EAST AFRICA PROTECTORATE.

REPORT

ON THE

FORESTS OF BRITISH EAST AFRICA

By D. E. HUTCHINS.

With a Map and 25 Photographs.

Presented to both Houses of Parliament by Command of His Majesty.
October, 1909.

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By D. E. HUTCHINS.

THE FORESTS OF BRITISH EAST AFRICA.

"Marshes must be drained, *forests skilfully thinned*, and rivers taught to run in ordered measures."—(Sir C. ELIOT.)

I estimate that the Government timber forests of British East Africa occupy an area of about two million acres, distributed approximately as follows:—

FOREST AREAS, BRITISH EAST AFRICA—ACTUAL TIMBER FOREST.

LOWLAND TROPICAL FOREST.

South of Mombasa.

	Acres.
Shimba hills, 6 square miles	3,840
Other coast forests not yet demarcated, 4 square miles	2,560
Tavèta forests, about 15 square miles	9,600

North of Mombasa.

Lowland forest near Voi	1,250
Arabuku and Shikoko (timber forest, about 12 square miles) ...	7,680
Witu forest, about 4 square miles	2,560
Tana River forest, fringe averaging about $\frac{1}{5}$th mile broad by 200 miles long	25,600
Juba River forest, fringe about 200 miles long by about $\frac{1}{2}$ mile of average width (in some places it is 8 miles broad)... ...	64,000
Total, Lowland Tropical Forest	117,090

HIGHLAND EXTRA-TROPICAL FOREST.

	Acres.
Kilimanjàro-Laitok, 12 square miles	7,680
Erok forest, about 16 square miles	10,240
Other forests on Anglo-German boundary, about 50 square miles	32,000
m'Dì forests, on mountain tops, near Voi	6,000
Forests near Nairobi and South of Uganda Railway, area estimated, surveys not yet completed	61,440
Aberdare forests (see page 18)	477,440
Kenia forest (Ross' preliminary plan)	400,000
Mau forests (see page 23)	768,379
Elgon, 50 square miles	32,000
Total, Highland Forests	1,795,179

For the Kakamèga and Kikelèwa forests (page 13) and certain unexplored forests we may allow about 200 square miles = 128,000 acres.

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Total Area, Government Timber Forests, British East Africa.

	Acres.
Highland forests	1,795,179
Tropical forests	117,090
Forests unclassed and unexplored	128,000
Grand total	2,040,269*

According to a recent calculation (Sir H. Johnston in "Nineteenth Century" for October, 1908) the total area of the East Africa Protectorate is 205,000 square miles; so that the Government timber-forest area forms $\frac{1}{64\cdot3}$ part only of the total area of the Protectorate, or 1·55 per cent.

This, it will be understood, is exclusive of the scrub and thorn bush of the plains, which, possibly, occupies an area six or eight times the area of the timber forest.

This estimate has been framed on the best existing data. It is subject to correction with the progress of the existing forest surveys and the possible discovery of more forest in the south-west and north-west of the Protectorate.

If we consider the Highlands alone, and take Sir H. Johnston's area of 16 million acres for the area of the Highlands, the proportion of forest is nearly one-eighth. Allowing for unexplored forest there is altogether an area of nearly 2,000,000 acres of timber forest in the Highlands: or 13 per cent. the area of the Highlands.

Since the first draft of this report was written, I have enjoyed the advantage of a two-months' tour through the Kenia forest, viewing the forest girdle and measuring the timber from both above and below. A nearly complete circuit was made of the Alpine region, lying at an elevation of between 11,000 and 14,000 feet. My fellow-traveller, Mr. McGregor Ross (Director, Public Works Department), triangulated round the Alpine region, and his preliminary map of the Kenia forest furnishes the latest information on this important forest area. The accompanying forest map† has been compiled as the result of my own travels in British East Africa and information supplied by Forest Officers, Surveyors, and travellers.

The photographs† speak for themselves. For them I am indebted to Mr. Battiscombe, the Deputy Conservator, who accompanied me on my first tour through the forests, and to Mr. Ross, who accompanied me on the Kenia tour, mentioned above. In looking at them it must be remembered that they represent, in almost every instance, the outside of the forest or isolated trees. Photographs of the interior of the dense dark forest failed, as I have known them to so frequently fail on other occasions.

In Equatorial Africa are four mountain masses girt with well-defined forest girdles, Kilimànjaro, Kenia, Ruwenzori, and Elgon. Of these, the first has but a small part of its forest girdle in British East Africa, the second is entirely within, the third entirely without, and the fourth about half within and half without. The first three are capped with eternal snow. Of these mountain forests it is the Kenia forest which, from its situation near the Uganda Railway, and the size and growth of its timber, claims the first attention, and particularly so in a report on the forests of British East Africa, where it forms the largest compact mass of forest. The topography of Kenia may be compared to that of an inverted saucer with a snowy tooth-like ridge in the middle. It is this inverted-saucer shape which gives to the Kenia country and its forest their value. The country rises gradually and inappreciably to the edge of the forest belt. It rises slowly in the forest belt, thus enabling the timber to be easily run out. In much of the forest belt it is only by consulting a barometer that one can tell whether one is rising or falling, so gradual is the general ascent. It is this gradual ascent of the Kenia highlands that gives to them their agricultural value and to the forest its possibility of easy timber working. If Kenia had risen steeply there would have been a rainfall coming in deluges. It would not have had the temperate climate and moderate rainfall it now possesses. It would have had excessive rain on the south and east sides, with deficient rain on the north and west sides. At present, the excess of rain on the south and east sides, and the deficiency on the north and west is only

* To this might be added 105,466 acres of private forest (page 64): but this forest is being rapidly destroyed and need not be considered unless early measures can be taken to redeem it. The figure 2,349,709 acres includes 94,944 acres (Grogan) and 7,680 (Arabuku) leased forest.

† See at end of volume.

moderately accentuated. This unequal distribution of rain is often seen in mountains with constant rain-winds, Mexico for instance. The amazing fertility of the highland country of British East Africa generally, and of the forest country in particular, arises from its rich, deep, red, volcanic soil; and its abundant well-distributed rainfall, which may be taken to vary from 20 inches in the Rift Valley to about 120 inches or 150 inches on the wetter mountain slopes. Nairobi, at the beginning of the forest country, has a rainfall of 35 inches.

The geographical position of the forests of British East Africa is well stated by Alfred Wallace:—

> "With but few and unimportant exceptions, a great forest band, from a thousand to fifteen hundred miles in width, girdles the earth at the Equator, clothing hill, plain, and mountain with an evergreen mantle. Lofty peaks and precipitous ridges are sometimes bare, but often the woody covering continues to a height of eight or ten thousand feet, as in some of the volcanic mountains of Java and on portions of the Eastern Andes. Beyond the forests, both to the north and south, we meet first with woody and then open country, soon changing into arid plains or even deserts, which form an almost continuous band in the vicinity of the two tropics." ("Natural Selection and Tropical Nature."—A. R. Wallace.)

When this was written it was not known that there was in Equatorial Africa a region similar to the Equatorial Andes, with snowy mountains of practically the same height and extra-tropical forests of large extent, beautifying a white-man's country equal in area to Ireland. Little was known then of lofty Kilimanjàro, of Kenia with its 15 glaciers, or of rainy Ruwenzòri wrapped in perpetual mist.

THE TROPICAL COAST FOREST.

The coast forest is quite tropical throughout. It begins with the Mangroves of the coast and extends in British East Africa to the moderate elevation (1,200 feet) of the Shimba hills. The temperature is that of an unmitigated tropical climate (mean of Zanzibar, 80°). It may be noted here that in German East Africa the coast forests rise to comparatively temperate climates in Usambàra, but that this is not the case with the coast forests of British East Africa. The forest on the Shimba hills, though not compact, still contains some fine specimens of timber trees, and all along the edges of the numerous forest glades is a good growth of the Rubber tree *Landolphia kirkii* and other species of *Landolphia*. The comparatively small and broken character of these forests renders their timber of secondary value, but there is a small yield of first-rate rubber, and there are great possibilities of increasing the yield of rubber by planting in the numerous forest glades and on the well-watered lands adjoining the forest. *Ebony occurs widespread throughout the coast scrubs, usually as small trees with crooked stems. Stems up to 24-inch diameter can be obtained. The heartwood is very hard and as black as coal. Tent mallets and walking sticks are made of it. It is probably too scarce and crooked to export with profit, and the tree is too slow-growing to plant with profit in forest plantations. The coast forests produce also a fine Copal Resin (*Trachylobium hornemannianum*). The production of this could, no doubt, be extended by planting the Copal trees.

Coast Forests.—What is wanted in these coast forests is a good timber tree like the Mora of Guiana (*Mora excelsa*), which will form a dense stand and fill up the forest. The Mora is a noble tree of Guiana, where it forms *pure forest*, a rare class of forest in the Tropics. It seasons without splitting, and is ranked well at Lloyds. The Mora is leguminous, with, apparently, a good natural reproduction. Teak, Mahogany and Mora should be planted in the coast forests, where there is a good rainfall, as on the Shimba hills.

It is possible also that Cloves might be planted commercially and flourish, as in the neighbouring island of Pemba, where they were introduced not many years ago from the Straits Settlements.

It will be necessary to demarcate out the actual valuable coast forest and leave the remainder, and by far the greater portion, of the land available for plantations of Rubber, &c., simply reserving trees of the more valuable species whenever they occur.

Tavèta Forests.—In the exclusion of Kilimanjàro from the British boundaries, a small portion of the upper and more of the lower slopes, the Tavèta District, was

* *Dalbergia melanoxylon.*

left within the British boundaries. This Tavèta District contains good forest. Sir C. Eliot describes it as the best forest in the Protectorate, but this would be exclusive of the best forest at Kenia and Eldoma Ravine, which he had not seen. It is undoubtedly good forest, though it is said to contain mostly hardwoods. I was, unfortunately, unable to visit the Tavèta Forest. Major Smith, the Director of Surveys, informs me that the Tavèta forest is of a good class, but is now being destroyed since the fear of the Masai raids has gone. There are indications that the forest here has retreated, judging from the burnt stumps and old trunks.

Arabuku and Shikoku Forests.—Competent authority estimates the actual forest in the Arabuku and Shikoku area at only 12 square miles. At its best it is far from being equal to the timber forest on the Kenia and Aberdare mountains. Its chief value lies in the Sandal (m'Huhu), *Brachylæna* sp., and Bembu kofe, *Afzelia cunanzense*, together with a few other timbers which reach a sufficient size to be sawable.

Witu Forest.—Close to the village of Witu lies the Witu forest, about 40 square miles in area. This is a good forest, containing large timber, great trunks from which canoes are made and handsome furniture wood. Here, also, occurs a timber which is much prized, and is known locally as Teak.

Tàna River Forest.—In the dry northern portion of the Protectorate are two narrow strips of forest fringing the Tàna and Juba Rivers. In places, on alluvial land, this forest spreads out to widths of 5 or 6 miles, and, occasionally, 8 miles. These two rivers are comparable to the Nile, in that they have their rise in heavy rainfall areas, and flow through desert country to the sea. The Tàna River flows from the Kenia forest and the Juba River from the forest-clad slopes of the Abyssinian mountains. Both rivers rise, fall, and flood their alluvial lands in the desert, as does the Nile. Whereas, however, the Nile delta is extra-tropical, with a particularly fine winter climate, the alluvial lands on the Tàna and Juba Rivers are in the unmitigated tropics, and almost under the Equator. Mosquitoes swarm, and malarial fever is rife. From a health point of view, the forest bordering these rivers should be cleared, as ancient man cleared and rendered more healthy the delta of the Nile. Undoubtedly most of the forest on the Tàna and Juba Rivers should be cleared and turned to cultivable land, exactly as the surplus forest lands of Canada, Siberia, and Australia must be cleared to allow of human settlement and progress. Climatically, the clearing of this forest is as important as is the retention of the forest of a different character in the temperate and healthy climate of the mountains where these rivers rise. Even, apart from the question of healthfulness, these alluvial river lands under a tropical sun are, proverbially, productive agriculturally, while the timbers they produce are, as a class, too hard to be generally useful to human industry.

The Tàna River has been ascended and the forest viewed by various officials and travellers during the last 10 or 15 years, especially before the making of the Uganda Railway, when it was proposed to utilise the Tana River as a waterway to the interior. The explorers' estimates of the forest area vary greatly; but the figures of the forest area adopted in this report may be taken as sufficiently accurate. I find that those travellers who have had the best means of observing the forests give fairly concordant figures.* It seems that the forest on the Tàna River is inferior to that on the Juba River.

FOREST ON JUBA RIVER.

I am indebted to Mr. Salkeld, the Provincial Commissioner, Kismàyu, for the following information regarding the forest and timbers on the Juba River :—

The forest fringing the Juba River begins about 5 miles north of Yonti. It forms a barrier between the alluvial tract bordering the river and the dry Somali country. Its distance south of Mfudu, from the river, varies from 1 to 5 miles. Its width is from 1 to 5 miles. Mfudu is almost exactly 100 miles north of Yonti.

2. From Mfudu the forest extends again about 100 miles northwards. Here, it is right on the river bank and varies in width up to about, at some places, 8 miles across.

TIMBERS OF THE GÈSHA DISTRICT, JUBALAND.

"Shànferède" is the most common timber, but white ants get into it very easily.

"Koben" comes next in abundance; it is a very hard wood and splits when worked. Full grown, its diameter is about $2\frac{1}{2}$ feet and its height about 20 feet.

* Mr. Battiscombe has recently returned from a special inspection of the Tàna River forest fringe, and estimates its area and value even lower than the figures here given.

"Daigàn" seems an excellent red wood. Rafters for the Government House, now building at Gèsha, are being cut of this wood. When old, it has a diameter of 10 feet or more.

"Harèri" has a diameter of 3 feet, and is said to grow to a height of 50 feet.

"Shauri" is a very strong red wood, much used by the Wagèsha for making canoes. This tree is not very plentiful, and, being much prized by the Wagèsha, nearly every tree belongs to someone. The old trees have a diameter of 13 feet, and grow very straight.

These timbers commence about 140 miles up the Juba River, and extend northwards along the river banks in the forests.

"Huya Guled" grows only to a height of 8 feet, with a diameter at base of only 2 feet.

"Didi" is a very hard wood which grows to a height of about 20 feet, and diameter of over 2 feet. This tree is found in large quantities.

"Idshebel" is a thorny tree, which grows in the shape of an umbrella.

"Bissac" has much the same shape but is not thorny.

RUBBER.

British East Africa has a comparatively small area of heavy rainfall coast country. Though under the Equator, it is thus a country not particularly well suited for the growth of rubber. The comparatively heavy rainfall coast area is confined to the triangle south of Mombasa, and an ever-narrowing coast strip extending up the coast north of Mombasa. Outside this area Rubber may be cultivated profitably, but it must be remembered that the conditions are not the most favourable for Rubber cultivation. On the Lowlands, towards the lake, though the days are hot, and the rainfall generally heavy, the nights are cool owing to the altitude (nearly 4,000 feet). Thus, neither at the coast nor the lake do we get the ideal rubber climate, hot and wet throughout the greater portion of the year. Rubber is not known to exist in payable quantity near the lake. Vine rubber occurs throughout the forests of British East Africa from the coast up to elevations of 6,000 or, even, 7,000 feet in the wetter Highland forests. At the coast *Landolphia kirkii* is abundant, and *Landolphia florida* often seen. The latter, up to the present, has not yielded marketable rubber. In the Highland forests only one *Landolphia* vine occurs, and this not in the abundance that is seen at the coast. There are scrub areas on the coast where rubber exists up to an occasional average of 400 vines per acre (over 1-inch diameter); and 100 vines per acre is the usual average in the Kirwìtu area north of Mombasa. Mr. Powel came to the conclusion, after consultation with the Liwali of Tàkaungu and others (Report, January, 1907), that the yield from workable vines would average per vine as follows:—

New vines	1/5 lb.
Tapped vines	1/10 lb.
Root of vines	2 lbs.

Mr. Battiscombe estimated that if the vines were worked systematically it would be possible to obtain a sustained yield at the rate of 20 lbs. of rubber per acre per year in the country between Tàkaungu and the Chogni hills, north of Mombasa. The estimate is based on a yield of 1 lb. per vine, 100 vines per acre, and a rotation of 5 years, viz., one year complete tapping and four years' rest. This is a scrub area with the vines standing thick throughout. It may be taken as the maximum area for British East Africa. South of Mombasa it is doubtful if the yield would average one-sixth of this.

The rubber-yielding capabilities of the newly-discovered n'Goa rubber tree (*Mascarinhasia elastica*) are not yet fully known. It has been but little tapped for rubber. When it comes to be better known to the rubber gatherers we shall learn more facts both regarding its abundance in the forest and its rubber-yielding capabilities. For planting purposes it may be the most suitable rubber tree for the Mombasa coast districts. There is no doubt that it is the most suitable *indigenous* rubber tree for planting purposes. It bears seed abundantly, and is easily propagated. There are some healthy young trees in the Shimba hills forest plantation. As a young planted tree it is quick-growing. The wild tree, I noted as a small or medium-sized tree, not as large as the *Funtumia elastica* of Uganda, which it otherwise somewhat resembles. It is frequently seen on the Shimba hills, but is not at all as abundant as the rubber vine *Landolphia kirkii*. The n'Goa rubber rarely occurs naturally outside the strips of forest lining valleys and bordering streams.

It is tapped by making cuts with a knife across the trunk; the latex flows freely and coagulates easily. A not very clean sample of its rubber was valued in London at 3s. 6d., against 5s. 2d. for Parà. (Kew Bulletin, 1907—283.)

In the lower Highlands of British East Africa occurs a species of *Landolphia* which has been labelled at Kew as *Landolphia jasminochyla*. It differs little in appearance from the *Landolphia kirkii* of the coast, but does not grow to so large a size, nor does it yield rubber so abundantly. In the lower Kenia forest, between 5,500 feet and 6,500 feet, it is occasionally met with, but not large enough nor sufficiently abundant to make its collection commercially profitable. In the Nandi country it is more abundant, and it was thought by explorers that the collection of rubber here might prove a profitable industry. Permits have, therefore, been given on the share system under the following conditions:—

Permission is herewith granted to * * * * * to collect rubber in * * * for a period of one year from the date of issue of this permit. This permit is issued subject to the following conditions:—

(1) All rubber collected under this permit to be shown to the District Commissioner, * * * , and to remain Government property until one-third of the value of the rubber has been paid in cash to the District Commissioner.

(2) The rubber vines to be tapped so as not to injure them, viz., only lengthways slits to be made, and not more than four slits of 4 inches to 6 inches long per vine.

(3) This permit does not convey exclusive rights, but as far as is practicable with an unsurveyed area, no other rubber rights will be granted for one year in this area.

(4) This permit is liable to cancellation at any time should it appear that the vines are being destroyed, forest fires caused, or any other forest offence committed.

Neither, however, of the two collectors who have been at work in and near the Nandi country has been able to make rubber collecting profitable. Mr. P. A. van Breda, who has recently collected some 500 lbs. of rubber in the Nandi forest, estimated that there the rubber vines yielded an average of $\frac{1}{4}$ lb. per vine per year. After collecting 500 lbs. on the one-third share system, he gave up the collection on account of trouble with natives and because he found it did not pay him.

Other *Landolphia* vines that have been identified in British East Africa are *Landolphia petersiana*, common along the coast, and not furnishing rubber. *L. watsoniana*, Nandi, at 5,000 feet, said to be rubber-yielding. *L. tayloris*, from Rabai hills. *L. ugandensis*, Kericho and Nandi, 5,000: yields good rubber. (Linton.) *L. lucida hespida?*

Clitandra kilimandjarica is the source of the Laitokitok rubber, obtained at about 3,000 feet on the northern slope of Kilimanjaro. Samples sent home have been valued at from 3s. to 4s. 10d. per pound, the price depending on the skill with which the sample has been prepared. (Linton.)

In German East Africa the natives pay a tax of Rs. 15 a year for the right of collecting rubber. In British East Africa there is an export duty of 10 per cent. on the value of the rubber collected.

THE SCRUB FOREST OF THE PLAINS.

Between the tropical coast forest and the forest of the highlands lies a wide stretch of nearly waterless and nearly uninhabited country, sparsely covered with scrub forest—the terror of old caravan days. This scrub forest rises gradually from near sea level to a little below the level of Nairobi, 5,500 feet. At its upper level are scattered trees and grassy plains, inhabited by only a few wandering Wakombas living amongst the hills on the northern side of the railway. Towards the coast and on hill slopes, it is more thickly wooded. Below Kiu (mile 267 on the Uganda Railway, elevation 4,860 feet) the country is unhealthy and badly infested with ticks. The coast belt of tsetse fly extends up to Makindu, elevation 3,280 feet. Kiu marks the limits of the white man's country and of the highlands. The forest between Kiu and the coast has little technical value. In places there is a picturesque growth of the red-barked Acacia. Such of the forest as is not too far from the railway will furnish a certain supply of firewood, for which it should be cut over in rotation. Attempts also should be made to introduce trees with a technical value

that may spread self-sown and thus give a value to this at present almost useless country. The *Acacia catechu* is one such.

An Industry for the Plains.

In the dry malarial plains inland of Mombasa, it is possible that a forest of the Cutch tree *Acacia catechu* may be raised at quite small expense. The tree, though it rarely forms pure forest naturally, is easily propagated by sowing the seed broadcast. It is specially worthy of trial in some of the useless scrublands bordering the Uganda Railway. The Cutch tree is valuable, not only for its astringent product, but for its timber, which, though excessively hard, is durable and useful for railway sleepers. It also seasons well and is, says Gamble, not attacked by white-ant or by teredo. The rate of growth is fairly rapid—four or five rings per inch of radius. Its habitat is widespread. It is common in most parts of India and Burma and, according to Mueller, extends to an altitude of 5,000 feet, and as far eastward as East Africa. It is possibly, therefore, already indigenous in the low country between the sea and Nairobi, or towards the lake. In any case, to be turned to economical use, it should be propagated artificially, and at first on lands adjoining the railway. It would furnish a first-rate firewood, as it weighs about 65 lbs. per cubic foot; indeed, some of the Indian specimens reach a weight of 75 lbs. per cubic foot. The Cutch, a valuable tannin material, is obtained by a simple process of boiling the wood chips. There is quite an Indian literature on the subject giving details and particulars of the process. The import of Cutch and Gambier to England represents a value of about £500,000 sterling yearly. Cutch is worth about £25 a ton. Cutch trees are considered exploitable, says Gamble, when they reach a diameter of one foot.

Mesquit.—Another tree which might prove a profitable introduction to the plains would be the Mesquit (*Prosopis juliflora*). This tree has run wild on dry scrub-lands at Hawai. Casually introduced, it has taken possession of otherwise worthless lands. It grows vigorously, and furnishes a hard firewood unsurpassed in quality, and a sweet pod, of which stock are fond and which has fattening qualities. The feeding value of this pod in Hawai is so good that it is gathered and brought into towns for feeding horses in their stables. It is found particularly useful for fattening pigs. Herds of pigs are allowed to run among the Mesquit trees in Hawai.

There might, however, be an objection to this tree if it were to overrun the country. It has thorns like the "Mimosa" (*Acacia horrida*) of South Africa, and in Texas the tree is objected to by the stock-riders and those who keep sheep. The spontaneous growth of this tree in Hawai and its useful qualities form an interesting study, which I have discussed in a recent paper in the "Transvaal Journal of Agriculture," 1906.

Forest of Plains at Voi.—Fringing the Voi stream is an area of 1,000 to 1,500 acres of forest. Mr. Jordan, Government Surveyor, describes this as containing fair timber though often hollow. But the timber is good enough to warrant the erection of a saw mill for working it. The land on which the forest grows is rich, though there is not enough water in the Voi River to irrigate much of it. Voi is notoriously unhealthy. Anopheles are said by a competent observer to be as numerous in places as on the West Coast of Africa. I cannot recommend the retention of this forest from a climatic or health point of view.

The scrub forest will furnish firewood and charcoal and fencing posts in the future, as it now supplies firewood (where it is accessible) to the Uganda Railway. Its unhealthiness will be decreased by its being largely cleared, burnt over yearly, and converted, by close grazing, to short sweet veld. It is an ideal goat country. Goats are as badly wanted here as is their decrease in the Mediterranean region.

FOREST ON THE HIGHLANDS OF BRITISH EAST AFRICA.

As mentioned in my report on the Kenia Forest, the forest on the highlands of British East Africa is extra-tropical in character and closely resembles the Yellow-wood forest of South Africa. It belongs to the dense evergreen class of forest commonly seen at high altitudes in the tropics. It is, in fact, the Yellow-wood forest of South Africa with a larger number of trees to the acre, a greater variety of trees, and a larger average size of tree. It is further enhanced in value (compared to the South African forest) by the addition of Cedar (*Juniperus procera*) in the drier forest, and of Ibean Camphor in the wetter forest, and of Sandal (m'Hugu) in the lower forest. Everywhere, however, it preserves its general likeness to the indigenous forest of South Africa. The same forest which occurs at sea level (or near it) on the southern coast of Cape Colony, at 3,000 feet in Natal, and between 4,000 feet and 6,000 feet in the Transvaal, is seen between 6,000 and 9,000 feet in British East Africa. Going towards the Equator the number of species increases. This is not an advantage, but it is not a great disadvantage, as there is a general resemblance to one another among the hardwoods, and they are not so excessively hard as is the case in tropical forests.

The characteristics of this class of forest are:—

(1) A stock of timber per acre which is low compared to some other classes of forest, and a comparatively low timber increment. The timber produced is lacking in straightness and regularity of growth. To this Cedar, Yellow-wood, and Pillar-wood, the three most abundant trees in the forests of British East Africa, are happily exceptions. The first two are coniferous. In the best forest, the standing stock and timber-increment are good, and this seems to be the case with much of the forest in British East Africa, particularly that part of the forest which is rich in Cedar.

(2) There is a large proportion of unsound trees. This, and the want of regularity, is the most striking contrast between this forest and the great forests of the northern hemisphere. In British East Africa, Cedar is particularly liable to unsoundness; in some of the Cedar forests not 10 per cent. of the trees above two feet in diameter are sound.

(3) In its natural dense state it resists fire completely, but if, with irregular working, it is too much opened out, it falls an easy prey to fire. The forest is less liable to burn in British East Africa than in South Africa.

(4) Its natural reproduction is not strong, and unless this is closely studied and the forest carefully treated, natural regeneration may fail, and the forest disappear, as may be seen to-day in the worked-out forests adjoining the Uganda Railway.

(5) Natural regeneration can, however, be aided, and by skilful treatment rendered certain.

(6) Artificial regeneration is difficult and expensive. It is not possible to cut the forest down and replant it, except at a cost so high as to be, in most cases, prohibitive. Plantations should only be used to supplement natural regeneration, and to introduce certain valuable exotic trees on the chance of their maintaining themselves and spreading by natural means.

(7) As a water-conserver this class of forest is unequalled, and, in some countries, notably Hawai, Mauritius, and the Indian Nilgiris, is carefully maintained for this purpose.

(8) It is of great natural beauty and forms the chief adornment to countries where it exists; it has played an important *rôle* in fostering the love of the beautiful and the sentiment in favour of national forests.

Possible Yield.—The possible timber-producing power of this class of forest is apparently the highest on record. The *Eucalyptus globulus* planted in it on the Nilgiris of South India produces an average of 10 tons of timber (dry weight) per acre per year or 7,000 cubic feet. (Mean maximum yield up to 45 years of age.) In his recent report on the forest of the Nilgiris Mr. Cowley Brown records a mean

yearly yield from a plantation of *Pinus longifolia* of 250 cubic feet per acre, in a plantation 18 years of age (page 129).

The nett production of carbon in such forests is equivalent to the yield of a coal mine. The ability of this class of forest to supply the world with fuel when the coalfields are exhausted I have discussed elsewhere. ("Nature.")*

In order to improve the present low-stocking of East African forests it will be necessary to introduce species of stronger forest floras into the glades and open spaces in the forest, particularly shade-bearing species, which, as members of larger and more vigorous forests floras, may push their way and occupy ground among the present indigenous trees. With this object the following shade-bearing species have been introduced into the forests of South Africa :—

Acacia melanoxylon.
Sequoia sempervirens.
Cedrela toona, &c.
Cupressus macrocarpa.
Various Conifers.
Extra-tropical *Abies* (seedlings only).

Of these *Acacia melanoxylon* and *Cedrela toona* are specially indicated for the highland forests of British East Africa. Both are doing well on the Nilgiris, but particularly *Cedrela toona*. This is one of the most valuable timber trees known, yielding a Cedar wood of the best quality. It grows vigorously at 6,000 feet elevation on the Nilgiris, yielding a timber which has sold locally at high prices. *Acacia melanoxylon* is subject, on the Nilgiris, to a Loranthus parasite, and species of Loranthus are common in the highland forests of British East Africa.

It is probable that the high productive power possible to the forest would not in East Africa be entirely confined to plantations of introduced trees. *Pygeum africanum* (the m'Wèri of the Kikuyu, and the Red-Stinkwood of South Africa) grows like a Eucalypt in young plantations.

Probable Yield.—For all the better class Yellow-wood forest of British East Africa a general average yield equal to that of the yield of the Gouna forest of Knysna may be assumed, viz., a stocking of 1,000 cubic feet per acre, worth, at 2·4d. per cubic foot, £10 per acre.

Leaf-shedding Species.—It is somewhat remarkable that in a climate with about half the temperature range of the forest regions of South Africa there should be more leaf-shedding trees. In my tour through the forests I have noted the following as leaf-shedding species :—

m'Zai.
m'Ringa.
m'Koi, m'Kurave, and other Albizias.
m'Lalàchi (*Calodendron capense*).
m'Tàti.
m'Airozi (shed its leaves after the rains).
m'Ngrima (*Ochna*). *Ochna* in the large forests above 6,000 feet was seen everywhere coming into leaf in December.
All the Figs.

The greater prevalence of leaf-shedding species in British East Africa is a useful feature, since leaf-shedding trees are more easily transplanted.

Minor Forest Produce.—With the valuable timber trees, which will be introduced into the forest in the hope of their spreading naturally, are several plants or shrubs which yield valuable minor forest produce. Ramie may be seen growing luxuriantly in the Government farm near Nairobi, also the two other valuable fibre plants, *Sisal* and *Fourcroya gigantea*. The former shows the more vigorous growth at the Government farm and is the one to cultivate in British East Africa. Various wild fibres abound. There is an excellent wild Raspberry, two good Blackberries, the wild Apricot, and several other fruits which could be improved by cultivation. For honey and beeswax, see page 46.

The highland forest may be divided into two zones:—The lower zone from 5,300 feet to about 7,000 feet, the upper zone from about 7,000 feet to 9,300 feet.

HIGHLAND FOREST OF THE LOWER ZONE.

The highland forest begins with timber of a somewhat inferior character, and a great variety of species. With increased altitude the forest, except where it runs into drier country (as in the Rift Valley), improves in quality, and shows a less number of species. Of the lower zone, the forest about Nairobi may be taken as the type.

* Reprinted as a pamphlet by the Cape Forest Department.

The chief timbers in the lower zone of forest are:—

Nairobi Trees.

Ibean Sandal (m'Hùgu). The most valuable timber, durable and scented.
Croton (m'Kindùri). Useful for indoor work, would inject well for outdoor work.
Albizia (m'Kùruwe). Some of the Albizias resemble Ash.
Indian Pine (m'Airozi). Works up well.
Markhamia (m'Ho). Good timber but small.
Greenheart (m'Zìga). A shapely Hardwood.
Pillar-wood (Saizi). A tall tree; works up well.
Pinkwood (m'Karàra). A large tree with pink or reddish timber.
Milettia or Wistaria tree (m'Kuvu).
Chestnut (wild) (m'Lalàchi).
Plane (m'Tandìra). Ochna.
White Ironwood or Todalia (m'Ndarendu).
Smokey-heart (Ruàzi).
Grey Box (m'Nyenye). A boxwood substitute; seasons well.

Sandal (muHùgu), Mairozi, Greenheart, and m'Karàra are the four most valuable species of the lower zone, and, probably, the only four worth planting.

Sandal (muHùgu) is intrinsically the most valuable timber in the Protectorate. 10s. 6d. a cubic foot is being paid for it by a Bombay sandal merchant, and the price seems likely to rise to 15s. a cubic foot. Though a species of *Brachylæna*, it bears a close resemblance to the Sandalwood of Southern India, *Santalum album*.

WEIGHT OF TIMBERS : from Cubes 1 foot by 1 foot by 1 foot.

Timber.	Green Wood.	Air-dried Wood, 5 years seasoned.
m'Ona, Poon, *Chrysophillum*	49 lbs. per cubic foot.	29 lbs. per cubic foot.
m'Wèri, Red Stinkwood, *Pygeum africanum* ...	66 „ „	44 „ „
muTamaiyu, Olive, *Olea chrysophylla*	80 „ „	70 „ „
m'Shàmi, Horse Chestnut, *Allophilus abyssinicus*	54 „ „	39 „ „
m'Sengèra, Yellow-wood, *Podocarpus milanjianus*	47 „ „	32 „ „
m'Taràkwa, Cedar, *Juniperus procera*	44 „ „	36 „ „
m'Gàiyità, Beukenhout or Boer Beech, *Rapanea rhododendroides.*	74 „ „	44 „ „
m'Sharàge, Black Ironwood, *Olea hochstetterii* ...	77 „ „	54 „ „
m'Zàiti, Camphor, *Ocotea usambarensis* (Eng.) ...	... ...	42 „ „
m'Hùgù, Sandal, *Brachylaena* sp.	... ...	59 „ „

These cubes were prepared by my predecessor, Mr. Elliott, excepting Camphor and Sandal.

APPROXIMATE WEIGHTS DERIVED FROM SMALL PIECES, FULLY AIR SEASONED (G. BAKER).

m'Koiyi, *Piptadenia buchani*	45 lbs. per cubic foot.
m'Orgwaigwa	37 „ „
m'Segèta	38 „ „
muKahòkuhò	37 „ „
Saizi, Pillar-wood, *Wehea africana* ...	43 „ „
m'Werèri, *Tabernaemontana abyssinica* ...	37 „ „
muSumàra, Wild Fig, *Ficus* sp.	38 „ „
m'Guma, Common Wild Fig, *Ficus* ...	36 „ „
m'Kòmakòma	35 „ „
m'Ondonia	54 „ „
m'Kùruwe, *Albizzia* sp.	28 „ „
m'Nyenye, *Euphorbia* sp.	48 „ „
m'Nyàwa	50 „ „
m'Shogi	35 „ „
m'Ngarìma, *Ochna* sp.	47 „ „
Ruàzi, Smoky heart	50 „ „
m'Zaiti, Camphor, *Ocotea usambarensis* ...	35 „ „
m'Wànda, Box	52 „ „
m'Signea	42 „ „
muKahàkuhà (red)	32 „ „
muKahàkuhà (white)	21 „ „

Particulars of these and trees of the higher zone are detailed in Appendix II.* It will be sufficient here to note that with the knowledge that has been gained

* Printed separately.

at Nairobi by using the different timbers, Sandal (muHùgu), in general estimation, ranks first. That it is so good an all-round timber, whether for sandal work, sleepers, fencing posts, or firewood, marks it for propagation in this class of forest, where, on account of the short branching trunks of the trees, there must always be a large proportion of fencing posts and firewood.

Croton (m'Kinduri) is a peculiar tree with the Japanese aspect that gives to Nairobi its picturesque appearance. It is peculiar to the lowest portion of the lower zone of highland forest, and ceases a short distance above the level of Nairobi.

Albizia occurs throughout the lower zone. There are several different species which have not yet been determined. It usually occurs near streams or in moist valleys.

m'Airòzi is one of the best timber trees of the lower zone. It grows to a shapely tree in forests where most of the other species are crooked. Such well-grown trees furnish a timber which is much in request by carpenters at Nairobi.

m'Ho is a particularly handsome tree, with its large yellow bell-shaped flowers abundant throughout the lower forest, but it is rarely large enough for sawing.

Greenheart (m'Zìga) extends to the upper drier forest, and is described in my report on the Lingham and Grogan Forest. Its greenheart-wood is ornamental and scented.

Pillar-wood (Saizi) is a shapely tree occurring right throughout the highland forest from the level of Nairobi to an altitude of 9,000 feet, where the highland forest gradually merges into Bamboo.

Chestnut (m'Lalàchi) and various perishable timbers have been used for poles. A longer experience will show that they have no durable qualities in the ground, and it is wasteful to the forest and to the user to employ them for poles.

The Yellow-wood Forest of South Africa shows a distribution of species similar to that seen on the highlands of British East Africa. In the lower zone of the latter there is a great variety of species; in the upper zone the number is greatly reduced. The highest forest is almost entirely composed of four species, that is to say, the two Yellow-woods (*Podocarpus*), Cedar (*Juniperus*), and Black Ironwood (*Olea*).

One of the finest forests in South Africa is the Manùbi Forest on the coast of the Transkei, now some 2,500 acres in extent (not long ago four times this size). No forest west of the Kei River has such fine timber. Here the distribution is remarkably like that of the forest in British East Africa; near the sea—Umzimbìt, Boxwood, Safraan, Sneezewood, Erythrina, Essenwood (*Ekebergia capensis*), Wild Chestnut, Red currant (*Rhus laevigata*), Hard Pear (*Strychnos hennengsii*), &c., at a higher level—Black Ironwood, White Ironwood (*Todalia lanceolata*), Red Stinkwood, and the two species of Yellow-wood.

LOWER ZONE FORESTS NEAR LAKE VICTORIA.

Belonging to the lower zone are certain forests in the neighbourhood of Lake Victoria Nyanza. These the time at my disposal did not allow me to visit. The Kakamèga Forest is described as about 80 square miles in area, densely stocked, and with as much as 80 per cent. of one species of tree. Trees of a very regular growth: it is at an altitude of about 5,000 feet, and does not extend to the top of the Nandi escarpment. It is doubtful whether this should be classed as highland or lowland forest.

Ten miles north-west-west is another similar forest, Kikelèwa. The trees in this forest are described as being not more than 18 or 24 inches in diameter, but as standing close together.

FOREST OF THE UPPER ZONE.

These forests contain the largest timber and almost all the coniferous timber. They are thus more valuable than those of the lower zone. The timber in the forest of Kenia has been described in my report printed as a Parliamentary Paper, "Colonial Reports—Miscellaneous, No. 41 East Africa Protectorate, 1907." I have also reported separately on the forest situated near Eldoma Ravine, and comprised in the Lingham and Grogan Concession. These reports with what is here said regarding the forest of the Aberdare Range will be found to be sufficiently descriptive of the forest of the upper zone. Its four chief timbers are the two Yellow-woods, Cedar (*Juniperus procera*), and Ibean Camphor (*Ocotea usambarensis*). In the drier portion of this area Cedar wood is the chief timber, in

the wetter portion, Ihean Camphor. The two commonest timbers are the two Yellow-woods. There has been some doubt with regard to the nomenclature of these two Yellow-woods.

Podocarpus gracilior (Pilger) Mukòrmbe.—This is a sounder, better-shaped tree than the ordinary Yellow-wood, but, unfortunately, in Equatorial Africa it has a somewhat restricted distribution. This tree has some resemblance to the big Yellow-wood tree of South Africa, *Podocarpus elongata.* Though large it does not attain the massive growth of the South African tree. According to Pilger's monograph, the correct name of the Mukòrmbe Yellow-wood is *Podocarpus gracilior.* Mr. Burtt-Davey has compared my specimens from British East Africa with the specimens in the Kew Herbarium, and also with the description in Pilger's monograph, and he arrives at the conclusion that the East African tree is *Podocarpus gracilior.* This is confirmed by Dr. Stapf, of the Kew Herbarium. Pilger gives the following habitat for *Podocarpus gracilior:*—Abyssinia, Galla-land, Kenia, Leikipia Plateau 6,000 feet to the foot of the Aberdare Mountains. He omits Mau, where it is most abundant.

Pilger has recently studied and re-arranged the genus *Podocarpus*, see "Botany of the Anglo-German Boundary Commission" (Jour. Lin. Soc., Vol. 37, 116).

Podocarpus thunbergii. Musengèra.—This, according to Pilger, should be *Podocarpus milanjianus* (Rendle); but *Podocarpus milanjianus* is only, says Mr. Burtt-Davey, a geographical variety of the South African Yellow-wood for which Pilger reverts to the old name of *Podocarpus latifolius.* Pending the general adoption of Pilger's nomenclature, it seems inadvisable to upset so well an established a name as *Podocarpus thunbergii*, which I accordingly retain. The habitat of *Podocarpus milanjianus* is given as Usambàra, Kilimanjàro, Kenia, Leikìpia, 6,000 feet, m'Lanji Mountains, 6,000 feet, Ruwenzori 9,000 to 10,000 feet. In Equatorial Africa it grows from 3,600 feet (Lake Victoria) to 12,000 feet on Kenia.

It will thus be seen that one of the Yellow-woods of British East Africa is of the same species as that in South Africa, and this is much the commoner Yellow-wood of the two. The Yellow-wood in South Africa has been used in house-building like pine timber in Europe, for two centuries. Says Mrs. Trotter in her charming work "Old Cape Colony," "Vergelegen" and "Paarde Vallei" set in a fold of the "Heldeberg are both beautiful spots. The second house is certainly very old, as the "Colony counts age; the woodwork in the earlier part of the building is of Teak, the "slightly later additions are in Colonial Yellow-wood."

KILIMANJÀRO FOREST.

Most of the Kilimanjàro forest belt lies between the German boundary, and the forest within the British boundary has little economical value at present. Major Smith, Director of Surveys, has kindly supplied me with the following note regarding the forest within the British boundary, on the upper slopes of Kilimanjàro, from his recollection of the forest seen during the International Boundary Survey:—

"There is a patch of forest within the British boundary (on the northern side "near Endwoinet) measuring 12 square miles, approximately. It is good forest, "timber well grown, and the forest-floor rich in humus. Cedar is the chief species. "The forest improves as the mountain is ascended, and the best forest is not seen "in British territory. The forest belt thins out on the west side and is then about "only one mile wide. Near Endwoinet is the best forest within the British "boundary. The Kilimanjàro forest belt averages about five miles broad, its maxi-"mum thickness being on the south and east sides towards Usèri, where it may be "about 7 miles thick." Major Smith's work did not take him to the west and south-west sides. The distribution of the forest on Kilimanjàro resembles that on Kenia and other mountains of British East Africa. The good forest has a lower limit of 5,600 feet. This is the elevation at which begins the good forest on the slopes of south-east Kenia. Meyer quotes 6,000 as the lower limit of the Kilimanjàro forest.

Hans Meyer, in his work recounting the first ascent of Kilimanjaro, gives the following account of the forest:—

"Between 3,000 feet and 4,000 feet the tree-steppe gradually passes into thick "bush, where it reaches the lower limit of the mist zone, and gives place to the hilly "country of Jàgga—the cultivated region of Kilimanjàro—which extends to an "elevation of 6,200 feet. * * *

"From 6,200 feet—the lower limit of the Cloud Zone—the primeval forest, well "watered and well drained, stretches upward along an increasingly steep subsoil

"of solid rock, till it reaches a height of about 9,800 feet. In the north the forest "is limited to a strip between 7,200 and 9,100 feet and in the North-west it dis- "appears altogether, and is replaced by shrubs and grass. From the primeval "forest, on the south side, belts of wood run upwards along the more sheltered "watercourses and hollows, but even these cease at 10,500 feet, which may be stated "as the maximum limit of the growth of trees.

"Above the forest the grass-lands rise to about 12,800 feet; they are at first 'studded with shrubs, but these gradually disappear with the increasing eleva- "tion. * * *

"Omitting the cultivated zone of Jàgga, which ought properly to be included "in the bush region, the vegetation of Kilimanjàro thus naturally divides itself "into the six following zones:—Tree-steppe, 300 to 3,000 feet; bush, 3,000 to "6,000 feet; forest, 6,000 to 10,000 feet; grass-land, 10,000 to 13,000 feet. In the "case of the forest, man as well as nature has been at work, so that its limits have "been determined, as much by the hoe and the firebrand as by temperature and "moisture. All the others are the result of natural conditions, and, above all, of "climate. * * * From a European standpoint, the commercial value of the "products of Kilimanjàro so far is nil. *The timber is worthless,* India-rubber is "scarce, the Orchilla lichen certainly not common, and minerals are almost "absent. * * *

"As a rule, the trees attain a height of from 18 to 20 feet, while the stems "average about 18 inches in girth, and are plentifully draped with 'Grey-beard' "moss."

This no doubt refers to the inferior upper forest. Descending the mountain, Meyer describes the different grades of forest thus:—

"At 8,500 feet the heaths abruptly give place to the typical tropical forest, "with its tall trees, its rich variety of species, and its luxuriant undergrowth of "herbs, bushes, ferns, and moss. Rain is here of daily occurrence, and as the "undergrowth prevents the evaporation of the moisture, this zone constitutes the "immediate source of the water-supply on this side of the mountain. The ground "is soft and clayey, the path slippery, and often difficult to trace. Below 7,500 feet "there is less moisture, and the forest becomes less dense. Instead of the herbaceous "undergrowth, there are thickets of shrubs and creepers, and, instead of grey- "bearded lichens, the stems and branches are covered with brown moss. As we "proceed downwards, the ravines gradually deepen, and along the banks of the "streams tall tree-ferns, with their crowns of spreading fronds, rise grandly by "the side of the clear, cool water. At 6,500 feet the forest suddenly thins away, "and terminates abruptly in a belt of dense bush.

* * * * * * *

"As I turned to take a farewell look backwards (in the direction of the Taita "wilderness), a scene of unexpected loveliness met my eye. High above the masses "of cumulus clouds, which drifted slowly over the steppes, rose the snowy dome of "Kìbo, solitary, serene, majestic, yet soft and shadowy as a mirage. Involuntarily "the Màsai name of *Ngàje Ngài* (the house of God) rose to my lips, as I gazed in "rapture on the phantom shape hanging thus suspended in mid-air. Only once, "in the Himalayas, looking from Darjiling towards Kanchinjinga, have I seen "anything to equal it at once for beauty and impressive grandeur."—(Hans Meyer.)

With regard to the general question of the introduction of Conifers to the cold region above the indigenous forest, it is useful to note Meyer's limits for ice and permanent snow on Kilimanjàro. He says:—"The limit of the ice on Kibo would "be defined by a line passing round the mountain at the following altitudes:— "South, 13,100 feet; south-east, 12,500 feet; west, 13,800 feet; north-west, 18,500 "feet; north, 18,700 feet; north-east, 18,860 feet; east, 18,700 feet; south-east, "17,550 feet." This absence of snow, except at a high elevation, on the north-east side of Kilimanjàro, is due to a warm upper current. I found the peak of Kenia entirely bare of snow in the middle of the snowiest time of the year, May.

From the various accounts that have reached me, I gather that the Kilimanjàro forest belt does not now contain timber as good as that in the Kenia and Mau forests of British East Africa. It will be noted, page 61, that Herr Eckert considers the Kilimanjàro timber inferior to the Usambàra timber of German East Africa. But a native, who knows the forest well and who was recently a forest guard, described it to me as being good forest, and said it has the following timbers, besides those commonly occurring on the equatorial highlands of Africa:—m'Sàmbu, m'Songoiya,

Kivìru, n'Dìdi. Of these, m'Sàmbu (probably the same as the m'Sàmbia of the East Africa coast and of Uganda) is the most valuable. My informant was a Chàga, and the above are the Chàga names.

Erok Forest or Ol Donio Erok.—A detached block of forest lying north of Kilimanjàro and about 16 square miles in area. I have no information as to the quality of this forest, but understand that it is highland forest of fair quality. It is about 70 miles from Kilimanjàro summit, and five marches from Kiu. (Major Smith, Director, Surveys.)

m'Di (Sonduz) Forests.—These have not yet been demarcated or fully examined. They are on two mountain tops, with a little forest on a third. A surveyor estimates these forests at, approximately, 6,000 acres. One of them, Sagàla, lying at about 5,000 feet elevation, is near a missionary institution, and it is understood that there is little or no forest here, free of rights, and very little good forest left. The other is above the estate of the London and South African Agency (Mr. Wacher), and has been estimated by Mr. Jordan, the Surveyor, at about 5,000 acres. There is some first-rate timber here, and the demarcation and preservation of this timber, both in the interest of the Uganda Railway and of the water flowing from it, is important.

It is 8 miles from the Uganda Railway (mile 112) to the London and South African Company's fibre estate; and a 2-foot tramway has been laid the whole distance by the Company.

THE ABERDARE FOREST.

The Aberdare Range lies north of Nairobi, and represents a broad high range of mountains flanking the eastern side of the great Rift Valley. In Kimabop it rises to a height of 13,000 feet, and the highest point of the northern end of the range known as Setima is slightly higher—13,400 feet (Mackinder). It is separated from the Kenia Forest by a 50-mile plain, and in climate and forest may be regarded as a branch of the Kenia highlands. Its scenery, however, is more broken and picturesque than that of Kenia. The total length of the range and its prolongation towards the railway at Limuru is about 90 miles. The forest stretching from Lari to beyond Ol Bolasat has a total length of 82 miles. Of this, the southern half for about 50 miles (to 4 miles north of Nyeri) is wet; and the northern half, of about 32 miles, is drier. Along the southern half the breadth of the forest may be averaged at 3 miles, which gives 150 square miles of forest. A good view of the northern half is obtained from Kenia. This, I estimate, at 357 square miles, made up as follows:—

	Square miles.
Good upper forest 32 by 3 miles	96
Middle forest 32 by 2 miles less two-fifths of the area for glades	37
Lower forest of Juniper and Olive	64
"Thomson forest" (south of Korai Setima) ...	160
Total Northern Aberdare ...	357 = 228,480 acres

There are thus 150 square miles or 96,000 acres in the Southern Aberdare, and 228,480 in the Northern Aberdare.

Four miles south of "Korai Setima" is the largest forest remaining on the Aberdare Range in country uninhabited except by Wanderobo—the Thomson forest. It lies north-west of Nyeri, and is comparable to the Kenia Forest at a distance, and apparently about 20 miles long by 8 miles broad. Mr. Battiscombe tried to penetrate this forest at one time, but found it impossible to do so even by elephant paths. He says it is not so good as it looks at a distance. There are large openings where it has been destroyed either for pasture, cattle, or elephant catching. There is probably of good forest here about 100 square miles (the area of the "New Forest" in England). This forest represents the northern end of the good Aberdare Forest, the only part which the Kikuyu have not yet reached.

The belt of forest and bamboo along the Southern Aberdare was originally probably about 10 miles thick. The forest has been reduced to its present narrow dimensions by the depredations of the Kikuyu. I have viewed this belt of forest from various points, and everywhere it is apparent that the Kikuyu cultivation is rapidly eating into it. In some places, such as Kuranjis, the Kikuyu gardens have

cut entirely through the forest and are in the Bamboo. I have made careful enquiries from those who have traversed the whole length of the Aberdare, and I think that the thickness of the remaining belt of forest may be taken to average about 3 miles. Thus, the Kikuyu have in the Southern Aberdare destroyed about 50 × 7 or 350 square miles of forest!

Like Kenia, the eastern side of the Aberdare has, towards the south, heavy forest and an abundant rainfall. It is impossible here to attempt to describe the scenery of this country. More beautiful than the Nilgiris, it recalls the descriptions of the highlands of Ceylon or part of the Atlas mountains. It is rare to find a valley without a stream of water, and every second or third valley will contain a strong, rushing stream of crystal, cold water. It is here that trout will thrive and multiply. It may be compared with parts of the Kenia forest, page 69.

The forest on the wetter south-eastern side contains an assortment of timbers similar to those at Kenia. Mr. Hinde, the Provincial Commissioner of the province, showed me 50 kinds cut at the Italian saw-mill in the Aberdare forest. Amongst this is Ibean Camphor (m'Zaiti); but it does not appear to be so abundant as in the Kenia forest, and gradually dies out going south. On account of its strength and durability it is the favourite timber with the Kikuyu for their bridges and out-of-door work. The altitude of the forest belt is similar to that at Kenia. At Chief Kurori's, where it has been thrown back by the sad depredations of the Kikuyu, it begins now at an altitude of 6,660 feet.

At the higher elevations and in the Bamboo forest the only trees of any size are Yellow-wood (*Podocarpus thunbergii*), Pillar-wood (*Saizi*), and the parasitical tree m'Zai. This tree, though parasitical in early life and never affording timber of value, is of a singularly beautiful appearance towards the beginning of the warm, dry season, in December. Its foliage has then the appearance of a South African Oak tree in Spring.

Above the Bamboo forest is an area of downs with patches of Shola forest at the lower northern end. On the western side, overlooking the Rift Valley, there is no great area of forest, but both here and on the northern drier end of the eastern side is much Juniper. In all the valleys, even those running far out into the plains (part of the Rift Valley), Juniper is abundant, sometimes in the form of well shaped, small trees about 18 inches in diameter by 40 or 50 feet high, but often as low-branching, round-top trees. These as they stud the grassy plains have a picturesque effect much like the "Mimosa" in the eastern grassy plains of Cape Colony. Indeed at the first view I took them for Acacias. Young Juniper trees are seen occasionally. Everywhere it is a struggle against the grass fires. The trees are fast disappearing. It is a marvel how so inflammable a tree has survived the grass fires so long. The natural reproduction of Juniper where the conditions are at all favourable is enough to secure a good re-growth of this valuable tree provided only fires are excluded.

WESTERN ABERDARE.

This was once a fine forest of Cedar and Olive, but it is in dry country, and has been attacked, both above and below, by the grazing fires of the Masai. There is, however, enough Cedar left to provide for the natural regeneration of this valuable species, and the nearness of this forest to the Uganda Railway justifies expenditure here on fire-protection, forest culture, and replanting. From the Kijàbe Mission ground to the boundary of the East African Syndicate area, scales 22 miles on the (1 inch = 4 miles) map, and I estimate the average breadth of the forest left at 2 miles. This gives 44 square miles or 28,160 acres as the area of the Western Aberdare forest.

Above the forest proper is the bamboo, containing a varying proportion of Yellow-wood. This extends throughout the central and southern portions of the forest, and may be estimated, roughly, as 65 miles long by an average of 3 miles broad, or 195 square miles in all: equals 124,800 acres.

Kipapièri, 11,100 feet, stands out a great outlying mass of the Setima Range. The dry half has been granted to the East African Syndicate, the eastern half is demarcated forest. The whole of the Kipapièri has been gazetted as reserved forest, but nevertheless half of it has been granted to the Syndicate.

Area of Aberdare Forest.

	acres.
Eastern Aberdare—	
Southern forest	96,000
Bamboo forest with Yellow-wood	124,800
Northern forest	228,480
Western Aberdare forest	28,160
Total	477,440

KENIA FOREST.

It will be sufficient to refer briefly to the Kenia Forest, it having been already specially reported upon (Colonial Report, Miscellaneous, No. 41, June, 1907). Mr. McG. Ross, Director of the Public Works Department, and I, have now made the entire circuit of the Kenia forest, viewing it, above and below, almost throughout. We travelled round the upper margin of the forest with the exception of a length of about 21 miles. Here we had to follow the lower boundary on account of the inclement weather prevailing at that season of the year (April, May, and June) in the Alpine region. Mr. Ross triangulated round the mountain and I measured linear sample areas through the various classes of forest. The details of these measurements will be published, with the revised Kenia reprint of my Kenia report, on the completion of Mr. Ross's plan. His preliminary plan of the Kenia forest belt gives an area of 400,000 acres. The main features regarding the forest are these :—

Area.—The forest belt extends right round the mountain with the exception of a small gap of 6 miles on the north-west side, and even here the slopes are not entirely bare of trees. The Kenia forest girdle has somewhat the shape of a crescent, with the thick portion towards the south-east and the points at the north-west gap, but this difference in the breadth of the belt is more apparent than real, since almost half the breadth of the thick portion of the belt is taken up by a solid zone of Bamboo, extending unbroken for about 22 miles in the south-east, and running in a broken form, mixed with Yellow-wood, up the entire western side of Kenia. In all the drier parts of the mountain the Bamboo belt is not continuous, and in the driest part of the forest runs out to a point and ceases altogether. The Kenia Bamboo is the same species, *Arundinaria alpina*, as occurs in the Mau forests—see page 22. It does not seed and die out over large areas, like so many of the tropical Bamboos. It attains its largest size in what seems to be the zone of maximum precipitation, though perhaps not the wettest part of the forest. Here, stems with a basal diameter of 5 inches and a length of 60 feet are met with. At its broadest part (between Kenia summit and Nyeri) the forest belt is 16 miles broad. The total distance round the outer edge of the forest, neglecting the sinuosities, is about 120 miles. The area of the bare Alpine region above the forest is, approximately, 352 square miles or 225,280 acres. In the north-east of the Alpine region lie the picturesque "Table Mountain" and "Rotunda or little Kenia" (Mackinder's "East Mountain"). The Alpine region slopes gradually from the edge of the forest towards the snowy Peak of Kenia. Towards the north it becomes a rolling grassy plateau. Here there is a dry, bracing climate, and a most favourable region for white settlement. In the wet south, the Alpine region has giant heath and tussock grass above the forest, and above this, short grass and marshy ground up to the glaciers. This is a dripping region in the wet season, with mist and cloud during the cold season.

Timber Forest.—The densest forest and the largest stock of timber lies in what may be termed the Great South-East Bay of Kenia. This is the area of heaviest rainfall, and it is bounded on the south and east by prominent ridges running out from the main mountain mass. Here is to be seen the largest stock of timber per acre. The great Camphor trees lie along a belt between 6,000 and 7,500 feet altitude, while between 5,500 and 8,000 feet is the zone of giant hardwoods. These belong to a variety of species, and a large proportion of them are more useful than are hardwoods generally. Growing in a temperate climate, many of them are not too hard to be easily worked, to season well, and to be capable of injection with an antiseptic. They grow to majestic proportions, their huge buttressed trunks rising like columns to a height of 60 or 80 feet without a branch. In the best forest of this class there is little undergrowth; but over most of the forest there is enough undergrowth to make it necessary, when traversing the forest, to follow elephant or other paths. Very rarely, indeed, is the ground quite clear of undergrowth. It

is probably to the presence of this undergrowth that is due the somewhat poor natural reproduction of the forest, making it necessary to work the forest, carefully, by gradual and skilfully-conducted thinnings; and to assist the re-growth of the best species by hoeing and cleaning under and around selected seed-bearers. Thus, under normal conditions, Camphor shows little natural reproduction, and this almost entirely from suckers; but the recent operations of the Forest Department have resulted in *a good show of self-sown seedlings*, and there is every reason to hope that the reproduction of this valuable species is now assured.

In Northern and Western Kenia there are three well-marked belts of forest :—

(1) The upper belt of Cedar, yarrah, and Cork (m'Zuchai) is wedge-shaped. It thins out and gradually disappears, going south.

(2) The Yellow-wood-Bamboo belt is wedge-shaped, thinning out, and disappearing as one goes north.

(3) Further north, near the " forest gap," its place is taken by a belt of hardwoods, which divide the upper from the lower Cedar forests. At its broad southern end the Yellow-wood-Bamboo belt extends upwards to the limit of tree vegetation, there being only a strip of " Giant heath " above it.

After Cedar, which is found in all but the wettest parts of the Kenia Western forest, the most valuable forest (in the north-west Bay and south of the Nuki River) is undoubtedly the lower fringe containing Outeniqua, Yellow-wood and Cedar (see Nuki River Outeniqua sample area), where, out of a stock of 3,642 cubic feet per acre, 61 per cent. of the trees and 78 per cent. of the timber was Outeniqua. See also the figures in my 1907 Kenia Report, where (at page 12) it will be seen that the Nuki River linear area gave 5,041 cubic feet per acre, and contained 46 per cent. Outeniqua, 28 per cent. Cedar, 13 per cent. Black Ironwood, 5 per cent. Olive, and 7 per cent. of the valuable hardwoods, Red Stinkwood and Greenheart. See also (at page 12) the Cedar sample area, with a stocking of 4,750 cubic feet, of which 91 per cent. is Cedar.

The most valuable timbers in the Kenia forest are :—

Yellow-wood in two species, *Podocarpus thunbergii* and *P. gracilior*. The first occurs wide-spread throughout the forest. It scarcely differs from the well-known Yellow-wood of South Africa, that has been used for house-building for 200 years, and, more recently, when creosoted, has been found to furnish a first-rate sleeper. It has a timber like an even-grained deal, free of knots. As a flooring board it is unsurpassed. It takes creosote well, but will not last out-of-doors unless injected with an antiseptic. The second species of Yellow-wood produces sounder and better timber than the first. The size and shape of its timber has been compared to the Kauri of New Zealand. But, unfortunately, its distribution is restricted, it being confined to a small zone at the bottom of the Western side of the Kenia forest, and to the strips of forest bordering rivers on the plains below the forest, where the growth of all trees is inferior.

If Kenia be compared to an elongated inverted saucer with the peak on the southern side, Outeniqua occurs on the rim of the saucer, from north to south, all down the western side. Fires have no doubt much destroyed this fine timber, and it is not now continuous. On the northernmost part of the Kenia forest, Outeniqua occurred only in the form of a few detached patches. In Western Kenia it extends in a broken belt a breadth of from a few hundred yards to about 2 miles, and forms about 50 per cent. of the trees, and about 75 per cent. of the timber which, here on the fully-stocked areas, carries 3,500 cubic feet per acre. See the Outeniqua linear sample area, " Nuki, 1898."

Less abundant than Yellow-wood, but far more valuable intrinsically, are the two timbers Cedar and Camphor. These are the two premier species of the Kenia forest. They both grow to a great size, up to 12 feet diameter, and over 100 feet high, but present a striking contrast in their shape.

Cedar (*Juniperus procera*) is tall, straight, and mast-like; Camphor has a growth resembling the park Oak of England, an irregular-shaped trunk with huge spreading limbs. As an indication of the size attained by the Kenia Camphor tree, it may be mentioned that two-thirds of a single Camphor log in the South-East Bay of Kenia, near the " Castle " Forest Station, yielded all the wood (beams, lintels, and verandah posts) required for a two-storied house of eight rooms, built mainly of wood. The botanical name of the Kenia Camphor tree has recently been determined as *Ocotea usambarensis* (Eng.). I was fortunate on my last tour in procuring

complete flowering specimens, which were sent to Kew for determination. The Kenia Camphor tree resembles the real Camphor tree of China and Japan, but smells less strongly of camphor. It is the same genus as the well-known Stinkwood, *Ocotea bullata*, of South Africa. It is a first-rate timber, apparently, equal to Teak in durability and easy working, and useful for all purposes where Teak is employed. Camphor, as already stated, is confined to a comparatively narrow zone in the wetter south-east side of Kenia. Near the "Zambesi Falls," south of the Rupingaze River, I found the Camphor belt 5 miles broad, but probably its average width does not exceed 3 miles; and the length of the Camphor belt is about 33 miles; that gives an area of 99 square miles of forest wherein Camphor abounds.

The Kenia Cedar tree is the same tree that occurs wide-spread on the Equatorial highlands of Africa and in Abyssinia; its timber is of great value, being scarcely distinguishable from the typical Cedar of the familiar lead pencil. But it is too often unsound, and is thus best employed in work where much length is not required. On Kenia, it is found at all elevations on the drier northern and western slopes, from 7,000 to 11,000 feet. On the north-west side of Kenia there is as much Cedar on the upper as on the lower slopes of the forest, hardwoods occupying the wetter middle zone; both the upper and lower Cedar have suffered from fire. The largest Cedar yet measured was near the upper grass-lands, in mixed forest. It is figured on the accompanying photograph.* This tree is estimated to contain about 1,546 cubic feet of timber, of which, probably, about one-third is unsound. Though evidently of great age, it has still a well-developed crown in vigorous growth. Its mean diameter is 12 feet 4 inches. It forks a short distance from the ground, like all the Cedars here, perhaps the result of fire. The largest stem has a serviceable bole of 65 feet, and a total height of about 110 feet. The locality is a mixed forest of bamboo and hardwoods, with a few Cedars near the upper edge of the forest. This record Cedar is growing at an approximate elevation of 9,850 feet. Cedar is wonderfully durable, and old trunks of great age, in all stages of slow decay, are found throughout the forest; some prostrate and covered with a forest growth of many years; others, gaunt and whitened with age, stand erect, mute witnesses of the forest that once grew there!

Of the hardwoods may be mentioned:—

Jarrah, m'Oinyère.—The last big tree found at high altitudes, and occurring also in the Aberdare and Mau forests. It is abundant in northern Kenia, and extends south only some 18 or 20 miles beyond the forest gap. It grows to a large diameter, but shows no length of stem at this high altitude (12,000 feet). It has a timber resembling Jarrah, but has otherwise no connection with the well-known eucalypt, furnishing the yarrah of commerce. It appears to be durable, and would probably furnish good sleepers.

Cork tree, m'Zuchai.—A fire-resisting, small, hardwood of the upper north-western forest. It extends south only about 12 miles beyond the forest gap. It could furnish sleepers which would probably be durable, or it would be valuable for fuel in the event of this favourable region being occupied by white colonists. It grows with Jarrah, but is smaller and less abundant.

