

# THE VEGETATION OF ANGOLA

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[The following account, written 'by request' for a considerably less specialized public than that normally consulting the *Journal of Ecology*, could not, in the final event, owing to circumstances beyond the writer's control, be published as anticipated. It was, however, felt that ecologists might find an English *précis* of Gossweiler and Mendonça's (1939) monograph of some value, and it is accordingly here published, almost as originally written. The somewhat 'elementary' style, the tendency to an emphasis on vernacular names, and other features, are marks of its original destiny, for which the reader's indulgence is requested.—H. K. A. S.]

## INTRODUCTION

Angola lies almost wholly within the southern zone of Tropical Grassland (Savanna), bounded by the Tropical Rain-Forest of the Congo in the north and by the Kalahari Desert (*Sandveld*) in the south. Only in the detached territory of Cabinda, in the extreme north-west, does Tropical Rain-Forest occur on Angolan territory, and only a narrow coastal strip in the south-west of the colony (R. Cunene-Mossâmedes-Benguela) is occupied by true desert and semi-desert. Speaking very broadly, therefore, the vegetation over a great part of Angola is of a rather uniform character; it is estimated that at least three-fifths of the total area are occupied by communities of the summer-bare ('monsoon') forest type, and a further third by savanna communities, the two types frequently mingling. It is, indeed, only within a comparatively narrow coastal belt varying from 30 to 150 miles in width that any major departures from this type occur, such as the Rain-Forest and Desert already mentioned, Montané or Cloud Forest, Summer-green Forest, 'Baobab' (*Adansonia*) associations, Sclerophyll Scrub of the *macchie* or *chaparral* type, Thorn Scrub, etc.

Zonation is nowhere marked, except in the south-west and south, where roughly concentric belts of desert, 'mopane' bush and thorn scrub succeed one another as the rainfall increases towards the interior.

A very rough general picture of the country, in relation to the predominant vegetation, may be obtained from a consideration of it on the basis of the six more or less artificial 'regions' (or 'geographic provinces') laid down by Whittlesey (1924). These are: three western regions, those of Luanda, Benguela and Mossâmedes, based upon the principal centres of population on the coast, but not by any means co-extensive with the administrative Provinces and Districts of those names (Whittlesey's Benguela region, for instance, having a considerable south-easterly extension); a northern and north-eastern one, the Congo Border region; a south-eastern one, Upper Zambezia; and a narrow southern one, the Kalahari Desert border. Regarded somewhat differently, the Luanda and Congo Border regions form a northern section (or two-fifths) of Angola; Benguela and Upper Zambezia a central section (or further two-fifths); and Mossâmedes and the Kalahari Desert border a southern section (or one-fifth). Each of these three sections is traversed, for a greater or less distance, by an east-west-running railway line—the central section entirely, the northern one nearly half-way, the southern for only a short distance. To the traveller passing up-country by any of these routes, from the three chief ports, the vegetation would appear more or less as follows.

In the northern (Luanda-Congo) section there is a coastal belt of desolate country, 100–150 km. wide, forming a strongly undulating plain, with parallel ridges of limestone, sandstone and conglomerate towards the inner margin. In the north there is parkland (cf. p. 37), but grass and trees thin out southwards. The baobab or *imbondeiro* (see pp. 34–7) is the commonest and most conspicuous tree, often growing in clumps in the north. North of the R. Cuanza the cashew-nut (introduced by man) is noticeable, and north of Ambrizete raffia palms occur. In the southern part of the region, thorns (*Acacia*), spurges (*Euphorbia*) and so-called ‘agaves’ (*Vellozia*, etc., not *Agave* itself) become conspicuous. The flood-plains of the streams form ribbons of brilliant green in a waste of yellow and drab. In these valleys occur various useful trees, producing nuts (e.g. *Anacardium*) or yielding timber for construction. On the islands off Luanda the coconut-palm may be noted.

Adjacent to the highlands, in the subplateau region, is a zone of denser vegetation, forming a transition from dry scrub to the magnificent montane or ‘cloud’ forest, which clothes the west flank of the highlands over a strip up to 60 km. wide (see pp. 28–30). Wild products include palm nuts and oil, native coffee, kapok, gums, monkey bread, and beeswax (from hollow trees). Coffee plantations are frequent; sugar-cane is grown along the streams, as well as some rubber and cacao.

On the plateau, savanna and xerophytic scrub predominate. Areas of ‘heath-like scrub’ (*anharás do ongote*, cf. p. 39) occur about Malange. The Cuango basin is mainly covered by savanna. Farther east is a large area intersected by numerous parallel valleys, indicating high rainfall; those that are not stony or marshy are filled with a dense forest of tall trees and lianas. The inter-stream spaces are largely covered by heath-like scrub of the *chanas da borracha* type (see pp. 39–40).

In the central (Benguela-Zambezi) section the coastal belt is narrowed to 20 km. The land rises in a series of low terraces, with semi-arid, porous soil. It bears some scrub, but so sparsely as to appear bare from the sea, except along the watercourses, which support a luxuriant flora, including palms.

The lower slopes of the escarpment are furrowed by deep valleys concealed by dense tropical vegetation, but the face of it is desolate, with outcropping boulders and a sprinkling of dust-covered baobabs, acacias and ‘agaves’. As the higher levels are reached the country becomes progressively moister, and the scrub gives way to mixed park and grassland.

On the plateau, east of the high ranges, with a soil poor in lime and nitrogen but rich in potash, there is fairly dense forest, almost unbroken on the western slopes. The less rugged country has a covering of coarse grasses, with patches of scrub, especially in the sheltered valleys. Here the trees rarely exceed 15 m. in height and give very slight shade; the trunks are crooked and the branches numerous. There is little or no underbrush, and the vegetation is nowhere a formidable barrier to communication. *Chanas da borracha* are frequent on the south-eastern part of the plateau.

The eastern part of this section, comprised largely of the headwaters of the R. Zambezi, is flat and sandy, with sluggish streams meandering through wide marshy valleys. During the rains many of the tributaries merge, and the larger streams may be 6–8 km. in width.

In the southern (Mossâmedes-Kalahari) section, desert and steppe predominate. The coastal zone, 150–200 km. wide, differs markedly from that of the central section, in its steep basalt cliffs and utterly desolate hinterland. Sand-dunes are frequent. As much as two years may elapse between rains. Fugacious annuals and grasses spring up briefly after

the showers, but only along the inner margin of the plain is there permanent vegetation, consisting of small scattered shrubs.

The Serra da Chela, rising somewhat abruptly 800 m. above the coastal zone, gives rise to such abundant precipitations (over 1750 mm. annually) that at its base the seasonal streams create marshes—a kind of oasis in this region of desert. The foothills are covered with ‘bunch-grass’; bushes and a few baobabs. The higher slopes (a strip about 20 km. wide) are densely forested with acacia, mopane (*Copaïfera*), baobab and mimosa. The close undergrowth makes passage difficult except along trails. The small summit plateau is rocky, with sparse steppe vegetation.

The country eastwards, between the rivers Cunene and Cubango, is a sand-flat, covered with thorn, almost impenetrable in places. Baobabs and fan-palms (*Hyphaene*) are characteristic in the Cunene valley. From January to May the whole country may be flooded at irregular intervals.

The following account of the vegetation, being compiled almost entirely from Gossweiler and Mendonça’s monograph (1939), in which the vegetation is classified by Rübél’s system, deals with the various communities under the following heads:

- I. Rain-forest (high forest and brushwoods, including mangroves).
- II. Montane woody communities (high forest and brushwoods).
- III. Hard-leaved woody communities (high forest and brushwoods).
- IV. Summer-green forest.
- V. Summer-bare (‘monsoon’) woody communities.
- VI. Heath-like scrub.
- VII. Herbaceous communities.
- VIII. Marsh and aquatic communities.
- IX. Desert communities.

Relative to the area occupied by each in Angola, they would be arranged approximately in the following order of descending importance: V, VII, IX, VI, II, IV, III, I, VIII. The first four of these are of far greater importance than the remaining five, accounting for probably over 90% of the total area; the first two alone account for 80%.

## I. RAIN-FOREST

### (a) *High forest*

True tropical rain-forest is practically confined, in Angola, to the north-eastern part of the detached territory of Cabinda, lying north of the mouth of the R. Congo (or Zaire) and separated from Angola proper by a strip of the Belgian Congo. It covers an area of about 1500 sq.km., and forms part of the country known as Maiombe which extends over French and Belgian as well as Portuguese territory and includes a total area of rain-forest estimated at 12,000 sq.km. Portuguese Maiombe is almost entirely mountainous, reaching an altitude of 600 m. on the French frontier. The average annual rainfall is in the region of 1350 mm.

In the rain-forest, terrestrial vegetation reaches its greatest luxuriance. It is a massive evergreen formation, comprising, in the high forest, several distinct strata, of which the tallest elements frequently exceed 50 m. in height. (Trees over 30 m. in height are rare in Angola proper.) Such luxuriance is only attained in a hot, humid, tropical climate, and usually on humus-rich, calcium-poor soils. In the rain-forest of Portuguese Maiombe, the

tallest trees are generally provided with compound leaves (e.g. many Leguminosae, Burseraceae, Meliaceae), while the lower strata more often have simple leaves with an apical 'drip-tip'. In nearly all cases the foliage is coriaceous, shining and glabrous.

Woody-stemmed climbers ('lianes') are frequent and very characteristic of this community. Their leaves are mostly concentrated at the apex of the stems, which reach the canopy of the uppermost storey at about 40 m., while their flowers and fruit are frequently borne on the lower parts, even down to ground level. This habit of 'cauliflory' is also shared by many of the trees and shrubs.

The plants of the lower storeys, owing to the lack of light, never develop into a dense formation, except where felling of the tall trees by man provides the necessary illumination, in which case dense 'secondary forest' may be formed.

In the more mountainous localities, exposed to a moisture-laden breeze, large epiphytes, such as orchids and ferns, are found on the trunks and branches of the trees.

A characteristic feature of the rain-forest is the production of 'prop-roots' and 'buttress-roots' from the trunks of many of the larger trees. Societies of tree-ferns (*Alsophila*) occur in some of the damp ravines.

Herbaceous vegetation is scarce and almost confined to the lower levels, especially along watercourses, as in the Luango and Luale Valleys. Grasses are practically confined to roads and clearings.

