoubtedly have been and still are, have been allowed to dominate too exclusively the minds and enterprise of a large section of the people of the country. It is now realized, however, that there exist other interests of equal, if not of greater potentiality, and that whereas



the mines are a diminishing asset, the resources of the soil offer a vast and profitable field for the investment of capital and the exercise of well-applied industry.

Perhaps the most satisfactory feature of the more recent trade returns is the confirmation they afford of the continued development of the natural resources of the Union. In the matter of a considerable variety of food-stuffs, including wheat and meat, the figures indicate that the country is becoming more nearly self-supporting, largely decreased importations being recorded, while, at the same time, it is seen that the instruments of husbandry are being imported in ever-growing volume. The importation of live stock also shows considerable increase, and with the facilities of free freight offered to farmers and breeders this particular item may be expected to increase rapidly from year to year. Increased importations of fencing wire, sheep dip, windmills, water-boring machinery, manures, and fertilizers all point to a more enterprising as well as a more expansive agriculture. The greater quantities of grain bags imported imply an increasing production of cereals. On the other hand, the importation of mining machinery shows a general decrease, due, probably, to the fact that most of the construction work of the mines is more or less complete. An interesting feature of the import returns has been the immense increase in the value of motor cars and motor vehicles, which is evidence of a wide development of this form of transport in South Africa. The satisfactory increase in building material naturally follows more prosperous conditions generally. The establishment of large soap works in the Union has made its effect felt, and so far as the commoner kinds of soap are concerned a heavy decrease in importation is recorded. There is also to be observed in this connexion a decrease in the importation of oils (castor, coco-nut, and cotton-seed), probably to be accounted for by the establishment in Natal and the Transvaal of extensive oil extraction plants, where coprash, ground nuts, and palm kernels, which are landed free of duty from the east and west coasts of Africa, are being crushed in considerable



quantities. Tallow also appears as a diminishing item in the list of imports, due perhaps to increased supplies obtainable in the country itself. Imports of manufactured tobacco and cigars show a not unexpected decrease, and as practically the whole of the tobacco crop is consumed in the country, it is not unreasonable to surmise that these items will continue to diminish. In regard to cigarettes, on the contrary, imports have increased, for the country does not produce in sufficient quantities a suitable tobacco to meet all requirements.

With regard to food-stuffs, the lessened imports, side by side with increased exports, afford ample testimony to the progress which has been made in agriculture. This has been dealt with in detail in the section on the economic position of the agricultural industries, and it need only be added here that the fruit trade has shown considerable advance of late years, and under the favourable conditions which now obtain in regard to cheapened transport to the European markets additional impetus has been given to this important branch.

Sufficient has perhaps been stated to indicate that South African commerce is travelling on sound lines. In no direction is there any outstanding record of development; the returns merely show the steady progress of a country gradually awakening to a realization of its resources and putting forward its best efforts, amid many obvious difficulties, to achieve its destiny.

Transport and Communications

An event of first-rate importance from a commercial point of view was the signing in 1912 of the ocean mail contract, together with the two subsidiary agreements respecting Government and other freights. The contracts were entered into for a period of ten years with the Union-Castle Mail Steamship Company, the former contractors, who bound themselves to observe the provisions of the Post Office Administration and Shipping Combination Act, which debar them from giving, offering, or promising to any person any rebate, refund, discount, or reward upon

Ocean
transport.

condition that such person shall ship, or in consideration of such person having shipped, goods by ships of a particular line to the exclusion of any other.

For a great number of years, under the guidance of the late Sir Donald Currie, the 'Conference Lines', as the combination was styled, have held an almost undisputed sway over South African shipping. Attempt after attempt was made by outside companies to break through the barrier, but they invariably had to retire from the field beaten, or, if successful to the point of holding their own for a sufficiently lengthy period to become inconvenient, were glad to join the combination on the terms offered. In regard to efficiency of service and regularity of sailing, the Conference Lines, it must be admitted, have done good service to South Africa. Their system of deferred rebates, moreover, against which the Post Office Act was primarily directed, had one good effect in ensuring uniformity of rates. The country, however, had determined that the system, whatever its advantages, should be ended, and that shippers should be put in a position to avail themselves of the cheapest freight procurable unfettered by any such obligation as had previously existed.

The annual subsidy agreed upon between the Government and the Mail Steamship Company is £171,000, and the company undertake during the period of the contract to build at least six new mail steamers of 15,000 tons register. Under the speed clause, the contractors bind themselves to carry the mails from Southampton to Table Bay and *vice versa* in sixteen days fifteen hours. The Government, however, reserves the right to call upon the company to perform the voyage in sixteen days, on payment of an additional subsidy of £19,000 per annum. An important feature of the contract is the arrangement with regard to the maximum rates for certain perishable articles of export. Fresh fruit which has passed the Government grader is carried at 40s. net per ton of 40 cubic feet space; butter at $\frac{1}{2}$ d. per lb.; frozen meat at $\frac{3}{4}$ d. per lb.; and citrus fruits and pineapples at 25s. net per ton. Eighteen thousand



cubic feet space of cold or cool chamber accommodation must be provided in every mail steamer, and the contractors undertake to carry free of freight duly certified pedigree stock. There are several other conditions all alike favourable to the development of the export trade of the country.

The principal ports of the Union are six in number, namely, Cape Town, Simonstown, Mossel Bay, Port Elizabeth, East London, and Durban. There are also several small harbours of minor importance, among which may be mentioned, in geographical rotation, Walfish Bay, Port Nolloth, Knysna, Port Alfred, Port St. John's, and Port Shepstone. Ports and harbours.

Of the first six named, Cape Town, Port Elizabeth, East London, and Durban are the great gateways of the country's trade. Through them pass the bulk of its imports and its exports, each serving its own 'hinterland', and each participating to a greater or less degree in the trade of the interior, to which all have access by means of the trunk lines of railway of which they are the terminal points. Mossel Bay, though connected with the main line of railway from Cape Town at Worcester, has no trunk line of its own going directly inland, and its commerce is restricted to its own 'hinterland' district; while Simonstown, commercially unimportant, is a fortified naval station of the British Fleet.

Cape Town, the principal port of the Cape Province, is picturesquely situated on the southern shore of Table Bay. Behind it on the south the huge mass of Table Mountain rises like a wall, and shelters both the town and the bay from the prevailing south-easterly winds. Founded by the Dutch East India Company in the middle of the seventeenth century as a port of call for the revictualling of their fleets on the way to and from the East Indies, Cape Town gradually became an important trading port, as the settlement of the country progressed and trade developed, until the shipping visiting the port now aggregates over 3,500,000 tons net register per annum, with a total trade of over 1,000,000 tons of cargo landed. Chief ports : position and trade.

and shipped. It retains, to a large extent, its original characteristic as a port of call, for not only is it the first port touched at by the vessels of the regular South African steamship lines, but it is much used by vessels trading between Europe and Australia and passing to and fro between South America and the East in search of freight ; and in addition to the revictualling trade, a large business has sprung up since 1910 in the supply of bunker coal, which is brought round the coast from the neighbouring province of Natal.

As the first South African port of call on the voyage from England, Cape Town, 6,181 miles from London, is the principal port for the landing and embarkation of passengers and mails for the inland provinces, as well as for those parts of the coastal provinces which are in direct communication with Cape Town by rail.

Simonstown, which is situated on a sheltered bay almost in the north-western angle of False Bay on the other side of the Cape Peninsula, is the naval base of the British Fleet in South African waters. The docks, which belong to the Admiralty, consist of a fine tidal deep-water dock and graving dock, the latter completed in 1911, with the necessary equipment for the refitting and repairing of men-of-war. The docks are not available for commercial purposes, and the harbour is of importance solely as a naval station.

Mossel Bay, 242 miles from Cape Town, is the first port of call after leaving Cape Town for steamers of the regular European steamship lines engaged in the South African trade and passing up and down the coast between Cape Town and Durban. The harbour is an open but sheltered roadstead, and there is a small tidal dock affording facilities for the loading and discharging of the lighters by which all cargo is transferred to and from the ocean-going vessels in the roadstead.

Port Elizabeth, situated on Algoa Bay, 428 miles by sea from Cape Town, was founded in 1820, and has rapidly developed in commercial importance. As a harbour it has few natural advantages, the roadstead being exposed to

the full force of the south-easterly gales, which are often of great severity at certain seasons of the year. Steamers up to 2,000 tons net register and sailing vessels of 2,000 tons, drawing about 21 feet, can be berthed alongside one of the jetties, but with the exception of small cargoes of coal imported coastwise practically the whole of the tonnage handled is landed and shipped by lighters.

East London, at the mouth of the Buffalo River, the lower reaches of which constitute the harbour, is the next port of importance along the coast, and is 131 miles distant from Port Elizabeth and 559 miles from Cape Town.

Durban, or Port Natal as it is still sometimes called, 253 miles from East London and 812 miles from Cape Town, is now the first port of the Union of South Africa, both as regards the volume of its trade and the facilities it offers for the accommodation of shipping. Its situation on a land-locked lagoon, with a deep-water entrance that is practicable at all states of the tide and at all times of the day and night, render it accessible to the largest ocean-going steamers trading in the southern hemisphere. There is practically no limit to the length of vessel that can be berthed alongside the quays, the greatest depth obtainable being $38\frac{1}{2}$ feet over a length of 1,000 feet.

Of the minor ports and harbours already mentioned, Walfish Bay, situated almost in the centre of the coastline of German South-West Africa, is solely of strategical importance as an outpost of empire. The port is visited occasionally by men-of-war, but there is very little trade. This isolated enclave in foreign territory is dealt with elsewhere (see Chapter XX). Port Nolloth, 280 miles north of Cape Town, is the starting point of the Cape Copper Company's railway to the copper mines at O'okiep. Considerable quantities of copper ore and regulus are shipped to the United Kingdom. The whole of the port equipment belongs to the Cape Copper Company, which undertakes the landing and shipping of all passengers and cargo. Knysna, between Mossel Bay and Port Elizabeth, is in the centre of one of the forest districts and has

a small export coastwise trade in timber. Port St. John's, at the mouth of the Umzimvubu River, midway between East London and Durban, is another small port for coastwise trade. It serves a thickly populated native territory which is without rail communication. Port Alfred, at the mouth of the Kowie River, between Port Elizabeth and East London, and Port Shepstone, at the mouth of the Umzimkulu River, 80 miles south-west of Durban, are small ports on which considerable sums of money have been spent in the past in fruitless endeavours to develop them in competition with Port Elizabeth and Durban ; but their trade never developed to any extent, and the efforts to keep the harbour entrances open were gradually abandoned.