Ibean Poon (m'Ona) and m'Kuruwe, Albizia sp., are two well-grown, good timbers of large size, but not sufficiently abundant to be of much importance economically. They only occur in the wetter lower forest.

Black Ironwood, Olea laurifolia, is fairly abundant, though not nearly so common as in the Mau forest.

Pillar-wood (*Saizi*) is a useful and widely-distributed tree, but nowhere abundant.

Olive (*Olea chrysophylla*) is abundant on the western side of Kenia, where for firewood and sleepers it would be of the first importance were a railway made to Kenia. Probably, also, it will be possible to bud on to this the cultivated Olive, as is done so largely on the Mediterranean. The cultivated Olive has been successfully budded and grafted on to the common wild Olive of South Africa.

mu Kuhàkuhà, Bastard Cedar.—A useful softwood of medium size, abundant and important to the forester on account of its easy reproduction. It grows freely from cuttings, seed, or suckers.

m'Nyenye, Grey Box.—One of the most abundant hardwoods; it might prove valuable as a Boxwood substitute.

Wild Lemon, mu Kahòkuhò, Xymalos monospora.—Grows larger than in South

* See page 148.

Africa, but nowhere here forms pure forest as in the South. It is a good softwood, now only utilised for beehives.

Red Stinkwood, m'Wère, Pygeum africanum.—Grows over a large area in Southern and Eastern Kenia; but is small and not of the importance it has, as a timber-tree further south, in the Aberdare forest and in South Africa.

m'Wànda or m'Chorave-Box.—In structure and hardness this timber resembles Boxwood, and it would probably form a good Boxwood substitute. It grows to a much larger size than real Boxwood (*Buxus*) and is abundant, especially at higher elevations in the Kenia forest.

Giant Heath, Erica arborea.—This is a small tree or shrub only. It is not a timber-tree, but it must be mentioned here on account of its utility to the traveller in the Alpine region. It occurs above the forest, and furnishes the firewood, without which travelling in the Alpine region would be scarcely possible. It extends 1,000 or 1,500 feet (occasionally higher in valleys) above the forest. It is a first-rate firewood, and its stem furnishes the ornamental wood used in briar-root (Bruyère) pipes.

WORKING THE KENIA FOREST.

To get timber from the Kenia forest to a market, the best route is across the plains by road or rail to the Uganda Railway. I am not in favour of any attempt being made to cart it below the falls and thence float it down the Tàna River to the sea. A road to below the falls would be expensive and serve no other purpose. Floating down the Tàna River would be attended with many difficulties, not the least being the pestiferous climate.* A road or railway, on the contrary, to the Uganda Railway, would act as one of the projected feeders to the railway, and would be entirely in healthy country, across plains at an altitude of 6,000 or 7,000 feet.

A railway from Gilgil (or from the western point on the Uganda Railway below Nakuru) to a point near the Equator on the Guàso Nyìro River, where it would tap the supplies of wood from Western Kenia, and (with a little haulage) from Northern and Southern Kenia, and the Eastern Aberdare, would be about 68 miles in length, and along its entire course through easy country—the first 24 miles across the Laikìpia Plains, then about 16 miles round the northern end of the Aberdare-Setima Range, and then 28 miles across the rolling plateau sloping down to the Uganda Railway at Gilgil. There is one moderate escarpment on the route near the railway at Gilgil. There are no large rivers to cross, and the streams so rarely contain much water, that they could be left unbridged (as is the case with some light branch lines in Australia and South Africa), or bridged with the local Cedar timber. Timber for all other railway requirements: sleepers, fuel, culverts, bridges, and buildings, would be obtainable of the best quality on the spot. It is probable that the reconnaissance survey, now being carried out by Captain Stevenson's assistant, Mr. Hall, will find that this railway can be made at an extremely moderate rate. It will be noted that in Victoria, Australia, through a forest country, railways have been made lately on the broad, 5 feet 4 inches, gauge, at as low a cost as £1,200 per mile!

Failing the railway, a good ox-waggon road would provide an economical form of transport from the Kenia forest to the Uganda Railway. It is particularly worthy of notice that in countries such as this, which much resembles South Africa, ox-waggon transport can compete successfully with railway transport, unless the latter be conducted under unusually economical conditions. The annual reports of the Cape Government Railways contain repeated references to the damage to the railway caused by ox-waggon competition. The last annual report of the General Manager of the Cape Government Railways is thus criticised:—"He recognises "the great seriousness of the ox-waggon competition, and quotes the case "of a man who uses the railways to carry his low-rated produce, but uses his "waggons to compete with the railway in carrying more highly-rated goods. We "read the other day of goods which are carried from King William's Town to Alice "for 9d. per 100 lbs., while the railway charges 2s. 3d.; and of a firm at Burghers-"dorp which saved £25 by carrying 20 tons by ox-waggon instead of by railway. "Mr. McEwen wishes to put down the ox-waggon by a prohibitive tax on way-bills, "but this appears to most people impossible. The Superintendent of the Avontuur "Line proposes to alter the rates and so run the ox-waggon off the road; and, we

* Since the above was written Mr. Battiscombe has returned from his inspection of the Tana River and reports that for about 200 miles the river consists of one long series of cataracts.

"understand, that he has been allowed to try this experiment, which appears to us to "be on the right lines. But if Mr. McEwen is almost in despair over the ox-waggon "now, what will be his condition when, as proposed, he has raised the rates and "therefore made it even more advantageous to employ the ox-waggon?"—*South African News.*

The General Manager himself, in his Yearly Report, says:—I have again "to draw special attention to the question of ox-waggon competition, which "is still very strongly in evidence on the Midland and Eastern systems, "particularly the latter. The country has saddled itself with a heavy debt in "order to open up the back districts of the Colony and to bring them into touch "with markets for their produce, and the Government is fairly entitled to expect "that such districts should make use of the railways for the conveyance of their "goods. Before the construction of these branches, all classes promised support, "but, as soon as the railway is an accomplished fact, in many cases the very people "who agitated so strongly for this means of communication, still continue to make "use of road transport, utilising the railway for goods which may be required in a "hurry, for South African produce, and other low-rated traffic, and for passengers. "This competition shows no sign of abatement in the Native Territories, where the "road transport is principally in the hands of natives, who are able, owing to "their limited wants, to quote rates with which the railway is quite unable to "compete except at a great loss, and I would again strongly recommend that legis-"lation be introduced inflicting a heavy, if not prohibitive, tax on way-bills where "the waggons compete in districts served by railways. This is seemingly the best "means of reaching the people who support and encourage this competition.

"The waggon should be used in its legitimate way as a feeder to the railway "instead of a competitor."

On the Laikipia Plains, between Kenia and the Uganda Railway, conditions are similar to those prevailing in the Native Territories of Cape Colony, where the railways find themselves so hard pressed by ox-waggon competition. The country is dry, nearly flat, with good water and pasturage, and suited generally to waggon transport; native labour is even cheaper than in the Native Territories of Cape Colony. In the huge herds of cattle kept by the Masai, exists an enormous unutilised power now going to waste. The Masai are intelligent, eager for gain, and, to-day, peaceable and well disposed. If it should be found impossible to make a branch line of railway to Kenia, the working of the Kenia forest and the bringing of timber to the Uganda Railway are to be accomplished by the aid of the Masai and their cattle.

MAU FOREST.

The Mau forest is the name applied to all that portion of the Highland forests lying between the Rift Valley, on one side, and the Lake and Mount Elgon on the other. It is thus the largest forest area in British East Africa, but it presents nowhere one compact forest area like the Kenia forest. While the largest forest area, it at the same time contains, though only over a comparatively small area (the Elgon escarpment), the heaviest stock of timber in the forests of British East Africa. The only portion of it that has been explored by foresters is that comprised within the Lingham and Grogan grant. On this I have reported separately. Much of the forest is very wet and occupied only by Bamboo. A small variety of Bamboo, believed to be a separate species, is said to occur locally in the Mau forests. As elsewhere, the Bamboo forest occupies the wettest areas. But there are localities where the Bamboo is absent, and one steps directly from park-like grass-lands into dense evergreen forest. Forest fires have had much to do with this.

Rain falls for some nine months of the year, cloud and light rains usually filling up the period (July, August, and September) between the big and small rains. The rainfall and temperature vary, of course, with the altitude, but it is noteworthy that the heavy-rainfall area is not confined, as on the eastern side of the Rift Valley, to southern and eastern aspects. On the contrary, the Mau area appears to be the meeting ground of rains brought over with the easterly winds from the Indian Ocean, and of rain beating up from the west over the dripping Congo region. Thus, on the Mau area, we have the feature of heavily-timbered, wet areas on slopes facing north, south, east, and west, together with an absence of that deterioration of tree growth, seen in parts of the Kenia and Aberdare forests, caused by the constant drift of rain, mist, and cloud from one quarter, the

South-east. Thus, immediately below the Bamboo belt, we find the wettest and coldest forest showing a fine growth of timber in a few species; this is rarely witnessed elsewhere in British East Africa. In this area is often seen a heavy stock of timber confined almost entirely to the following species :—

Yellow-wood, *Podocarpus thunbergii.*
Yellow-wood, *Podocarpus gracilior.*
Ironwood, *Olea laurifolia.*
Cedar, *Juniperus procera.*
Olive, *Olea chrysophylla.*

In the wetter areas the Cedar is of large stature, but, too frequently, very unsound. There are parts, however, of the Mau forests where the Cedar is seen at its best, forming nearly pure forest of straight, mast-like stems. In a part of the Sotìk forest, travellers describe the Cedar as standing close and straight like a pine forest. Greenheart (m'Zìga) occurs wide-spread in the Mau forests. Sandal (m'Hùgù) is said to be abundant between Tindoretti and the Kabarak-nsone Mountains. Camphor is said to occur in the Mau forests, but the observation requires confirmation. As mentioned, the finest timber occurs in a strip of forest running parallel with the Elgeyo escarpment. Here there are said to be Cedars up to 12 feet diameter.

Filling hollows between grass-lands, is forest of an inferior character, much resembling the " Shola " forest of the Nilgiris in South India. The resemblance of this forest to the Shola forest of the Nilgiris has been remarked by more than one traveller. Such forest is seen on the road between Loudiani and Eldoma Ravine. Stretching down towards the dry Rift Valley is inferior forest running into scrubby Cedar forest.

The Mau forests have the great advantage, and the small disadvantage, of being almost free from natives. They have thus escaped the destruction that has been wrought by natives in the Kenia and Aberdare forests. *Per contra*, it is now necessary to import natives to work the forest.

AREA OF MAU FORESTS.

For the area of the Mau forests, only careful estimates are available. There are but few and partial surveys, and a large part of the Mau forest has not yet been seen by a forester. Fortunately, I have been favoured with a detailed estimate by Mr. Hoey, who has traversed and explored nearly every part of the Mau forests, and knows them thoroughly. Mr. Hoey's estimates have been checked by Mr. Guy Baker, of the Forest Department, who spent over a year in parts of the Mau forests demarcating and surveying. I rely on the following estimate, therefore, as being fairly correct :—

Area of Mau Forests.

	acres.
Elgeyo forest (bulk of Lingham and Grogan's), stretching towards Nandi, approximate area of good forest	60,000
Sotìk to Naivasha, the largest of the Mau forests, about 25 by 15 miles	240,000
Elgèyo escarpment forest (northern site of Uasin Guìshu) ...	89,600
Londiani, Mau, from Mount Blackett	20,480
Ravine, Khàmàsia (poorest part of Lingham and Grogan's forest)	80,420
Scattered forests in Nandi country, including Tindoret and Kàpwàn forests	160,000
Sotìk Lumbwa forests—between highest point Mau and Lumbwa, exclusive of Bamboo	32,000
Mount Londiani forest, right-hand-side road to ravine (including Lingham and Grogan's forest)	85,879
Total (acres)	768,379

ELGON FOREST.

Travellers who have ascended Mount Elgon and explored the forest give somewhat conflicting accounts of the forest. Sifting the various accounts received, I gather that there is practically no forest left on the Uganda side, while on the British East Africa side the forest is far from having the value or extensive area

that was at one time supposed. Pending its exploration, the extent may be estimated at somewhat less than one-tenth the area of the Kenia forest, say, 50 square miles. It is important that the Elgon forest should be visited and reported upon by a forester as early as may be.

BOTANICAL DETERMINATIONS.

I am indebted to the Kew Herbarium for the following determinations of dried specimens collected by Mr. Battiscombe and myself during our tours in the forests of British East Africa. I have added notes to facilitate identification without referring to the specimens :—

"Kik." = Kikuya : "Ma." = Masai names.

Xymalos monospora, Baill. mu Kuhòkuhò (Kik.). Wild Lemon.
Dombeya Mastersii, Hook. f. m'Kyau or m'Keo (Kik.).
Dombeya nairobensis. The common m'Kyau of the Kikuyu country.
Eugenia cordata, Laws. Water Protea.
Trichocladus malosanus, Baker. Wytch-hazel. ol Bulegelug (Ma.).
Schefflera cf. S. Volkensii, Harms.
Psychotria sp. m'Korwe (Kik.). Very abundant in the Kenia forest.
Rubiacea. Kenia Coffee.
Rapanea rhododendroides, Mez. (Myrsine.) Beukenhout. Found up to 11,000 feet, Kenia.
Chrysophyllum sp. (Ibean Poon.) m'Ona (Kik.).
Landolphia (jasminochyla) sp.? The Kenia Rubber Vine.
Conopharyngia near C. Holstii, Stapf; possibly new.
Kigelia sp.
Ocotea usambarensis, Eng. Ibean Camphor. m'Zaiti (Kik.).
Ocotea? Most probably identical with the Stinkwood, *Ocotea bullata*, of South Africa.
Faurea saligna, Harv. Terblantz of South Africa.
Macaranga sp. m'Tundu.
Macaranga?
Ficus Holstii, Wrbg.
Ficus sp. m'Gumu (Kik.).
Myrianthus arboreus, Beauv. m'Tuyu. Fruit like a large Mulberry, lower Aberdare.
Salix capensis, Thunb. Willow.
Juniperus procera, Hochst. Cedar. mu Taràkwa (Kik.).
Podocarpus gracilior, Pilger. The large Yellow-wood, like the South African Outeniqua.
Podocarpus milanjianus, Rendle. m'Sengèra. The common Yellow-wood; scarcely differs from the well-known *P. thunbergii* of South Africa.
Cassia didymobotria. Muvènu (Kik.); Seneroich (Ma.). A shrub with brilliant yellow flowers, used medicinally by the Masai.
Grewia occidentalis. Pretty blue flowers. Ol-neligwè (Ma.).
Triumfetta sp. Muguyu (Kik.), probably *T. ruwenzoriensis*.
Crotalaria laburnifolia. Ibean Laburnum. Mwèzia (Kik.).
Erithrina tomentosa. Muhùti (Kik.).
Pygeum africanum. m'Wère (Kik.). Red Stinkwood, the fine timber tree.
Xanthoxylon sp., near *Ruwenzoriensis*. m'Gochua (Kik.). Bark, leaves, and berries medicinal.
Olea chrysophilla. m'Tamàyu (Kik.); Ol-lorien (Ma.). Olive.
Nuxia congesta. m'Chòrowe (Kik.); Ol-birun (Ma.).
Cordia holstii. m'Ringa (Kik.).
Juniperus procera. m'Taràkwa (Kik.); Ol-taràkwe (Ma.). Cedar.
Heptapleurum sp. m'Tàti (Kik.).
Oncoba brachyanthera. The Embu Rose.
Maerua sp. The Naivasha Capparis. A small tree with white flowers.
Ritchiea fragrans, R. Br. The large-flowering Kikuyu Creeper.
Walburgia ugandensis. Greenheart. m'Zìga (Kik.).
Brachylaena sp. Ibean Sandal. m'Hùgu. (Kik.); m'Hùhu (Swàhìli).
Allophilus abysinicus. Horse Chestnut. m'Shàme (Kik.).

Elaeodendron sp.? Safraan. m'Tànga.
Balsamodendron sp. Ibean Ash. m'Nùnga (Kik.).
Acacia cf. robusta, Burch.
Acacia cf. spirocarpa, Hochst.
Acacia cf. pennata, Willd.
Combretum abbreviatum, Engl. } Kenia, Rupingàzi River. Brilliant red
Combretum cf. apiculatum, Sond. } flowers.
Olinia usambarensis, Gilg. Referred to *O. cymosa*, in Mr. Battiscombe's list (Grogan's forest).
Agoria salicifolia. The Kenia Ilex.
Wedelia abyssinica, Vatke. cf. The common Wild Sunflower.
Plumbago zeylanica, L. The White Plumbago.
Carissa Arduina, Lam. Abundant on the Laikìpia plain.
Buddleia salviaefolia. The Wild Sage of South Africa. Kenia and Aberdare forests.
Albizia fastigiata. The common m'Kùruve of the East African Highlands.
Erica arborea. The Giant Heath of Kenia and Kilimanjàro.
Haleria lucida, Linn. Wild Fuschia.
Acanthus arboreus, Forsk. The tall *Acanthus* of the Grogan forest.
Protea abyssinica, Willd. cf. The Ravine Protea.
Weihea africana. Pillar-wood. m'Saizi (Kik.).
Schrebera alata. Seed like coffee. A large tree in the Londiani forests.
Garcinia gerrardii. m'Nyàva. Kenia forest. Timber, Box-like.
Canarina campanula. The brilliant red-flowered parasite growing on trees.

TABLE COLLECTION OF TIMBERS OF BRITISH EAST AFRICA.

For ready reference I have prepared five table collections of the chief timbers of British East Africa, which have been distributed as follows :—

The Right Honourable the Secretary of State for the Colonies	1
The Chief Conservator of Forest, Nairobi	1
South African Forest School, Cape Town	1
The Imperial Institute, London	1
Royal Botanic Gardens, Kew	1

The woods in the five collections are identical, cut from the same pieces of timber, so that in referring to any numbered specimen in one of the collections it can at once be identified in all the others. Specimens have been distributed so as to be available for ready reference by those who may seek to work the forest.

FOREST YIELD.

It is the yield that may be expected from the forest which is perhaps the most important and practical part of this report. The yield of the forest on the highlands of British East Africa will be considered under the following two heads :—

(1) The yield in South Africa.
(2) The yield so far as determined in British East Africa.

I shall conclude with a general table of the yield of various extra-tropical forests and of some others added for comparison.

YIELD OF FOREST IN SOUTH AFRICA.

THE YELLOW-WOOD FOREST OF CAPE COLONY.

The Knysna Forest.—The largest compact area of Yellow-wood forest in South Africa is situated at Knysna, on the southern coast. The area by survey is 91,066 acres. The forest here at sea-level resembles the forest in British East Africa at an altitude of 8,000 feet. The Knysna forest has been worked for some 200 years; there was much irregular working and loss from forest fires before it

was brought under the control of the Forest Department. Thus in 1889 the standing stock per acre was averaged at the following figures only :—

6	Yellow-wood trees containing	300	cubic	feet	of sawable timber.
4	Ironwood „ „	80	„	„	„
2	Stinkwood „ „	70	„	„	„
6	Trees of other species „	160	„	„	„
Total 18	trees containing	610	„	„	„

When I took charge of these forests in 1889, there were still portions of forest that, for want of roads, had not been worked. Thus there was a fine virgin forest at Gouna. Three felling-sections (or coupes) extending over 182 acres, marked and measured in this forest, yielded of exploitable timber per acre, 31 trees, containing 1,081 cubic feet. At the same time a poor worked-out forest at Groot Brak yielded only 10 merchantable trees, containing 122 cubic feet per acre. Taking the good and the bad together, the average at this time for the Knysna forest was as above : per acre, 18 trees, containing 610 cubic feet of merchantable timber.

Eleven years afterwards, in 1900 (after 15 years of systematic working), it was reported that the yield of merchantable timber per acre had varied from 120 cubic feet, in the poor forest near George (Hooge Kraal), to 517 cubic feet per acre in the richer Storms River forest (Lottering). It is now estimated (1907) at 300 cubic feet per acre on the basis of past sales and 400 cubic feet on the basis of exploitable timber marked for sale. In the 1900 valuation the whole forest was valued thus :—

On the basis of past sales £106,000.

On the basis of exploitable timber marked for sale £259,000, or slightly over £3 per acre. These figures, of course, are not the capital value of the forest.

On the basis of an average value of 2.4d. per cubic foot we have the following money values for the Knysna forest per acre :—

	£	s.	d.
1889—Maximum virgin forest at Gowna on basis of exploitable timber	10	16	2.4
1889—Estimated average for the whole forests on basis of exploitable timber	6	2	0
1907—Valuation for the whole forest on basis of sales	3	0	7

Amatola Forests.—After the Knysna forest the next most important area in Cape Colony is that situated along the Amatola and Perie Mountains, north of King Williamstown. In 1893 the Conservator of Forests in charge of those forests estimated the average stock at 1,400 cubic feet. He estimates it now at 1,200.

Money value of stock.—In the Amatola forests in 1891 Mr. J. S. Henkel valued the exploitable timber at £13 per acre. This is the average of the timber marked for felling in the various forest Sections during the years 1888 to 1891.

Eastern Forests, 1901 Valuation.—J. S. Henkel.

Class of Forest.	Stock value per acre.	Acrim.	Value per cubic foot.
	£ s.		
1st. Best forest on Amatolas	13 0	30	2·5
2nd. Stockenstrom and coast forests	7 0	20	2·5
3rd	5 0	10	1·0
4th	1 10	—	—

(Cape For. Flor.; Sim).

Third class and 4th class forest at £5 and £4; £2 10s., and £1 10s. per acre for worked out and very poor forest.

Transkei.—These forests have not yet been surveyed; indeed they are still in process of demarcation. Most of the forest is of excellent quality. The fine Manubi Forest on the coast of the Transkei is valued at £13 per acre (J. S. Lister). This is the figure adopted for first class forest on the Amatolas.

Says Mr. A. W. Heywood, the Conservator in charge, writing to me recently :— "The stocking of the Transkeian forests varies enormously. The best forests, viz., "those least damaged in the mountains of East Griqualand average about 4,500 cubic "feet of sawable timber per acre, of which by far the largest proportion is Yellow-"wood. This figure is not so high as Foucarde's for the Impetyne Forest, Natal, "where he computed the stocking to be 7,000 cubic feet per acre. I doubt if there "is a single forest in the Transkei which would touch that figure.

"There is little Black Ironwood in the mountain forests, and the trees are cut "large.

"The following analysis may be taken as typical of our best mountain forests :—

No. of Trees.	Species.	Cubic feet per acre.
7	Sneezewood	350
23	Yellow-wood (*Podocarpus thunbergii*) ...	3,915
3	Yellow-wood (*P. elongata*)	315
8	Others	126
41		4,706

"Regarding current prices for merchantable timber, Yellow-wood may be put "down at 2s. to 2s. 6d. per cubic foot, sawn in 1 inch planks and quarterings. "Sneezewood poles at 1s. 3d. per cubic foot. Stinkwood poles 7s. 6d. each."

Thus the sawable timber in good mountain forest Transkei at 2.4d. the cubic foot is worth £47 1s. 2½d. per acre.

SUMMARY.

For many years to come, owing to its poorly stocked condition and inaccessibility, the yearly yield from the whole indigenous forest may be taken as not exceeding one million cubic feet. The actual yield during the five years 1899-1903 was :—

	Cubic feet.
Knysna	1,797,505¾, also 64,118 running feet Kamassie.
Eastern	1,365,527½, also 26,361 poles, &c.
Transkei	479,156
	3,642,189 cubic feet, or 728,438 cubic feet yearly.

POSSIBILITÉ OF THE CAPE FORESTS.

With regard to the "possibilité" (capability or normal yield) of the Cape forests, I made an estimate on leaving the Knysna forests in 1892 which brought up to date reads thus :—

The total capability of the 300,000 acres of productive timber forest in Cape Colony (that is to say, the quantity equal to their production which can be extracted yearly without exhausting them), may be estimated at 3,000,000 cubic feet approximately, thus :—

	Cubic feet.
Stinkwood and other specially valuable woods	112,500
Yellow-wood	450,000
Waggon-wood (Assegai, White Pear, and White Ironwood)	300,000
Ironwood	937,500
Other woods, Lemon-wood, White Els, Red Else, Wild Chestnut, &c.	1,200,000
Total	3,000,000

This estimate was framed on the basis of an average stocking of 1,000 cubic feet per acre. At 2.4d. per cubic foot it would represent a yearly income of £30,000. The actual revenue realized from the Yellow-wood forests, so far, is about one-third of this figure, much forest being as yet undeveloped and much, also, overworked and destroyed or understocked.

The Cape forests have to face fires and droughts which, from time to time, do immense damage. The damage from fire has been appalling, and is still serious. The droughts encourage the fires, and, when they are severe, stunt and kill the trees as they stand in the forest. It is stated in the Cape Forest Flora (Sim 1907) that in the Eastern forests an enormous number of Ironwoods died during the droughts of 1897-1899.

There is little chance of this figure (3,000,000 cubic feet) being realised for many years.

TIMBER SOLD FROM CAPE FORESTS.

During the 12 years 1889 to 1900 there was sold from the Knysna forests:—

Yellow-wood 2,180,028 cubic feet in 69,954 trees, or an average of 181,669 cubic feet yearly.

This was divided between the two Yellow-woods thus: *Podocarpus thunbergii* 1,327,342 cubic feet in 59,723 trees; *Podocarpus elongata* 852,686 in 10,231 trees.

In the whole of the Cape Yellow-wood forests there has been an average yearly sale during recent years of 462,968 cubic feet of Yellow-wood in 10,809 trees. It is interesting to note that the quantity of timber is about equally divided between the two species, but the number of trees cut stands in the ratio of 8,276 upright (*Podocarpus thunbergii*) to 2,533 Outeniqua (*Podocarpus elongata*); viz., the average size of the "upright" is little more than one-quarter of the "Outeniqua."

Yellow-wood forms 54 per cent. of the timber sold from the Knysna forests; 68 per cent. of that sold from the eastern forests, and 80 per cent. from the Transkei forests (For. Flor. Cape Col., 1906).

Stinkwood, Ocotea bullata.—Of this, the most valuable timber in the Knysna forests, there has been sold a yearly average (1889 to 1900) of 3,230 trees, cubing 45,841 (in that Conservancy).

Sneezewood, Ptaeroxylon utile.—Of this, the most valuable timber in the eastern forests, there has been sold a yearly average (1895 to 1900) of 1,016 trees cubing 6,582 cubic feet (in that Conservancy).

Black Ironwood, Olea laurifolia.—During the 12 years, 1889 to 1900, there has been sold from the Knysna forests 377,671 cubic feet in 18,435 trees.

The following table shows that the average yearly output of various timbers from the Cape forests during recent years has amounted to 721,214 cubic feet in 26,500 trees.

Cape Forests Yearly Sales.

——	Cubic feet.	Trees.
Yellow-wood (*Podocarpus*)	462,968	10,809
Black Ironwood (*Olea laurifolia*)	73,814	2,754
Assegai (*Curtisia*)	51,142	4,190
White pear (*Apodytes*)	23,934	1,679
Sneezewood (excluding poles)	16,033	1,236
Other species	47,479	2,593
Total yearly average	721,214	in 26,500

As mentioned, I do not think the utmost output that can be expected for many years from the Cape forests will exceed one million cubic feet yearly.

AVERAGE SIZE OF TREES IN THE CAPE FORESTS.

Knysna Forests.

The average yield of the exploitable trees has been:—

	Cubic feet.
Stinkwood (*Ocotea bullata*)	14
Upright Yellow-wood (*Podocarpus thunbergii*)	22
Outeniqua Yellow-wood (*Podocarpus elongata*)	83
Black Ironwood (*Olea laurifolia*)	20

Eastern Forests.

Red Stinkwood (*Pygeum africanum*)	50
Wild Lemon (*Xymalos monospora*)...	17
Cape Beach (*Myrsine melanophleos*)	26
White Ironwood (*Todalia lanceolata*)	18
Wild Chestnut (*Calodendron capense*)	34

Transkei Forests.

Upright Yellow-wood	79
Outeniqua	111
Black Ironwood	51

FOREST AREAS, CAPE COLONY.

Area of Yellow-wood Forest.

The area of Yellow-wood forest cannot be stated exactly as only those of Knysna have been accurately surveyed. These, according to Fourcade's survey, are 90,818 acres. According to existing data the total area of Yellow-wood forest in Cape Colony may be put down at about 300,000 acres. Even of this forest a portion is too inaccessible or scattered to yield marketable timber.

The total forest area of Cape Colony, including plantations not yet come into bearing and the Cedarberg area, which contains only scattered trees (although trees of a very valuable kind), may be stated at 529,902 acres.

Actual Forest Area of Cape Colony (September, 1904).

Forest Areas.	Acres.		
Transkei - demarcated indigenous	102,000		
Plantations	2,062	(1905)	104,062
Actual Forest Area, Eastern Conservancy	168,000	(Cons. Rep.)	
Plantations (including Port Elizabeth drift sands (3,570)).	8,877		176,877
Actual Forest Area, Knysna Conservancy	90,818	(Fourcade)	
Plantations	905		91,723
Actual Forest Area, Western Conservancy :—			
Plantations (excluding drift sands)	11,691		
Indigenous Yellow-wood	1,555		129,740
Cedarberg Forest	116,494		
			502,402

If we allow another 27,500 acres for forests in the Transkei not yet brought on to the reserves, that would make a total of 529,902 acres of Government timber forest in Cape Colony.

Area of Forest Reserves, Cape Colony.

The total area of the forest reserves, according to the last published statement (Cape Forest Flora; Sim 1907), is 1,208,923 acres.

	Acres.
Western Conservancy	222,964
Knysna Conservancy	312,604
Eastern Conservancy	459,994
Transkei Conservancy	213,361
Total	1,208,923

THE YELLOW-WOOD FOREST OF NATAL.

In 1888/89 Mr. H. G. Fourcade, then Forest Surveyor to the Cape Government, was deputed to visit and report on the forests of Natal. He reported a maximum stocking of 10,000 cubic feet (in 33 trees) in the Gwangwane Forest, and in the Impetyne Forest 46 trees, containing 7,008 cubic feet.

GWANGWANE FOREST—(The best Yellow-wood forest in Africa).

Fourcade describes this as magnificent forest, the finest he has yet seen in South Africa, and the nearest approach to a pure forest of Yellow-wood. The trees are well grown and regular, average between three and four feet in diameter and 100 feet in height, and consist chiefly of upright Yellow-wood mixed with a few Outeniqua Yellow-woods, Stinkwoods, Wild Chestnuts, and White Ironwood. In the lower portion of this forest, the standing stock was estimated at 10,000 cubic feet, viz., 25 Yellow-wood, containing 9,000 cubic feet, and eight other trees, containing 1,000 cubic feet. There was a good re-growth of young Yellow-wood; some of this in the pole stage.

IMPETYNE FOREST.

Area about 1,800 acres, mean altitude 5,000 feet.

In a sample area 1·63 acres in extent 58 trees, containing 11,425 cubic feet of log wood, were measured.

Standing Stock Per Acre.

	Cubic feet
26 Upright Yellow-wood	6,186
5 Stinkwood	560
3 Bogabog	153
2 Other species	109
36 trees, containing	7,008

IXINGINA FOREST, POLELA.

In 1904 T. R. Sim, the Conservator of Forests, Natal, obtained the following measurements from a sample area of nearly pure Yellow-wood forest along the lower mountain slopes at Ixingina.

Standing Stock Per Acre.

Podocarpus thunbergii,	68	trees	containing	5,750	cubic feet.
Podocarpus elongata	1	,,	,,	225	,, ,,
Celtis rhamnifolia	2	,,	,,	64	,, ,,
Xymalos monospora	2	,,	,,	85	,, ,,
	73			6,124	

Of saplings there were 67 Yellow-wood and 156 of other kinds.

AVERAGE FOREST, POLELA DISTRICT.

A sample area, selected to represent the average of the forest, was found to cover 2·92 acres. Fifty-nine trees measured were estimated to contain 3,842 cubic feet of sound log wood, and the standing stock per acre consisted of :—

	Cubic feet.
6 Outeniqua Yellow-wood	603
7 Camdeboo Stinkwood	426
2 Sneezewood	114
2 Wild Chestnut	105
2 Natal Mahogany	41
2 Other woods	81
21 trees, containing	1,370

LOW YIELD OF SOUTH AFRICAN FOREST.

The comparatively low yield of much of the Yellow-wood forest of South Africa is due to two causes:—

(*a*) The slow growth of the native trees.
(*b*) Imperfect stocking. The number of stems per acre is but a small fraction of a complete stock.

YIELD OF FORESTS OF BRITISH EAST AFRICA.

It has not been possible, as yet, to make valuation surveys to more than a limited extent in the forests of the Protectorate. The significance of the figures that have been obtained will be understood after what is said above regarding the yield in the similar forests of South Africa.

During my visit to the Protectorate sample areas were measured in the Kenia forest and in the Eldoma Ravine forests. After I left, Mr. Battiscombe measured a sample area in the coast forest. Details of my measurements will be found in my special reports on the Kenia and Eldoma Ravine forests. It will suffice, therefore, now to briefly recapitulate the results obtained.

KENIA FOREST.

Six sample acres were measured embracing altogether 21.16 acres of forest. In these sample areas every tree was measured by Mr. Battiscombe and myself. A general form factor of 0.50 was assumed. One of these sample areas (Embu) was carried right through the belt of forest a distance of 3.67 miles, as far as the bamboo. The other linear areas were shorter and there were some maximum areas which were of various shapes according to the shape of the areas having the maximum stocking or stand of timber.

Kenia Timber Sample Areas, 1907.

Linear through average forest.	Stock per acre. Cubic feet.
Embu (S. Kenia) 13.36 acres, Camphor timber 51 per cent., Yellow-wood 16 per cent. (3.67 miles by 10 yards)	2,546
Mutàmbi River (S. Kenia) 4.09 acres (1.01 miles by 10 yards), various hardwoods, 16 per cent. Camphor	1,182
Nuki River (W. Kenia), Outeniqua 46 per cent. and Cedar 28 per cent. of the timber, 0.5 acres (242 yards by 10 yards) ...	5,041
Maximum Stock, selected areas.	
Embu (S. Kenia) 0.5 acres selected to include the largest Camphor trees (Camphor 78 per cent. of the timber) ...	8,516
Sagàno River (W. Kenia) 0·68 acres, Yellow-wood 86 per cent. of timber	2,827
Nuki River 2.03 acres, rectangular, Cedar 91 per cent.	4,750

Comparing these figures with inspection notes of the general stock in the forest, the following average figures were estimated:—

Estimated average stocking Kenia forest south.

	Cubic feet.
South towards East (Embu country)	3,500
South (Kikùyu country)	1,500
South-west—up to Nùki River	2,100
General average for southern half of Kenia	2,300

Kenia Timber Sample Areas, 1908.

The following abstracts, pages 32 to 38, give the results obtained from nearly all the more important sample areas measured by me during my recent tour through

the Kenia forests with Mr. Ross. In every case the sample areas were given a linear form so as to obtain the best average. With one trifling exception, the linear areas were all 20 yards broad. Their length varied from 144 yards to 6 miles 432 yards. They were selected to represent the different types of forest, and consist of thin strips of timber taken haphazard through the forest. The only precaution observed, was that they should represent fully-stocked areas. Thus, when the line selected ran across ground that was bare, or that from fire or other reason did not contain the average stand of timber, such bare or imperfectly-stocked areas were excluded from the measured areas. A general form-factor of 0.50 was assumed.

The diameter measured was the diameter at about 5 feet from the ground; the height was the height of serviceable bole, so that the result shows the cubic contents of serviceable sawable timber in the bole, except in certain cases noted, such as Camphor, where the limbs were of sufficient size to furnish good sawable timber. All the measurements were taken by myself, personally, assisted occasionally by Mr. Ross and Forester Nielsen, when they could spare the time from survey work.

The system of measurement was the same as that followed by Mr. Battiscombe and myself in the Kenia timber measurements of 1907, so that the results are directly comparable. Heights were estimated, using a 10-feet pole with a little red flag on top. Three of these 10-feet rods also gave the 10 yards distance on each side of the line. Diameters were measured with a tape, held out, stretched across each tree. Callipers would have been impracticable for the larger trees, and cumbersome where the undergrowth was dense. The error of the stretched top was small, viewed from the distance required to estimate the heights, and this error, moreover, was always on the safe side. Only mature trees over 18 inches diameter were measured, but immature trees over 4 inches diameter were noted.

Altogether, 183,362 *cubic feet of timber, standing on* 102.52 *acres of ground, were measured. As a general result, the average of all the timber sample areas measured shows an average stock of* 3,265 *cubic feet per acre.*

On the completion of the Kenia forest map, it will remain to allot the average stocking to each class of forest, allowing for glades and imperfect stocking, and so to arrive at a closer approximation of the total stock, together with totals for each class of timber such as Cedar, Camphor, Yellow-wood, Hardwoods, and Bamboo.

Zuchi Mixed Forest Linear Sample Area—Upper Forest.

(S.E. Bay of Kenia.)

Linear Area through Upper Forest.—In measuring Camphor trees buttresses are excluded, but big limbs are reckoned in, as this tree carries so large a proportion of its timber in its huge branches. Trees under 18 inches diameter are not measured, as these would scarcely ever be mature.

Names of Trees.	No. of Trees.	Percentage of Trees.	Cubic Feet Gross Cylinder.	Percentage of Cubic Feet.
Camphor	72	27·27	64,029·11	71·00
Yellow-wood	110	41·66	13,052·72	14·47
m'Tundu	4	1·51	326·24	·36
Wild Lemon	1	·38	26·18	·03
Tumàra	3	1·14	372·74	·41
m'Saizi	6	2·27	593·57	·66
Chogi	3	1·14	551·21	·61
Tabernamontana sp. ...	3	1·14	209·81	·23
muKahàkuhà	1	·38	125·36	·14
muKongòro	6	2·27	509·64	·57
muTendèra	1	·38	80·79	·09
muAnda	4	1·51	708·10	·79
muTuma	44	16·66	6,643·31	7·37
MuNunga	2	·76	265,11	·29
muNgrìma	1	·38	158·75	·18
muTáozu	1	·38	95·45	·10
muZegèta	2	·76	2,439·64	2·70
	264	99·99	90,187·71	100·00

Length 2 miles 1,680 yards. Breadth 20 yards. Area 21·49 acres. Form factor 0·50.
Elevation 6,850 feet to 8,750 feet. Total cubic feet 45,093·85. Stock per acre 2,098·37 cubic feet.

Zuchi Camphor Linear Sample Area.

(S.E. Bay of Kenia.)

Linear Area taken through the Centre of the Camphor Forest Zone. — In measuring the Camphor trees buttresses were excluded; but big limbs were reckoned in, as this tree carries so large a proportion of its timber in its huge branches. Trees under 18 inches diameter are regarded as immature. Their numbers are noted but they are not included in the following figures. This area may be considered typical of the best Camphor forest. The forest extends north and south-west of this sample area—about two days' march south and one or two days' march north.

Names of Trees.	No. of Trees.	Percentage of Trees.	Cubic Feet Gross Cylinder.	Percentage of Cubic Feet.
Camphor	31	40·26	50,348·68	88·02
Yellow-wood	20	25·97	2,799·68	4·89
m'Saizi	2	2·60	279·02	·48
m'Airozi	14	18·18	2,052·81	3·59
muKahàkùha	1	1·30	188·15	·32
muKongoro	1	1·30	147·48	·28
muTuma	4	5·19	845·93	1·48
muSharàge	3	3·90	421·73	·73
muKèo	1	1·30	121·18	·21
	77	100·00	57,204·66	100·00

Length, 871 yards. Breadth, 20 yards. Area, 3·60 acres. Form factor, 0·50.

Total cubic feet, 28,602·33. Elevation, 6,850 feet. Stock per acre, 7,945·09 cubic feet.

"Table Mountain" m'Wèru, Linear Sample Area.

This is a sample area in the forest opposite the m'Wèru country. It was taken as low down, and as much was done, as could be managed, getting back to camp the same day. The forest was average forest, selected as such, along a native path leading from the top to the bottom of the forest. The length was obtained by pacing as the ground was level and the path straight. Sample area was 500 yards long by 20 broad = 2.06 acres. The sample area, somewhere near the centre of the forest (the elevation between 7,850 and 8,000 feet), was within the Camphor zone, further south, but no Camphor was seen here either in this, or in the Rotunda m'Wèru sample area or in any portion of the forest near here.

Names of Trees.	No. of Trees.	Percentage of Trees.	Cubic Feet, Gross.	Percentage of Cubic Feet.
Yellow-wood	46	58·23	4,728·83	35·44
muKàrombòsi	5	6·33	3,969·76	29·75
Ironwood	7	8·86	1,406·28	10·54
muAnda	4	5·06	1,206·92	9·05
Choge	4	5·06	791·67	5·93
muSamàra	10	12·65	687·33	5·15
Red Stinkwood	1	1·27	308·86	2·31
muKongoro	1	1·27	222·35	1·67
muKendèle	1	1·27	21·21	·16
	79	100·00	13,343·21	100·00

Length of sample strip, 500 yards. Breadth of sample strip, 20 yards. Area, 2·06 acres.

Stock, using 0·50 form factor = 6671·60 cubic feet or 3,238·64 cubic feet per acre.

Rotunda m'Wèru Linear Sample Area.

This is a small sample area near the bottom of the forest opposite the m'Wèru country. It is a few yards over 5 miles from the top of the forest going down the cattle path leading from the Rotunda mountain to the m'Wèru villages. The sample area was measured along an elephant path in average forest. There was no time to make it larger as I had to get back to camp the same day, and came down so far, at some risk of trouble with the natives. I was disappointed to find no Camphor anywhere in this forest.

This sample area is near the bottom of the forest, at an elevation of about 7,400 feet. It was measured in three sections with the result that there was an average stock of 3,232 cubic feet per acre, the size of the sample area (in three sections) being 1.41 acres. It was necessary to take three sections in order to get intact portions of the forest, which here had been a good deal cut about by the m'Wèru natives. Details of the three sections are as follows :—

"Rotunda" m'Wèru Linear Sample Area. Section 1.

Names of Trees.	No. of Trees.	Percentage of Trees.	Cubic Feet. Gross.	Percentage of Cubic Feet.
Yellow-wood...	7	58·34	1,443·24	68·62
muSamàra	2	16·67	355·29	16·89
Tabernæmontana	1	8·33	132·29	6·29
muSàra	1	8·33	119·28	5·68
Ironwood	1	8·33	53·01	2·52
	12	100·00	2,103·11	100·00

Length of sample strip, 40 yards. Breadth of sample strip, 30 yards. Area, 0·25 acres. Elevation, 7,600 feet.

Stock, using 0·50 form factor = 1,051·56 cubic feet or 4,206·24 cubic feet per acre.

"Rotunda" m'Wèru Linear Sample Area. Section 2.

Names of Trees.	No. of Trees.	Percentage of Trees.	Cubic Feet, Gross.	Percentage of Cubic Feet.
Yellow-wood	15	48·39	2,196·83	48·77
muÀnda	4	12·90	646·34	14·34
muSàra	3	9·68	474·63	10·54
muKòmbo-kòmbo	3	9·67	421·51	9·36
Tabernæmontana	2	6·45	282·89	6·28
muSamàra	2	6·46	195·61	4·34
Cedar	1	3·22	189·89	4·21
Pillar-wood	1	3·23	97·19	2·16
	31	100·00	4,504·89	100·00

Length of sample strip, 210 yards. Breadth of sample strip, 20 yards. Area, ·87 acres. Elevation, 7,600 feet.

Stock, using 0·50 form factor = 2,252·45 cubic feet, or 2,589·00 cubic feet per acre.

"Rotunda" m'Wèru Linear Sample Area. Section 3.

Names of Trees.	No. of Trees.	Percentage of Trees.	Cubic Feet, Gross.	Percentage of Cubic Feet.
muSàra	7	38·89	502.53	24·07
muKombo-kombo	5	27·78	590·17	30·30
Yellow-wood	2	11·11	263·11	13·15
Tabernaemontana	2	11·11	246·80	12·36
muÀnda	1	5·56	319·07	16·12
Pillar-wood	1	5·55	79·52	4·00
	18	100·00	2,001·20	100·00

Length of sample strip, 70 yards. Breadth of sample strip, 20 yards. Area, ·29 acres. Elevation, 7,600 feet.

Stock, using 0·50 form factor = 1,000·60 cubic feet, or stock per acre, 2,901·74 cubic feet.

KENIA, N.E. PLATEAU, "CRYSTAL-BURN, No. 1," LINEAR SAMPLE AREA; taken through a forest of nearly pure Yellow-wood.

This is a Cedar forest above and a Yellow-wood forest below, each forest pure, viz., containing practically no other species. There is only a little mingling where the two species meet. The Cedar occupies the upper drier forest, the Yellow-wood the lower damper forest. The whole area is just above the Bamboo. The ground is clear of undergrowth and the couvert dense. The ground in the Yellow-wood forest is carpeted with the coarse "Tree-moss," found in damp forest throughout extra-tropical Africa, while in the drier Cedar forest the ground is covered with a thin pasture grass.

Here and there are glades occupied by Elder and Blackberry bushes, Nettles, and grass; but the glades are small in area, and none fell within the linear area. This was run on a compass bearing straight through the centre of the forest.

Names of Trees.	No. of Trees.	Percentage of Trees.	Cubic Feet, Gross.	Percentage of Cubic Feet.
Yellow-wood	30	78·94	6,097·80	91·48
Cedar	3	7·90	301·83	4·54
muÀnda	3	7·90	193·71	2·90
Olive	2	5·26	72·59	1·08
	38	100·00	6,665·93	100·00

Length of sample strip, 188 yards. Breadth of sample strip, 20 yards. Area, 0·77 acre. Elevation, 9,600 feet.

Stock, using 0·50 form factor = 3,332·96 cubic feet, or 4,433·05 cubic feet per acre.

The following number of trees below 18 inches in diameter and above 4 inches, were not included in the above cubage: Yellow-wood 20, Cedar 2, muÀnda 2.

KENIA, N.E. PLATEAU, "CRYSTAL-BURN, No. 2," LINEAR SAMPLE AREA; taken through a forest of nearly pure Cedar.

This is the continuation of Crystal-burn, No. 1, taken through the nearly pure Cedar forest. See note above under "Crystal-burn, No. 1."

With the exception of a very few Olive and Yellow-wood trees, this is an area of pure Cedar forest. It gives a comparatively low stocking, because most of the trees are under 18-inches diameter, a large number just under 18 inches. It will be noted that there are 37 Cedar trees measured against 71 omitted as being immature.

Names of Trees.	No. of Trees.	Percentage of Trees.	Cubic Feet, Gross.	Percentage of Cubic Feet.
Cedar	37	86·05	3,783·89	87·55
Olive	5	11·63	341·63	7·91
Yellow-wood	1	2·32	196·35	4·54
	43	100·00	4,321·87	100·00

Length of sample strip, 282 yards. Breadth of sample strip, 20 yards. Area, 1·16 acres. Elevation, 9,600 feet.

Stock, using 0·50 form factor = 2,160·93 cubic feet, or 1,862·01 cubic feet per acre.

The following number of trees below 18 inches in diameter and above 4 inches, were not included in the above cubage: Cedar 71, Olive 2.

"DEEP GORGE" LINEAR SAMPLE AREA.

This sample area is on the N.E. Kenia plateau, near "Table Mountain," elevation 9,600 feet. The timber is 81 per cent. Yellow-wood, 12 per cent. Jarrah, 4 per cent. Red Stinkwood. This area, 2·53 acres, is representative of the upper forest on the north-east side of Kenia. It is a forest of over-mature Yellow-wood. There were many big old trees dead or dying as they stood, not counted in the above

enumeration. The line was cut by the compass on a N.E. and S.W. bearing; trees within 10 yards on each side were measured.

The undergrowth was succulent and mainly composed of *Plectranthus*, with a little bramble and Elder; "Tree moss" in the wetter parts. In the Jarrah, the big branches are measured in. General form factor, 0.50. There was little Yellow-wood reproduction, a few seedlings on the ground but almost no poles; standing stock per acre, 3,361 cubic feet.

"North End" Yellow-wood.

West Kenia, upper forest above the Bamboo. "North End" linear sample area situated 5 miles S.W. of the northern end of the Western forest. Inferior forest composed of Bamboo and Yellow-wood, with only a narrow fringe of Cedar on top. The Yellow-wood is of fair quality on top. At the bottom the linear area ran into thick but not continuous Bamboo. Elevation, 8,700 to 9,300 feet. Timber: 59 per cent. Yellow-wood, 22 per cent. Red Stinkwood, 11 per cent. muAnda, 7 per cent. Cedar. Area, 3·26 acres; standing stock per acre, 1,417 cubic feet.

"North End" Cedar, Sample Area A.

Situated 3 miles from north end of Kenia Western forest; elevation, 9,400 feet; on the upper edge of the Kenia forest, the upper portion an old burnt Cedar forest, the Cedar killed by fire. The Olive has resisted the fire. Some of the Cedars were fine pieces of timber, 30 inches diameter and 60 feet of clean bole, and apparently as sound as when they were killed by fire. Area, 1.40 acres. Elevation 9,350 feet. Percentage of timber, Cedar, 85 per cent.; Olive, 12 per cent. Standing stock per acre, 5,142 cubic feet.

"North End" Mixed Forest, B.

Situated 3½ miles from north end of Kenia Western forest. Elevation, 8,900 feet. This was in the hardwood area below the Cedar. There were a few particularly fine Cedars, but, on the whole, the timber here was much inferior to the Cedar forest, both in the quantity and quality of its timber. The whole forest had the appearance of having been traversed by fire not many years ago. Elevation, 8,900 feet. Area, 2·50 acres. Timber: Cedar, 53 per cent.; Red Stinkwood, 14 per cent.; Olive, 13 per cent.; Yellow-wood, 9 per cent.; m'Anda, 7 per cent.; Beukenhout, 3 per cent. Standing stock per acre, 1,346 cubic feet.

"Nuki River, No. 1," Outeniqua Linear Sample Area.

This sample area was selected as typical of the Outeniqua Yellow-wood forest, *Podocarpus gracilior*. It is too small, and a larger area was planned, but circumstances prevented both Mr. Battiscombe and me measuring a larger area. This sample area extends from the lower edge of the forest upwards towards the Snowy Peak of Kenia.

Names of Trees.	No. of Trees.	Percentage of Trees.	Cubic Feet, Gross.	Percentage of Cubic Feet.
Outeniqua	16	61·54	3,587·91	78·80
Ironwood	4	15·38	408·97	8·98
Olive	4	15·38	230·27	5·06
Cedar	1	3·85	198·80	4·37
m'Wazàzia	1	3·85	127·23	2·79
	26	100·00	4,553·18	100·00

Length of sample strip, 144 yards. Breadth of sample strip, 20 yards. Area, ·60 acres. Elevation, 7,300 feet.

Stock, using 0·50 form factor = 2,276·59 cubic feet, or 3,642·54 cubic feet per acre.

The following number of trees below 18 inches in diameter and above 4 inches, were not included in the above cubage: Ironwood 1, Outeniqua 6, Yellow-wood 3.

"Nuki River, No. 2," Black Ironwood Linear Sample Area.

This sample area is the continuation of "Nuki, 1," Outeniqua. It is on the edge of the Outeniqua belt, and represents the ordinary hardwood forest of the lower

elevations. The stock of timber per acre is not much above one-half of that where the Outeniqua Yellow-wood abounds.

Names of Trees.	No. of Trees.	Percentage of Trees.	Cubic Feet. Gross.	Percentage of Cubic Feet.
Ironwood	16	50·00	1,909·84	44·64
Red Stinkwood	3	9·38	859 04	20·08
Olive	8	25·00	714·77	16·71
Outeniqua	4	12·50	603·70	14·11
Cedar	1	3·12	190·90	4·46
	32	100·00	4,278·25	100·00

Length of sample strip, 272 yards. Breadth of sample strip, 20 yards. Area, 1·12 acres. Elevation, 7,300 feet.

Stock, using 0·50 form factor = 2,139·13 cubic feet or 1,909·94 cubic feet per acre.

The following number of trees below 18 inches in diameter and above 4 inches, were not included in the above cubage : Ironwood, 7, Cedar, 3, Yellow-wood, 2, Red Stinkwood, 1.

"Nuki River, No. 3," Cedar Linear Sample Area.

This sample area is about half-mile (going up a gradual slope) into the forest from Sample Areas, "Nuki River, No. 1 and No. 2." It is a Cedar forest on a ridge between 7,700 feet, and 7,900 feet elevation. The Cedar is old, and stands above young Yellow-wood as dominated poles.

Many of these old Cedars fork; some fork badly, spoiling the timber. In every case the above dimensions represent the quantity of sound sawable timber, as far as can be estimated without felling the trees.

Little ground herbage—grass, Plectranthus.

Names of Trees.	No. of Trees.	Percentage of Trees.	Cubic Feet. Gross.	Percentage of Cubic Feet.
Cedar	40	58·82	10,195·79	80·47
Ironwood	14	20·59	1,292·93	10·21
Outeniqua	6	8·83	897·25	7·09
Olive	7	10·29	191·94	1·51
m'Wàzàzia	1	1·47	91·40	·72
	68	100·00	12,669·31	100·00

Length of sample strip, 492 yards. Breadth of sample strip, 20 yards. Area, 2·03 acres. Elevation, 7,900 feet.

Stock, using 0·50 form factor = 6,334·66 cubic feet, or 3,120·54 cubic feet per acre.

The following number of trees below 18 inches in diameter and above 4 inches, were not included in the above cubage : Yellow-wood 42, Outeniqua 18, Ironwood 4, Cedar 2.

"Hausburg Valley, South," Linear Sample Area.

Line, an elephant track proceeding straight up the southern side of the Hausburg Valley. This area is typical of the forest below the Bamboo and Yellow-wood belt in the North-west Bay of Kenia.

Names of Trees.	No. of Trees.	Percentage of Trees.	Cubic Feet. Gross.	Percentage of Cubic Feet.
Cedar	73	39·04	21,817·57	65·12
Ironwood	60	32·09	7,471·70	22·29
Olive	51	27·27	3,672·88	10·95
Outeniqua	3	1·60	552·05	1·64
	187	100·00	33,514·20	100·00

The following number of trees below 18 inches in diameter and above 4 inches, were not included in the above cubage : Yellow-wood 84, Iron-wood 24, Olive 20, Cedar 4.

Length of sample strip, 1·40 miles. Breadth of sample strip, 20 yards. Area, 10·18 acres. Elevation, 7,800 to 8,000 feet.

Stock, using 0·50 form factor = 16,757·10 cubic feet, or 1,646·08 cubic feet per acre.

Yellow-wood in Bamboo forest, Rockingstone Pass, Linear Sample Area.

In this area all the trees were not measured, but they were counted and sample trees measured. The area was 10 yards (estimated) on each side of the path leading

from the top of the forest through the Bamboo to the bottom of the forest. In the Bamboo there were practically no trees but Yellow-wood, so it was possible to count them rapidly as one passed down the path. The length of the area was obtained by pacing, checked by the perambulator. This area is typical of the Bamboo and Yellow-wood forest of West Kenia. The area contained 10·38 Yellow-woods per acre, averaging 28 inches diameter by 32·5 feet of bole, or 138·97 cubic feet. Length of sample strip, 6 miles 430 yards; breadth, 20 yards; area, 45 acres. Stock per acre, 721 cubic feet.

Rockingstone Pass. Mixed Forest. Linear Sample Area.

Elevation about 7,700 feet. Length, 52 yards; breadth, 20 yards; area, 0·21 acres. Timber, Yellow-wood, 42 per cent.; Olive, 27 per cent.; Cedar, 16 per cent.; Ironwood, 16 per cent. This is at the bottom of the forest. The area is too small to have much significance. Stock per acre, 7,812 cubic feet.

Cedar and Olive lower forest. Linear Sample Area.

Average Cedar and Olive forest on a strip running out on the plains at about the centre of the N.W. Bay of Kenia. This is second-class dry forest, containing only comparatively small trees. It is typical of the low dry forest : with timber, 90 per cent. Cedar, 5 per cent. Greenheart, 3 per cent. Olive, and 2 per cent. Ironwood.

Names of Trees.	No. of Trees.	Percentage of Trees.	Cubic Feet, after using form factor.	Percentage of Cubic Feet.
Cedar	94	76·49	7,592·01	89·70
Olive	13	10·56	275·29	3·25
Greenheart (m'Ziga) ...	11	8·95	426·25	5·03
Ironwood	5	4·00	169·95	2·02
	123	100·00	8,463·50	100·00

Length of sample strip, 780 yards. Width of sample strip, 20 yards. Area, 3·20 acres. Elevation, 7,400 feet.

Stock, using 0·50 form factor = 8,463·50 cubic feet, or 2,644 cubic feet per acre.

The following number of trees below 18 inches in diameter and above 4 inches, were not included in the above cubage : Olive 84, Ironwood 76, Cedar 25, Greenheart 12.

Summary of Kenia, Sample Areas, 1908.

	Linear Area.	Timber Measured.	Cubic Feet per Acre.
	Acres.	Total Cubic Feet.	
Zùchi, mixed	21·49	45,094	2,098
Zùchi, Camphor	3·60	28,602	7,945
Table-mountain Mwèru	2·06	6,672	3,239
Rotunda Mwèru	1·41	1,052	4,206
		2,252	2,589
		1,001	2,902
North-East Plateau "Crystal burn" No. 1.	0·77	3,333	4,433
North-East Plateau "Crystal burn" No. 2.	1·16	2,161	1,862
North-East Plateau, Deep gorge ...	2·53	8,504	3,361
North end Yellow-wood	3·26	4,620	1,417
North end Cedar	1·40	7,199	5,142
North end mixed forest	2·50	3,366	1,346
Nùki Outeniqua	0·60	2,277	3,643
Nùki Ironwood	1·12	2,139	1,910
Nùki Cedar	2·03	6,335	3,121
Hausburg south	10·18	16,757	1,646
Rocking-stone pass, Yellow-wood in Bamboo.	45·	31,893	721
Rockingstone pass, mixed	0·21	1,641	7,812
Cedar and Olive of plains	3·20	8,464	2,644
Total	102·52	183,362	Average of all the sample areas. 3,265

Sample Areas—Eldoma Ravine Forests.

Four sample areas embracing 10·27 acres were measured.

Eldoma Ravine West—higher forest.

Linear through average forest.

	Cubic feet.
North Caravan road near Lèrigèri River—Yellow-wood, Cedar, and Ironwood (1,963 yards by 10 yards)	1,939
1st class upper forest near Lèrigèri River—Yellow-wood, Cedar, and Ironwood (340 yards by 10 yards)	5,745

Maximum stock linear.

On ridge running north from Caravan road near Lèrigèri River (235 yards by 10 yards)	6,160

Comparing these figures with inspection notes (I measured a small linear area on the North Caravan road which ran 3,600 cubic feet to the acre) the following general figures were arrived at:—

Estimated average stocking.

	Cubic feet.
Maximum stock on ridges, Yellow-woods, Cedar, and Ironwood	6,000
General average (exclusive of Wytch Hazel areas)	2,000

This figure (2,000 cubic feet) may be compared with the general average for Southern Kenia 2,300 cubic feet.

No sample area was measured in the lower forest. It is inferior to the upper, and besides the areas of Wytch Hazel has many grassy glades.

Eldoma Ravine East.

This forest is so much broken and scattered that no general estimate could be framed. At its best, it is inferior to the lower forest west of Eldoma Ravine. A sample area taken through good average forest yielded, however, the following figures:—

	Cubic feet.
El-dolat 1,197 yards by 20 yards, various Hardwoods and Cedar	1,093

ELGEYO ESCARPMENT ESTIMATED.

This forest was not visited by me, but I understand that Mr. Lingham found stands running to 80,000 cubic feet per acre (soft wood only, though most of the forest there is soft wood), while Mr. Grant, who was surveying and measuring here for weeks, estimated 150,000 feet board measurement over some 20 square miles of forest. This figure requires verification. 100,000 cubic feet per acre is the maximum volume of the far-famed Redwood forest (*Sequoia sempervirens*) of California and of Eucalypts in Australia. At 10 feet board measurement to 1 cube, Mr. Grant's figure would amount to 15,000 cubic feet, which approaches double the Kenia maximum area of 8,516 cubic feet, and seven-and-a-half times my general average for southern Kenia and of the first-class upper forest at Eldoma Ravine.

TROPICAL FOREST NEAR THE COAST.

In the Mwèle coast forest Mr. Battiscombe obtained recently in a sample area of the best coast forest, with 117 trees to the acre (83 of these exploitable), 5,029 cubic feet. The height growth here is good. This is probably the maximum for a coast forest.

The above figures refer to the cubic content of merchantable timber in the boles.

STANDS OF TIMBER—AFRICA AND EUROPE.

		Cubic feet per acre.
1. A general average Southern Kenia forest (my 1907 Report)		2,100
2. Embu linear sample area, through the forest, 3·67 miles ...		2,546
3. General average, my 1908 Kenia linear areas (102 acres measured)		3,265
4. Màbìra, Uganda, linear sample area		4,102
5. Tropical coast near Mombasa, Mwèle linear area through the best forest (Battiscombe)		5,029
6. Yellow-wood, Ironwood, and Cedar forest, "Eldoma Ravine West, Lèrigèri"		6,160
7. Zuchi, Kenia S.E. Bay; linear, 1908, 3·6 acres, through Camphor forest		7,945
8. A half-acre of big Camphor trees, Embu, Kenia (maximum of 1907 sample areas)		8,516
9. Timber in a normal forest of Scotch pine, 120 years old, in mid Europe (Weise's Yield Tables)		
	1st class ...	9,060
	3rd class ...	5,340
Do., do., at age 90		
	1st class ...	7,950
	2nd class ...	6,100
	3rd class ...	4,620
	4th class ...	3,530
	5th class ...	2,690
10. Timber in a mature forest of Aleppo Pine, "Main forest," Cyprus		2,021
11. Maximum South African Yellow-wood forest		10,000
12. Elgeyo Escarpment, Grogan, maximum area coniferous timber only (Grant)		15,000
13. Heaviest timbered areas known—as reported, approximately, for the following forests:— Redwood (*Sequoia sempervirens*), California: Douglas Pine, Oregon: Blue-gum (*Eucalyptus globulus*), Tasmania: and various Eucalypts, coastal forests of Northern New South Wales...		100,000

SANDAL (M'HUGU) STOCK.

Most of the Sandal forest has, unfortunately, been alienated and the Sandal destroyed. There is, however, a good piece of Sandal forest some 1,200 acres, near Nairobi, belonging to Messrs. Handcock and Thomson; and I have been supplied with the following data regarding the Sandal it contains:—

Sandal in the best stocked forest.

	Per acre.
Standing trees per acre (of which about one-half are sound) ...	60
Logs on the ground	30
Total trees per acre	90

The average stocking is estimated at 30 trees per acre. In good m'Hugu forest near Nairobi, the mature m'Hugu averages about 14 inches diameter, with 40 feet of bole. On the coast north of Mombasa, in the Sekoku forest, Forester Minshall estimates the Sandal trees at about 20 trees to the acre. It stands over scrub, and is almost the only timber tree there. The trees average about 12 inches diameter, 18 feet of bole, and 35 feet high; but trees up to 18 inches diameter and 40 feet of bole are met with.

It may be noted that in 1907 Sandal wood yielded the Mysore State as much as one million rupees, and this is a constant revenue. The tree is not allowed to be destroyed, as happened in Western Australia.

MONEY VALUE OF TIMBER FOREST.

Obviously in so young a country as British East Africa, there are but slender data for estimating the eventual money value of the forest. Mr. Clutterbuck, who has worked the forest on a large scale at Njoro for the supply of fuel to the railway, values this forest at £5 per acre. On the basis of South African data, the value of various classes of forest is given in the table of alienated forest, page 64.

EXTRA-TROPICAL YIELD TABLE.

A TABLE OF MEAN YEARLY YIELDS IN CUBIC FEET PER ACRE (ACRIM) OF VARIOUS EXTRA-TROPICAL FORESTS AND SOME OTHERS ADDED FOR COMPARISON.