The southernmost point reached by the rain-forest in Portuguese territory lies approximately in lat. 5° 12' S., slightly to the north of the R. Lubusi. It extends farther south into Belgian territory, however, almost to the Congo estuary between Banana and Boma. Northwards it reaches the Gabon estuary in French territory. In the dry, very hot district known as Sub-Luale (Portuguese Maiombe), west of the main rain-forest area, there are reported to be 'two masses of alluvial forest depending on edaphic conditions', about 40 km. from the sea, at an altitude of 70 m. Here are found many of the elements characteristic of the montane cloud-forest of Cazengo and Amboim, at altitudes of about 700 m., but this community is not regarded as forming part of the typical rain-forest of Maiombe, which belongs floristically to the forests of Gabon and the Belgian Congo. The few baobabs (*Adansonia digitata* Juss.) which occur in this area are associated with the non-typical elements just mentioned, but some have been introduced by man.

Along the courses of the R. Chiloango and its tributaries, about 50 km. from the coast, at altitudes up to 50 m., occurs more or less extensive gallery or fringing forest, of rain-forest type and of great luxuriance, up to 1 km. in width. Its presence is due to the flooding of these valleys during the period of greatest heat, though the rainfall does not exceed an average of 1100 mm. annually.

#### (b) *Brushwoods*

Under this heading a rather motley assemblage of communities must be included: the dense bush of the hill summits of Upper Maiombe, forming an edaphic climax of the true high rain-forest; the dense bush of the alluvial tracts of the river valleys; certain palm societies of the littoral; and the mangrove communities of the river estuaries and lagoons. The rainfall requirements of these being the same as those of the high rain-forest, it has been suggested that the existing differences of stature may be largely due to the action of wind.

The rain-forest brushwood of Upper Maiombe is found above the 300 m. contour. Its

floristic composition is little known, but it includes trees (often cauliflorous) 10–18 m. in height, and some woody climbers. Herbaceous elements are represented by Begoniaceae, Acanthaceae, etc., and in sheltered damp valleys and on stony slopes with moderate illumination a dwarf bamboo (*Puelia*) forms the lower stratum. Epiphytes occasionally occur.

At the mouth of the R. Congo (Zaire), between Sumba and the Ponta de Quiombe, there is a low-lying alluvial area of about 250 sq.km., lying between the savannas and the mangroves (see below, p. 28), covered by an hydrophilous community known under the vernacular name of *taba*. This interesting community, forming relatively high,\* closed bush, depends for its existence upon the periodic tidal flooding of the country adjoining the mangroves. The subsoil is a greyish clay, covered with a layer of black mud about 1 m. thick. Annual rainfall is about 700 mm. The constituent elements of this formation have their roots permanently submerged. In contrast to the mangroves, however, the floristic composition of the *taba* bush is remarkably varied, over fifty different species being reported, including several palms and ferns.

In the districts of Cabinda, Zaire and Congo, on the margins of lagoons and permanent pools in the *Adansonia* zone (see p. 34), up to an altitude of 50 m., occur small irregular patches of bush, some of the constituents of which reach 30 m. in height. Certain of the species of this community are characteristic of the forests of Gabon and the Gulf of Guinea, such as the *vanza* (*Pentaclethra macrophylla* Benth.) and *nesanga* (*Musanga smithii* R.Br.), and reach the southern limit of their distribution at about lat. 7° S., to the west of Bembe.

East of long. 19° E., the trans-Angolan railway line follows, almost exactly, the watershed dividing the drainage basin of the Cassai from that of the Zambezi, and this line represents roughly the southern limit of the fringing (or gallery) forest of rain-forest type, referable to the present subdivision. Alluvial fringing-forest of this type is, of course, dependent not only upon the shelter afforded by the river valleys but even more so upon the high water-table in the immediate proximity of the streams. In many places it is subject to flooding, and the components are in fact almost all hemi-hydrophytes. It is found from 600 m. up to 1200 m., and at the lower levels and more favourable climatic conditions towards the northern frontier attains considerable development, some of the dominant elements reaching 30 m. in height. Tall-stemmed palms do not occur in these galleries, but climbing palms (and other climbers), up to 20 m. in height, are common. South of the Cassai-Zambezi watershed the fringing-forest becomes poorer, and is of the montane brushwood type (see p. 30). In the Malange district the rain-forest galleries are themselves fringed by montane forest (p. 28), which clothes the slopes of the valleys up to the level of the *panda* bush of the plateau.

In the littoral zone north of the R. Cuanza, at altitudes up to 350 m., a leguminous tree known as *tala-menha* (or as *mufuta* in the Maiombe district) forms frequent galleries. This species (*Oxystigma mafuta* De Wild.), which is confined to this habitat, in its exceptionally voluminous densely branched crown and coriaceous evergreen leaves at a distance bears a strong superficial resemblance to the mango.

Three palm genera form communities of some importance under this heading. The oil-palm (*Elaeis guineënsis* Jacq.) is abundant in the Cabinda district (except in the Maiombe rain-forest), principally as a relic of cultivation. Natural oil-palm communities

\* No actual figures of stature are available.

are found on the alluvia of the Congo estuary, in areas of mangrove, papyrus, baobab, *Hyphaene* palm and grass-savanna, and the roots of the trees are sometimes permanently submerged in running water. In the districts of Cuanza Norte and Cuanza Sul this palm forms natural societies almost at sea-level, in very hot, sheltered situations, depending for water on phreatic sources, as in the oases, though about 600 mm. of rain fall annually.

Several kinds of raffia-palm (*Raphia*) are gregarious, forming communities with their roots in running water during the whole year, and at the mouth of the Congo covering hundreds of hectares of muddy alluvia. Other species, however, are found at altitudes up to 1600 m. In the Sacandica region (north Congo district) the natives cultivate a species of *Raphia* for the fibre.

In Lower Maiombe the mangue palm (*Sclerosperma mannii* Wendl.) forms societies in the alluvial forests at 40 m. altitude, mostly in the shelter of tall trees but occasionally fully exposed to the sun. This is a dwarf, stemless species, forming tufts from which arise the pinnatipartite leaves sometimes 4 m. in length. It only grows by streams having a slow current, and in the rainy season the base may be submerged for weeks at a time.

### (c) Mangroves

This peculiar formation appears to be a special case of the type of vegetation exemplified by the *taba* bush already considered (p. 27). It is confined to the alluvial mud of the river estuaries, sheltered from the direct action of the waves but always reached by the sea. The principal constituent is the *miengo* (*Rhizophora mangle* L.), which forms dense, almost pure communities at the river mouths in the northern littoral of Angola. Here the dominants may reach 20 m. in height, with trunks 80 cm. in diameter, but southwards from the R. Cuanza it does not exceed the stature of a shrub, as, for example, at Lobito. At this latitude it is rare, and its place is finally taken by other fruticose halophytes such as *Laguncularia racemosa* (L.) Gaertn. f., *Scaevola lobelia* Murr. and *Suaeda fruticosa* Forsk. In the Congo region, the *miengo* is often accompanied by *Avicennia africana* P. Beauv., which reaches 3-5 m. height, and frequently by a rhizomatous fern, *Bolbitis auriculata* (Lam.) Alston.

Immediately behind the pure *Rhizophora* swamps north of the R. Cuanza there often exists a mixed mangrove community, of considerably lesser stature, in which the *Rhizophora* itself plays no part. At the mouth of the Congo, the area of mixed mangrove on the Angolan side is estimated at 50,000 hectares and extends nearly 100 km. from the Atlantic. This formation is sometimes dense, at other times more or less open, or interrupted by lagoons and sandbanks, and is traversed by innumerable narrow, tortuous channels, some of which afford passage to a canoe at high water. The most important constituent of this formation is the *mafua* (*Chrysobalanus ellipticus* Soland.), a shrub with a height of 6 m. or so in the region of the Congo, with a short stem and ample crown, but at its southern limit, in the Cuanza region, reaching a height of barely 1½ m.

## II. MONTANE WOODY COMMUNITIES ('CLOUD FOREST')

### (a) High forest

The montane forest of Angola is sometimes referred to as 'coffee forest', from its constituting the natural habitat of the wild coffee plant so extensively cultivated in the colony. It is also termed 'rain-and-cloud forest' (or simply 'cloud forest'), since it depends for its existence upon the constant condensation, in the valleys and sheltered slopes of the

subplateau area, of the water-vapour brought in by the moisture-laden westerly sea-breeze. The area of country occupied by this type of forest is relatively small, consisting of a narrow strip between the altitudes of 350 and 1000 m., running roughly parallel to the coast, but retreating from it northwards, extending from lat. 11° 30' to 7° 50' S., and very discontinuous in its southern part. It reaches its most extensive development in the district of Cuanza Norte. Other very small patches occur outside this area, principally in the higher stream valleys east and south-east of the Malange plateau. The montane high forest is always so situated as to be sheltered from the dry winds that blow from the east in the month of June; but montane brushwood communities (see below, p. 30) can frequently develop with some luxuriance even when exposed to these winds. Rainfall is about 1100–1200 mm. annually, and relative humidity about 82.

The dominant tree species of this community, at least in Cuanza Norte, are the leguminous *Albizzia glabrescens* var. *angolensis* E. G. Bak. and (more locally) *A. gummifera* (Gmel.) C. A. Smith, and the ulmaceous *cabenda* (*Celtis zenkeri* Engl. and *C. soyauxii* Engl.). The *Albizzias* have very compound leaves and hold their leaflets perpendicularly to the sun; those of *A. gummifera* exhibit nyctitropic movements. The leaves of all four species are coriaceous and pubescent, though those of *A. glabrescens* become glabrous and shining on the upper surface in the adult state. The leaves of the *Celtis* are entire, with long drip-tips. Nine or ten other tall species (*Celtis*, *Ficus*, etc.) are associated with the four just mentioned, but none of them are cauliflorous like so many of the components of the lower strata, and as so frequently occurs among the taller elements of the true rain-forest. The *Celtis* and one or two others possess tabular buttress-roots.

The Angolan montane forest differs from the more typical montane forest of the Mediterranean and Cape regions in that its major dominants are characterized by compound, instead of simple leaves, and in having buds protected by bracts instead of by bud-scales.

Characteristic species of this community are the cotton trees, or *mafumeira* (*Ceiba pentandra* (L.) Gaertn. and *Bombax reflexum* Sprague). The *Ceiba* forms clumps or groves in Cuanza Norte and reaches a height of over 30 m.

The summits above the montane forest zone usually support a very sparse xerophilous vegetation of steppe or stony desert type, with a narrow but well-defined zone of grass savanna between it and the forest.

The wild coffees (*Coffea canephora* Pierre and *C. welwitschii* Pierre) originally formed part of the lower (shrubby) woody storey of these forests, but the intensive exploitation of the coffees has now resulted in the almost total extermination of this stratum, leaving only the tall trees to provide the necessary shelter for the coffee plantations. Many climbers (especially Combretaceae) also originally formed part of this community. Tree-ferns occur in the valleys in the northern part, and the climbing fern *Gleichenia* sometimes forms almost impenetrable barriers at the upper edge of the forest (above 800 m.) adjoining the grass zone.