Railways. The railways of the four South African colonies which form the Union are of comparatively recent growth, practically the whole of the 8,391 miles of Government and private lines which were in operation on December 31, 1912, having been constructed within forty years before that date. At the end of 1872 there were only 63 miles of railway in existence, consisting of the Cape Town and Wellington line of $57\frac{1}{2}$ miles, with a short spur line of $5\frac{1}{2}$ miles to Wynberg, now a suburb of Cape Town. These lines, which had been built by private enterprise, were taken over by the Government of the Cape Colony in 1873, and thus formed the nucleus of the Cape Government Railways, now merged with the Government railway systems of the other colonies in the South African railways.

**Develop-
ment of
the
system.**

In order to understand the development of the Government railway system as it exists to-day, it is necessary to review briefly the events which led to the construction of the five main lines from the coast to the interior, for the network of railways which covers the country to-day is not the result of a gradual development from the coast belt towards the interior, but has been subsequently built up on the main lines, which were first of all pushed far inland to two definite objectives with little or no regard to the development of the intervening areas. The first of these objectives was Kimberley, which rapidly developed



into an important centre as the result of the opening of the diamond mines there in 1871. The second was Johannesburg, which sprang into existence with the discovery of the Witwatersrand gold-fields in 1886.

Following on the acquisition of the railway from Cape Town to Wellington in 1873, the Government of the Cape Colony at once undertook construction not only from Wellington, but also from the two other seaports of the colony, namely Port Elizabeth and East London, Kimberley being the ultimate objective in each case. Early in 1884, the lines from Cape Town and Port Elizabeth had both reached De Aar junction, a point 146 miles south of Kimberley, which was reached towards the end of the following year, while the line from East London had been completed as far as Burghersdorp, about 130 miles east of De Aar junction, and 30 miles south of the Orange River, the southern boundary of the Orange Free State. In the meantime railway construction had been proceeding apace in the neighbouring colony of Natal. The Government had in 1878 taken over a short suburban line of $5\frac{1}{2}$ miles at Durban, which had been built by private enterprise, and also opened the first section of the main line running inland towards the capital of Pietermaritzburg; and at the end of 1885, just after the completion of the line to Kimberley, the Natal main line was opened to Estcourt, 149 miles from Durban and 100 miles due south of the borders of the Transvaal, then the South African Republic.

In the following year (1886) the Witwatersrand gold-fields were proclaimed by the Government of the Transvaal and the centre of railway attraction shifted almost immediately from Kimberley to Johannesburg. Strenuous efforts were then made by the two competing colonies of the Cape and Natal to be the first to open up railway communication with the new gold-fields and to secure the major share of the rapidly developing trade. The main line from Port Elizabeth already had a branch from Naauwpoort (69 miles south-east of De Aar Junction) to Colesberg, which was only some 20 miles south of the

Orange River, the southern boundary of the Orange Free State. This branch was extended to the Orange River at Norval's Pont (328 miles from Port Elizabeth), and by arrangement with the Free State Government the Cape Government Railways undertook the construction of the 333 miles of railway right through that country to the Transvaal border at Viljoen's Drift, on the Vaal River, not more than 40 miles from the new gold-fields. The extension to Norval's Pont and the first section of 120 miles thence to Bloemfontein were opened in December 1890, and eighteen months later (in May 1892) the remaining 213 miles to the Transvaal border was completed. In the same month, the main line from East London, which had been extended across the Orange River at Bethulie, was linked up to the line from Port Elizabeth at Springfontein, 35 miles north of Norval's Pont, thereby placing the Transvaal in direct communication with both ports, as well as with Cape Town by means of the connecting link from Naauwpoort to De Aar Junction. Six months later, the final section of 40 miles from the Vaal River to the gold-fields was completed and a junction effected at Germiston with the isolated line of railway that had in the meantime been constructed along the Witwatersrand.

Meanwhile the Natal Government railways had also pushed their main line up to the Transvaal border and early in 1891 had reached Charlestown, 307 miles by rail from Durban and about 160 miles by road from the gold-fields, but it was not until four years later that the difficulties which arose with the Government of the South African Republic were overcome and the line from Natal was carried across the border and linked up with the main line from the Cape a few miles south of Germiston. Early in 1890, however, when the rail-head of the Natal line was still at Glencoe, over 200 miles away, and Kimberley was the nearest point on the Cape railway system, a private company, styled the Netherlands South African Railway Company, had opened the first portion of a railway along the line of the gold-bearing reefs of



the Witwatersrand. In the following year (1891) the same company opened the first section of a railway from the Portuguese border, forming an extension of the railway from Lourenço Marques on the harbour of Delagoa Bay, and thus giving the Transvaal independent access to the sea through a non-British port. The construction of this line was begun from the Portuguese end, but in 1892, when the main line from the Cape had reached Germiston, construction was also undertaken from that via Pretoria, the capital of the republic. The line was completed by the end of 1894, twelve months before the main line from Natal, which had reached the Transvaal border in 1891, was linked up with Germiston.

These lines form the main arteries of the Union Government railway system at the present day, and it is from them, as already indicated, that the network of connecting and branch lines has gradually been built up. The rapidity of the development of the railways has been especially marked since the conclusion of the Anglo-Boer war, and is clearly shown by the following table, which gives the number of miles of Government lines open at the end of each decade in each of the four colonies which are now comprised in the Union :

<i>Decade.</i>	<i>Cape of Good Hope.</i>	<i>Natal.</i>	<i>Transvaal.</i>	<i>Orange Free State.</i>	<i>Total.</i>
	<i>Miles.</i>	<i>Miles.</i>	<i>Miles.</i>	<i>Miles.</i>	<i>Miles.</i>
1872	63	—	—	—	63
1882	968	100	—	—	1,068
1892	1,891	378	163	385	2,817
1902	2,317	636	888	464	4,305
1912	3,490	1,053	2,197	1,106	7,846

The physical features of the five main lines from the ports to the interior are more or less similar, inasmuch as they all have to climb the mountain barrier fringing the great central plateau, the elevation of which is from 2,000 to 6,000 feet above sea-level. The main line from Cape Town makes the final ascent to the plateau through the Hex River Pass, rising 1,627 feet in $16\frac{1}{2}$ miles to the summit, 3,193 feet above sea-level, $145\frac{1}{2}$ miles from Cape



Town. On the other four lines the rise to the inland plateau is not so rapid, as the mountain ranges become more broken and irregular towards the east, the foot-hills extending over a wider belt of country. The ascent is more gradual, therefore, and is broken by frequent descents to slightly lower levels, although approximately the same elevation of between 3,000 and 4,000 feet is ultimately reached.

In addition to the Government railways there are 545 miles of privately owned railways within the Union, the principal of which are :

<i>Line.</i>	<i>Miles open.</i>	<i>Owner.</i>
Vryburg to northern border of Cape Province	112	Rhodesia Railways.
Worcester to Mossel Bay	205	New Cape Central Railway Co.
Port Nolloth to O'okiep	100	Cape Copper Co.
Grahamstown to Port Alfred	43	Kowie Railway Co.

Of these lines 178 miles are worked by the Government Railway Department, namely, the section of 112 miles from Vryburg to the Cape border, which forms part of the Rhodesian main line to Bulawayo, the whole of which (597 miles) is worked by the Union Government on behalf of the Rhodesian railways, and 56 miles of the smaller private lines. On the other hand, the New Cape Central Railway Company works, on behalf of the Government, the short section of line from Mossel Bay to George (32 miles), which is unconnected with the Government railway system, except by the New Cape Central Railway Company's line.

Equip-
ment and
traffic.

The standard or normal gauge of the South African railways is 3 ft. 6 in., although the first line built in the country, that from Cape Town to Wellington, was of the standard British gauge of 4 ft. 8½ in. A 2 ft. gauge has also been used to some extent, 466½ miles of branch lines out of the total Government mileage of 7,846 being of the narrower gauge. Of the private lines the majority are of the standard 3 ft. 6 in. gauge, the exceptions being the Cape Copper Company's line, which is 2 ft. 6 in., the South-



Western Railway Company's 2 ft. gauge line of 21 miles running inland from the little port of Knysna, and a short agricultural line of 8 miles in Natal which is of 1 ft. 6 in. gauge.

As might be expected in a country which is as yet but slightly developed and sparsely populated, and where the distances between the present centres of development are so great, the railways are almost entirely composed of single track, doubling only having taken place at or near some of the more populous centres. The development of the coal-mining industry in the Transvaal and Natal, both for bunkering and export and for internal consumption on the gold-fields, has severely taxed the capacity of the main line from the Natal coal-fields to Durban, the principal coal shipment port, and also of the line from the colliery district of the Transvaal to Germiston, the centre of the gold-mining area, with the result that the doubling of both lines has become imperative and is likely to be undertaken wholly or partially in the near future. All the 2 ft. gauge Government lines are single track and also all the privately owned lines, while of the 7,379½ miles of 3 ft. 6 in. gauge making up the rest of the Government system only 150½ miles are other than single track. In spite of the restrictions imposed by the 3 ft. 6 in. gauge the locomotives and rolling-stock on the Government lines compare very favourably in point of power, size, and capacity with those of broader gauge railways.

In regard to speed, the heavy gradients and sharp curves coupled with the narrowness of the gauge prevent anything in the way of high speeds being attained, from 45 to 50 miles an hour being practically the limit that is reached on some short sections under favourable conditions. On the long-distance runs the best average time is made by the limited expresses between Cape Town and Johannesburg, which accomplish the journey of 956 miles (via Kimberley) in 36¼ and 36½ hours, an average of slightly over 26 miles per hour. Of the short runs the best is the Johannesburg-Pretoria service, the 45 miles with two



stops being accomplished in 75 minutes, or at an average rate of 36 miles per hour.