	Cubic feet.
Blue-Gum (*E. globulus*), Nilgiris, India, 10-20 years old. Average for the best plantations (Brandis and Hutchins)	700
Blue-Gum plantation, Worcester, Cape, when 7 years old. Sample area one-third acre in the best part of the plantation (Hutchins) ...	659
Karrie, Prince Kasteel, Tokai, 13 years old in 1900 (Gower)	626
Blue-Gum, Harkerville, Knysna, one-tenth acre sample area, 11 years old (MacNaughton)	622
Blue-Gum, Harkerville, Knysna, 10 years old. 13 acre sample area (burnt forest land) (MacNaughton)	613
Karrie and Saligna Eucalypts, at Tokai (Block B 50), the big trees, over 100 feet high, at 22 years of age, gross content (Ryan and Lane-Poole)	559
Karrie, Cedar ridge, Tokai, 6 years old in 1900 (Gower)	533
Blue-Gum, Newman Plantation, Nilgiris, at 34 years of age, 7,200 feet elevation, planted 6 × 6 (Cowley Brown)	528
Sphinx Rock (*Eucalyptus saligna*), at Tokai, 13 years old in 1900, $\frac{1}{4}$ acre, 491 trees per acre (Gower)	527
Blue-Gum, Nilgiris, Mutinàd Plantation, at 23 years of age, 7,200 feet elevation, planted 6 × 9	472
Eucalyptus saligna. Valuation Survey, Ceres Road, 1905 (Elder); boles only	458
Blue-Gum, Worcester, Cape Colony, 5 years old, coppice regrowth after cutting (Birrell)	457
Eucalyptus botryoides. Valuation Survey, Ceres Road, 1905 (Elder); boles only	408
Blue-Gum, on swampy ground, Natal, estimated yield of plantation per acre per year (Report, Surveyor-General, 1879)	400
A plot of *Pinus insignis* on high mountain slopes, Cathcart Plantation, 8 years old	385
Ten years old *Acacia melanoxylon*, Nilgiris (Hutchins)	378
Karrie, Manor House Ridge, Tokai, 5 years old in 1900 (Gower) ...	377
Twenty-six years old *Acacia melanoxylon*, Nilgiris (Hutchins)... ...	371
Karrie and Saligna Eucalypts, at Tokai, Block B 50, the big trees, over 100 feet high, at 22 years; stem content only (Ryan and Lane-Poole)	348
Cluster-Pine, Plumstead, 14 years old (Hutchins), 1896	342
Blue-Gum, Worcester, Cape Colony, first crop cut at 16 years, mean of whole 60 acres (Birrell and Railway Truck Weights)	333
Eucalyptus pilularis. Valuation Survey, Ceres Road, 1905 (Elder); boles only	330
Eucalyptus punctata. Valuation Survey, Ceres Road, 1905 (Elder); boles only	324
Blue-Gum, Kluitjes Kraal (Birrell), (Con. Rep., 1897), 11 years old ...	322
Casuarina equisetifolia, Madras, India, good soil (Hutchins)	315
A plot of 4½ years old *Eucalyptus gomphocephela*, at East London, planted 5 feet × 5 feet (Con. Rep., 1904)	306
Eucalyptus corynocalyx. Valuation Survey, Ceres Road, 1905 (Elder); boles only	301
Maximum yield, Black Wattle, Natal, cropping at 5 years (Sim) ...	300

	Cubic feet.
Teak, Nilambur Plantation, cut at 60 years, stem contents, final yield only (Beddome)	280
A plot of *Pinus halepensis* on high mountain slopes (Cathcart), at 8 years old (Cons. Rep., 1904)	260
Acacia melanoxylon, Nilgiris, general average of two good plantations (Cowley Brown, 1906)	260
Eucalyptus corynocalyx. Valuation Survey, Ceres Road, 1905 (Elder); boles only	255
Casuarina equisetifolia, Mysore, India, maximum (Hutchins)	252
Douglas Pine, in North Oregon, 38 years, in one acre sample plots, boles only (H. S. Graves in "Indian Forester" for March, 1898)	234
Sihlwald, Conifers, maximum ("Journal of a Forest Tour")	229
Eucalyptus siderophloia. Valuation Survey, Ceres Road, 1905 (Elder); boles only	225
Pinus pinaster and other pines, except *P. insignis*, East Cape Colony, general average over 1,137 acres, 9 years (Sim in "Forest Flora, Cape Colony")	203
Schiffershaffer, Baden, mixed forest, maximum in experimental plots (Fernandez)	200
Douglas Pine, in North Oregon, 22 years, in $\frac{1}{4}$ acre sample plots, boles only (H. S. Graves)	197
Cluster-Pine, 8 years old, Concordia, Knysna, 1901 (MacNaughton) ...	193
Spruce in Thuringia, at 100 years, the subject of a very striking photo. in Dr. Schlich's "Forestry in the United Kingdom"	178
Scotch Pine, Viernheim, on rich alluvial of the Rhine Valley, boles only (Fernandez)	175
Scotch Pine, best forest, maximum acrim (at 50) years (Weise)	170
Forest of Levier, one of the most productive forests in France, net revenue £3 3s. per acre. Slopes of Jura Mountains between first and second plateau, 2,500 feet, almost entirely Silver Fir (Smythies) ...	166
Maximum in Spiedel's yield curves, *i.e.*, first-class Spruce at 60 years. This may be taken as the maximum of practical forestry in Europe	152
Mean yield, Black Wattle, Natal, 40 lbs. per cubic ft., and cropping at 10 years (Sim)	150
Sihlwald, mean for whole forest ("Journal of a Forest Tour."—Hutchins)	146
Scotch Pine, Germany, on rotation of 65 years, maximum timber acrim, good forest (Weise)	138
Eucalyptus microcorys. Valuation Survey, Ceres Road, 1905 (Elder); boles only	126
Callitris sp. Valuation Survey in two good plantations, Nilgiris, average (Cowley Brown, 1906)	110
Scotch Pine, average forest maximum acrim at 60 years (Weise) ...	102
Coniferous forest in Ardennes (estimated by Professor Fisher in "Indian Forestry," July, 1897)	100
Maximum in Natal indigenous forest. Gwangwàne Forest, if worked at a rotation of 100 years, boles only (Fourcade in Natal Report, 1889)	100
Sihlwald, Leafwoods, mean ("Journal of a Forest Tour."—Hutchins)	100
Herrenweis, mean, leaving out the highest forests ("Journal of a Forest Tour."—Hutchins)	100
Forests of State of Baden, average for best Spruce forests ("Journal of a Forest Tour."—Hutchins)	100
Eucalyptus sideroxylon. Valuation Survey, Ceres Road, 1905 (Elder); boles only	96
Eucalyptus leucoxylon. Valuation Survey, Ceres Road, 1905 (Elder); boles only	89
Forests of Saxony, average (Fernandez)	85
Sissoo, Changa Manga, India, at 16 years (Smythies in "Indian Forestry," August, 1895)	83
Wattles (mostly Black Wattle), East Cape Colony, general average over 643 acres at 7 years (Sim in "For. Fl., Cape")	83

	Cubic feet.
Scotch Pine, Germany, first quality forest, rotation of 120 years (Schlich, 1 Vol., 168)	81
Oak, Viernheim, on rich alluvial of Rhine Valley (Fernandez)	80
Oak, high forest, Germany, rotation of 90 to 120 years, maximum (Brandis)	80
Estimated acrim of properly-worked indigenous forest, boles only (Fourcade, Natal Report)	30-70
Coniferous forest, mean in Ardennes (Government Commission of 1883)	70
Eucalyptus crebra. Valuation Survey, Ceres Road, 1905 (Elder); boles only	66
Weymouth Pine, North America, at 90 years, stem only, medium quality (Pinchot and Graves, monograph, 1896)	63
Oak, coppice, Germany, rotation of 15 to 25 years, maximum (Brandis)	57
Eucalyptus tereticornis. Valuation Survey, Ceres Road, 1905 (Elder); boles only	56
Deodar, Himalayas, between 100 and 200 years, boles only (Brandis)	55
Average forests of Baden ("Journal of a Forest Tour."—Hutchins)	53
English forests, if restored, average estimated yield (Schlich's Manual, Vol. 1, page 60)	50
Estimated acrim, Burmese Teak plantations (Brandis) (For. Fl.)	47
Mean for forests of Germany (Fernow)	43
Average French State Forests (Official Returns)	43
Average French Communal Forests (Official Returns)	37
Quercus dilatata, pure, averaging 100 feet × 24 inches diameter, at about 7,000 feet, Western Himalayas ("Indian Forestry," March, 1887)	36
Simple Coppice, Ardennes (Fisher in "Indian Forestry," July, 1897)	35
Indigenous forest, Cape, Eastern, first-class forest (1900 valuation), boles only	30
Mean yield of sawable timber forests of Germany (Fernow in "Outlook Timber Supply, U.S.A., 1902")	22
Mean present yield forests of Norway believed to be in excess of the "Possibilité," boles only (Colonel Bailey in "Trans. Royal Scottish Arbor. Society" for 1901)	21
Indigenous forest, Cape, Eastern, second-class forest (1900 valuation)	20
Minimum in Spiedel's Yield Curves, *i.e.*, fifth-class Beech at 60 years old. This may be taken as the minimum of practical forestry in Europe	15
Communal forest of Chamonix, Spruce, Silver-Fir, Larch, selection fellings only. Higher parts at limit of tree vegetation (A. Smythies)	13
182 acres virgin forest at Gouna Knysna, per acre 1,081 cubic feet in 31 trees, assuming a rotation of 100 years, boles only (Fourcade in Natal Report, 1899)	10·8
Indigenous forest, Cape, Eastern, third-class forest, boles (1900 valuation)	10
Mercantile Spruce, boles in mixed hardwoods, Na-ha-sa-ne, forest, U.S.A. (Pinchot)	8
Average yield, Knysna forests, boles, 610 cubic feet in 18 trees, assuming a rotation of 100 years and no improvement in yield (Fourcade in Natal Report)	6

In the above table some of the figures relate to gross content and some to stem content only; unless otherwise stated gross content is to be understood.

FOREST FIRES.

Though forest fires are less to be feared than in South Africa with its long dry season—either summer or winter, there are large areas of forest in the Protectorate where enormous damage has been done from fire, and where systematic fire measures will be necessary in the future in order to protect the forest from fire My report on the forest of Kenia describes the mischief wrought by fire on the drier western side of the Kenia forest. In the Aberdare forest, fire is not confined only to the drier western side. As the range runs northwards towards the drier country

and as it decreases in altitude it becomes drier and the forest is liable to suffer from fire on both the eastern and western sides. I was a witness to the mischief wrought by fire in the northern portion of the Aberdare forest. This I have described under the Aberdare forest. On descending to the western side of the Aberdare range I traversed a slope where a forest had been entirely destroyed by fire. My inspection note regarding this runs as follows:—

> On the steep, stony upper slopes are scattered trees of Juniper, Olive, and Mwoinda—the Juniper mostly injured by burning, but some has been barked. Mr. Battiscombe has been here on two previous occasions. The first time he came here the "Setima" slopes were covered with a good growth of Juniper. The second time he found the whole forest burnt over. It was the last burn before the Masai left here, but it was most disastrous to the forest. Now, from the valley below one looks up to barren, stony slopes with only a fringe of forest along the top and a few scattered Cedar trees, just enough to show what fine trees once grew here.
>
> In the exceptional dry seasons, which occur at intervals of years, very fierce fires may occur in a class of damp forest that, ordinarily, is not inflammable. Such a fire occurred a few years ago in the damp forest near Njoro. It originated in a private forest, swept across the railway, and did enormous mischief. There was evidence of similar fierce long-interval fires occurring in the Kenia forest.

THE FOREST THAT WILL NOT BURN.

In the climate of the wetter portions of the highlands there is a class of forest which is practically safe from fire. Here the rainfall is so regular and so large in amount that the forest never becomes dry enough to burn.

During the dry season, when fires are raging on the plains and in the drier forest, there are quite light rains which keep this class of forest always uninflammable. When the Kikùyu wish to destroy large trees here the vegetation must first be cut and then dried like hay and built round the trees; in this class of forest the vegetation will not burn unless it has been previously cut. Thus the outlook for successful fire-protection in British East Africa is most hopeful. For, even in the drier forest where fire has done so much mischief, it will be easily brought under control by the usual system of fire paths and watchers. Where it abuts on the plains and Masai grazing lands, I anticipate no difficulty in arranging with the Masai so that their grazing fires are performed at a time and under conditions that will render them controllable. Over considerable areas in the Protectorate I have noticed that the grass if not burned for several years seems to become less inflammable. The rank, old, matted grass forms a layer which gradually kills down the grass underneath—the forester's greatest enemy. The next stage is that the old grass rots down into humus, and conditions favourable to forest reproduction ensue. It is the shortness and mildness of the dry season in British East Africa as compared with South Africa that renders this process possible.

It was found on the Nilgiris, Southern India, that the effect of stopping the grass fires was to reduce the area of the grass lands and consequently the game. This was the conclusion arrived at by the Nilgiri Game Protection Association as the result of a careful and extended experiment. It is exactly the reverse of what happens in South Africa, where, when the grass is left unburnt for one or two years it becomes more and more inflammable, and more and more dangerous to the neighbouring forest.

NATURAL REPRODUCTION.

The natural reproduction in the forests of British East Africa is on the whole somewhat better than that in South Africa. And, as in South Africa, there is much variation—some forests showing very few seedlings on the ground, others a sufficiently complete stock of young trees of all ages. As a rule, the re-growth of seedlings and saplings is insufficient, and it is the scantiness of trees in the pole stage that chiefly strikes the observer. In the upper forest, where Yellow-wood is abundant, there is almost always a good show of Yellow-wood seedlings, but the forest evidently requires to be opened out to allow these to develop. It appears in British East Africa that Yellow-wood, though shade-bearing for a number of years, becomes soon like many other trees—light-demanding. This is perhaps more so in British East

Africa than in South Africa, owing to the sun being more frequently veiled by mist and clouds in British East Africa.

What appears to be an important point is, that in the fertile climate of British East Africa it is sufficient to work the ground to produce an abundant crop of self-sown seedlings. In the Black Wattle plantation at Escarpment on the ground cleaned and kept clean for nurseries, there came up self-sown among the young Black Wattles and Eucalypts an abundant crop of little Cedar trees (*Juniperus procera*). In an outlying portion of the Kenia forest, near the Embu Civil Station, I noticed a good reproduction of Croton, where the ground had been kept clean by a forest path. I have seen an abundant crop of Mahùgu seedlings come up self-sown on worked garden-ground at Nairobi. It appears possible, by "wounding" the ground, for two or three years, below and around the valuable species, to obtain sufficient re-growth of seedlings in the case of most species; and with the cheap labour of the country there should be little difficulty in carrying out such a simple work economically.

Coppice reproduction.—The railway fellings and the depredations of the Kikuyu show what species reproduce well from coppice. Generally, the coppicing species are those of secondary value. Of the first-rate species, the conifers naturally do not coppice. I have no observations on Ibean Camphor, but from the straight natural shoots it formed in the forest, am inclined to think that it may furnish good coppice. The coppicing species observed are:—

muKahàkuhà.
m'Kiau.
m'Ho.
m'Oringa.
m'Tùndu.

Of these the first two on the list are trees of some value, the first especially. m'Ho may also be turned to useful account. In the native gardens between Fort Hall and the Aberdare Range I noticed a number of m'Ho (*Markhamia platicalyx*), m'Oringa, and m'Tùndu (*Tiliacious*) regularly cultivated, and cut as coppice, by the Kikuyu. No doubt the origin of these trees was that when the forest was destroyed they, as coppicing species, remained.

WHITE ANTS (*Termites*).

White ants are an important factor in the durability of timber in warm countries. They are troublesome in the warmer parts of South Africa, and in tropical countries entirely alter the conditions of timber use. On the highlands of British East Africa white ants are comparatively a mild pest. It is not known yet exactly how they will affect houses built of perishable soft-wood, but it is certain that White-ants on the highlands are comparatively a mild pest. They are, however, quite bad enough in houses in Nairobi to make the use of Cedar and other durable native timbers far preferable to Deal.

GAME IN THE FORESTS.

Compared to the abundance of big game on the plains, there is but little in the forests. That, however, is no reason why the game in the forests should not be preserved, especially as there is more chance of effectual protection than on the plains. In the forests there is cover and shelter for the game; the forests will not be alienated but remain Government property; the forests will have the advantage of protection by the forest staff. On the plains, on the contrary, though it is sad to think of, the game (apart from the special game preserves) seems destined to disappear as it has from the plains of South Africa. When the wonderfully rich grass lands of British East Africa come to be occupied, farmers in defence of their flocks and herds will destroy lions and other carnivoræ. In many parts of the country sheep farmers must do so. Lions have already been poisoned on a large scale, and during my tour I came across poisoned lions and other animals lying dead on the veld. It is difficult to blame the farmers for this destruction. Leopards are destroyed similarly in South Africa.

The animal that is particularly deserving of protection in the forest is the elephant. It is long-lived, but multiplies slowly. It keeps out of the way of men and their works, and is neither dangerous nor destructive to man. Rogue elephants, if they exist, are nothing like so abundant as in the forests of India. The elephant is turned to important use in working the forest in Burmah, and I have every hope that it may be similarly employed on forest work in British East Africa. Its help in getting out the timber is sadly needed. It is not necessary here to recapitulate the evidence with regard to the taming of the African elephant. Jumbo was an African elephant, and tame elephants with large ears figure in Roman coins as taking part in processions. I have had experience of elephants in the forests of India and of South Africa, and am of opinion that the taming of African elephants is a matter of mahouts. I think tame Indian elephants may not be necessary. With 25,000 Indians in British East Africa there should be little difficulty in obtaining the services of sufficient mahouts; and I propose, with the assistance of the Game Ranger, Mr. Percival, to attempt the trapping and taming of some African elephants as soon as more pressing work has been disposed of. I hope to render effective the preservation of elephants in the forests as soon as foresters are located in the forests (instructions have already been given to commence building the foresters' houses). At present, the rules against destruction of elephants by native hunters are but partially enforced. My inspections showed that elephant killing by the natives in the Kenia Forest is still in full swing. I came across the dwellings of the Wanderobo hunters in parts of the forest; there was no difficulty in purchasing the poisoned arrows and darts which they employ in killing elephants. They use a vegetable poison which has an action on the heart, and is said to kill an elephant in five minutes. Elephant pits are frequent. During one whole day in Southern Kenia, the forest was so thick with elephant pits that no one of our party dared to venture off the beaten paths. Patches of forest are destroyed and burnt over in order to encourage the growth of fresh succulent herbage. Elephant pits are then dug in the paths leading to these elephant grazing grounds. Ivory is advancing in price, and it is certain that in the absence of a forest staff elephants in the large forests would become as scarce as they now are in the forests of South Africa.

I recommend that the Kenia and other forests, as they become demarcated and placed in charge of a protective staff, should be constituted game-preserves, and all game within their boundaries placed in charge of the Forest Department. At present, the ordinary game licence carries a permission to shoot two elephants yearly. This permission should be restricted so as to exclude elephants in the large forests where they are likely later to be turned to use in working the forest.

With the elephants will be preserved the other game of the forest. Buffalo, the large and rare buck—the "bongo," water-buck, bush-buck, and various other bucks which frequent the forest glades, but more especially the grass lands above the forests. It is probable that much of the game now on the plains will take refuge in the forests as the plains become settled and populated.

Not the least important use of the forest is the food and shelter it supplies for birds. The bird life of the forest is more varied and abundant than the animal. During my visit more sport was obtained from birds than animals in the forest. The spotted wood-pigeon, *Columba arquatrix*, arrived in countless flights, apparently migrating from the Uganda country towards the highlands of British East Africa. This fine wood-pigeon occurs, I understand, as far south as the Transvaal, but always on the highlands. Mr. F. J. Jackson tells me that in British East Africa it is always a bird of passage.

Excellent sport, too, was afforded by the crested guinea-fowl of the forest, *Guttera pucherani*, and there is no more delicious game bird than this when hung for a few days in the cold climate of the Kenia Forest.

BEES.

Bees (*Apis mellifera* var. *adamsoni*) represent a considerable source of forest wealth. At present the honey is eaten and forms a dearly-loved article of food; the wax is usually thrown away. Bees are so abundant in the forest that it seems likely that bees-wax, in the future, will become an important source of forest revenue. There are regions in equatorial Africa where milk and honey form the chief diet of the natives. All through the Kikuyu country bee-hives are common. The natives take three or four feet of a soft-wooded tree, hollow it out, and then fit a piece of

split board at each end. These hives are very common. Sometimes two or three will be seen in one large tree, and tied as high as 50 feet or more from the ground. The bees are not put into these hives, but they go in of themselves. These hives are of exactly similar appearance. When a swarm leaves one of these hives and finds another of exactly similar appearance, it naturally makes its home there. This system of bee-keeping saves a great deal of trouble, and the yield of honey from these hives is large. Practically all the bees of the country live in this state of semi-domestication.

The extra-tropical bee of British East Africa is quieter and more yellow in colour than the Cape bee. In fact, it is so yellow that it may be described as yellow or fawn, banded with black bands. It is tamer than the Cape bee. I have seen some ten or 12 hives taken, both the Kikuyu wooden bee hives and the quite wild bees in trees. Little smoke was used, but I never saw a man badly stung; indeed it was rare for a man to get more than two or three stings. The honey is of excellent flavour, particularly that from the Begonia blossom, which festoons so many of the forest trees.

Both the extra-tropical East African bee and the South African "yellow-bee" are commonly kept in hives, and the only essential difference between the two systems of bee-keeping is, that in British East Africa the hives are in the forest, and the wild swarms enter the hives voluntarily. It is probably an essential feature of the East African system that the hives are all alike, so that wild swarms take naturally to their new homes in preference to hollow trees, holes in the ground, and the other resorts of wild bees.

UGANDA RAILWAY FOREST.

Wooden fuel has supplied the motor power of the Uganda Railway since 1902. Up to March, 1908, the Uganda Railway had received 15,657,586 cubic feet of firewood, cut from the forests it traverses—the thorn scrub of the plains and the timber forests of the highlands. No doubt an equal quantity of wood has been wasted, burnt or left to rot because it would not split easily. Improved methods of working are gradually reducing this waste. The Uganda Railway is using at present between three and four million cubic feet yearly of firewood. Pine timber required for constructive purposes has been imported to the extent of about one million cubic feet yearly; no wooden sleepers are used. Allowing for expansion and probably wooden sleepers in the future, Mr. Currie thinks that forest should be provided to furnish some 30 million cubic feet yearly in the future.

Seasoning of firewood.—The seasoning of firewood is perhaps a more important matter than the seasoning of timber. It would probably be economical to season more thoroughly the firewood employed on the Uganda Railway by drying it in iron sheds, where a high temperature can be secured almost daily at no cost, especially if some of the temporary iron buildings on the railway were pulled down and replaced. The actual calorific value of firewood of course depends largely on the extent to which it is seasoned. 100 lbs. of firewood as used on the Uganda Railway will probably be found to contain on an average from 25 lbs. to 30 lbs. of water. Olive and similar hard-woods will contain less than Cedar. In a suitably-constructed shed of unlined corrugated iron with a daily temperature of 80 Fah. for several hours, it seems likely that this 25 to 30 per cent. of moisture could be reduced to 8 or 10 per cent. of moisture. This would mean an increase in its heat-yielding power of about 67 per cent. (say, from 200,000 units to 335,000 units).

Wasteful working.—At present there is considerable waste in cutting fuel for the railway. The trees are felled too high—sometimes as high as 6 feet above the ground. Wood that will not split well and all branch wood below about 4 inches is not used. No saws are employed. The system of working the fuel with Kikuyu labour, using no tools but axes and knives, could be economically replaced, to a considerable extent, by machinery for sawing wood and a system of light tramways. This it was arranged should now be done. One of the largest fuel contractors expressed his willingness to import machinery and lay down tram rails at once and at his own expense.

The misuse of Cedar and Yellow-wood for firewood.—The misuse of Cedar for railway fuel is a patent abuse which has been already noticed. In the early days it was necessary to obtain fuel at any cost; and, in the absence of systematic control,

Cedar, a valuable soft-wood, was used as well as the hard-woods which form the natural fuel supply of the railway.

As a firewood Cedar is inferior to a greater extent than is indicated by the mere difference in weight between its soft-wood and a hard-wood such as Olive. A timber like Olive makes a distinct and very hard heart-wood, mainly composed of Lignine. Cedar (*Juniperus procera*) has little more than essential oil in its heart-wood, which is largely composed of Cellulose. Cellulose contains a smaller proportion of carbon than Lignine. Yellow-wood has also been misused for fuel, but not to the same extent as Cedar. The Manager of the Uganda Railway is fully alive to the desirability of putting an end as soon as possible to the use of Cedar for railway fuel. When at Nairobi, I had the advantage of discussing these and other questions affecting the working of the railway forest with Mr. Currie. As the outcome of our discussion I drew up the following memorandum, which has been agreed to by Mr. Currie, with the exception of payment for fuel beyond the railway mile zone. As the railway and the forest are both Government properties, this is not a question of Government expenditure, but a matter of correct book-keeping. It would seem correct that fuel and timber from Government forests should be debited to the railway and credited to forest revenue.

The arrangement arrived at with regard to the working of the railway forest was as follows:—

Future Working of the Railway Forest.

(A). *A Railway Forest Zone.*—The railway mile zone, situated between Kiu (mile 267) and mile 508, to be reserved absolutely for railway purposes. This area may be conveniently termed the "railway forest zone." It comprises some 150 running miles of alienated land, thus leaving about 91 miles (or 182 square miles) for forest purposes. This area is calculated to provide in the future about three times the present railway wood consumption of four million cubic feet. No further alienations of land to take place within this area, which is to be administered as State forest by the Forest Department in trust for the Railway Department. Within this area no trees will be allowed to be felled unless marked for felling by the Forest Department. It is agreed, further, that within this area there will be reserved, on both sides of the railway, a strip 200 yards broad, within which trees will be felled only when they reach the period of their physical maturity; in other words, only trees that are dead, or nearly so, will be marked for felling by the Forest Department. This 200-yards strip is to be preserved entirely in its natural condition for two reasons:—

(1) To protect the remaining forest against the sparks of locomotives and fires caused thereby.
(2) To show the natural beauty of this part of the country as the game zone is preserved to show the game.

The above arrangements with regard to the railway forest zone to come into force as soon as the re-organisation of the Forest Department now in progress has taken place.

(B) *Plantation sites.*—Between Kiu and the coast and between mile 508 and the lake, plantation sites to be selected and demarcated by the Forest Department in communication with the Manager, Uganda Railway. A site sufficient to provide one million cubic feet of firewood yearly is to be selected between Muhoroni and Port Florence. Such plantation sites to adjoin the railway and to be selected for depth and quality of soil. A local supply of water is preferable but not essential. The production of fuel is to be the chief object sought, and after this Iron-bark, Tallow-wood, Black-Butt, &c., for sleepers. This work to be proceeded with as soon as possible in order to prevent the possible alienation of good planting sites.

(C) *Supply of Railway Fuel.*—Fuel to be supplied to the railway both departmentally and on contract, the contractor engaging only to fell trees marked for felling by the Forest Department, and after due warning on breach of any of the Forest Regulations to have his contract rescinded. The contractor to be held responsible for forest fires and for felling unmarked trees under such penalties as may be agreed upon.

These fines to be recovered, by way of liquidated damages, from the first payment made to the contractor after the receipt of the Conservator's requisition; and

after recovery to be paid over to the Conservator and utilised by him for reforesting purposes within the "railway forest zone."

The departmental supply of fuel to be undertaken by the Forest Department as soon as possible after the re-organisation of the Department. It is desirable, for a time at least, to have fuel supplied both on contract and departmentally, and thus to test the economy and utility of both systems.

(D) *Misuse of Cedar.*—The use of good sound Cedar and Yellow-wood timber for fuel to be discontinued as soon as a siding can be run into the Government forest, at or near, mile 508: this forest to be worked under arrangements similar to those mentioned above for the "railway forest zone."

(E) *Funds provided by the Railway.*—For the working of the "railway forest zone," particularly the cost of replanting areas where the forest has been destroyed and for marking the exploitable timber in the existing forest, there will be provided out of Railway funds a yearly sum of £4,000.

(F) *Plantations of Black Wattle.*—Arrangements are being concluded for the planting of about 2,000 acres of Black Wattle or other railway fuel by lease-holders, who will have occupation of railway land for a term of 35 or 99 years. The number of Wattle or other trees to be planted on these lands not to be less than 1,000 per acre. In view of the uncertainty of Wattle growing here, and possible difficulties with some of the Wattle growers, the issue of further Wattle leases to be suspended for the present.

Exhaustion of the Railway Forest.

On assuming the duties of Conservator of Forests in charge of the railway forests in 1902, Mr. Elliott estimated that in 17 years the fuel on the railway mile zone would be exhausted. The consumption has increased since then. Mr. Battiscombe now estimates that in seven or eight years the wood fuel on the Uganda Railway mile zone will be exhausted.

Mr. Elliott proposed to ensure the regeneration of the railway forest by adopting "strip fellings," the strips to be 100 feet wide and a mile deep. This system, though it has never been properly tried, does not appear likely to succeed. A considerable area of forest has now been cleared without regard to its natural regeneration. In such localities the forest is almost entirely destroyed, and can only be replaced by artificial planting, and for this I fear the cost will be heavy. *It must, however, be put in hand without delay for the sake of the railway fuel supplies.* There is another class of forest which has been only partially destroyed and which is still capable of restoration by timely measures. In this forest the following treatment may be found to succeed.

Treatment of Partially Destroyed Railway Forest.

In marking trees for felling every consideration must be made subordinate to the natural regeneration of the forest. All well-grown young trees to be reserved and the rest not to be marked for felling until regeneration is assured.

Natural Regeneration Cuttings.

1st. Seed or cutting. Lighten the covert by not more than one-third. Work the ground around all seed-bearers of good species. Go over the ground yearly for two or three years, hoeing and clearing as required.

2nd cutting. At the end of three or five years mark trees for felling where reproduction has been secured. Space-plant where necessary. Continue hoeing and clearing where necessary, particularly round good species.

3rd. cutting. After two or three years more, mark trees where reproduction is assured, taking off all the covert possible. Space-plant and plant with nursery trees where reproduction has failed.

4th. cutting. It should be possible to make a final cutting, the forest being completely restored two or three years after the third cutting.

The Production of Fuel in Railway Plantations.

There are many trees that can be planted to produce firewood at a more rapid rate than the indigenous forest in its natural state. For this purpose the Eucalypts and Wattles are well known. Black-wattle has been planted to some extent in the Protectorate. The Black-wattle in these plantations is as yet too young to afford

conclusive results, but if the Blue-gum grows in British East Africa as on the Nilgiris, its production of wood fuel per acre should be considerably in excess of that of the Black-wattle: *see* below under *Eucalyptus globulus*. There is every reason to expect that between 7,000 and 8,000 feet and a 65-inch rainfall on the Ibean Highlands, Blue-gum will give a mean yield of not less than 10 tons dry weight per acre per year. Such a production of wood-fuel alongside the railway would soon solve the problem of an ample supply of wood-fuel for the railway. *See* also pages 103 and 118. So far as is known, no other tree in the world can produce 10 tons per acre, per year, as an average over a long term of years. This has been done on the Nilgiris, where the climatic conditions closely resemble those of British East Africa, see my report (Madras, 1883) when measurements were taken by me under the superintendence of Sir Dietrich Brandis, F.R.S. The wonderful figures I then obtained have been confirmed and brought up to date in a recent series of measurements made by Mr. Cowley Brown, an officer of the Madras Forest Department, specially deputed for the purposes. See his report, dated 4th October, 1906 (Board of Revenue, Madras, No. 207).

It is important to note that while Wattle plantations require replanting in about 15 years, the Blue-gum on the Nilgiris reaches its maximum yield, according to Cowley Brown, at 75 years, yielding thinnings at intervals of about five years. If clean cut at 75 years, little, if any, replanting would have to be done. An alternative treatment for Blue-gum would be to cut it over as coppice at about 15 or 20 years, in which case no replanting would be required, and the yield per acre, according to my experience in South Africa, would be greater although the timber would be less mature, and of somewhat less calorific value, even in a quite air-dry state. Undoubtedly the most economical production of railway fuel would be as pole coppice cut at six or eight years of age, and planted six or eight feet apart. This system is by far the most economical in working, since no thinnings are required, and the timber is clean cut, rendering the extraction and working easier and more economical. And further, there is the great advantage that the poles only require to be sawn across instead of being sawn lengthways as well, for it is one of the bad qualities of Blue-gum that though it cracks and warps in every direction when drying, the logs will not cleave easily. I have known many old Blue-gum trees in South Africa that wood-cutters would not take as a gift, owing to the impossibility of splitting them up. *Eucalyptus robusta*, which grows freely in British East Africa, splits like clear pine, but is a most inferior firewood in ordinary grates.

Fuel value of Eucalypts and Wattles on the Nilgiris.

The following figures for Nilgiri-grown timber were determined by the College of Engineering, Madras, in 1899:—

Species.	Weight per cubic foot.	Modulus of rupture in lb.
Eucalyptus globulus	56·2	657
Acacia melanoxylon	46·8	886.9
Acacia dealbata	35·9	491.9

The yield of firewood per acre in the case of the Acacias is usually much below that of the fast-growing Eucalypts, particularly *Eucalyptus globulus, vide* yield table (Acrims), page 41; but as a firewood, burnt in an open fire or hearth, Acacia firewood is preferred.

Fuel Supply for the Railway and Steamers at Port Florence.

This is at present obtained from two sources:—

(1) The highland forests.

(2) Thornwood from the low country.

The Highland Forest.—As soon as the highland forests come under systematic working enormous quantities of firewood must be available. It is obviously not economical to spend much on low-country plantations (which in so unhealthy a country must be expensive) while the timber in the great forests remains unutilised.

Low Country Thornwood.—I see no objection, climatic or otherwise, to continuing the cutting of the "Thornwood." It is the produce of more than one Acacia having a general likeness to *A. horrida*. The wood is liable to attacks from borers

as soon as stored, and if stored for any length of time these borers, I am told, will reduce to powder a large proportion of the timber. Grass lands and Acacia scrub stretch along the railway for a distance of nearly 80 miles from Port Florence; in fact, from the heavy rainfall and timber forests of the great Ibean Plateau, to Lake Victoria Nyanza. So far as it may be economical for the railway to cut the scattered fuel in these Acacia scrubs, the cuttings should be done in rotation, arranging that the cuttings should not go over the same ground again till after an interval of from 15 to 20 years.

One frequently hears regrets expressed that there is no coal in British East Africa. But even if coal were found, it would have to be of a very good quality and very well placed to compete with the present economical supply of wood-fuel to the Uganda Railway; and to the country at large it would be an undoubted misfortune if imported coal were used instead of waste wood unsuitable for timber. Taking the best hardwood at half the hauling power of coal, the railway now gets its wood for one-third the cost of imported coal at Mombasa, one-fifth the cost of imported coal at Nairobi, and about one-seventh the cost of imported coal at the Lake. A recent number of the "Colonial Office Journal" had the following statement regarding the cost of certain railway fuels:—"In the Federated Malay States the cost of wood-fuel per engine-mile in 1906 was 13.99 cents, or 3.9d. The corresponding figure for coal in West Africa was 5½d. to 7d. On the Uganda Railway the cost is 2.44d. per mile for wood-fuel."

Brick Fuel or Briquettes.

"Patent fuel" in compressed bricks is used on the Mexican railways, a country, like British East Africa, without coal. The same fuel is used in various other railways at a distance from coal mines. It is usually compressed coal slack compacted by various processes. Bricks of compressed peat have been in use on Bavarian Railways for the last 60 years. This costs 7s. 4d. per ton, and is cheaper there than coal, while, in the locomotives, two-third-ton compressed peat is as good as one ton of coal. An electro peat-fuel brick is also made. This averages 30 cubic feet to the ton, as against coal 45 cubic feet. In dry countries it is not necessary to use electricity. ("Peat," by Bjorling, 1907.) As a means of utilising the quantity of waste wood in the forests of the Protectorate, the making of compressed charcoal bricks seems worthy of consideration. For this purpose it would be necessary to make charcoal in a kiln. This would produce besides charcoal, wood vinegar, tar, and wood creosote. One hundred lbs. of wood (dried at 300 degrees Fah.) yield when calcined about 30 lbs. of charcoal and 70 lbs. of gaseous products. Of the 70 lbs. of gaseous products, 63 lbs. is crude wood vinegar, from which about 4 lbs. of pure Acetic acid is obtained. The wood vinegar would furnish a useful bye-product with a local sale of some extent. The wood creosote would be used for creosoting sleepers. The tar would be used for compacting the charcoal into bricks.*

There would be considerable economy in the use of such a brick fuel in place of wood fuel, particularly where it had to be carried long distances, as in the case of the steamers on Lake Victoria Nyanza. It might even be possible to make it in sufficient quantities to supply the ocean steamers at Mombasa. Its calorific power would be equal to (or superior to) coal, and be more than double the calorific power of the best hard firewood. Only about half the weight of kiln-dry wood is heat-producing, of air-dry wood less, and of partially seasoned wood much less. Almost half the weight of even kiln-dry wood is useless oxygen (cellulose 49·3 per cent.; average wood about 44 per cent.). There is also over five per cent. of useless hydrogen, and one or two per cent. of mineral ash. So that chemically about half the weight of even kiln-dry wood produces no heat on combustion. This may be compared with the 81 per cent. carbon in English steam coal.

In converting quite dry wood to charcoal in a kiln more than two-thirds of the weight goes. In making charcoal in the ordinary way the weight is diminished by three-quarters or even more, and the bulk by one-half. The economy of carbonising the wood is thus apparent, but to get the charcoal into a useful compact form that

* Up to the present, the only satisfactory binding material has been pitch or resin: 4 per cent. pitch and 1½ per cent. resin gives the best results. In 1906 England made 1½ million tons of briquettes, Germany 14½ million tons. The English cost of briquette-making, reckoning every charge including interest on capital, and depreciation of machinery, works out to 9s. 7½d. per ton.
(W. Galloway, S. Wales Inst. of Eng., June, 1909.)

would burn well, the charcoal would have to be compressed by machinery and mixed with tar, nearly, in fact, repeating the process by which coal was made geologically. Such a process would be expensive, but, as we have seen, it would save from one-half to three-fourths the cost of carrying wood fuel, and it would furnish creosote which is expensive stuff to import, as it cannot come with ordinary ships cargo.

In America, carbonising plants have been erected on a large scale in order to utilise the saw-dust from the saw-mills. This accumulates in enormous quantities and becomes a nuisance difficult to dispose of. Charcoal from these factories is produced at astonishingly cheap rates, and in quantity which is in excess of the demand for charcoal.

The carriage of wood fuel for use on the Uganda railway forms no inconsiderable portion of the traffic at present. The traveller passes numerous trains loaded with nothing else but wood fuel. The substitution of bricks of compressed charcoal would do away with one-half or three-quarters of that carriage—the carriage chemically of a quantity of useless water and oxygen. This carbon brick fuel is free from the sulphur in coal and thus corrodes the boilers less. It also produces less smoke.

SPECIAL RATES FOR TIMBER ON THE UGANDA RAILWAY—THE FARTHING RATE.

In my report on the Kenia forests, I advanced reasons for granting a special railway rate for colonial timber of one farthing per ton-mile. It was pointed out: (1) That the carriage from Kenia to the coast would be all (or nearly all) on a down grade. (2) That looking at the value of the Kenia forest, it would be to Government interest to carry the timber at a loss, in fact to carry its own timber for nothing, if it could thereby get it on to the world's markets: (3) That the farthing rate is in force not only on railways worked with cheap coloured labour like the Uganda Railway, but on railways worked with more expensive white labour in South Africa. Since this was written I have visited South Africa and discussed railway rates with some of those interested in the South African timber trade. As I have shown elsewhere in this report, South Africa imports timber to the extent of about £1,500,000 worth yearly. Most of this, too, is from foreign countries, most of the million and a half going into foreign pockets. It is to South Africa that British East Africa must look as the chief market for its extensive and valuable forests. It is held in South Africa, that unless a specially favourable rate be granted, the long land carriage over the Uganda Railway will be prohibitive. The question is so grave a one for the forests of the Protectorate that I feel it cannot be passed over in silence here.

The rate at present charged for the carriage of Colonial timber on the Uganda Railway is 1d. per ton-mile. Other rates are even higher. The first-class passenger rate, for instance, is nearly 4½d. per mile as against 1d. on the Japanese Railways! At the same time, the railway is worked with the utmost economy—the rolling stock and sleepers, of a flimsy character condemned many years ago in South Africa; the buildings temporary, of corrugated iron; the labour, with some trifling exceptions, coloured and cheap. No doubt a more substantial railway could carry at a cheaper rate. Porforio Diaz is one of the most astute of the world's rulers, and perhaps no present-day ruler has done so much for his country. The original Tehuantepec Railway, completed in 1897, was a light railway. Like the old Beira Railway and the present Uganda Railway, it never paid, and has now been replaced by a good trunk line and terminal ports at a cost of £9,500,000. The line is 189 miles, from sea to sea. President Diaz, in opening the new line lately, said he considered that Mexico had good value for the 9½ millions. The Uganda Railway is a trunk line, and with the heavy timber traffic that must pass over it from the forests, a more substantial line on a broader gauge may prove necessary and (like President Diaz's new railway) more economical in the working. Obviously, a railway that cannot carry economically is not the line for the British East Africa Protectorate. As long as the railway remains in its present condition, the correct policy would appear to be to use it in its present form to develop the country, and if it cannot carry the timber at workable rates without a loss, to put up with that loss till the development of the country warrants the improvement of the railway. In Germany, the

trunk lines are on the 4 ft. 8½ in. gauge, while the feeding lines of railway in the Black Forest are on the metre gauge. In Victoria (Australia), a forest country, we have the 5 ft. 4 in. gauge. In South Africa the railways are now all on the 3 ft. 6 in. gauge. They were begun on the 4 ft. 8½ in. gauge and it is generally admitted that that would have been the most useful gauge for the present traffic. Some years back the General Manager of the Cape Railways proposed in his yearly report to broaden the Cape Town-Johannesburg line as far as De Aar. Whatever the future of the Uganda Railway, the General Manager reports that it cannot now carry at the farthing rate, and that a halfpenny rate is a bare cost-price rate. It remains only to consider whether, in view of the importance of getting the forests worked, the halfpenny rate should not be granted for all Colonial timber, and a farthing rate for timber coming from Government forests.

Timber traffic on the German railways.—Not long ago Sir Charles Eliot wrote: "The chief practical question for the Uganda Railway at present is whether it " would not be advantageous to reduce the freights. I observe that the German line " in Usambàra is said to have increased its receipts by reducing its charges."

When recently in German East Africa, I was informed by the officials in Dàressalàam that the German railway is now bringing down to the coast from the Usambàra forests as much as 5,000 " feste metres " monthly (177,000 cubic feet), and it is expected that this figure will shortly be doubled! This statement was confirmed by the officials aboard one of the German steamers. It amounts to a yearly export of 2,124,000 cubic feet, which is somewhat more than half the total present consumption of indigenous timber by the Uganda Railway. This timber is put on the railway at Willemstahl, only four hours by rail from the seemingly flourishingly little German port of Tanga. Willemstahl is in a fairly temperate climate (4,500 feet): forest-working machinery on a large scale has recently been sent to it from Germany. If the German railway to Tanga is now bringing out over two million cubic feet of timber yearly and expects shortly to be bringing out four millions yearly, that is a reason for no longer delaying a working timber freight for the Uganda Railway. The forests in British East Africa seem to be better than those in Usambàra, but they are farther from the sea. Some special inducement such as a farthing rate on the Uganda Railway is required to tempt capital and labour to the more distant forests.

A halfpenny rate prevails on the Cape Railways, for timber carried coast-wise.

Cost of Railway Transport in Cape Colony.

Cape Government Railways for fencing posts per ton mile (distances over 31 miles)	½d.
South African firewood going inland, for distances over 200 miles	¾d.
South African firewood coast-wise, for distances over 100 miles per ton mile	½d.
Speciàl rate, Ceres Road to Cape Town (85 miles), timber and firewood from the Government forest, per ton mile	¼d.

(Forest Fl.C.C. 1906.)

A special low rate is also allowed for pit props sent from the Government forest at Ceres Road to the Kimberley Diamond Mines.

Quite recently the Cape Government Railways have notified that they are prepared to carry lime for manurial purposes, *consigned coast-wise*, in truckloads of not less than five tons, at a farthing per ton mile.

It has been stated that in no other country is timber exported commercially, over so long a distance by rail, as from the Kenia or Eldoma Ravine forests to Mombasa. This, however, is not the case.

In Thuringia, the Bavarian Alps, and the highlands of Southern Germany generally, are extensive coniferous forests, which are sedulously cultivated and yield good returns. I visited some of these forests in 1889, *vide* my "Journal of a Forest "Tour." The timber from these forests, after supplying the small local markets, goes, to the Baltic on one side, and as far as the Black Sea on the other. Some of this timber goes, partly by rail, and partly by rafts on the Rhine and the Danube, to Rotterdam and ports on the Black Sea. But much of it now goes the whole way by rail to the Baltic, a *distance of* 500 *miles*. On rail the timber may be seen both sawn and in the log, long logs being railed with each end on a truck. Some of these logs, especially those used for scaffolding poles, are of great length. The timber trucks have special pivoted carriers with saw-teeth bearings on which the logs rest,

and on which they are chained; for these logs so fastened take the pull of the whole train and go round the curves.

Some of this German timber no doubt eventually finds its way to South Africa, shipped as Baltic timber! *It will thus be seen that prices in South Africa are sufficiently high to pay for a land carriage of* 500 *miles and a sea carriage of* 6,000.

The possibilities of long carriage by rail are seen also in the very low rates—a fraction of a farthing per mile, charged by American Railways, for the carriage of wheat from the north-west; or in the low rate charged for fruit from California.

In considering the question of railway rates on timber, it is necessary to disabuse one's mind of the high rates charged for timber carriage in England. This has frequently formed a subject of complaint from British forest owners. It is one of the causes that suppress the British forest industry and take £26,000,000 out of the country yearly for imported timber!! Possibly its reform may have to await the time when there are national forests and national railways in England. As was stated not long ago in a leading article in the London "Times": "Our "commerce is being throttled by the enormous cost of internal carriage; goods often "cost more for a short transit to the coast than they subsequently do for sea-carriage "to the ends of the earth." 1d. per ton-mile is a common rate in the agricultural districts of England. The *average* rate in the United States of America for all descriptions of railway freight is stated at under a half-penny per ton-mile.

In British East Africa, unless a special low rate for the carriage of timber on the Uganda Railway be conceded, there is the danger that the timber industry there will be throttled, an industry which should be the chief industry of the country. Against loss on a farthing rate for the carriage of timber, should be set gain in subsidiary forest traffic—forest machinery, supplies, and passenger traffic; also the increased rates I propose for the carriage of imported timber and corrugated iron.

I recommend that, pending the development of the country and the reconstruction of the Uganda Railway on a larger gauge, special rates for the carriage of timber be conceded as follows:—

For the carriage of any Colonial timber coast-wise, per ton mile ...	½d.
For the carriage of timber cut in any Government forest coast-wise ...	¼d.

INCREASED DUTY ON IMPORTED TIMBER AND CORRUGATED IRON.

In reporting recently on the Lingham and Grogan Forest I proposed that in order to encourage the working of these and the valuable timber forests of the British East Africa Protectorate generally, a permanent farthing rate (per ton-mile) should be guaranteed to Colonial timber passing over the Uganda Railway. To meet the loss involved in making this concession I propose (1) an increased import duty on imported timber and corrugated iron; and (2) increased rates on the railway for the carriage of imported timber and corrugated iron. Not only would such a countervailing duty tend to meet the cost of the concession to those developing the resources of the country, but it would serve to check an evil which has grown up year by year, till it has now assumed quite serious proportions. I allude to the continued construction of unwholesome temporary buildings of corrugated iron in place of using the excellent building materials existing on the spot. In the forests of the country are rich stores of Yellow-wood, of Cedar, of Camphor, and of hard-woods. Cedar and Camphor are timbers of proved durability and strength, while Yellow-wood is as durable as Pine for the interior work of buildings. Stone walling is put up at a fraction of its cost in South Africa. Excellent bricks have been made by missionaries and others. The old brickwork at Fort Smith remains sound to this day. Pottery is an old art amongst the Kikuyu. Yet, nearly all the buildings erected in Nairobi, and a large proportion of those in the country, are constructed entirely of imported timber and corrugated iron! In spite of the abundance of excellent building materials on the spot, the entirely unsuitable corrugated iron and perishable Pinewood continue to be almost exclusively used for house-building purposes. It is right to add that an earnest attempt is now being made to revive the brick-making industry in Nairobi, while at Fort Hall are quite model buildings erected of good permanent local material by the Provincial Commissioner, Mr. Hinde. In the two chief towns of German East Africa, corrugated iron buildings scarcely exist.

The evil, which has now attained such serious proportion, had its origin when the construction of the Uganda Railway was pushed forward, with feverish haste, to reach the Lake. All the railway buildings from Mombasa to the Lake are of corrugated iron and imported Pine. The unhealthiness of these buildings can only be mentioned here. Temperatures in them range in the 24 hours from a low temperature at night (unless they are kept unventilated) to 85° and 90° during the day, while during bouts of damp weather they are as damp as a tent. In most of the municipalities in South Africa corrugated iron buildings are now prohibited. In British East Africa there is an unrepealed tax on brickmaking! The unwholesomeness of the iron buildings under an equatorial sun, and their ultimate greater costliness is admitted. They are expensive in their upkeep, particularly in paint, and they must ultimately be replaced by buildings of a permanent character. But they are quickly and easily put up, and their first cost is unhappily small.

It will, I think, be generally admitted that on public grounds the strongest reasons exist for increasing the Customs duty and the railway freight charges on corrugated iron and imported timber. I am aware that to increase the custom duties will require the consent of the other Governments who are parties to the Brussels Conference, and that this consent would only be sought on serious grounds of public policy. Such grounds exist at present. I recommend that the present import duties on sheet iron and imported timber be raised from 10 to 20 per cent.

According to the tariff at present in force on the Uganda Railway, a preference is given to Colonial produce. This preference is less than on the Cape railways, and I suggest its increase to a point that will more distinctly encourage the use of the rich resources of the country and place a tax on the further erection of the present insanitary buildings.

I have mentioned this matter at some length because the present fashion in building is an obvious public evil, and the farthing rate seems to be generally considered the *sine quâ non* of successful forest utilisation.

At Kampàla, the native capital of Uganda, are good houses, built entirely of the country's products—brick and timber.

Temperatures in Tin Buildings at Nairobi.

Maximum, Agriculture and Forest Department Offices on an average day, February, 1907	84°
Maximum temperature in my tent pitched in the shade ...	79°
Maximum temperature in a stone building	72°

These temperatures were taken with standard thermometers, properly exposed, and are averages for several days. Obviously good health and good work cannot long continue at a temperature ranging to 80° throughout the year, while 72° is little above the average temperature of a well-warmed office in England.

LOCAL TIMBER FOR THE UGANDA RAILWAY.

A question vital to the economical working of the forests of British East Africa is the use of local timber by the Uganda Railway. The forest now supplies the entire hauling power of the railway. It should, besides, furnish its sleepers and building material.

The Uganda Railway has, at great cost, been made entirely of imported material, and much of this work it is now too late to replace with the more economical and suitable local material. From sea to Lake, through the entire course of the Uganda Railway, nothing but corrugated-iron buildings are seen; and all the sleepers, except a section laid recently with Jarrah sleepers, are metal. The Uganda Railway had to be made hastily, but there is a danger that what was once done as a matter of public policy may crystallise into a traditional policy, and that the corrugated iron, the foreign timber, and the metal sleepers may continue to be imported! I submit that in order to develop the resources of the country, indents for corrugated iron, foreign timber, and metal sleepers should be rigidly scrutinised, and only admitted when it is established that they cannot be replaced by local material. I am writing these concluding remarks, on this section of the report, after travelling over the little (2 ft. 6 in. gauge) Government railway at Cyprus. Its carrying capacity

(rolling stock all bogey) is, for the gauge, superior to that of the Uganda Railway, its sleepers are all wood (partly local) and its buildings substantially put up of local material. Its sleepers (measuring 5 ft. by 4 in. by 3 in.) cost about 1s. 6d. each, against 5s. for the Uganda Railway, not to mention the troublesome packing of the Uganda Railway sleeper and the metalling of the permanent way, costing, I understand, something like £100 per mile. The cost of native wooden sleepers supplied to the Uganda Railway is Rs. 2 each, so that there is a considerable economy in using wooden sleepers; and, looking at the Cyprus Railway, a considerable gain in an easy and effective road. In South Africa (3 ft. 6 in. gauge) metal sleepers have been discarded after prolonged trial, and the creosoted Yellow-wood sleeper has found universal favour.

The Manager of the Uganda Railway has recently completed an interesting series of tests on the suitability of various native timbers for sleepers. The subject is discussed in my report on the suitability of native timbers for the construction of the proposed Nile Railway from Jinja (March, 1908). It will be sufficient here to note that while the hardwoods are difficult to creosote, of doubtful durability unless creosoted, and always liable to crack, there are two softwoods which are abundant and readily available throughout the highlands of British East Africa. These are Cedar and Yellow-wood. The suitability of the first for railway purposes was demonstrated in Mr. Currie's experiment; but it is not as abundant nor as sound as Yellow-wood, the timber which has been so well tried and has succeeded so well in South Africa. But Yellow-wood must be creosoted or injected with an antiseptic. It is useless without. So that the utilisation of native timbers for sleepers on the Uganda Railway turns mainly on the establishment of a creosoting or injection plant. This has, I understand, been recognised by the Uganda Government, and a creosoting plant is being installed. If this cannot, for want of funds, be done at once in British East Africa, it should be noted that much may be accomplished in the cautious use of Cedar and such hardwoods as Red Stinkwood, Olive, and Ironwood. It may be worth noting, also, that a small creosote-injection plant can be obtained for £270 (Black and Son), and a hot-steeping plant for £35.*

THE SOUTH AFRICAN TIMBER MARKET.

As has been stated, considerable quantities of timber from German East Africa are now being successfully placed on the European market. As far as I can learn from enquiries made in German East Africa, this timber does not differ materially from the timber of the forests of British East Africa. It will mostly resemble that found at the lower levels of the highland forest of British East Africa, that is to say, timber of the mixed hard-wood class for which it is less easy to find a market.

There are, no doubt, certain timbers in British East Africa which will find a place on the markets of the northern hemisphere. They will be timbers which will fulfil some particular use, or answer some particular fashion. Thus, there are few flooring boards better than Yellow-wood. In its homogeneous texture and regular wear it has few equals. A Yellow-wood floor is nearly equal to a Teak floor. Yellow-wood grown in its equable extra-tropical climate shows a regular growth which is absent in timbers grown in the brusquer climates of the northern hemisphere. I feel certain that Yellow-wood has only to become known as a flooring board in Europe and America, to get largely in demand. Samples sent home from South Africa at different times have been well reported upon, but South Africa has no surplus Yellow-wood to export.

Enquiry has shown that there is a certain demand for British East African Cedar in America for use in making coffins. The South African Cedar, *Callitris arborea*, is similarly in demand for making coffins among the Boers. There is also a demand for Cedar for lead pencils, and I have seen excellent pencils made from East African Cedar (*Juniperus procera*), made by Faber, though it has been stated that a softer cedar is preferred at present for the pencils.

* Since writing the above, I have seen, at the Forest School, Nancy, France, the results obtained by Prof. Henry in his experiments on the impregnation of timbers with antiseptics by mere soaking in hot solutions. They are significant of what may be done in countries where the erection and working of a regular creosoting plant would be too costly. Narrow gauge Beechwood sleepers have recently been impregnated in France by hot soakage, at a cost of only 3*d.* per sleeper. Details of Prof. Henry's results will be found in "Preservation des Bois contre la Pourriture" par E. Henry, Berger-Levrault et Cie : Paris.

Black Ironwood (*Olea*) is a singularly beautiful furniture wood. There is an increasing export of it from South Africa, and I understand that considerable quantities of Black Ironwood are being sent from British East Africa to the continental market.

Apart, however, from certain special lines, which will probably have to be developed gradually, I am of opinion that the market for the bulk of British East African timbers is South Africa. There is there an immediate demand on the mines for every kind of hard-wood. For a large part of the mining timber durability is not essential. The mines will usually take any hard-wood provided it is strong, fairly straight, and will last for a few years. De Beers use large quantities of Blue Gum. There are few indigenous timbers which are not better than the Blue Gum timber grown rapidly in plantations, and cut before it is mature. Yet this timber is considered good enough for mining purposes, and has been in constant use for many years. Other mines use the native timbers from the indigenous forests as far as this is available from accessible forests in South Africa. Other timber is brought 6,000 miles from Australia—about £250,000 worth yearly!

The timber from the indigenous forests of British East Africa, which has now been rendered accessible by the making of the Uganda Railway, should find its natural outlet on the markets of South Africa. There are no canal dues to pay, as against the export of timber to Europe, and there is shipping eager for freight both in South Africa and in the ports of East Africa.

In considering the question of placing British East African timber on the South African market there is the important matter of the South African Customs Convention. The Customs Convention exists throughout the whole of the South African States, including Central Africa. It is difficult to see how, when British Central Africa has been admitted to the Customs Convention, British East Africa can long be excluded. Until British East Africa is admitted to the South African Customs Union its timber, on arrival at South African ports, has to pay a duty which, with certain exceptions, amounts to 12 per cent., and British East Africa taxes its produce (or would tax produce coming from South Africa) with a 10 per cent. duty. It should not be difficult to adjust such a small difference, particularly as the South African duties were lately less, and the all round 12 per cent. duty is subject to many exceptions, while the 10 per cent. British East African duty has so few exceptions that they need not be considered.

There is, further, an export duty of 5 per cent. on timber exported from British East Africa, so that timber exported from British East Africa to South Africa has to pay duties amounting to 17 per cent.

The timber trade can hardly be expected to develop till these artificial barriers are removed.

There are thus four obstacles in the way of getting East African timber on the South African market:—

1. The South African import duty of 12 per cent British East Africa should join the South African Customs Convention.
2. The British East African export duty of 5 per cent. on timber.
3. Absence of a special railway rate—farthing rate recommended.
4. The want of a good waggon road, tramway, or light railway from Gilgil to West Kenia (a distance of 68 miles), page 71; and from Londiani to Elgeyo.

SOUTH AFRICA REQUIRES £1,500,000 WORTH OF TIMBER YEARLY.

The average yearly value of timber imported to South Africa is estimated in round numbers at 1½ millions:—

Cape Colony	£500,000
Transvaal, including manufactured wood, door frames, &c.	750,000
Natal, Orangia, and Rhodesia	250,000
Total	£1,500,000

The yearly timber importation to Cape Colony is estimated to amount on an average to 8,000,000 cubic feet, worth £500,000 ("Extra-Tropical Forestry," pages 6-7.)

It may be worth noting that the timber bill of South Africa capitalized at 3½ per cent, represents a sum (43 millions) which is not far short of the national debt of Cape Colony, 46 millions.

RAILWAY TIMBER.

In 1903, a year of inflation, the Cape Government Railways used timber to the value of £303,137, viz., sleepers, £196,737; other timber, £106,400. ("Extra-Tropical Forestry," page 16.)

In 1904 the mileage of South African Railways was 6,654 miles. At present prices it is estimated that not less than £322,000 (nearly one-third million pounds) worth of sleepers will be required yearly for South African Railways. The South African sleeper contains 2½ cubic feet, and the price paid has averaged close on 5s. per sleeper.

By now, 1907, there must be about 8,000 miles of railway open in South Africa. At 2,000 sleepers per mile, and 10 per cent. for renewals, that represents a yearly requirement of 1,600,000 sleepers for renewals. The cost of these at 5s. is £400,000.

TIMBER IMPORTS TO CAPE COLONY.

Importation of Timber to Cape Colony on which duty has been paid.
Customs Returns.

Year.	Quantity.		Total Value.		
	Timber in cubic feet.	Staves (which may be estimated at 10 per cubic foot).	£	s.	d.
1882	3,716,781	—	235,367	0	0
1883	3,146,262	—	204,214	0	0
1884	1,535,102	—	94,769	0	0
1885	1,157,345	—	67,418	0	0
1886	884,203	—	41,459	0	0
1887	1,198,923	—	54,987	0	0
1888	957,780	404,938	59,225	0	0
1889	2,611,641	773,311	163,508	0	0
1890	1,523,317	182,845	97,396	0	0
1891	1,474,601	186,970	80,229	0	0
1892	3,366,442	492,037	200,343	0	0
1893	3,988,739	579,796	215,311	0	0
1894	3,752,524	398,664	201,413	0	0
1895	3,761,036	528,093	193,779	0	0
1896	5,337,891	467,166	266,919	0	0
1897	4,538,011	?	271,779	0	0
1898	4,009,478	201,495	251,204	0	0
1899	3,643,736	?	214,673	0	0
1900	2,885,988	251,000	182,800	0	0
1901	4,800,672	457,887	335,417	0	0
1902	7,419,273	343,392	516,333	0	0
1903	10,177,317	527,576	727,501	0	0
	75,687,062	5,795,170	4,676,044	0	0
	Total for 22 years ...		4,676,044	0	0
	Annual average for 22 years		212,547	9	1

This is exclusive of timber imported free for Government purposes.

Before the late war the average value of timber imported from over-sea to Cape Colony was between a quarter and one-third of a million pounds sterling. At the conclusion of the war it rose to over half a million; and during the commercial activity and inflation following the war, the value of timber imported through the ports of Cape Colony amounted in 1903 to over a million pounds sterling. During 1903 the Customs Returns show that 10,704,893 cubic feet of timber, valued at £727,501, were imported. Of this quantity about 10,317,064 cubic feet, valued at £687,491, came from Europe and America, and 387,829 cubic feet, valued at £40,010, in the form of Ironbark, Jarrah, Kauri, and Kari, from Australia and New Zealand.

TIMBER PAYING DUTY—CUSTOMS RETURN.

Unmanufactured wood imported into Cape Colony during the year ended 31st December, 1903:—

Description.	Merchants and others.		Colonial Government.		Total.	
	Quantity. Cubic feet.	Value.	Quantity. Cubic feet.	Value.	Quantity. Cubic feet.	Value.
		£		£		£
Ash	32,452	4,617	108	27	32,506	4,644
Bass	24,297	3,103	—	—	27,297	3,103
Birch	3,909	466	—	—	3,909	466
Cedar	3,854	507	—	—	3,854	507
Cottonwood	337	65	—	—	337	65
Elm	845	172	6,283	1,375	7,128	1,548
Gum	5,261	539	—	—	5,261	539
Hardwood	2,134	232	25	10	2,159	242
Hickory	83,755	13,658	—	—	83,755	13,652
Ironbark	—	—	1,019	121	1,019	121
Jarrah	57,821	3,906	85,909	11,789	143,730	15,695
Karri	49,825	5,190	78,622	12,579	128,447	17,769
Kauri	114,633	6,425	—	—	114,633	6,425
Mahogany	8,005	2,698	—	—	8,005	2,698
Maple	2,110	288	—	—	2,110	288
Masts and Spars	915	25	—	—	915	25
Oak	12,022	2,141	1,406	465	13,428	2,606
Pine	8,858,748	519,885	419,540	41,918	9,278,288	561,803
Poplar	91,643	12,319	—	—	91,643	12,319
Satinwood	52	34	—	—	52	34
Teak	141,942	42,045	70,130	21,483	212,072	63,528
Walnut	18,194	3,838	—	—	18,194	3,838
White	562	108	—	—	562	108
Staves, No.	527,576	15,361	—	—	say 23,000	15,361
Other kinds...	959	111	—	—	959	111
Total	10,041,851	637,733	663,042	89,768	10,200,317	727,501

In addition to the timber that paid duty, the following timber was imported duty free for railway purposes:—

Sleepers	£196,737
Other timbers	106,400
Total	£303,137

or altogether £1,030,638.

ESTIMATED TIMBER REQUIREMENTS OF CAPE COLONY.

Neglecting the exceptional year 1903, but allowing for the expansion and growth of the Colony, we may take 8,000,000 cubic feet, worth £500,000, as the average yearly importation of timber, in the future, to Cape Colony. ("Extra-Tropical Forestry.")

TIMBER IMPORTS TO THE TRANSVAAL.

During 1902 the value of timber imported into the Transvaal amounted to £342,660, of which £275,332 is classed as "unmanufactured" in the Customs Return (Government Notice 50, of 1903). This is exclusive of furniture and cabinetware, which was imported to the value of £373,175. Altogether timber in its various forms reached a total value of £715,835 for 1902, exclusive of timber and wood imported free for Government use, civil and military. This may represent another £200,000 worth, bringing up the grand total of the Transvaal's timber bill for 1902 to something not far short of a million sterling. We may perhaps assume £750,000 as the normal yearly timber bill of the Transvaal for house-building, mining, and railway timber, including timber manufactured to such an extent as doors and window frames, but excluding articles such as furniture, where the manufacture represents the major portion of the value.

TIMBER IMPORTS TO NATAL.

The Customs Returns, 1896–1903.

	Year.	Deals and Timber, Unmanufactured.		Boards and Planks.		Manufactured Goods, including Sleepers, Boats, Oars, Houses and Frames, Woodware and Corks, but not Furniture, Waggons, Carriages, or Barrels.	Total Value.
		Cubic feet.	Value.	Cubic feet.	Value.		
			£		£		£
	1896	5,170,290	221,164	1,761,272	91,077	65,140	377,381
	1897	4,186,492	173,015	1,394,283	76,341	60,151	309,507
Affected by the War.	1898	1,687,052	85,055	1,152,422	74,920	41,418	201,393
Affected by the War.	1899	1,378,829	59,987	916,655	56,733	45,895	216,613
Affected by the War.	Government Imports	—	1,616	—	1,755	50,627	
Affected by the War.	1900	1,465,082	58,307	552,948	34,724	26,944	139,714
Affected by the War.	Government Imports	—	4,786	—	639	14,314	
Affected by the War.	1901	2,518,009	151,390	757,336	55,998	53,751	270,080
Affected by the War.	Government Imports	—	3,235	—	549	5,157	
	1902	3,143,402	182,005	2,037,687	124,475	81,560	396,723
	Government Imports	—	2,286	—	25	6,372	
	1903	2,518,009	151,390	757,336	55,998	56,372	270,080
	—	—	3,235	—	549	2,536	
					Total for 8 years		2,181,491
					Annual average for 8 years		272,686

NECESSITY OF PRESERVING THE FOREST.