In the broken country near Amboim, in Cuanza Sul, the montane forest formation makes its closest approach to the sea, being here only 80 km. from the Atlantic. This is the most favourable area for coffee cultivation, the country from 400 to 1200 m. being made use of for this purpose. The forest here is only a shadow of what it once was, but, even so, trees exceeding 30 m. in height are more frequent here than in any other part south of the Congo. Their frequency, however, does not exceed one per hectare. In contrast

to the Cazengo forests (Cuanza Norte), climbers here are scarce, Combretaceae being entirely absent.

In the small but numerous deep valleys on the east and south-east of the Malange plateau, between about 9° and 11° 30' S. lat., there are small areas of montane forest, with trees 20–30 m. high, clothing the slopes above the rain-forest gallery up to the level of the plateau, where they meet with *panda* bush (see p. 37). At the transition zone to the latter, societies of tree ferns, wild bananas and bamboos are commonly met with.

#### (b) *Brushwoods*

Montane brushwoods differ from montane high forest in the absence of trees more than 12 m. in height and in not having more than two strata of vegetation, or only rarely traces of a third. Trees of even 12 m. are very scarce in these communities, not amounting to more than one per hectare.

Such communities frequently form the zone of transition from montane high forest to the next major unit adjoining it—often a zone of some extent in the case of the 'coffee forest' of Cuanza Norte. In other localities this type of bush clothes the higher hills, exposed to dry wind and intense light, from 300 to 1000 m.; sometimes large areas are almost smothered with gregarious sarmentose shrubs and woody-stemmed climbers. Such vegetation offers few commercial possibilities, either for timber or for coffee exploitation, and has therefore so far remained intact.

Where irregularities of the ground in the mountain region cause the constant formation of local cloud, striking small 'islands' of montane brushwood are sometimes found, completely surrounded by steppe or savanna. These mostly occur in the northern half of Angola, at about 200 km. from the sea. Superficially they have the appearance of being relics of former extensive forests, or else of having been deliberately planted by man, but there seems no doubt that cloud is actually the determining factor. In floristic composition they are practically identical with the more typical montane brushwoods. They are, however, so exposed to wind that the various components are greatly reduced in stature and are often unable to set proper fruit.

Fragments of this type of community, which may represent true relics of former forests, are found in some of the precipitous ravines, where there are rapids and waterfalls, on the Benguela plateau and on the western slope of the Serra da Chela, at altitudes of 1600–2000 m. Podocarps, rarely more than 5 m. in height, grow gregariously in some of the more humid localities, and support a considerable population of epiphytes.

In the Cuango valley, Congo district, between latitudes 6° 10' and 6° 40' S., there is a noteworthy strip of country about 10 km. wide covered with montane brushwood. The country here, formed of red sandstone and lying at altitudes of 650–900 m., is very precipitous, and causes the formation of local mists whether the wind blows from the south-east or from the north-west. Farther north, near Sacandica, there is a development of this type of bush in the narrow sheltered ravines, which are sometimes 100–200 m. in depth.

Where the natives cut down the tall trees, secondary montane bush is formed. In such areas, the pineapple often forms considerable communities, and vegetates so vigorously that it chokes out all the other vegetation of the lower strata. Its leaves reach 3 m. in length, but the fruit is always acid, presumably owing to the absence of the direct rays of the sun. The oil-palm is frequent in the secondary bush. A raffia-palm, *maiamba*, is



cultivated by the natives along the streams, the fibre being used for clothing. A rubber-plant, *verungo* (*Landolphia*), and a wild coffee (*Coffea canephora*) are constituents of this community.

### III. HARD-LEAVED WOODY COMMUNITIES

#### (a) High forest

The dominants of this type of forest have evergreen coriaceous leaves, and are as a rule, trees of medium height, inhabiting a moderate climate, and forming phyto-sociological units analogous in appearance and ecology to the holm-oak and cork-oak forests of the Mediterranean region.

The Angolan communities may be classified into three groups, according to edaphic conditions and origin of water supply, as follows:

(1) Forest depending exclusively upon rainfall, though conditioned by physiographic and edaphic factors.

(2) Forest conditioned by local edaphic factors, depending on water supplied by streams and springs.

(3) Forest determined by edaphic conditions created by the supply of water from phreatic sources and from very variable atmospheric precipitation.

(1) Fragmentary populations of *mafuca* (*Parinari* spp.), confined to the sandy formations of Lunda and the R. Cuango, are found in the *panda* bush (see p. 37). They reach a height of 18 m. Another species of the same genus, limited to the sandy-clay tracts of Malange, Benguela and Huila, yields an edible fruit. Two leguminous tree species (sometimes only shrubs), with a superficial resemblance to the yew tree, viz. *mussamba* (*Brachystegia tamarindoides* Welw.) and *mucuwe* (*Cryptosepalum pseudotaxus* E. G. Bak.), form important though variable consociations in the districts of Lunda and Moxico, in the Cuanzo and Cubango basins, and elsewhere. They are limited to sandy soils and to localities sheltered from dry winds. The *Brachystegia* is the more common of the two and has a wide distribution. East of Malange it forms dense forest, many square kilometres in extent, with three strata of vegetation and dominants 12 m. in height. Here occurs the twining rubber-plant *vivungo* (*Carpodinus gracilis* Stapf). The *Cryptosepalum*, the most noteworthy element of the *Hiemilignosa* climax, appears either in large communities or isolatedly amongst the *Isobertinia* communities of the *panda* forest, recalling the small firs sometimes found in the beech forests of northern Europe. Below 1000 m. it scarcely occurs. Its dark yew-like foliage produces such dense shade that no lower strata of vegetation, except a few cryptogams, can exist.\*

(2) In the beds of the torrents in the desert region north of Mossâmedes, between the altitudes of 70 and 700 m., are found small thickets of an evergreen tree (*Adina microcephala* Hiern) known to the colonials under the name of *pao oleo* (oil wood), or to the natives as *mahambo*. The branchlets bear a resemblance to those of the oleander, and it is almost the only tree in this region which retains its leaves at the end of the dry season. Its roots penetrate the crevices of the rock, and the tree may reach a height of 15 m. In these thickets there is no undergrowth, owing to the absence of soil.—A very widely dispersed palm on the margins of rivers and lakes is the *calolo* or *palmito* (*Phoenix reclinata* Jacq.), though it never forms closed or dense communities. It is caespitose at the base, and, in favourable localities, such as near the sea in the Cabinda and Zaire

\* Cf. Trapnell and Clothier (1937), p. 12.

districts, its cylindrical stems may reach a height of 13 m., or even more, with a diameter of 15 cm. The papyrus plant is often associated with it. The uprooted stems of the palm are sometimes found cast up on the shore of Cabinda bay.—A screw-palm, or *quissare* (*Pandanus welwitschii* Rendle), forms dense and extensive galleries along the R. Cuanza at about 1000 m. altitude; in the region of Carianga and Quibala, Cuanza Sul, it is the dominant tree in the ravines at about the same altitude, though here it does not form dense masses; and in the Caconda region (Huila district), at about 1600 m., examples 6 m. high, with erect branched trunks, are common. In the Luanda and Zaire districts it forms clumps along the streams at 200–500 m. altitude.—In the upper Cunene and Cubango basins may be noted local small communities of a raffia-palm, a bamboo (*Oxytenanthera*) and a Proteaceous shrub (*Protea chysolepis* Engl. & Gilg) which holds its leaves tangentially to the light, in the manner of an *Eucalyptus*.

(3) Of species dependent mainly upon an underground water supply, the most important in Angola are the *mateba* palms (*Hyphaene guineënsis* Schum. & Thonn.). On the alluvial sandy tracts near the sea in the Cabinda and Zaire districts, and also in the *Adansonia* zone in these parts, the *mateba* forms extensive populations; it has, in fact, given its name to the Ilha da Mateba in the Congo estuary. The trunks are often found cast up on the beaches. These communities are generally more or less open, but they do not at any time reach inland as far as the rain-forest of Maiombe. The palm has an erect, robust, usually undivided trunk, resembling that of the *Borassus* palm of the Gulf of Guinea and S. Thomé. Its growth, like that of the baobab, is slow, and it probably reaches an equally great age, i.e. well over 500 years. Grasses and a few shrubs constitute the lower stratum of these palm communities.—A related species of the same genus (*Hyphaene luandensis* Gossw.) covers many thousands of square kilometres along the littoral of the Zaire and Luanda districts, reaching its greatest development at only a few metres above sea-level. A remarkable feature of this species is its habit of forming tufted stools, remaining permanently stemless and barren quite apart from any cutting or mutilation.—Another species (? *H. benguelensis* Welw.) forms a noteworthy isolated sparse community on alluvial sand in the Catengue region of Benguela, scattered through the *Maprounea africana* association (p. 35), and accompanied by *Aloë palmiformis* Bak., which sometimes becomes dominant, with stems 5 m. tall.—Yet another species (*Hyphaene ventricosa* Kirk) forms dense populations in the Coroca valley, not far from its mouth, in complete desert, sometimes reaching 12 m. in height. This species, too, tends to be caulescent and sterile in the Cunene valley, and similar caespitose sterile forms of an undetermined species are reported to exist in thousands near Lui (Iongo) in the Cuango basin, Malange district.

#### (b) Brushwood

This community consists of open or closed stands of shrubs of less than 6 m. height, with evergreen, rigid, coriaceous leaves, forming populations of considerable extent. These communities correspond to the *chaparral*, *macchie*, *phrygana* and *tomillares* of the Mediterranean region.

In the *Adansonia* zone of the Zaire district, on sandy soil at altitudes of 50–80 m., dense, sometimes impenetrable thickets, thousands of square kilometres in extent, are formed by almost pure stands of the Loganiaceous shrub *Strychnos ligustroides* Gossw. They constitute one of the most noteworthy communities of this zone, and have been compared to the *Phillyrea-Rhamnus* scrub of the Iberian Peninsula. The *Strychnos* has much of the

appearance of the Oleaceous *Phillyrea latifolia*, but is more compact and box-like. The most characteristic communities are found on the elevated country of the littoral, on waterless alluvial sands remote from native settlements. It has been suggested that they are essentially dependent upon local climates resulting from the condensation of moisture from the westerly winds in the form of regular atmospheric precipitations. The *Strychnos* extends southwards, in the *Adansonia* zone, to the Serra da Chela and the Cunene valley (where it is rare), and reappears in Mozambique on the east coast of Africa.