The main line coaching-stock is almost entirely of the side-corridor type, with separate four- and two-berth compartments arranged for combined day and sleeping accommodation ; in the 2nd and 3rd class coaches the compartments are arranged with six berths. For suburban and branch line passenger traffic various types of stock are in use, the principal being the ordinary side-door separate compartment type and the side-door central corridor type. Dining saloons are run on practically all the through main line trains and also on some of the longer and more important branch lines. Wagon-stock of high capacity has been in use for a number of years.

Since the establishment of the Union, the rates and fares in the several provinces have been assimilated to a great extent and considerable reductions have been effected. Specially low rates are in force for the conveyance of South African produce both internally and for export, and also on coal for export and bunkering purposes.

Manage-
ment.

The chief executive head of the department is the General Manager, whose head-quarters are at Johannesburg. He is assisted by three Assistant General Managers, each of whom is in charge of one of the three systems into which the railways and harbours are divided for the purposes of executive control.

System A, which comprises the main line and branches from Cape Town to Vryburg (1,444 miles), as well as the section of the Rhodesia railways from Vryburg to Bulawayo (597 miles), is controlled from Cape Town, the Assistant General Manager stationed there also being in charge of the ports of Cape Town and Mossel Bay.

System B, which is controlled by the Assistant General Manager, Bloemfontein, includes the main lines from Port Elizabeth to De Aar, East London to Springfontein, and Naauwpoort to the Vaal River, and all their branches (3,059 miles in all), together with the ports of Port Elizabeth (Algoa Bay) and East London (Buffalo Harbour).

System C comprises practically the whole of the lines in Natal and the Transvaal (3,311 miles) with the port of Durban (Port Natal), and is in charge of the Assistant General Manager, Johannesburg.

Under the divisional system, which was introduced soon after union was accomplished, the three systems were subdivided into eight divisions, system A into two, and systems B and C into three each. One division on each system is controlled directly from the Assistant General Manager's office, the other five being controlled by local Divisional Superintendents responsible directly to their respective Assistant General Managers. The Divisional Superintendents have entire charge of the whole of the 'transportation' service in their respective divisions; that is to say, they control the maintenance of way and works, the train and engine working or 'running', and the station or 'traffic' working. The construction of new lines and of important works on open lines is under the control of the Engineer-in-chief, whose headquarters are at Johannesburg, and who also exercises through his inspecting engineers a supervisory control over the maintenance of way and works on open lines. The maintenance of locomotives, rolling-stock and mechanical equipment, as distinct from its actual operation, is in charge of the Chief Mechanical Engineer, whose headquarters are at Pretoria, the principal workshops being at Salt River (Cape Town), Uitenhage (Port Elizabeth), and East London, in the Cape Province; at Bloemfontein, in the Orange Free State; at Durban and Pietermaritzburg, in Natal; and at Pretoria, in the Transvaal. In addition to maintenance and repair work, the construction of new coaches and wagons is undertaken to some extent at all the shops except Pietermaritzburg, but principally at Salt River, Durban, and Pretoria. The Stores Department has its head-quarters at Germiston, at the centre of the Witwatersrand gold-fields, an important junction where the main lines from the Cape through the Orange Free State, from Natal and from Delagoa Bay all converge, 8 miles east of Johannesburg. The principal stores dépôts



are at the same centres as the workshops, and also at Johannesburg and at Mafeking, on the Rhodesian section. With the exception of a small refreshment-room contract in Natal, the whole of the catering on the trains and at stations is undertaken by the department, the Catering Manager having his headquarters at Johannesburg, with an assistant at Cape Town. The whole of the railway advertising, public advertising on railway premises, and station bookstall work is also carried out by the department.

Railway
and
harbour
adminis-
tration.

The Constitution of the Union makes elaborate provisions with regard to the administration of its railways and harbours, with the view of avoiding the dangers which experience has shown to arise when a Government becomes responsible for the administration of commercial undertakings. Subject to the authority of the Governor-General the control and management of railways, ports, and harbours, are exercised through a board consisting of three Commissioners, appointed by the Governor-General for a period of five years, during which they cannot be removed from office except by the Governor-General for cause assigned, which must be communicated to both Houses of Parliament, and a Minister of State who is Chairman. The salaries of the Commissioners are fixed by Parliament and cannot be reduced during their term of office. All revenue from railways, ports, and harbours must, at least before the expiration of four years from the establishment of the Union, go into a separate fund and is to be used only for the purposes of these undertakings. Their earnings are not to be more than sufficient to meet the outlays necessarily incurred in their proper administration, and they are to be administered, as the Constitution says, 'on business principles', due regard being had to agricultural and industrial development within the Union and the promotion, by means of cheap transport, of the settlement of an agricultural and industrial population in the inland portions of the provinces of the Union.

Posts and
tele-
graphs.

The first establishment by the Government of anything in the nature of postal communication in South Africa



was in 1806, when a service maintained by Hottentot runners was introduced three times a week between Cape Town and Stellenbosch, 30 miles distant; but it is interesting to note that nearly 200 years earlier it was customary for captains of vessels trading to and from the East to place letters under conspicuous boulders on the shores of Table Bay (then known as Saldanha Bay) with a view of their being subsequently collected and conveyed to their destinations by other vessels passing in the opposite direction. In 1897 several stones which bear inscriptions indicating that they were so used were unearthed in the vicinity of the General Post Office at Cape Town. One, now deposited in the vestibule of the General Post Office, bears the following :

THE LONDON ARRIVED THE 10 OF M
HERE FROM SVRAT BOVND FOR
ENGLAND AND DEPARTED THE 20 DICTO
RICHARD BLYTHE CAPTAIN 1622
HEARE VNDER LOOKE FOR LETTERS.

The beginning of telegraph construction in the Cape Colony was in 1860, but it was not until July 1, 1873, that the lines were transferred to the control of the Government. In Natal, under an Act of 1863, the Government was empowered to grant a concession to a company for the construction of telegraphs, and in 1874, when the Government obtained possession of the company's lines, only one connexion existed, between Durban and Pietermaritzburg, a distance of about 51 miles. In 1876 the line to the north was extended to Kimberley, and in 1879 the Cape Colony and Natal were connected, establishing in the following year, by means of the East Coast cable, a connexion between Cape Town and Europe. In 1879 telegraph offices were opened at Pretoria and Standerton in the Transvaal; in 1885 an office was established at Barberton, and in 1886 and 1887 offices were opened along the Witwatersrand. In 1882 the first telephone exchange in South Africa was opened at Port Elizabeth, followed in 1884 by the opening of a similar exchange at

Cape Town, and in quick succession exchanges were established at all the principal towns throughout the Cape Colony, Natal, Transvaal, and Orange Free State. Trunk line communication has been established between all important centres. Separate postal and telegraph administrations were maintained in the Cape of Good Hope, Transvaal, Natal, and Orange Free State until May 31, 1910, when the Act of Union took effect and the four services were amalgamated.

The department is under the control of a Postmaster-General who is responsible to the Minister of Posts and Telegraphs. The head-quarters are at Pretoria. As soon as possible after amalgamation, steps were taken to assimilate rates and obtain uniformity of practice, but this could not be accomplished in all cases without fresh legislative enactment. On September 1, 1911, however, all previous post-office laws were consolidated in Act No. 10 of 1911, which enabled an adjustment to be made in all tariffs with the exception of those appertaining to telephones, which necessarily vary according to the relative importance of the benefits obtained by subscribers to the different exchanges.

Since 1876 the department has been responsible for the Anglo-South African mail contract. The first contract entered into, which came into force on October 1 of that year, provided for a regular weekly mail service, the passage between the United Kingdom and Cape Town to be completed in twenty-six days. The present contract with the Union Castle Mail Steamship Company has force for ten years from October 1, 1912 (p. 127).

Wireless telegraphic stations have been established by the department at Slangkop (Cape) and Durban (Natal). The normal range of the Durban Station is about 250 miles by day and 1,000 miles by night, whilst the higher power installation at Slangkop has a range of, approximately, 400 miles by day and 1,600 miles by night. These are the guaranteed ranges, but are greatly exceeded at night time by both stations. The telegraph lines encircle the whole of the Union and extend northwards to Rhodesia,



PLATE VH. THE ORANGE RIVER AT NORVAL'S PONT
(High Commissioner for South Africa)



PLATE VIII (a). CATHKIN PEAK



PLATE VIII (b). DEVIL'S CHIMNEY. NATIVE HUTS

(High Commissioner for South Africa)



westwards to German South-west Africa, and eastwards to Mozambique.

Mails are conveyed by every description of transport, from the aboriginal 'runner' to the modern motor-car and railway travelling post office. Across the desert in the north-west of Cape Province camels are employed. Money order conventions are in force between the Union and Austria, British East Africa and Uganda Protectorates, Ceylon, Commonwealth of Australia, Dominion of Canada, Germany, Hong Kong, Hungary, India, Mauritius, New Zealand, Norway, Nyasaland Protectorate, St. Helena, United States of America, and Zanzibar, while there is also a direct exchange with the United Kingdom. Savings Banks are conducted by the department at Cape Town (for the Cape of Good Hope and Orange Free State), Pretoria (for the Transvaal), and Pietermaritzburg (for Natal).

CHAPTER VII

THE PEOPLES OF SOUTH AFRICA

By W. BASIL WORSFOLD

BRITISH South Africa is here taken as including (1) the Union, (2) Southern Rhodesia, and (3) the Native Territories under the direct control of the Crown. According to the census of 1911 the population of South Africa, so defined, is approximately 7,300,000; and this total is made up of 1,300,000 Europeans, 5,375,000 Bantu (or dark-skinned African natives), about 150,000 Indians and 475,000 'coloured persons' and Asiatics other than Indians. These figures at once distinguish South Africa from the other oversea dominions, Canada, Australia, and New Zealand; since here alone the European population is a small minority—rather more than one in five within the Union, and rather less than one in six in South Africa as a whole—and the great majority of the inhabitants are Natives and other coloured peoples.

Intro-
ductory.