In my special reports on the Kenia and Eldoma Ravine Forests I gave reasons why the forest, on account of its technical and climatic value, should be preserved. It is not necessary here to enter further into these reasons. Every resident in British East Africa is agreed that the forest is essential to the well-being of the country. It has been laid down as the policy of Government that the forest should be preserved. It may, however, be useful to attach here a few notes regarding the results achieved in other countries where the forest has been systematically conserved and cultivated for many years.

FORESTRY IN CAPE COLONY.

In the new edition of Dr. Schlich's classical "Manual of Forestry" (Vol. 1, 3rd edition, 1906), it is stated: "Of all the Colonies the Cape has most successfully grappled with the forest question." The Cape forests have now, for a quarter of a century, been worked systematically like the forests on the Continent of Europe. All the officials, with the exception of a few native guards in the Transkei, are whites; and the system on which the forest is worked is that laid down by an eminent French forester, Count de Vasselot. Extensive plantations have been formed, and there has been a total expenditure on forestry which, with interest, amounts to over £1,000,000 (one million pounds sterling). All the best timber trees of the world, so far as they are climatically suited, have been included in the plantations. When these are completed, and the timber has matured, the half million pounds sterling, which now goes *yearly* out of Cape Colony to pay for imported timber, will be saved to the country; that is to say, all the timber now imported will be produced in the Colony.

FORESTRY IN GERMAN EAST AFRICA.

Forestry in German East Africa is organised on lines similar to those herein recommended for British East Africa. The expenditure has averaged £12,000 yearly, which balances the revenue. The forest districts administered are Kilimanjàro, Usambàra, and the coast. About 200 hectares (494 acres) are planted yearly with Teak and Mahogany on the coast, and Camphor, Cedar, &c., on the highlands.

The following note embodies information gathered in conversation with Herr Eckert :—

The Forest Staff.

The head of the Forest Service is "Herr Regierungs und Forstrat" Eckert, who, after some years' service in Java, is now in charge of the Forest Department at Dàr-es Salàm. Under him are 3 Conservators and 15 European Rangers or Foresters, with 86 native Guards.

The Forest Budget.

There is a revenue of 200,000 marks (£10,000), and an expenditure (till recently) of £12,000. The revenue comes from timber, mangrove-bark, and payments for forest leases.

The Forests.

The present forest policy is against any alienation of forest. Some 23,000 hectares (56,810 acres) have already been alienated, viz., 20,000 in Eastern Usambàra, and 3,000 at Ulunguru; but they were acquired in the early days from native chiefs. The following are the estimated areas of existing Government timber forests (excluding unexplored forest) in German East Africa :—

	Hectares.
Kilimanjàro	100,000
Western Usambàra	84,000

Altogether, in Usambàra, Kilimanjàro, and elsewhere, Herr Eckert estimates the total area of timber forest at 250,000 hectares (617,500 acres)—a much smaller area of timber forest than that of British East Africa. This 250,000 hectares excludes a large area of thorn and scrub forest. The forest on Usambàra is good, with straight clean boles running up to 60 feet; the Kilimanjàro forest is second-rate, with irregular boles of 30 or 40 feet. Cedar is not found below 6,000 feet. It and Olive occur on the drier side of Kilimanjàro, with Yellow-wood on the wetter side. There are, according to Engler, three species of Yellow-wood in Usambàra. Of these, one is *Podocarpus milanjiensis*, and there is another with a longer leaf. Other good trees in the Usambàra forests are :—*Kaya senegalensis* (Mahogany), *Bochoneura usambarensis* (m'Sàmbèla). The German liner "Ad. Woerman," it may be noted, is decked, panelled, and ornamented throughout with West African "Mahogany" obtained from West Africa, probably *Kaya senegalensis*.

Plantations.

These are composed of Camphor and Black Wattle inland, with Teak and Rubber (*Funtumia elastica* and *Castilloa*) on the coast.

Some 50 acres of Camphor are being planted yearly, seed being obtained from Japan.

Working.

The question has been much discussed whether to thin and get natural reproduction or to clear-cut and plant. The Government policy now is thinning. Timber has for long been exported to Europe; it is now on the point of being sent to South Africa. Timber is worked by both grantees and departmentally. Herr Eckert told me that it cost the Forest Department half a rupee per cubic metre (or about a farthing per cubic foot) to cut Cedar; while they sold it at 8½d. the cubic foot. He had sold lately 3,000 cubic metres of Cedar at 24 marks, which amounts to £3,600.

Black Wattle.

Has now been grown for seven-years in German East Africa, and grown (so says Herr Eckert) quite close to the coast; but the growth there is poor. The tan analysis of German East African Black Wattle is very good, about 43 per cent. of tan. There are a few hundred acres of Government planting, but over 1,000 acres of private.

FORESTRY IN INDIA.

The Indian Forest Administration now represents the most complete forest organisation amongst English-speaking people, though, no doubt, in a few years, it will be surpassed by the American Forest Service. The Indian Forest Service now comprises two hundred European officers and 11,000 native officials: the European forest staff is about the same numerically as the European forest staff in South Africa. The net Indian forest revenue has risen from £40,000 in 1864 to £670,000 in 1904. The Indian Forest Department now administers an area of 239,000 square miles, or 15,296,000 acres. There is at present a gross income of £1,481,000, and an expenditure of £811,000. The net revenue per acre works out to $1\frac{1}{8}$d. The permanent forest area in India amounts to $8\frac{1}{2}$ per cent. of the total area. During the last five years the average area under fire-protection in India amounted to 31,285 square miles, the average of failures being 7 per cent. (Review of Forest Ad., 1903-4.) The only wood of any importance that is exported is Teak. Taking India through, one-fourth of the area is estimated to be under forest of some sort—demarcated, protected, or unclassed.

In the neighbouring Island of Ceylon the Forest Department has charge of 42 per cent. of the area of the Island, and there is a Conservator with eight assistants, but a net revenue of only £5,600.

FORESTRY IN GERMANY AND FRANCE.

The German forests ($34\frac{3}{4}$ million acres) now yield about £22,000,000 a year. Of this about £8,000,000 is spent on maintenance and £14,000,000 is net. The Germans work the forest departmentally; the French through contractors and lessees. Nearly 10 per cent. of the industrial population get employment out of the German forests. The French forests yield £1,250,000, and have £500,000 spent on them yearly. The mean yield in money of the French forests is at the rate of 6s. per acre, while the Prussian forests yield at the rate of 7s. per acre, and the forests of all Germany at the rate of 8s. per acre. The actual net forest revenue of Germany is somewhat greater, since the Forest Budget is debited with the cost of forest schools, fisheries, &c.

It is noteworthy that Germany spends eight millions, France half a million, pounds sterling yearly on forestry, and Japan a quarter of a million. In British East Africa the forest revenue for 1907 amounted to £13,000, and the budget expenditure to £10,000.

FOREST LANDS OF EUROPE AND BRITISH EAST AFRICA.

In Europe 31 per cent. of the land surface is occupied by forest. The percentage so occupied being, according to the latest returns (Prof. A. L. Hickman, 1907):—

Sweden	48 per cent.
Russia in Europe	38 „ „
Servia	32 „ „
Austria	30 „ „
Germany	26 „ „
Norway	24 „ „
Belgium	18 „ „
Bulgaria	18 „ „
France	16 „ „
Great Britain	4 „ „
Portugal	3 „ „
British East Africa	1·55 „ „
Do. Do. Highlands ...	13 „ „

FOREST ALIENATION.

One of the most difficult tasks in every new country, where the land is being granted to a new population, is to prevent the alienation with it of the valuable forest, that should be kept as part of the State domain. In many tropical and extra-tropical countries, the preservation of the forest is absolutely essential for the well-being of the country. Once alienated, no means have yet been devised in the world's history of preserving it. The rights of private property are sacred, the world through, and the grantee of forest lands, especially in a new country, has to turn them to account and get a return for what he is spending in developing his property. If the forest has an immediate value, it will be cut down and sold for timber. If it has no immediate value, which is more usually the case, it will be cleared by burning or otherwise to make room for crops or pasture. In any case, the result is the same. The forest is destroyed with the exception, perhaps, of small patches left for beauty, for shelter, and for local timber requirements. All large areas of forest must be kept as Government forest to preserve them from destruction. To preserve the forest from alienation is a task requiring good administrative machinery and constant watchfulness.

Ever since British East Africa was opened up by the construction of the Uganda Railway it has been the prey of the speculator and fortune-hunter seeking forest and other concessions. The pleasant climate and the game attract visitors and speculators. The land is fair to look upon. Labour at present is as cheap as in India. The search for minerals has, so far, been productive of little result. The country's wealth lies in its forests and the cultivation of its fertile soil. To cultivate the soil however requires patience, skill, and hard work. To obtain a forest concession and float a company is an easy road to fortune!

It is astonishing under what transparent pretexts concessions of valuable forest rights are sought, and in some instances, alas, have been obtained. At present it requires almost the whole time of an inspecting forest officer to report upon and gainsay such applications. They not infrequently demand long and costly journies to distant parts of the country. Several such applications were referred to me for report during my stay in the Protectorate.

On the other hand, the *bonâ fide* settler searching for land may have his application for land delayed by the suspicion that valuable forest is concerned. The work of the Land Office in dealing with such applications is delayed, and it costs the Forest Department time and money to ascertain what is the character of the forest involved.

To remedy this state of matters, which is at present the cause of serious trouble in the Protectorate, I recommend:—

(1) Demarcation—distinct on the ground and accompanied with a map.
(2) An Ordinance, like the Cape Forest Act, No. 20, of 1902, rendering null and void the sale of demarcated forest or the alienation of forest rights therein.
(3) Trustees for the State forest finally reserved.

We have seen that of 482 square miles of land in the highlands and in the railway mile zone, 300 square miles have already been alienated. Some of this is forest; it is all fitted to produce supplies of timber and fuel for the railway. It is such land as the American railway companies are buying up to plant with railway forest. The Manager of the Uganda Railway is of opinion that in the "railway forest zone" no more land should be alienated.

The following return has been compiled from the files of the Forest Department and from plans furnished by the Land Office. It does not claim to be more than an approximation, but it is as correct as the data now available will allow. It will be observed that *over a quarter of a million acres of forest have been alienated or leased, and that this is valued at a little over a million and a quarter pounds sterling.* The values assumed are the values of similar forest in South Africa according to the data given at pages 26 and 27 of this report. These may be fairly taken as the normal value that the forest of British East Africa will have under ordinary colonial conditions. These values are, of course, not those which the forest has to-day while the country is as yet undeveloped. To the grantees the forest represents, in most cases, at present, little more than the value of the land it covers; say, at 2s. per acre, £26,441. So that the loss to the State over this alienated forest represents some-

thing like £1,260,804, less £26,441, or £1,234,363. It is usual, in countries where there are national forests scientifically worked, to provide an item in the forest budget for the redemption of such alienated forest as may come into the market, or be obtainable otherwise, on terms advantageous to the State; that, I would urge, should be the policy in British East Africa. I invite attention to the areas coloured red in the forest map accompanying this report.

The following return shows that there are approximately 158,944 acres of leased forest land and 105,466 acres of permanently alienated forest.

Situation.	Grantee.	Area.	Forest alienated. Value estimated on South African data.	Why alienated.	Remarks.
		Acres.			
Ravine ...	Lingham and Grogan.	94,944	Forest at £6 per acre, £569,664.	Leased for timber working.	The area of grass and forest has been arrived at as follows:— Acres. Blocks A, B, C, D. 89,978 Block E ... 14,170 Block on Uasin Guishu plateau. 44,796 Total ... 145,944 Less grass land estimated ... 54,000 Balance, forest 94,944
Shikoku ...	British East Africa Trading and Development Syndicate.	64,000	At £1 per acre, £64,000, contains scattered Sandal.	Leased. Forest of secondary value.	Survey area of grant. Actual forest occupies a smaller area. Page 3.
Njoro ...	Lord Delamere.	40,000	At £7 per acre, £280,000.	Granted by Foreign Office.	Estimated, no survey of forest.
Molo ...	Dr. Atkinson.	10,000	At £7 per acre, £70,000.	Granted by Land Office, Nairobi, as grazing ground.	Surveyed area.
Nairobi ...	Dr. Atkinson, now Handcock & Thompson.	1,000	At £20 per acre, £20,000.	Granted before formation of Forest Department.	Estimated, no survey.
Làri ...	Uplands of East Africa Syndicate.	1,026	At £10 per acre, £10,260.	Granted by Colonial Office.	The recent grant at Làri.
Limoru ...	Caine Bross ...	7,680	At £10 per acre, £76,800.	Granted before formation of Forest Department.	Estimated.
North of Elmenteita.	East Africa Syndicate.	39,200	At £3 per acre, £117,600.	Granted by Foreign Office.	Estimated at one-eighth the total area of the grant of 490 square miles.
Kijabi ...	American Mission.	2,560	At £8 per acre, £20,480.	Granted by the late Commissioner.	Area of forest estimated.
Various small grants:—					
M'Bagazi ...	MacQueen				
Kikuyu	MacAllister Scotch Mission Peak & Bull				
M'Bagazi	Patterson Grieve Oulton	4,000	Say £8 as an average, £32,000.	Granted before formation of Forest Department.	Estimated approximately.
Nairobi ...	Baker . .				
Naivasha ...	Fey ...				
Total ...	... ...	264,410	Acres, valued at £1,260,804.		

In 1904 Mr. Elliott, the late Conservator of Forests, wrote to the Land Officer:—

"This restriction is quite sufficient, and is, in fact, what I have been urging "Government to do ever since I came to the country, viz., to sell trees, not the land

"on which they stand. I shall be delighted to sell Dr. Atkinson any number of trees "on the terms in force in this Department for the sale of standing trees."

DEMARCATION.

For effectual demarcation, two things are necessary, a map and a well-beaconed line, if necessary, cut through the forest. Such a line is best shown by beacons composed of stone cairns, in the centre of each of which is inserted a strip of sheet copper stamped with running numbers. The beacons must be in easy view the one from the other. Where stone cairns cannot be erected other substitutes will suggest themselves—a wooden post of some durable timber sunk deep in the ground, an iron fencing standard built around with sods, or, better still, an exotic tree planted, such as a Eucalypt. The map should be on as economical a scale as possible; all that is strictly required is to show the position of the forest, and its topography and the beacons demarcating its boundaries. Such a map is usually provided by a plane-table survey connected up and checked by a simple triangulation.

Where the forest boundaries abut on valuable ground, or at points where trespass is particularly to be feared, fencing should be resorted to. This makes the best possible demarcation, but naturally its expense is prohibitive on a large scale.

The necessity of demarcation has been already clearly recognised by the Forest Department in the Protectorate. Unfortunately the Forest Department has been so undermanned that but little effective work has been possible. Its energies, too, have been dissipated, as has been mentioned, by the necessity of reporting on land applications. It was gratifying to note the good demarcation work that has nevertheless been accomplished by Mr. Guy Baker at Làri and Londiàni. To gazette large areas as forest reserves without defining the boundaries by demarcation, or rendering the boundaries effective by a local forest staff, seems of doubtful utility. It may lead to confusion and overlapping as in the case of an area along the northern flank of the Aberdare Range, which has been gazetted demarcated forest, and gazetted also a Masai grazing ground. It is an essential feature of demarcation that the forest demarcated is clear of forest rights; or, if any forest rights are admitted, that this is only done after the fullest enquiry, and under the pressure of absolute necessity. Demarcation must be so arranged as to proceed, step by step, with the concurrence of the Administration officers; and when there is a difference as to the location of the demarcation line, a temporary boundary should be run and the permanent boundary settled by a small mixed commission of Forest and Administration officers. The procedure followed at the Cape, which is an old-settled country, where rights of long standing have to be investigated, is detailed in the Cape Forest Act, No. 28, of 1888.

ORDINANCE RENDERING FOREST ALIENATION ILLEGAL.

The forest, once demarcated as above, should come under the operation of the Forest Laws rendering illegal the alienation of forests, and placing a bar to the accrual of forest rights. For the East Africa Protectorate I recommend the promulgation of an Ordinance in terms similar to the Cape Forest Act, No. 20, of 1902.

"*Act No.* 20, 1902, *Section* 3.—After the date of the passing of this Act it shall "not be lawful, without the consent of both Houses of Parliament first had and "obtained, to alienate, or grant, or dispose of any servitude upon any Crown Forest "which has been formally declared to be a demarcated forest, or any part thereof; "and all such alienations, grants, or disposals that may hereafter be made shall "be null and void; providing that nothing in this Act shall be taken as affecting "existing rights, or as prohibiting the sale of forest produce or the grant of grazing "rights in such forests, under and in accordance with regulations made under the "Forest Act of 1888, or under the said Act as amended by this Act; and provided "that it shall be lawful for the Minister to effect by exchange of lands or otherwise "small rectifications of the boundaries of any demarcated forest; and provided "further, nothing in this Act contained shall be held to affect the rights of Govern-"ment to issue permits or licences, under the provisions of the Precious Stones "Act of 1899, the Precious Minerals Act of 1898, and the Mineral Lands Leasing "Acts of 1877 and 1883, for prospecting for precious stones, precious minerals, or "other minerals, or to dispose of land containing such stones and minerals."

TRUSTEES FOR THE STATE FORESTS.

When a section of the public estate has to be specially administered; or when, like the forest estate, it is in constant danger of alienation, it is desirable that it should be safeguarded by being vested in trustees. Some years ago, the Victorian railways were vested in three Commissioners. The newspapers report that a similar course is now proposed for the Cape railways. With every care in demarcating and every precaution on the part of the Land Office, it is possible that grants of land infringing the boundaries of the State forests may be made; and there would then be the conflict of two administrative acts, the one granting forest land, and an Ordinance declaring such a grant illegal. To make quite clear the position of the State forests it seems desirable that they should be vested in trustees. The object sought is to make the alienation of a State forest as impossible as the alienation of a private forest. This course has not yet been found necessary at the Cape, where an administrative act, if it clashed with an Act of Parliament, would be illegal and of no effect. In British East Africa it would appear desirable that the demarcated forests should be vested in trustees. These might be the Commissioner of Lands, the Chief Conservator of Forests, and a non-official member representing the national side of the forest question: such non-official member being nominated, from time to time, by Government. It might be desirable to have two non-official trustees. These three or four trustees would form a Forest Board, which should elect its own Chairman and meet, at least once a year, for the transaction of forest business. The ownership of the demarcated forest should be vested in these trustees. It is not intended that such a Board should obtain control of the management of the forest. This would rest with Government acting through the Forest Department. The function of the Board would be simply to place the national forest estates in the same position with regard to alienation as land that has been sold or otherwise disposed of.

Since the above was written, at a meeting of Provincial Commissioners and Heads of Departments held at Nairobi in March, 1908, His Honour the Lieutenant-Governor occupying the Chair, it was resolved that the legal status of the demarcated forests should be assimilated, as far as may be, to that of privately-owned land. This resolution was subsequently approved by His Excellency the Governor.

PRIVATE FOREST.

As mentioned, the restrictions that have been placed on the destruction of forest on private lands have never proved really effective. If the owner wishes to destroy the forest he can generally do so without committing any overt act bringing him within the grasp of the law. Under Clause 4. A. "General Conditions for the "Acquisition of Land in the Protectorate," it is laid down:—

"(4.) Ten per cent. of the area of every selection must be kept in perpetuity as "forest land. Selections on which less than 10 per cent. of the area is forest must "be planted with forest by the holder to bring the area under forest up to 10 per "cent. of the total area; but if there is no forest on a selection the holder need not "plant more than two per cent., and the Conservator of Forests may in his discretion "dispense with the obligation entirely." The planting shall extend over a period of 16 years from the date of agreement, a reasonable proportion of forest must be planted every year, and the forest must be maintained to the satisfaction of the Forest Officer. For the purposes of this rule any belts of forest of not less than one chain in width are accepted as forest.

I recommend that this clause should be repealed. It has remained a dead letter up to now.

FOREST DESTRUCTION.

In describing the Aberdare forest I have pointed out the enormous destruction of forest wrought by the Kikùyu. The Civil Station of Fort Hall is situated in comparatively dry country and at a low elevation (4,200 feet), where there was

probably never dense forest; but going from Fort Hall towards the Aberdare range one has not travelled many miles before it is evident that the country not long ago was covered with dense forest. Enquiry shows that the greater portion of the forest between Fort Hall and the Aberdare mountains has been destroyed in recent times. The missionaries who have settled here, and magistrates who have known the country for some years, are unanimous as to the complete and appalling destruction of forest that has taken place here. Mr. Hinde, the Provincial Commissioner, has calculated that the average thickness of the *forest belt here has diminished at the rate of about half a mile yearly.* This is mentioned by Mr. Hinde in his report of 24th April, 1906. Father Perlo, of the Italian Mission, an old resident, confirms Mr. Hinde's estimate.

Shortly after his arrival from India Mr. Elliott, the late Conservator, wrote: "In the Wakikùyu country the forests are honey-combed with patches of cultivation; "a man goes into a bit of dense forest, cuts down all the trees, and sets fire to "them; he cultivates a few crops of sweet potatoes and beans with perhaps some "Indian corn, and after a few years, when the soil becomes impoverished, he "abandons the patch and repeats the process elsewhere. Scores of these abandoned "plots may be detected, even though nature has done its best to repair the damage. "Most of the indigenous forest trees, I may say all that are of any value for timber, "are very slow-growing, and do not establish themselves on exposed soil.

"Again, the Màsai have a custom of firing the grass lands which occur on the "flats and bottoms between the hills. These fires extend every year, further and "further into the forest above the flats, and destroy thousands of trees for no "purpose whatever."

In his book on the East Africa Protectorate, 1905, Sir Charles Eliot wrote:—

"Nomad tribes must not be allowed to straggle over huge areas which they "cannot utilise, nor ought the semi-settled natives to continue the wasteful and "destructive practice of burning a clearing in the woods, using it for a few years, "and then moving on and doing the same elsewhere."

Mr. H. B. Muff, in his Geological Report (Colonial Report, Miscellaneous, No. 45), page 53, writes:—

"The loss of the forest may be attributed partly to the effects of the grass fires, "which sweep the plains twice a year at the end of the dry seasons; to a small extent, "perhaps, to destruction by the Masai; but by far the greater part is almost cer- "tainly due to the Wakikuyu. These natives plant their 'shambas' on ground "which they have cleared of forest. The cultivated soil is slowly washed away by the "rains, and the 'pan' of *muram* formed. The ground is then deserted, and a new "clearing made in the forest. The native population is thus encroaching on the "forests, which are being slowly destroyed. Over the deserted ground the grass "returns, and a few small trees spring up here and there, forming an easily-recog- "nised 'park-like' type of scenery. A good example of this kind of country is "traversed by the Fort Hall Road between the Ruìru and Thìka Rivers. Where "the alluvial land beside the rivers can be cultivated a few families of natives may "remain, but the higher ground between the rivers is deserted. Owing to the "complete change in the character of the soil, the forest cannot spread again over "the deserted land, either naturally or by the aid of man. If the red clay has "been completely removed the land is useless for cultivation, and as pasture it must "be easily affected by drought on account of the thin unretentive nature of the sub- "soil.

"In view of the white settlement of the country, much of this fertile red clay "is sure to be brought under cultivation. It may be as well, therefore, to insist on "the destructive erosion of the soil of de-forested tracts by the rain, all the more so, "because its ravages pass unnoticed until the damage is done and beyond "repair. . . . . The likelihood of erosion should be kept in mind from the "first, because one of the best methods of preventing it is the retention of the hill- "tops in forest, and the alternation of strips of forest with tilled land on a long "slope."

Forest destruction is indeed proceeding at a rate which observers of every shade of opinion admit to be alarming. When, in 1883, I came from India and took charge of the forests in the East of Cape Colony (British Kafraria) the forests there were in exactly the same position as are the Aberdare forests in British East Africa to-day. The forest was honeycombed with native gardens; and the burning and destruction of the forest went on unchecked. To-day all this is changed. The forest lies secure within its own boundaries, while the natives are cultivating their

gardens outside the forest boundaries in a less barbarous and wasteful manner. The forests of the Protectorate present an asset comparable to the gold and diamonds of South Africa, but their value lies largely in the future. It is admitted on all sides that to allow the present destruction of the forest to proceed unchecked is a waste of the country's resources which can only be viewed with the utmost alarm. At the same time to station a force of police around the forest sufficient to protect it from further destruction would entail a cost far beyond the present value of the forest, or perhaps even exceeding its prospective value. It is mainly for this reason that up to the present nothing effective has been done to check so serious a public evil. Like the Kaffirs in South Africa and the wild tribes bordering the forest in India and other countries, forest lands are sought for cultivation on account of their richness. The Kikùyus sometimes leave the ground to fallow, or "brack"; at other times they abandon it altogether when the rich forest soil is exhausted or washed away. The problem is to settle the Kikùyu on good ground which they can cultivate as permanent cultivators. At present, their methods of cultivation are entirely simple and barbarous. They scarcely scratch the rich soil. They keep domestic animals, but do not use the manure. In order to stop the forest destruction of the Kikùyu and settle them on the ground as permanent cultivators, I recommend that the same course should be followed as was adopted with the Kaffirs in South Africa.

(1) Demarcate the forest with clear, well-defined boundaries, and have a forest staff on the spot to see that these boundaries are not infringed.

(2) Ensure the complete exclusion of the Kikùyu from the boundaries finally settled for the forest by a zone of white settlers.

In regard to the breadth of the white settlers' zone, this would depend on the topography of the country and the density of the native population. Around the Aberdare Forest where the ground falls more rapidly and there is a dense population of Kikùyu the white settlers' zone could not probably average more than two miles broad. Around the Kenia Forest I have estimated that it might be five miles broad.

At lower elevations are ample lands suitable for Kikuyu occupation, land which fear of the Masai kept them from cultivating in the old days.

SETTLERS' ZONE ROUND KENIA AND ABERDARE.

In his reports on the proposed forest concession to Lord Warwick and Mr Moreton Frewen, Mr. Hinde writes:—

"Both Sir Charles Eliot and the late Sir Donald Stewart recognised that this "country would probably become the richest agricultural centre of the Protec- "torate. If the survey is conducted under the supervision of an Administration "officer there would be no local objection on the score of native rights and, I think, "no friction with the natives."

In his letter of 29th April, 1906:—

"There is a considerable area below the forest belt unoccupied and suitable "for European agriculturists. The lower slopes of Kenia are said to be the richest "agricultural areas in the Protectorate."

I do not think that there is any forest measure that could be of more benefit to the forest and eventually to the natives themselves than the formation of a zone of white settlers round the outskirts of the forest and between it and the lands set aside as permanent cultivating ground for the natives. I suggest that the agricultural forest zone outside the forest zone should be surveyed into farms of about 500 acres, each farm, with its water-rights and suitable high-lying, dry ground for the homestead and farm buildings. These farms should then, on certain dates well advertised beforehand, be put up to auction and sold, in alternative blocks, to the highest bidder. There might be yearly sales in England of blocks of these farms, the sales spread over three or four years and the farms well advertised in England, in Australia, and South Africa. Sales should be to *bona fide* occupiers only. The farms might be on quit-rent terms, and be sold by auction under regulations similar to the Cape Land Acts. Purchasers to be British subjects and married men with wives and families of not less than three

children. After 10 years of occupation by the grantee and his family the farm might be purchasable on paying 20 years' quit rent. Should the farm, at any time for a period of ten years after allotment, cease to be personally occupied by the grantee or, in case of his death or illness, by his family, possession to be resumed by Government without payment of compensation for improvements.

The land round Kenia and skirting the Aberdare forests is the pearl of the Protectorate from an Agricultural point of view. Though many of those who have taken up land in British East Africa are mere speculators, and not likely to succeed as cultivators of the land under any circumstances, it is certain that they have not had a chance of securing the best land. The country between Nairobi and Fort Hall and in the Rift Valley is markedly inferior to the agricultural land round Kenia and on the eastern side of the Aberdare. I do not think it would be possible to imagine a more favourable scheme of land settlement for whites.

It is conceivable that the settlement of this land by white colonists may be of the utmost importance to the future of the country. Native troubles may never arise, but it is desirable to provide against them. To leave the natives in sole occupation of these forests and their outskirts is to invite native trouble. In their forest fastnesses they have long defied their hereditary enemies the Masai. To have to expel them from a forest such as Kenia might be a costly task. At each Kaffir war in South Africa, forest such as the Kenia forest was the refuge of the Kaffirs, and to finally dislodge them entailed an expenditure of millions and the loss of many lives. As long as the Kaffirs had the Perie and Amatola forests to retire to, and fight from, they remained restless and unsettled. After the last Kaffir war the plan was adopted of settling Europeans and Fingoes round the forest. In "British Kaffraria" the land round the forest represents the pick of the agricultural land, as it does in British East Africa. The German peasants who were settled on these lands are now a strong, prosperous, and permanent colony. They were given quite small peasant holdings. A few English settlers on larger farms have done equally well, and one can only regret that there were so few of them.

Unless some such policy be adopted for settling the land skirting the Kenia and Aberdare forests, there will be constant difficulty in keeping the natives out of the forest and staying its destruction, while to allow them to continue to make their homes in the forest is to place a premium on native unrest.

The making of a railway along the flanks of the Aberdare forest and on to the Kenia forest would, of course, be of the utmost benefit to such a scheme of land settlement. For healthfulness and fertility these lands are unrivalled, but for successful settlement they require to be rendered accessible and secure against native troubles

Report on the East Africa Protectorate, 1903-4 (Africa No. 15, 1904), states that there is no prospect of the Protectorate paying its way or being anything but a financial burden to the home Treasury, until it is developed by white settlers.

Says Mr. Moreton Frewen, in the "Monthly Review":—"This is the district "which, beyond question, in soil, climate, and economic advantage, presents the "greatest attractions to the white settler. . . . About every two miles on its cir- "cumference of, perhaps, 150 miles, sparkling streams of ice-cold water rush down "through striated channels, the snows ever renewing and ever melting under an "equatorial sun. This entire circumference is a beautiful region for settle- "ment . . . the most delightful zone in East Africa."

FOREST CULTIVATORS.

Forest cultivators are men who cultivate forest lands under temporary permits from, and under the supervision of, the Forest Department. At the end of a few years they surrender their plots of ground more or less completely planted with the trees that they have put in with their crops. They are an important adjunct to the successful management of forest in South Africa. Their usefulness is two-fold; they help in the protection of the forest, and they restore ruined forests which it would not be economical to restore by other means. In British East Africa, in addition to these advantages, their use, if judiciously employed, will afford means of gradually withdrawing the natives from those parts of the forest where they could not be withdrawn rapidly and altogether. In Cape Colony, forest cultivators

help to protect the forest against fire and eventually return their ground planted with trees. In Burmah, forest cultivators have long been the means of forming the largest and most economical plantations of Teak.

HISTORY OF THE FOREST DEPARTMENT.

Forest conservation in the East Africa Protectorate originated in April, 1902, with the appointment, as Conservator of Forests, of Mr. C. F. Elliott, late Conservator of Forests, Punjab, India, a retired officer of the Indian Forest Department. He was first put in charge of the forest traversed by the Uganda Railway, but shortly after his arrival his work was extended so as to include all the forests of the Protectorate. In 1902-3 the Forest Department spent £670 16s. 3d. out of a budget provision of £900. In September of that year Judge Cator wrote as follows:—

> "I wish you would back up Elliott in all his suggestions. The report discloses a very serious state of affairs, but not a bit worse than I expected. I have always urged that the native chiefs should be ordered to put an end to their wasteful practices, but some people say it is useless to make the attempt, and others, I believe, think it is too much trouble. No doubt it will be a difficult task, but I think the ultimate prosperity of the country is largely dependent upon the preservation and extension of the forest land, and I should make the natives collectively responsible."

In order to introduce regularity in the working of the forest situated in the railway mile zone, Mr. Elliott recommended that the cuttings for the fuel supplies of the Uganda Railway should take place in strips of 100 feet wide and one mile deep. It was hoped to secure the natural regeneration of the forest by the system of "strip fellings," which in other countries and with other trees (especially Conifers) have given good results. In very few instances, however, were the dimensions set down for the strip-fellings observed; and the indications are that even if they had been, strip-felling would not have proved a complete success.

In April, 1904, four Assistant Conservators were appointed by the Secretary of State, two of these being already in the employ of the British East African Forest Department. In 1903-4 there was a budget provision of £3,056, out of which £2,104 7s. 3d. was spent, all of the expenditure, with the exception of £400, being on personal emoluments.

About 1904-5 attempts were made to re-plant artificially areas cut over in the railway mile zone. In that financial year there was a budget provision of £3,742 and an expenditure of £3,140 13s. 3d., all of this expenditure, with the exception of £464, being on personal emoluments.

In April, 1905, Mr. Elliott's three-year appointment terminated, and he was succeeded temporarily by Mr. Linton, Director of Agriculture. Before leaving, Mr. Elliott made a complete tour of most of the accessible forests. He left behind him several instructive reports and made various useful recommendations. The latter, however, were rarely carried out and he did not, I am informed, receive that support from the Administration which the importance of his work and the expenditure incurred on it would naturally have demanded.

In November, 1905, one Assistant Conservator was invalided to England and did not return. Out of a budget provision of £3,743 for 1904-5, £3,140 13s. 3d. was spent.

In 1906 Mr. Linton left the country and Mr. E. Battiscombe, one of the junior Forest Assistants, was appointed Acting Conservator of Forests. The remaining two Assistant Conservators proceeded to England, one of these (Mr. Baker) is now undergoing a six months' course of training under the advice of Dr. Schlich.

At the close of 1906 the staff of the Department consisted of Mr. Battiscombe (Acting Conservator), two Assistant Conservators on leave, five European Foresters

or Rangers, and a number of native Guards. In 1905-6 out of a budget provision of £3,993, there was spent £2,894 18s. 9d.

In the short history of the Forest Department in British East Africa the points inviting criticism are:—

(1) The disproportionately large expenditure on personal emoluments.
(2) The want of support accorded to the Conservator.

The total forest expenditure up to the end of March, 1906, amounts to £8,810 15s. 6d. (according to the Treasury return before me), of which £7,377 12s. 11d. is debited to Personal Emoluments and £1,433 2s. 7d. to Other Charges. The expenditure on planting, demarcating, fire protection, &c., has been disproportionately small.

The records of the Conservator's Office at Nairobi contain abundant proof of the sad want of support given to forest work by the Administration. As some justification for this absence of support it is stated that the Forest Department was wanting in a defined policy and in unity of action. Mr. Elliott had not had experience of this class of forest and Mr. Linton was entirely without forest training or experience. In September, 1905, Mr. J. Ainsworth, Sub-Commissioner, Nairobi, wrote:—

> "The Forest Department had no definite policy and had not apparently made up their minds, and, as a consequence, co-operation was difficult.
>
> "In conclusion, I would remark that it has often come to my notice that grass fires, more often than not, are responsible for considerable destruction in the forests. Last year the forest near Ruiràka was burning for days and hundreds of valuable trees were destroyed, while in other parts similar fires added to the destruction."

Mr. Ainsworth is well known for his interest in forestry, and his extensive tree-planting operations have left a beautiful garden to Nairobi and done much to hide its ugly corrugated-iron buildings.

ORGANISATION OF THE FOREST DEPARTMENT.

It usually happens, in the beginnings of forest work, that men with general rather than special forest qualifications are appointed; they are given inspection duties, the idea being that they should exercise a general control, acting as police and inspecting officers. This stage of forest organisation, however, rarely does more than bring to light the evils that exist. Without a staff, inspecting officers are generally powerless, and it rarely happens that any real forest work can be rendered by the staff of other departments. However small, it is better to start, as early as possible, with a complete forest staff. At present the forest staff of the British East African Department consists of three Inspecting or Controlling Officers, three Foresters or Rangers, and a number of native Guards. No forest buildings have yet been erected.

The strength of the future staff will depend on the extent to which the forests are worked intensively. The opening of the Kenia Forest would require two or three Controlling Officers with a corresponding staff of Foresters and native Guards. Similarly with regard to the Mau Forest and the forest comprised within the Lingham and Grogan concession. Till these forests are brought into working, I recommend the following staff:—

Administrative Staff.

1 Chief Conservator, £800, rising by £50 to £1,000.
1 Deputy Conservator, three grades at £350, £400, and £450.
4 Verderers (Assistant Conservators), four grades at £200, £250, £300, and £350.
3 Forest Demarcators from £200 to £350, same grades as Verderers.

Executive Staff.

15 Foresters, £120, and eight grades of £10 rising to £200.
5 Assistant Foresters, £50 by ten grades of £5 to £100.
120 Native Guards, Rs. 10 per month to Rs. 20. Average Rs. 15 per month or £12 per year.

Office Staff.

1 Head Clerk, £200 to £300.
1 Clerk, £120 to £250.
1 Typist, £120 to £200.
4 Messengers (Peons), Rs. 10 per month to Rs. 20. Average Rs. 15 per month or £12 per year.

ALLOWANCES.

Horse Allowances.

Chief Conservator, two horses or mules at £25	50
Deputy Conservator, two horses or mules at £25	50
3 Verderers, two horses or mules at £25	150
3 Forest Demarcators, two horses or mules at £25	150
15 Foresters, one horse or mule each at £20	300
Total	£700

The proportion of native Guards to European Foresters in the above scale is eight to one. This appears sufficient. It may be found possible afterwards to increase the proportion of native Guards. It would be economical to do so, but until the Department is well organised and has been in working order for some years, it would be dangerous to increase the proportion of native subordinates. The native Guards have already been accused of levying blackmail on the ignorant natives, and, though they are probably no worse in this respect than the native police generally, it is necessary, in the interest of a pure Administration, to provide against such a contingency, although it may involve some extra cost at first.

For forest which is worked intensively a Forester's charge should not exceed 5,000 acres. Thus, if all the forests in the Protectorate were worked intensively a large staff would be necessary.

CAPE FOREST STAFF.

The Cape Forest Staff consists of one Chief Conservator, four Conservators, 15 Assistant Conservators (termed District Forest Officers and Superintendents), and about 100 Foresters.

SUBSISTENCE ALLOWANCES.

At present Forest Officers draw (along with other Government officers) a travelling or subsistence allowance at the rate of Rs. 5 (6s. 8d. per day). The same allowance is given to officials of various grades. This is not in accordance with the usage of other countries. The head of a department or senior officer has obviously to travel in certain style, to entertain, and to keep servants on a scale which is not necessary in the case of junior officers. At present, in the Cape Forest Department, Conservators draw £1 per day, Assistant Conservators (District Forest Officers) 15s., and Foresters from 3s. to 5s.

I recommend the following scale for the Protectorate:—

Chief Conservator	Rs. 7 per day.
Deputy Conservator	5 ,,
Verderers and Demarcators	4 ,,
Foresters	2 ,,

Mention should be made here of an objectionable feature in the form under which travelling allowances are drawn at present. Travelling allowance bills have now to be made out in triplicate and with an amount of domestic detail which should be omitted. Thus, in order to draw the allowance of Rs. 5 per day, it is necessary to specify an expenditure totalling this amount. Usually it is made up with details of tin provisions, candles, &c. The other expenses of travelling, such as extra servants and camp equipment are not demanded in the account. The

present form of account, besides involving unnecessary clerical work, has the disadvantage of encouraging an unnecessary expenditure in fanciful and unwholesome tinned provisions, to the neglect of the plain, but more wholesome, fresh food obtainable in the country, often at much less cost. I recommend the substitution of a fixed travelling allowance for the present bills and their unnecessary details.

TRAINING OF FOREST OFFICERS.

It is of the utmost importance that all appointments to the administrative grade of the Forest Department should be given only to candidates who have qualified themselves for the work by a course of approved forest training. Such a course, to be effective, should occupy not less than two years; and it should take place at one of the recognised schools where such a training is given. In English-speaking countries there are but few of such institutions. There is one in India (for subordinate forest officials), one in England, two or three in America, and one in South Africa. On the continent of Europe and in Japan there are numerous well-equipped forest schools.

The South African Forest School has been recently established, but the course of instruction is sound and well-considered. It instructs, moreover, in extra-tropical forestry, and is the only school of extra-tropical forestry in English-speaking countries. It would be preferable, therefore, to recruit the Administrative Staff, as far as possible, from passed candidates of the South African Forest School. Not only is this a school where special consideration is given to extra-tropical forestry, but the indigenous forest in which the practical training is given closely resembles the highland forest of British East Africa. This is a most important advantage possessed by no other forest school.

FORESTERS: THEIR POSITION AND PROSPECTS.

A good staff of Foresters is the keynote of successful forest administration. The absolute necessity of economy in all forest expenditure will not permit of their pay exceeding limits of from £120 to £200 per year, but no effort should be spared to render their lives contented, happy, and healthy. A discontented man cannot make an energetic and zealous Forester. Foresters are necessarily left so much to their own resources, that, unless they are zealous and active, their service becomes inefficient.

Each Forester is entitled to the use of a reasonable piece of ground round his house, which, where ground is available, may be 10 acres for a garden and 100 acres grazing for a horse and cow. Foresters should be encouraged to raise all the provisions they may require for their own use, but not allowed to sell produce. Their stations will be often in remote localities; and without the resources of the family circle and a little home farm, the loneliness and isolation would be insupportable or lead to relations of too close a nature with the natives.

For the highlands of British East Africa, Foresters should be Europeans—young married men of the working class, or the equivalent of the Foresters trained by Colonel Bailey in his Edinburgh forest course. They should be men born and bred in the country, used to a country life, and able to ride and shoot. Men who have led a town life are quite unsuitable. The greater portion of the forests of British East Africa is situated on the highlands above 6,000 feet elevation. For the tropical forest near the coast and the low country near the lake, European Foresters are not economical and must be largely replaced by native Assistant Foresters.

Leave.—Foresters on £120 are, I understand, at present only entitled to three months' leave at the end of three years. This is insufficient for Europeans in an Equatorial climate, at any rate during their first years of service before they have become acclimatized or learnt how to take care of themselves. I recommend that European Foresters should be granted six months' leave on full pay at the end of four years and a second-class passage both ways, to either England or South Africa, for themselves and their families. Foresters from South Africa would be nearer their homes and should be given the preference for this reason, especially where there is a chance of getting men who have been trained in South African forest work. From Mombasa to Delagoa Bay is six days only by direct steamer, or rather less than a quarter the time required for the sea passage from Mombasa to England.

Shooting.—The shooting which may be enjoyed by forest subordinates should be regulated by the Conservator, acting under general instructions from Government. It is not advisable to issue Public Officers' Game Licences to subordinate forest officials since their cost (£10) is such as to tempt the Forester to reimburse himself with ivory or skins, and occupy himself shooting to the neglect of his forest duties. This has actually happened in one case.

Language.—The language test for all forest officials should be of a simple practical nature, not the literary test such as is required at Mombasa. All junior officers of the Department should be required to pass in the language before obtaining promotion, and all officers serving in the Kikuyu country should be encouraged to pass a colloquial test in that very useful language. Indeed, it is questionable whether Kikuyu should not be substituted for Swàhìli as the first language test for all forest officials serving in the highlands of British East Africa.

Duration of First Appointments.—All appointments, unless otherwise stated, to be for three years and on probation of one year.

FOREST BUILDINGS.

In the Protectorate it is the practice that all buildings are designed and erected by the Public Works Department. That is the general rule (and rightly so) in most Colonies. In the case of forest buildings, however, it has long been found that, while utilising the service of the Public Works Department to the fullest extent in the designing of forest buildings, it is more economical to leave their construction to the Forestry Department, aided, where necessary, by the advice and assistance of the Public Works Department. It usually happens that forest buildings are in remote localities where the Public Works Department contractors charge high rates to work, while the Forest Department, with its local staff and command of material on the spot, can often put up buildings (perhaps roughly, but strongly and well built) at one-half the cost of such buildings erected by the Public Works Department. Timber from wind-fall or diseased trees can often be obtained at small prices in the neighbouring forest.

In Cape Colony the cost of erecting the standard Forester's house, a four-roomed dwelling of brick and stone, is £350. While I was in the Protectorate two forest cottages were erected by the Public Works Department. They are temporary iron structures. One near Nairobi, smaller than the standard Forester's cottage, cost £370; and the little tin tenement at Londiani (about half the size of a standard Forester's cottage) cost £250. I understand that there was no waste in either of these unsatisfactory buildings. It is the system that is at fault.

I need scarcely point out how necessary it is to observe economy in forest buildings. For the major portion of forest expenditure, planting and aiding natural regeneration, little return can be expected till it has (with interest at $3\frac{1}{2}$ per cent.) tripled in amount. In the Forest Department perpetual economy is the first requisite of good management, more so than in those departments of the public service which are able to show an early return for money expended.

Twelve Foresters' cottages (for white men and their families) have now to be erected, so that this is a matter demanding attention.

SYSTEMATIC WORKING OF THE FOREST.

In forests of this class the two most important points to secure are:—

(1) A better stocking, that is to say, an increased stand of timber per acre.
(2) A good natural regeneration.

These two points will probably be best secured by the sylvicultural system known in the text-books as "Jardinage or Selection-felling"; and the form of Selection-felling best suited to ensure a good natural reproduction will be that known as the "Group" system. But see also page 49. We may distinguish three kinds of Jardinage.

(1) *Simple Jardinage.*—Trees culled here and there throughout the forest as it may be convenient to fell them, care being taken that the whole forest is gone over gradually and the possibilité not exceeded. This is applicable to portions of the forest which for their remoteness or other reasons are of little value.

(2) *Jardinage regularisé* or Selection felling in Sections.—In this form of jardinage the forest is divided into Sections so arranged that a Series of Sections is completed during the rotation, which for the forests of British East Africa could be conveniently taken at 20 years. In the Cape forests the rotation has been fixed at 40 years. A 20 years' rotation would, in my opinion, have been better, in that it would have been more favourable to natural regeneration and to the rapid clearing off of the over-mature exploitable timber. On the other hand the 40-year rotation tends to bring the forest more rapidly towards the foresters' goal—the regular forest. The short rotation is safer for the forest; the long rotation is better for the forest yield and for those working in the forest, since, with the long rotation, there is more timber to be removed per acre and the working is more concentrated.

Boppe and Jolyet, in their text-book (Sylviculture), in discussing the length of jardinage rotations, say :—" In general, more frequent cuttings are advisable with shade-bearing than with light-demanding species, in fertile than in poor soils, in favourable than in severe climates."

In the highland forests of British East Africa most of the species (like those in the forest of South Africa) appear to be shade-bearing; the soil is eminently fertile, and the climate favourable to tree growth, so that, according to European practice, short rotations are indicated. In view, however, of the advisability of working towards the gradual regularisation of the forest, I am of opinion that the jardinage rotation should not be shorter than 20 years. A long 40 years' rotation like that in force in the Cape forests would be more properly described as a " rotation of conversion." In France the jardinage rotations range from 8 or 10 to 15 years. It is 10 to 30 years in the Teak forest of Burmah, and 40 years in some of the Indian Sàl forests. In British East Africa I consider that the exploitable timber should be marked in Sections of about 250 acres, and a Jardinage rotation of 20 years, while protected forest (especially certain water-protective areas), forest not yet laid out in Sections, and the railway " natural beauty " zone would be marked on a Jardinage rotation of 10 years.

(3) *Group System.*—In this system the Forester, when marking the exploitable timber, marks the trees for felling according to the sylvicultural requirements of each group. The primary object is to secure the natural regeneration of each group. The system is well described in Dr. Schlich's classical text-book of forestry, a work which is readily accessible and to which it is not necessary to do more than to refer here. The group system has given excellent results in the treatment of large forest areas in Germany. It can be studied to advantage in the Black Forest near Baden. D'Arcy, in his excellent short treatise on Indian working plans, describes the group system thus :—" This is merely a modification of the method of successive fellings. All the calculations connected with the manner of prescribing the possibility, &c., are identical in the two methods, and the gradual exposure of the young seedlings is secured by means of two or three successive regeneration fellings. The successive fellings are, however, in the group method, all made simultaneously by groups, that is to say, wherever a patch of seedlings is already established, it is at once exposed, in greater or less degree, to the climatic influences. Where seedlings do not exist, the cover is opened out with a view to their establishment, the method, in fact, amounts to this, that the volume of material to be felled annually in the block under regeneration having been determined, this volume is felled by patches or groups wherever a group of established seedlings exists. The method is applied in exactly the same way as the method of successive fellings, and comprises similar clearings, thinnings, and selection fellings." In British East Africa there will have to be much hoeing and cleaning of the ground to assist natural regeneration.

POPULAR ACCOUNT OF THE PRACTICAL WORKING OF THE FOREST.

The above will be rendered clearer by reproducing here what I wrote in 1891 when in charge of the Knysna forests at the Cape.

" We Foresters claim—and it is a claim that anyone can satisfy himself about

by taking a walk through the forests—we claim to be using and at the same time improving the forests in our charge.

"The forests at Knysna and along the Amatolas are managed on this system. The larger forests are divided up, and the small forests grouped together into a working unit called the 'Series.' In the Knysna Conservancy the area of Government forest workable under present conditions is about 52,000 acres. This is divided into 13 Series with an average of about 4,000 acres each. Each Series is divided into 40 equal parts, termed Sections, so that these Sections average about 100 acres each.

"One of the Series in the Knysna Conservancy—that nearest George—has been so much overworked in the past that it has been entirely closed for the present. So there are now open and being worked at Knysna 12 Series cut up into 40 Sections averaging a 100 acres each. Each year, in each Series, a fresh Section is opened. It will take 40 years to work through each Series, and at the end of that time the Sections first opened for working in 1883 will again have mature wood grown up in them. You will understand that when a forest Section is worked not all the trees are cut down, but only those that are mature. Who is to judge what trees are mature? In this lies the pith of the whole matter. If you leave the judging to the wood-cutter, as in the old days, he will very naturally judge those trees mature which suit his own convenience. He will pick out the best trees and leave the worst to grow and form the forest of the future, he will overwork and destroy the accessible forest and leave mature timber to rot in the inaccessible forest. To avoid these evils each forest Section, before being thrown open to the public, is thoroughly and closely examined by the Forest Department. Every tree in the Section is inspected and those which, *looking at the future of the forest*, should now be felled, are numbered, measured, and entered in a book kept for the purposes. This is a long and tedious business and occupies the Conservator and Foresters for several months. We are always glad when it is over!

"It is pleasant to walk through a marked Section. At about every 100 yards (the distance depends on the density of the forest) lines, termed virées, have been cut to guide the workers. As one walks down these lines, or along an old slip-path, or occasionally along an elephant-path, the trees marked for felling come into view. Each of these doomed trees carries a large cross in red paint high on its trunk; at its foot, half-buried in fern and beautiful foliage, is a number (also in paint) and below all, probably on a gnarled root, is the Government stamp. With a little practice you will be able to see why each tree marked for felling has been selected. Here is a hoary old giant of several centuries' growth. His massive limbs were flung out very much as they now are when the white man first came to the country; his bole runs up straight and cylindrical for 40 or 50 feet like the columns in the aisle of a cathedral. No one cared to tackle him under the "free selection" system. He may be still good timber or he may be a mere rotten shell and too rotten already to work with profit. It is easy to see why he has been marked for felling. Age. By his side, perhaps, stands a slender stripling. We wonder why this has been marked for felling. Surely it will be worth much more in 40 years. But it bears the fatal red cross, and we look again. There on the other side of the trunk is a black streak; higher up a decayed branch. That tree is rotten at the heart. It must be cut down to make room for a sound tree. Whatever value it has is in the present. In marking the trees for felling in a forest Section this is the principle followed:—Unless there are cultural reasons to the contrary, every tree is marked for the axe that will not in 40 years increase in value more than its present value put out at interest at three per cent.

"I must touch very briefly on forest culture or what is termed sylviculture. Before a tree is marked for felling one has to look on the ground and look around to see what there is to replace it. No Forester, if he can help it, makes a large gap in the forest. A gap in the forest is a dangerous thing. It lets in wind and sun. Wind may blow down the surrounding trees; sun is more to be feared—it deteriorates the forest soil, inducing a growth of grass and inflammable herbage. A sudden exposure to sun will kill the seedlings of most forest trees. Stinkwood (*Ocotea*) is especially tender in this respect. So you see that when a Forester plods down the virée lines, day after day, marking the trees that are to be felled next year, he has plenty to think about, plenty to do; and when each year's Section of forest has been completely examined, the most arduous part

of his duties for that year are over. His work is checked by his superior officer, the Assistant Conservator, who, book in hand, checks 10 per cent. of all of his measurements and criticises his selection of trees for felling.

"Everything being now ready the forest Sections are thrown open to the public on the 1st of March in each year. The forest remains open for felling till the following June. All timber has to be worked and got out of the forest by the end of December; 15,000 trees on an average are thus felled yearly in the Knysna Conservancy. The average size of the timber from these trees varies according to the quality of the forest. In the Gouna Forest, near the port of Knysna, where it is almost virgin forest, the average of the trees felled is 56 cubic feet each. In the poor forests near George and Plettenberg Bay, in forest that has been overworked and irregularly worked for 50 years, this figure falls from 56 cubic feet per tree to only 12 cubic feet, and as low as 8 cubic feet at Wit Els, the end of the forest country towards Humansdorp.

"Each Section remains open for two or three years. It is then put in order by the Forest Department and closed for 40 years. Planting, sowing, and improvement thinning, more or less, according to circumstances, are required to put a Section in order."

Time required to mark Timber.—In the Zuchi linear forest area at Kenia where there is an average stock of mixed timber, Mr. Ross, a Forester, and myself marked $21\frac{3}{4}$ acres in 4 hours 40 minutes, or one acre in $13\frac{1}{2}$ minutes, which is at the rate of nearly 56 trees per hour. Here, the forest was open and the path good.

Working of the Forest in German East Africa.—On my return from British East Africa, I visited Tànga and Dàr-es-salàam. His Excellency the Governor of German East Africa kindly supplied me with the following information through his officials in charge of the forest work and Museum at Dàr-es-salàam.

The railway running inland from Tanga skirts forest-clad hills higher than the Shimba Hills in British East Africa and a branch forest railway has now been made up into the hills. Remunerative prices for Usambàra timber are realised in Europe. I had it on good authority that there were trees over 200 feet high in this forest, and that some of the timber fetched 6s. to 7s. the cubic feet in Europe, also that a wire-way and tramways to work the forest have recently been put in at a cost of about £70,000. Three companies are now working here; and their united yearly output is expected soon to reach 70,000 or 80,000 tons. It is possible that this is too intensive working for the stock of timber in this class of forest.

The extension of the Tànga line to Kilimanjàro will open up further supplies of timber, though, according to information supplied to me by the officials in Dàr-es-salaàm, it is doubtful whether the Kilimanjàro Forest is better than that found on the mountains of Usambàra. The forest here is worked much as I have recommended that the Kenia Forest should be worked. The exploitable trees are first marked by the Forest Department and then sold to contractors or lessees, who extract or manufacture the timber under specified conditions.

SLIPPING AND SAWING OF TIMBER.

The sawable timber in South African and East African forests being more scattered than in most European forests, different methods of working become necessary. More slipping is necessary, involving the use of oxen or buffalos. The desirability of introducing buffalos is mentioned on page 78. The oxen of the country are small, but in the hands of skilful bush-workers (like those at Knysna, Cape Colony), could no doubt be turned to useful account. The cost of slipping is reduced by hand-sawing and local saw-pits. With cheap labour and (at present) dear cattle local saw pits seem preferable in British East Africa for all that portion of the forest where the sawable timber is scattered, or for those portions of the forest which are inaccessible and where it will be costly to slip to a saw-mill. The Knysna bush-workers are skilful pit-sawyers. They do an astonishing amount of work in a climate the reverse of bracing. I am of opinion that their services for working the forest in British East Africa are desirable. They are mostly white men, and constitute almost the only class of white men doing hard manual labour continuously out-of-doors in South Africa.

Saw-mills.—There are at present three saw-mills at work in the forests of British East Africa:—(1) Dr. Atkinson's "Equator" Saw-mill; (2) The Limùru

Saw-mill; (3) The Italian Mission Saw-mill. I have visited all three, and was pleased with their working and equipment. The first two are on the Uganda Railway. The Limùru mill has been recently established. Dr. Atkinson's mill has been in operation for four or five years. It has lately been re-equipped with a 30 horse-power engine. At my visit three whites, one Indian, and 50 natives were employed. There are circular saws up to 5½ feet and a travelling bench with four vertical saws. The Italian Mission saw-mill in the Aberdare Forest employs five whites, natives of Northern Italy. They have been there for some years, and afford a convincing proof of the suitability of the equatorial highlands to continuous white manual labour. The mill is worked by two ingeniously contrived water-motors acting with a 10-metre fall of water. The mill comprises machinery for horizontal sawing, planing, mortising, also tongueing and grooving. This mill turns out the timber used at the various branches of the Italian Mission. It is instructive to note the good quality of work turned out from the apparently crooked and inferior logs brought to the mill, mostly, too, second-class timber. There is little Yellow-wood here, no Cedar, and practically no Camphor or Red-Stinkwood (muWère). It should be noted that their timber, after being cut up, is soaked for 24 hours in a hot solution of sulphate of copper. After this, timber for outside work is tarred, and timber for inside work treated with that excellent preparation carboleum.

USE OF THE TAME BUFFALO FOR HAULING TIMBER.

In speaking of the game of the forest I have recommended that early attempts should be made to tame the elephant and use it for working the forest. Of easier practical application than the taming of the African elephant is the use of tame buffalos for forest work. Economical timber extraction is one of the most important points in the working of these forests, perhaps the most important point; the exploitable timber is commonly too scattered to pay for the making of good roads or laying down tramways; it only remains to haul along roughly-made slip-paths. For this purpose horses are not hardy enough. Native cattle are in use in British East Africa for hauling logs, but they are rather expensive, somewhat liable to disease, and not strong enough for very heavy timber. On the mountains of tropical India I found buffalos stronger and hardier than cattle. Among the native cattle in Southern India were many strong fine oxen, but for moving heavy timber buffalos were always preferred, and in wet hill-country, when the fine cattle from the plains sickened and died, buffalos succeeded. The buffalo may be seen domesticated in all the warm climates of the northern hemispheres from China to the Mediterranean. Buffalos could easily be sent to East Africa. I strongly recommend the importation of a bull and two or three cows at once, the cost to be borne by the Forest Department, and the animals used to form the foundation for a herd which would be maintained at one of the forest stations and used for forest work subsidiary to breeding purposes.

An excellent account of the Indian domestic buffalo, particularly its value as a dairy animal, will be found in the "Cape Agricultural Journal" for August, 1904. Captain T. Ellis, of the Indian Transport Service, quotes experiments proving that buffalo's milk is twice or even three times as rich in butter fat as the average cow's milk. As a pack animal it is better than the ox and carries, of course, much more than the donkeys at present used as pack animals in the Protectorate. The introduction of the domestic buffalo to East Africa is to be recommended, therefore, for other purposes as well as for hauling timber.

In the Teak forests of Burmah, the heavy work of hauling the Teak logs to the rivers and streams is done by elephants and buffalos.

PLANTATIONS.

A beginning has been made with plantation work. There are two small plantations near Nairobi and one on the railway above Nairobi. The little planting done has suffered to some extent from the vigorous growth of the indigenous herbage. This, I hope, now will be able to be kept in check by the system of cutting the

herbage and mulching, which has been followed with success in similar plantations in South Africa. In this fertile climate, the difficulty lies not so much in the raising of young trees or in their planting out but in the protection of the young trees, until they are grown up, from the exuberant growth of the ground-herbage and weeds. Little planting was done before last year, but interesting results have already been secured. Of the indigenous trees, the quickest early grower is Red Stinkwood (muWère). It will grow four feet the first year from seed. m'Tàti is also a quick grower, but this has very inferior timber compared to Red Stinkwood. At Londiani various Eucalypts, Blackwood, and Black-wattle have been planted. The most promising of these young trees appears to be Blackwood. On the Shimba hills about 100 acres have been planted with Teak, Rubber, and indigenous trees. Teak has also been planted at Mazèras. The teak in both these plantations is promising, but particularly that near Mazèras. In the Mazèras plantation are about two acres of Teak, fine straight poles, which at four years of age average 28 feet high. Some smaller plantations have also been made along the line of railway. There are two small plantations of Black-wattle at Escarpment, which without showing quite the vigorous growth of Black-wattle in Natal nevertheless promise well. Near Muhoroni is a plantation where Black-wattle and Teak are planted together. It will be interesting to note the development of such a juxtaposition. This is at a slight elevation above the level of Lake Victoria Nyanza. At Kurori's, at the foot of the Aberdare mountain, was a particularly interesting small plantation, formed by Mr. Battiscombe two years ago. Here are seen flourishing the indigenous trees m'Kùruwe (*Albizzia*) and muWère (*Pygeum*). The best tree here is Tallow-wood (*Eucalyptus microcorys*), which at 18 months' old was nine feet high and looked entirely healthy. *Eucalyptus pilularis* the same age averaged five feet high. The elevation here is 7,500 feet, the rainfall (according to the Italian Mission observations) about 130 inches.

TEAK PLANTING.

It is proposed to continue the planting of Teak in the tropical country near the ocean and, tentatively, near the lake, so far as this can be done at a cost that will leave a profit with the late maturity of Teak. The financial position of a Teak plantation is helped by thinnings furnishing poles of partially mature timber. These thinnings would begin at from 15 to 20 years of age. Such partially mature Teak has been used for sleepers, sent to South Africa from Java. Some of that first sent was very immature and soon failed; that sent more recently is of better quality. Teak (*Tectona grandis*) would succeed best on the coast hills at an elevation of 1,000 or 2,000 feet. Teak grows quickly (Gamble considers four rings per inch an average on suitable soils and climate), but it matures slowly. At Nìlambùr, the only Teak plantation which is considered a complete success, in India proper, first-class trees mature in 95 years; second-class in 140 years. In the natural forest Teak takes even longer to mature, viz., from 150 to 200 years. Dr. Nesbit writing recently in the "Nineteenth Century," states that to attain good marketable dimensions Teak requires 150 years in the moist zone and 180 in the dry zone. Brandis has estimated the mean yearly production of timber in the Teak plantations of Burmah at only 47 cubic feet. Teak attains a large size, but does not reach the gigantic dimensions of Yellow-wood or Ibean Camphor. Like Cedar and other trees in the Protectorate (and, indeed, in other countries too), it is frequently unsound in the centre of the heartwood, which has to be cut out in working the timber.

With the exception of the Nìlambùr plantation in India and the Kumri plantations of Burmah, Teak plantations in British India and Burmah have not been considered successful, but it is doubtful whether this conclusion is quite valid. In Java the Dutch have made a conspicuous success with their Teak planting, and some 100,000 acres of Teak plantations have been laid down at an average cost of not above £1 per acre! Thinnings of partially mature timber from these plantations are now being sent to South Africa in the form of sleepers, and realize prices as high as 2s. per cubic foot, while sound, mature trees in the log fetch 7s. per cubic foot. Teak is exported yearly from the forests of Burmah to the value of £1,500,000, the average value there being 2s. 3d. per cubic foot. Teak in the Indian forests has a number of insect enemies. Special precautions seem necessary to ensure that in importing the seed from India, these insect enemies are not imported

too. It is a precious thing, as South African experience has shown, to be able to secure the best trees of other countries without their natural insect pests.

A Central Nursery.

There are so many valuable trees which can be grown on the highlands of British East Africa that it seems desirable to establish a central nursery in some very accessible situation, where such trees can be seen growing in an arboretum, and where the young trees selected can be bought by visitors. Such nurseries were established in Cape Colony a quarter of a century ago, and the sale of trees from them averages now half a million young trees yearly. Similar nurseries have been since established in the newer South African States. The Transvaal nursery is situated at Irene, near Pretoria: when I visited that nursery recently, I found that this year's sales amounted to one million trees. The first requisite for a Central Government nursery is that it should be on the railway. I propose, therefore, to select some suitable site on the railway between Nairobi and Kikuyu; and I trust that next year funds will be available for the starting of such a useful establishment in the country.

METEOROLOGY.

The weather of British East Africa presents many points of peculiar interest. This is not the place to do more than touch on these points in so far as they concern the tree-growing capabilities of the country, and the healthfulness for Europeans of the highland forests.

The Equator passes through the heart of the Highlands. Mount Kenia, with its glistening crown of eternal snow, is barely south of the equatorial line. But British East Africa lies some 8 or 10 degrees south of the earth's thermal equator. This position and the perpetual air current from the Indian Ocean combine to give the Ibean highlands a temperature difference between summer and winter which, for an equatorial country, is surprisingly large.