Populations of various species of *Vellozia*—woody monocotyledons related to the lily family—assume a certain importance in some parts of Angola. The most noteworthy communities are those found on the Benguela plateau. One species, known as *senque*, forms the dominant element of the transition zone between the *panda* bush (p. 37) and the grass steppe at 2200 m. on Mt. Moco. The plants resemble dwarf *Dracaenas*, with a short, thick, woody stem and short branches bearing a tuft of spear-shaped leaves at the tip; they do not exceed 3 m. in height. Less extensive communities, probably of the same species, occur lower down, at about 1800 m., in the Bailundo (Teixeira da Silva) region. Another species, only 1 m. in height, is fairly frequent in exposed situations, at 1100 m. altitude, in the regions of Amboim and Cazengo; a third forms communities in similar situations near Pungo Andongo, west of Malange. In the immediate neighbourhood of the cataract of Cambambe, in the gorge of the R. Cuanza near Donco, still another species, barely exceeding  $\frac{1}{2}$  m. in height, owes its existence to the spray from the falls, blown back on to the perpendicular cliffs by the westerly breeze.

#### IV. SUMMER-GREEN FOREST

Communities of trees which lose their leaves owing to a simultaneous lack of atmospheric humidity and appreciable lowering of temperature are confined, in Angola, to fragmentary areas, mainly in the littoral and *Adansonia* zones of the northern part of the colony. The leaves of such trees are unable to resist the excessive transpiration caused by the dry continental winds that commence to blow from the east in June; at this period, therefore, they wither and fall, and flowering and fruiting generally take place before the unfolding of the new leaves three or four months later. These communities bear a certain resemblance, in physiognomic appearance, to the summer-bare forests of the *Adansonia* zone.

Between the rivers Cuanza and Congo, the dominant of the littoral riverine galleries is the *mafuma* or cotton-tree (*Ceiba pentandra* (L.) Gaertn.), associated with the *mutala menha* (*Lonchocarpus sericeus* H.B.K.), of South American origin, and often accompanied by the mango, the oil-palm, the hog-plum, the coconut and the tamarind. As this list shows, the community exhibits very strong biotic influence, probably of very long standing. The cotton-tree has for centuries been exploited by the natives for canoe construction, till very few well-grown examples, with trunks 8 m. tall and 1 m. thick, have been left in the more densely populated areas, while the tracts bordering the streams have always been the chosen sites for the native settlements and cultures.

The cotton-tree is an important constituent of some of the fragments of fringing forest occurring in the savanna country of the upper Cuango basin (the 'Cassange depression', east of the Malange plateau), and is sometimes associated with the baobab.

In the same region, along the R. Cuige, at about 1000 m. altitude, a species of willow (*Salix subserrata* Willd.), bearing some resemblance to the 'weeping willow', forms small communities. It occurs also on the Serra da Chela, near Huila, Humpata, etc., and reaches

5 m. in height. This species has, however, a tendency to preserve part of its foliage throughout the year. In the Cassange region also occurs the common Leguminous shrub *munage* or *musoso* (*Entada abyssinica* Steud. var. *microphylla* Oliv.), forming considerable populations on the savannas on fertile clay soils.

In the *Adansonia* zone between lat. 7° 30' and 11° 30' S., the *mubanga* thorn (*Acacia welwitschii* Oliv.) forms almost pure stands covering hundreds of square kilometres, separated by areas of savanna, fringing forest, etc., according to the local topography. This community reaches its culminating phase in the neighbourhood of the watercourses (e.g. along the R. Calucala, Luanda district), where the roots penetrate to the water-table and the trees in consequence reach a height of 25 m., with trunks 40 cm. thick. Elsewhere between the rivers Cuanza and Loge *A. welwitschii* forms communities (sometimes dense) not exceeding 13 m. in height, but even at this stature it is one of the tallest species of thorn in Angola. On lake margins, where there is a difference of 2 m. in the water-level between the dry and the rainy seasons, this *Acacia* is associated with the baobab and other trees. The lower strata are represented by a variety of shrubby and herbaceous elements.

The *muheia* (*Acacia albida* Del.), one of the very few thorns in Angola ever to exceed *A. welwitschii* in height, forms scattered galleries and communities in the *Adansonia* zone of the southern part of the colony.

Near S. Antonio do Zaire, at the mouth of the Congo, is an area of dense bush not more than 6 m. high consisting almost entirely of the Combretaceous tree *mungo* or *mungua* (*Pteleopsis diptera* (Welw.) Engl. & Diels), no doubt largely dependent on the condensation of moisture from the sea-breezes.

#### V. SUMMER-BARE ('MONSOON') WOODY COMMUNITIES

It is estimated that about three-fifths of the total area of Angola are covered by vegetation of this type, i.e. by communities of trees and shrubs which lose their leaves, either entirely or partially, in the dry season (May–October), but whose buds are not protected during the leafless period, as are those of the summer-green forest, by bud-scales. The only relatively large areas not covered by these 'summer-bare' woody communities, in fact, are the savannas of Luanda and Benguela provinces and of the Cuango basin, the coastal strip of desert in the south-west, the area of montane 'rain-and-cloud' forest in the districts of Cuanza Norte and Cuanza Sul, the scattered patches of summer-green forest, hard-leaved forest and evergreen savanna in the coastal belt from Cuanza Sul northwards, and the widespread inter-fluvial patches of heath-like communities (the *anharas do ongote* and *chanas da borracha*) found throughout the summer-bare forest of the interior.

Two main subdivisions of this type of community are recognized in Angola: one, less extensive but more varied, occupying the littoral or sublittoral zone, the other, far more extensive and more uniform, the plateau of the interior.

##### (a) *The Adansonia zone of the littoral*

The summer-bare woody communities of the littoral zone are characterized by the presence, as a kind of 'indicator', of the well-known 'baobab' tree, *Adansonia digitata* Juss., whose habit and curious swollen trunk are too familiar to need description. In Angola it is called the *imbondeiro*. This zone extends from the extreme north (including the territory of Cabinda) to the extreme south, and is never far from, and often adjoins, the sea, except in the *muteate* bush (*Copaïfera mopane* (Kirk) Benth.) (p. 38) of the valleys of the Cucu-

lovar and Cunene rivers in the extreme south-west. The annual rainfall is usually in the region of 300–700 mm. and never exceeds 1200 mm. The soil is predominantly formed of brick-coloured or yellowish or whitish sandy-clay, and is furrowed by ravines as the result of the torrential rains. Over this terrain the baobab community forms open forest, groups of the dominant tree species being surrounded by shrubs of various kinds forming dense masses of a few dozen square metres in extent. The most important trees that accompany the baobab in this community are the *mubanga* (*Acacia welwitschii* Oliv.), the *muxixe* (*Sterculia setigera* Del.) and the *quissoma* (*Euphorbia conspicua* N. E. Br.), but these species do not extend north of lat. 6° 30' S., nor does *Acacia welwitschii* occur south of lat. 11° 30' S. The intervening spaces are occupied by savanna or steppe. In the former latitude, in the territory of the Mussorongos bordering the Congo, two introduced tree-species play an important rôle, viz. the South American *cajueiro* or cashew-nut (*Anacardium occidentale* L.) and the Asiatic *mangueira* or mango (*Mangifera indica* L.). They are found scattered over the sandy hills, at intervals of 50–200 m. or so, and their perennial foliage provides the native population with shelter and shade throughout the year. For five months of the year the staple food of the Mussorongos is the cashew-nut, which is gathered under the trees and stored in corked bottles. (The cashew tree is not found in the territory of Cabinda.) In the same area are found extensive societies of the Agavaceous *Sansevieria cylindrica* Boj.

In lat. 11° 30' S., after a littoral strip of clay soil, about 5 km. in breadth, almost devoid of vegetation of any kind, occur grass savannas with fragments of *macchia* scattered over them. At 12° 30' S., the latitude of Benguela, are found a large number of xerophytes, of which one of the most characteristic is the *candeia* (*Acacia detinens* Burch.), forming a community of some extent, bordering on the littoral desert, and forming a transition from the typical baobab community of the north-central littoral to the mixed *Acacia-Kirkia* forest of the Coporolo valley south of Benguela. Many of the constituent elements of this community also occur in the vegetation at the foot of the Serra da Chela, inland from Mossâmedes. In the erosion-valleys of the R. Cavaco and its affluents, about 35 km. from the sea, are found stands of *mungando* (*Combretum imberbe* Wawra), a tree of about 15 m. in height, recalling the *jiquiri* (*Pteleopsis myrtifolia* (Laws.) Engl. & Diels) in appearance. It is limited to the stony margins of the (generally dry) river-beds, often in the neighbourhood of the taller, but less frequent, *uê* thorn (*Acacia albida* Del.).

In the dry mountainous region of Catengue, at about 600 m. altitude, in lat. 12° 50' S., occur very considerable societies of *Aloë palmiformis*, with spikes up to 6 m. in height; and the *ongerite* (*Maprounea africana* Muell. Arg.), a shrub or small tree up to 7 m. in height, with evergreen leaves, forms noteworthy populations.

Some of the other more important communities of the *Adansonia* zone may be briefly referred to.

At altitudes around 120–150 m. on lands with a rocky subsoil between Calucala and Bengo in the Luanda region, and again in dry ravines near Mumbonda in Cuanza Sul, many square kilometres of country are covered by *mutonge* or *cabenda* bush (*Copaïfera gossweileri* Exell). The plants are 3–5 m. in height, with twisted trunks covered with the sticky resin which exudes naturally. Fossilized gum, known as *cocota*, is found on the sandy tracts near Luanda, and may indicate the existence of former extensive *mutonge* forests in this region. Other more or less dense formations of this species occur along the littoral where there is a considerable condensation of water-vapour from the sea-breezes.

Between the rivers Cuanza and Loge, Luanda district, there are considerable areas covered with open bush of low trees or shrubs, 4–6 m. high, grouped together at intervals of 10–20 m., and interspersed with tall perennial grasses, 2–3 m. in height. The most characteristic woody species are certain Leguminosae such as *mufuto* (*Albizzia versicolor* Welw.), *mulolo* (*Bauhinia thonningii* Schumach.), *mussongue* (*Acacia sieberiana* DC.) and *mubanga* (*A. welwitschii* Oliv.), the last-named not ascending above 180 m. The grasses are subject to annual fires. Dense gallery forests clothe the ravines and stony river beds (dry for six months) in this region.