And to this salient fact is added another scarcely less significant. The bulk of the European population is composed of two sections, respectively of Dutch and British origin, which are almost equal numerically, but speak different languages, have different customs and pursuits, and one of which—the Dutch section—up to 1902 maintained in part a separate political existence. In South Africa, therefore, the statesman is confronted by two very difficult problems: the administration of a backward, but numerically predominant, non-European population, and the fusion of two European stocks. Moreover, the Union of South Africa is not only weakened in counsel by racial division, but impeded in its development by an economic situation which is as baffling as it is unique. Elsewhere in the Empire aboriginal races, when brought into contact with European colonists, have dwindled or disappeared; but in South Africa the Bantu have multiplied and thriven under European administration. The presence of this preponderant dark-skinned population, unable, or unwilling, to provide manual labour sufficient to satisfy completely the industrial needs of the country, has had the effect of excluding hitherto the European from the unskilled labour market, and thereby prevents the Union of South Africa from offering a livelihood to the class of European emigrants which, as in the case of the other oversea Dominions, would otherwise have contributed most effectively to build up its European population.

The Aboriginal Races

Origins.

The period of effective European colonization begins with the establishment of a permanent victualling station and port of call by the Dutch East India Company at Table Bay in 1652. The aboriginal races with which the European settlers have come into contact from this date onwards are (1) the yellow-skinned Bushmen and Hot-tentots, and (2) the various branches of the dark-skinned Bantu. The two former constituted the 'native' population of the Cape Colony up to the close of the régime of



the Dutch East India Company in 1795; but to-day they have become practically extinct, as separate races, although the Hottentot stock has contributed largely to the population of mixed European and African blood known officially as 'coloured persons'. The latter, with the expansion of the area of European occupation, and after more than a century of costly and sometimes desperate wars, have been brought with varying degrees of completeness under the control of European officials; and having benefited physically by a modified introduction of European methods of government, now show a rate of increase slightly higher than that of the European population of the Union.

The respective origins of the Bushmen and Hottentots are unknown. Both were primitive nomadic peoples; but while the Hottentots had attained to the pastoral stage, and were capable of being trained to industry by association with the European settlers, the Bushmen maintained themselves in caves and thickets, feeding upon roots, berries, and honey, and the flesh of such wild creatures as fell to their bone-tipped poisoned arrows.

The Bantu of South Africa, on the other hand, are virile and prolific. The word itself, *Aba-ntu*, is the plural of *um-ntu*, which means in the dialects of the principal east coast tribes a 'human being'; and its use, as a generic term for the natives of Central and South Africa, is due to the late Dr. Bleek. The actual birthplace of the race has not been determined; but it is known that the more vigorous branches migrated southwards from Central Africa by way of the east coast; and the admixture of Asiatic blood, especially apparent in certain physical and social characteristics of the military tribes of South Africa, is generally supposed to have been the result of intermarriage with the Phoenicians, Arabs, and Indians, who from time immemorial had established settlements upon this coast of Africa.

The determining characteristics of the Bantu are:
(1) Tribal organization under paramount and lesser chiefs, with a system of communal land-tenure and

communal or collective responsibility for crime, maintained by a body of customary law. (2) A language inflected mainly by prefixes, and dependent in the construction of sentences upon harmony of sound. Prior to the appearance of European teachers, the Bantu had no knowledge of written signs; oral narratives and folklore being their only development in the direction of literature. (3) A religious sense, founded upon the supposed power of the spirits of the dead to work good or evil to the living, and a belief in witchcraft and other manifestations of the supernatural. (4) A knowledge of agriculture and of some of the useful arts. Horned cattle, their chief possession, form the common measure of wealth and the medium in which tribute to the chief, fines for offences, and the bride-price are paid. They have settled habitations, and use, mainly as a protection against cold, certain primitive articles of dress. (5) The institution of polygamy, and the passing of cattle from the intending husband to the father of the bride, which, with the consent of the latter, constitutes a contract of marriage under Native custom.¹ (6) Among the east coast tribes in particular, a natural instinct for war, with the possession of simple but effective weapons, and a special aptitude for military discipline. Among such tribes, prior to the establishment of European control, the whole life of the adult males was devoted to war and councils of war, and most of the work of cultivating the soil and tending cattle was left to the women.

Political
and eco-
nomic

The Bantu may be distinguished roughly as 'military' and 'industrial'. The main features, which under primi-

¹ 'The contract [Ukulobola] is not one of purchase and sale. The woman does not become her husband's slave. . . . The customs regulating the restoration or retention of "ikazi" or "lobolo" cattle constituted in the heathenish state a salutary check on both husband and wife. . . . If the husband ill-treated his wife beyond all reconciliation, she returned to her father's protection and the husband recovered either a small residuum or, in some cases, none of his cattle, thus losing both wife and dowry. On the other hand, should separation have resulted from the wife's misbehaviour, most of the cattle were returned, the woman lost caste, and her father suffered' (*Report of South African Native Affairs Commission, 1903-5*).



tive conditions differentiated the two groups, are these. distribution. In the military tribes the power of the chief, or 'king', was almost absolute, and the 'town', or principal kraal, was laid out with a view to defence; the huts being placed in a circle round the chief's hut and the cattle pen, and the whole enclosed by a stockade. Among the industrial tribes, on the other hand, the power of the paramount chief was limited by (1) the council of lesser chiefs, and (2) the *pitso*, or general assembly of the tribesmen; the town was 'open', since the dwellings, which were generally more commodious than the beehive-shaped huts of the military tribes, were disposed without regard to defence and unprotected by any fence. The military tribes, again, had little land under permanent cultivation, and confined themselves mainly to the pasturing of cattle; while the industrial tribes cultivated permanently the fertile lands in the neighbourhood of their 'towns' and had attained some skill in the working of metals, the weaving of coarse cloth from cotton, and the making of pottery.

By reason of their superiority in war the military tribes secured possession of the most fertile and well-watered regions, and the industrial tribes were, for the most part, scattered over the central plateaus, or driven for safety into the western deserts. The chief seats of the Native population, therefore, are found in close proximity to the Drakenberg and its allied ranges (which intercept the moisture-laden clouds brought by the monsoon winds), and in particular in the regions lying east and south-east of these ranges, and between them and the sea. Consequently, while the Native population of the Cape proper and the Free State Province is comparatively small, dense masses of these dark-skinned people are to be found in the Transvaal, Natal, and in the Transkeian territories running eastward from the old Cape boundary to Natal. Taking the 1911 census in conjunction with the returns given by the (Union) Native Affairs Department, the distribution of the total Native population of the Union (4,030,000) among the four provinces is as



follows: in the Cape proper, 650,000; in the Free State, 340,000; in the Transvaal, 1,220,000; in Natal (with Zululand), 950,000; and in the Transkeian Territories, 900,000.

Economic
distribu-
tion.

Natives in
Reserves
and Na-
tive Terri-
tories.

Passing from political to economic distribution, we find that one half of the four million Natives within the Union are living on lands assigned for their exclusive occupation; nearly one half on private or Crown lands, or on mission reserves; and the remainder, only some 230,000, in townships and municipal areas. Of the three groups thus distinguished, the first and largest consists of Natives living by agriculture, under the modified tribal government of their chiefs, upon tracts of land set aside and reserved to them for communal occupation by the various South African governments now merged in the Union. To this group must be added the population of the three Native Territories of the High Commission; viz. (1) Basutoland, with 400,000 Natives and 1,300 Europeans; the Bechuanaland Protectorate, with 124,000 Natives and 1,700 Europeans; and Swaziland, with 99,000 Natives and 1,100 Europeans. The collective native population of over 600,000, thus obtained, will be incorporated into the Union in the course of time, and it is now to all intents and purposes economically identical with the first of the three groups within the Union. Considerably more than one half, therefore, of the actual and prospective Native population of the Union remain under tribal conditions, and are only slightly associated with the European community. On the land which they thus occupy (with few exceptions) communally, and free from any charge except the hut or poll-tax, they are able to support themselves in comfort by tilling the soil and pasturing cattle; and it is only in exceptionally bad seasons that economic compulsion causes their young men to leave their kraals, in order that they may earn money by selling their labour to the white employer. The periods during which they are willing to remain away from their homes are very brief; the average contract of service being for three to six months on the mines, and for rather longer



in the case of farm labourers. As a general rule they do not thus seek employment after they have reached the age of 40, and the number of adult male tribal Natives between the ages of 15 and 40 under European employment at any given time is estimated to be only one-fourth of the total number of such persons. It is from this group that the mining industry of the Union draws its main supply of British African Native labourers. According to the returns of the 1911 census, there are 342,000 persons of all races, of whom 47,000 are Europeans, engaged in this industry. In the Transvaal Province it is necessary to supplement the supply of British African labour, thus obtained, by the importation of Native labourers, under contract for a year's service on the mines, from Portuguese East Africa. Of the 300,000 Native labourers employed in the Proclaimed Labour Districts of this province, one-third are drawn from Portuguese territory; while of the 200,000 out of this total who are at work on the mines, no less than one-half are thus imported.

The second group of approximately 1,750,000 Natives live mainly on the privately owned lands of Europeans, and provide much of the labour required by the Dutch and British farmers for agriculture, stock-raising, and fruit-growing. The terms upon which they, and their families, are permitted thus to occupy these lands vary from a regular tenancy, with the payment of a rent in money, to a contract of employment for wages as hired labourers. But the majority of the Natives comprised in this group are 'labour tenants', or Native 'squatters'. The former class, in return for the use of the land which they occupy and cultivate for their own benefit, give the European owner (and farmer) some two or three months' labour, as required by him in the course of the year. The latter are found on Crown lands, on private lands, and especially on the large areas of undeveloped land held by land companies; and the Native squatter is generally allowed to cultivate as much land as he can in consideration of rendering a half-share (or such other proportion as may be agreed) of the produce to the European proprietor. The Natives of

Natives
living on
Crown and
private
lands.

Urban
 Natives,
 Coloured
 people,
 and Asia-
 tics.

this group hold a definite place in the economic system of the European community, as supplying labour for agriculture; but the conditions under which the majority of them live, though no longer tribal, are still very primitive.