Difference between Summer and Winter.—At Nairobi the mean temperature (maximum + minimum ÷ 2) for July and August is 61°; for March and October, 66·7; difference 5·7°. This is approaching half the difference between summer and winter at Cape Town. At Machàkos (near Nairobi), where observations are older, the difference is between 60·3 and 67·7, or 7·4°, exactly half the Cape Town difference! At Mombàsa the mean temperature of March is 82° Fah., of July 75·3, or a difference of 6·7°.

This prolongation of the S.E. Trade wind and of the southern winter is doubtless largely due to the monsoonal effect of the Sahara, where in June, July, and August there is a huge area of intensely heated country, the hottest large area on the world's surface. The mean temperature here in July is about 100° Fah.

Going inland the winter difference nearly disappears, thus :—

Entebbe January, 72·7° (H. G. Lyons).
July, 70·0°

No doubt a portion of this smoothing down of the summer and winter difference at Entebbe is due to its lying to windward of the great lake.

In considering the adaptability of Southern Mexican trees for equatorial highlands, an important point to look at, after the comparative altitudes, is the difference between summer and winter temperatures. In South Mexico this is slight. Thus, six places in South Mexico, on the plateau between 6,000 and 8,000 feet elevation and between latitudes 14° and 19°, have an average seasonal difference varying from 6° to 12°, with 10° as the average. This may be compared with 7°, the average seasonal difference for the highlands of British East Africa close to the Equator and between elevations of 6,000 to 8,000 feet. In Southern Mexico temperature naturally depends primarily on elevation. Mexico city, in latitude 19, and with an elevation of 7,200 feet, has a mean temperature of 61° Fah., while the mean of the coldest month is 53° and of the hottest 66°, or a difference of 14°.

This winter difference of temperature on the highlands of British East Africa is of especial moment on account of the great importance of introducing Pine trees to the forests, and the fact that the extreme southern portion of the world's extra-tropical Pine zone (in Nicaragua) occurs on highlands which are nearly, but not quite, equatorial, and thus enjoy a small variation between summer and winter.

Rainfall.—The rainfall in British East Africa decreases from south to north and from west to east. Thus, at Dàr-es-salàam it amounts to an average of 72 inches; at Mombàsa (nine years' average) to 57; at Malindi (eight years' average) to 38 inches; at Kismàyu (ten years' average) to 14·78 inches. That is at sea-level. Going inland it increases with the increased elevation of the country and the wetter western regions, and amounts on the highlands above Nairobi to 150 or more inches. Outside the east-coast strip of forest and heavier rainfall, there is a general increase from east to west till the heavy rainfall of the Congo country is reached.

THE SMALL COST OF FORESTRY IN BRITISH EAST AFRICA.

The cost of an efficient system of Forestry, calculated to stem the tide of forest destruction, to demarcate the existing forest, and provide for their scientific working, I calculate at not less than £16,000 per year. This is only about £2,000 in excess of the present revenue. For the year ending March 31st, 1908, in which the Uganda Railway took a somewhat reduced quantity of wood, the forest revenue amounted to £12,924, of which £2,802 was cash and £10,122 the value of wood supplied free to Government Departments and settlers. It is probable that £14,000 may be looked on as the normal forest revenue of British East Africa (until the Kenia and other more distant forests are tapped), thus leaving the nett cost of efficient Forestry at only £2,000, an altogether insignificant sum considering the interests at stake and the large revenues realisable when more of the forest is brought into working.

Nevertheless, it has been supposed in some quarters that the forest appropriation should be less, that there should be a forest surplus now at the outset of forest conservancy, when we have not only to put the forest estates in order but to make up the leeway of the past few years It is estimated that since British rule was established in the country about one-tenth of the present total forest area or some 350 square miles of good timber forest have been destroyed by the Kikuyu—destroyed recklessly, and for which there has been no return beyond the comparatively small quantity of timber used by the Uganda Railway. We have now to arrest this destruction, to demarcate the forest, to fence and otherwise protect its boundaries, to police the whole forest, to establish Forest Stations, with their irrigated nurseries, together with the necessary buildings for the Foresters and their labour; to plant young trees where natural reproduction fails, but chiefly to replace indiscriminate felling by fellings regulated to produce natural reproduction; to turn to useful account the "Kumri" cultivation of the Kikuyu, and to prevent the grazing fires of the Masai from spreading into the forest. Much of this work is effected automatically by the mere presence of the Foresters at their Stations and by their forest patrols. All can be effected with the requisite organisation and at surprisingly small cost. But there is naturally a modicum of expenditure without which the machinery breaks down. In considering economies, often so necessary in public expenditure, special care must be taken that in forest expenditure the critical minimum is not passed. The results may be ruinous. In my Yearly Forest Report for 1907-8, I wrote:—

"It has been thought that the work of the Forest Department could be increased "or diminished without serious loss. But this is not so. It is true that the "improvement of the forest can be curtailed by reducing the amount spent on "planting, though this, it is easy to show, is poor economy with the cheap and "abundant supplies of native labour offering in the forest districts where planting "is most required. But the policing of the existing forest, its protection against "forest fires, and the provision of timber (with due regard to the reproduction of the "forest) for the Nairobi saw-mills and the Uganda Railway, are necessary works "which have to be met irrespective of the amounts of the forest budget. In a few "years, when the forest demarcations now in progress are completed, a reduction "in the expenditure of the Forest Department may be possible. But this is not so "now. Now is, indeed, the parting of the ways for Forestry in British East Africa. "The systematic conservation of the forests cannot be postponed further without "losing the greater portion of the forests. We have here a country of unsurpassed "fertility; a white-man's country on the Equator, where the climate and soil are "the same as on the Equatorial highlands of the Andes, which have been inhabited "by a vigorous race of whites for the last 350 years. The beauty and fertility of "the East African highlands hinge alike on their forests."

In many enterprises, and very frequently in Forestry, it is necessary to incur an expenditure for which there is no immediate return. Otherwise, Forestry need not be so largely the State business that it is. We have seen that Cape Colony has, in recent years, spent £1,000,000 (one million) on its Forestry in order to produce at home, the timber that now costs £1,500,000 (1½ millions) yearly to import from abroad; that Japan is spending £250,000 yearly on Forestry; while in Germany, the country where Forestry has been longest established on a scientific basis, £8,000,000 is the yearly cost and £22,000,000 the yearly revenue from the State forests. The closest scrutiny of forest work in British East Africa shows that to be effective the expenditure of the Forest Department must, for the present, be not less than £16,000 per year. An expenditure of £20,000 yearly would be more economical, in that it would allow of the most effective use of the minimum forest staff, and more rapidly put the forests into the most productive state.

This report shows that it is necessary to incur some extra expenditure for a few years on these two grounds :—

(1) to demarcate the forest.
(2) To take up the arrears of the last few years.

It is needless to enlarge on these two points. It is recognised on all sides that the forests must be demarcated to save them from further destruction.

As regards (2), it is sufficient to refer to the " History of the Forest Department," given at page 70 of this report, showing how much of the most necessary work of the Department has been postponed pending its re-organisation. Should any extension of forest work arise, the present machinery of the Department can be increased at small cost, while the revenue would show a large increase. This extension may be looked for in three directions :—

(1) The removal of the disabilities blocking the export of timber to South Africa, *vide* page 57 of this report.
(2) The opening of the Kenia forest to timber operations on a large scale.
(3) The working of the Lingham and Grogan forest lease.

Pending any one of these three events the Forest Department will require not less than £16,000 per year for its efficient working for the next three years, the greater portion, or perhaps the whole, of this expenditure being recouped by revenue.

It is the case with most Government Departments that their expenditure can be varied with the progress of the country, that a higher expenditure would be useful, but that the postponement of a higher expenditure pending the development of the country would lead to no irreparable loss. But this is not the case with the Forest Department. Timber and wood-fuel are the first necessaries of civilised existence, while even for the uncivilised natives large supplies of wood for fuel and hut-building are an absolute necessity. Wood-fuel furnishes the motive power of the Uganda Railway, a cheap and efficient motive power, more economically than coal in many other countries. To meet the wants of the Uganda Railway in timber and fuel, to supply the saw-mills now at work and others to follow, together with the wants of the natives and white settlers throughout the country, the forest *must* be used. It is not possible to postpone the use of the forest. It is the work of the Forest Department to ensure that while the forest is used it is not abused. It is a singularly fortunate circumstance that while £16,000 per year is necessary for the Forest Department to perform its functions, the Department is able to show, thus early in the day, a revenue nearly equalling expenditure!

ROUTE.

I arrived at Mombasa November 11th, 1906, and after conferring with His Excellency the Governor on the 12th, left the same day for Nairobi. From the 14th to the 21st was spent in the Nairobi Forest Office, with one day inspecting the Karùri Forest, near Nairobi. Rain prevented a projected excursion to the N'Gong Forest on the 19th. (This was the only occasion on which rain caused the least delay during my stay in the Protectorate.) On the 22nd I proceeded to Làri, and on the 23rd to Escarpment with the Commissioner of Lands. On the 26th I returned

to Nairobi, and on the 27th left for Fort Hall, which I reached on Saturday, December 1st. The Prov.-Commissioner returned to Fort Hall on the 3rd, and after conferring with him I left for the Aberdare Forest (Kurori and Kuranji) on the 4th. From the 5th to the 9th was spent in the Aberdare Forest; on the 11th I was detained at Fort Hall; and on the 12th left with Mr. Hinde for the Tàna River, Embu, and the Kenia Forest, which was reached on the 16th December. Till the 16th January I was occupied with my inspection of the Kenia Forest. Want of paths was a constant source of delay when inspecting the Kenia Forest. Where elephants were abundant an elephant path could generally be found leading in the right direction. Where elephants were not abundant it was necessary to cut our way through the forest, and here the progress made was scarcely two miles per hour. Very little of the forest is sufficiently free of undergrowth to be easily walked through without three men with slashers going ahead. On the 17th January I left the Kenia Forest and marched (about 50 miles) across the plains to the Aberdare (Setima) Range. This was crossed and the railway struck at Gilgil, January 20th. On January 21st I returned to Nairobi and was occupied with the preliminary report on the Kenia Forest and interviews with the Manager, Uganda Railway, till the 31st January, when I left on a tour of inspection embracing the railway forests and the Lingham and Grogan Concession forests. Till the 4th February I was occupied inspecting the railway forests, after which date my route is described in my separate report on the Lingham and Grogan leased forests. February 18th, Elburgon to Port Florence, visiting en route Dr Atkinson's saw-mill and forest together with parts of the railway forest zone. On the 19th-20th I returned to Nairobi in compliance with a telegram from His Excellency the Acting Governor, directing the early submission of preliminary reports on the Kenia and Eldoma Ravine Forests. February 21st to March 4th; finished and submitted the two preliminary reports; prepared and submitted estimates of forest expenditure for the ensuing financial year, and arranged a forest policy with the Manager of the Uganda Railway. March 5th, embarked for South Africa.

To the officers of the East Africa Protectorate it would be vain for me to attempt to express my obligations. From the kindness and encouragement of His Excellency the Governor when I landed, to the day when I embarked for South Africa, it has been one unvarying chain of hospitality and help.

NOTE.

Before this report was published, Mr. Winston Churchill, at his visit to British East Africa, considered that it should be completed by an examination of the whole of the Kenia Forest, the greater portion of which had not been seen when this report was written. This has accordingly been done, and the report resubmitted in August, 1909.

D. E. HUTCHINS.

The following trees are recommended to be declared "Reserved" species in the draft Forest Ordinance for British East Africa:—

HIGHLAND TIMBER TREES.

English Names.	Vernacular Names.	Botanical names.
Cedar	mu Taràkwa	Juniperus procera.
Yellow-wood	mu Sangèra	Podocarpus thunbergii var. milanjianus.
"	"	P. gracilior.
Sandal	m'Hugu or m'Huhu ...	Brachylaena sp.
Camphor	m'Zaiti	Ocotea usambarensis.
Black Ironwood	m'Sharàge	Olea laurifolia var hochstetteri.
Red Stinkwood	m'Wère or Moèri	Pygeum africanum.
Cape Chesnut	m'Lalàchi	Calodendron capense.
Greenheart	m'Zìga	Walburgia Ugandensis.
Pillarwood	m'Saizi	Weihea Africana.
Horse chesnut	m'Shàme	Allophilus Abysinicus.
Albizzia	m'Kùruwe	Albizzia fastigiata.
Poon	m'Òna	Chrysophyllum sp.
Ash	m'Nùnga	Balsamodendron sp.
Smokey heart	Ruàzi	
Safraan	m'Tànga	Elaeodendron sp.
Redwood	mu Karàra	
African teak	mu Koi	Piptadenia buchanani.

COAST TIMBER TREES.

English Names.	Vernacular Names.	Botanical Names.
n'Goa Rubber	n'Goa	Mascarinhasia elastica.
Vine Rubber	m'Pìra	Landolphia Kirkii.
Copal	m'Tandarùsi	Tricolobium hornemannianum.
Ebony	m'Pingo	Dalbergio melanoxylon.
Bark Mangrove	m'Kòke	Rhizophora mucronata
„	m'Chumsi	Brugueira gymnorhiza.
South African teak	Bemba kofe	Afzelia cunanzense.
Uganda teak	m'Vùria	
Shingle wood	m'Gàmbo	
Wild guava	m'Pèra mwìtu	
Mango	m'Wembe	Mangifera indica.
Tamarind	m'Ukwàju	Tamarindus indica.
„	m'Karambìki	
„	m'Kwè	
„	m'Rèhe	Brachystegia sp.
„	m'Igome	
Rattle Tree	Kèli-kèli	Erythrophlœum guineense.

The following list shows the altitude of some of the more important places mentioned in this report :—

Position.	Height. in feet.	Authority.
Eldoma ravine, civil station	7,092	Cadastral survey.
Londiàni mountain	9,855	„
Kijàbi mountain	8,723	„
Setima range, highest point	13,244	„
„ lesser peak	11,027	„
Kinangop, highest point Aberdare range ...	12,772	„
Kabèti (near Kikuyu station)	6,834	„
Longonot volcano	9,007	„
Sùswa volcano	7,666	„
Donyo-Sàbùk mountain	7,009	„
Oldalàt	7,872	„
Kamàsia mountains	9,264	„
Tenderìt or Làngài	8,809	„
Elgon summit	14,197	„
Kilimanjàro summit	19,328	Major Smith.
„ forest	6,200 to 9,800 and 10,500 ft. in valleys.	Hans Meyer.
Kenia summit	17,040	
„ forest	5,500 to 12,000	Hutchins.
Fort Hall civil station	4,600	Stevenson.
Muhoròni teak plantation	4,140	Railway levels.
Embu civil station	4,900	Stevenson.
Fort Ternàn	5,000	Railway levels.
Lùmbwa	6,220	„
Londiàni	7,410	„
Molo	7,940	„
Njoro	7,000	„
Nakùru	6,000	„
Naivàsha	6,200	„
Kijàbi	6,800	„
Escarpment	7,400	„
Limòru	7,300	„
Kikùyu	6,700	„
Nairòbi	5,450	„
Machàkos road	5,250	„
Kiu	4,860	„
Làri forest station...	8,000	Aneroid.
Kenia "castle" forest station	7,000	„
Nyeri forest station	6,000	„
Nyeri hill	7,200	„
Dagoreti forest station	6,300	„
Shimba hills forest station	1,200	„

APPENDIX I.

CONIFERS OF MEXICO AND CENTRAL AMERICA.

In considering trees for cultivation on equatorial highlands it is evident that the timber trees of Mexico and Central America are of paramount importance. Here only on the globe do we find equatorial highlands in touch, so to speak, with the great forest-flora of the Northern Hemisphere. Too often the native trees on equatorial highlands are species that have strayed up into the cold from the tropics, slow in their growth, weak in their reproduction, and of no timber value. But on the highlands of Mexico and Central America we find once more the conifers and valuable timber trees of that great northern forest-flora that stretches round the world through Eurasia and North America.

There is a curious point in connection with the forest and vegetation on equatorial highlands. To the plant world of cold temperate countries the climate of equatorial highlands, with its cloudy skies and cool, equable temperatures, seems to be more congenial than the climate of the extra-tropics, with its hungry, empty skies—hot by day and cold by night. Many forest trees of the United States of America besides conifers reappear in Southern Mexico and Central America, viz.: Elms, Ashes, Limes (Lindens), Willows, Alders, Hornbeams, Hazels, Oaks, Planes, Cercis canadense, Liquidamban styraciflua, &c. And it seems to be the experience of gardeners that, on the whole, the flowers and vegetables of Northern Europe succeed better on equatorial highlands than in the extra-tropics, as in South Africa and Australia.

In Southern Mexico temperature naturally depends primarily on elevation. Mexico city, in latitude 19° and with an elevation of 7,200 feet, has a mean temperature of 61° Fah., while the mean of the coldest month is 53°, and of the hottest 66°, or a difference of 13°. In considering the adaptability of Mexican trees for equatorial highlands, the most important point to look at, after the comparative altitudes, is the difference between summer and winter temperatures. In South Mexico this is slight. Thus six places in South Mexico, on the plateau, between 6,000 and 8,000 feet elevation, and between latitudes 14° and 19°, have an average seasonal difference varying from 6° to 12°, with 10° as the average. This may be compared with 7°, the average seasonal difference for the highlands of British East Africa close to the equator and between the same elevations.

The heaviest rainfall in Southern Mexico is usually between elevations of 2,000 and 5,000 feet. This is the "tierra templada" region; and here, in the wetter parts, from June to October, it rains every day between 2 p.m. and midnight, and there are light rains and mists throughout the year. (This is the rainfall of the forest districts, Aberdare, Kenia, and Mau of British East Africa, the rainy season being March to June instead of June to October.) Further south, in Guatamala and Central America, there are two rainy seasons—a large and a small rainy season as in British East Africa. The heaviest rains in Mexico occur on the eastern side of the plateaux and mountains: Hann quotes Orizaba as a case in point. On the eastern side in summer it rains every afternoon; the western side is dry and dusty with only occasional showers.

To the north-west of Mexico is the great Sonora desert. This corresponds with the great Sahara to the north-west of British East Africa.

The limit of perpetual snow on the mountains is 15,000 feet, which is 500 feet higher than in Equatorial Africa. As in British East Africa and Uganda, only three of the volcanic mountains rise above the limit of eternal snow—Orizaba, Popocatepetl, and Ixtaccihuatli. Of these three, only the last has sufficient snow to form glaciers. These three may be compared to Kilimanjàro, Kenia, and Ruwenzori; but the African mountains all have glaciers.

As in British East Africa, the summit level of the mountain passes, on each side of the plateau, lies at an elevation of about 8,000 feet—the Cordillèra of Mexico—the Kikùyu and Mau escarpments of the Uganda Railway.

Forest area.—Says Robertson: "The greatest forest region of Mexico is on the Sierra Madre Occidental, from near the northern boundary south to the centre of Jalisco State. He estimates this as 800 miles long with a mean average width of 45 miles. The Sierra Madre Oriental forest is of less width. The Sierra Madre del Sur is a smaller forest, but contains timber of huge size—pines 250 feet according to Wilmot." The cross ranges and volcanoes of Southern Mexico also contain large blocks of forest, of which that in Western Michoacan is perhaps of greatest extent and yields the largest and densest timber. The forests of Southern Mexico are moist and show a good natural reproduction. The area of dense timber forest left to Mexico is stated at over two million acres; or the same as British East Africa.

Under the wise Government of President Porforio Diaz, what remains of the once fine forest of Mexico is being conserved, though much remains to be done in improving the Forest Administration. Offers from American syndicates for the forest have been refused. Says J. Brown, who recently made a forest tour in Mexico: "Government refuses to sell the forest-lands, but leaves the right to cut timber under official direction." He adds, "Americans are here trying to secure concessions in pine lands, but the Government seems to understand the case and refuses to give away its valuable possessions." ("Arboriculture," August, 1903.)

On the eastern well-watered slopes of Southern Mexico the tropical forest of Mexico extends to an elevation of 2,000 or 3,000 feet; coniferous forest begins at 6,000 feet. The coniferous forests are best about 9,000 and 10,000 feet, ascending to 13,000 feet on the high volcanoes.

Distribution of the Forest.—In Southern Mexico the best forest occurs on the western mountains, and the south-western slopes. It is said that to-day practically all the good timber is on the west and south-west of the plateau. The first pine on the eastern slopes, occurring immediately above the savanah, is *Pinus teocote*. On the heavy rainfall area of the

Orizaba mountain slopes the first pine, says Drude, is *Pinus leiophylla*, at 6,700 feet. At 7,600 feet are found forests of *Pinus montezumæ*, the branches festooned with *Tillandsia*. Here the pines begin to replace the Oak. Higher still are seen forests of that curious Silver-fir *Abies religiosa* and the pine with so many botanical names, *Pinus montezumæ*, extending to over 10,000 feet elevation. The limit of the coniferous forest is stated to be 13,000 feet. The end of tree vegetation on Orizaba is marked by a stunted growth of *Pinus montezumæ* and *Alder*. The largest existing forests are at elevations of about 9,000 or 10,000 feet on the volcanic mountains.

On the steep western slopes, says Drude, the coniferous forest extends down as low as 3,800 feet: this is but little above the level of Lake Victoria Nyanza. On the western slopes in the wild province of Guerèro, latitude 17°, Wilmot describes the pine forest as beginning at an elevation of about 7,000 feet, though quite good pine is found as low as 2,000 feet. Here the forest is rather open. At 9,000 feet he found the "great dense coniferous forest." From 9,000 feet to 11,000 feet he describes the forest as "perfectly magnificent, composed of gigantic pines, Cedars, Firs, and Live Oak (*Quercus virens*)." The latter grows to a fine tree, with 60 feet of bole. The Douglas Pine (*Abietia douglasii*) grows here to a similar size. The White Pine (*Pinus lambertiana*, or a variant of this great tree) grows to a huge size. "It quite frequently attains a height of 250 feet, with a diameter of 5 to 7 feet." There are three Yellow Pines nearly as large. All these pines show a strong natural reproduction at every break in the forest canopy. The "Guerrèro Lumber and Milling Co.," at the time of Mr. Wilmot's visit, were making a traction engine road into the heart of this forest at a cost of £30,000.

From this it will be seen that the best coniferous forest in Southern Mexico begins at the exact point, 9,000 feet, which marks nearly the upper limit of the leafwood forest belt round Kenia.

CONIFERS OF MEXICO.

In the monograph on the Coniferae by Parlatore (de Candolle's Prodromus) mention is made of 22 species of Mexican conifers, viz.: 14 species of pines, 1 Silver Fir, *Abietia douglasii*, 1 Taxodium, 3 species of Cypress, and 3 of Juniper.

According to more recent authorities, the late Dr. Maxwell-Masters, Professor Sargent, and Mr. Shaw, there are some 31 species of conifers in Mexico:—

Pines	17
Junipers	6
Cypresses	4
Silver-Fir	1
Abietia	1
Thuja	1
Taxodium	1
Total	31

THE PINE FORESTS OF MEXICO.

Professor Sargent, in his great work "The Silva of North America," states that the highlands of Mexico are often covered with great forests of pine trees. He adds that, in spite of the great number of Mexican pines that have been mentioned and described, he does not think that there are really more than twelve or fourteen distinct species.

Says J. Brown, "The pine forest is not dense as a forest, and, while in the aggregate there is a considerable quantity, it is difficult of access and generally not of the highest quality." ("Arboriculture," August, 1903.)

Robertson says: "The great forests of the mountain ranges are predominantly coniferous and by far the largest element in their composition is the genus Pinus. * * * Oaks are nearly pure at the lowest elevations of about 3,000 to 6,000 feet (on the gulf slopes), and form approximately an equal proportion of the forest with the pines, at elevations of 6,000 to 8,000 feet; * * * on the Pacific slope pines are said to be found at as low an elevation as 2,000 feet."

The following list of pines, comprising seventeen species, has, with the exception of three species—*Pinus altamirani* (Shaw), *P. pinceana* (Gordon), and *P. pringlei* (Shaw)—been verified by herbarium specimens and accepted as authentic by Dr. Maxwell Masters, to whom questions relating to conifers have been habitually referred by the Kew authorities. ("General View of the Genus Pinus," Linn. Soc. Journ. Bot. Vol. 35, 1904.) In a few cases where Dr. Masters does not mention localities, they have been supplied from Kent ("Veitch's Manual") and Professor Sargent ("Trees of North America," 1905).

The following United States species extend into Mexico:—

Pinus chihuahuana,
„ *strobiformis,*
„ *edulis,*
„ *cembroides,*
„ *ponderosa.*

The remainder of the pines of the Mexican region are found in Mexico and Guatamala only.

In addition to these seventeen authentic species of Mexican pines, together with *P. donnel-smithii, P. cubensis, P. filifolia, P. tenuifolia* and other little-known pines of Central America, there are numerous other species which are mentioned in catalogues and described by various travellers. Roezl's list in Gordon's "Pinetum" embraces no less than sixty species outside those

accepted as authentic by Dr. Maxwell Masters! In his "General View of the Genus Pinus" (Journ. Linn. Soc.), Dr. Maxwell Masters cites Roezl's species to the number of 92; and of these is able to refer all but one to accepted species. ("Catalogues des Graines de Conifers Mexicains; en vente chez B. Roezl et Cie, Horticultures à Napoles près Mexico pour automne 1857 et printemps 1858.)

Messrs. G. R. Shaw and Pringle are now engaged on the difficult task of picking out what are good species from the lists of Roezl and others. Mr. Pringle is an assiduous explorer and botanical collector in the Mexican forests. Professor Sargent writes to me that their work is expected to be completed in about two years. It will no doubt comprise certain additions to my list of pines; and there are some other pines occurring on the mountains of Guatamala, Costa Rica, and Nicaragua, which are not found in Mexico.

On these Mexican and Central American highlands we find a well-marked, natural group of extra-tropical pines, extending far into tropical latitudes—latitude 9° N., near Panama. The number of species (25 or more) within so small an area may be compared with the nine species of European pines (Dr. Maxwell Masters' list), viz., *P. pinaster, P. sylvestris, P. pinea, P. montana* (*P. mugho*), *P. bruttia, P. halepensis, P. cembra, P. peuke, P. laricio.* It may be compared also with the total number of pines in the United States of America, viz., 38. (Sargent, 1905.)

In 1907 the Mexican forests were visited by C. C. Robertson, a student sent to Yale by the Orange River Colony. His "Notes on the Trees of Extra-Tropical Mexico" is full of interest. With the new species of Shaw and Pringle he enumerates 25 pines and 14 other conifers, or 39 in all. This is exclusive of lower California.

THE PINE TREES OF MEXICO.

(1) *Pinus altamirani.*
(2) „ *ayacahuite.*
(3) „ *cembroides.*
(4) „ *chihuahuana.*
(5) „ *edulis.*
(6) „ *hartwegii.*
(7) „ *leiophylla.*
(8) „ *lumholtzii.*
(9) „ *montezumæ.*
(10) *Pinus oocarpa.*
(11) „ *patula.*
(12) „ *pinceana.*
(13) „ *ponderosa.*
(14) „ *pringlei.*
(15) „ *pseudo-strobus.*
(16) „ *strobiformis.*
(17) „ *teocote.*

The following species are described in Robertson's notes:—

Pinus latisquama.
„ *arizonica.*
„ *engelmanii.*
„ *greggii.*
„ *nelsoni.*
Pinus tenuifolia.
„ *filifolia.*
„ *eslavae?*
„ *lawsoni?*

The most useful pines of Southern Mexico appear to be:—

P. ayacahuite.—The largest and best of the timber trees of Mexico (Robertson).

P. oocarpa.—A variety of this, *P. oocarpoides,* extends nearly to sea level in Guatamala.

P. hartwegii.—Nearly allied to the preceding. It is described as commonly an Alpine Pine.

P. leiophyla.—The big "Candlewood" Pine; one of the most valuable timber pines of Mexico.

The above three pines have been mentioned by Mr. Shaw as being particularly valuable timber pines.

P. montezumæ.—This, in one or other of its various forms, is the most generally useful timber pine of Central and Southern Mexico: and the one most worthy of introduction elsewhere.

P. patula.—This is the fine pine resembling *P. longifolia.* It is usually Alpine, except the *macrocarpa* variety.

P. teocote.—The lofty Toch-pine. A tree of the Pitch-pine class. This and *P. patula* are allied.

P. strobiformis.—Is a useful, soft, white pine, not liable to warp.

P. pseudo-strobus.—A tall tree like *P. strobus,* the handsomest of all the Mexican pines grown in France.

NOTES ON THE 17 BEST-KNOWN PINE TREES OF MEXICO.

(1) *Pinus altamirani.*—This is one of G. R. Shaw's new species. I have only seen a cone, which seems to indicate a tree belonging to the *strobus* section with thick apophyses. The seed is small with a long wing—half an inch long. Robertson describes it as a useful tree, sometimes 80 or 90 feet high and 30 inches diameter, common on the lower slopes of the mountains near Uruapan at 5,000 to 5,500 feet.

Recognition.—Leaves in threes, fours, or occasionally fives 6 inches to 8 inches long.

(2) *Pinus ayacahuite.*—The common White Pine of Mexico. A large tree attaining heights of 100 feet with white, soft, useful timber. "One of the largest and probably the best of the timber trees of Mexico: closely allied to *P. strobiformis*, and perhaps the same species, but growing to a larger size than *P. strobiformis;* not occurring pure." (Robertson.)

Habitat.—Spread through Mexico from Guatamala to the United States of America, always at a considerable elevation—8,000 to 9,000 feet in Central Mexico. This tree is fairly hardy in England.

Recognition.—The young trees are like *Pinus strobus* or *P. excelsa.* Leaves in fives, 3 inches to 6 inches long. Cones 9 inches to 12 inches. Scales with a thickened tip.

(3) *Pinus cembroides.* One of the four American Pignons or Nut Pines that spreads southwards over the mountains of Northern Mexico as far as Orizaba (Kent). Usually a small bushy tree growing in bleak dry country, of no value for timber, but occasionally reaching a height of 60 feet in sheltered cañons of Arizona. It forms open forests in lower California and over many of the mountain ranges of Northern Mexico and Arizona (Sargent). The nuts are an important article of food for the natives and are sold in large quantities in Mexican towns (Sargent).

Habitat.—Latitude 18° (just south of Mexico city) to latitude 35° in California. Ascends to 10,000 feet on the mountains of Mexico. Not hardy in England.

Recognition.—A low tree with short leaves (in twos or threes) and small globose cones of which the central scales only contain seeds. These are large, from ½ inch to ¾ inch long and eatable. Unlike the European Stone-pine, they have a small wing. The ripe cones of *P. cembroides* open so irregularly and with the scales so far apart, that this cone has been compared to a small handful of dried apple sections. I have cones from different collectors, and all present this loose and irregular appearance.

(4) *Pinus chihuahuana.*—A tree of Arizona and Northern Mexico, small and only useful for firewood in the United States of America: larger, and used for mining timber and house building on the Sierra Madre of Mexico. It is one of the pines that is best suited for cultivation in Orangia and the Transvaal, and worthy of trial in the Rift Valley of British East Africa. Gooding describes it as a good tree in itself, but not making good forest. It is usually only seen large enough for posts and firewood.

Habitat.—On dry mountains in Northern Mexico and Arizona, and southward into Durango, on the plateau 6,000 to 8,000 feet. The average rainfall of the Chihuahua desert is only 11 inches, and probably not very much more on the neighbouring mountain range where this pine grows. Chihuahua town has an average of 20 inches.

Recognition.—Leaves 2½ inches to 4 inches long, in bundles of threes. Cones 1½ inches to 2 inches long. Seeds small-winged.

(5) *Pinus edulis* (Nut Pine).—This is also one of the American Nut Pines or Pignons that extends into the mountains of Northern Mexico (including the mountains of Lower California). It is usually a small tree, only occasionally reaching heights of 30 or 40 feet, but the wood is valuable for fuel, for fencing, and for charcoal-making in the country where it grows, considerable quantities of charcoal being used in smelting. It is occasionally sawn into lumber in Western Texas. The edible seeds or nuts are largely consumed by the natives and sold on the markets of Northern Mexico.

Habitat.—It often, says Sargent, forms extensive forests at the eastern base of the Rockies up to 7,000 feet in Utah, Nevada, Arizona, and Lower California.

Recognition.—Leaves in two-leaved (or rarely in three-leaved) clusters, about 1 inch long. Cones small and globular (like the other Nut Pines) also about 1 inch long, only the central scales with seeds.

(6) *Pinus hartwegii.*—The "Palo blanca" (White Pole or Stick) of the Mexicans. Usually a medium-sized tree, but on Orizaba reaching a height of 100 feet. Timber very resinous, reddish; esteemed. One of the three most valuable timber pines of Mexico. (Shaw.)

Habitat.—An Alpine Pine, beginning at an elevation where the Oyamel (*Abies religiosa*) ceases; flourishes at 10,000 feet altitude on Orizaba.

Recognition.—Leaves long and thin in bundles of five (occasionally four), of a dark green colour. Foliage dense, the tree is handsome with a compact crown. Cones 4 to 5 inches long, egg-shaped. Maxwell Masters says it is frequently confounded with *P. montezumæ.*

(7) *Pinus leiophylla.*—The "Ocote chino," or "Chinese Torch" of the Mexicans. A large tree yielding a valuable hard timber, reaching a height of 100 feet. On the mountains of Oaxaca it attains an immense size. (Gordon.) One of the three most valuable timber pines of Mexico. (Shaw.) Usually of small or medium size only. (Robertson.)

Habitat.—Central Mexico and Guatamala. "Found in many parts of the colder regions of Mexico—mountains of Angangueo at 7,000 feet." (Gordon.)

Recognition.—Leaves in fives, slender, 4 inches to 5 inches long, closely set on the ends of the branches and often in tufts. Cones small, 1½ inches to 2½ inches long. The cone-scale has a square apophysis with an umbo which is usually smooth, but some times has a small, barely perceptible prickle. The cone in my collection is authenticated by G. Shaw.

"Seeds small and black, with a wing nearly ¾ inch long, and rather broad." (Gordon.)

(8) *Pinus lumholtzii.*—Apparently a small, unimportant pine of the dry country of Central and North-West Mexico, but Robertson describes it as "a very beautiful tree with its sparse drooping foliage, somewhat like *P. patula*, but even more ornamental owing to its longer leaves." A tree of the Western Sierra Madre.

Recognition.—Hanging leaves in threes. Dr. Maxwell Masters says he has not seen the cones. A cone sent me by Professor Sargent is small, under 2 inches in length; the cone-scale has a nearly square apophysis, with a smooth inconspicuous umbo. It is of a warm brown colour and a regular conical shape. My cone has G. R. Shaw's label and was collected near Tula.

(9) *Pinus montezumæ.*—A much-varying species, which has been described under many names. (Robertson.) A large valuable timber tree—the "common pine of the mountains and highlands of Mexico between latitude 17° and 25°, from 4,000 feet to 12,000 feet elevation." (Kent.) So widespread a pine naturally varies greatly, and a host of synonyms (70—M. T. Masters) are referable to *P. montezumæ*. Timber white, soft, and resinous. "The most common tree of Southern Mexico, where the quantity of standing timber of this species is perhaps as great as that of all the other pines taken together: it may be said to be the *Pinus ponderosa* of Southern Mexico, with timber better than *P. strobus*, viz.: one-third heavier and much stronger. Considering its wide range, good reproduction, rapid growth, large dimensions, and good timber, there can be little doubt that this species is the most important tree for future forestry in Southern Mexico, and a most desirable one to introduce into other countries." (Robertson.)

Habitat.—The whole of Mexico, except the north. It is fairly hardy in the west of France and in England. There are several trees under different names at Bicton (South Devon).

Recognition.—Leaves in fives and nearly as long as *P. australis:* the foliage tends to form bunches like mops at the end of the branches. The tree has a round, spreading head of dense foliage. Cones 2½ inches to 5 inches long; bark very rough.

(10) *Pinus oocarpa.*—The Egg-cone Pine. This tree differs but little from *P. hartwegii*, of which it may be only a geographical variety. The timber is highly esteemed. One of the three most valuable timber pines of Mexico, according to Shaw.

Habitat.—The volcanic mountain of Jorullo in Mexico and (if we regard *P. oocarpoides* as a geographical form) nearly to sea-level in Guatamala, though only abundant at 4,000 to 5,000 feet.

Recognition.—Leaves in fives, long and thin. Foliage dense. The specimen cone in my collection is egg-shaped, smooth, and with a rather lustrous surface. It is 2½ inches in length. It has square apophyses which are flat or but slightly convex. The cones are solitary and on long stalks.

(11) *Pinus patula.*—This is a fine Mexican pine, much resembling the Himalayan *P. longifolia,* but under cultivation in Europe standing more cold than *P. longifolia.* It is described as a particularly graceful tree with spreading branches and drooping leaves. Good specimens are to be seen at Bicton, East Devon, and elsewhere in the South of England. Robertson says it reaches a height of 70 feet, and is fairly common on moist mountains 7,000 to 8,000 feet. Timber light, soft, and inferior. It is an ornamental, rather than a timber, pine.

Habitat.—Central Mexico, 6,000 to 12,000 feet, generally Alpine, except the *macrocarpa* variety.

Recognition.—Leaves in bundles of three but frequantly of four or five, 9 to 12 inches long. Cones 4 inches long. Seeds ⅓ inch long with wings about ½ inch long.

P. patula var. *macrocarpa* is a larger tree with larger cones growing at lower elevations. This fine tree grows to a height of upwards of 100 feet.

(12) *Pinus pinceana.* (Gordon.)—The weeping Mexican Pine. A very handsome pine, growing 60 feet high with drooping branches like the weeping willow.

Habitat.—The Mexican plateau, 6,000 to 9,000 feet.

Recognition.—Leaves in threes, but frequently in twos; very slender; from 3 inches to 4 inches long. Cones 3 inches long, with irregular scales. Seeds very large, wingless, and more than half an inch long. Gordon says it is easily distinguished from all other Mexican pines by its weeping habit.

It is right to add that this pine is not recognised by Kent, and in Masters' lists appears as a doubtful species. ("General View of the Genus Pinus," p. 651, and "Conifer Conference," p. 237.)

(13) *Pinus ponderosa.*—This well-known timber extends over the American boundary into Mexico, but is of little importance in Mexico. It is seen only in the mountains of Northern Mexico.

(14) *Pinus pringlei.*—One of G. R. Shaw's new species. The cone is 4 inches long on a

short stalk; the cone-scales with large, square, flat apophyses, the surface of cone smooth and slightly polished like that of *P. teocote*.

It is called after Mr. Pringle, the explorer, who yearly pays a visit to the forests of Mexico, collecting cones and other botanical specimens. Robertson describes this as a semi-tropical species, growing in open forest, and not producing straight or large timber, only known at present on the lower slopes of the mountains near Urnapan, where it is associated with *P. oocarpa, P. montezume, P. tenuifolia, P. altamirani*, &c.,

Recognition. Leaves in threes, rather coarse and rigid, but very spreading, 8 inches to 10 inches long. Cones 2½ to 4 inches long, scales hard, smooth, and not much thickened. Cones resemble those of *P. patula*, and like them are very persistent on the branches.

(15) *Pinus pseudo-strobus.*—A tall tree growing from 60 to 80 feet high. (Gordon.) The most handsome of all the Mexican pines grown in France. (Naudin.)

Habitat.—Mexico, 8,000 to 11,000 feet.

Recognition.—Says Robertson: "Quite unlike *P. strobus*, but like *P. montezume*: it may be only a variety of *P. montezume*." Leaves in fives; very slender, 8 inches to 10 inches long. Cones large, from 4 inches to 6 inches long. The cone-scales have a thick convex apophysis with a distinct, though blunt, umbo (specimen cone, G. Shaw). Seeds middle-sized, with a dark marbled wing, 1¼ inches long. (Gordon.)

(16) *Pinus strobiformis* (the White Pine of Northern Mexico).—This is a pine of the United States and will be found described in detail in the various works dealing with the United States pines. It is the same as the *Pinus ayacahuite* of Parlotore and *P. reflexa* of Engelmann. It was called "reflexa" no doubt from the cone-scales, which are like those of the common Strobus Pine prolonged and turned back. It is very like *P. ayacahuite*, but with smaller leaves and cones, and by some botanists is considered to be not specifically distinct from *P. ayacahuite*. *P. strobiformis* and *P. chihuahuana* are the White Pines of Chihuahua.

Sargent describes *P. strobiformis* as a tree from 80 to 100 feet in height with a trunk rarely more than two feet in diameter and short, slender, often somewhat pendulous, branches, forming a narrow pyramidal head. The cones are from 5 to 9 inches in length, and about 1½ inches in breadth, and are light green even when mature (according to Sargent), with smooth scales about 1¼ inches long. After the scales open, their upper parts turn light brown, slightly tinged with red and their bases dull dark red.

Habitat.—P. strobiformis is scattered over the rocky ridges and "the sides of the cañons of the Santa Catalina and other mountains of Southern Arizona along the lower margin of *P. arizonica*, and over the Sièrra Madrè and Chihuahua mountains in Mexico. It grows at elevations from 6,000 to 8,000 feet, never forming groves, and usually growing singly along the lower margin of the forest."

Timber.—The timber of *P. strobiformis* is hard and close-grained, though light. The heartwood is pale red. The cross sections show large serrated passages and numerous obscure medullary rays. Weight 30 lbs. per cubic foot. The rarity of this tree and the inaccessibility of the places where it grows in the United States prevent the use of this wood in that country, although the timber is as valuable as that of other Western White Pines. (Sargent in "Silva of North America.")

This is a slow-growing pine of a dry country, but Professor Sargent states that, considering the dryness of the region which it inhabits, it appears to grow with comparative rapidity, judging from the specimens of wood in his collection.

Recognition.—Leaves in fives; slender, 3 inches to 4 inches long. Cones 5 inches to 9 inches long. Seeds ½ inch long, nearly wingless. A large tree, up to 4 feet diameter and 100 feet high.

There is a large-coned southern form of *P. flexilis*, common on the mountains of Eastern Arizona and New Mexico, which, says Professor Sargent, has sometimes been referred to *P. strobiformis*.

(17) *Pinus teocote.*—The "Candlewood" of Mexico. The "Pino de Okote" of the Mexicans. A tall tree attaining a height of 100, or, according to Mueller, 150 feet, who states that the timber is remarkably durable and yields the brea turpentine. Says Robertson: "This is one of the more common pines in drier situations on the mountains of Eastern and Southern Mexico at elevations of about 6,000 to 9,000 feet. It is seen both as a large and a small, scrubby tree. The wood is thought to be good. It is resinous and durable, and is used for sleepers and firewood. Large trees growing on shallow, clayey soil were seen. These had a fairly quick growth."

Habitat.—5,000 to 11,000 feet elevation, forming pine forests of considerable extent on Orizaba and the mountains of Oaxaca. Kent thinks there is only one specimen of it in England—at Bicton. This I have seen.

Recognition.—Leaves in threes, from 3 inches to 5 inches long. Cones in my collection from 1½ inches to 2½ inches long on rather a long stalk. Scales with a peculiar round regular apophysis. The half-opened cone shows each scale curving out symmetrically. Seeds very small with a wing rather more than half an inch long. (Gordon.)

Kent remarks that it is closely allied to *P. patula* and distinguished from *P. patula* by its shorter leaves and smaller cones.

JUNIPERS OF MEXICO.

Mexican forests are renowned for their Cedars. *Juniperus flaccida, J. occidentalis,* and *J. pachyphloia* abound in the north-east, sometimes forming pure forest, while *J. mexicana* is widespread. Kent describes six species of Mexican Junipers; Vera mentions five.

(1) *Juniperus flaccida,* the handsome tree of botanic gardens in the south of Europe, occurs in the mountains of Central and North-East Mexico, 5,000 to 8,000 feet, and in the south-west of Texas. Its foliage is described as of a peculiar bright green. Frost kills it in northern Europe. It is never more than a bush or quite small tree.

(2) *J. occidentalis,* a tall species of south California and northern Mexico; in Mexico forming pure forest of some extent. It may be only a variety of *J. californica.*

(3) *J. monosperma* is closely allied to *J. occidentalis.* It is rarely seen below an elevation of 6,000 feet. Robertson describes it as a smaller tree than *J. pachyphloea.*

(4) *J. tetragona* is also similar to *J. occidentalis,* but has a more southern habitat. "It covers large areas in central Texas and spreads over the Mexican plateau to near the city of Mexico." Robertson describes it as usually only a bush 4 or 5 feet high.

(5) *Juniperus pachyphloea,* the "Thick-bark" Juniper. This is the most valuable timber Juniper of Mexico. It is a fine Cedar 50 to 60 feet high, and 3 to 5 feet in diameter. It occurs throughout Mexico, Colorado, and Texas. "It inhabits dry arid mountain slopes from 4,000 to 6,000 feet along the desert ranges of New Mexico." Kent remarks, "It is described by those who have seen it in the elevated cañons of its native mountains as the most beautiful of the Western American species, with an open shapely head, a massive trunk covered with checkered bark and foliage of a cheerful colour."

Gooding writes (1907): "The wood of this tree is very brittle but it takes a beautiful polish and is practically everlasting. I found posts of it in the walls of the old cliff dwellings which could not have been less than 400 or 500 years old and which were in perfect condition.

(6) *J. mexicana* is a smaller, but widely-spread Juniper in Mexico, ranging from the Sièrra Madrè southwards at elevations of from 6,000 to 10,000 feet on the mountains.

CYPRESSES OF MEXICO.

The various Cypresses that have been described as growing in Mexico are resolved by Dr. Maxwell Masters into two species, that is to say, *Cupressus benthami* and *C. thurifera,* both of these important timber trees. *Cupressus arizonica* and *C. guadalupensis* are regarded by Dr. Masters as varieties, but I follow Sargent in ranking them both as distinct species. There are thus four species of Cypress in Mexico and many more varieties which have to be distinguished in cultivation.

(1) *Cupressus arizonica.*—As remarked above, Dr. Maxwell Masters makes *Cupressus arizonica* a variety of *C. benthami.* Professor Sargent, influenced no doubt by botanical information from Mexico, regards *C. arizonica* as a separate species. It seems preferable, therefore, to follow Professor Sargent, and to regard it as a separate species. *C. arizonica* is described in Sargent's "Silva of North America" as a tree usually 30 or 40 feet, but occasionally 70 feet high, with a trunk from 2 to 4 feet in diameter, with smooth, close, thin, light reddish brown bark, more or less covered with a glaucous bloom; the bark on old trunks is thin and dark brown and hangs in long shreds. The inner bark is bright red. *C. arizonica* was introduced into European gardens in 1882 and has proved hardy in England. (Masters.)

Habitat.—C. arizonica is found throughout the mountains of Southern, Eastern, and Central Arizona, often constituting (usually on northern slopes) almost pure forest of considerable extent, at elevations of from 5,000 to 8,000 feet above the sea. But its distribution in Arizona is described as local. From Arizona it extends into the mountains of Northern Mexico, where it is found in the provinces of Sonora and Chihuahua.

Recognition.—There seems to be nothing remarkable about the cones or foliage. Perhaps the bark in shreds on old trees may help to distinguish it. The cone is about one inch in diameter, dark-red brown, covered with a thick glaucous bloom. It has six or occasionally eight scales. Seeds are dark red brown with thin narrow wings.

Timber.—Sargent describes the wood as easily worked; it weighs 30 lbs. to the cubic foot. It is light, soft, close-grained, often faintly streaked with yellow.

(2) *Cupressus benthami* (End.).—A tall tree of the "tierra fria" of Mexico and Central America, usually between 5,000 and 7,000 feet elevation: Robertson says between 4,000 and 9,000 feet. *C. lindleyi* or *C. lindleyana* is now regarded as a variety of *C. benthami.* Kent cites a superb specimen of *C. lindleyi* "upwards of 80 feet high and nearly 3 feet in diameter at Fota Island, near Cork." In cultivation on the Mediterranean *C. lindleyana* bears a close resemblance to *C. lusitanica.* The variety *knightiana* was introduced some years ago, and still survives in the warmer parts of the British Isles. Kent calls this "the most elegant of the half-hardy Cypresses," and says there is a remarkably beautiful specimen at Power's Court in Ireland. Gordon says it is a larger, finer tree than the normal form of *C. benthami,* growing to a height of 120 feet and 2½ feet or 3 feet in diameter on the mountains of Mexico, and hardier in England than *C. benthami.* Thus, the *lindleyana* variety seems a somewhat better tree than the normal *C. benthami,* and the *knightiana* variety better still. The timber is described as fine-grained and excellent.

The varieties of this fine tree are eminently worthy of introduction to the equatorial highlands of Africa, particularly those from Guatamala and the forests further south.

Habitat.—This tree has a wide habitat, extending from the mountains of Guatamala through Mexico. On Orizaba in Central Mexico *C. benthami* (proper) is found at elevations above 6,000 feet.

Recognition.—Smallish globular cones, each scale furnished with a knob or prickle like *C. lusitanica*, the cone-scales have large points in the *knightiana* variety. It is usually seen as a tall tree with an ample dense head of foliage. It closely resembles *C. lusitanica* in appearance, and is united with it by Carrière. Dr. Masters gives a figure in his "View of the Genus Cupressus."

(3) *Cupressus guadalupensis.*—This Cypress is found on Guadaloupe Island and the mainland of Lower California, and further south in Mexican territory. Sargent in his "Forest Trees of North America," refers to *C. arizonica* under the name of *C. guadalupensis*, but in his "Silva of North America" and in his more recent (1905) "Trees of North America," *Cupressus arizonica* and *C. guadalupensis* are distinct. Dr. Maxwell Masters, again, classifies *C. guadalupensis* as a variety of *C. macrocarpa*. I have grown both trees for some years in South Africa and find that the behaviour of *C. guadalupensis* and *C. macrocarpa* under cultivation does not support Dr. Masters' view, and I am of opinion that *C. guadalupensis* should be regarded as a distinct species of Cypress. Sargent in his "Silva of North America" remarks "*C. guadalupensis* appears distinct in its more flaky bark, more slender branchlets and glaucous and more glandulous foliage. This beautiful tree has been cultivated for the last twenty years in several gardens near San Francisco, and has been introduced into Europe." *C. guadalupensis* is described by Watson in the "Proceedings of the American Academy," 1879, and by Bruer and Watson (Bot. Cal. 2-114).

A widely-spreading or drooping tree, stem diameter to 5 feet. (Palmer.) Very quick growing on the mountains of Lower Gippsland. (Mueller.)

(4) *Cupressus thurifera* (Humboldt).—The Cedro blanco or White Cedar of Mexico. A tree growing to a height of 50 or 60 feet in Southern Europe, but stated by Hartweg to reach a height of 120 feet in the mountain forests of Mexico. He states he saw a tree of this height near Real del Monte. (Trans. Hort. Soc. London Ser. 11, Vol. III., p. 124.) It was originally discovered by Humboldt a century ago near Tasco and Tehuantepec.

This tree must not be confounded with *C. thyoides*, the White Cedar growing in the swamps of the Atlantic sea-board from Maine to Florida. *C. uhdeana* (Gordon) is referred to this species by Dr. Maxwell Masters; to *C. lusitanica* by Carrière.

Habitat.—"Mostly Alpine, but the exact habitat is not well known." (Kent.) It is cultivated at La Mortola, Italy, and in botanic gardens in the South of Europe. It is not hardy in Northern Europe. Tehuantepec is in Southern Mexico, almost the extreme south, in latitude 17°, elevation 5,500 feet, and 28 inches rainfall. Seeman collected it also in the Sièrra Madrè. Dr. Maxwell Masters cites localities in Central Mexico and elevations as low as 4,000 feet.

Recognition.—A small, smooth, globular, or nearly globular cone. Dr. Masters states that the cone he has seen in the Paris collection is nearly half an inch in diameter. Gordon describes the cones as the size of a large pea. The cone has six scales, and the smoothness of the scales without any knob or prickle distinguishes it from most other cypresses. Dr. Masters gives a drawing of the cone in his "View of the Genus *Cupressus*." The seeds are wingless and with hard shells.

It is normally a tall tree with horizontal, spreading branches, turned down or pendant at the ends.

It seems possible to refer all the American species of Cypress to two:—

(1) *C. benthami, C. thurifera* and their varieties allied to *C. torulosa* of the Old World;
(2) *C. macrocarpa* and its varieties allied to *C. sempervirens* of the Old World;

exactly as all the Old World Cypresses may be referred to one or the other of these two types.

OTHER CONIFERS OF MEXICO.

Thuya gigantea (Nutt) (*T. plicata* of Sudworth's Check List). Giant Cedar.—This fine northern tree extends along the western slopes of the Rocky Mountains into Northern Mexico. But, though it still grows to the size of a fine tree, it only occurs in Mexico at what is at present too high an altitude for economical use. In the future, when roads are made and the forests opened up, this tree will have a value in Mexico. The *Thuya gigantea* of Alaska and British Columbia is a noble tree rising to a maximum height of 200 feet, with clean boles of 100 feet. It furnishes a white, soft timber which is tough and absolutely clear of knots. This timber splits with facility and can be used out-of-doors without showing any sign of splitting or warping. *Thuya gigantea* is largely cultivated as an ornamental tree in Europe, and shows a good natural reproduction there. In the damper parts of England it is a rapid grower.

Habitat.—On high mountains in Northern Mexico only. (Wilmot.)

Recognition.—Gordon describes the Mexican Arbor-Vitæ as "differing from the common American Arbor-Vitæ in having the branches very much shorter, stouter, and densely covered with small ovate flattened leaves, bluntly pointed, and in four rows, with a plaited and jointed appearance."

Taxodium mucronatum (Montezume's Cedar).—No account of the forests of Mexico could omit mention of its great Cedar with its wide-reaching pendulous branches shading the mountain streams. This tree lives to a great age, and in its huge diameter may be compared to the Californian *Sequoias*. Like the latter trees, too, it is almost the sole surviving species of many geological ancestors that have now become extinct. Says Kent: "In Tertiary times, and perhaps earlier, it was not only spread over Europe from the Mediterranean to the Baltic, but also over North America and Greenland. It seems to have disappeared from Europe in the Pleiocene Age." Fossil imprints referred to *Taxodium* have been found at Bournemouth and at other places in England. The geological history of this species is like that of many others. The geological fluctuations of climate, which destroyed them in Europe, simply sent them up or down the great mountain ranges on the western side of the American continent. The American continent had much of its present shape in Miocene times. The Isthmus of Panama existed then and the mountains of Mexico.

The Mexican *Taxodium mucronatum* differs so little botanically from the Swamp or Bald Cypress of the Southern United States of America that many botanists regard them as only varieties. It is more convenient, though, to look on them as different species, though this difference may be mainly geographical. Sargent tells us that in Southern Europe, where the two trees are cultivated side by side, there is not the slightest difficulty in distinguishing them. Damman and other cultivators in Southern Europe tell me that under cultivation the two trees remain distinct and quite easily recognisable. Gordon ("Pinetum," p. 307) states that the Mexican Cedar differs from the "Bald Cypress" in being "nearly evergreen and much tenderer." Dr. Maxwell Masters, in the "Gardeners' Chronicle" for 1899, states that the seeds of *Taxodium distichum* are erect but the seeds of *T. mucronatum* pendulous. Naudin states that in France *T. mucronatum* sheds its leaves only once in two or three years, never bears fertile seed, and is liable to be killed by frost in all parts of France. It grows better in Spain and Portugal. Both the *Taxodiums* are much cultivated in Europe, seed being imported from America. Only quite exceptionally is fertile seed produced in Europe. Hansen says *Taxodium distichum* was introduced into Europe about 1840.

In the Botanic Gardens, Cape Town, are samples of the two trees, and these are easily distinguishable. *Taxodium mucronatum* is the big tree with the wide-spreading branches and seats underneath it, perhaps the most ornamental tree in the Gardens, with its pendulous branches, like a weeping willow. It is never quite leafless, the new leaves appearing and the old leaves turning brown and dropping off at the same time, viz., Spring. This tree seeds freely every year and yields good seed from which young plants are easily raised. It has a diameter of about 3 feet at 5 feet from the ground, and a total height of 55 feet or 60 feet. It has a short, tapering bole. The Superintendent of the Gardens thinks it was planted about the time the Gardens were formed in the time of Sir Lowry Cole's rule (1828-1834), viz., about 75 years ago. Near this is a tree of *Taxodium distichum*. This has a different appearance, being a small tree of stunted growth: it is leafless the whole of the winter and it has never borne good seed.

There is a tree about 20 years old in the Tokai arboretum. This is labelled *Taxodium distichum*. Its leaves take on a fine autumn tint and the leaves fall about mid-winter. It is growing in a damp place, but has a stunted appearance, with a curious flat top. There are similar trees of about the same age in the Government plantations at Ceres Road, all very slow growing.

In Mexico, Kent states that *Taxodium mucronatum* "towers to a height of 175 feet or more, with a massive trunk 10 to 15 feet in diameter, and individual trees are known greatly exceeding these dimensions. Thus, there is a gigantic specimen at Santa Maria del Tule, whose trunk has a diameter of *about* 35 *feet*. If the sinuosities of the trunk be followed the girth is 146 feet. According to A. Tweedie who visited this tree in 1902, the diameter at 6 feet is 51 feet!

"Of course we stopped to see the big tree of Tule. It is one of the biggest trees in the world, not excepting the giants of California. Imagine, it is one hundred and fifty-four feet in circumference at a height of six feet from the ground, or, to give a better idea of its size, 28 men, with outstretched arms, their finger-tips just touching, can barely span its girth. It is a tree of which there are many in the country, especially the famous grove near Diaz's Palace at Chepultepec." ("Mexico as I saw it in 1902," by A. Tweedie.) This tree, like a typical Cedar, is short for its thickness. It is 150 feet high and has a branch-spread of 141 feet. It is believed to be 2,000 years old!

Another tree of historic interest stands in the garden of Chepultepec, near the city of Mexico; it is called the Cypress of Montezume by Humboldt, and it is the tree under which Cortes passed the night (*La noche triste*) after the retreat of the Spaniards from Mexico City. This was in 1520. This historic tree is now 170 feet high with a diameter of about 15 feet, and is reputed to be over seven centuries old! It is jealously guarded. An American forest officer who visited the tree recently and proposed to examine its recent growth with a Souvax borer was promptly arrested. Zuccarini quotes a tree near Oaxaca with a diameter of 47 feet, enlarging to 67 feet at the base.

These figures place the Montezume Cedar first as the thickest of extra-tropical trees. The big trees of California, *Sequoia wellingtonia* (*S. gigantea*), while reaching a height of 325 feet, or perhaps double the height of the Montezume Cedars, are somewhat inferior to them in diameter. Indeed, the thickness of these giant Mexican Cedars is greater even than that of those vegetable monstrosities, the tropical *Adansonia digitata* or Baobab.

Robertson says that forests of this tree once covered a large part of the Valley of Mexico * * *. It does not seem to form forests of any extent at the present time, but to commonly occur singly or in small groups along the water-courses or even in the river beds; on the plateaux of Southern Mexico. Usually it is a tree about 50 to 80 feet high, often divided into two or more stems, and with a very irregular crown. It delights in a wet soil (which is inundated for a part of the year, at least) and in the dry atmosphere of the tableland; but the trees at Chapaltepec show that it does not demand a swampy soil. It does not occur naturally where the frosts are other than light and occasional.

The Montezume Cedar may perhaps play an important part in the afforestation of the better watered parts of the high plateau country of South Africa and of equatorial highlands. Probably it will be found too slow-growing to plant in extensive plantations, but its good natural reproduction and first-rate timber will make its introduction into every forest an essential feature of forest policy. If the Montezume Cedar is too slow-growing to plant at a profit, it should be introduced into every forest where the climatic conditions are suitable, so as to attempt its spread by natural means. Its dense covert renders it little liable to destruction from fire.

Timber.—Wilmot has seen timber of the Montezume Cedar in lumber yards in Mexico. He describes it as like that of the Bald Cypress of the United States, and highly valued as timber. It should be mentioned, however, that timber of the Bald Cypress, from the United States, that has been imported recently to Cape Colony is somewhat disappointing. It is but slightly scented, and that not of a particularly agreeable odour, while in appearance the planed-up wood, as seen in door panels, scarcely differs from ordinary deal.

Robertson describes the timber as excellent.

Habitat.—Middle and Southern Mexico, between 5,000 and 8,000 feet. It grows in damp places and bordering streams, and is said in places to form large forests, as between Chepultepec and Tescuco, near Popotla.

Recognition.—This tree is easily recognised when once seen. The leaves are in two rows, like a Yew, hence the name *Taxodium*. The foliage is of a beautiful fresh green colour in Spring like that of *T. distichum*, but it is nearly evergreen and is wanting in the brilliant autumn tints of *T. distichum*.

There are separate male and female flowers on the same tree. The cones are the size of small marbles, globular, woody, and with a point (*mucronatum*) to the scales. There are two seeds at the base of each scale.

Taxodium distichum var. *pendulum.*—This is a small, slender, cultivated variety of *Taxodium distichum*, with the leaves *spirally* arranged on the deciduous branchlets, which are mostly pendulous. This form of leaf also occurs on erect branches and branchlets of the common form. Sargent tells us that this *pendula* variety is seen occasionally growing up spontaneously in forests of the ordinary Bald Cypress, and on account of its peculiar appearance is under cultivation in the United States. Both there and in Europe it is cultivated under the name of "Chinese Tree." The big tree in the Botanic Gardens, Cape Town, has been wrongly referred to this variety. This form is closely related to the Chinese Water Pine (*Glyptostrobus heterophyllus* of Endlicher), and forms the subject of Dr. Maxwell T. Masters' monograph dated February, 1900 ("Journal of Botany"). Dr. Masters maintains *Glyptostrobus* as a separate genus, but the differences separating the Chinese Water Pine from *Taxodium distichum* var. *pendula* are slight, and Kent unites them.

The Mexican Silver-Firs.

Abies concolor.—This wide-spread tree of the Pacific States, U.S.A., extends into Mexico. Robertson states as far as the tropic and perhaps further south. *See* Appendix 3, "Foreign trees for Equatorial Highlands."

Abies religiosa (Oyamel).—It is called "*religiosa*" from being used in Mexico for church decoration. One of the finest conifers of Mexico with a wide distribution, and growing down to an elevation as low as 4,000 feet, a beautiful tree, like most of the Silver-Firs. It is described by Gordon as "an elegant tree, attaining a height of 150 feet, with a smooth brown bark and rather thin of branches." Kent says that "*Abies religiosa* was discovered by Humboldt who saw it in two localities on the mountains near the city of Mexico, at about 4,000 feet altitude. It was afterwards seen in other places by botanical explorers of the country, but always at a high elevation on some of the mountains at the extreme verge of aborescent vegetation, where it becomes dwarfed to a flat-headed bush, as on Orizaba." Robertson states it is common on the mountains of Southern Mexico, usually at high elevations; above 8,000 feet and often up to 11,000 feet. Its wide distribution makes it a particularly favourable tree for cultivation on African mountains and equatorial highlands. If it can obtain a footing and spread naturally it will be of incalculable benefit sylviculturally in the evergreen timber forests of African mountains. Its straight growth, dense stands, shade-bearing, and good natural reproduction will correct the sylvicultural defects of the African timber-forest, while its timber is exactly of that class which is wanting in the African forest.

Pringle states that the timber is of good quality and hard for a Fir: this no doubt is due to its warm habitat. Mueller adds that the timber is particularly well suited for shingles and lathes.

Habitat.—It extends right through Mexico, from the Sièrra Madrè in the north-west, into Guatamala, and is probably the only Silver-Fir found to any extent in tropical latitudes (though, of course not in a tropical climate). It is stated to be most abundant about latitude

19° and 9,000 feet. It was introduced to England in 1838, and has attained a height of 70 feet at Fota Island, near Cork. It has only survived the unsuitable British climate in a few localities in the south-west of England and Ireland. It grows as a beautiful tree on lawns in the south-west of France.

Recognition.—A lofty tree with smooth grey bark fissured in old trees. The leaves are solitary and rather thinly set on the branches, spirally arranged: about 1 inch long and silvery underneath when young.

Cones stalkless, 4 to 6 inches long, and 2 to 2·5 inches in diameter; dark violet blue in colour when young, changing to brown in the old cones. The bracts are longer than the scales, with a triangular recurved top. Seeds rather large, angular, and soft, with a transparent wing.

See also Appendix III., "Foreign trees for Equatorial Highlands."

Abietia douglasii (Kent). (*Pseudótsuga mucronata* (Sudworth). The Dougles Fir.—This noble tree, so well known in Oregon, extends, both in its normal form and in the *macrocarpa* variety, into Mexico. It is well known as one of the largest trees in the world, reaching, in Oregon, dimensions of 12 feet diameter and 300 feet high. The southern tree is much smaller, but it is still a good-sized tree, except in very dry localities. In Oregon the Douglas Fir is a shade-bearer, and seems to carry a denser stock per acre than any known tree. Says Kent, "In the bottom lands of the Columbia basin, the trees often stand so close together that the traveller can with difficulty push his way through the lofty trunks, free of branches for upwards of 200 feet, and supporting a canopy of foliage so dense that the sun's rays never pierce it." It has produced the highest "Acrim" of any tree cultivated in Europe, namely, 485 cubic feet, between 1888 and 1893, on the Earl of Mansfield's property at Taymount, Scotland.