After the baobab, the most striking plant in the Luanda region is the *quissoma* or *mucuto* (*Euphorbia conspicua* N. E. Br.), one of the cactiform spurges. It occurs throughout the littoral zone from the R. Mebrige, Ambrizete, to the Serra da Chela, forming its most extensive communities between the Rivers Cuanza and Loge, often near to the sea. In these regions it rarely appears at altitudes above 200 m., but ascends to 800 m. in the *Copaïfera mopane* bush at the foot of Chela. In dry sandy country the plant is normally under 7 m. in height, and scarcely branched, but in depressions where water accumulates for two or three days it can sometimes behave as a hemi-hydrophyte, and is then much branched and may reach a height of 15 m. The *quissoma* is apparently influenced more by factors of physiography and climate than by edaphic or biotic factors. It is accompanied by a variety of other elements, from the halophytic evergreen shrubby Salvadoraceae, near the shore, to the arborescent *Sterculia setigera* Del. and the palm *Hyphaene luandensis* Gossw., in more inland situations. Grasses are infrequent.

In the immediate neighbourhood of the *Copaïfera gossweileri* bush already mentioned (p. 35), but only on elevated rocky outcrops in extremely dry situations, between lat. 7° and 15° S., the *paco* (*Ptaeroxylon obliquum* (Thunb.) Radlk.) sometimes forms dense populations. It is a tree up to 6 m. in height, with an erect trunk 10–15 cm. thick clothed with bitter bark, and an ample crown of deciduous leaves. In the region of Huila it is known by the name *ommumbungurulu* to the natives, who use an infusion of the inner bark in the treatment of swamp fever. The wood is very resistant to extremes of temperature and to insect attack (it is one of the few woods which the termite, or *salalé*, does not devour), and since the tree appears to thrive in the conditions of drought and aridity prevalent in the littoral, where little else grows but thorns, it is commended to the attention of silviculturists.

Near Bembe, in the upper Mebrige valley, Congo district, the only noteworthy element over areas of many square kilometres of savanna country is the *musse* (*Crossopteryx febrifuga* Benth.). It is an erect shrub, 2–3 m. in height, leafless for at least four months of the year, and occurs almost exclusively on steep, stony hills and slopes. It is one of the plants of which the bark is employed by the natives in the preparation of febrifuge infusions. It is found also in Cuanza Norte, sometimes below the rain-and-cloud forest, as on the dry hot slopes of the ravines near Dondo, on the R. Cuanza, where it is frequent, and sometimes above it, as on the summits of the Queta Mountains at Golungo Alto, alt. 1100 m., where it forms small societies. North of lat. 7° 30' S., in the less arid localities of the savannas, from 400 to 950 m. altitude, the *Crossopteryx* gives way to *Sarcocephalus esculentus* Afz., a shrub 3 m. in height, with somewhat succulent evergreen leaves.

From the R. Congo to about lat. 11° 30' S., frequent masses of the thorn *mungenio* or *sende* (*Dichrostachys glomerata* (Forsk.) Chiov.) occur, from the maritime hills up to 200 m.

or so. It sometimes forms impenetrable bush 2–3 m. in height, but never in patches more than 10 hectares in extent. This thorn is confined exclusively to the *Adansonia* zone.

From lat. 11° 30' southward there are frequent extensive populations of thorns of the genus *Acacia*, leafless for almost the whole year, forming dense bush 2–4 m. in height. Reference has already been made to the *candeia* (*A. detinens*) bush, between Lobito and the R. Evale: a second species, known as *colete* (*A. etbaïca* Schweinf.) is generally associated with it. The baobab is infrequent in this country, except in the intervals between the areas of thorn. *A. detinens* is also moderately frequent in the river valleys of the Mossâmedes district, mostly as a shrub of 1–2 m., rarely becoming a tree. It yields a colourless and semi-transparent gum, which coagulates on the trunk in 'tears' the size of a nut. In the *Copaïfera mopane* country of the upper Cunene basin, several other *Acacia* species occur, the most important being *A. kirkii* Oliv., a producer of gum arabic. This gum and that of *A. detinens* form a staple article of food among the tribes of Damaraland: they are said to be pleasant-tasting, easily digested, and very nutritious when accompanied by sufficient liquid. The gums are also dissolved and kneaded with clay and used as flooring for dwellings, in the absence of suitable timber.

In the dry erosion-valleys of the *Adansonia* zone, certain shrubs of the genus *Commiphora* sometimes form communities of some importance; they are known by the native names of *mungolo*, *calusange* and *mulelame*. They are usually 3–4 m. in height, rarely up to 9 m., with twisted trunks and bushy crowns, though they are leafless for five to seven months of the year. One species (*C. welwitschii* Engl.) is the dominant element in some of the ravines of the littoral between Luanda and Ambriz. Various other species form consociations in the *mopane* bush of southern Huila.

#### (b) *The panda forest of the interior plateau*

This community, in the composition of which the baobab plays no part, is the most extensive vegetational unit in Angola. The colonists call it *mata de panda*—*panda* bush—from the native name for certain Leguminous trees of the genera *Isoberlinia* and *Brachystegia*, which form the dominant elements for thousands of square kilometres.\* The country so covered ranges in altitude from 800 to 2000 m., with an annual rainfall of about 1300 mm. The soil is usually a reddish clay, but is often sandy, and, in general, fertile. The important types of vegetation known as Parkland, Orchard, and *mopane* bush are included in this subdivision (see below).

In the *Isoberlinia* (*múmuê*, *homoê* or *mutubuê*) communities, lower strata of various shrubs and perennials are usually present, but in certain *Brachystegia* (*samba* or *muchovi*) communities such dense populations are often formed, principally in sandy country, that no other vegetation can exist; such pure communities are admittedly of small extent, but it is impossible for the annual fires to penetrate them, owing to the absence of combustible grasses and other herbage.

#### (1) *Parkland*

The more or less self-explanatory term 'Parkland' is used to denote grassland over which are scattered tall trees, singly or in groups, i.e. savanna with scattered elements of the summer-bare forest. [This type of vegetation occurs frequently in the *Adansonia* zone, as well as in the dry, sparse *panda* bush; it is found, for example, even in the territory of Cabinda, in very sandy country in the neighbourhood of the mangrove swamps, where

\* It is the *Brachystegia-Isoberlinia* woodland of Trapnell & Clothier (1937).

the only important trees are the baobab, the mango, the *muguengue* or hog-plum (*Spondias mombin* L.), the tamarind, the *quilulo* (*Antiaris welwitschii* Engl.) and the *mateba* palm (*Hyphaene guineënsis* Schum. & Thonn.)] In the *panda* bush country above 900 m., especially on clay soils, many other Leguminous genera (e.g. *Azelia*, *Burkea*, *Albizzia*, etc.) enter into the composition of the parkland, associated with certain *Combretum* spp. and Euphorbiaceae (*Paivaëusa*, *Maprounea*, etc.), and particularly with the Rosaceous species *Parinari curatellifolium* Planch., which is the best and most typical 'indicator' of park country; it forms groups of half-a-dozen individuals on the plateaux of Malange, Benguela and Huila, and the fruit is edible. Often present in the grass are caespitose Rubiaceae and rubber-yielding Apocynaceae, such as *Fadogia* and *Carpodinus*.

It is scattered throughout the parkland that one finds the patches of sandy desert formed by the steppes and savannas of the plateau; the *chanas da borracha*, or heath-like communities; and the dense *panda* forest of the plateau. In all these communities (except in the grass steppes on sandy soil), as on the parkland itself, the vigorous growth of the grasses makes annual fires almost inevitable, when the hot wind from the interior has completely dried up their aerial parts at the end of the dry season. The grasses, however, being of the steppe type, are never sufficiently robust and dense near the large trees to give rise to flames capable of injuring the foliage, and the trunks are protected by an almost non-inflammable layer of bark. It is evident, therefore, that 'forest fires' in Angola are far from being the disasters that they often are in many other countries, and it is even open to doubt whether the influence of the fire in these 'pyrophytic' communities is great enough to create a 'fire climax' as has sometimes been suggested.

### (2) Orchard

The term 'orchard' indicates country, somewhat similar to parkland, characterized by the more reduced stature of its arboreal elements, the greater robustness of the perennial grasses (again of the steppe type) and the greater number of perennial herbs growing amongst the latter. The shrubs and small trees of this type of vegetation include many Leguminosae, Combretaceae, etc., and among the herbaceous or sub-shrubby elements there is a preponderance of Leguminosae and Compositae. 'Orchard' country is even more 'pyrophytic' than parkland, owing to the greater relative development of the grasses, but here again serious damage to the woody components of the vegetation is almost unknown. In planted orchards of introduced fruit trees (oranges, medlars, etc.), however, quite small fires can cause considerable damage. The area of 'orchard' in Angola is relatively limited and broken up, both in the *Adansonia* zone and on the plateau.

### (3) Muteate or Mopane Bush

The *muteate* (*Copaïfera mopane* (Kirk) Benth.) occupies in Angola a very definite area, viz. a roughly triangular tract of country in the districts of Mossâmedes and Huila, from lat. 13° 20' N. near the R. Coporolo, southwards to the Damaraland frontier at Ruacanã on the R. Cunene, with its northern limit running round the foot of the Serra da Chela and thence south-eastward almost to the R. Cubango. It thus adjoins the littoral desert of Mossâmedes and, south and south-east of Chela, includes an important part of the *Adansonia* zone.

Before the fall of the leaves, *muteate* bush is somewhat similar to the *mutonge* or *cabenda* (*Copaïfera gossweileri*) bush (see p. 35) of Cuanza Norte. It has been compared in physiognomic aspect to the beech forests of northern and central Europe. Its altitudinal limits lie



between 200 and 1500 m. Where its area abuts on the Mossâmedes desert, it forms steppes with bushes only 1–2 m. in height, but in more favourable terrain it becomes entirely dominant, forming monotonous forests, giving little shade, both on the plains and on the stony hills. In the erosion valleys at the foot of the Serra da Chela it reaches a height of 15 m. The herbaceous layer of the *muteate* bush is composed of ephemeral grasses on the sandy tracts south of the R. Cunene, but mostly of Acanthaceae on coarse sand and gravel; rhizomatous plants are completely absent.

#### VI. HEATH-LIKE SCRUB

This community, though very broken up, is one of the most important in Angola. It covers the vast treeless plains occupying the level interfluvial watersheds of the plateau, and consists of dwarf shrubby vegetation exhibiting a close superficial resemblance to the heaths of western Europe. The leaves of the component species, however, though coriaceous and evergreen, are not revolute at the margins as in the typical heath-forming Ericaceae; this family is in fact poorly represented in Angola. A marked characteristic of the Angolan heath-like scrub is the poor development of the aerial parts and the correspondingly enormous development of creeping or underground rhizomes and roots, sometimes in the proportions of 1 to 30, measured vertically.