The third, and by far the smallest, of the three groups consists of the 230,000 Natives, who, together with the coloured population, provide the bulk of the manual labour required by the Europeans in the towns other than that which is employed in the mining industry. It is the element of the Native population which is most closely identified with the white inhabitants, since it comprises the Natives who are, comparatively speaking, in regular European employment, including domestic service, and living continuously under conditions which compel them in varying degrees of completeness to adopt the dress, and conform to the mode of life, of Europeans. It is in connexion with this group that the 'Coloured' and Asiatic population of the Union must be placed. The number of persons returned under the head of 'All other Coloured races'¹ in the census of 1911 is (in round numbers) 625,000. Of this total some 150,000 are Asiatics, and 475,000 mixed African, and African and European peoples.² The majority of these latter, the 'Coloured people' of South Africa, as distinguished from the immigrant Asiatics, are to be found in the Cape Province, where they provide a body of skilled and unskilled labourers considerably more advanced in civilization than the small section of the Natives who are regularly employed in the towns, but otherwise holding much the same economic position as such Natives. Of the Asiatics, the British Indians of Natal and the Transvaal are, with few exceptions, small traders or coolies employed in the sugar and tea plantations³; the Malays

¹ The term 'Coloured' is a misnomer in so far as it includes such Hindus as belong to a white stock.

² e. g. the Griquas are 'of mixed Hottentot and (African) slave descent, with an infusion of European blood' (*Native Affairs Commission* of 1903-5).

³ [The presence of this Indian population has constituted a problem within the larger Native problem. Indians were admitted into Natal under indentures in 1860, and were allowed to settle after expiry of their con-



of the Cape Peninsula are practically a working-class population; and the few Chinese in the Cape are labourers.

The foregoing accounts enable us to form a general conception of the relationship of the European community to the aboriginal inhabitants. Broadly speaking, more than half the Natives have as yet no social or economic connexion with the Europeans except such as is afforded by the intermittent engagement of their adult males as manual labourers in the industries of the Union, and by the presence among them of European magistrates, missionaries, and traders. Of the almost equal number living on the land of Europeans the majority are untouched by European civilization; and only a small proportion, possibly one-fourth, of the Natives as a whole are associated with Europeans in industrial relationships to an extent sufficient to cause their habits and mode of life to approximate, in varying degrees, to those of the European community. Apart from the effects produced by this partial admission to a partnership in industry, the main agencies directly employed for the purpose of raising the Natives (and Coloured people) in the scale of civilization are these: (1) Religious and secular education. (2) The gradual substitution in the administration of justice of European principles of law (with individual responsibility for crime) for the tribal discipline of the chiefs, communal responsibility, and Native customary law, and of individual for communal tenure of land. (3) A training in citizenship provided by the introduction

Present
condition
of Native
popula-
tion.

tracts; the consequences of this were not seriously recognized until some three decades later. Then their activity and competition with the whites in trade became seriously felt, and a series of restrictive measures, such as the imposition of a poll-tax upon non-indentured Indians, were enacted, aiming later at the restriction of the activities of settlers and at the limitation of immigration, though behind all this there remained among white planters a sense of dependence on Indian labour. The application of the various laws has caused serious friction from time to time, which has provoked strong feeling in India itself; moreover, it has spread in South Africa beyond the confines of Natal, as when by way of restricting it to that province Asiatic immigration into the Transvaal was prohibited and the registration of Indians already settled there was undertaken (in 1907) by means of finger-prints. The question of the status and treatment of Indians again became acute in 1913.]

of local self-government, and admission to the parliamentary franchise.

Education. In considering these agencies and the results which are being obtained from them, it must be remembered how small is the European community and how recently European control has been established. The first agency, indeed, is due mainly to religious and philanthropic enterprise, the sources of which are to be found in Britain and other parts of Europe, and not in South Africa. The operation of the various Christian missions, dating from the establishment of a station by the Moravian Brethren near Swellendam, prior to the first British occupation of the Cape (1795), has been recognized as a powerful factor in the civilization of the Natives by the greatest British administrators; and the missions, in respect of their educational work, have acquired to-day the financial support and general co-operation of the Union and Protectorate Governments, with the result that the main work of Native education is carried on under a system of State-aided mission schools. The institutions thus maintained by the joint efforts of the Churches and the State comprise (1) Elementary Schools, (2) Training Colleges for teachers, and (3) Trade and Industrial Schools for both sexes. A measure of the extent to which the Native population as a whole is served by this system is afforded by the fact that, while some 15 to 20 per cent. of the Europeans are under instruction, the percentages of the Natives (excluding Coloured people and Asiatics) under instruction are approximately 5 in the Cape, 3 in the Free State, 1.5 in Natal, and 1.2 in the Transvaal. The great mass of the Natives, therefore, remain outside the scope of the existing machinery of education; but the results obtained within the limited field of its operation are none the less sufficiently definite to justify the gradual extension of the assistance given by the State, and the education authorities of the Union have adopted the policy of developing the mission system on its practical side by giving special encouragement to trade and industrial schools, and by promoting instruction in the elementary rules of hygiene.



At the same time the value of the religious teaching which is a characteristic feature of the mission system is fully recognized, and it is required that regular moral and religious instruction should be given in all Native schools, whether government or mission. It is in the Cape Province that Native education has been longest in operation and has produced the most striking results. Here, in addition to the Natives properly so called, a large number of Coloured children have attended the schools, and of the non-European population of this province as a whole some 5 per cent. are under instruction. For many years past such educated Natives and Coloured persons have been employed as carriers of letters and telegrams, clerks, interpreters, and school-teachers, &c.; and have competed with Europeans as carpenters, blacksmiths, wagon-makers, shoemakers, printers, saddlers, &c. Indeed, skilled Coloured labour has become so important, industrially and politically, in the Cape Province, that whereas in the Transvaal the white Trades Unions endeavour to exclude it, here they invite it to co-operate with them. Further evidence of the progress of Native education is furnished by the fact that the Natives themselves are beginning spontaneously to claim its advantages. It is proposed to meet this demand in two ways: (1) by recognizing and assisting schools established by Natives independently of the missions, where such schools are adequately supported by local Native contributions or rates and satisfy the requirements of the Education Departments; and (2) by the establishment of a Union Native College sufficiently equipped to enable Natives and Coloured men of exceptional gifts to obtain University degrees and qualify for professional careers. In this connexion the existence of the Native press must be mentioned, as being in itself a proof of educational progress. Although it is as yet in a rudimentary stage, it performs a useful service in spreading a knowledge of current events among its readers, and through them among the illiterate masses. Thus to widen the range of information, and stimulate the intelligence, of the Native population is its main

The Native press.

achievement. As the chiefs and other responsible leaders are too primitive to convey their thoughts through the medium of print, the Native papers cannot be considered representative of Native opinion as a whole; at the same time the grievances and crude aspirations to which they give expression merit attention as indications of the working of the Native mind.

Religion.

According to the census of 1911, one-third of the total non-European population of the Union are members of a Christian Church. The Wesleyans have the largest (non-European) membership (456,017); the Anglican Church stands second (276,849); the Dutch Churches third (204,702); the Lutherans fourth (195,308); the Congregationalists fifth (173,982); the Presbyterians sixth (72,114); and the Roman Catholics last (37,242). The African Methodist Episcopal Church, which is the product of the Ethiopian, or Church Separatist movement,¹ has 59,103 members. Allowing for the greater prevalence of Christianity among the Coloured as against the Native population, it may be assumed that at least one-fourth of the Natives of the Union are Christianized. Apart from the professing Christians, there are to be found among the non-European population 115,701 Hindus, 45,842 Muhammadans, and 1,783 Buddhists and Confucians. The number of non-European people returned as being of no religion is 3,012,648. It would be superfluous to dwell upon the general utility of the spiritual work of the missionary organizations, since it is recognized on all hands as a powerful factor in civilization, but the relation of Christian teaching to polygamy may be noticed. This institution had a natural justification so long as the constant occurrence of tribal wars produced a marked preponderance of females over males. To-day, however, with the complete suppression of such tribal strife by European control, this preponderance has been removed, and while some 20 per cent. of the married Natives remain poly-

¹ The origin of this movement is to be found in the desire of a section of the Native Christians to emancipate themselves from the authority of the European Churches. It is, in part at least, a political or 'Natives' rights' movement.



gamists, the number is decreasing. Apart from the main cause, the fact that there is now only a slight excess of females over males, the decline is assisted by economic pressure, consequent upon the introduction of European commodities and a higher standard of domestic comfort, which makes it increasingly difficult for a Native to obtain the *lobolo* (bride-price) cattle and provide in other respects for more than one wife and her offspring. Thus a great obstacle to the spread of Christianity among the Native population is being slowly but surely removed.

The general operation of the agencies for civilization grouped under (2) and (3) has been described in preceding paragraphs, and it is only necessary to add to that account information upon one or two particulars. The substitution of individual for tribal tenure of land was a feature in Sir George Grey's Kafir policy (1854-62), and thirty years later it became one of the main objects which Rhodes sought to achieve by the Glen Grey Act (1894). Under this enactment of the legislature of the (then) Cape Colony, provision was made for dividing the district of Glen Grey, hitherto a 'reserve' in communal occupation, into 'locations', and for subdividing the arable land of these locations into allotments of four *morgen* (rather more than eight acres) to be held, with their respective rights of commonage, in perpetual quit-rent tenure by individual Natives. The succession to the allotment was regulated by the provisions of §§ 24 and 25: 'The allotment and other immovable property of every registered holder shall not be capable of being devised by will, but upon his or her decease shall devolve upon and be claimable according to the rule of primogeniture by one male person to be called the heir,' and determined by the table of succession set out in § 24.

Elsewhere in the Act provision was made for the introduction of a simple system of local self-government consisting of (nominated) Location Boards and (partly elective) District Councils.¹

¹ *South Africa; a Study, &c.* (by the writer), 1895. Notes on 'Sir George Grey's Kafir Policy' and 'The Glen Grey Act, August, 1894'.



Extension
of Glen
Grey Act.