The southern tree, instead of the light white timber of the northern tree, has a reddish wood that is heavy, hard, strong, and durable.

Wilmot describes the Douglas Pine as reaching dimensions of 42 inches in diameter and 60 feet of bole, in the forests of Guerèro, South Mexico. He adds that it occurs in patches throughout these forests.

Habitat.—The Douglas Fir extends through Northern Mexico as far south as the city of San Luis Potosi, just within a tropical latitude (Kent), and as far as Guerèro in Southern Mexico. (Wilmot.)

Recognition.—In character this curious tree is half an *Abies* and half a *Tsuga*. The cone of the Douglas Fir is quite like nothing else. Behind each cone-scale is a large, exserted, three-cornered bract, looking like two barbs and the pointed shaft of an arrow. The whole cone is stuck over with these pointed projections, which stick out like pins on a pincushion.

CENTRAL AMERICA.

PHYSICAL FEATURES AND CLIMATE.

Between Mexico and the Isthmus of Panama, from latitude 18° to latitude 8°, lie the Republics of Guatamala, Salvador, Honduras, Nicaragua and Costa Rica. In topography and forests, as far at least as Nicaragua, this is one country. On the Atlantic side is the belt of tropical forest, then gradual slopes, then a volcanic range, then the plateau with scattered volcanoes, and then the steep western mountain range which here, as in Mexico, is termed the Sièrra Madrè. Going southwards towards the Isthmus of Panama, the mountain chains, the volcanoes and the plateau country gradually decrease in height and breadth, although there are volcanoes rising to 11,000 feet in Panama. The great central plateau of Guatamala, here called "altos" (heights), lies at an elevation of 6,000 feet to 8,000 feet in the north, 5,000 feet in the middle, and 3,500 feet in the south.

Rainfall.—The Atlantic slopes are very wet, the Pacific slopes are drier and more fertile. It is here that is concentrated the bulk of the inhabitants. The climate is excessively wet on the Atlantic side, rainfalls of over 100 inches being common there, where the moist north-east trade winds are forced upwards by the mountain slopes. "The annual fall at Tual on the northern slope of the central Guatamalan chain (2,700 feet) is about 195 inches; in Coban, on the top of the mountains (4,300 feet) 100 inches; and in Salama (3,050 feet), on the dry inland district of Central Guatamala, only 27 inches; while in Guatamala city (4,850 feet), on the crest of the Southern Cordillera, the rainfall is 57 inches. The zone of maximum rainfall lies between 2,000 and 3,500 feet in elevation; above that precipitation often assumes the form of mist and, at heights above 10,000 feet, of snow." (Mill.)

The Trade-wind here blows across a steamy tropical sea, and all along the eastern slopes the air is ever loaded with moisture, the north-east trade winds being here nearly continuous through the year. There is much less rain on the Pacific slopes. There the climate is comparatively dry, pleasant and healthy for Europeans at the higher elevations; here are pine forests interspersed with open grass lands, affording rich pasture.

"The great feature which distinguishes Central America from Mexico is the rainfall, which, in the case of the former, is greater and more evenly distributed, owing to its originating from two distinct sources at the same time—the Pacific Ocean and the Caribbean Sea.

The humidity of the air in Guatamala is great, but differs in different localities, being greater as a rule in the mountains and in the low coast belt than in the valleys in the interior. The mountain region in the north is much more humid than that in the south, and the humidity of the air is greater on the Atlantic coast than the Pacific. Three distinct zones of precipitation are noticeable, but the rainy season, as a rule, occurs between April and November, the other months being those in which the least rain falls." ("Bull Am. Geog. Soc.," 1903.)

Winds. In Guatamala there are light rains in November and December, which do not occur further north the early and latter rains of equatorial regions. The dry period is stated to last from February to April, and the rainy season from July to September, while between these periods are months of moderate rain.

Down the coast of California and Northern Mexico, out at sea, blows the north-east trade, but along-shore there is a local north-west wind.

Along the west coast of Mexico south of the tropic, and the west coast of Central America, are local south-east and north-west monsoons, with the belt of tropical calms out at sea. This south-east monsoon may perhaps be looked on as the south-east trade drawn north over the belt of tropical calms. In the Pacific, as in the Atlantic, the true south-east trade blows a little north of the equator, but this monsoonal prolongation takes it as far north as the tropic at the extreme point of the peninsula of lower California.

Temperature.—In Guatamala, as in Mexico, they distinguish the hot, the temperate and the cold zones of vegetation. The first is the coast and low-lying hills up to an elevation of 2,000 feet, with a mean annual temperature of about 82°. Above this is the "tierra templada," between 2,000 and 6,000 feet, and above this the elevated central plateau deeply cut into, like that of Mexico, by wooded kloofs termed "barancas." The mean temperature is 58° Fahr. at Quezaltenango (7,700 feet), and 66° in the city of Guatamala (4,850 feet). This, it may be noted, is one degree warmer than Nairobi—65°. Soils are generally volcanic and fertile; the land is cultivated up to an elevation of 10,500 feet.

Maize yields two or even three crops in the hot coast zone and one crop in the temperate and cold zones. Sugar-cane is grown up to an altitude of 5,000 feet. Wheat is grown above 5,500 feet. The finest coffee plantations of Guatamala are situated chiefly on the lower slopes of the volcanic range facing the Pacific, a district remarkable for its fertile soil and relatively dry and pleasant climate. The coffee plantations lie mainly between 2,000 and 4,000 feet elevation.

Regarding temperature, there are two maxima and minima annually, the former occurring in April-May and August, and the latter in July and December-January. The temperature is comfortable and agreeable in both winter and summer except for the narrow coast belt. Thunderstorms are characteristic of all parts, and the phenomenon of circular lightning is often observed. ("Bull. Am. Geog. Soc.," 1903.)

FORESTS.

The Mexican forests are continued south along the Andes to Nicaragua and Costa Rica, but, as the general level of the country declines, the extra-tropical forest of Mexico becomes more and more broken, skirting the flanks of the higher volcanoes. From Mexico to southern Guatamala extends a chain of great pine-clad volcanoes, culminating in Acatenango, the highest point in Central America. In the south of Guatamala, towering above the Pacific, are the two great volcanic mountains, Volcan d'Agua and Volcan Fuego. Here, in latitude 15°, at an altitude of 10,000 to 12,000 feet, several travellers describe the great forests of pine as magnificent.

The forest scenery of the Volcan d'Agua is described as "the most lovely sight in the world." Formerly the crater of this extinct volcano was full of water and formed a lake. In 1541 a portion of the upper rim gave way and the newly-founded city of Guatamala was overwhelmed in an avalanche of water, mud and trees. After this catastrophe the capital was removed to its present position, farther away from Volcan d'Agua.

Elsewhere on the higher mountain slopes are forests of Oaks and Alders, with Cypresses in the dry parts of the interior of the Pacific slopes. "White Pine and Oak woods," says Karl Sapper, "cover the mountains, while the plains form grass savannas diversified by thorny forest." Forest in Guatamala extends up to an elevation of 12,500 feet. Here we have a picture of the trees and cultivations that will succeed in British East Africa.

THE EXTRA-TROPICAL PINES OF CENTRAL AMERICA.

It seems that all or nearly all of the southern Mexican pines extend into Guatamala. Dr. Masters mentions *Pinus ayacahuite* and *P. leiophylla* as being found both in Mexico and Guatamala; and *P. filifolia*, *P. tenuifolia* (Conifer Conference), and *P. donnell-smithii* as in Guatamala. Subsequently, however, Dr. Masters in his "View of the Genus Pinus," ranks *P. tenuifolia* as a synonym of *P. strobus*.

Pinus cubensis (*P. heterophylla*, of later American writers). Slash Pine.—This is one of the Pitch Pines of the United States of America. The timber scarcely differs from the best Pitch Pine (*P. australis*), and fetches the same price on the market. Sargent, in his "Silva of North America," describes it thus: "The most beautiful of the pines of the Southern States; the broad, compact, shapely dark heads of the Slash Pine, raised on massive trunks, stand out boldly among the more open-headed and less symmetrical long-leaved (*P. australis*) and Loblolly Pines (*P. tæda*), which it seems destined gradually to replace and to become a chief factor in the restoration of the southern pineries. For its seedlings, produced in great numbers every year, are able to thrive without direct sunlight, and,

overcoming the more slow-growing seedlings of the other species, sooner attain sufficient size to resist the fires which endanger all young plants in the maritime pine belt of the south."

Highlands of Central America, Gulf States of United States, and mountains of West Indies.

Pinus donnell-smithii.—More than one traveller speaks of the fine forests of this pine on the Volcan d'Agua.

Habitat.—I can find no mention of *P. donnell-smithii* as occurring in Mexico. It seems to be confined to the highlands of Central America.

Recognition.—Resembles *P. hartwegii*, but differs in its smaller cone-scales with less prominent apophyses. It is a five-needled species with fimbriate bud-scales and three-sided leaves. The cones are about four inches long, thick, the scales with thickened apophyses and winged seeds. (Masters.) *P. hartwegii*, it will be remembered, has a general resemblance to *P. montezumæ*.

Pinus filifolia.—Gordon describes this as a very handsome tree, growing from 40 to 60 feet high, and abundant in Guatamala, particularly near Santiago and on the "Volcan del Fuego" in exposed places, and on the mountains near Guatamala city. It produces a light, white timber of little value.

Habitat.—Its exact range does not seem to be known. It is not mentioned among the Mexican pines and seems confined to the highlands of Central America. It is described as "very tender" under cultivation in England.

Recognition.—This pine will be recognized by its long leaves and general resemblance to *P. palustris.* Leaves in fives, very long and slender—8 to 12 inches long. The cones are pendulous, about 8 inches long, slightly curved, the apophyses rhomboid, with a prominent umbo. Seed speckled, much shorter than the obliquely oblong wing. (Masters.)

P. tenuifolia.—A very fine tree with slender branches and beautiful foliage, often 100 feet high and 3 feet in diameter, and forming dense forests. A species of warmer, wetter, regions.

Habitat.—Guatamala, in the State of Chiapas, and in Mexico at 5,000 feet elevation, &c.

Recognition.—Leaves in fives, very slender, 8 inches to 12 inches long. Cones 2 inches to 3 inches long, 1 inch to 1½ inches broad, scales ½ inch or less wide, having a transverse ridge across their middle, terminated in the centre by a black, blunt point; stalks stout, ¼ inch to ½ inch long. (Robertson.)

FORESTS OF COSTA RICA.

In Costa Rica also there is extra-tropical forest, the mountains rising to a height of 5,100 feet at the water divide. Cartago, the former capital of Costa Rica, was at an elevation of 4,500 feet. On the Atlantic side the forests are almost impenetrable, woven together, as they are, by lianas passing from tree to tree. Neither aboriginal nor Spanish culture ever made great inroads on the primeval forests of the Atlantic coast. (C. V. Hartman, 1901.)

FORESTS OF NICARAGUA.

As far south as Nicaragua we find forests of Oak and Pine on the summits and western slopes of the Andes. The forest conditions here still resemble those of Mexico. On the gradual Atlantic slopes is a wet climate with, at first, dense tropical forest wherein mahogany (*Sweitenia mahogani*) and various Cedars, but particularly *Cedrela odorata*, are the most valuable timbers. The Cedars extend higher up the mountains where "the temperature is milder and the nights rather cold." Eight different species of Cedar are mentioned in Niederlein's list of Nicaraguan timbers:—*Cedro espino, Cedro real, Cedro comun, Cedro caoba, Cedro, Cedro macho, Cerito, Cedron.* Passing upwards through a land of heavy forest, cloudy skies, fogs and rain, the dividing line of the Andes is reached; and here, under a clear sky and in the brilliant tempered sunshine of an Alpine region, are fine forests of pine and Oak. The scene changes from the gentle Atlantic slope to rugged, picturesque plateaux interspersed with lakes and high volcanic pine-clad mountains. It is Mexico over again, on a small scale, a continuation of Mexico and its forests reaching to within 10° of the equator. As in Mexico, the Oaks occupy the lower slopes, the pines the upper. "There are pine forests as, for instance, near San Rafael which are over 30 miles in length and about 6 miles in width, crossed by numerous rivers. The Pines often mingle with the Oaks, although the Oak prefers a better soil. Of the pines in these forests the Ocote Pine (*Pinus teocote*) seems the most notable." (G. Niederlein.) Proceeding westward toward the Pacific, the country becomes gradually drier and the forest scattered, while the altitude drops to a lower terrace where there are no more pines but only Oaks. Then the country falls in another terrace to the shores of the great lake of Nicaragua where the climate and vegetation are tropical.

On the western slope the tropical forest extends to an altitude of 3,000 feet. Above this are the savannas, and then commence the forests of pine. ("Geographie Botanique."—Drude.)

THE TROPICAL PINE FOREST OF CENTRAL AMERICA.

In addition to the extra-tropical pines of the highlands there is tropical pine forest on the sands of the coast. On the Atlantic coast extensive deposits of sand are covered with grass and scattered pine trees, known as pine ridges in British Honduras and along the Mosquito Coast. This pine is *Pinus cubensis*, or one of the two or three tropical pines that are found in Cuba, probably *P. terthrocarpa* or *P. bahamensis*. The pine forest grows on the barren coast sands, which are gradually filling up the shoal water and marshes left between the coral reefs and the old coast line of the continent, and it extends up the sandy valleys of the rivers. This pine is described as a Pitch Pine. It is good enough to be worked for sawn timber and is exported along with Mahogany from the luxuriant primeval forest of the interior, a forest which, like the tropical forest of Mexico, abounds in Mahogany, Logwood, Cedar, and other valuable tropical timbers, as well as India-rubber trees.

Here is the Crown Colony of British Honduras with Belize as its capital and chief port of export for mahogany. [Belize is the English form of Valiza or Baliza, the Spanish rendering of Wallace, the British freebooter who first gained a footing on the Spanish Main in the eighteenth century. All along this coast the natives speak a broken form of English derived from the buccaneers and their half-breed descendants. This is all that remains after 300 years of intercourse with England and Sir George MacGregor's ephemeral "kingdom" of 1819.] The accessible Mahogany and Logwood have now been cut out and the export trade is declining rapidly. It is stated to have fallen from £420,000 in 1893 to £280,000 in 1897.

The moist Atlantic side of Central America is covered with luxuriant primeval forest; Mahogany, Palms, Logwood, Bamboos in the tropical portion; in the higher parts, Oaks, Alders, Pines and Cypresses. In the dry parts of the interior of the Pacific slopes Pine and Oak woods cover the mountains; one of these Oaks is said to bear acorns as large as turkey eggs—apparently the largest acorn known!

SOUTHERN LIMIT OF THE FOREST REGION OF MEXICO AND CENTRAL AMERICA.

On the mountainous country of Costa Rica, about latitude 9° N., occurs the southern end of the Mexican forest region of Oaks and Pines. I can find no reference to pine forests south of Panama, though the Isthmus of Panama is occupied by fairly high mountains and though the Isthmus geologically has existed as far back as Miocene times. Beyond Panama, in South America, on the great Andian chain, is country similar to that north of Panama—a "terra caliente" up to 3,000 feet, a "terra templada" between 3,900 and 6,500 feet, and a "terra fria" between 6,500 and 10,000 feet, with giant snow-clad volcanoes rising to over 18,000 feet. The average height of the Andes of Ecuador is 11,400 feet, and Chimborazo rises to a height of 20,498 feet.

Above the "terra fria" of Ecuador is a fourth region, the Paramos, "the bleak, stormy and almost uninhabited region of the mountains from 10,000 to over 13,000 feet, lying principally in the Eastern Cordillera, with a mean temperature from 54° to 45° Fahrenheit. Trees are often found near the lower limits of this zone, but the typical Paramos begin above the tree line." ("Internat. Geog.") Little seems to be known of the forests of the Equatorial Andes. In the Quindiu Pass, the lofty Wax Palm, *Ceroxylon andicola* grows up to 10,000 feet. As in Equatorial Africa, there are two rainy seasons in the Equatorial Andes—late Spring and late Autumn. (April to June and September to December.)

The causes that have operated in limiting the spread southwards along the Andes of the pine forests of Central America I have never seen satisfactorily accounted for. In Chili there are a number of North European and North American flowering plants—not less than 46, according to Darwin's "Origin of Species," and more, according to Dr. Phillippi, the Chilian botanist. In animals and insects there is also a close relationship. In insects, however, the relationship is generic, not specific, showing that the connection between the two faunas is an ancient one in this case. ("Travels amongst the Great Andes of the Equator," by E. Whymper.) Says, Willis, "The universal American character of the floras of the different parts of America from north to south is probably in part to be ascribed to the long chain of the Rocky Mountains and the Andes, which has formed a highway for migration."

In the Equatorial Andes, far up on the eastern side, comes the semi-tropical forest of Brazil, brought up by the abundant moisture of the eastern trade winds. Above this, at high altitudes, is a bleak, treeless country with no trace of the Mexican forest or flora generally. Grisebach, in his "Vegetation du Globe," gives a plan showing the different floral regions of the world. This plan indicates the Mexican flora as extending to the Isthmus of Panama, and there stopping. It is not only the Mexican forest which stops at Panama, but the whole Mexican flora. Possibly the stoppage was caused by a lower elevation, in glacial times, of the volcanic regions of Central America, or possibly by some change in the climate of the tropics, which may have stopped the spread southward along the mountains of the extra-tropical flora of Mexico.

Drude, in his chart of the distribution of Conifers, indicates by a line the southern limit of the genus *Pinus* in the New World. He draws this line north of Panama in latitude 11°. The line passes from here across the northern portion of Haiti. It is worth noting that in the Old World he places the southern limit of the pines in latitude 10° S., that is to say, in Timor or Bornea, a little north of the Australian continent. The further extension of the pine region southward will shortly be merged in the pine forest which man

is starting in the colder regions further south. Conifers introduced by man are now naturalized in Chili and South Africa. They are becoming naturalized where they have been introduced more recently in Australia and New Zealand.

Appendix II., Indigenous Trees, will be printed separately.

APPENDIX III.

FOREIGN TREES FOR EQUATORIAL HIGHLANDS: SUITABLE FOR THE HIGHLAND FORESTS OF BRITISH EAST AFRICA.

The highlands of British East Africa are of recent formation. It seems probable that when the country rose and an extra-tropical* climate was produced forest came in from the cool south and from the Abyssinia highlands on the north. But this forest is far from being the best type of extra-tropical forest. It has developed in a comparatively small extra-tropical area away from the fierce competition of larger forest areas. It is capable of enormous improvement by introducing to it the best trees of larger extra-tropical forest floras. During the quarter century that the extra-tropical forest of South Africa has been cared for and systematically cultivated at the Cape, its trees have been found to be surpassed in quickness of growth and quality of timber by numerous timber trees selected from the larger forest floras of Australia, of California, of the Mediterranean region, and of the Himalayas.

For the improvement of the extra-tropical forest of Equatorial Africa, trees growing naturally under similar climatic conditions must be sought. This is not to say that experiments should not be made with all extra-tropical trees on the assumption that altitude will compensate latitude, but such experiments should be conducted with the utmost care. At any moment trees not climatically fitted are liable to be attacked by disease (the Larch, in the lowlands of Europe, is a familiar case in point), and even if they escape disease and grow vigorously, their timber may be inferior (familiar examples of this are the Deodar and Strobus Pine in Europe). The following list of extra-tropical trees suitable for introduction to equatorial highlands has the figure (1) and (2) prefixed to each tree:—

(1) indicates those climatically suited.
(2) indicates those climatically suited, assuming that altitude compensates latitude.

In this list, apart from such particularly valuable trees as *Cedrala australis* (the most valuable timber tree of Australia), the Camphor tree (*Cinnamonun camphora*) and some others, the trees that, as a class, claim particular attention are the Conifers.

CONIFERS FOR BRITISH EAST AFRICA.

Pine timber wanted.—Nine-tenths of all the timber used in the civilized world is coniferous. In the tropics, the proportion of pine timber is less, since, in the best buildings, timber such as Teak, that is proof against white ants, has to be employed. In British East Africa, Ibean Camphor, Cedar, Saizi, and some other timbers are naturally fitted to replace Teak, while Yellow-wood (itself a coniferous timber) has long taken the place of Pine in the old farmsteads of Cape Colony. In some respects Yellow-wood is better than Pine, in some respects inferior. It is doubtful, however, if pine timber can ever be entirely displaced. Its general soundness, its good strength compared to its weight, its straight grain, easy working, and the low price at which it can be put on the market, are qualities which will probably make it ever hold its own in the world's timber trade. Australia has no pine forests (its so-called pines are not real pines) and it is infested with White-ants almost to the extreme south, yet Australia spends on an average £1,000,000 yearly on imported pine timber. It is safe to assume that in British East Africa, where white ants are but a mild pest, there will always be a considerable demand for pine timber. The production of pine timber is now one of the most important forestry questions in the Protectorate.

No pine forests now.—There are no pine forests now in British East Africa. Their place would be naturally in the bamboo zone above the evergreen forest. This is the distribution throughout Mexico and Central America. In the Canaries, Scott-Elliot ("Wanderings of a Naturalist in Mid-Africa") remarks on the striking resemblance of the evergreen forest on Ruwenzori to that on the Canaries; and there appears to be a general resemblance between the highland forest on Ruwenzòri, Kilimanjàro, the Aberdare, and Kenia. During the last 8 or 9 years, since British East Africa has been occupied by white men, who came here to make their homes, various attempts have been made to plant pines. The result has been complete failure! Other trees which they planted have succeeded well; but I have not yet seen a single pine tree. The seed has come up well but the young pines have refused to grow beyond 3 inches

* By Extra-tropical is to be understood the sea-level climate, between about latitude 23½ and 43½ or the ten degrees of latitude lying immediately outside the tropics. Cape Town, Sydney, Buenas Aires and Valparaiso lie at about the centre of the southern Extra-tropics with mean temperatures about 62° Fah. On Extra-tropical highlands Mexico City has a mean temperature of 60°. Nairobi of about 64°. The most convenient division of the world's climates seems to be:—Tropical, mean temperature, 80°: Semi-tropical, 70°: Extra-tropical, 60°: Cold-temperate, 50°: Cold, 40°: Arctic, 30°: Polar, 20°.

or 4 inches high. While all the pines tried have failed nearly all the Cypresses have succeeded. The pines tried have been those that do well in South Africa. The pines of Mexico and Central America remain to be tried.

Many of the forest trees of Florida extend to the highlands of Cuba. In the "Isle of Pines" are extensive forests of *Pinus cubensis* and its allies. *Pinus Khasya* is a pine with a range from a tropical climate to 10,000 feet. It flourishes in a wet climate and seems to be one of the pines best suited for cultivation within and near the bamboo forest. A small supply of seed I brought with me from South Africa did not, however, do well in the forest nurseries. *Pinus massoniana*, *P. merkusii*, *P. insularis*, and the pines of Cuba, are others that suggest themselves after the pines of Southern Mexico and Central America.

Whether the pine forest of the future, in British East Africa, will find its place immediately above the evergreen forest, or in the colder drier regions above the zone of heaviest precipitation, is one of the most interesting points in the future forestry of these regions. Throughout Mexico and through Central America to as near the equator as Panama, it is in the colder drier region above the zone of greatest precipitation that pine forest occurs. I think it probable that between the upper limit of the good evergreen forest and the lower limit of the pine forest there will be room for a zone of some of the mountain Oaks of Mexico, and perhaps the best timbers from the mountains of New Guinea.

In British New Guinea the Owen Stanley range, latitude 9° S., rises to a height of over 13,000 feet, and in Dutch New Guinea, the "Snowy mountains" nearly under the equator rise to about the height of Kenia. This is north of Timor to which pines have extended naturally. The Australian Red Cedar (*Cedrela australis*) mentioned above grows up to a high elevation on these mountains and there are coniferous forests of Araucarias up to an elevation of 7,000 feet. We should try to get seed for British East Africa from the Owen Stanley mountains as early as may be.

THE PINE FORESTS OF CENTRAL AMERICA.

The volcanic mountains rising above the Mexican plateau were once covered with magnificent pine forests, and enough of these pine forests remains to this day to show that they are capable of producing the finest timber. American syndicates have recently sought to obtain concessions for working some of these forests, but their offers have, in the interests of the forests, been mostly declined by the Mexican Government, page 85. Mexico has a greater variety of timber of the Cedar class than any country in the world, but without its pine forests would be in a poor way. Mexico, like British East Africa, has no coal mines. In Appendix I. I have given notes on the Coniferous forests of Mexico and Central America so far as these have a bearing on the forestry of British East Africa.

Mr. Shaw, an American naturalist who has explored the Mexican pine forests for some years, will shortly publish the result of his studies. That work will be of the utmost value to foresters in British East Africa. Better suited climatically than even the forests of South Mexico are those of Guatamala and Central America southwards as far as Panama. On those beautiful volcanic mountains in Guatamala so renowned for their varied scenery, Volcan d'Agua and Volcan Fuego (in latitude 15°, at an altitude of 10,000 to 12,000 feet) are great forests of pines. *Pinus donnell-smithii*, says Dr. Masters, forms a complete belt around the Volcan Fuego, commencing at about 10,000 feet, and on the Volcan d'Agua extends to the summit 12,337 feet. The mixed forest ceases at about 10,000 feet. You step suddenly out of this into the more open pine-belt where the only undergrowth is a coarse grass. This is strikingly like the picture of forest distribution on Kenia except that the pine forest is wanting on Kenia.

The pines of Central America are stated to possess timber varying from the Pitch-Pine class (which like *P. canarinesis* may run as heavy as 60 lb. to the cubic foot) to timber of the *Strobus* class, one of the lightest and softest of pine timbers. *Pinus tenuifolia* so closely resembles *P. strobus*, the great "White Pine" of North America, that latterly Dr. M. Masters has considered these as identical. *P. filifolia* is another timber of the "White Pine" class.

It is probable that most of the pines of Southern Mexico extend into Guatamala and that the majority of these have resinous durable timbers of the Pitch-pine class.

Pine Forests of Nicaragua.

Of these pine forests, so intensely interesting to the forester in British East Africa, little is known. They are situated at a high altitude on volcanic mountains and are inaccessible as regards working, though approachable by mule tracks. They mark the most southerly known limit of extra-tropical pines, the equatorial limit of the Coniferous forest of Mexico. These Nicaragua pine forests are on the comparatively dry side—the western—of the Sierra. They are described as of considerable extent; thus, the pine forest of San Rafael is stated to be 30 miles long by 6 miles broad. It thus contains about 115,200 acres.

For British East Africa, seed should be obtained as early as possible from these pine forests of Central America: and it would be desirable, as soon as an opportunity offers, to send a forest officer there from the Protectorate to examine and report on these little known forests, and himself obtain reliable supplies of the best pine timbers. Mr. L. Gooding is now in Mexico exploring and collecting seed for the Forest and Agricultural Departments of the Transvaal, each Department contributing £200.

Southern Mexico, Guatamala, and Nicaragua have formed the homes of Europeans for 350 years. Gonzales de Avila took possession of Nicaragua in 1522, or 385 years ago. In 1570, Nicaragua formed part of the "Capitania General de Guatamala." It is not only their forests that interest the colonist in British East Africa, but their farming, their plantations, and all that has been done in a country that has been occupied by Europeans

during the last three and a half centuries. It is the work of the Agriculturist to profit by their experience, to sow their rust-resistant wheat, to employ their cultivations (often unknown in other climates) and to import their hardy animals—horses, cows, pigs, &c.—suited to an equatorial mountain climate. It is the work of the Forester to spread their pine forest over climatically suited regions, as Foresters in South Africa are doing with the more northern pines. In Central Africa we see a country that is almost a parallel with the equatorial Alpine regions of Africa—the same climate, the same rich volcanic soil, the same Alpine region with eternal snow capping the highest mountains!

Extra-Tropical Spruces.

The Spruces are trees of cold countries. The great Canadian belt of extra-arctic forest, measuring about 3,500 by 500 miles, is chiefly composed of Spruce. Of the 16 or 17 species of Spruce (*Picea*) that have been distinguished, but four, and these doubtfully, are inhabitants of extra-tropical climates, and none of extra-tropical latitudes. These four, the cultivation of which may be attempted with some chance of success, are:—

Picea morinda, of the Himalayas;
P. orientalis, of the Caucasus;
P. brachytila, of Yunan;
P. likiangensis, of Yunan and Likiang.

To these may perhaps be added the *Schrenkiana* variety of *P. obovata*.

Extra-Tropical Silver-Firs.

The Silver-firs occur further south than the Spruces. Several of them are found in undoubted extra-tropical climates, and one, *Abies religiosa*, of Mexico, in tropical latitudes. Their timber has always a value (and an increasing value) for paper pulp, if they cannot find a market as lumber; and to the Forester they are very precious for their sylvicultural qualities. They are all shade-bearers and remarkably regular in their growth. Thus their presence in the forest renders the forest both more dense and more regular. These are exactly the qualities in which the indigenous evergreen forest of South and East Africa is lacking. The introduction of Silver-firs into the higher wetter forests of British East Africa—Aberdare, Kenia and Mau—thus becomes a point of primary importance in the forest policy of the country. Any Silver-fir which would naturalize readily and show a strong natural reproduction would enormously increase the value of the forest. The species which gives the best promise of success is *Abies religiosa*, the Oyamel of Southern Mexico (described below), but all the following species which grow in extra-tropical climates are worthy of trial. The list is arranged approximately in the order of their suitability for trial in British East Africa:—

Abies religiosa, of Mexico and Central America.
A. firma, the "Momi" Silver-fir of Southern Japan and Yunan.
A. pindrow, of the Himalayas.
A. numidica, of the Atlas Mountains.
A. pinsapo, of the mountains of South Spain.
A. cephalonica, of the mountains of Greece.
A. cilicia, of the mountains of Asia Minor.
A. bracteata, of California.
A. concolor, of California.
A. alba, of the Mediterranean: the common Spruce of Europe.

The extra-tropical Silver-firs are well illustrated in the Kew Museum. Most of the cones are from specimens grown in England, showing the sort of climate in which these trees flourish or can put up with.

Extra-Tropical Hemlock-Spruces or Tsugas.

The Tsugas are northern trees of cold climates, but four Tsugas appear to extend into extra-tropical climates and should be tried on the higher mountains of British East Africa, viz.:—

Tsuga aragi, of Southern Japan.
„ *yunanensis*, of Yunan.
„ *brunnoniana* (var. *chinensis*), of Szechuen and Yunan.
„ *brunnoniana*, growing in the wetter Himalayas between 8,000 and 10,000 feet, may be tried near the snow limits on Mount Kenia.

Abietia douglasii (the Douglas Pine).—This noble tree, allied to the Tsugas, extends from Vancouver to Southern Mexico. This southern form is well worth trying in British East Africa. It is described with other Mexican trees, *vide* Appendix I., Conifers of Mexico and Central America.

THE EXTRA-TROPICAL PINES.

Of the 78 recognised species of pines (M. Masters) some 40 are natives of extra-tropical climates, and most of these worthy of trial cultivation in extra-tropical British East Africa. These will be found briefly described in the list below of trees suitable for introduction to British East Africa. Those belonging to the forests of Mexico and Central America which represent the bulk of those to be first tried are described in more detail in Appendix I., Conifers of Mexico and Central America.

TROPICAL PINES.

The pines have their greatest development in cold countries; they mark the limits of tree vegetation going towards the North Pole. They are abundant, and show no loss of vigour in extra-tropical countries, both at high and low levels, witness the pines of the Mediterranean region and the pines of the Himalayas, of Yunan, and of Central America. But pines do more. They extend into tropical climates, pure and simple; witness the pine forests of Mergui, of Cuba, and of the Philippines; while in Timor they are well into the southern hemisphere though still in the tropics. When started by man in the extra-tropics of the southern hemisphere they grow with vigour, and at several points in South Africa have become completely naturalized. On Table Mountain and in the Cape Peninsula the introduced pines, *Pinus pinaster* and *P. pinea*, have been naturalized for about 200 years.

How far the artificial cultivation of pines in an entirely tropical climate could be attempted with success has not yet been proved; and in a country like British East Africa which has both a tropical coast and extra-tropical highlands pine-planting should be pushed forward with vigour on the highlands but for the present tentatively and experimentally only on the coast. There is a demand for fire-wood at Mombasa, and this could probably be best met by planting *Casuarina equisetifolia*, as mentioned elsewhere in this report. Nevertheless, as regards tropical pines, it should be borne in mind that some of them have hard, heavy timbers suitable for use in the tropics, while the demand for firewood would absorb the otherwise waste wood in the slabs, tops, and branches. Some of the tropical pines are no doubt as heavy and full of resin as some extra-tropical pines. *Pinus canariensis* has, in its heartwood, a timber so full of resin that it is almost imperishable, and weighs 60 lbs. the cubic foot. Such a pine would furnish an ideal firewood for the Uganda railway.

The tropical pines that have been described and recognized as good species are the following nine. (M. Masters):—

Pinus merkusii, of Tenassarim and the Burmese lowlands.
„ *khasya*, of the Burmese lowlands, and extending to 10,000 feet elevation.
„ *insularis*, of the Philippines and Timor.
„ *occidentalis*, of the West Indies.
„ *oocarpoides*, of the Mexican coast lands.
„ *cubensis*, „ *terthrocarpa*, „ *bahamensis*, } of Cuba and the Isle of Pines.
„ *massoniana*, of tropical China.

THE BLUE-GUM AND OTHER INTRODUCED TREES ON THE NILGIRIS.

The climate of the Nilgiris in Southern India bears a close resemblance to the climate of the highlands of British East Africa. It has long been occupied by Englishmen and, after the trees of South Mexico and Central America, it is the Nilgiri trees that have most interest to the Forester on the highlands of British East Africa. There are two or three trees of the Nilgiri Sholas that may be worth trial planting on equatorial highlands (these are detailed below), but it is the Australian and other trees now naturalized on the Nilgiris that have such a special interest for the tree-planter on equatorial highlands. The Blue-gum and some other Eucalypts, the Blackwood (*Acacia melanoxylon*), *Pinus longifolia*, *Pinus insignis*, *Cupressus torulosa*, the Deodar and a Conifer called *Frenela rhomboidea* (possibly some other species of Callitris), are the naturalized trees that have given the best results on the Nilgiris. Their growth is described in a recently issued report by Mr. Cowley Brown (Board of Rev., Madras, No. 207, of 4th October, 1906), and in the list of trees for Equatorial highlands given below. As regards both trees and horticulture the "Nilgiri Manual" may also be consulted and the various reports of the Madras Forest Department. The results obtained up to 1882 will be found described in my report, "The Growth of Australian Trees on the Nilgiris," Madras, 1883. The tree that from its extraordinary growth has excited a world-wide interest is *Eucalyptus globulus*, the common Blue-gum.

The prevalent opinion at Ootacamund is that the Blue-gum (*Eucalyptus globulus*) will never produce serviceable timber on the Nilgiris. Logs of any size are found to warp, split, and crack. For this reason some large trees felled recently near Coonoor by the District Forest Officer were quite unsaleable until they had been cut up and converted into fuel billets. Blocks varying in size from 4 feet 6 inches to 6 feet girth show large radial cracks and fissures. The huge tree (No. 5) felled in Arambi, 11-5, appeared at first to be perfectly sound and of a fairly dense timber. After a few days of exposure, however, cracks or heart-shake appeared both in the stump and in the bole. Mr. Gordon Hadfield states that "unsquared small-sized poles are quite serviceable as rafters and in all situations above ground, but that if sawn they inevitably sag and if placed under ground they rot."

It must be borne in mind that this Blue-gum timber is mostly immature, but it is doubtful whether Blue-gum, either on the Nilgiris or in British East Africa, will produce timber of much value, except for fuel. It must always be remembered that the Blue-gum is a native not of tropical mountains but of a cold temperate climate.

What has to be determined in British East Africa is whether, grown at an elevation of about 7,000 feet and a rainfall of 64 inches (Nilgiri average for 30 years), it will produce a greater weight of wood-fuel than any other tree known. When I measured the Nilgiri plantations in 1883, I obtained a yearly yield of 10 tons from some of the best plantations. It is evident from Mr. Cowley Brown's report that these wonderful figures have been maintained. Mr. Cowley Brown says the growth is still "little short of marvellous." A ten-year old plantation under the most favourable conditions averages 90 feet in height with

a volume in weight of 120 tons per acre. *See also* page 50. In other words the increment is about 1 ton per acre per month, that is, nearly 75 lbs. (1·63 cubic feet) per acre per day!! This is four times the average of Black Wattle timber in Natal. Page 106.

Mr. Cowley Brown records a Nilgiri Blue-gum as 170 feet in height, with a diameter of 5 feet. This was a tree 56 years old. He indicates 60 as the age of the maximum height growth, and arrives at the conclusion that a plantation under favourable conditions would not begin to deteriorate until it was at least 75 years of age; he takes this as the correct rotation for the Nilgiri Eucalypt plantations. At this age there would be 18 trees per acre approaching 200 feet in height and 3 feet in diameter.

An important point with reference to the cultivation of Blue-gum on tropical mountains has now been set at rest. When I measured the Nilgiri Blue-gum plantations in 1882, the oldest being then 11 years, there had been no natural reproduction, and it was commonly held that the Blue-gum on the Nilgiris could only be reproduced by fresh seed imported from Australia. Mr. Cowley Brown's recent report shows that the Blue-gum is now reproducing itself on the Nilgiris. There was a somewhat similar experience when the Blue-gum was introduced to South Africa, where it is climatically at home, that is to say, it did not reproduce rapidly at first, but began to do so when about 20 years of age.

Mr. Cowley Brown states that at 5,500 feet (the height of Nairobi) it is useless to expect a satisfactory growth of Blue-gum. In my report of 1882 I commented upon the remarkably inferior growth of *Eucalyptus globulus* in one of the Nilgiri plantations, "Black Bridge," planted at as low an elevation as 5,500 feet. Mr. Cowley Brown now remarks "The condition of the plantation gives reason for the opinion that it is useless trying *Eucalyptus globulus* at such a low elevation as this. The oldest Blue-gums planted at this elevation in British East Africa, the Machàkos avenue trees, are reported to be now gradually dying out.

The following list comprises trees suitable for cultivation on tropical or equatorial highlands at altitudes between about 5,000 feet and 14,500 feet, or the limit of permanent snow. The altitudinal limits of the existing highland forest are from 5,400 feet to 11,000 feet, with some extension both ways for forest in valleys and river fringes. In this list have been inserted on account of their utility as shelter trees or for hedge-rows:—

Dodonea viscosa; Duranta elisia; Carissa grandiflora (*Amatungula*); *C. arduina, &c.; Hakea laurina; Bambusa fortunei; Plumbago capense; Leptospermum laevigatum* (Australian Myrtle); *Acacia cuninghamiana; Thuya orientalis;* English Gorse; Mexican Hawthorn (*Crataegus mexicana*); *Hibiscus syriacus;* White Mulberry; *Parkinsonia aculeata;* Oleander; Plumbago.

For the lower highlands the indigenous Croton makes a good screen and rough hedge.

EXTRA-TROPICAL TREES FOR EQUATORIAL HIGHLANDS.

(1) = trees climatically suited.
(2) = trees climatically suited, assuming that altitude compensates latitude.

(2) *__Abies bracteata.__ Californian Silver-fir.

One of the most beautiful and rarest of the Silver-firs. Its only known habitat is on the outer western ridge of the Santa Lucia mountains in South California, where it grows only in a few isolated groves scattered along the moist bottoms of cañons, usually at elevations of about 3,000 feet. (Kent.) It succeeds in sheltered southern localities in England.

This very beautiful fir can always be recognized by its unique cones which look like a pin-cushion stuck over with half inserted pins.

Santa Lucia mountains, South California, 3,000 feet.

(2) **Abies cephalonica.** Grecian Silver-fir.

This is a fine tree with widely-spreading branches, a native of the mountains of Greece. It does not differ greatly from the common Silver-fir, *Abies alba*, of which at one time it was ranked as a variety. Its timber is considered similar to the common Silver-fir.

Mountains of Greece from 2,500 to 5,000 feet.

(2) **Abies cilicia.** Taurus Silver-fir.

A tall mast-like tree associated with the Cedar of Lebanon in the forests of Asia Minor and described by travellers as the most picturesque of all the Silver-firs. On the mountains of Cilicia it forms pure forest of considerable extent, becoming mixed at higher elevations with *Cedrus libani* and *Pinus laricio.* (Kent.) It grows fairly in England, doing better in the wetter parts.

Taurus 4,000 to 6,000 feet.

(2) **Abies concolor.** Californian Silver-fir.

This is also a Californian tree, but, in contrast to *A. bracteata*, is widely spread. It is found from the cold Pike's peak region to the San Bernadino mountain of South California and (according to Robertson) in moister situations of the Western Sierra Madre of Northern Mexico; and, it is said, further south in the mountains west of Durango City, on the tropic. It has been described by various names other than *A. concolor*, and is itself probably only a mountain form of the gigantic *A. grandis*, which reaches a height of 300 feet in the valleys of Oregon and British Columbia. Unlike *A. grandis, A. concolor* has a second-rate timber, and its cultivation in British East Africa is probably only worth attempting for ornamental

* The Mediterranean form of the common European Silver-fir *Abies alba* may perhaps be worth trial. As a planted tree it seems to succeed on the Mediterranean coast and even to occur there naturally in certain instances.

purposes. In the damp Californian valleys it grows to a noble tree 250 feet high. The northern tree is perfectly hardy in all parts of England, but requires there to be given plenty of space.

Mountains of California and Mexico.

(2) **Abies delavayi.** Delayay's Silver-fir.

Little is known of this Silver-fir; but it appears extra-tropical in its climatic requirements, and to be worth trial-cultivation at elevations from 8,000 to 10,000 feet in British East Africa.

Yunan. ("Index Floræ Sinensis." Dr. Masters.)

(1) **Abies firma.** (*A. momi* of Sargent.) The Momi Silver-fir.

This, according to Sargent, is "the largest of the Japanese Fir trees, and an inhabitant of the mountains of Southern Hondo, where it is said to be abundant in the forests of deciduous-leaved trees. It is the species best known to the Japanese, furnishing them with the fir-wood of commerce, and one of the chief ornaments of their parks."

Mountains of Southern Japan, Yunan, Corea, and Japan.

(2) **Abies numidica.** The Algerian Silver-fir.

The Silver-fir of the Atlas where it grows along with *Cedrus atlantica* and *Taxus bacata* up to an altitude of 6,000 feet where there is snow for a good part of the year. Its habitat is extra-tropical, but it is little likely to succeed permanently in British East Africa.

Mountains of Kabylia (the ancient Numidica) 4,000 to 6,000 feet. (Kent.)

(2) **Abies pindrow.** (*Abies webbiana.*) Himalayan Silver-fir.

Gamble distinguishes this as the Western Himalayan Silver-fir, growing at a lower elevation. Other authorities make one species of both the eastern (*Abies webbiana*) and the western Silver-fir.

Western Himalayas above 7,000 feet.

(2) **Abies pinsapo.** Spanish Silver-fir.

The Spanish Fir of English lawns, where it is one of the hardiest of the exotic firs. It is hardier than the allied *A. numidica*, and may perhaps have a somewhat better chance of succeeding in British East Africa.

Mountains of South Spain 3,600 to 6,000 feet. (Kent.)

(1) **Abies religiosa.** Oyamel Silver-fir.

A noble tree yielding a useful timber. With the doubtful exceptions of *Abies firma* and *A. concolor*, it is the only *Abies* found in tropical latitudes. It gets its name from the use of its branches to decorate churches. *See also* Appendix I., "Forests of Mexico and Central America." Says Robertson: "A large, beautiful tree, sometimes reaching a height of 150 feet and a diameter of 6 feet, with dark brownish bark. Trees in the open have pyramidal crowns of numerous slender branches when young; and when old sometimes heavy, spreading branches extending almost to the ground. The trees, however, usually grow in very dense stands, and being decidedly shade-bearing they form a heavy canopy. Timber valuable and (for a Fir) hard. Common on the mountains of Southern Mexico, usually at high elevations above 8,000 feet, and often up to 11,000 feet: in Guerrèro at about 4,000 feet. Regrowth plentiful where there is enough light. Forest usually pure and even-aged." This is the silver-fir that has the best chance climatically of succeeding on equatorial mountains.

All the *Abies* (Silver-firs) have a fixed and increasing value for paper pulp. Should *A. religiosa* succeed in the Kenia and other mountain forests of the Protectorate it will increase the value of these forests enormously, both from an economic and sylvicultural point of view.

Southern Mexico and mountains of Guatamala, from 4,000 feet upwards, usually at higher elevations.

(1) **Abietia douglasii,** var. **Mexicana.** (*Pseudotsuga douglasii.*) Douglas Fir.

The northern Douglas Pine now represents the biggest stock of timber left in North America. The southern variety, extending to the mountains of southern Mexico, is well worth trying in British East Africa. According to Wilmot it grows in Guerrèro to a tree of huge size. *See* Appendix I., Mexican forests.

Southern Mexico.

(1) **Abietia fortunei.** Fortunei's Fir.

A large tree with spreading Cedar-like branches. Fails after some years in England.

Mountains of Southern China where it is very wet in summer and not quite dry in winter.

(2) **Acacia baileyana.** (Baileyana Wattle.)

This beautiful Wattle may be described as an ornamental form of the Black Wattle. The leaves are of a silvery white and arranged in rosettes. It grows as fast, and to much the same size, as the Black Wattle. Mr. Rudyard Kipling picked out this tree as the handsomest in the Cape Peninsula. A specimen in the Ainsworth garden at Nairobi looks fairly healthy, and is some 25 feet high.

East Australia.

(2) **Acacia binervata.**. Binervata Wattle.

A good tan Wattle, nearly as good as Black Wattle. Grows well in the Cape Peninsula; ornamental and quick-growing. Should be tried against the common Black Wattle in wet and cold localities.

East Australia.

(1) **Acacia catechu**. Cutch tree.

Tree with a very hard, durable timber suitable for sleepers, chiefly valued as yielding cutch, a tan extract. This peculiarly valuable tree may be worth propagating artificially on the dry plains inland of Mombasa. According to Mueller it extends to East Africa and up to an elevation of 5,000 feet. *See* paragraph entitled "An Industry for the Plains." in this report: page 9.

Southern Asia.

(2) **Acacia cuninghamiana.** Cuningham's Wattle. (Golden Wattle in British East Africa.)

A handsome Acacia with whitish phyllode foliage, looking, at first sight, not unlike a Eucalypt. It has sweet-smelling yellowish flowers, is of a handsome appearance, and seems not unlikely to take the place of *Acacia baileyana* in South Africa, and occupy the position of the most handsome Wattle on the highlands of Equatorial Africa. It has been grown for some years in British East Africa, and is said to have been originally introduced by Sir Charles Eliot. It forms a handsome wind screen: the bark has no tan value.

East Australia.

(2) **Acacia dealbata.** Silver Wattle.

Professor Maiden, of Sydney, the highest authority on the Wattle Acacias and their classification, now ranks *A. dealbata* as a variety of *A. decurrens.* The Silver Wattle should not be cultivated on tropical highlands on account of (1) its practically worthless bark; (2) its habit of degenerating to a worthless scrub and becoming a pest as has happened on the Nilgiris (South India).

Writing in 1896, Mr. Cowley Brown refers to *Acacia dealbata* as being still the nuisance it was in 1882 when I knew it on the Nilgiris. It has spread widely and extensively, reproducing itself from root suckers, layers, and coppice—most prolifically from the root suckers. It is strongly shade-bearing, and itself affords an extremely dense shade. On the Nilgiris it seldom reaches more than 30 feet in height and is very liable to be bent over by the wind. Its fuel production is poor, probably not averaging above two tons per acre. It succeeds best on the Nilgiris at an elevation of about 6.000 feet. The only excuse for planting *A. dealbata* in place of *A. decurrens* is that it stands rather more frost, and sometimes, as in New Zealand, grows larger. In Nairobi the trees of *A. dealbata* in the Ainsworth garden are smaller than *A. decurrens* of the same age. It is only right to add that so far *Acacia dealbata* has shown no signs of running into scrub in British East Africa. But in any case it must be kept out of tan wattle plantations; and, in view of the prospective importance of the Black Wattle bark industry common prudence demands that Silver Wattle should be kept out of the country.

East Australia.

(2) **Acacia decurrens.** Black Wattle.

The well known Wattle that has been so largely planted in Natal, under the name of *A. mollisima,* is *Acacia decurrens,* variety *mollis.* The average production of bark, mine-poles and firewood is estimated as being worth something near £100,000 a year to Natal—£75,000 for bark and £25,000 for poles used locally or sent to the mines. It grows best in Natal at elevations between Maritzburg and Colenso, particularly along the so-called "mist belts." The coast-wise limit of good growth is at Inchànga, 2,000 feet elevation, 40 inches rainfall, and about 30 miles from the sea. The mean temperature at Inchànga would be about 63° or 64°, which is nearly the mean temperature of Nairobi. There are several varieties of Black Wattle, viz., *mollis, normalis, pauciglandulosa, leichardtii.* The three last occur in Queensland. Two, at least, of these are growing in Natal. *A. decurrens*, var., *mollis*, is the commonest in Australia, and that which is almost exclusively planted in Natal, Cape Colony, and the Transvaal. *Normalis* is the local Sydney variety, and *leichardtii* and *pauciglandulosa* local varieties found north of this as far as the tropics. All four are stated to yield bark of similar value. When planted together in British East Africa the *normalis* variety shows the more vigorous growth. This is seen in the Wattle plantations of Messrs. Felix and Favre, near Nairobi, and in the Railway plantations at Nakuru. In South Africa both varieties grew with equal vigour. Climatically one would expect the *normalis* variety to do better on equatorial highlands. As an ornamental tree the *normalis* variety is the prettiest with its delicate foliage like that of the asparagus creeper in ferneries. At Tokai, near Cape Town, this variety has been grown sufficiently abundantly to yield a fair supply of seed. I have seen occasional specimens of it in Natal. The Black Wattle is one of the "golden wattles" of Australia, and all its varieties are beautiful, particularly when in flower in Spring.

Those who may wish to consult an Australian work on the subject of Wattle growing cannot do better than read "Wattles and Wattle Barks," by J. H. Maiden, Government Botanist, New South Wales. (Technical Education Series, No. 6, Sydney.) Those interested in Black Wattle cultivation in Natal should read an excellent paper by Mr. T. R. Sim, Conservator of Australia, and all its varieties are beautiful, particularly when in flower in Spring.

The data given below are extracted from Mr. Sim's paper and my own notes taken during a visit to Natal.

The Black Wattle in Natal.

Rainfall.—From 20 inches, if soil is deep and moist and mists frequent. But 30 inches to 40 inches is more suitable.

Price of Wattle land.—From £1 to £6 per acre, on an average.
Cartage limits killing profits.—Fuel, 8-10 miles; mine props, 16-20 miles.
Seed per acre.—In lines, 1 lb. to 1½ lbs.; broadcast, 3 lbs. to 5 lbs.
Thinning.—Cut out dominated stems; prune back dominating stems; first unremunerative thinning at 3 or 4 years; keep as far apart as you can so long as canopy is maintained and stems are clean. Usual final espacement, 6-10 feet, or 2,200 to 440 stems per acre.
Crop.—Time, from 5 years; average 10 years.

Yield.—Average, 5 tons of dry bark, 30 tons of dry timber.
Price.—Bark average at Dalton, the centre of Noodsberg District:—£6 to £6 10s. per ton for bark in bundles; ground and bagged, £1 more. Fuel £5 to £20 per truck of 20 tons. Pit props (heavy), double fuel prices.

There are some 30,000 acres of Black Wattle plantations in Natal.
Owing to the dry weather in 1906 hindering the stripping of the trees, the Natal export of wattle bark fell from £112,000 worth, in 1905, to £80,000 worth in 1906. A considerable increase is, however, looked for during 1907. The price of bark for 1907 is about £1 per ton higher than in 1906. Owing to the extent of land suited for the growth of this tree being somewhat limited, Wattle land has recently changed hands at prices varying from £5 to £10 per acre. £6 per acre may be looked on as the average value of good Wattle land in Natal. In Natal the industry is now a well-established and, generally speaking, a very profitable one.
Yield of Firewood.—The yield in firewood, at 40 lbs. per cubic foot and cropping at ten years, amounts to a mean yearly timber yield (Acrim) of 150 cubic feet. Where the Wattles grow very quickly and can be cut at five years, the Acrim would be 300 cubic feet. The Black Wattle grows as well in the eastern districts of Cape Colony as in Natal. The average over 643 acres of Wattle plantation (mostly Black Wattle) at Fort Cunnynghame, cropped at 7 years, was an Acrim of 83 cubic feet. (Sim, in "For. Fl. of Cape Colony.")
In the Transkeian District of Cape Colony, where there has been much destruction of forest by natives, special plantations of Black Wattle have been formed to supply the natives with poles and thus save the young trees in the forest.
An average sample of Natal Black Wattle analysed by Mr. A. Pardy, F.C.S., of Maritzburg, gave:—

Soluble matter	47·90
Non-tannin	11·94
Tanning matter	35·96
	95·80

So far the Black Wattle has grown with surprising vigour both in German and in British East Africa. It grows even faster than in South Africa; and the bark seems to promise to be richer in tannin. An analysis from 6-year old trees at Nakuru (British East Africa) (10 lbs. of bark stripped as it came) yielded 43 per cent. of tan as against 34 per cent. stated to be the average for Natal bark. Maximum growths of 3 inches in diameter and 14 feet in height per year have been recorded near Nairobi. The analysis of Black Wattle grown in German East Africa shows a higher percentage of tan than analyses of South African or Australian bark. Thus the Black Wattle bark in German East Africa runs from 40 to 45 per cent. of tannin while the Natal average is about 34 per cent. (Dr. Samasa). Germany is the chief market for Black Wattle tan bark, prices there ruling from £8 to £10 per ton, against £6 per ton for Quebracho. French tanneries seem to use more of Quebracho wood.
The question of making Black Wattle Extract has been revived lately. Since the extract contains barely 50 per cent. of tannin and the dry bark up to 45 per cent. there is little economy in making Black Wattle Extract, especially as the dry bark is easier to handle and export than extract.
Tasmania and East Australia.

(2) **Acacia implexa.** Implexa Wattle.

A medium-sized tree, with ornamental white flowers coming in the middle of summer, when all the other Wattle flowers are over. It is worth trial as an ornamental tree on equatorial highlands.
Queensland.

(2) **Acacia melanoxylon.** Blackwood.

This well-known tree has been successfully planted throughout South Africa. It is seen at its best in Natal, where a small and a large-leaved variety are distinguished, and it grows to a noble tree there. Its straight, rapid growth, its good natural reproduction and dense covert render its introduction to the forests of the Protectorate well worth trial. On the Nilgiris, South India, it has been cultivated for half a century. At first it grew as vigorously as the Blue-gum, but, after a few years, was attacked by a species of *Loranthus*, which stunted and eventually destroyed many of the trees. Species of *Loranthus* are only too common in British East Africa. Later accounts speak of the *Loranthus* trouble as less serious now than when I knew the Nilgiris in 1882. With a little care Foresters there keep it under. Timber produced from Nilgiri trees has so far been lighter than the Australian wood; but there is no evidence to show that when mature it will not be as good as the Australian timber, that is to say, a first-rate timber. The timber resembles Walnut and is the most valuable of the commercial timbers of Tasmania. On the Nilgiris, under favourable conditions, Blackwood grows to a height of 140 feet, and a diameter of

3 feet. It is a fairly rapid-growing tree there, showing a growth rather more than half of the extraordinarily rapid Blue-gum. Single trees show a very high individual increment. Cowley Brown cites one of 8·3 cubic feet and remarks, "It is probably the biggest on the Nilgiris." On the other hand, the Acrim in the Rallia plantation at 33 years of age was only 48·5 cubic feet, and the individual increment only 1 cubic foot. The Loranthus parasite still continues to infest the Nilgiri trees, but the damage has been less than was threatened in 1882. Blackwood is considered by Cowley Brown to be a decided shade-bearer on the Nilgiris, an extremely important point in the introduction of this tree to the indigenous forest of British East Africa. It ranks, too, as a shade-bearer in South Africa—most of the introduced trees there being light-demanders.

It has already been grown to some extent in Equatorial Africa. At Lari, 8,000 feet, it does uniformly well. At Nairobi and Kiambu, 5,500 feet, it requires a deep soil and moist situation to do well.

Tasmania, and the cooler parts of South-East Australia.

(2) **Acacia penninervis.** Penninervis Wattle.

A good, tanbark Wattle. Small tree, up to 40 feet high; worth trial-planting in British East Africa.

East Australia.

(2) **Acacia pycnantha.**

At the Government farm, Nairobi, was a plot growing so vigorously that planters might be tempted to waste money on the risky experiment of planting this species. It is a climatic exotic in British East Africa and little likely to give a return either in bark or fire-wood. In South-East Australia it is the most valuable of all the tan Wattles. As a young tree it grows rapidly in Nairobi, but many die off. No analysis has yet been obtainable from its bark. Its growth is never equal to that of the Black Wattle.

Southern Coast of Australia.

(2) **Acacia saligna.**

This is a particularly hardy Wattle. It bears much climatic displacement, and it might give good returns on the highlands of British East Africa, though the climate here is quite foreign to that of its natural habitat in West Australia. In the Cape Peninsula it has run wild and has yielded good returns for many years. It gives an excellent fire-wood and a bark fairly rich in tannin. On a soil of medium fertility it gives a firewood yield rivalling for a few years that of the Blue-gum. Its bark has for some years been the chief tanning material of the Cape Town tanners.

There are some healthy-looking young trees in the "Escarpment" plantations that have come with Black Wattle seed from Cape Town. I noticed one of these standing 4 feet at one year of age.

South-West Australia.

(2) **Acer macrophyllum.** Macrophyllum Maple.

A large tree, usually found near streams. It yields much of the curled and "bird's eye" Maple that always commands a market.

North Mexico and United States of America.

(2) **Acer rubrum.**. Red Maple.

Worth trying where there is plenty of moisture. It grows naturally in swampy ground. Foliage rather more brilliant in autumn tints than the common Sugar Maple.

Eastern Texas.

(2) **Acer saccharinum** (Wang) of Hough, of Sargent in "Census Rep.," and of Gamble. *A. barbatum* (Mich), of Sargent in "Silva of United States of America." *A. saccharum* (Marsh), of Sudworth.

Sugar Maple.—This tree is the glory of the North American forests, and one of the most valuable trees there. "A noble tree," says Sargent in his great forest flora of North America. It forms pure forest in the north, and grows to a height of 100 or 120 feet. It is the principal Sugar Maple. The yield of the other Sugar Maples is of little account. The wood is used for a variety of purposes, but chiefly in its ornamental forms for the interior work of houses. It is a first-rate firewood, and the ashes are particularly rich in potash. In forestry it is notable as a strong shade-bearer.

There are low mountains in South-Eastern Texas where the climate is not unlike that of the mountains of British East Africa between 6,000 and 8,000 feet. So valuable a tree is worth trial-planting and endeavours should be made to get seed from the mountains of South-Eastern Texas. *Acer saccharinum* has failed in Natal, but the failure there may be largely due to the dry Springs. It is worth trial between 8,000 and 10,000 feet on Equatorial highlands.

Eastern damper portions of the United States of America, from Canada to East Texas.

(1) **Acrocarpus fraximifolia.**

One of the largest of the Nilgiri shola trees. It may be worth while introducing it to the highlands of British East Africa.

Nilgiris, South India.

(1) **Agathis palmerstoni.** Queensland Kauri.

Timber useful, coniferous, resembling Kauri pine. A very desirable introduction for Equatorial highlands whenever climatically-suited seed is obtainable.

Mountains of New Guinea.

(2) **Albizzia lebbek.** Siris.

A large deciduous tree growing up to 5,000 feet on the Himalayas. It furnishes a valuable though a hard wood. Gamble thinks it is probably the East Indian Walnut of the European market. It has the good quality of growing very rapidly during the first year. In India it is largely cultivated as an avenue and garden tree. Its flowers are admired. It stands drought and has been planted as an avenue tree in Cairo and Port Said, whence Mr. Rhodes sent cuttings to Rhodesia. These Egyptian avenue trees have fine dense foliage and a handsome appearance. It is found growing wild in Central Africa, and may be worth cultivating in British East Africa if it is not already there.

Himalayas, to 5,000 feet.

(1) **Aleurites moluccana** (*A. triloba*). Candlenut tree.

Grows on the mountains of Southern India up to a height of 4,000 feet or more, and may probably be usefully cultivated about Nairobi. It is valuable (some say very valuable) both as an ornamental tree and for the nuts, which are eatable and yield an oil, useful both for burning and as a drying oil for paints. This tree came originally from the Malay Archipeligo and has become naturalized in South India. Timber of poor quality—38 lbs. to the cubic foot. (Gamble.) In Natal it grows rapidly along the coast districts and inland as far as Maritzburg.

India, naturalized.

(1) **Alnus firmifolia.** Mexican Alder.

A small tree of high altitudes in Southern Mexico. Robertson says that there are probably other species of Alder in Southern Mexico.

South Mexico.

(1) **Alnus glabrata.** Alder.

A good timber tree: closely allied to *A. acuminata*. Robertson describes it as "a large tree often 60 feet high and 2 to 3 feet in diameter, with a straight stem and full crown, making an excellent shade tree; common along streams and planted as a shade tree along the roadsides." It prefers to have plenty of soil moisture.

Southern Mexico and Guatamala.

(2) **Angophora lanceolata.** Australian Apple.

Worth trial-planting as a shade tree; timber second rate.

Queensland.

(2) [perhaps (1)] **Araucaria bidwilli.**. Bunya-bunya.

This is a fine tree with an eatable nut like an acorn, and a good durable building timber. I saw various specimens growing well in Natal, where it may eventually take the place of the common European Oak in Cape Colony. If the Bunya-bunya Pine succeeds in British East Africa it will prove a valuable acquisition. It may do better in the Rift Valley than in the very wet forest country. It should be tried wherever the Cedar grows. The crops of nuts were formerly an article of food highly prized and fought for by the Australian blacks. Valuable as are its nuts, it is at the same time one of the most ornamental of the Araucarias. At Lari, 8,000 feet, in the forest plantations is a young tree growing as vigorously as any I have seen in South Africa.

Queensland mountains; perhaps on higher mountains in New Guinea.

(1) **Araucaria brasiliana.** Araucaria of Brazil.

This fine forest tree grows over wide areas in Southern Brazil and further north in the mountains whence seed should be obtained for forest work in British East Africa. It is one of the few trees which, in the forests of Brazil, form pure forest. It furnishes a good pine-like timber; and should do best at about 7,000 feet on the highlands of British East Africa.

Southern Brazil, up to 3,000 feet.

(1) **Araucaria cookii** (*A. columnaris*, (Hook).) Cook's Araucaria.

This is one of the noblest of the Araucarias, running up to 150 or 200 feet on its native mountains. It often presents a weird appearance shedding the branches of its stem and replacing these by a bushy growth. Hooker called it *A. columnaris*.

It may prove a tree of great value in the mountain forests of British East Africa.

Mountains of New Caledonia.

(1) **Araucaria cunninghamii.** Moreton Bay Pine.

Pine-like timber. A lofty tree, up to 200 feet. The most widely distributed of all the Australian Araucarias. Grown successfully all through Natal, but best near the coast and middle regions. Von Mueller states that this tree grows at an elevation of 5,000 *feet on the mountains of New Guinea.* It is probable that it grows also at higher elevations and that it is a tree worthy of introduction to the mountain forests of British East Africa, though its timber is but an inferior deal, not at all equal to pine timber.

Eastern Australia, latitude 14° to 32°, coast, and 80 miles inland. Mountains of New Guinea, 5,000 feet.

(1) **Araucaria excelsa.** Norfolk Island Pine.

This well-known tree, the most symmetrical of all trees, does not appear to have yet been tried in British East Africa. Good seed is always troublesome to obtain. It is difficult to say whether this remarkable tree is more ornamental grown in masses as forest or as single trees on lawns. It furnishes a good straight clean timber, which has been used for masts, &c.

Warm extra-tropics and mountains within the tropics.

(1) **Araucaria montana.** Mountain Araucaria.

This seems one of the most desirable of the Araucarias for introduction to the highlands of British East Africa.

New Caledonia, on mountains.

(1) **Araucaria rulei.** Rule's Araucaria.

A small Araucaria, 50-60 feet, much cultivated in Australia for its picturesque look.

New Caledonia, on mountains.

(2) **Argentine Cedar.**

This is probably a Cedrela. It is said that there are great forests of it, and that the timber resembles Mahogany. Its botanical name is unknown to me.

Mountain slopes of Tucuman.

(2) (1?) **Aspidosperma quebracho.** Red Quebracho.

This is a remarkable tree: it yields a tannin extract of great strength. Its export from the Argentine has had a long-continued disturbing effect on the tan bark markets of Europe. The timber is excessively hard, but almost imperishable; and though it is said to take nearly a century to mature, it may be worth trial-planting in British East Africa.

Northern Argentine, particularly the Gran Chaco and wetter regions to the north.