This interesting community appears to represent a climax of the summer-bare forest of the plateau (*mata de panda*) (p. 37), resulting from the combination of a sandy soil, a low water-table, and continual violent winds. The last-named factor is probably the most important. In floristic composition the community is exceedingly complex, and no one element ever achieves dominance. Two principal subdivisions are recognized, known in the colony under the names *anharas do ongote* (dwarf *Cryptosepalum* scrub) and *chanas da borracha* (rubber-plant scrub).

The *anharas do ongote* occur principally on the Bié plateau (districts of Huila, Benguela, Huambo and Bié), on the Malange plateau, and in the upper Zambezi and Luêna basin in north-eastern Moxico (where they are known as *cacué*) at altitudes of 900–1600 m. The soil is generally sandy-clay. Grasses and other herbaceous plants (except for tuberous or bulbous species) are extremely scarce. The dominant elements are various species of the Leguminous genus *Cryptosepalum* (often an important component of the *panda* bush), the species on the Bié plateau being known to the natives as *ongote* (In the province of Luanda heath-like formations are almost entirely absent.) This *ongote* scrub is only some 10–25 cm. in height, with rhizomes 5–10 cm. thick, and the patchwork formed by the varying shades of green of the foliage of the different species during the dry cold season has been compared to an immense multicoloured carpet spread over the ground. The influence of fires in this community is negligible, owing to the paucity of grasses.

The *chanas da borracha*,\* so-called from the frequent occurrence in them of rubber-yielding Apocynaceae, are found over the greater part of the Lunda district and in central and southern Moxico from the R. Lungue Bungo to the R. Cuatir or Cuatiri, at altitudes of 850–1400 m. The soil consists of continental alluvia of highly permeable sand, of immense thickness, whitish on the surface owing to the action of rainwater. It has been suggested that these sandy 'heaths' represent extinct sand-dunes, originally formed through wind-action and aridity, and subsequently colonized and fixed by vegetation when conditions of greater humidity supervened.

\* See also Gossweiler & Mendonça (review by G. M. Roseveare) 1941), p. 65.

The term *chana* connotes, to the Angolan colonist, a sandy *grass-covered* plain of the 'heath' type. The presence of an extensive grass population is one of the most important features distinguishing the *chanas* from the *anharas*. For ten months of the year the grasses almost entirely conceal the creeping woody vegetation, though they actually consist of separate tufts, and never exceed about 1 m. in height. The poverty of the soil, however, generally prevents the grasses from developing strongly enough to provide fuel for serious fires, which are consequently infrequent. Bulbous plants are here almost entirely absent.

The rubber-producing plants of this community (species of the Apocynaceous genera *Landolphia*, *Carpodinus*, etc.) were formerly intensively exploited by the Ganguelas and natives of Lunda, but this exploitation had greatly decreased or even died out by 1938 or 1939. The rhizomes of these plants are underground, slender, much branched and of enormous length.

Other members of the community have a pulvinate habit, i.e. there are no rhizomes, but the rootstock is branched repeatedly within the superficial layers of the soil, without producing roots, sending up to the surface a dense tuft of stems which just project above the surface. Examples of these are the Lecythidaceous (Barringtoniaceae) *Napoleona gossweileri* E. G. Bak. and the Rubiaceae *Appunettia angolensis* R. Good.

There is no doubt that these evergreen rhizomatous and pulvinate plants play an important part in preventing wind-erosion on these sandy tracts. The general aspect of the *chanas* has been compared to the *tomillares* of suffrutescent Labiatae of the Mediterranean and to the *phrygana* of dwarf *Quercus*, *Cistus*, etc., of the Balkans and Asia Minor. It is an interesting fact that, in the narrow transition zone from the *chanas* to the surrounding *panda* bush, nearly all the component tree species of the latter community produce dwarf creeping forms, with caespitose woody underground bases, but otherwise indistinguishable from the typical forms.

Some analogous communities have been reported from the extreme north of the Congo district, near Sacandica, east of Maquela do Zombo, on ancient alluvial sands of great thickness. The country is traversed by numerous deep ravines clothed with dense montane-type brushwood, but the low hills and wind-swept plains are covered with vegetation and grasses closely resembling that of the *chanas*. The precise status of these formations has, however, apparently yet to be determined.

#### VII. HERBACEOUS COMMUNITIES\*

It is estimated that about a third of the total area of Angola is covered with herbaceous vegetation—mainly savanna and steppe communities. Such vegetation is less exacting in its requirements of rainfall, humidity and soil-fertility than forest communities, but low rainfall is by no means the only reason for the absence of the latter in the area occupied by grassland. From a study of various regions of Angola in which, in spite of a rainfall as high as, or higher than, that of well-forested areas, the vegetation is nevertheless of the grass-savanna type, it seems evident that edaphic conditions constitute the determining factor. The soil of the grassland tracts is for the greater part of sand, or sandy clay (though there is some variation in this respect), highly permeable, and lacking any considerable water supply in the subsoil.

The principal continuous savanna area in Angola lies north of lat. 13° S. and west of

\* A somewhat more detailed account of this section will be found in Gossweiler & Mendonça (review by G. M. Roseveare) (1941).

long. 16° E., extending, however, eastwards to long. 18° E. on the Bié plateau. A second notable savanna area is formed by the basin of the R. Cuango, including the 'Cassange depression'. The vegetation of these savannas is almost entirely herbaceous, with, of course, a great preponderance of grasses. The aerial parts of the constituents are renewed annually. Practically all the vegetation of this type is directly dependent for its existence upon the rains of March and April, the period of greatest heat and humidity. Flowering and seeding takes place immediately after these rains. With the onset of the dry winds from the east and north-east in June and July, and the consequent fall of humidity to a figure much below 80, the herbaceous vegetation rapidly withers and dries up. Towards the end of the ensuing resting period, a month or two before the first rains, the annual fires occur, and these stimulate the vegetation to renewed growth. Fresh green leaves spring from the grass-tufts, and the herbaceous perennials send up flowering stems preceding the vegetative shoots. This habit of precocious flowering is very pronounced in many cases, and it is often only by carefully marking the spot where a given flowering shoot has appeared that it is possible to associate with it the corresponding foliage, which is sometimes produced long after all trace of the former has vanished.

Throughout the great area of summer-bare forest of the districts of Lunda, Moxico and Bié, occur islands of savanna, generally on the interfluvial plains or surrounding the sources of the streams. These constitute the *chanas* already referred to (p. 39), characterized by the presence of a large and varied population of dwarf, creeping, rhizomatous shrubs, growing between, and often concealed by, the tufts of grasses. The grasses, up to 1 m. in height, with rather rigid stems and leaves due to the strong development of sclerenchymatic tissue, belong mostly to the genera *Hyparrhenia*, *Andropogon*, *Loudetia*, *Tristachya* and *Ctenium*.

The vegetational types of 'Parkland' and 'Orchard', referred to under the section on summer-bare forest (see pp. 37-38), could be regarded with almost equal justice as special types of savanna, since at least 50% of the constituent vegetation consists of savanna grasses.

A special type of grass-community, in which the stems and leaves are persistent instead of dying down every year, is formed by *Setaria welwitschii* Rendle. In Angola, this community, as such, is confined to the littoral region from Luanda to Novo Redondo, with an average rainfall of 350 mm., where it is found on the black soils, or *chernozyoms*, and is dependent upon the climatic action of the ocean; the grass itself, however, occurs both north and south of this area as a constituent of other communities. The culms of the *Setaria* are suffrutescent, spreading, compressed and flexuous, and slightly over 1 m. tall including the terminal inflorescence. The leaves become greyish green in colour soon after unfolding. This somewhat anomalous community partakes both of the physiognomy of evergreen herbaceous communities and also of the morphological structure of hard-leaved brushwoods. It has little or nothing in common with savanna, since, quite apart from its physiognomy and morphology, it is, in contrast to savanna, entirely non-pyrophytic. Only about a dozen other shrubs and herbs are recorded from this community.

Fragments of evergreen herbaceous communities, in which the dominants are perennial evergreen grasses of the genera *Paspalum*, *Eragrostis*, *Cynodon*, etc., occur on marshy ground near the river mouths from the Congo to the Cunene, being usually limited on the seaward side by littoral desert and on the landward side by savanna or by marsh vegetation. These fragmentary communities are dependent as much upon the proximity of the sea as upon edaphic conditions.

## VIII. MARSH AND AQUATIC COMMUNITIES

The herbaceous flora of the permanently damp localities, where water comes to the surface but does not form pools, is extraordinarily rich and varied. The general aspect of the vegetation is that of grass meadow, but with monocotyledons forming a large percentage (nearly half) of the total, endemism is higher in this type of vegetation, in Angola, than in any other. Floristically and ecologically, however, these interesting communities are far from being well worked out.

For these damp spots, which occur commonly both on the higher plateaux and on the less elevated territory of Lunda, Moxico and the Cuanza and Cubango basins, the natives have various names, such as *molola* (south of Angola), *omuramba* (Cuenene basin), *neaca* (Benguela plateau), and *tenga* (Lunda). *Molola* and *omuramba* both designate depressions or very open valleys, more or less clayey, which become partially or completely dry at the height of the dry season. *Tenga* indicates ground that is marshy throughout the year, as is frequently the case both in the neighbourhood of springs and sources and also along the margins of the rivers that have made deep wide valleys for themselves in the sandy plains of Lunda and Moxico.

These communities are usually surrounded by savannas of the *chana* type (cf. pp. 39–40), and may themselves surround, or adjoin, fringing forest of the montane (rain-and-cloud) type. Though occurring throughout the main area of *panda* bush (summer-bare forest), they never immediately adjoin it. Vegetation of this type may also constitute a narrow zone between the swamp communities adjoining the streams, and the surrounding savannas.

Marsh vegetation of this type is, as a rule, less pyrophytic than savanna, since the aerial parts of the components dry up much later. The annual fires nevertheless stimulate them to renewed growth within a week or so, in exactly the same manner as the grasses and other herbaceous vegetation of the savannas. Shrubs occur sporadically in this community: they are mostly evergreens, and rarely exceed 1 m. in height.

Communities of the reed-swamp type—often representing a stage in the invasion or reclamation of submerged ground by terrestrial vegetation—are of frequent occurrence on the margins of rivers and lakes, in immediate proximity to the water. Here the rhizomes and bases of the stems are submerged throughout the year. The vegetation is of a coarse, rank type, including such well-known plants as reed (*Phragmites mauritianus* Kunth) and papyrus (*Cyperus papyrus* L.), besides many other tall grasses and herbs. As noted above, a narrow zone of marsh-type vegetation often separates the reed-swamp from the surrounding savanna.