In 1898 the principles of the Glen Grey Act, as modified by experience, were introduced in the Transkei,¹ and here in 1910 the system was in operation in seventeen out of the twenty-six districts to which the Act applied, and 1,400 individual titles to land had been secured. In this larger field it is found that individual land tenure has given general satisfaction, and that there is a growing disposition on the part of the Natives to favour its extension to other districts. Local self-government has been applied also with considerable success in the Transkeian Territories and in Pondoland. In 1910 the population represented in the General Council of the latter country numbered 80,000, while the Transkeian General Council was representative of 600,000 persons and had a local taxation revenue of £62,264. The composition of the General Council is partly elective, but its powers are purely deliberative, and all executive decisions are made by the (European) magistrates, who are *ex-officio* members. The substitution of individual for communal land tenure is not merely important as tending to lessen the interval between the respective modes of life of the Native and European communities, but it also promises to improve the economic position of the great mass of the former. Owing to the withdrawal of the checks formerly exercised upon the growth of population by tribal warfare, famines, and epidemics, the Natives are now increasing rapidly, and it has become more and more difficult for them to support themselves upon the land reserved for their sole occupation. The Native methods of agriculture must remain primitive for many years to come, but it is believed that the introduction of individual tenure will increase materially the general productiveness of the Native Territories and Reserves.

Acquisi-
tion of
land by
Natives
and
Coloured

With this question of the substitution of individual for communal land tenure is associated the second and more contentious question—whether or not Natives should be allowed to acquire land outside the areas assigned for

¹ See following chapter (VIII).



their exclusive use and occupation. In the Transvaal and Free State, under the old Republican government, Natives or Coloured persons were debarred from possessing land. At the present time (under a decision of the Transvaal Courts) Natives are entitled legally to possess land in the Transvaal, but they are forbidden by law to acquire by purchase, or lease, land in the Free State Province. In the other two provinces no distinction in this respect is made between Natives or Coloured people and Europeans. The establishment of Natives or Coloured persons, individually or collectively, as landowners and householders in areas exclusively occupied by Europeans would be attended in certain cases by such grave practical inconvenience¹ that legislation consolidating the laws of the several provinces, and materially restricting the rights in this respect possessed by Natives and Coloured people in the provinces other than the Free State, may be expected from the Union Parliament. The broad justification for such a course lies in the consideration that, as Europeans are excluded rigorously from acquiring land in the areas reserved for the Native population, it is only reasonable that a similar disability should be imposed upon the Natives themselves in respect of areas occupied, or to be occupied, by the European community. If, however, as seems probable, Natives and Coloured people in the mass should be thus excluded from possessing land outside the Reserves, some provision will be made, no doubt, for putting the educated Native or Coloured person—the man who is European in all but colour—upon an equality in this, as in other respects, with Europeans.²

A strong difference of opinion exists on the question of the extension of the franchise to Natives and Coloured persons. As a measure of the actual degree of progress in this matter so far attained, the return of the registered parliamentary voters in the Cape, by whom collectively the

people in European areas.

The Coloured vote.

¹ Or danger: e.g. the outbreak of bubonic plague in Johannesburg in 1904, prior to the removal of British Indians and Natives from the town.

² [In this connexion reference should be made to the following chapter (VIII), where the Act of 1913 of the Union Parliament dealing with land purchase, &c., is outlined.]

fifty-one Union Members of Parliament for this province were elected in 1910, may be added. Of the total electorate of 142,367, the European voters numbered 121,346 and the 'Other than European' 21,021. The latter number, constituting the 'Coloured vote' of the Union, was composed of 6,633 Kaffirs and Fingos, 715 Hottentots, 911 Malays, 764 Indians, 20 Chinese, and 11,978 persons of other mixed and Coloured races.

The Europeans

Origins.
 The Dutch.

The original stock of the Boer or Dutch Afrikaner people contained a considerable admixture of French blood. The foundation of the predominant white population of the Union was laid almost exclusively between the years 1652 and 1690, and during the last decade of this period the Dutch East India Company made active endeavours to increase the population of their recently established settlement at the Cape of Good Hope. The census of 1687 returned a European population of 573, exclusive of the officials and servants of the Company. In 1691 the number of permanent settlers of all ages and both sexes had risen to (in round numbers) 1,000. Since the Company made no further efforts to introduce fresh colonists after this date, we have in this 1,000 persons the progenitors of the Dutch Afrikaners of to-day. The immigration lists and other official records show that the main elements of which this parent stock was composed were as follows: (1) The discharged soldiers, sailors, and other servants of the Company who formed the original settlement in the Cape Peninsula, and were planted on 26-acre plots at Rondebosch in 1657, and subsequent settlers of the same class. (2) Parties of young women from the public orphanages of Holland, who were sent out by the Company in 1685 and the immediately succeeding years, in order that the unmarried settlers might be provided with wives. (3) A community of Huguenot refugees of whom at least 150 remained in the Colony (1688-90). And (4) an approximately equal number of mainly Dutch families, sent out



From Holland concurrently with the French. The first and last of these elements were not entirely Dutch, and the population of 1691 was racially two-thirds Dutch, one-sixth French, one-seventh Low German, with a few Swedes, Danes, and Belgians. The Low German element was almost identical with the Dutch, but the French settlers, apart from the complete difference of race, were of a relatively higher social grade, and exercised an appreciable influence upon the life and character of the Afrikaner community. Drastic measures were taken from the first by the Company to prevent the Huguenots from maintaining themselves as a separate nationality, and by the middle of the eighteenth century the French language was forgotten and the refugees themselves had been completely incorporated into the Dutch majority. In the compulsory abandonment of French and the hurried acquisition of Dutch, Olive Schreiner (Mrs. Cronwright Schreiner) has found the origin of the clipped and broken Dutch *patois* known as the *Taal*. For the French, having learnt Dutch imperfectly, and from illiterate sources, communicated to the rest of the white community the mutilated dialect which for two centuries has been the national tongue of the South African Dutch. The barrier of the *Taal* and the illiberal and monopolist system of the Dutch East India Company, under which all external trade was carried on by the officials of the Company,¹ together cut off the settlers almost completely from social and intellectual intercourse with Europe, and at the close of the Company's régime, when Britain temporarily occupied the Cape Colony (1795), the white inhabitants formed to all intents and purposes a seventeenth century community. 'In the common life of the European peoples,' says the same writer, 'the Boer has had, and could have, no part. Behind him, like a bar, two hundred years ago the *Taal* rose, higher and higher, and land-locked him in his own tiny lagoon.'²

¹ 'In all things political, purely despotic; in all things commercial purely monopolist' (the late Judge Watermeyer).

² Olive Schreiner, in the *Fortnightly Review*, 1896.

In 1806, when British rule began, the Cape Colony had a total population of 73,633 persons, of whom 26,720 were whites, 17,657 Hottentots, and 29,256 (mainly African) slaves. Up to the formal cession of the Colony to Britain in 1814, the British inhabitants consisted of officials, soldiers, merchants, and missionaries. Six years later, however, some 5,000 British emigrants were brought out by the government and settled in the east of the (then) Colony, and owing to these settlers, and their descendants, and to the withdrawal of a large section of the Dutch farmers from this part of the Colony in the Great Trek (1835-8), the Eastern Province of the Cape Colony became predominantly English-speaking, in contrast to the Western Province, which, with the exception of Cape Town, remained almost exclusively Dutch. Under this, the Albany Settlement, as it was called, an appreciable British population was introduced for the first time into South Africa. Considerable bodies of British immigrants were brought into the Cape Colony, wholly or in part by the government, at two subsequent periods—over 4,000 in 1846-51, and some thousands again in 1858-62. As regards the other three provinces of the Union, British immigrants to the number of 4,500 were introduced into Natal in 1849-51, and this 'Byrne' immigration,¹ in conjunction with the return of a large proportion of the 'Emigrant Farmers' (Boers) to the west of the Drakensberg upon the establishment of British authority, has caused the European population of this province to be predominantly English-speaking. During the reconstruction of the Transvaal and the Orange Free State after the war, some 2,000 British agricultural settlers were established side by side with the Boer farmers, and employment was found for 3,500 young women, mainly domestic servants, who were brought out from Britain by the joint efforts of the government and private organizations. With the exception of these state, or state-aided, immigrations and the natural increment arising from them, the British population of the Union is due almost

¹ So called from its chief promoter.



entirely to immigration consequent upon the discovery of diamonds at Kimberley (1871) and of gold on the Witwatersrand (1886), and the general industrial and commercial development which has followed the active exploitation of the mineral wealth of South Africa from 1870 onwards.

South Africa has attracted an appreciable number of emigrants from Central and Eastern Europe and a sprinkling of Italians. Such immigrants are to be found chiefly in the mining areas or in the neighbourhood of other large towns. Apart from this miscellaneous foreign population, considerable bodies of German settlers were established in the Cape Colony during the governorship of Sir George Grey (1854-62). In 1857 over 2,000 men of the Anglo-German Legion were settled in British Kaffraria to strengthen the (then) frontier against Kaffir aggression. This measure was followed by the introduction of 2,300 German agricultural immigrants into the same territory in 1858-9; and in the following year a further and considerable number of this class of German immigrants were introduced into the Colony itself. In the last years of the South African Republic, and especially during, and after, the construction of the Netherlands South African Railway from Pretoria to Delagoa Bay, officials and employes, with other professional and semi-professional persons, were brought over from Holland by the Boer government. The majority of these 'imported Hollanders', including almost all of the officials and employes of the Netherlands Railway Company, left the country during the war; but a certain number have remained in the Transvaal and the Free State Provinces.

Of the total European population of the Union (1,276,000) in 1911, the Cape Province has (in round numbers) 582,000; the Transvaal, 420,000; the Free State, 175,000; and Natal, 98,000. A comparison of these returns with those of the preceding census of 1904 shows that in the several provinces the respective rates of increase per 100 during the intervening seven years, are: in the Cape, 0.59; in the Transvaal, 41.56; in the Free

Other
European
popula-
tion.

Political
distribu-
tion.

State, 22.96; and in Natal, 1.52. As the result of the relatively rapid growth of the European population of the Transvaal, this province is entitled under the system of automatic redistribution of seats established by the South Africa Act, 1909, to send nine additional members (45 instead of 36) to the next Union House of Assembly.¹

Economic
distribution².