(1) **Bamboos.**

The Bamboos of commerce belong to the genera *Bambusa Arundinaria, Phyllostachys, Dendrocalamus* and *Gigantochla.* The Common Bamboo of India is *Dendrocalamis strictus.* The Common Bamboo of South Africa is *Bambusa balcooa* (according to Sim also *Bambusa vulgaris*, and several other species). *Arundinaria tessellata* is the mountain Bamboo of South Africa, known there as Berg Bamboo. For the highlands of British East Africa the Southern Japanese Bamboos seem the most economically useful; but the bamboos from Central America and the Equatorial Andes are those which are most climatically suited. The common large Bamboo of Southern India is *Bambusa arundinacea* (Thorny Bamboo). Gamble describes this as a magnificent species. *Gigantochla maxima*, or an allied species, produces stems thick enough, when cut in half, to serve for canoes! The *Arundinarias* are mostly extra-tropical or Alpine. The small *Arundinaria falcata* grows up to 7,000 feet on the Himalayas. The large *Arundinaria falconeri* grows up to 8,000 feet on the Himalayas. *Arundinaria japonica* is the "Mettakè" of Japan, commonly planted out-of-doors in England: *Arundinaria alpina*, the common East African bamboo.

Bamboos occur in the extra-tropics of both hemispheres, and they extend in tropical countries right round the globe. In New Guinea there is a zone of Bamboos above the forest and below the Alpine region, as on the mountains of British East Africa.

In Japan Bamboo-growing is a great national industry. Bamboos are grown both for their timber and for food, the young shoots being eaten. Bamboos grow easily from cuttings. It is best to take two or three joints to each cutting and take the cuttings near the base of the stem.

Japanese Bamboos.—The cultivation of Bamboos in Japan gives returns of from £6 to £8 per acre per year. Only one species of Bamboo is commonly grown in Japan for food, the largest one, *Phyllostachys mitis*, called by the Japanese "Moso." It was introduced from China where it has been cultivated for food for centuries. *Phyllostachys aurea* has also edible shoots. Shoots of other kinds are too bitter to be eaten. These Bamboos are cut much like we cut Asparagus, the tenderest shoots and those which bring the largest prices are the ones dug up before they emerge from the soil. It is said that the Bamboo shoots are very nutritious, but somewhat indigestible to Europeans at first. The following are some of the more important Japanese Bamboos:—

Phyllostachys mitis. The largest hardy species in Japan, growing to a height of over 50 feet and the stems sometimes over 6 inches in diameter. This, as mentioned above, is the common edible Bamboo of China and Japan.

Phyllostachys quilioi. The second largest hardy species growing in Japan, and the great timber Bamboo of the Japanese.

Phyllostachys henonis.—This is inferior in size to the two previous Japanese Bamboos, but it is the commonest kind seen in Japan.

Phyllostachys nigra.—This was formerly largely cultivated in Japan for export. It is a smaller species than the preceding. It has its stem covered with large brown spots, which spread as it grows older until the whole stem become dark brown and almost black. This is one of the most ornamental and hardy of the Bamboos. It succeeds well even in England.

Phyllostachys castillionis.—This is a smaller ornamental species. This Bamboo, with its golden stems, mixes well with the black Bamboo in ornamental plantations.

Bambusa quadrangularis.—This is not of much value, but is used for decorative purposes.

For information concerning the cultivation of Bamboos the following works may be consulted: "The Bamboo Garden," by Freeman Mitford; "Monograph on Indian Bamboos," by J. G. Gamble ("Annals of the Royal Botanic Gardens, Calcutta"); "Bulletin, No. 43, United States Department of Agriculture," by D. G. Fairchild. I have had the good fortune to meet all these three authors and discuss bamboo-growing with them. No doubt bamboo-growing has a future in Equatorial Africa, but it is difficult to get either seed or cuttings in good condition.

(1) **Bambusa balcooa.** Cape Bamboo.

It is this Bamboo that has been naturalized at the Cape for about a century. Cuttings are easily procurable and it should be tried at once from Nairobi upwards. The stems are used throughout South Africa, the thin stems for whip-sticks, the thick stems for purposes where strength is required, such as ladders.

Cultivated widely in South Africa.

Himalayas.

(2) **Bambusa fortunei.**

This will probably form one of the best hedges in the Protectorate. Sim terms it the best hedge plant in the lowland districts of Natal and up as far as the mist belt. It is easily raised from cuttings and easily kept in order as a hedge. It should succeed about Nairobi.

Japan.

(2) **Beaumontia grandiflora.**

This is a creeper, with splendid large white flowers and dense foliage. It is mentioned here, as no plantation of ornamental trees near Nairobi should be without it.

Brazil.

(1) **Belis jaculifolia** (*Cunninghamia sinensis*). Belis.

A handsome Conifer growing in dense damp forests on the mountains of tropical China and Formosa. Of this and other trees in Formosa the Japanese Forest Department would supply the seed. It is so handsome and useful a tree that the Japanese have introduced it to their islands where it has long been under cultivation both in the forests and as an ornamental tree in parks. Unlike the Araucarias, it is hardy against frost and drought; and, unlike most conifers, it sends up suckers from the root and re-shoots when cut. A tree found chiefly in mountain valleys; its timber is used for planking. Whatever Conifers may ultimately succeed in British East Africa, there seems no reason to doubt the ultimate success of the Formosa Belis. *Belis jacufolia* (Salisbury), as Masters points out, is the older and more correct name. *Cunninghamia sinensis* (R. Brown) is the one most in favour with gardeners; but the latter name is liable to be confounded with quite another tree, viz., *Araucaria cunninghamii*, of Queensland. Those who prefer the name *Cunninghamia* do so on the ground that "Belis" may be confounded with "Bellis," the botanical name of the "Daisy" of English grasslands.

Mountains of Formosa and South China, 5,000 to 8,000 feet.

(1) **Bougainvillea, spp.**

Inserted here like *Beaumontia* because it is indispensable to any plantation of ornamental trees. There are three usual species under cultivation with colours—magenta, rose, and terra-cotta. The first is the hardiest, but all three should do well in a climate such as Nairobi. They may be used for hedge purposes and ground work as well as climbers. The common magenta species is frequently seen in Nairobi gardens.

Tropical and Extra-tropical Brazil.

(1) **Broussonetia papyrifera.** Paper Mulberry.

It will probably be found that this useful tree will succeed admirably from 5,000 feet upwards in British East Africa, or at lower elevations under irrigation. I have found it to be easily raised and to grow rapidly. It has been successfully cultivated in both tropical and extra-tropical climates. On a good soil and in a damp climate it has proved very fast growing. I have found it in Cape Colony to grow easily from either cuttings or seed. It furnishes a good paper stock and may prove a valuable cultivation in the Protectorate.

China and Polynesia.

(1) **Callitris, sp.** (or possibly *Cupressus.*)

A tree has been long grown on the Nilgiris under the name of *Frenela rhomboidea.* What this species really is remains perhaps to be determined. At Ootacomund (Arambi plantation) at 7,500 feet, it grows vigorously, with an Acrim of 111 and an individual increment of 1 cubic foot.

The growth of these trees on the Nilgiri is equal to the largest Callitrises in Australia. Cowley Brown estimates the growth in 60 years as 110 feet high and 2 feet 6 inches diameter. The 30-year old specimens in Sim Park, Coonoor, are described as magnificent.

(2) **Callitris calcarata.** Cyprus Pine.

A pretty, small tree, with the appearance of a Cypress, but foliage more dense and of a fresher green colour. Timber more or less scented, durable, and with the rich, dark brown

colouring of Cape Stinkwood. Not fast-growing, but yielding timber that is very ornamental and usually durable. The handsomest specimen plank in the timber museum at Kew is labelled *C. calcarata.* It is worth growing in British East Africa, if only as an ornamental tree. There are a few trees growing fairly of (probably) this species at Deepdene, near Kiàmbu, British East Africa.

East Australia.

(2) **Callitris columellaris.**

This is a straight-growing coast species, and probably not so well suited to the highlands of East Africa as *C. robusta* and *C. calcarata.* It is, however, worth trial at about the elevation of Nairobi, or somewhat lower.

East coast of Northern New South Wales and South Queensland.

(2) **Callitris cupressiformes.** Oyster Bay Pine.

This is the Callitris, long known as *C. rhomboidea.* It is a small, bushy tree, but very ornamental with its graceful, nodding top. It is widespread in Australia, and will grow almost anywhere in the Extra-tropics. The tree called by this name on the Nilgiris may be *C. columellaris.*

From Tasmania to Queensland.

(2) **Callitris robusta.** Black Cypress-pine.

Maiden, in his recent monograph on the Callitrises, places this first in economic importance. Its timber is often highly ornamental and durable against both decay and attacks of white ants. It should be tried along with the other Callitrises in dry localities, such as Naivasha and the Rift Valley.

Inland Australia; widespread.

(1) **Callitris whytei.** m'Lànji Cedar.

The Cedar of the highlands of British Central Africa—Rhodesia northwards. It is chiefly seen on the m'Lanji Range, where it extends in broken forest over an area of some 50,000 acres. Its timber is highly scented, sound, and resembles generally the Cape Cedar, *Callitris arborea.* It is strong and durable, resisting white ants and fungoid rots. It is the common house-building timber in Central Africa. It has been planted to some extent in British East Africa, so far with promising results. It seems desirable to continue the planting, but not on a large scale till its climatic fitness has been more fully proved. I gather from Mr. Cowley Brown's report that this tree is growing well on the Nilgiris. It is the "South African Pine" (p. 31) of his report.

m'Lànji Range and southwards to Rhodesia.

(2) **Callistemon lanceolatus.** Red Bottle Brush.

Has brilliant flowers, varying from pink to crimson colour. Wood durable and hard. Several other Callistemons have equally brilliant red flowers. The Callistemons are slow-growing small trees with the practical value of often succeeding on salt, swampy ground. The *Melaleucas* are even better in this respect. Both furnish durable fencing poles.

Queensland; in beds of rivers.

(2) **Carissa grandiflora.** (*Amàtungùla.*)

This is the queen of hedge shrubs in Natal, and there seems every likelihood of its proving sufficiently hardy to be used as a hedge in British East Africa. In Natal it forms an ideal hedge, prickly and impenetrable, growing naturally close, and wanting little clipping, but standing clipping well. It is evergreen, and unless kept clipped too close, furnishes good supplies of a pretty plum-like fruit, which is juicy and palatable, either eaten raw or cooked.

South Africa.

(2) **Carissa spp.**

Other Carissas good for hedge purposes are *C. ferox, C. arduina, C. cerandas,* and *C. browneii.*

Naudin recommends *C. arduina* for planting as a railway fence in the South of France.

(1) **Carpinus caroliniana.** (*C. americana.*) Hornbeam of Central America.

A tree of the Eastern U.S.A., but reappearing on the mountains of Mexico and Central America. If a shade-bearer like the European Hornbeam it may prove a useful introduction to forest on Equatorial highlands. It is closely allied to the European Hornbeam.

Southern Mexico and Central America.

(1) **Casimiroa edulis.**

A tall fruit tree that seems worth introducing to Equatorial highlands. It is said to flourish up to an elevation of 7,000 feet in Mexico and to produce a fruit very highly esteemed by some, though the kernels of the fruit are poisonous and the fruit itself may be slightly narcotic.

Mexico.

(2) **Cassia auriculata.**

A shrub with tan bark worth about double that of Black Wattle on the London market. It grows less rapidly, however, than Black Wattle and not larger than a bush. It might be

planted on land too dry and warm for Black Wattle. It grows well on the Mysore plateau, 3,000 feet, Southern India, and has a range from sea-level up to perhaps 5,000 feet.
India.

(2) **Castanea vesca.** Sweet Chestnut tree.

This is the common Chestnut tree of Europe, which in Italy and Sardinia supports a considerable population on its nuts. It is scarcely likely to succeed in British East Africa, but may be tried from 6,000 feet upwards, on rich volcanic soil. It is seen at its best on the slopes of Vesuvius and Etna.
South Europe and mountains of Asia.

(2) **Casuarina cunninghamiana.** Beefwood.

To this species is referred the common Casuarina of the Transvaal, where it grows well from Johannesburg to Delagoa Bay. It is the tree long cultivated at the Cape under the name of *Casuarina leptoclada*—a name that originally came with the seed from the Botanic Gardens at Grahamstown. A handsome shade tree, but of little timber value; and, curiously, both in the Transvaal and at the Cape, it is generally a failure when planted close in timber plantations or when left to itself on the veld. There are some specimens of it growing well in the Ainsworth garden at Nairobi, and a few young trees elsewhere in British East Africa, particularly at Port Florence. It is a quick-growing, handsome pine-like tree, well worth planting for ornamental purposes.
East Australia.

(1) **Casuarina decaisneana.** Beefwood.

A large tree of the inland districts of Australia, with durable, hard timber, but very slow-growing. It might be worth planting in the Rift Valley on the dry plains of the northern part of the Protectorate.
Central Australia.

(2) **Casuarina equisetifolia.**

This is the tree that has been so largely planted on the sands of the Madras coast, at Mauritius, and along the Suez Canal, &c. It is seen at its best in the tropics, though it grows with some vigour up to an elevation of 5,000 feet.
Tropical Australia and Asia.

(2) **Casuarina glauca.** Desert Beefwood.

This is worth trying on the Athi plains or the desert country in the north of the Protectorate.
Interior of East Australia.

(2) **Casuarina torulosa.** Beefwood.

A small, shade-giving handsome tree; may be tried with the preceding.
Queensland.

(2) **Catalpa speciosa** and **C. bignonoides.** *Catalpa.*

These are the trees so strongly advocated for remunerative planting in America, particularly the Southern States, U.S.A. In South Africa they have been carefully and repeatedly tried, but can not be compared to Eucalypts for remunerative planting. In Egypt, as young trees at any rate, they grow as fast as Eucalypts. Their timber is more generally useful than the best of the Eucalypts; and they seem to be really useful for remunerative planting in America in spite of a somewhat damaging over-advocacy. I consider that both species should be carefully tried on Equatorial highlands. They are ornamental, should they fail as timber trees. As ornamental trees they succeed in Southern Mexico. With them should also be tried the Japanese *C. kaempferi.*
Southern States, U.S.A.

(2) **Cedrela angustifolia.** Cedar of Peru.

Well worth trial if the seed can be procured along with *C. guianensis* and *C. montana* of Caracas. After Conifers such as Pines, Cypresses, Araucarias, Callitrises, &c., the Cedrelas take the first place as desirable trees for Equatorial highlands. As a rule they are trees for the lower elevations, extending down to tropical temperatures, while the Conifers, especially the pines, should extend to the limit of tree vegetation, and perhaps to the snow. Though the typical Cedar wood is the produce of various species of Juniper, the largest supplies of Cedar and the most valuable Cedar timbers are obtained from the various species of Cedrela.
Peru.

(1) **Cedrela australis.** Red Cedar of Australia.

The most valuable timber tree in all Australia. It is durable, does not split or warp in seasoning, works well, and when polished has the colour and figure of Mahogany! It weighs only 28 lbs. the cubic foot. It grows to a tree of giant size. Trees with a diameter of 10 feet and a total height of 200 feet are on record. "Cedar-getting" was long a special industry in Queensland and northern New South Wales; but most of the accessible good timber has now been cut out. The seed is difficult to procure good, and it is only recently that a supply of good seed has been secured for South Africa. Both seeds and young plants have been imported for the forests there. From Australia this valuable tree extends to the mountains of Guinea, whence, if possible, seed should be procured for British East Africa.
New Guinea and East Australia.

(1) **Cedrela bogotensis.** Cedar.

This is one of the most important trees to plant in the British East African highlands. This should be one of the first tree seeds obtained as soon as a systematic attempt to procure tree seeds from Nicaragua is made.

Nicaragua, up to 8,000 feet, and near Bogota, the capital of the State of Colombia.

(1) **Cedrela febrifuga.** Cedar.

Closely allied to *Cedrela australis* of Australia. All the Cedrelas have good or useful timbers. It is an important tree to introduce.

Mountains of Java, Sumatra, and Timor.

(1) **Cedrela fissilis.** Acajou wood.

A valuable introduction: should be tried both in the coast forests and at lower elevations of the highland forest, say, near Nairobi.

Mexico.

(1) **Cedrela odorata.** Moulmein Cedar.

A tropical and semi-tropical tree. It is quick-growing, and rapidly runs up to a huge tree from 4 to 6 feet in diameter and 80 feet of bole. A tree of the first economic importance, with a durable cedar-wood weighing 36 lbs. per cubic foot The timber is scented and is used for boxes and wardrobes when it is desired to keep away insects, also largely for cigar boxes. The timber is dark red or brown in colour. Splits easily and furnishes good shingles. It may be seen growing well in the Botanic Gardens at Durban, Natal.

In British East Africa it should be planted either near the coast or at the lower elevations of the highland forests, n'Dì for instance. Few more valuable trees could be introduced.

Coastlands of Central America and West Indies; Mexico at moderate elevations.

(1) **Cedrela paraguensis.** Cedar.

This and the following two Cedrelas, though not so well climatically suited to British East Africa as the preceding, should be given a trial, on account of the peculiar value of their timbers, viz., Cedars without the brittleness of the Junipers. All the Cedrelas are first-rate timbers.

Paraguay.

(1) **Cedrela serrata.** Hill Toon.

This, though a separate species botanically, is of interest chiefly as the mountain form of *C. toona*. Its timber is of good quality, without, perhaps, being equal to *C. toona* or *C. australis*. It merits early trial in British East Africa. At the Government farm, Nairobi, are two or three small trees, the largest 7 feet. They are now two years old and have quite a healthy appearance, but suffered at one time from caterpillars.

Himalayas, to 8,000 feet.

(2) **Cedrela toona.** Toon.

The Indian *Cedrela toona* is only a geographical variety of *Cedrela australis*. This also produces first-rate Cedar timber and should be planted in British East Africa, though, naturally, for equatorial highlands, seed from the mountains of New Guinea is to be preferred, or even the Himalayan *Cedrela serrata*. *Cedrela toona* is really a tropical tree and grows only to an elevation of 3,000 feet on the North-West Himalayas, though it is found as high as 7,000 feet in Sikkim. (Gamble.) *Cedrela toona* grew 6 feet in two years in the park at Dàr-es-salàam, and was very vigorous-looking, with leaves over 3 feet long. It grows very well at Coonore, on the Nilgiris (6,000 feet elevation), and the timber grown there has fetched high prices locally.

Young trees seem quite hardy at Nairobi. Few trees have done better in the forest arboretum at Nairobi.

Himalayas, to 3,000 feet.

(1) **Cedrela velloziana.** Cedar.

A fine tree with first-rate timber; if possible seed should be procured from the mountains of tropical Brazil.

Brazil.

(1) **Cedrus deodara.** Deodar.

The finest timber tree on the Himalayas and growing well on the Nilgiris (*see* report on Nilgiri trees, Crowley Brown, 1906). It is hence a tree of the first importance for planting, both as an ornamental and a timber tree, in British East Africa. But, as a timber tree, it must be planted with caution, till the quality of the timber yielded by the Nilgiri tree has been proved. The Deodar grows well in Europe, but the timber of European-grown trees is far from having the fine qualities of the Himalayan tree. It is noteworthy that the more rapidly grown tree of the wetter portion of its Himalayan habitat produces the better timber.

Himalayas, 4,000 feet to 10,000 feet: drier outer slopes; less abundant on dry inner slopes.

(2) **Ceratonia siliqua.** Carob.

Climatically an exotic, but it may be worth trying on the drier plains. As is well known, the sweet pods form a valuable food for stock, and ground up are understood to be

one of the chief ingredients in "Thorley's Food for Cattle." It grows well in South Africa even out of its climatic habitat, but I have never seen it there with the growth and vigour of the Mediterranean tree. In Cyprus, where it is seen at its best, the subsoil is limestone.

Mediterranean.

(2) **Cercis siliquastrum.** *Judas Tree.*

This well-known ornamental tree is worthy of cultivation on Equatorial highlands. The flowers have a beautiful rose-colour, and are produced before the leaves, which themselves take on fine tints and are ornamental. The wood, when large enough to be of any use, is also ornamental, of a grey colour, streaked with black, green, and yellow.

South Europe and Japan.

(1) **Ceroxylon andicola.** Wax palm.

A majestic hardy palm well worthy of trial on the higher mountains of British East Africa. Yields wax. Grows up to snow level, on the Andes.

Andes, to 11,000 feet.

(1) **Chamaedora elatior.** Palm.

One of several ornamental palms growing in the warmer temperate plateau region of Mexico. Should be noted for ornamental planting in British East Africa.

Mexico, 4,000 to 5,000 feet.

(1) **Cinchona officinalis.** Quinine tree.

It should grow easily, from Nairobi upwards. It is said to be the richest yielder of quinine. On the Nilgiris, Cinchona has been successfully planted under Eucalypt standards. The mixture, says Cowley Brown, appears very successful.

Equatorial Andes, between 6,000 and 10,000 feet.

(1) **Cinchona succirubra.**

This is the species most largely cultivated for quinine in South India. In British East Africa it would most likely succeed in the damper regions above the country where coffee flourishes. Large areas were laid down under Cinchona in Ceylon after the failure of coffee. The price of quinine is now so low that it is hardly worth while planting Cinchona trees. Various other species are cultivated for quinine.

Andes.

(1) **Cinnamomum calisaya.**

This and other species of Cinnamomum grow on tropical mountains. *Cinnamomum cassia* up to 6,000 feet. *Cinnamomum zeilanicum* up to 8,000 feet in Ceylon. The spice is given by the bark; the root yields camphor.

There are about 24 species of Cinnamomum, most of them with useful timber, not too heavy and more or less scented. Some of these would be suitable for the m'Di forests.

(1) **Cinnamomum camphora.** The common Camphor tree.

This is the well known tree, yielding both the camphor of commerce and a valuable timber, easily worked, seasoning well, and durable in the ground. The timber is of a wide utility. It has been used in South Africa both for making furniture and for railway sleepers. It furnishes a first-rate sleeper that is protected from decay and white ants by the camphor with which its tissue is imbued. The Camphor tree is seen at its best on mountain regions within the tropics. In Formosa, the country of camphor trees, it grows from 3,000 feet elevation upwards. It thrives on the Nilgiris. (Cowley Brown.) It is important to introduce it to the indigenous mountain forests of the Protectorate. It spreads itself rapidly. Birds distribute the berries. For British East Africa seed should be obtained through the Japanese Government from the mountains of Formosa. Fresh seed, specially packed, should be used. Dried seed gives a very poor germination. Autumn is the season for obtaining fresh camphor seed. Camphor succeeds best in Ceylon at elevations of 3,000 feet to 5,000 feet. It has been propagated there from seed imported from Japan and from root cuttings. The imported Japanese seed has given disappointing results. Camphor is said to thrive not only in ravines but on wind-blown hill crests where scarcely anything else will succeed. It does not flourish under 2,000 feet. The tree as cultivated in Ceylon is coppiced and not allowed to reach more than 5 feet high. Camphor is distilled from the leaf clippings. It is considered that the bushes may be clipped three or four times a year. Clippings obtained from the Hakgala Gardens in Ceylon yielded at the rate of 0.75 per cent. to 1 per cent. of Camphor, and from 27 per cent. to 34 per cent. of Camphor oil. Mr. Nock estimated that on an average 14 lbs. of clippings per year could be obtained from each bush. This would work out to 190 lbs. of Camphor per acre; with trees 8 feet by 4 feet apart, or 1,360 trees to the acre.

"The World's production of Camphor in 1907 was estimated at about 10,600,000 lbs., distributed in the following proportions per cent.:—celluloid making, 70; explosives, 2; disinfectants and medical, 28." (Bull, Imp. Inst., 6-2-1908.)

During the last two years synthetic Camphor has been produced commercially on a large scale in England, France, Germany, and America, so that the planting of Camphor otherwise than for timber is risky.

Formosa, China, Japan, &c., widely cultivated.

(2) **Cocos plumosa.** Palm.

A hardy, extra-tropical Palm, worthy of introduction for ornamental purposes. The common coco-nut palm is *Cocos nucifera.*

South Brazil.

(1) **Coços flexuosa.** Palm.

A hardy ornamental palm suited to equatorial highlands.
Brazil.

(1) **Copernicia cerifera.** Palm.

A hardy extra-tropical Palm, particularly suited to equatorial highlands.
Bolivia.

(2) **Cordyline australis.**

This is an effective ornamental tree. It is considered palm-like and is very popular in Cape Town gardens. It more nearly resembles a Yucca. It grows to a height of 8 or 10 feet in a few years; is easily raised from seed and bears seed profusely.
New Zealand.

(2) **Corylus colurna.** Cobnut tree.

Wood handsome and not warping. Nuts equal to the English cob. (Gamble.) The Himalayan nut tree may be tried in British East Africa, but is not well suited climatically. In Kew Gardens are one or two handsome well-grown trees looking like young Oaks at first sight.
Greece and West Himalayas, 5,500 feet.

(1) **Crataegus mexicana.** Mexican Hawthorn.

Has a large eatable fruit, is ornamental, and may prove a useful hedge plant.
Mexico.

(2) **Cryptomeria japonica.** Japanese Cedar.

This is perhaps the finest of the many fine trees of Japan. The great avenue of these trees there has a world-wide fame. It has grown well, though not as it grows in Japan, at Darjeeling on the Himalayas, and with varying success on mountains within the tropics. It succeeds as a young tree in Nairobi; 7,000 feet is probably its best altitude on Equatorial highlands. It is propagated from slips as well as from seed. It should certainly be given a trial in the mountain forests of British East Africa. It flourishes on the mountains of Yunan not far from tropical latitudes.
Japan and China, particularly Yunan.

(1) **Cupressus benthami.** Bentham's Cypress.

Differs little from *Cupressus thurifera*, but has a wider habitat extending from elevations of 4,000 feet to 9,000 feet. Cedar-like timber. Should be carefully tried on Equatorial highlands. One of the two Cypresses into which Dr. M. Masters resolves all the Mexican Cypresses. A tall tree of the highlands of Central America and Mexico. Robertson mentions that it grows in dense stands, where the trees take a good form. The isolated trees are ornamental and are planted in Mexican parks. It bears transplantation to the South of England and Ireland where numerous well-grown specimens may be seen. It grows at higher elevations and stands more cold than the other Cypresses of South Mexico. It yields a valuable timber.
Mexico.

(2) **Cupressus funebris.** Funebris Cypress.

A very ornamental, and at the same time useful, timber tree; but it is not, I believe, found growing within tropical latitudes. It might be tried at 9,000 or 10,000 feet on the slopes of Kenia.
Himalayas and China.

(1) **Cupressus guadalupensis** (*C. arizonica.*) Guadalup Cypress.

It is doubtful if this should not be ranked as a dry-country variety of *C. macrocarpa*. In any case it is easily distinguished from *C. macrocarpa* under cultivation: I have grown the two side by side for years in South Africa. *C. guadalupensis* is hardy in Egypt, Cyprus, and the drier parts of South Africa where *C. macrocarpa* fails.
Robertson describes it in Mexico as a tree usually about 40 feet high, but occasionally 70 feet high, and 24 inches to 48 inches in diameter: sometimes forming large groves of pure forest—an ornamental tree with valuable timber. It extends into Mexico through the western forests as far south as the tropic, and perhaps further, at between 7,000 and 8,000 feet elevation. "It often occurs in kloofs near the streams, *i.e.*, in situations where the soil moisture is fairly abundant but where the atmosphere may be very dry."
Mexico.

(1) **Cupressus lindleyi.** Lindley's Cypress.

Dr. M. Masters classifies this as a variety of *Cupressus benthami*. It seems to be a finer tree than the normal form of *C. benthami*, and to merit extensive and careful trial-planting in British East Africa. It occurs in Southern Mexico and probably also in Guatamala. (*See* Appendix I., "Conifers of Mexico and Central America.")
Mountains of South Mexico and Central America.

(2) **Cupressus lusitanica.** Portuguese Cypress or Cedar of Goa.

This is one of the finest of the Cypresses; trees up to 60 feet high in the Botanical Gardens at Maritzburg, and one of the best of the Cypresses in Cape Colony. There are numerous well-grown trees in the Transvaal. Both at the Cape and in the Transvaal trees of from 15 to 20 years of age show a strong natural reproduction. The origin of this tree is unknown. Portugal has the largest trees. There are fine forests at Busaco, but the Portu-

guese botanists consider it to have been originally introduced. It does not, however, occur in the wild state either near Goa or Macao. *Cupressus sinensis* is a gardener's name for this tree, and *Cupressus pendula glauca* a garden variety. (Masters in "Jour. Lin. Soc.," June, 1896.)

Though not quite climatically suited to the Highlands of the Protectorate, it shows considerable climatic adaptability. This and its good natural reproduction recommend it for early trial on an extensive scale in British East Africa. There are several most promising young trees in Nairobi and in the forest plantations at Lari; and it will be planted largely in the other forest plantations.. At Deepdene, near Kiambu, there is a fine avenue of young *Lusitanica* cypresses growing almost without a blank and with an appearance of full vigour. 2,500 trees have been planted in this avenue, and at 2¼ years of age they have an average height of 14 feet. Carrière, and later Dr. Henry, refer *C. lusitanica* to *C. benthami*; page 92.

Portugal.

(2) **Cupressus obtusa.** Obtusa Cypress.

A straight-growing large tree. Though extinct as a wild tree, it is abundant as a planted tree all over Japan. Its timber is the best in Japan for the interior finish of houses; also for lacquer work. It is very highly esteemed in Japan. (Kent.) It likes an open, loamy soil and is said to die out in calcareous soils; merits trial at the higher elevations in British East Africa.

Japan.

(2) **Cupressus pisifera.** Pisifera Cypress.

Very like *C. obtusa*, but with a wider habitat. It does better as a cultivated tree out of Japan. In Japan it grows to a larger size than *C. obtusa*. In Europe these dimensions are reversed. In Japan the timber is considered somewhat inferior to *C. obtusa*. Merits trial at the higher elevations of equatorial Africa.

Japan and China.

(2) **Cupressus sempervirens.** The Cypress of Cyprus.

The well-known "common" Cypress of the Mediterranean. The growth of these trees on poor limestone soil and with only 15 inches rainfall at Cyprus is wonderful. The mean temperature here is the same as Nairobi, but there is a short, cold winter and great summer heat. It stands heat, drought, and cold; and yields one of the most durable, useful timbers. Its growth in Egypt and the eastern Mediterranean is nearly as good as in Cyprus. As a graceful object the open and spreading varieties are without rival. It is the tree of Persian poetry and romance. It flourishes on the plateau region of South Africa. There are some young, healthy trees in the Ainsworth garden at Nairobi. In Mr. Watkins' garden, Nairobi, it shows a vigorous, rapid growth. There are several trees of *Cupressus sempervirens* in Mr. Muirhead's Cypress avenue at "Deepdene." They show a growth faster than any I have seen elsewhere and look quite healthy. At 2¼ years of age they average 15 feet in height! This very picturesque tree is best suited to the drier regions of Equatorial highlands.

Asia, Persia, China.

(1) **Cupressus thurifera.** White Cedar.

A noble tree in the forests of Southern Mexico and Guatamala, where it grows to heights of 120 feet, at elevations between 5,500 and 7,000 feet. It yields a valuable timber. Does well in South European Botanical Gardens.

C. uhdeana is a variety of this species. *See* Appendix I., "Conifers of Mexico."

Mexico and Central America.

(1) **Cupressus torulosa.** Torulosa Cypress.

A first-rate timber, more durable in the ground than Deodar. Easily propagated. Patchy distribution in the Himalayas; seems to prefer limestone. Attains 150 feet in Kumaon (8,000 feet), with a rainfall of 150 inches. This valuable tree seems to have a fair chance of succeeding in the colder, wetter parts of the mountain forests of the Protectorate. It grows so well on the Nilgiris that I have marked it (1). Mr. Gamble seems to think this is the most valuable timber-producer of the Nilgiri exotics; naturalized on the Nilgiris for about half a century. Cowley Brown ranks it first amongst all the Conifers planted on the Nilgiris.

Outer, wetter Himalayas, 3,500 to 8,000 feet.

(2) **Cupressus lawsoniana.** Lawson's Cypress.

Grows well on the Nilgiris, but shows a growth somewhat inferior to that of *Cupressus macrocarpa*. This is a well-known tree. Nothing is known regarding the quality of its timber on equatorial highlands, but the few trees planted show a good growth.

Northern California.

(2), Nilgiris (1) **Cupressus macrocarpa.** Macrocarpa Cypress.

Grows very well on the Nilgiris: introduced about 1864. Eighteen-year old trees in Cowley Brown's Valuation Survey had an average height of 43 feet with a diameter of 7 inches, an acrim of 172 and an individual increment of 0·4 cubic feet. The Nilgiri trees at 18 years old show abundant cones, but have only recently yielded fertile seed. The maximum height-growth at 18 years was 72 feet high and 21 inches diameter; a clump of young tree 6 years old averaged 30 feet in height. On the Nilgiris it is described as undoubtedly a shade-bearer and of vigorous growth. I have seen some promising young trees at various places in British East Africa. At 2½ years, Mr. Muirhead's trees at "Deepdene" were 12 feet high, and with every look of a most vigorous growth. In South Africa, *C. macrocarpa* has been extensively planted: and at Tokai and elsewhere, in the Government forests, is growing up

into good straight sticks of timber. It is, however, chiefly planted as an ornamental tree, for which purpose it is a great favourite. In Egypt and Cyprus its place is taken by *C. guadalupensis.*

In its wild form it is seen now only along a very narrow strip of coast land south of San Francisco perhaps its last retreat with the drying-up of the country.

California.

(1) **Cyphomandra betacea.** Tree Tomato.

This useful fruit tree is already growing vigorously at the American Mission, Kijàbi, and elsewhere in the Protectorate. It bears freely nearly all the year around. Its fruit requires careful cooking, and seems specially adapted for mixing with other fruits.

South America, to latitude 34°, cultivated widely.

(2) **Dalbergia sissoo.** Sisu.

A first-rate timber tree; a tall, rapid-growing leaf-shedder. More planted than any other tree in India, after Teak. I saw some fine young trees of Sisu in the Zoological Gardens at Cairo. A tree in the Botanic Gardens at Durban has died out, probably owing to its being too near the sea. Timber strong, durable, seasoning well, but somewhat heavier than teak. Root bitter, untouched by white ants. Sisu is a familiar object (now) in the streets of Nairobi, but its success there seems doubtful.

It may do well at 7,000 feet under the Equator.

Himalayas, to 5,000 feet.

(1) **Dendrocalamus strictus.** Common Bamboo of India.

Of 150 million bamboo stems estimated to be cut yearly in India, 100 million come from this species. It grows in leaf-shedding forest. One of the bamboos suited for trial-planting in British East Africa at the lower elevations. It is said to be the only one of the valuable bamboos yet planted in British East Africa.

India, extending to Burmah.

(2) **Diospyros kàki.** The Persimmon or Kàki of Japan.

A small, pretty tree bearing one of the best of fruits—the Persimmon. It succeeds under irrigation at Durban, and should be tried without delay at Nairobi. There are numerous cultivated varieties in the East with fruits up to the size of an apple. For equatorial highlands it should be one of the choicest of fruit trees.

China and tropical Asia.

(2) **Diospyros virginiana.** The American Persimmon.

Also yields a good fruit. This attains the size of a large tree.

Gulf States, U.S.A.

(2) **Dracaena.**

Various species, useful for ornamental purposes. *See also* under "Cordyline." *Dracaena draco* is the long-lived vegetable curiosity of the Canary Islands. There is a tall native Dracaena common near Nairobi.

(1) **Duranta elisia.**

There is a good hedge of this at the Government farm, near Nairobi, and it seems to have become naturalized near Nairobi. It is a pretty shrub or small tree with blue flowers and curious fruits: grown as an ornamental shrub in South Africa and hardy enough at Nairobi to form a good hedge shrub.

South America.

(2) **Dysoxylon fraserianum.** Pencil Cedar.

A tall tree; timber used for cigar boxes. Trial-planting near Nairobi or in the m'Dì forests.

Queensland.

(2) **Dysoxylon Muelleri.** Pencil Cedar.

A large handsome tree with valuable timber. Trial-planting near Nairobi or in the m'Dì forests.

Queensland.

(1) **Erythroxylon coca.** The Cocaine Shrub.

Yields cocaine, which is perhaps the best of the stimulating drugs, and superior to alcohol. Forty million pounds of the leaves, worth £2,000,000, are now said to be yearly produced in South America. It is cultivated to some extent in India. It may do well in British East Africa, and is a most valuable cultivation.

Mountains of Peru and Bolivia.

(2) **Eucalyptus acmenoides.** Acmenoides Gum.

One of the commercial timbers of New South Wales and Queensland. Maiden compares it to Tallow wood. It is, however, without the greasy nature of Tallow wood, and harder. Very durable in the ground, but liable to crack and split when cut up. This should only be tried where the more valuable Eucalypts, such as Tallow-wood, *E. microcorys*, *E. resinifera*, and the Iron-barks may fail.

A few trees are growing vigorously at "Deepdene," near Kiambu. They average 11 feet in height at 2 years.

Northern New South Wales and Queensland; coast and coast mountains.

(2) **Eucalyptus amygdalina** (var. *linearis*). Narrow-leaved Gum.

This is worth growing as an ornamental tree only. It has the quick growth of a gum, but quite slender, drooping leaves, differing from most gums. There are specimens of this tree already growing in British East Africa; it is pretty common at Parklands, Nairobi.

East Australia.

(2) **Eucalyptus bicolor** (*E. largiflorens*, of Mueller). Bicolor Box.

This is a second-rate gum, only worth planting in country too dry for the Ironbarks. In the very dry country of the interior of Australia it becomes dwarfed to a bush.

This might be usefully planted in the northern desert country of the Protectorate.

Inland Eastern Australia.

(2) **Eucalyptus botryoides.** Botryoides Gum.

Timber hard, strong, and durable, but cuts up badly. Growth poor at Wilkinson's, near Maritzburg, Natal. Good growth at the Cape, particularly Tokai.

Eastern Australia.

(2) **Eucalyptus citriodora.** Scented Gum.

Timber of good shape and quality. It is often grown for its sweetly scented foliage. It is hardy in all the warmer districts of South Africa. This is one of the Eucalypts best suited to British East Africa. There is a row of tall trees in the Ainsworth garden at Nairobi, but the growth of these I should not describe as being more than fair. It is a peculiarity of these trees that they have roughish bark—not very rough bark, but decidedly different from the very smooth bark of the tree in the Cape Peninsula. There are many smaller trees in British East Africa, all, as young trees, showing a good vigorous growth. At two years of age they average 10 feet in height at the Government farm, Nairobi, and 15 feet in the semi-tropical climate of Port Florence.

Tropical to extra-tropical Eastern Australia.

(2) **Eucalyptus coriacea.** White Gum. Alpine Gum.

The hardiest against cold and the only really mountain Eucalypt of any size in Australia. It grows to a fine tree at 5,000 feet elevation in the Transvaal. It may be useful as an avenue tree at higher altitudes in equatorial Africa. The timber is second-rate.

Australian Alps.

(2) **Eucalyptus corymbosa.** Bloodwood.

Timber durable in the ground, but wasteful to cut up owing to gum veins. Grew well at Wilkinson's, near Maritzburg, Natal, about 60 feet in 16 years. The "Bloodwood" is quite worth growing experimentally for sleeper purposes in the "Railway forest zone." It is slow-growing at Cape Town, but quicker in warmer localities.

Eastern Australia.

(2) **Eucalyptus crebra.** Crebra Iron-bark.

A first-rate timber, very durable in the ground. In America said to stand extremes of drought, heat and cold better than the other Iron-barks; but in Cape Colony it is inferior in growth to the Paniculata and Siderophloia Iron-barks. Its timber, however, is always straight, and cuts up well. A fine tree on the Natal coast. In the northern part of New South Wales its habitat has a wide extension inland over the dry plateau country. It is probably the most valuable Eucalypt for planting in the drier plains of the Rift Valley. As a young tree it is doing well near Nairobi, particularly at Deepdene.

Eastern Australia.

(2) **Eucalyptus globulus.** The common Blue-Gum.

The common Blue-Gum has naturally been planted in British East Africa, and in many localities shows a good growth, though nowhere is it quite equal to the Blue-Gum on the Nilgiris in Southern India, where there has been a phenomenally rapid and vigorous growth, (*vide* page 103 and "Report on the growth of Australian trees on the Nilgiris," by the Author, Madras, 1883). The only old Blue-Gums I have seen in the Protectorate were those planted by Mr. F. J. Jackson, C.B., some 13 years ago round the Civil Station of Eldoma Ravine. There are some lengthy avenues of tall Blue-Gums there. They do not show the best growth. The elevation and rainfall are enough but the situation is dry and wind-swept. When I saw them they were suffering from drought. Three had turned brown and looked dying. A few trees in the garden, however, on better soil and watered, have quite a healthy appearance. Blue-Gums have been planted to a considerable extent in Nairobi, and, so far, have succeeded better in Nairobi than at the same elevation on the Nilgiris. But the old trees at Machàkos are reported to be now failing. I doubt if the Blue-Gum will show a permanent good growth below 7,000 feet in Equatorial Africa. *See* pages 50, 102 and 103.

In South Africa the Blue-Gum grows with wonderful vigour, and has been more largely planted on farms than all other trees put together. There are Blue-Gum trees up to 200 feet in height, both in Cape Colony and Natal. On the Government farm, Zaneen, in the Transvaal low veld, Blue-Gums grew 100 feet in five years. But there and, indeed, in most of the localities where it has been grown in South Africa, it is quite a climatic exotic. Nearly all the South African Blue-Gum timber is of inferior quality, seasoning badly, and decaying rapidly in the ground. Generally, another Eucalypt can be found that is not a climatic exotic that will yield a good timber, and that will grow as fast as the Blue-Gum.

The use of Blue-Gum (as a coal mine) to produce continuously 10 tons (air-dry weight) of wood-fuel per acre per year is discussed in the body of this report: page 50.

Tasmania and South-Eastern Australia, particularly cool, damp Gippsland.

(2) **Eucalyptus dealbata.** Stanthorpe's Messmate.

A medium-sized drought-resistant tree; timber durable, but cutting up badly. This species of Eucalypt may be tried on some of the dry, hot plains.

Inland Queensland.

(2) **Eucalyptus diversicolor.** Kari.

This tree, though a climatic exotic, may be seen growing fairly in the Transvaal and well in Natal. What age it will reach in each place, and what will be the quality of its timber, are questions which can only be settled experimentally by the curious. The practical man will prefer to spend his money on trees which are not climatic exotics.

On Mr. Muirhead's estate of Deepdene, near Kyambu, at an elevation of about 5,600 feet, there has been some remarkable planting of Kari. I understand that 10 acres have been planted with 15,000 trees. I found these trees growing with a vigour unsurpassed by any that I have seen in South Africa. At 2¼ years of age they averaged 30 feet high. The planting is almost without a blank and does the utmost credit to the enterprising Natal Colonist, Mr. Muirhead, who has planted not only these Kari trees, but a fine avenue of *Lusitanica* Cypress, and numerous other trees detailed elsewhere in these notes.

Western Australia.

(2) **Eucalyptus exserta.** Exserta Gum.

A medium-sized tree with durable timber. (Bailey.) Tender to frost. It may be planted on the dry plains.

Queensland, on inland rivers.

(2) **Eucalyptus ficifolia.** Crimson Gum.

This is the gorgeous crimson-flowering Gum of the suburbs of Cape Town. It is a tree of hot, dry summers and cold, wet winters: and thus is unlikely to succeed lastingly in equatorial Africa. Nevertheless at 7,000 feet (Njoro: Mr. Claude Smith) it looks quite promising, and at three years of age has flowered well. At Nairobi its success seems doubtful. the climate being too hot and forcing for it.

West Australia: coast.

(2) **Eucalyptus gracilis.** Gracilis Gum.

A small tree with durable timber. (Bailey.) This may be useful for the dry plains.

Australia, inland; widespread.

(2) **Eucalyptus hemiphloia.** Grey box.

A good, strong timber, durable, prized for sleepers in Victoria. Slow-growing, but probably well-suited to the drier parts of the Protectorate. Best developed in the coast districts, but widely spread over the interior plateau country of New South Wales, particularly the white, large-fruited variety, classed at "Albens." This tree is suitable for the drier plains not below 4,000 or 5,000 feet altitude.

Eastern Australia.

(2) **Eucalyptus maculata.** Maculata Gum.

A strong-growing, large-leaved Gum. Elastic timber, but of rather uncertain durability in the ground. It is worth planting in the Protectorate as a handsome, quick-growing tree. It seems singular that it should not yet have been planted. It should succeed at almost any elevation, where there is a fair rainfall, up to about 7,000 feet. It shows a fair growth at Lari, 8,000 feet.

Tropical Queensland.

(2) **Eucalyptus meliodorora.** Yellow Box.

So far as I am able to judge from young trees that have not yet fruited, it is this tree that with Tallow-wood (*E. microcorys*) shows the best growth among all the Eucalypts yet planted at Nairobi. Its timber, in quality, comes a long way below Tallow-wood. It may be planted as an alternative to Tallow-wood for ornamental purposes, and in country too dry for Tallow-wood, though even here unless it shows some superiority of growth it cannot compete with the Iron-barks. Yellow Box timber, though durable and strong, is liable, like so many of the Eucalypt timbers, to crack badly.

It is usually found as a handsome tree with more or less drooping foliage scattered through open forest.

South-Eastern Australian coast and interior; mountain ranges and table-lands; widespread.

(2) **Eucalyptus microcorys.** Tallow-wood.

Tallow-wood is a first-rate timber, and, among all the Eucalypts yet planted in British East Africa, it shows so far the best growth. This is a most fortunate circumstance and an important fact to remember in the Forestry of the country. Among Eucalypt timbers it ranks second only to the Iron-barks in durability and strength. It is equal to, or better than, Jarrah. Its timber is imbued with a greasy resinous matter which prevents it splitting on seasoning, the common fault of most of the Eucalypts. The Engineer-in-Chief, New South Wales, gives it an average life as a sleeper of 20 years, against 25 years for Iron-bark.

Southern Queensland and north coast forests of New South Wales.

(2) **Eucalyptus occidentalis.** Mallet bark.

A few trees of this interesting species are growing well at Deepdene, 5,600 feet elevation, British East Africa. It yields the famous "Mallet" tanning bark.

Western Australia: drier inland districts.

(2) **Eucalyptus planchoniana.** Planchon's Gum.

One of the best of the semi-tropical Eucalypts. It grows to a tree of huge size and yields a good timber. In British East Africa it might be tried both in the coast hill forests, and in the highland forest at the lower elevations.

Queensland.

(2) **Eucalyptus paniculata.** Paniculata Iron-bark.

Of the Iron-barks (*Eucalyptus paniculata*, *E. crebera*, *E. siderophloia*, and *E. sideroxylon*), Maiden ranks this the first. Though thus occupying the premier position among the Eucalypt timbers it is hardy and fairly quick-growing. It shows a general good growth at the Cape. In Natal, near Maritzburg, it grew 50 feet in 16 years, and it succeeds on the semi-tropical Natal coast near the sugar plantations. It is likely to do well in British East Africa, but does not appear yet to have been tried.

Eastern Australia, coast and inland.

(2) **Eucalyptus pilularis.** Black-butt or Flintwood.

The fastest-growing Eucalypt at Tokai, near Cape Town, and one of the fastest in the Protectorate, though not so fast as Tallow-wood and the Melliodora Gum. At 16 years it grew to a tree of enormous size at Wilkinson's, near Maritzburg, Natal. It grew 60 feet in 5 years at Tokai and the same height in 10 years in the middle districts of Natal. It thrives best in sheltered damp localities, and in Queensland and New South Wales attains gigantic dimensions. Trees over 300 feet high are known. In Queensland it is generally a mountain tree. (Bailey.) It occurs as a quite young tree in various plantations in British East Africa, with so far a good growth, but a growth always inferior to Tallow-wood, and showing some susceptibility to drought.

Victoria to Queensland.

(2) **Eucalyptus raveretiana.** Thozet's Box.

A large tree with a hard but useful indoor timber. It is one of the giant Eucalypts, reaching a height of 300 feet, and should be tried in British East Africa as a shade-tree and as a quick producer of firewood.

Queensland.

(2) **Eucalyptus resinifera.** Mahogany Gum or Forest Mahogany.

This is one of the Eucalypts being grown on a large scale for sleepers in South Africa. It has a timber like Jarrah and is believed to be equal to Jarrah. It seems to have a fair chance of succeeding in British East Africa and should be given a careful trial. It is growing well under varying conditions in South Africa, but did not, it appears, succeed on the Nilgiris (South India, 7,000 feet). There are several varieties of this fine timber tree. One of the northern large-fruited varieties should be chosen for planting on Equatorial highlands.

East Australia.

(2) **Eucalyptus rostrata.** Rostrata Red Gum.

According to Bailey, this well known timber is not so durable in Queensland as further south, where it has a well-established reputation. It and the closely-allied *E. tereticornis* are the Gums most commonly met with in the Transvaal after *E. globulus*. Near Maritzburg, Natal, I saw trees up to 120 feet in height.

It scarcely differs from *E. tereticornis*. These two trees are the "Red Gums" planted so largely in the streets of Nairobi.

Interior of Australia; rare near the coast.

(2) **Eucalyptus saligna.** Saligna Gum. (Blue Gum in New South Wales.)

There are many fine specimens of *E. saligna*, both in Natal and in the Transvaal, but the timber is not always of the best. Except for its rapid straight growth there is little reason to plant it in British East Africa. There are some good trees of this species near Salisbury, Rhodesia. Near Nairobi it grows as fast as the common Blue-Gum and is almost certain to prove more long-lived. It is a tall, straight tree, suited for avenue purposes.

East Australia.

(2) **Eucalyptus sideroxylon.** Sideroxylon Iron-bark.

This ranks fourth among the Iron-barks. It may be worth planting in dry localities on the plains or in the Rift Valley. In such places it should be tried against *E. crebra*. Being a native of the southern plateau country of Australia, it is able to stand frost and drought. It is slow-growing for a Gum.

South-East Australia.

(2) **Eucalyptus siderophloia.** Broad-leaved Iron-bark tree.

By many this is considered the best of the Iron-barks. For practical purposes it may be considered equal to *E. paniculata*. It shows a good straight growth in the better watered parts of Natal. It is given the first place as a sleeper timber by the Engineer-in-Chief of

both the New South Wales and Queensland railways. It should be planted at the lower elevations on the highlands and in the coast hill forests. It might even succeed and furnish timber of good quality on the coast.

East Australia.

(2) **Eucalyptus tereticornis.** Tereticornis Gum.

To this species belong most of the so-called "Red Gums" planted at Nairobi and elsewhere in East Africa. It is not a tree one would select for avenues, though largely planted for this purpose. In the Transvaal it is seen flourishing from Johannesburg down to the sea level at Delagoa Bay. It is the commonest tree in the Transvaal after the Blue-Gum. It grows nearly as fast as the Blue-Gum, but has, when mature, a superior timber. It scarcely differs from *E. rostrata*, but is generally a straighter, better-grown tree; to be preferred to *E. rostrata*. There are several varieties of it.

Queensland. Coastal country, usually in dry open forests.

(2) **Eucalyptus terminalis.** Bloodwood.

A dry country form of the ordinary Bloodwood, *E. corymbosa*. It would be a tree for the plains between Voi and Kiu.

Queensland; interior.

(1) **Eugenia arnottiana.**

This is one of the best trees of the Nilgiri sholas. Mr. Gamble terms it the chief timber tree of the sholas. It is a curious fact that there has been an exceptional fine growth of this tree in the heart of a Eucalypt forest ("Old forest") on the Nilgiris. It would seem as if the drying and sheltering effect of the big Eucalypts has stimulated the shola tree to an improved growth.

Nilgiris: South India.

(2) **Eugenia eucalyptoides.** Mini.

This is a very handsome tree, with dense, dark-green, crinkled, drooping leaves. It is slow-growing, but of so striking an appearance that it is worth trial in British East Africa. Seed can be obtained from the Maritzburg Botanical Gardens.

South America.

(2) **Eugenia nhanica.** Nhanica tree.

Berry, a table fruit. Would probably succeed in British East Africa

South Brazil.

(2) **Eugenia pyriformis.** Uvalho do Campo.

Fruit eatable. This also should be tried in British East Africa.

South Brazil.

(2) **Ficus spp.** Fig-trees.

There are various extra-tropical Fig-trees worth planting for shade and ornament on Equatorial highlands. They will flourish among rocks where few other trees will grow; and they can all be propagated by simply inserting a stick or stake in the ground and watering till established. They all bear figs of sorts. *Ficus carica* is the common eatable Fig. *F. macrophylla* is the fine Australian Fig-tree. It would be of little use to attempt to enumerate here the various extra-tropical Fig-trees. Many of them are as yet unnamed. The tropical Fig-trees are even more numerous and more unnamed. Most of the Fig-trees (like the M'Gumu and M'Kuyu Figs of British East Africa) begin life as parasites on other trees.

Tropics and extra-tropics throughout the world.

(1) **Ficus repens.** Ornamental creeper.

This, at Nairobi, may take the place of the Ivy of colder climates.

Tropics and warm extra-tropics.

(2) **Flindersia australis.** Crow's Ash.

One of the chief timbers of Queensland. A leaf-shedder; wood yellow, very strong, and durable.

Queensland.

(2) **Flindersia oxleyana.** Queensland Yellow-wood.

Wood of a bright yellow colour, elastic, and not readily attacked by white ants.

Queensland.

(1) **Fraxinus berlandieriana** (A. de C.) (Sudworth.) Green Ash.

This is probably the only Ash that can be planted with much chance of success in British East Africa. It grows to a tree 60 feet high in Southern Mexico, in tropical latitudes. "The most common shade tree in the towns of Southern Mexico at elevations of 5,000 to 7,500 feet. It is often 60 or 70 feet high and 5 feet or more in diameter: forming a large, full crown with ample foliage. It makes a better shade tree than any other American Ash, and it should be a valuable tree if grown for timber. * * It prefers situations with plenty of soil moisture, such as banks of streams. It bears heavy crops of seed, which ripen from May till late August. In 1894 Mr. Pringle found it indigenous in the mountains of Michoacan, growing as a small tree widely scattered over the hills and in various situations." (Robertson.)

Mexico and Texas; but Sudworth thinks originally indigenous in South Mexico.

(2) **Glyptostrobus heterophyllus** (*Taxodium sinensis*). Chinese Water Pine.

This tree may be planted for ornamental purposes in British East Africa. It should succeed about the elevation of Nairobi. So curious with its thread-like branches and closely pressed fine leaves, it has long been cultivated in the gardens of Europe and the United States. Sargent, in his "Silva of North America," states that it is merely a variety of *Taxodium distichum*, not uncommon in the forests of Florida. *See* page 94.

South China; its exact distribution not known. Planted along the edge of rice-fields.

(2) **Gmelina arborea.** Kuli.

A large leaf-shedding tree, with timber, light, durable and sometimes replacing Teak. Also an ornamental tree. Seed could be obtained from the Madras Forest Department.

Tropical India, up to 5,000 feet.

(2) [or (1) Nilgiris], **Grevillea robusta.** Silky Oak.

This tree with its fern-like foliage and yellow flowers is one of the most striking of ornamental trees. It grew well up to 7,000 feet on the Nilgiris. The few trees that I have seen planted in British East Africa showed everywhere an entirely vigorous healthy growth. It may be planted in all well-watered situations from about 3,000 to 7,000 feet. It furnishes a good soft timber that is straight in the grain and splits well; used in Australia for making butter-boxes, but the timber is handsome enough for the interior finish of houses.

On the Nilgiris this species grows best at about 6,000 feet. Mr. Cowley Brown remarks, "The wood is of considerable repute in the cabinet-making trade. Sir Frederick Price has some beautiful panels of this species framed with *Acacia melanoxylon*. The contrast between the pale silvery grain of the former and the rich dark brown of the latter is very striking." The wood of *Grevillia robusta* is said to be durable and not to crack when exposed to extremes of weather.

There are other species of Grevillea with showy red flowers that are well worth planting for ornamental purposes.

East Australia.

(1) **Hagenia abyssinica.** Hagenia.

This is described as a tall, ornamental tree in Abyssinia. Possibly it may be one of the many trees not yet determined in British East Africa.

Abyssinia, 3,000 to 8,000 feet.

(2) **Hakea laurina.**

The finest hedge tree in the Transvaal, where it grows as close and dense as an English Privet. I found it growing vigorously at Deepdene (Kiambu), Mr. Muirhead. A patch of bushes unclipped are now 12 feet high at 2¼ years of age. Their appearance is equal to the growth of this fine hedge plant in the Transvaal.

West Australia.

(2) **Hancornia speciosa.** Hancornia Rubber Tree.

This may be worth trial in the highlands of British East Africa. It is a small tree yielding a good rubber.

Brazil and Argentine.

(2) **Hibiscus syriacus.**

One of the best hedge plants in the Transvaal. Raised on a large scale in the Government nursery at Irene, where there is a single hedge of 16 different species.

(1) **Hicoria myristicæformis.** Hicory.

A medium-sized tree of Northern Mexico and of Southern Mexico in kloofs. It should be a tree of peculiar value on equatorial highlands on account of its elastic timber.

South Mexico.

(1) **Hicoria pecan.** The Pecan-nut tree.

This fine northern tree extends south to the kloofs of Mexico. Robertson states it is found near Monterey, in the Sièrra Madrè, and is a larger tree than the last species. It is planted in Mexico, as in North America, for the sake of its nuts. To secure good nuts selected seed or grafting is necessary. The good timber is yielded by the tall, straight stems of close forest. Robertson says a species of Hickory is also found at the lower elevations in Southern Mexico.

South Mexico.

Ilex paraguensis. The Màte Tea Tree.

Yields the South American Màtè Tea. This is a valuable cultivation which might be tried near Nairobi. It is the universal tea of South America. It is free from the tannin of common or Chinese tea, and is likely in the future to replace the latter to a considerable extent, even in England, where the taste for Chinese tea is so strong. Personally I prefer it, but the taste has to be acquired.

South Brazil.

(1) **Jacaranda mimosifolia.** Jacaranda.

Bears gorgeous blue flowers and yields the valuable scented Palixander wood of Brazil. It is planted in avenues in Maderia, and, in summer, when in blossom, these look as if festooned with Wistaria blossoms. This beautiful tree should be cultivated both for timber and ornament.

No tree is more ornamental and few, for a non-coniferous tree, yield more valuable timber. There are strong-growing young trees in the Ainsworth garden at Nairobi.

Brazil, on highlands.

(1) **Juglans nigra.** Black Walnut.

The fruit of this tree is of less account than *J. regia*: but, cultivated in the Extra-tropics, it usually makes better timber than the common Walnut of Europe; and, further, it grows on tropical mountains through a large part of America: so that provided seed is obtained from the right place this tree should be climatically suited to the highlands of British East Africa. Robertson describes *J. mexicana* (S. Wats) as a separate species, with leaves and branchlets more hairy than the typical *J. nigra*, fruits 1½ inches to 2½ inches long and 1 inch to 2 inches broad. "A tree often 65 feet high with a short stem 3 to 5 feet in diameter and stout spreading branches. It should prove a useful timber tree under proper treatment, and may be a valuable fruit tree." In Eastern Mexico: common in mountain valleys near Monterey at 2,500 feet.

Mountains of tropical America.

(1) **Juglans regia.** Common Walnut Tree.

The wild form of this tree grows on mountains within the tropics, and if the common cultivated form should fail on the highlands of British East Africa, as is probable, the wild form is worth growing for its timber or perhaps as a stock on which to graft the cultivated form. This latter seems doing badly at the Government Farm, Nairobi, but has been grown successfully for many years in Mexico. In South Africa it succeeds only where there is an abundance of lime in the soil. It succeeds fairly in the upper and middle districts of Natal. Sim reports that the fruit of the Natal trees are inferior and attributes this to the want of grafting. In Cape Colony ungrafted trees bear good fruit. In the Himalayas, Brandis states that the Walnut occurs as a true forest tree; the nuts of this tree are thick-shelled and useless for eating. It extends south as far as the mountains of Burmah, and here would be the locality to obtain this valuable tree for cultivation on Equatorial highlands.

Extra-tropics of Asia.

(2) **Juglans rupestris.** Mexican Walnut.

The only native walnut of Mexico if we consider *J. mexicana* as a variety of *J. nigra*. The nuts there form a common article of food. It extends in canyons to Southern Mexico where the climate resembles that of Equatorial highlands. Occasionally 50 feet high and 5 feet diameter, but usually smaller and with a very short trunk. In kloofs it extends down to the plains. It makes a good shade tree and is of fairly quick growth. (Robertson.) As a young tree it is doing well in the Transvaal. (Legat.)

There are other species of Juglans and several of Hicoria bearing valuable nuts, but there is little chance of any of these succeeding in British East Africa. They want a more decided winter season.

Northern Mexico.

(1) **Juniperus bermudiana.** Pencil Cedar.

A first-class timber tree, yielding at one time the Cedar of lead pencils. This valuable tree already shows a good growth in a few localities where it has been planted in British East Africa. As a tree it is ornamental and useful, if somewhat slow-growing. For British East Africa, seed should be obtained from the tropical mountains of the West Indies.

Bermuda and tropical mountains, to 6,000 feet.

(2) **Juniperus brevifolia.** Azores Cedar.

This is a fine tree in the Azores, where it grows up to an elevation of 5,000 feet. It well merits trial at somewhat higher elevations in British East Africa. One of the tallest Junipers and the most valuable of Cedars. Kent regards this as only a geographical variety of *J. oxycedrus*. The wood is so durable, even in the trying, damp climate of the Azores, that old timber is dug up sound, the buried remains of former forests. ("Veitch's Manual.")

Azores, up to 5,000 feet.

(2) **Juniperus drupacea.** Plum Juniper.

This tree's natural climate is a wet winter and a long dry summer—the climate of the Eastern Mediterranean. It is unlikely to succeed permanently in British East Africa; but it is a graceful tree and worthy of trial-cultivation.

Asia Minor.

(1) **Juniperus flaccida.** Flaccida Juniper.

An ornamental tree with foliage of a peculiar bright green; flourishes in South Europe. *See* Appendix I., "Conifers of Mexico and Central America."

Mountains of Central Mexico, 5,000 to 8,000 feet.

(2) **Juniperus macropoda.** Himalayan Pencil Cedar.

It is cultivated in India on the plains. Wood harder than the American Pencil Cedar. Trees up to 90 feet high on the Taurus mountains. A tree of slow growth, but suitable for cultivation on high, dry, wind-swept localities in such a climate as Naivasha or somewhat higher. It is regarded as only a geographical variety of the indigenous Cedar of British East Africa (*Juniperus procera*). It is not likely that *J. macropoda* will grow better in East Africa than *J. procera*, but it may be less subject to the fungoid disease of *J. procera*. In any case its cultivation would be of great interest.

Asia Minor, 2,000 to 6,000 feet, and the drier Himalayas about 5,000 feet.

(1) **Juniperus mexicana.** Mexican Juniper.

For trial-planting as an Alpine tree above the bamboo forest of Equatorial Africa. It is doubtful if this tree is large enough for economic-planting. *See* Appendix I., "Conifers of Mexico."

Mexico and Central America.

(1) **Juniperus monosperma.** Monosperma Juniper.

Allied to *J. occidentalis*, but growing at lower elevations *See* Appendix I., "Conifers of Mexico and Central America." Robertson states that this is a smaller tree than *J. pachyphloea*.

Texas and Mexico.

(1) **Juniperus occidentalis.** Occidentalis Juniper.

A tall species stated to form pure forests of well-grown trees in Mexico. It is closely allied to and difficult to distinguish from *J. californica*. *See* Appendix I., "Conifers of Mexico and Central America."

Mountains of California and Northern Mexico.

(1) **Juniperus pachyphloea.** Thick-Bark Juniper.

This grows to the size of a timber tree in Mexico and produces a valued timber, which, although brittle, is strong and very durable. It is described as a beautiful tree with a massive trunk. The prevailing and largest Juniper of the mountains of Western Texas (Sargent), though in Texas it is not a tree of much economic importance. This seems to be a Juniper of real economic importance in Mexico and Central America, and well worth early trial-planting on Equatorial highlands. *See* Appendix I., "Conifers of Mexico and Central America." On Equatorial highlands trees raised from South Mexican seed may prove rivals to the giant *J. procera* of British East Africa. I have heard no complaints of *J. pachyphloea* having unsound timber like the indigenous *J. procera*.

Mexico, 4,000 to 6,000 feet.

(2) **Juniperus sphærica.** Sphærica Juniper.

Little is known about this species except that it came from China. It can be procured from European botanical gardens. It may be worth trial in British East Africa.

China.

(2) **Juniperus virginiana.** Ordinary Pencil Cedar.

This, in the Florida tree, furnishes the well-known Pencil Cedar of commerce. The ordinary American tree (var. *scopulorum*) extends from Canada to Florida. This is slow-growing and is scarcely worth planting in British East Africa. But the fine timber tree of Florida and tropical mountains which now furnishes the bulk of the pencil Cedar of commerce is well worth attention. Pencil-makers have paid as much as 10s. per cubic foot for the timber of this tree in Florida. It is softer and perhaps less brittle than the indigenous *Juniperus procera*.