In depressions in the desert areas near the coast, where the soil is damp and more or less brackish, occur small patches of herbaceous vegetation with a special flora, consisting mostly of grasses (*Sporobolus*, *Eragrostis*, *Diplachne*, *Heleochoa*, etc.) and sedges (*Scirpus*, *Juncellus*), but also including the characteristic chenopod, *Arthrocnemum fruticosum* Moq., and (north of the R. Cuanza) the fern *Bolbitis auriculata* (Lam.) Alston. The ecology of this community is still obscure.

Aquatic vegetation is represented, in the lakes and in gently moving streams, or in the slack water at the edges of the rivers, by several species of water-lily (*Nymphaea*) and Hydrocharitaceae (*Ottelia*). In some lakes of the littoral region the former are sometimes accompanied by the water-chestnut (*Trapa bispinosa* Roxb.). Some of the coastal lakes

contain such dense masses of hornwort (*Ceratophyllum*) that it is left high and dry when the level of the water falls. Species of *Aponogeton*, *Blyxa*, etc., are to be found during March and April above the 1000 m. line. At similar altitudes, on the margins of the Cunene and Cubango, the yellow-flowered Gentianaceous 'water-lily', *Limnanthemum*, covers large stretches of water. Free-floating plants such as the Aroid *Pistia stratiotes* L. and the 'fern' *Azolla pinnata* R. Br. often completely cover the surface of the water with a green sheet.

On the rocks of cataracts and waterfalls exposed to the direct rays of the sun, especially in the early part of the day, are found communities of the peculiar and interesting plants Podostemaceae and Hydrostachyaceae. In appearance they resemble mosses or liverworts: the roots are modified into irregularly linear, branched, disciform or digitate thalloid structures, adhering tenaciously to the living rock in the swiftest current. The stems are usually also prostrate, but sometimes erect and up to 25 cm. high. They may be annual or perennial, but their vegetative period does not exceed about a month and a half, coinciding with the period when the rocks of the cataracts are submerged during the great rains. Fruiting takes place when the water-level falls sufficiently to expose the plants to the air, and by the time the dry season commences, in June, the dried-up masses of these plants may be seen covering the rocks of the cataracts. Some species attach themselves to stones in the beds of slowly moving streams of less than 20 cm. depth. In Angola, all the species of this community occur on the plateau, up to 1300 m., except one (*Angolaea fluitans* Wedd.) which descends to 50 m. at the Cambambe cataracts on the R. Cuanza.

In shallow brackish water near the coast the tasselled pondweed (*Ruppia maritima* L.) occurs, while off-shore may be found, between the tide-marks, 'meadows' of grass-wrack (*Zostera nana* Roth).

#### IX. DESERT COMMUNITIES

Under this heading are included Steppes as well as typical Dry Desert. In Angola, only the Desert of Mossâmedes falls into the latter category. Elsewhere in the colony steppes occur frequently, especially on the littoral, as a function of edaphic factors and not of rainfall. For example, in the regions of Cacongo and Zaire, where the annual rainfall is about 700 mm., grass steppes are frequent on the sandy alluvia almost up to the French frontier, while on the Mossâmedes littoral, with an annual rainfall of 240 mm., there are steppes of *Aristida prodigiosa* flowering and fruiting in the month of September, i.e. at a time when in all other parts of Angola the grass vegetation of the savanna type is undergoing a resting period.

The distinction between steppe and desert is not always clear, and there appears to be a great absence of agreement in the employment of the two terms. The following field test has been suggested. The observer lies with his eye at ground-level and looks along the surface. If he sees a continuous 'wall' of vegetation, the community should be classified as 'steppe'; if gaps appear, the community may be regarded as 'desert'. In Angola, however, the characteristic plants of the desert do not grow on the steppes, and indeed cannot, as a rule, be cultivated outside their proper habitat. The annual rainfall in regions of true desert is usually less than 250 mm.

The most important desert area in Angola is that formed by the Desert of Mossâmedes in the south-west corner of the colony. It is the north-western extension of the Kalahari Desert, and is part of the 'Namib peneplain' of geologists. Forming a rather narrow

coastal zone 15–45 miles in width, it reaches its northernmost limit at about lat. 12° S., a short distance north of Lobito, whilst to the south it widens rapidly as it approaches the R. Cunene, its eastern boundary crossing this river at about the cataract of Ruacaná, near the 14th meridian E. of Greenwich, approximately 150 miles from the sea.

While, however, it is fairly easy to outline the area occupied by this desert region, it is by no means so easy to present a general picture of the vegetation, since no comprehensive account of it appears to exist. One may take the profile traversed by the railway from Mossâmedes to Sá da Bandeira (Lubango) as a sample of what occurs in the immediate neighbourhood of the 15th parallel.

During the first 3 km., between the rivers Bero and Giraúl, the line passes through various fragments of *Litorideserta* modified by the biotic factor, but after the Lagôa da Mina, at an altitude of 30 m., there occur patches of ground that are without vegetation of any kind, even during the rainy season. The soil is composed of wind-polished superficial flints, and the absence of vegetation appears to be due as much to the dry east wind as to the absence of soil moisture. Immediately after these bare patches, the characteristic desert vegetation of the littoral is resumed. At about 20 km. from the sea, at 300 m. altitude, there appear steppes of the Acanthaceous *Petalidium tomentosum* S. Moore, with prostrate woody stems, 2–3 cm. in diameter, covered by wind-blown sand. Here also are seen groups of the curious Vitaceous plant, *Cissus macropus* Welw., known as *odre*; its short, thick, succulent stem, surrounded below with a *cheveux de frise* of spiny modified branches, is so characteristic that it can be recognized from a considerable distance. The sheltered depressions in the ground are clothed, in May, with psammophilous vegetation, dominated by the grass *Aristida gracilior* Pilger, which sometimes forms pure stands. Elsewhere on the Mossâmedes littoral another species (*A. prodigiosa* Welw.) predominates, which flowers in September—the period when fires generally occur in the interior—and ascends to 600 m. eastwards. The surface layer of the soil is formed in many places by coarse, rather compact, granitic sand, and in such habitats occur steppes of a characteristic succulent spurge (*Euphorbia ?dinteri* Berger).

In the region of Pedra Grande, about 40 km. from the sea, the desert merges into shrub steppe, with Capparids (*Boscia* spp.), Acacias, and other elements. Twenty kilometres on, the shrub steppe gives place to the continuous *muteate* bush (*Copaïfera mopane* (Kirk) Benth.) that occupies such a vast area in the south-west of the colony (see p. 38).

Besides the spurge mentioned above, there is another species (*Euphorbia ?rhipsaloides* Welw.), not seen along the railway line, which occurs in the valley of the Mucungo, a tributary of the Piambo, situated about 20 km. to the north of Mossâmedes. Like all the 'rivers' of the desert zone, the R. Mucungo runs in an erosion valley, with rolled flints and gravel, and is dry in the month of May. The soil in this region is formed of gneiss and mica-schists, with patches of gravel and coarse sand, and lacking any clay or humus. The hills are clothed with shrubs and herbs typical of stony desert. On the sandy and consolidated patches, exposed to wind action, are seen fragments of *Aristida prodigiosa* steppe, with other grasses intermingled. This formation has been compared to the *Stipa tenacissima* community of Tunisia, but the Mucungo grasses are not suffrutescent, and the tufts are more open. Shrubs, which are frequent, are represented by *Euphorbia* (Sect. *Tirucalli*), *Banhimia*, *Acacia*, and *Blepharis* (Acanthaceae), forming compact bushes 1–2 m. in height. Herbaceous vegetation is represented by *Zygophyllum simplex* L., with creeping stems.

In the region of Mossâmedes, *Welwitschia bainesii* (Welw.) Carr. (*W. mirabilis* Hook. f.), the most remarkable plant of the south-western African deserts, and one of the most interesting in the world, reaches its most northerly known habitat, though its precise area in Angola is as yet incompletely mapped. It has been reported north of the R. Giraúl, but the only part of Angolan territory where it is definitely known to occur is a small area of about 1000 sq.km. south and south-east of the town of Mossâmedes. This area lies between the rivers Bero and Coroca, from 20 to 80 km. from the coast, at altitudes between 40 and 150 m., extending eastwards slightly beyond the Pico de Azevedo. Between the Coroca and the Cunene it is not known to occur.

The *Welwitschia*—whose names commemorate those of the famous botanist and traveller, Dr Friedrich M. J. Welwitsch, and of the English artist and explorer, Thomas Baines—is remarkable, not only for its habitat and geographical distribution, but for its growth-form and botanical isolation. Technically the plant is a tree, but the trunk never exceeds about 1 ft. in height: it is a stout, two-lobed, obconical structure, narrowing downwards into a strong taproot. At the outer edge of each lobe is a groove, from which springs a leaf. These two leaves are the first pair produced after the cotyledons and are the only leaves the plant ever has: they continue growing at the base throughout its life (which may be of several centuries duration), wearing away at the tips and often becoming torn down to the base owing to the action of the wind. The stem continues to grow in thickness but not in length, and exhibits concentric grooves upon the upper surface, in the outer (younger) of which the inflorescences are produced. The flowers are dioecious—that is to say the male and female flowers are not only separate but are produced on different individuals. Pollination is effected by a species of plant bug (Hemiptera-Heteroptera). Seeds are produced in abundance, and are wind-dispersed by the aid of the winged perianth in which they are enclosed. They germinate in the occasional wet years experienced in this arid region (mean annual rainfall of Mossâmedes, 53 mm.). The bulk of the moisture required for current growth is derived from sea fogs, which cause a heavy deposit of dew.

The botanical relationships of *Welwitschia* cannot be discussed here—they are in any case somewhat obscure—but the plant is considered to be a Gymnosperm, i.e. a member of the same phylum as the Coniferae, perhaps most closely related to the *Ephedras* of the Mediterranean region, which are likewise desert-loving plants, though of very different appearance.

Between Monte Negro and the Pico de Azevedo the *Welwitschia*, in association with patches of *Aristida prodigiosa*, forms steppes. The soil consists of superficial deposits of coarse, compact, granitic sand, overlying schists, and gravels of the upper Tertiary strata of the 'Namib penepain'. During the months of April, May and June, in wet years, the *Aristida* affords protection to the *Welwitschia* seedlings immediately after germination. A few other species are found in this scanty community, including the fleshy-stemmed Geraniaceous plant *Sarcocaulon mossamedense* Hiern. Fugacious annuals also occur, flowering in May.