Passing from political to economic distribution, under the census of 1911 the European population is divided in respect of 'occupations' as follows: Professional, 59,721; Domestic, 290,560; Commercial, 81,627; Agricultural, 192,424; Industrial, 143,255; Indefinite, 10,745; Dependants, 492,959; Unspecified, 4,951. And in addition to this it may be noted that 26,258 persons, of whom 294 are women, are employed in the various branches of the Public Service; while of the nearly 350,000 persons of all races absorbed by the mines, 47,000 are Europeans. The main economic division into countrymen and townsmen—the former gaining a livelihood by agriculture and stock-raising, viticulture, and fruit-growing, and the latter by commerce, mining, and the lesser industries, still runs closely on racial lines. The Dutch remain for the most part on the land; the British congregate in the towns and industrial centres. At the same time, owing to the stimulus given to South African agriculture in the period of reconstruction (1902–7), the proportion of British people engaged in the cultivation of the soil is larger than it was before the war; while, on the other hand, with the control of the administration in the hands of the Dutch majority, an increasing number of Dutch Afrikaners are being employed as government officials and adopting professional careers.

Religion². As in the other oversea English-speaking communities, so in South Africa religious organizations are maintained, with slight exceptions, by the voluntary contributions of their respective members. The Dutch Churches (the

¹ The representation of the other provinces is not altered, since a larger number of seats were assigned originally to the two lesser colonies, the Free State and Natal, than they were entitled to have on a strict numerical basis.

² For tables relating to the total population, see pp. 518, 519.

Dutch Reformed Church and the Z.A. Gereformeerde Kirk) have the largest European membership—a membership which, according to the census of 1911, amounts to nearly 700,000 persons, and thus constitutes a clear majority of the white population of the Union. The Anglican Church is next in point of numbers with 255,000 members. These communions are followed at a considerable interval by the Wesleyans (80,000), the Presbyterians (58,000), the Baptists (15,000), and the Congregationalists (13,000). The Roman Catholic Church numbers 53,000 adherents; and there are 22,000 Lutherans, 46,000 Jews, and 35,000 persons of no specified religion.

In respect of education, on the other hand, the State Education. has assumed a full measure of responsibility. Apart from the institutions which it directly maintains, the government exercises a general supervision over all private schools. Under the Union Constitution (1909) the duty of providing for 'education other than higher education' is vested in the several Provincial Administrations 'for a period of five years and thereafter until Parliament otherwise provides', while 'higher education' is reserved for the Union Government. For the present it has been agreed by the education authorities of the Union, that 'higher education' is to be taken to mean 'education Higher. beyond the standard of matriculation'; but that (1) the Training Schools for (Elementary) Teachers should be left under the control of the respective Education Departments of the four provinces, and (2) Agricultural Higher Education should remain under the (Union) Department of Agriculture. As the result of this arrangement the Minister of Education for the Union is concerned directly with the University of the Cape of Good Hope, the seven University Colleges established throughout the four provinces, and the South African School of Mines and Technology at Johannesburg. The existing University, being only an examining and degree-conferring body, has no resident students; but the eight teaching institutions have a collective enrolment of some 1,200 students. Apart from bringing the various provincial systems into

uniformity and exercising a general supervision of the whole field of education within the Union, the first Minister of Education is engaged in 'the establishment of a University of South Africa to meet adequately the demands of the times'. A large instalment of the funds necessary for the creation of this long-desired teaching and residential University has been provided (conditionally) by private munificence; but the unhappy controversy as to the degree in which the bi-lingual principle embodied in the Union Constitution is to be applied to the teaching system of the new University, has prevented the Minister of Education, up to the time of writing, from obtaining the powers necessary for the execution of the project from the Legislature.

Agricultural, &c.

A generous provision is made for practical instruction in agriculture and the allied industries, and some fifteen institutions, ranging from the Transvaal College of Agriculture at Pretoria to experiment stations and stud farms, are maintained by government for this purpose. These institutions are distributed among the four provinces and are administered by the (Union) Department of Agriculture. Provision is made also in one or other of the higher education institutions for special training in medicine, civil and chemical engineering, mining, teaching, and other professional pursuits. It may be added that no less than five Rhodes Scholars are elected annually from within the Union.¹

Primary.

The machinery of primary education (as above defined) is provided in each province by an Education Department and local education authorities, consisting of School Boards, or Committees, and District Education Boards. The Departments, which are controlled by the Directors of Education for the several provinces and have adequate staffs of inspectors, are practically identical in organization; but the character of the instruction given in the schools, the nature and powers of the local education authorities, and the proportion of the total cost con-

¹ Rhodesia, 'as founder's kin,' has three scholarships; making eight for South Africa as a whole.



tributed by the localities, vary considerably in the several provinces. An endeavour is being made, however, by the Union Ministry of Education to introduce gradually uniformity in all such matters. Under the constitution of the Union as embodied in the South Africa Act, 1909, English and Dutch are both declared to be official languages and otherwise placed on an equal footing. This circumstance complicates the working of the machinery of administration as a whole, but the difficulties inherent in it are felt nowhere so directly as in education. Primary education especially has suffered; but it is satisfactory to know from the Union Education Reports that an endeavour is being made to 'formulate a common procedure in the respective use of Dutch and English as media of instruction, which will be acceptable to the education authorities in all four provinces.'¹

A fairly generous measure of recognition and financial support is given by the state to associations and institutions founded for the promotion of scientific research, art, and literature. The Royal Society of South Africa receives (1912) an annual grant of £250, and art galleries, museums and public libraries are aided similarly by grants varying from £1,300 to £15. The chief libraries are the South African Library at Cape Town and the public libraries at Johannesburg and Pretoria. In both the Transvaal and the Cape public libraries are established in the lesser towns, and there were in 1912 in the latter province some 160 of these useful institutions. But such progress as has been made in the artistic and intellectual equipment of the South African people is due, in the main, to private enterprise and munificence. To this source Johannesburg owes the collection of modern pictures of artistic value which are to be seen in its Art Gallery—and in effect the gallery itself; and the fine collection of Dutch and other masters with which Cape Town is enriched, was presented only recently to the people of the Union. The South African Library was furnished by Sir George Grey's MSS. and

¹ *The Union of South Africa* (by the writer), London, 1912, p. 459.



rare books, and the special scientific needs of Johannesburg have been supplied by the gift of the Seymour Memorial Library.

Architec-
ture.

In architecture, where an appreciable advance has been made in the evolution of a South African style, the impetus came from an individual. Not only did Rhodes appreciate himself the quiet beauty of the seventeenth and eighteenth century homesteads in the Cape Peninsula and the adjoining mainland, but he introduced to South Africa the gifted architect, Mr. Herbert Baker, who has adapted this Afrikaner model to modern requirements. Nor was Rhodes's influence confined to domestic architecture. He realized that in contour, atmosphere, and colouring South Africa was a larger Greece, and that therefore the forms and motives of classical architecture could be employed with special propriety in the designing of public buildings in South Africa. The two monuments of the first rank for which he was directly responsible, the Alan Wilson and the Kimberley siege memorials, are wholly Greek. The example has been followed in the stately memorial on the slopes of Table Mountain which bears his name, and the vast and imposing fabric of the new Union Buildings at Pretoria.

Literature.

In literature also the European community of South Africa can claim to have developed on original lines. In the scenes and thoughts supplied by the conflict between European civilization and native life and character a group of civil servants and native commissioners have formed subjects for some volumes of graceful verse; and a stormy and eventful past, together with the presence of the native population, has stimulated not a few writers to patient and laborious researches in the field of history and ethnology. It is, however, in the representation of the physical conditions of the country and the characteristic lives of its people through the medium of prose fiction that the most distinctive merit has been attained. The moods of nature, the strange life of the isolated Boer homestead, the trekking, hunting, and fighting of the pioneers, the discoveries of diamonds and gold, all alike



afford material for creative literature. Such material has been used with conspicuous success by Olive Schreiner in *The Story of an African Farm*, and by Sir Percy Fitzpatrick in *Jock of the Bushveld*.

Problems special to the Union of South Africa

The foregoing account of the peoples of the Union would be incomplete without some reference to the special problems by which this young state is confronted. The first and most important is the fusion of the two predominant European nationalities, the Dutch and British. In most respects the problem has been simplified materially by the union of the four colonies under the Crown, achieved by the National Convention of 1908-9; but in one aspect—the language question—it has been rendered more difficult of solution by this event. The main conditions which stand in the way of racial amalgamation are (1) the difference of character and pursuits which tends to keep the two nationalities apart, the British in the towns and the Dutch in the country districts; and (2) the use of separate languages. The first of these adverse conditions has been modified appreciably by the extension and improvement of railways and other means of communication and transport, and the development of the agricultural resources of the new colonies in particular and of South Africa as a whole, effected during the years immediately succeeding the peace of Vereeniging; and the continued operation of these agencies is secured by the provisions for the administration of the railways as a non-political and purely economic system contained in the constitution, and by the large measure of assistance and direction which the Union Government renders to agriculture in all its branches. The encouragement of European immigration by state aid, which would supplement usefully this development of the agricultural resources of the country, may also be expected so soon as such 'new-comers' can be introduced without detriment to

The fusion of the Dutch and British.

the material interests of the existing population. As it is, since the peace the number of British, resident and immigrant, able to find lucrative and congenial employment in agriculture and the allied industries has been appreciably increased. Concurrently, since the end of the war, the standard of education in the country districts of the Transvaal and Free State Provinces has been greatly advanced, and with these improved opportunities for acquiring a training in industrial and commercial pursuits a larger proportion of the Dutch population may be expected to seek employment in the towns. By the combined action of these two agencies—agricultural development and education—definite progress towards the ultimate fusion of the two nationalities may be achieved. An increasing proportion of the British will be associated by an identity of pursuits and interests with the main body of the Dutch on the land; and an increasing proportion of the Dutch will be associated similarly with the main body of the British in the towns.

Dual
official
language.