Although, as previously stated, the desert area extends north of Lobito, the characteristic South African desert plants stop short at Lengue, near Benguela. This marks the northern limit of the area influenced by the desert climate. On the zone of archaean rocks between Lengue and S. Pedro, on the Benguela railway line, about 22 km. from the Atlantic and at 120–200 m. altitude, may be found such typical desert plants as *Pachypodium lealii* Welw. and *Adenium boehmianum* Schinz (Apocynaceae), *Hoodia*

*parviflora* N. E. Br. (Asclepiadaceae) and *Sclerocarya schweinfurthiana* Schinz (Anacardiaceae), mostly with thick stems and more or less fleshy leaves. This zone gives way to the *candeia* (*Acacia detinens*) belt, in which this thorn clothes the low hills of the broken clayey country in almost pure stands.

A special type of desert community is that formed by the strand flora, which is composed of halophytes directly dependent upon the proximity of the sea, and the consequent salinity of the atmosphere, as well as upon the sandy nature of the habitat. Such plants are almost all perennials, though a few annuals occur in the southern sector of the Angolan coastline. Grasses are generally well in evidence, besides plants with more or less succulent stems and leaves such as Aizoaceae (*Mesembrianthemum*, *Sesuvium*, *Mollugo*), Chenopodiaceae (*Arthrocnemum*, *Suaeda*, *Salsola*), etc. Certain creeping Convolvulaceae (*Ipomoea*, *Merremia*, etc.) are very characteristic of this community, and Leguminosae are comparatively well represented. The number of species that manage to thrive under these conditions is, however, strictly limited, and the community is always a sparse one. A very similar community characterizes the mobile sand-dunes, such as are found in the neighbourhood of Mossâmedes and Pôrto Alexandre.

In the southern part of Angola there occur many areas of sandy desert, often quite extensive, scattered over the various formations. In the south-eastern corner of Bié province, these desert areas, occurring in the midst of *panda* bush or thorn scrub, are accompanied by considerable populations of the palm *Hyphaene ventricosa* and of the Anacardiaceous *Sclerocarya schweinfurthiana*. The detailed composition of the flora of this region is, however, practically unknown, and this also applies to much of the region to the west, i.e. to the south-eastern part of Huila province, where large areas of desert occur in the *Copaïfera mopane* bush. Ephemeral grasses—principally *Aristida* spp.—form a dense covering for a month or two (May–June), but disappear by August or September, leaving nothing but bare sand.

The large isolated area of alluvial sand around Catengue, south-east of Benguela, supports a noteworthy, though scattered, population of *Hyphaene* (? *benguelensis*), surrounded by, and interspersed with, the *ongerite* (*Maprounea africana*) association. Other large areas of shrub steppe or sandy desert occur immediately to the east of the Serra da Chela, and again south-east of this, between the Caculovar and Cunene valleys, but no information regarding the vegetation appears to be available.

In the northern part of the littoral zone (districts of Luanda, Cuanza Norte and Cuanza Sul) smaller areas of 'desert' occur, which would probably be better described as 'steppe'. In the 'musseque' region of the Luanda plain (alt. c. 110 m.) are grass steppes of *Aristida*, *Schizachyrium*, etc., with scattered individuals of *Aloë littoralis* Bak. and various Capraris. On some of the hills of the 'coffee forest' of Cuanza Norte, at 900–1000 m. altitude, there are similar grass and shrub steppes, mainly determined by physiographic factors. Steppes in which grasses play a minor part, or are absent, but in which a spurge (*Euphorbia strangulata* N. E. Br.), in association with other elements, is conspicuous, occur near Pungo Andongo (west of Malange) and on the hill summits at Amboim and Seles.

In the Zaire and Congo districts, grass steppes are frequent, e.g. on the 'musseque' of the plains of Sumba and S. Antonio do Zaire (alt. c. 120 m.), on the gravelly hills of the Bembe region (alt. c. 550 m.), on sandy alluvia in the Sacandica area (alt. c. 700 m.), and on the littoral from Ambriz to Ambrizete. The dominant grasses of these steppes are species of *Hyparrhenia*, *Andropogon* and *Loudetia*.



Under the heading of 'desert' must be included the frequent patches of sand occurring throughout the vast summer-bare forest (or *panda* bush) and savannas of the interior (Bié, Moxico and Lunda districts), before they have reached the stage of supporting creeping rhizomatous vegetation such as characterizes the *chanas*. The fact that the annual rainfall here is little short of 1000 mm. clearly indicates that the steppe vegetation of these sandy areas is the result of the poverty and great permeability of the soil. The constituent grasses are of the caespitose type, forming tufts with considerable intervals between them, and with erect unbranched culms; here, again, species of *Loudetia* and *Hyparrhenia* are conspicuous, as well as other genera. Contrary to the view, at one time put forward, that these areas were parts of former forests that had been destroyed by fire, it is now believed that they represent the first stage in the evolution of the plant-covering of former desert areas, the grasses being the pioneers in this process, to be eventually followed and accompanied by the woody rhizomatous elements of the true *chanas*. Whether the process can, under favourable circumstances, be carried to the stage when arboreal vegetation can be supported, and, if so, whether the so-called 'heath forests' or 'white sand forests' of Guiana and Borneo actually represent the achievement of this stage in those countries, are interesting points for speculation; certain similarities in the edaphic and floristic features of the respective communities suggest an answer in the affirmative.

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## GLOSSARY OF VERNACULAR NAMES, ETC.

agave	<i>Vellozia</i> spp.
anharas do ongote	Dwarf heath-like <i>Cryptosepalum</i> scrub.
baobab	<i>Adansonia digitata</i> Juss.
borracha	Rubber-yielding Apocynaceae ( <i>Landolphia</i> , <i>Carpodinus</i> , etc.).
cabenda	<i>Celtis Zenkeri</i> Engl. and <i>C. Soyauxii</i> Engl.; <i>Copaifera gossweileri</i> Exell.
cacué (= anharas do ongote)	Dwarf heath-like <i>Cryptosepalum</i> scrub.
'cajueiro (cashew)	<i>Anacardium occidentale</i> L.
calolo	<i>Phoenix reclinata</i> Jacq.
calusange	<i>Commiphora</i> sp.
candeia	<i>Acacia detinens</i> Burch.
cashew	<i>Anacardium occidentale</i> L.
chanas da borracha	Grass-covered plains with heath-like (rubber-plant) scrub.
cocota	Fossilized gum (? of <i>Copaifera</i> ).
colete	<i>Acacia etbaica</i> Schweinf.
fan-palm	<i>Hyphaene</i> spp.
homoé	<i>Isobertinia</i> spp.
imbondeiro	<i>Adansonia digitata</i> Juss. (baobab).
jiquiri	<i>Pteleopsis myrtifolia</i> (Laws.) Engl. & Diels.
mafua	<i>Chrysobalanus ellipticus</i> Soland.
mafuca	<i>Parinari</i> spp.
mafuma	<i>Ceiba pentandra</i> (L.) Gaertn.
mafumeira	<i>C. pentandra</i> (L.) Gaertn. and <i>Bombax reflexum</i> Sprague.

## Vegetation of Angola

mahambo	<i>Adina microcephala</i> Hiern.
maiamba	<i>Raphia</i> sp.
mangue	<i>Sclerosperma manni</i> Wendl.
mangueira (mango)	<i>Mangifera indica</i> L.
mata de panda (panda bush)	<i>Brachystegia-Isobertinia</i> woodland.
mateba	<i>Hyphaene guineënsis</i> Schum. & Thonn.
miengo	<i>Rhizophora mangle</i> L.
molola	Damp clayey depression or open valley.
mopane	<i>Copaifera mopane</i> (Kirk) Benth.
mubanga	<i>Acacia welwitschii</i> Oliv.
muchovi	<i>Brachystegia bequaertii</i> De Wild.
mucuto	<i>Euphorbia conspicua</i> N. E. Br.
mucuve	<i>Cryptosepalum pseudotaxus</i> E. G. Bak.
mufuta	<i>Oxystigma mafuta</i> De Wild.
mufuto	<i>Albizzia versicolor</i> Welw.
muguengue	<i>Spondias mombin</i> L.
muheia	<i>Acacia albida</i> Del.
mulelame	<i>Commiphora</i> sp.
mulolo	<i>Bauhinia thonningii</i> Schumach.
mumúé	<i>Isobertinia baumii</i> (Harms).
munage	<i>Entada abyssinica</i> var. <i>microphylla</i> Oliv.
mungando	<i>Combretum imberbe</i> Wawra.
mungenio	<i>Dichrostachys glomerata</i> (Forsk.) Chiov.
múngo	<i>Pteleopsis diptera</i> (Welw.) Engl. & Diels.
mungua	
mungolo	<i>Commiphora</i> sp.
musoso	<i>Entada abyssinica</i> var. <i>microphylla</i> Oliv.
mussamba	<i>Brachystegia tamarindoides</i> Welw.
mussesse	<i>Crossopteryx febrifuga</i> Benth.
mussongue	<i>Acacia sieberiana</i> DC.
mutala menha	<i>Lonchocarpus sericeus</i> H. B. K.
muteate	<i>Copaifera mopane</i> (Kirk) Benth.
mutonge	<i>C. gossweileri</i> Exell.
mutubué	<i>Isobertinia angolensis</i> (Welw. & Benth.).
muxixe	<i>Sterculia setigera</i> Del.
neaca	Permanently damp area.
nesanga	<i>Musanga smithii</i> R. Br.
odre	<i>Cissus macropus</i> Welw.
ommumbungurulu	<i>Platroxylon obliquum</i> (Thunb.) Radlk.
omuramba	Damp clayey depression or open valley.
ongerite	<i>Maprounea africana</i> Muell. Arg.
ongote	<i>Cryptosepalum</i> sp.
paco	<i>Platroxylon obliquum</i> (Thunb.) Radlk.
palmito	<i>Phoenix reclinata</i> Jacq.
panda	<i>Brachystegia</i> and <i>Isobertinia</i> spp.
pao oleo (oil wood)	<i>Adina microcephala</i> Hiern.
quilulo	<i>Antiaris welwitschii</i> Engl.
quissare	<i>Pandanus welwitschii</i> Rendle.
quissoma	<i>Euphorbia conspicua</i> N. E. Br.
raffia	<i>Raphia</i> spp.
samba	<i>Brachystegia gossweileri</i> Hutch. & Burt Davy or <i>B. russelliae</i> Johnst.
sende	<i>Dichrostachys glomerata</i> (Forsk.) Chiov.
sengue	<i>Vellozia</i> spp.
taba	Hydrophilous community of alluvial area of Congo mouth.
tala-menha	<i>Oxystigma mafuta</i> De Wild.
tenga	Perennially marshy ground.
uê	<i>Acacia albida</i> Del.
vanza	<i>Pentaclethra macrophylla</i> Benth.
verungo	<i>Landolphia</i> sp.
vivungo	<i>Carpodinus gracilis</i> Stapf.