The second adverse condition, for the moment at all events, has been aggravated by the attainment of administrative unity, since under the Union Constitution the English and Dutch languages are put on a complete equality. Not only does the South Africa Act declare them to be official languages of the Union, but it specifically directs that all records of Parliament and the Law Courts are to be kept, and all public notices issued, in each of the two languages. The insistence upon the strict interpretation of these provisions, to the extent of compulsory bi-lingualism in education,¹ has produced a grave recrudescence of the racialism directly arising out of the passionate attachment of the less advanced section of the Dutch Afrikaners to their national language. The hope of solution is to be found in the belief that a sense of responsibility will cause the leaders of the Dutch majority

¹ i. e. making Dutch the medium of instruction for one half, and English the medium of instruction for the other half, of the 'principal subjects' taught in one and the same school.



to hold the balance even, and in the expectation that, if this is done, the question will be decided on economic, and not on political, grounds.

The second problem is that of the supply of labour. The special labour conditions which obtain in South Africa are well known. Europeans only undertake manual labour under pressure of exceptional need. Native African labour never in the past has sufficed for the industrial requirements of the European population. Nor does it suffice to-day, although recent circumstances have tended to favour an increase in the available supply. The employment of Chinese on the Rand terminated in 1910, and the further importation of Indian coolies for the sugar plantations and tea gardens of Natal has been forbidden by law. The favouring circumstances are (1) the cessation of the abnormal demand for labour created by (a) the wastage of war, and (b) the provision of the new material equipment required to meet the industrial expansion consequent upon the establishment of British rule over South Africa as a whole; and (2) the rapid growth of the native population during the seven years 1904 to 1911—a growth so marked that for the first time the natives are shown by the census returns to be increasing at a higher rate by natural increment than are the Europeans by natural increment and immigration combined. Notwithstanding these circumstances, the most important industry in the Union, the gold industry of the Rand, is compelled to import from Mozambique approximately one-half of its supply of African labour.¹ The economic dependence of the Union upon Portugal is a grave disadvantage, which was aggravated by the decision to repatriate the Chinese. The right to recruit labour within Portuguese territory is secured by the Transvaal-Mozambique agreement² for a period of ten

¹ At December 31, 1910, out of a total of 179,083 natives employed on the Rand gold mines, 93,069, or 51.96 per cent., came from Mozambique.

² The acceptance of the agreement, although its provisions for the distribution of the Rand traffic as between Delagoa Bay and the British ports were disadvantageous to the coastal colonies—especially to Natal—was forced upon the National Convention by the circumstance that, as



years from 1909 ; but the Portuguese authorities, both at Lisbon and Lorenzo Marques, have manifested dissatisfaction at the continued withdrawal of African labour, which may be wanted for the development of their own territories, and it is possible that the recruiting of Natives for the Rand mines will not be permitted after the expiry of the agreement.

Measures
towards
ensuring
home
labour-
supply.

To render the Union self-sufficing in respect of its labour-supply is, therefore, a question of the highest economic moment. The required result can be obtained by (1) employing European unskilled labour; (2) increasing the African labour available in the Union and the Native Protectorates; (3) increasing the efficiency of African labour; and (4) reducing the labour requirements of the mining and other industries by the further use of mechanical appliances. Of these methods of solving the labour problem, the first is ideally the most desirable; but to raise the European population of the Union to the level necessary to break through the social convention which forbids the European from undertaking manual labour in South Africa, although ultimately it may become possible, is at present too remote a contingency to be taken into consideration. The last is unlikely to prove effective, in view of the large extent to which labour-saving appliances are employed already in the mining industry. The most hopeful line of advance is to be found in a combination of the second and third methods. An increase of the number of Natives available for employment as unskilled labourers may be expected as the joint result of natural increment and economic pressure—the latter consisting in part in the greater difficulty of making a livelihood by primitive agriculture in the congested and limited areas reserved for exclusive Native occupation, and in part in the greater need of earning money wherewith to purchase the commodities introduced by European civilization. The efficiency of

General Botha said, since the Chinese were being repatriated, the Mozambique labour supply was indispensable to the Transvaal, and to South Africa as a whole.



the Native labourer can be increased in two ways: by (1) lengthening the duration of his periods of service, and (2) raising his capacity. There is good reason to believe, therefore, that the efforts being made to fit the Native for a partnership in industry with the European will be assisted by the operation of natural forces; and that at no very remote period in the future the Native and Coloured population will be able at last to satisfy the labour requirements of the European community.

At this point the problem of the labour-supply merges into the third problem—the incorporation of the Native population into the European system. In the writer's opinion the mental interval which separates the average Native or Coloured person from the average European is too great to admit of this population being assimilated as can be done in the case of the European immigrants; and the Native or Coloured person, apart from exceptional instances, cannot claim, therefore, a political or social status identical with that of the European. It does not follow, however, that those Natives who have adopted a European mode of life, and become associated in industry with Europeans, should not have any political or social status at all. The problem, therefore, resolves itself into the determination of a status for the 'Europeanized' section of the Native African population, which, while not admitting Natives to equality with Europeans, will give them an effective voice in the administration of matters directly concerning them, and provide an incentive to the un-Europeanized majority to struggle for Europeanization. The task of thus incorporating the Native African peoples is undoubtedly one of great difficulty; but there is no reason to suppose it will baffle the statesmanship of the Union. On the contrary, the record of the past is wholly encouraging. A hundred years ago the whole of this vast dark-skinned population was in a condition of complete and dangerous barbarism. Even fifty years ago only a small fragment had been brought under European control. Gradually, and at great cost of life, effort, and money, the entire area of Native occupation

The incorporation of the Native population.



has been covered with a network of European magistracies, and to-day an almost unbroken peace is maintained.

Methods
of incor-
poration.

The present condition of the Natives, the civilizing agencies at work among them, and their main relationships to the Europeans have been outlined in the foregoing pages. Taking the non-European population of the Union and the Native Territories to number approximately 5,000,000, we have seen that of the people comprised in this total (1) one-half are living under (modified) Native conditions on lands reserved for their sole occupation; (2) seven-twentieths under partly Native and partly European conditions on lands within the area of European occupation; and (3) three-twentieths under (modified) European conditions and in close industrial association with European communities. Of these three classes a portion of the second and a majority of the third have reached a stage of civilization which admits of their being incorporated into the system of the Union by the grant of a definite political and social status. When once a status for non-Europeans applicable to all four provinces has been determined, the process of incorporation already begun in the Cape Province can go forward, subject only to the condition that no greater number of less civilized Natives are admitted at any one time than can be absorbed without risk of decivilizing the elements of this population previously incorporated. This condition must be observed; for experience—and for practical purposes this means the experience of the Native Affairs Department of the (former) Cape Colony—has shown that a permanent change of habits cannot be expected, unless there is both an efficient machinery for teaching the young, and an environment of civilization sufficient to prevent the Europeanized Native from falling back into barbarism. The necessity of observing this condition is recognized in the Native policy of the Union, the aim of which is, while generally keeping the Natives apart from the Europeans, to introduce into the locations, or Native quarters, a European standard of life. In pursuance of this aim, it is proposed to break up the large aggregations



of Native squatters in the country districts; since such aggregations tend to perpetuate a low standard of civilization among the Natives living within the area of European occupation. And in the towns and industrial centres it is desired to enlarge the Native quarters, and generally improve the housing accommodation, sanitary arrangements, and facilities for education at present available for Natives and Coloured persons engaged in more or less continuous employment, in order that an increasingly large proportion of the periodic Native workers may settle down, with their wives and families, to permanent industrial occupations. In the Cape Province, as before noticed, Natives and Coloured persons in theory have the same status as Europeans, including admission to the parliamentary franchise. In respect of this latter privilege, however, it must be observed that, although the voter's qualifications are the same for the non-European as for the European population—i. e. a low property or income qualification, and the ability on the part of the voter to sign his name and write his address and occupation—the value of the 'Coloured' vote was reduced materially by an original distribution of seats so arranged as to counterbalance the numerical superiority of the non-European population. Thus the average population per member of the mainly non-European constituencies in the (former) Cape Colony was four or five times as large as that of the mainly European constituencies. The Cape franchise, however, is not acceptable to the other provinces, chiefly, though not exclusively, because their respective Native populations are less advanced in civilization; and it remains therefore for the Union legislature to formulate a political and social status for non-Europeans applicable to all four provinces. For the successful performance of this duty time as well as statesmanship will be required; since, apart from the question of the franchise, it involves the readjustment and consolidation of the various laws, including police regulations and the Pass system, to which non-Europeans alone are subject in the several provinces.

Represent-
ation of
non-
European
population.

There are various electoral devices by which the principle of limited representation can be put into effect; but the system actually recommended by the Inter-Colonial Native Affairs Commission of 1903-5 has a special claim to attention. Its essence is the separate voting of non-European electors for a fixed number of members to be determined by the legislature. Under this system independent electoral divisions, with separate voters' lists and candidates, would be created for the non-European population, and no Native or Coloured man would vote in any European constituency. The Commission further recommended that the qualification should be the same for non-European as for European voters; that the qualification of the members to be elected by the non-European constituencies should be determined by the legislature; and that the number of seats to be granted should not be more than 'sufficient to provide an adequate means for the expression of the views, and the ventilation of the grievances, if any, of the non-European population', and should not be 'regulated by the numerical strength of the Native vote'.

Bibliography.

[Some of the following works deal not with ethnological but with political and administrative questions primarily: G. W. Stow, *The Native Races of South Africa*, London, 1905. *The South African Natives*, issued by the Native Races Committee, London, 1908. G. McC. Theal, *The Yellow and Dark-skinned People of Africa South of the Zambezi*, London, 1910. Hon. R. H. Brand, *The Union of South Africa*, Oxford, 1909. M. S. Evans, *Black and White in South Africa*, London, 1911. W. B. Worsfold, *The Union of South Africa*, London, 1912. And on special areas or peoples: *The Native Tribes of the Transvaal* (War Office), London, 1905. J. V. Gibson, *The Story of the Zulus*, London, 1911. Sir G. Lagden, *The Basutos : the Mountaineers and their Country*, London, 1909. M. Martin, *Basutoland : its Legends and Customs*, London, 1903. Dudley Kidd, *The Essential Kaffir*, London, 1904.]