Florida.

(1) **Lagerstrœmia indica.** Pride of Pretoria.

This is a hardy flowering shrub of the tropics and extra-tropics. It succeeds as far south as Cape Town. Pretoria in January is ablaze with its gorgeous pink flowers. Closely allied to this is the fine Indian timber tree *L. flos-regina*. This might also be grown as an ornamental tree and perhaps for its timber. It is found in India up to an elevation of 5,000 feet.

India.

(2) **Lapacho.**

This is a fine tree, said to be widely spread in the upper provinces of Argentina. The timber very durable and much used in building and other purposes. Botanical name not stated on the Argentine lists.

Upper Argentine.

(2) **Larix griffithii.** Himalayan Larch.

This useful timber tree is worth trial at an elevation of about 10,000 feet in British East Africa. In its native country it is a tree of slow growth.

Eastern Himalayas, 8,000 to 12,000 feet.

(2) **Larix leptolepis.** Japanese Larch.

This is the Japanese Larch that is being cultivated to some extent in Europe to replace the common Larch, which, grown as an exotic in the low country of Northern Europe, has become liable to disease. The Japanese Larch may be tried on suitable, cold, wet mountain sites in British East Africa, but has, I fear, little choice of succeeding permanently. Its timber has the same good qualities as the European Larch.

Central mountains of Japan, 5,000 to 7,000 feet, latitude 35° to latitude 38°. Cultivated at lower elevations. (Sargent.)

(2) **Leptospermum lævigatum.** Australian Myrtle.

The favourite hedge plant in South Africa. There is a vigorous looking hedge of this well-known tree in Mr. Watkins' grounds at Nairobi. This is now 3 years old and looks almost as well as in the suburbs of Cape Town. Only time can show if it is a lasting introduction. It does not look so well at Deepdene.

Coast of Australia.

(1) **Libocedrus macrolepis.** Chinese Cedar.

This tree seems well worthy of careful trial in British East Africa. It furnishes a good Cedar wood, and flourishes on mountains within the tropics in Formosa. The most valuable timber in Formosa.* (Masters.) The finest tree in Formosa. (Dr. Henry.)

Formosa and China.

(2) **Liriodendron tulipifera.** Tulip tree.

Sim describes this as the most successful deciduous tree in Natal. Old trees are scarce, but the many young trees are all doing well, and where planted on deep open soil are making growth as rapidly as the Poplars.

United States of America.

(1) **Litsea wightiana.**

One of the good shola trees of the Nilgiris that is worth propagating artificially. (Cowley Brown.)

Nilgiris, Southern India.

(2) **Liquidambar styraciflua.** Liquidambar Tree.

This tree should succeed near Nairobi. It may not be worth growing for timber, but it is very ornamental. Its leaves take on peculiarly brilliant autumn tints. It grows in the open at Kew Gardens and is seen there as a handsome small tree

Southern Mexico and United States of America.

(2) **Loxopterygium lorentzii.** Quebracho Colorado.

Very valuable, but slow-growing. Its timber is indestructible and full of tannin. The wood and tan extract made from it are largely exported from the Argentine. A first-rate timber for sleepers. *See also* under *Aspidosperma quebracho.*

Argentine.

(2) **Lysicarpus ternifolius.** Tom Russel's Mahogany.

An erect, pine-like tree which is worth trial-planting in British East Africa.

Queensland Mountains.

(1) **Magnolia fuscata.** Red scented Magnolia.

A small tree growing vigorously in the warmer Extra-tropics. It has small reddish-brown flowers, perhaps the most sweetly-scented in the world. Of all the curiously-scented Magnolias, I know of none so strongly and sweetly-scented as *Magnolia fuscata.* Its more correct botanical name is *Michelia fuscata.*

China.

(2) **Mangifera indica.** The Mango.

Comes to perfection at Bangalore, 3,000 feet, Southern India. Grafted trees should be obtained from the Lal Bagh Gardens there. The pearl of tropical fruits and a tree furnishing useful timber. It has run wild and formed forest in Jamaica: and it is thoroughly naturalized on the southern coast of British East Africa. The forest tree has worthless fruit but a timber that can be utilized for packing-cases and second-class carpentry.

India, up to 4,000 feet, or even 5,000 feet, as on Nandidrug.

(1) **Manihot glaziovii.** Rubber tree.

There are some healthy young trees in the Ainsworth garden at Nairobi. This is one of the Maniocs of the tropics, the plants that yield Tapioca. In Salisbury, Rhodesia, it was killed to the ground yearly by frost, and is only useful for moderate elevations in Equatorial regions.

Central America.

(1) **Melia azederach.** Syringa.

Largely planted in the warmer extra-tropics. Timber soft and of a red colour. There are numerous varieties or sub-species. There is a good and a bad variety under cultivation now in Salisbury, Rhodesia. It is quite hardy in Natal and in the lower districts of the Transvaal and the warmer parts of Cape Colony. In Natal, the Indians along the coast plant it for hedges. It is common as a planted tree in towns in Mexico, Southern States, U.S.A., Egypt, and the Mediterranean region generally. The variety grown at Nairobi is very ornamental and seems quite hardy. It should be extensively planted in all its varieties on Equatorial highlands.

Persia, and cultivated throughout the Extra-tropics of the world.

(2) **Melia composita.** Australian Syringa or White Cedar.

A large, leaf-shedding tree, larger than the ordinary Syringa, with timber of a light red colour, soft, and easy to work. Flowers fragrant. Brandis describes the Indian tree as having white flowers. Bailey, the Australian tree as having blue flowers. As a young tree in the nursery, raised from Australian seed, I cannot distinguish this tree from the ordinary Syringa, *Melia azederach.*

Queensland, New South Wales.

(2) **Melia indica.** Neem.

An evergreen medium-sized tree allied to the Syringa but less hardy against frost and drought. A useful, fairly durable timber, so bitter that white-ants will not touch it. Largely planted in Northern India as an avenue and ornamental tree. It should succeed near Nairobi.

Himalayas, to 5,000 feet.

* There is also a fine timber tree on the mountains of Formosa resembling *Acacia cyclopis*, one of the finest, if not the finest, of the Acacia timber trees. (Dr. Henry.)

(1) **Michelia champaca.** Champaka.

A tall, beautiful tree, with scented yellow flowers and a first-class timber, strong, durable, and not too hard; 37 lbs. the cubic foot. Timber in appearance similar to Camphor, and more durable than Camphor in the ground. Wood intensely bitter. (Gamble.) The finest of the trees on Nundidroog, South India, 4,800 feet elevation, latitude 12°.

Western Himalayas, to 5,500 feet, and Southern India on mountains.

(2) **Michelia fuscata.**

Better known as *Magnolia fuscata*, which see.

(1) **Michelia nilagirica.**

This is one of the best timber trees of the Nilgiri sholas, superior in its growth (according to Cowley Brown) to any introduced species except *Cupressus torulosa.* It furnishes good house-building timber.

Nilgiris, Southern India.

(2) **Morus alba.** White Mulberry.

Often planted (as at Pietersburg, Transvaal) in hedges. Perhaps the best Silkworm Mulberry. There is an allied variety growing to a large shade tree, but I have not seen this in South Africa.

Northern India, and up to 11,000 feet on the Himalayas.

(1) **Morus celtidifolia.** Mexican Mulberry.

A good timber tree and shade tree, well worthy of trial-cultivation in British East Africa. Robertson states that it is common as a small shade or fruit tree in the towns of Southern Mexico. *M. insignis* is stated to be a similar species reaching an elevation of 8,000 feet on the mountains of New Granada.

Mexico, up to 8,000 feet, Central America, and Peru.

(2) **Morus indica.** Silkworm Mulberry.

This is the tree commonly cultivated in Bengal to feed silkworms. It is rapid-growing and hardy, though often small. It has sprung up self-sown and ousted the Sissu from Changa-Manga and other plantations in India.

North-Western Himalayas, to 4,000 feet.

(1) **Morus rubra.** Red Mulberry.

The largest of the Mulberries, and a fine timber tree, with strong, durable timber. It has also a good, large fruit.

Mexico.

(1) **Nerium oleander.** Oleander.

So vigorous a grower on Equatorial highlands is well worth growing as a wind screen and shelter tree. Probably in no part of the world is it a more gorgeous bloomer. In Nairobi it is in full flower early in November. Easily propagated from cuttings. The leaves are poisonous to animals. This is its only drawback.

Tropics and extra-tropics of Eurasia.

(1) **Parkinsonia aculeata.** Jerusalem Thorn.

A very thorny hedge plant, cultivated largely in America. Flowers handsome. It succeeds in the lower Transvaal, but is killed by frost in Hanover, Cape Colony. It forms an impenetrable hedge, but should be introduced with caution for fear of its spreading and becoming a pest.

Mexico, and cultivated throughout the warmer parts of the world.

(2) **Paulownia imperialis.** Paulownia.

An ornamental tree worthy of trial-planting near Nairobi. It has been planted in various parts of the Transvaal. Only half-hardy in the colder districts. It does fairly at Maritzburg, Natal, but better nearer the coast. It grew 15 feet in 13 years at Irene, Transvaal.

Japan.

(1) **Machilus (Persea) nanmu.** Chinese Coffin Tree.

This is probably the most valuable timber tree of extra-tropical and semi-tropical climates. A tall, clean-stemmed tree, with ashy-grey bark. It furnishes the soft, scented timber used in the coffins of wealthy Chinese and very high prices are paid for it for this purpose. It is used in palaces and, as timber, is esteemed higher than Teak. £20 has been known to be paid for a plank of highly-scented wood of the best quality. It is an even-grained wood with a peculiar lustre when worked up. It is said to be as valuable as Sandal wood. For some years I have been promised plants or seed from Hongkong, but difficulty has been experienced in getting them. This very valuable tree should be introduced at the earliest opportunity and given extended trial in Equatorial highlands.

China, inland, about latitude 30°, and on highlands further south.

(2) **Persea teneriffæ.** Persea.

A fine tree with a mahogany-like timber. This seems a species worthy of introduction in the indigenous forest, though not like the preceding to merit expensive planting. *Persea gratissima* is the well-known Avacado pear.

Canaries, Madeira, and Azores.

(2) **Picea spp.** The Spruces.

The Spruces have much the same sylvicultural and economic value as the Silver Firs (*see* above, under *Abies*). But they are less trees of warm countries, and only 4 or 5 species can be termed extra-tropical. No species occurs on mountains within the tropics.

(2) **Picea brachytila.** Chinese Spruce.

One of the few extra-tropical Spruces. A southern form of the wide-spread Mongolian Spruce, *Picea alcockiana*. ("Index Floræ sinensis." Masters.)

Yunan.

(2) **Picea likiangensis.** Yunan Spruce.

Likiang at 2,800 feet. ("Index Floræ sinensis." Masters.)

Yunan.

(2) **Picea orientalis.** Eastern Spruce.

This must be regarded as an extra-tropical Spruce since it is found at an elevation of only 2,000 feet on the Caucasus. But the climatic conditions are not such as to favour its introduction to the mountain forests of British East Africa.

Caucasus, 2,000 to 6,000 feet.

(2) **Picea polita.** Tiger-tailed Spruce.

Rare in the wild state, but much cultivated as a small tree in Japan. It has done well in New Zealand. Kent considers this to be the most ancient of the Piceas and in process of dying out. It makes a pretty young tree. C. Hansen puts a low value on *P. polita* as a timber tree.

On mountains, Southern Japan.

(1) **Pinus altamirani.** Altamirani Pine.

A new species, apparently a useful timber pine. *See* Appendix I., "Conifers of Mexico and Central America."

Mexico.

(1) **Pinus armandi.** Armandi Pine.

The exact timber value of this tree is not known. As a native of the mountains of South China it may prove a useful introduction.

Southern China.

(2) **Pinus australis.** (*P. palustris.*) Long-leaf Pitch-pine.

A tree that from its technical value demands careful trial in British East Africa. It is the best of the four American Pitch-pines—*P. mitis, P. cubensis*, and *P. tæda* being the others. The timber in weight averages rather heavier than Teak. Its value as a timber is well known, but it has not proved as durable out-of-doors in South Africa as was thought. Many bridges built of it have failed in a few years. At the instigation of Michaux it was largely planted in 1830 in Southern France and Italy, but few of these trees now remain. It is possible that it may adapt itself better to changed climatic conditions on the mountains of equatorial Africa, but failure should not excite surprise. It is always a slow-growing tree when young. It succeeds well in parts of South Africa.

Gulf States of Northern America, from an elevation of 2,000 feet on the Appalachian Mountains to latitude 32° in Texas.

(1) **Pinus ayacahuite.** White Pine.

The common White Pine of Mexico. One of the first Mexican pines that should be tried in the Protectorate. Seeds should be obtained from Guatamala. *See* Appendix I., "Conifers of Mexico and Central America."

Mexico and Central America.

(1) **Pinus cubensis.** Pitch Pine.

One of the American Pitch Pines extending to the highlands of Central America. It is one of the most promising pines for the highlands of the Protectorate, and one of the most valuable for Equatorial highlands generally. *See* Appendix I., "Conifers of Mexico and Central America."

Gulf States, Cuba, and Central America.

(2) **Pinus densiflora.** Densiflora Pine.

This, in contra-distinction to *P. thunbergii*, is a pine of rich soils. It is met with planted everywhere in Japan, but only grows naturally on the richer granitic or volcanic soils. "Timber used for every description of carpentry by the Japanese." (Kent.) It is noted growing as a tree 40 feet high in Yunan (7,000 feet elevation). On the west coast of Corea, it is seen as a stunted tree covering the hills, kept closely cut for firewood, so that it rarely reaches more than one or two feet in height, with clusters of small branches. Near Pekin it is noted growing as a flat-headed tree somewhat like an old Cedar. In South Africa its cultivation has not, so far, been successful. (Index, "Floræ Sinensis," Dr. Masters.)

Japan and China.

(2) **Pinus excelsa.** Excelsa Pine.

Perhaps worth trial at high elevations in British East Africa. In Cape Colony it rarely grows well. A poor tree in the middle districts of Natal. Young trees looked doubtful in Mr. Hume's arboretum at Johannesburg; better in the park at Pretoria. This is the best

Himalayan common timber after the Deodar. In the Himalayas it grows faster than the Deodar, and thus tends to dominate and oust the Deodar. In good soils and at moderate elevations, says Gamble, it grows very fast. All the trees I have seen in South Africa were slow-growing.

Himalayas, at 6,000-12,000 feet.

(1) **Pinus filifolia.** Filifolia Pine.

One of the best pines for British East Africa. *See* Appendix, "Conifers of Mexico and Central America."

Mountains of Guatamala, latitude 14° to 17°.

(2) **Pinus halepensis.** Jerusalem or Aleppo Pine.

One of the hardiest pines under cultivation in South Africa, but not well suited climatically to equatorial highlands. It is a tree of a winter rainfall and a cold winter. It has failed uniformly in British East Africa between 5,000 and 6,000 feet; possibly it might succeed at a higher altitude. Timber usually second rate.

Mediterranean and Asia Minor.

(1) **Pinus hartwegii.** Hartweg's Pine.

One of the good timber pines of Mexico, but Alpine or semi-Alpine. It flourishes at 10,000 feet on Orizaba. *See* Appendix I., "Conifers of Mexico and Central America."

Mexico.

(2) **Pinus canariensis.** Canary Pine.

This tree grows at high elevations in the Canary Islands, latitude 28° N., but one must reflect that this is only some 10 degrees north of the thermal equator. It would possibly do well in those drier highland parts of the forest of the Protectorate where the Cedar flourishes. In the Canary Islands *P. canariensis* may be seen growing from sea level to a height of 8,000 feet on Teneriffe. The forests of this tree on Teneriffe have been more than once described. They are well illustrated by photos. and specimens in the Kew timber museum. There is also fine timber forest on the island of Palma, in what is known as the Caldero. This is at a lower level than Teneriffe, but well supplied with moisture, and the forest has been described to me by eye-witnesses as being very remarkable. The trees attain a huge size and are set in a surrounding of mountains having a peculiar beauty.

In the Caldero there is both evergreen forest and a zone of pine forest above it, the latter showing trees of enormous size. A pine 8 feet through and over 100 feet high is described.

The heartwood of the Canary pine, known as Pino tèa, is held to be imperishable. I had a specimen in my office at Cape Town taken from an old Spanish building, originally erected 200 or 300 years ago, and since rebuilt, the wood being found perfectly sound. In the Kew Museum is shown a sample of timber that is now quite sound and which has been for 200 years out of doors, employed in the construction of a sugar mill.

Canary Islands.

(2) **Pinus cembroides.** Nut Pine.

A small tree, yielding an edible nut. Does not occur further south than Orizaba, according to Kent. *See* Appendix I., "Conifers of Mexico and Central America."

Mexico.

(2) **Pinus insignis.** Insignis Pine.

This tree flourishes remarkably on the Nilgiris, in New Zealand, and South Africa. There are some striking trees in the Botanic Gardens at Ootacomund. But it has not yet been planted in the Government timber plantations on the Nilgiris. Mr. Cowley Brown recommends that it should be planted as a timber tree, citing its dense rapid growth.

In South Africa it shows a moderately rapid growth in the Cape western winter rainfall district. Here it is strictly within its own climatic habitat and promises to yield a timber of good quality. There are some particularly fine trees in the Government plantations at Tokai and Ceres Road. In the eastern districts of Cape Colony and in Natal it grows very rapidly, but the quality of the timber seems variable and the tree is subject to disease. In Natal, where were made the first large plantations of Insignis Pine, there has been much disappointment. The timber is described as worthless, being soft and woolly in texture. There is an extensive literature on the diseases to which this tree in Natal has fallen a victim. It affords one more instance of the risk involved in planting a tree as an exotic outside its climatic habitat. In spite of a rapid growth, the Insignis Pine should be planted on equatorial highlands for ornament only; or, with caution, for timber. It has failed, so far, in British East Africa.

Coast of California below San Francisco.

(1) **Pinus insularis.** Philippine Pine.

A tropical pine, but reaching some elevation on the mountains of the Philippines.

Philippines and Timor.

(1) **Pinus khasya.** Khasia.

After *P longifolia*, which is growing so well on the Nilgiris, after the pines of South Mexico and Central America, *P. khasya*, *P. merkusii* and *P. massoniana*, with, perhaps, *P. insularis*, are the most promising pines for the highlands of British East Africa. *P. khasya* forms pure forest and occurs over about 150 square miles of the mountainous and hilly country of tropical

Burmah. It has a wide range, being found up to an altitude of 10,000 feet. The timber is of the Pitch-pine class, hard, resinous, and weighing 37 lbs. the cubic foot. Its growth is of medium rapidity. "At 72 years of age average trees reach 2 feet diameter and 100 feet high." (Gamble.) The forests are much damaged by grass fires.

Tropical Burmah, to an elevation of 10,000 feet.

(1) **Pinus leiophylla.** Leiophylla Pine.

This is one of the finest of the pines of Mexico and Central America, where it reaches a height of over 100 feet. This, according to Shaw, is one of the three most valuable timber pines of Mexico. *See* Appendix I., "Conifers of Mexico and Central America."

Mexico and Central America.

(2) **Pinus longifolia.** Longifolia Pine.

This fine timber tree is well worth trial in British East Africa. Its timber is of good medium quality and the tree is fast-growing. I saw various promising trees in Natal, where it grows well up to 4,000 feet elevation. On the Nilgiris, this tree has produced the highest figure of growth of any pine there, and one of the highest figures ever recorded for pines, *vide* "Yield Tables," page 41.

In the "Cairn Hill" plantation, 7,235 feet elevation, at 18 years, it has an Acrim as high as 250 cubic feet, an average height of 45 feet, and an average diameter of 7 inches. Mr. Cowley Brown describes a tree with a height of 111 feet and a diameter of 3 feet 2 inches (form-factor ·5). "The species, he adds, is a light demander and produces practically no needles under dense covert. Owing to its susceptibility to wind it requires close planting." Eighteen-year old trees show an abundant crop of cones, especially on the large outside trees.

Outer Himalayas and Siwalik Range, 5,000 to 7,000 feet. Widespread from the hot, damp valleys of Sikim to the bleak, dry, stony hills of the Punjab.

(1) **Pinus massoniana** (*P. sinensis*). Chinese Pine.

A tropical and extra-tropical pine of South-east China, where it is widespread; plentiful on the mountains north of Foo-chow mixed with *Abies fortunei*. It is a useful pine, largely planted by the Chinese in tropical China round their villages. It has leaves in twos, rarely threes (very slender, from 4 inches to 6 inches long), and a very small cone for a tree of the Pinaster class.

The *P. sinensis* so extensively grown on the Hongkong mountain is referred by Dr. M. Masters to *P. massoniana*. It appears to be widespread on the tropical mountains of South China, from whence, or from the mountains of Formosa, seed should be procured for British East Africa. The Hongkong plantations are the most successful instance of pine-planting in tropical latitudes. They are now yielding good returns and are being managed on regular Working-plans. These plantations will be found described in the yearly reports of the Hongkong botanic gardens and parks, more especially since Mr. Dun has been in charge.

China, extending from Yunan and Formosa to North China and Japan.

(1) **Pinus merkusii.** Merkusii Pine.

A tropical pine growing in Burmah up to an elevation of 3,500 feet, and in the Philippines and Borneo up to 5,000 feet. In Burmah it forms small forests of little economic value, but is itself a large timber tree, moderately fast-growing, with timber as heavy as 51 lbs. to the cubic foot! As a tropical pine, it may be planted in the coast districts of the Protectorate and some way inland, perhaps as far as Nairobi. It would be suitable for railway fuel, house-building timber, and sleepers. If it should take kindly to the lower railway forests it may be a valuable introduction.

Drier mountains of Burmah, Philippines, &c., to 5,000 feet.

(2) **Pinus mitis** (*P. echinata* of the later American authors). Short-leaved Pitch-pine.

This is the most valuable Pitch-pine after *P. australis*, and the timber being finer and softer is preferred to *P. australis* for interior work. It might be tried at the higher elevations in British East Africa, but it is too northern a pine to afford much promise of success.

New York to Texas; the most northern of the four Pitch-pines of the Gulf States.

(1) **Pinus montezumæ.** Montezume's Pine.

The common pine in Mexico, between 17° and 25° latitude. A valuable timber tree. Easily recognised in English pinetums by its foliage, disposed like mops of very long needles. I know of some very good trees at Bicton, South Devon. It occurs under different forms in Mexico and has received a great variety of names. This, according to Shaw, is one of the three most valuable timber pines of Mexico. *See* Appendix, "Conifers of Mexico and Central America."

Mexico, 4,000 to 12,000 feet.

(2) **Pinus occidentalis.** West Indian Pine.

A tropical pine of the West Indies, Jamaica, etc., growing to some elevation on the mountains.

West Indies.

(1) **Pinus oocarpa.** Oocarpa Pine.

One of the best of the Mexican pines. One of the *three best*, according to Shaw. *See* Appendix I., "Conifers of Mexico and Central America."

Volcanic mountains of Mexico; the Oocarpoides variety at lower elevations.

(1) **Pinus patula.** Patula Pine.

A fine Mexican pine resembling *P. longifolia.* *See* Appendix I., "Conifers of Mexico and Central America."

Mexico, 6,000 to 12,000 feet; usually Alpine.

(2) **Pinus pinaster.** Cluster Pine.

On the Nilgiris this tree shows a growth not much inferior to *Pinus longifolia.* At 18 years the average height is 43 feet. It is curious to note that this tree on the Nilgiris has no cones, though they are so abundant on South African trees. Cluster-pine succeeds on the Himalayas but is unlikely to flourish on Equatorial highlands. It seems to have failed so far in British East Africa.

Mediterranean.

(1) **Pinus pinceana.** The Weeping Pine of Mexico.

It may be a variety only. *See* Appendix I., "Conifers of Mexico and Central America." A handsome tree; very ornamental.

Mexico, 6,000 to 9,000 feet.

(1) **Pinus pringlei.** Pringle's Pine.

One of Shaw's new species, about which little is known. *See* Appendix I., "Conifers of Mexico and Central America."

Mexico.

(1) **Pinus pseudo-strobus.** The White Pine of Northern Mexico.

This will be one of the pines to be tried in the drier country, say, about Naivasha and the Rift Valley. It grows in Mexico between 6,000 and 8,000 feet. *See* Appendix I., "Conifers of Mexico and Central America."

Mexico.

(2) **Pinus taeda.** Loblolly Pine. Oldfield Pine.

Not climatically suited to Equatorial highlands, but very hardy and worth trying as seed is so easily obtainable. In America its timber is of variable quality. The comparatively slow-grown timber from the primeval forest is equal to the best Pitch Pine; but much young quickly-grown and immature timber is put on the market.

Gulf States, United States of America.

(1) **Pinus teocote.** Torch Pine.

One of the grandest of the Mexican pines, reaching a height of 150 feet. Timber very resinous, burning so freely that it is one of the trees called Torch Pine or Candle-wood in Mexico. *See* Appendix I., "Conifers of Mexico and Central America."

Mexico.

(1) **Pinus lambertiana.** Giant Pine.

This tree, in its northern home, is of huge size; the loftiest of the pine genus, trees up to 300 feet being known. This is in Oregon and California. A tree resembling this or, perhaps, the same species, was found by Mr. Wilmot of the Cape Forest Department in the province of Guerèro, Southern Mexico. This Guerèro tree should be planted in British East Africa. The White Pine of Guerèro, says Wilmot, quite frequently attains a height of 280 feet, with a diameter of 5 to 7 feet! *See* Appendix I., "Conifers of Mexico and Central America."

Mexico, 5,000 to 11,000 feet on the slopes of Orizaba and elsewhere.

(2) **Pinus thunbergii.** Thunberg's Pine.

As growing in Yunan and the south coast of Japan this useful tree is worth trying in the Protectorate. It has been planted for centuries in Japan and marks the beginning of historical forestry. It is planted there on the sea coast, inland, and wherever there is poor or exhausted land to be utilized. It is planted for hundreds of miles along the roads as an avenue tree. Timber resinous and durable. It yields a large part of the firewood of the poorer classes.

Japan, Korea and Yunan.

(2) **Pinus yunanensis.** Henry's Yunan Pine.

A little-known pine allied to *P. massoniana.* Should be given a thorough trial on Equatorial highlands.

Yunan.

(2) **Pistacia mexicana.** Mexican Pistacia.

Worthy of trial-planting.

Northern Mexico.

(2) **Pittosporum undulatum.** Pittosporum.

This is probably the most ornamental tree in Australia, where it is frequently planted and is much in favour. It succeeds well in South Africa. It has fragrant leaves and flowers. It should succeed above 5,000 feet in East Africa.

East Australia.

(1) **Platanus lindeniana.** Plane.

A large Plane tree of Southern Mexico. Robertson mentions it as growing at 4,000 feet.

Southern Mexico.

(1) **Platanus mexicana.** Plane.

A large tree of Southern Mexico growing in moist valleys and along streams, also on Orizaba mountain, 4,500 to 5,500 feet. Would probably be one of the best trees for avenue purposes on Equatorial highlands. Robertson describes it as a large, widely-branching tree.

Southern Mexico.

(2) **Plumbago capense.** Common Plumbago.

This is the strong-growing, hardy, blue Plumbago of South Africa. It makes a dense hedge up to about 4 feet high, wants little clipping, and is very beautiful with its blue flowers. In hedges and borders it was the glory of old-fashioned Cape gardens. It is already growing, seemingly quite hardy, in Mrs. Sandiford's garden at Nairobi.

South Africa (eastern side indigenous, planted elsewhere).

(2) **Podocarpus chinensis.** Chinese Yellow-wood.

Wood white; durable indoors. This and the following species of *Podocarpus* should be given trial. They may develop qualities superior to the two indigenous species of *Podocarpus*.

Yunan and mountains of tropical China.

(1) **Podocarpus coriaceus.** The Yacca.

This is usually seen as a smallish tree about 50 feet high and 18 inches diameter. It yields an ornamental timber, highly prized for furniture and the interior wood-work of houses. The weight is stated at 47 lbs. the cubic foot, which is somewhat excessive for a generally useful timber. This tree is mentioned in all accounts of the forests of the mountains of Jamaica, and seed of it would no doubt be easily procurable.

Blue mountains of Jamaica.

(2) **Podocarpus totara.** Totara.

One of the chief timber trees of New Zealand and worthy of trial-planting in Equatorial highlands. The timber is more durable than most species of Podocarpus.

New Zealand; chiefly in the south.

(2) **Podocarpus thunbergii** (Var. *falcata.*) Falcata Yellow-wood.

A round-headed tree, with drooping foliage, looking more like a weeping Yew than a Yellow-wood. I saw several specimens in the middle districts of Natal. It may be worth planting as an ornamental tree only.

South Africa; indigenous.

(1) **Prumnopitys elegans** (*Podocarpus andina*). The Lleuque of Chili.

A stately tree, bearing eatable, cherry-like fruits. It should be introduced at an early date to the Protectorate, where it is nearly certain to flourish; but seed should be obtained from Ecuador. I follow the Kew list in writing *Prumnopitys elegans*, but the second name seems preferable.

Ecuador and southwards to Chili.

(1) **Prunus capuli.** Mexican plum. (*Prunus serotina*, var. *salicifolia.*)

Yields the Capulines fruits—a sweet but rather flavourless plum. Would probably succeed in the Protectorate if seed were obtained from Southern Mexico or Central America.

Mexico.

(1) **Psidium araca.** A Guava.

A good fruit Guava, growing on dry high ground.

Tropics of America.

(1) **Psidium cattleyanum.** The Purple Guava.

This has been planted with success in various parts of South Africa: as a young tree it succeeds well in British East Africa. It bears a smaller but in many respects better fruit than the common Guava. It is also more hardy within the tropics; the fruit is said to be one of the best flavoured of the Guavas. Other species of Guava worthy of trial-cultivation in British East Africa are *P. grandifolium*, *P. incanescens*, *P. rubrum* (growing on high mountains), *P. acutangulum* (growing in the higher regions of the Amazon), *P. arboreum* (tropical mountains of Brazil), and *P. montanum*, the Spice Guava of the West Indian highlands. The common Guava, *Psidium guayava*, has run wild in the West Indies.

These species are all ornamental and yield fruits by no means to be despised in their present unimproved condition. The fruits of *P. cattleyanum* are delicious.

Tropics and extra-tropics of South America.

(2) **Pteroxylon utile.** Sneezewood.

The well-known imperishable timber of South Africa. The limit of the durability of Sneezewood heartwood is unknown. Its economic cultivation in British East Africa is doubtful. But it flourished (for some years at any rate) on the Nilgiris.

Mountains of South-east Africa, from the southern coast to Zululand, and northwards.

(2) **Populus alba.** White Poplar.

This is the common Poplar seen throughout South Africa where it is now completely naturalized. The "Poplar bush" is to be seen on most Boer farms where there is any swampy ground, especially in the Transvaal. It furnishes a perishable, second-rate timber,

but one which is useful on a farm in default of a better, and there is now a demand for Poplar wood in South Africa for match-making. Poplar timber impregnates easily without pressure. *Populus alba* should be tried on swampy ground in British East Africa at about 7,000 feet elevation.

Eurasia.

(1) **Prosopis alba.** Algaroba Blanca. Mesquit.

One of the thorny trees yielding a sweet pod that may be worth planting on the grazing grounds of the dry plains. This is a farmer's, not a forest, tree.

Highlands of tropical South America.

(1) **Prosopis dulcis.** Mesquit of Mexico.

Says Robertson: "The Mesquits are probably the most common and valuable of the trees of the semi-arid and prairie regions of Mexico. The wood is excellent for sleepers and similar uses because of its durability, and both the wood and the roots, which are sometimes 50 feet long, make an excellent fuel. The pods are eaten by the Mexicans, and are an important fodder for cattle during the dry spring months. For this reason the trees are often left standing in the middle of cultivated lands. Probably cattle play an important part in disseminating the seed."

The Mesquit is often of shrubby size, but in the prairie region of the tableland, &c., trees about 30 feet high with good stems are commonly seen.

Mexico.

(1) **Prosopis juliflora.** The common Mesquit tree.

In Hawai it has been introduced with striking success. It there takes possession of otherwise worthless ground, feeds herds of pigs, and the pods are gathered and brought into the town for feeding horses. This is undoubtedly a tree of value to the farmer and should be tried in British East Africa, taking due precaution against it degenerating into a pest. It is the well known "Mesquit" tree of Texas and the West Indies. In Texas it tends to overrun pasture and is disliked in spite of its sweet pod, which is valuable feeding for stock. Cattle eat the sweet pods and pass the seed, thus spreading it over the veld. *See also* paragraph in this report, "An Industry for the Plains": page 9.

North and South America. Tropics and extra-tropics.

(1) **Quercus agrifolia.** Oak.

Slow-growing, and with inferior timber, but worth trial as an evergreen shade tree. It grows to a magnificent tree in Mexico.

Mexico.

(1) **Quercus calophylla.** Oak.

"A large tree, widely distributed on the moist mountains of Southern Mexico at fairly high elevations, 7,500 feet; a smaller tree at lower elevations. This is probably one of the evergreen Oaks that form a large part of the forests on the mountains in Michoacan about 7,000 feet, and as a smaller tree at 5,700 feet. These Oaks are fine trees, sometimes 5 feet in diameter, with clear boles for about 50 feet. They are lumbered at Conuy and the wood is used for sleepers, bridge-building, timber, &c., but it seasons badly. Yearly rings are not distinguishable. Leaves 4 inches to 8 inches long. Acorns 1 inch long with red flesh." (Robertson.)

Southern Mexico.

(1) **Quercus castanea.** Chesnut Oak.

Produces eatable acorns. May be a valuable introduction.

Mexico and Central America.

(1) **Quercus crassipes.** Oak.

"A fairly large tree with a spreading crown, growing in comparatively dry situations on the plateau of Southern Mexico often with *Q. reticulata.*" (Robertson.)

Mexico; 5,500 to 8,500 feet.

(1) **Quercus insignis.** Insignis Oak.

This is one of the Oaks yielding particularly large acorns. *See* Appendix I., "Conifers of Mexico and Central America."

Mexico.

(1) **Quercus magnolifolia.** Silkworm Oak.

Its leaves feed a silkworm.

Mexico.

(1) **Quercus reticulata.** Oak.

Robertson describes this as widespread, abundant, and "the largest and most valuable of the Oaks of the interior region. The wood cracks badly on drying, but is largely used for sleepers. In Southern Mexico a large tree 60 to 80 feet high, with a spreading crown, growing on the slopes of hills, on the tableland, at about 7,000 to 8,000 feet."

Mexico.

(1) **Quercus sideroxylon.** Ironwood Oak.

A magnificent Oak with timber that is hard and of some durability. This may be worth planting as an ornamental tree and an acorn-bearer.

Mexico, 5,000 to 8,000 feet.

(1) **Quercus skinneri.** Cozahual.

Perhaps the best of the Mexican Oaks. A leaf-shedder, with strong and durable timber and a fine large acorn. This is one of the Mexican trees demanding first trial in British East Africa.

Mexico, 7,000 feet on limestone.

(1) **Quercus virens.** Live Oak.

A hard, fairly durable timber; grows to a good-sized tree in Southern Mexico. *See* Wilmot's account of this tree in Appendix I., "Conifers of Mexico."

Mexico.

(1) **Quercus xalœpensis.** Poverty Oak.

This is a useful quick-growing Oak which is said to thrive on poor, clayey soils and to yield large crops of acorns.

Mexico and Central America, up to 5,000 feet.

Quercus spp. Oaks of Southern Mexico.

There are other Oaks of Southern Mexico and of the highlands of Central America which are worthy of extended planting in British East Africa, particularly on farms where acorns would furnish so valuable an addition to pig-rearing and the production of good firm bacon. *See* Appendix I., "Conifers of Mexico." As many as 80 species of Mexican Oaks are recognised; but Robertson, who travelled with Pringle recently in Mexico, states that very little is known about the Oaks of Southern Mexico. As a class, they are the trees in Mexico which come next to the Conifers in importance, so that their study urgently demands the attention of foresters and botanists. He cites the following species as likely to be of value to foresters in other countries:—*Q. acutifolia, Q. castanea, Q. corrugata, Q. lanceolata, Q. magnolifolia, Q. sideroxylon, Q. skinneri, Q. xaloepensis.*

(1) **Robinia sp.** False Acacia.

There are two or three species of Robinia in Mexico, more or less closely allied to the common *Robinia pseud-acacia.* They are desirable as ornamental trees and for their timber.

Mexico.

(2) **Sabal palmetto.** Palmetto Palm.

An enormous, Extra-tropical Fan-Palm, giving a timber resistant to decay and teredo! It yields a timber which planted in the ground outlives most other timbers. The tree is very handsome and should be given careful trial. It is one of the most striking of the Extra-tropical Palms. It succeeds under cultivation in South Africa.

Florida to North Carolina.

(2) **Salix alba.** White Willow.

One of the most useful of the Willows.

West Himalayas, to 6,000 feet, and widespread.

(1) **Salix bonplandiana.** The common Willow on the Mexico plateau.

It is planted both along streams and irrigation channels, and as a roadside tree for shade, for which purpose the fastigiate form is preferred. (Robertson.)

Mexico.

(2) **Salix caprea.** The Sallow.

On the whole this is the hardiest Willow of those yet cultivated at the Cape for osiers, and it makes a good basket. It succeeds also in the Transvaal and should be given a trial in British East Africa.

Europe and Northern Asia.

(2) **Salix humboldtiana.** Humboldt's Willow.

This seems to be one of the Willows most worth trial in British East Africa.

South America; widespread.

(2) **Salix purpurea.** Bitter Willow.

A good osier Willow and one of the best for introduction to Equatorial highlands.

North Africa, and widespread.

(2) **Salix rubra.** Red Willow.

Cultivated as an osier in North Africa; worth trial-planting.

North Africa.

(1) **Salix taxifolia.** Willow.

A medium-sized Willow with a wide distribution.

Mexico and Guatamala.

(1) **Salix tetrasperma.** Tetrasperma Willow.

The chief Indian Willow; a leaf shedder and a fine large tree. Timber red and soft; quick-growing. Yields both timber and twigs.

India and Himalayas, to 6,000 feet.

(2) **Salix viminalis.** Osier Willow.

This is the common osier of European osier beds.
Inner Himalayas, 5,000-9,000 feet, extending west to Europe.

(1) **Schinus molle.** Pepper tree.

The well known ornamental tree. There is no more graceful tree. So far, it has not done very well in British East Africa, but it needs a more extended trial in the drier higher parts of the highlands, say, country where the Cedar flourishes at 7,000 to 9,000 feet. Some good, medium-sized trees in the Ainsworth garden at Nairobi and elsewhere in British East Africa. In the valley of Mexico, says Robertson, and in the neighbouring States, it is very common as an ornamental and shade tree. It is completely naturalized, sometimes reproducing itself abundantly. The trees reach a height of about 40 feet. *Schinus terebinthifolius* is less ornamental.
Mexico; introduced and much planted. Indigenous on the Andes.

(2) **Skiadopitys verticilata.** Skiadopitys.

A curious tree, with a straight useful timber. In British East Africa this is most likely to succeed at elevations of 8,000 or 9,000 feet. In Japan it grows with a slender, well-shaped stem to a height of 100 feet.
Japanese mountains.

(2) **Syncarpia laurifolia.** Turpentine tree.

This is the timber most in favour now for marine piles. It has been found to outlive Jarrah, and in the form of round piles to resist teredo better than any other Australian timber. It also lasts well in the ground as a railway sleeper. It is fire-resistant in the beams of a house. Does well below 4,000 feet in the Transvaal. There is a fine straight tree 60 feet high in the Maritzburg Botanical Gardens. "Forms," says Professor Maiden, "magnificent straight trees in deep gulleys." In appearance it resembles a Eucalypt, and is commonly mistaken for one.
Queensland and New South Wales.

(2) **Tarrietia actinophylla.** Stave Wood.

A very large tree, with spreading head of a deep green, dense foliage, and numerous white flowers. Timber tough like English Ash, and bending better than Ash. (Bailey.) This seems worth trial-planting in British East Africa.
Mountains of Queensland.

(1) **Taxodium mucronatum.** Montezume Cypress.

The best known of the Mexican Cedars. It forms pure forest at about 5,000 feet, and various noble trees are referred to by travellers in enthusiastic terms. The Mexican tree is closely allied to the American *Taxodium distychum.* If this magnificent tree be not too slow-growing, it may form a valuable addition to the mountain forests of British East Africa. It is reported from Southern Mexico at Oajaca, latitude 17°, and probably extends into Guatamala and Central America whence seed should be obtained for British East Africa. *See* Appendix I., "Forests of Mexico and Central America."
Mexico, 5,000 to 8,000 feet.

(1) **Telopea speciosissima.** Waratah.

A beautiful flowering liana. It flourishes on the Nilgiris, and would no doubt do well at 6,000 feet and above in British East Africa.
New South Wales, Gippsland, and Tasmania.

(1) **Terminalia chebula.** Black Myrobolan tree.

A large, leaf-shedding tree, yielding the valuable Myrobolan tan nuts. Timber very hard and strong, also durable to some extent. This tree may be worth introducing for its valuable tan nuts. It is leaf-shedding and thus more easily planted.
India, to 5,000 feet; and Upper Persia.

(1) **Ternstromia japonica.**

This is one of the best timbers of the Nilgiris sholas, according to Cowley-Brown. It produces good house-building timber. Trial planting on a small scale.
Nilgiris, 6,000 to 7,000 feet.

(2) **Thuya orientalis.** Arbor-vitæ.

This tree may be worth trying in the highlands of British East Africa. It has been used for hedges in the Transvaal, but was there much subject to aphis.
China and Japan. Hills west of Pekin. (Dr. Masters.)

(1) **Tilia mexicana.** The Mexican Linden.

A large tree on Orizaba mountain at 7,000 to 9,000 feet and reaching a height of 50 feet and diameter of 2 feet near Monterey. (Robertson.) This and the allied *Tilia occidentalis* of Southern Mexico would be useful for planting as avenue trees. Their blossom is famous as honey-fodder, and their shade scarcely surpassed by any trees.
South Mexico.

(1) **Torreya nucifera** (*Tumion nucifera* of the later American botanists). Japanese Torreya.

Usually a small but sometimes a large tree. The large tree is described as a conifer

of unusual beauty, with its bright red bark and very dark green (almost blackish green) foliage. The small tree may be useful as forest cover. The kernels of the seed are an important article of food in Japan, and yield a useful cooking oil. (Sargent.) Dr. Masters in the "Index Florae sinensis," mentions this tree as growing in Northern China. Seed for British East Africa should be obtained from the mountains of Formosa or tropical China.

Southern Japan and China.

(2) **Tristania conferta.** Brush Box.

A gardener's name for this tree is "Lophostemon." Timber durable, but liable to warp. It makes a good sleeper timber. One of the most handsome avenue trees of Australia. A fine tree like a Eucalypt. This has the reputation of the best-foliaged tree in Natal. There is a fine specimen in the Maritzburg Botanical Gardens.

Usually found in the dense forests of the northern New South Wales coast, termed "Brushes"; often, however, in open forest.

(2) **Tsuga chinensis.** Chinese Tsuga.

It seems to be uncertain how far this Tsuga extends on the mountains over tropical China. Its habitat is probably partly extra-tropical.

China.

(2) **Tsuga aragi** (*Tsuga sieboldii*). Araragi Spruce.

A beautiful tree, 60 to 80 feet high. (Sargent.) Replaces *Tsuga diversifolia* south of Nikko. One of the three Tsugas that may be ranked as extra-tropical.

Mountains of Southern Japan; in dry stony valleys.

(2) **Tsuga brunoniana.** Himalayan Hemlock Spruce.

T. brunoniana is a fine forest tree in the wetter Himalayas, but slow-growing and the timber mediocre. (Gamble.)

Central and Eastern Himalayas, 8,000 to 10,000 feet.

(2) **Tsuga yunanensis.** Yunan. ("Index Florae sinensis"—Dr. Masters.)

One of the three or four Tsugas that may perhaps be regarded as extra-tropical.

(2) **Ulex europæa.** Gorse.

English Gorse may be seen growing well and flowering freely on the Government farm and elsewhere at Nairobi. It is naturalised in New Zealand and the more fertile parts of Australia and South Africa, also on the Nilgiris at 7,000 feet elevation. Near Ootacamand (Nilgiris) the hillside may be seen yellow with blossom. As an ornamental flowering shrub it is suitable for planting on Equatorial highlands. perhaps. also as a hedge plant at elevations from 7,000 to 9,000 feet.

Europe.

(1) **Alnus acuminata.** Alder.

This should be a profitable tree to plant near streams. It is one of the finest of the Alders.

Central America.

(1) **Ulmus crassifolia.** The evergreen Elm of Mexico.

It grows to a large tree and merits introduction to Equatorial forests and trial cultivation as an avenue tree.

Southern Mexico.

(2) **Ulmus panifolia.** Elm.

A pretty fresh-foliaged small tree in the Government nursery at Irene, now being raised for ornamental planting.

China.

(2) **Urunday.**

Timber very hard and ornamental, scored with white or yellow veins and spots. It is said to be extremely durable. Botanical name not known.

Northern Argentine.

(1) **Virgilia capensis.** Keur.

Is probably indigenous in British East Africa, but I have not noted it. In any case it is worth growing for its sweetly-scented pea-like flowers. In the forests of Knysna it plays an important part, covering the ground after a forest fire and maintaining forestal conditions till timber trees become established.

South Africa and naturalized Nilgiris.

(2) **Washingtonia filifera.** Californian Fan-palm.

A picturesque and graceful palm of medium size. The leaves tear apart leaving white threads at the line of separation. It has been largely planted in the Mediterranean, the Southern States of North America, and latterly in South Africa. It stands moderate frost, and likes a mean temperature between 60° and 70° Fah. It is easily propagated and is hardy under cultivation.

California.

SUMMARY.

Area and value of forest.—There are, in round numbers, 2,000,000 acres of good timber forest in the British East Africa Protectorate. Of this all but six per cent. is in the highlands, at an elevation of over 5,500 feet. It is entirely under Government control and is free of destructive rights.

The good forest on the coast consists of small scattered areas of local importance only. Except in the south-east corner towards the German frontier, the coast area is too dry to carry first-class forest. There is little rubber, and this little nearly all vine rubber. It is difficult to prevent the vines being destroyed in working the wild rubber of the forest. Though the southern coast of British East Africa is not an ideal rubber country, there seems considerable scope for private enterprise in the cultivation of suitable species. The northern coast is too dry for most commercial rubbers. The chief value of the coast forest lies in its Mangrove bark and Sandalwood (m'Huhu).

Near the coast, and inland, there is a very large area of dry, thorny scrub forest, only fitted to produce firewood and fencing posts. Its unhealthiness would be lessened by the removal of the scrub forest.

The highland forest is extra-tropical in character and differs little from the forest growing at lower elevations in the Transvaal, Natal, and Cape Colony. Under South African conditions, the highland timber forest of British East Africa would have an average value of £10 per acre, and be worth some £20,000,000. The highlands of British East Africa are better watered and more fertile than almost any part of South Africa. It may be safely estimated that, if properly worked, the highland forest of British East Africa will have a value exceeding £10 per acre at no distant date. Figures in support of the £10 valuation are given in detail in this report, pages 25 to 40.

Supply of timber and fuel to the Uganda Railway.—The chief value of the forest to-day is in the supply of firewood to the Uganda Railway and steam-boats, for which purpose it is far more economical than coal—one-third the cost of coal at Mombasa; one-fifth at Nairobi; and about one-seventh at the lake. There would be a considerable further economy if the firewood were used carbonized in the form of briquettes (page 51). In this form, its hauling power, weight for weight, and bulk for bulk, would be somewhat superior to the best coal, and the Uganda Railway would save about one-half of its present fuel trains.

Black Wattle.—To some extent Black Wattle may replace the forest firewood, but it cannot be depended upon alone. It is a climatic exotic, on the highlands of British East Africa; and may fail, as did, after a time, so many of the trees that were planted as climatic exotics in the Transvaal. The forest is fitted also to produce all the sleepers and building-timber required by the Uganda Railway, though many of the timbers will require special preparation. This subject is discussed in my report, dated March, 1908, on the use of native timbers for the proposed Nile Railway at Jinja.

Adjustment of the Customs tariff.—To encourage the use of East Africa timbers in the Protectorate, and to make it possible to export them to South Africa, various adjustments of the present Customs tariff are necessary. To forward the same end, an increased duty on imported timber and corrugated iron is recommended. Particulars of the most useful East African timbers are given in this report; details regarding the timbers generally will be found in Appendix II.

Special rates for native timbers on the Uganda Railway.—In view of the importance to the country of an early development of the forests, special rates for the carriage of native timbers on the Uganda Railway are recommended. South Africa imports at present about 1½ million pounds' worth (£1,500,000) of timber yearly. Vast stores of timber are going yearly to decay in the forests of British East Africa, while the carrying capacity of the Uganda Railway is only partially utilized by its present traffic. A special rate of one farthing per ton-mile is recommended, even though that rate, with the present gauge of the Uganda Railway, means working at a loss. To utilize the timber in the Kenia forest a good waggon-road or inexpensive branch railway to a point near Gilgil is required.

Destruction of the forest.—The forest has been much destroyed by fire and by the natives. In one forest, the Aberdare, the natives (Kikuyu) are estimated to have destroyed as much as 350 square miles (224,000 acres) of forest, in recent times. The present organization of the Forest Department, coupled with the forest demarcations now in progress, is sufficient to protect the forest against further destruction, both by fire and the "Kumri" cultivation of the natives. It is important that the natives should be taught to utilize cattle and other manures and abandon the wasteful system of "Kumri" cultivation. The protection of the forest against fire is easier than in the drier climate of South Africa. Much of the forest of British East Africa will only burn during periods of exceptional drought.

The best native timbers.—Yellow-wood for sleepers and house-building. Cedar for sleepers, house-building, furniture, and lead pencils. Ibean Camphor as a Teak substitute. Olive as a first-rate firewood, and a second-rate (but very durable) sleeper. Ironwood for house-beams, sleepers, and furniture. There are many hardwoods suited to various uses, some of them of great beauty, strength, and size; two or three very close-grained and good Boxwood substitutes.

Railway forest zone.—The remaining Government land on the highlands, a mile on each side of the Uganda Railway, where not specially required for such purposes as roads, buildings, &c., to be reserved, as the "Railway forest zone," for the supply of timber and fuel to the Uganda Railway. In South Africa and in America such land is now being bought back for railway purposes. Where the railway line passes through the indigenous forest, it is to be specially reserved against cutting any except dead timber, both for the beauty of the forest and the protection it affords against flying sparks from the railway engines.

Forest alienation.—More than three-fifths of the Railway forest zone, and (even after allowing for possible redemptions) over 100,000 acres of actual timber forest have been sold or granted at nominal rates and are in process of destruction by the owners. The present-day value of the forest being small, it is often destroyed for the value of the land it covers. This might be legitimate if the proportion of forest in East Africa were larger; but, with only 1½ per cent. of forest in British East Africa and a similar scarcity of timber in German East Africa, the preservation of existing timber is imperative. Three measures are recommended (page 63) for the certain prevention of any further forest alienation.

It is, of course, the first duty of the Forest Department to see that while the forest is worked it is not destroyed. That is, indeed, the sum and substance of State Forestry as understood on the Continent of Europe; and later, in the United States of America.

Native Forest Cultivators and Zones of White Settlers.—These two measures will be of the utmost help in the economical restoration and policing of the forest, pages 68 and 69. The native system of "Kumri" cultivation will be utilized for the restoration of the forest, while the presence of white settlers will be of advantage (1) showing the natives permanent cultivation methods, (2) in helping the police work of the forest. Special rules are recommended for the granting of such lands to white settlers.

History of the Forest Department in British East Africa.—This discloses a lack of support on the part of the Administration, and a *relatively* too high expenditure on forest salaries.

Planting.—Teak on the coast, and Black Wattle and Eucalypts on the highlands should be planted as far as funds will allow. The planting of certain areas cut over for the Uganda Railway or the Nairobi sawmills, and the planting of certain species to introduce them to the forest, are imperative and cannot be postponed.

Meteorology.—There is a slight winter on the highlands of British East Africa. Though situated on the Equator, these highlands are some distance south of the thermal-equator. This is of importance with reference to the introduction of many semi-tropical trees, particularly the important forest flora of South Mexico and Central America.

The tame Buffalo and the African Elephant.—The former should be introduced for forest work, at the earliest opportunity; and the latter taught to work at hauling and moving logs, pages 77, 78 and 46.

Financial.—Pending the development of outlets to South Africa, &c., together with roads to Kenia, the normal revenue of the Forest Department may be taken at £14,000. It should be much larger in the early future. The expenditure should be not less than £20,000 yearly: £16,000 may be taken as the minimum, below which, the Forest Department loses its efficiency. These figures must be considered unusually favourable for the initial stages of forestry in an almost undeveloped country. The demarcation of the forest will be complete in 3 or 4 years, when that item of expenditure will cease.

Appendix I.—Treats of the trees, mostly conifers, of South Mexico and Central America. These are specially wanted to complete the forestry of the highlands of Equatorial Africa. Nine-tenths of the timber used throughout the world is pine or fir. Both of these (except where introduced, as in South Africa) are absent from Africa, south of the Sahara. In South Africa, I was using, at one time, 5 tons of pine seed yearly.

Appendix II.—Treats of the indigenous timbers of the Protectorate. It is printed separately.

Appendix III.—Gives a descriptive list, in alphabetical order, of the foreign trees suitable for planting on the Equatorial highlands of Africa.

D. E. Hutchins.

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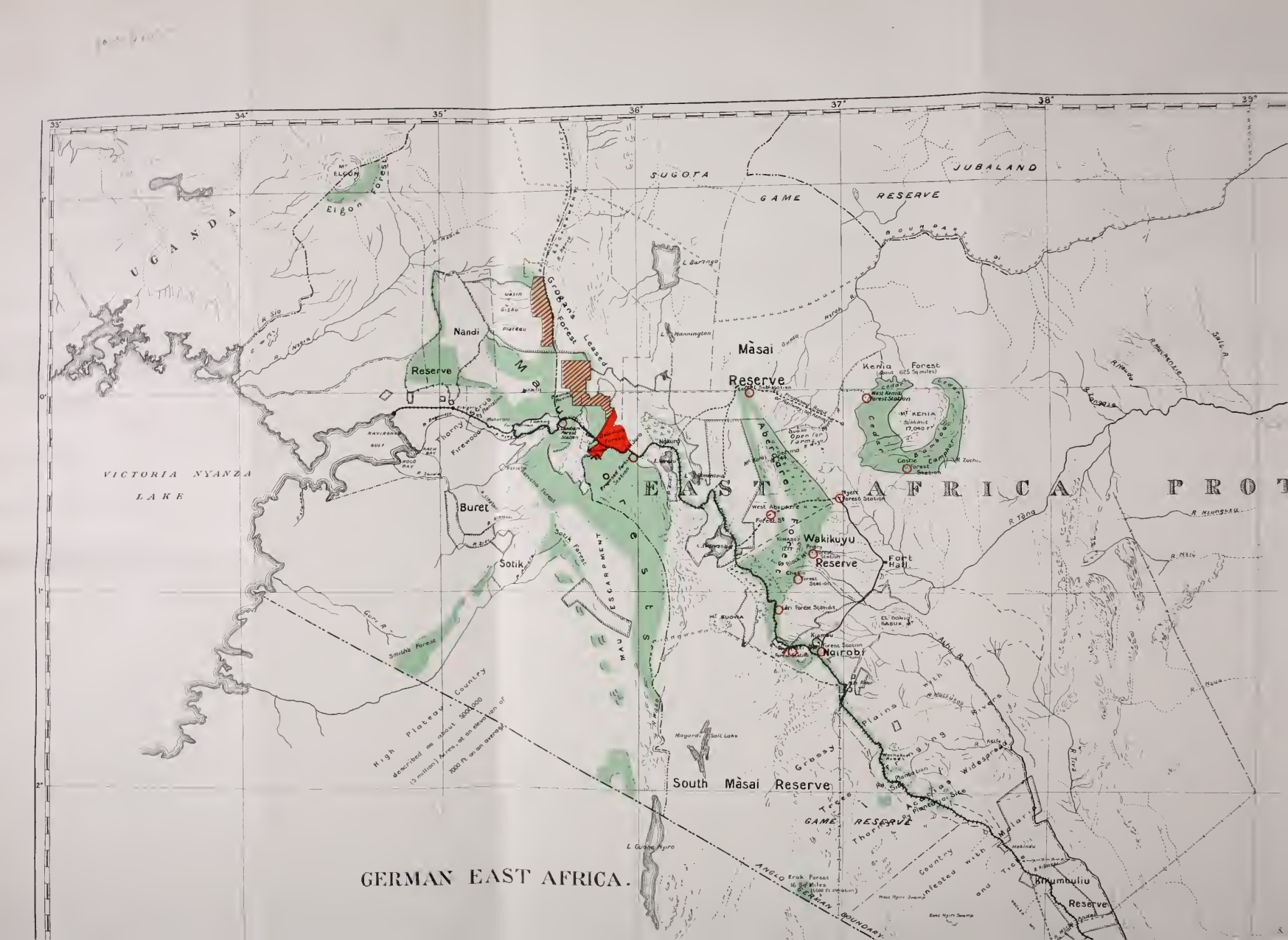
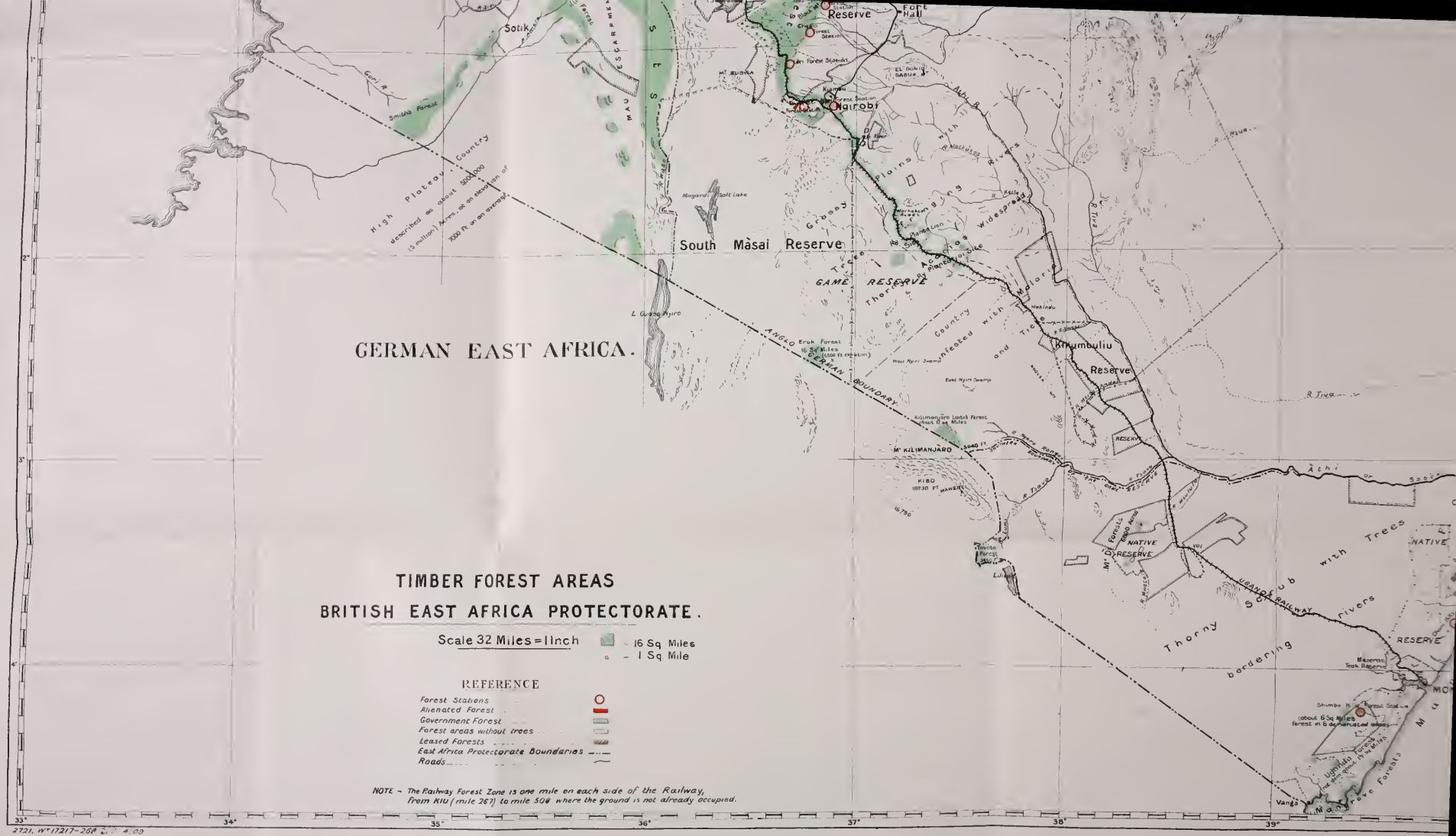

UGANDA
VICTORIA NYANZA LAKE
Elgon
SUGOTA GAME RESERVE
JUBALAND
BOUNDARY
Nandi Reserve
Grogan's Forest Leased
Masai Reserve
Kenia Forest
MT KENIA
Buret
Sotik
Thorny Firewood
Wakikuyu Reserve
Fort Hall
Nairobi
South Masai Reserve
GAME RESERVE
Kikumbuliu Reserve
EAST AFRICA PROT
GERMAN EAST AFRICA.
ANGLO GERMAN BOUNDARY

38°
39°
40°
41°
42°
JUBALAND
RESERVE
Lorian Swamp
R. Lakiira
Native
JUBALAND
PROVINCE.
Reserve
Juba River Fringe of Timber Forest
Kenia Forest
Bisahu hamu Swamp.
TÀNALAND
R. Tana Fringe of Timber
KISMAYU
AFRICA PROTECTORATE.
R. Tana
R. Nzungu
R. Nziu
Fort Hall
EL DONIO SABUK
Abi R.
R. Nsua
R. Tiva
R. Tana Fringe of Timber Forest
BIRIKAU
WITU
SULTANATE
Witu Forest (estimated at 4 Sq. Miles)
WITU VILLAGE
LAMU
KIPINI
Reserve
Kitumbuliu
INDIAN
OCEAN
R. Tiva
BOUNDARY
RESERVE

Hutchins
CHIEF CONSERVATOR OF FORESTS
(To accompany Report on Forests of Brit. East Africa)

Weller & Graham, Lt.d Litho, London



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Mangrove trees. Gàzi, South of Mombasa.

The weather-beaten Cedar of the plains, Ol-bolôsat.

Cedar in Uganda Railway fuel fellings "Escarpment" showing diseased heart.

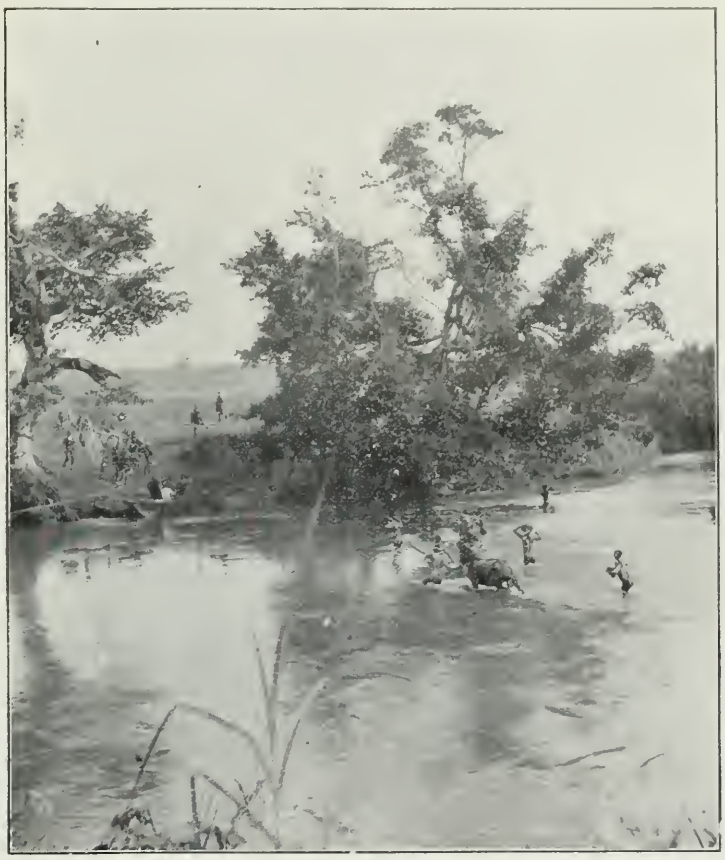
"Castle" Forest Station, Kenia. A fallen Camphor.

Large Greenheart (Eldalàt hill), Mau forest.

Croton tree, Nairobi.

"Jarrah tree." Northern Kenia about 11,000 feet.

The record Cedar 12 feet 7 inches diameter. 9,850 feet, Kenia forest.



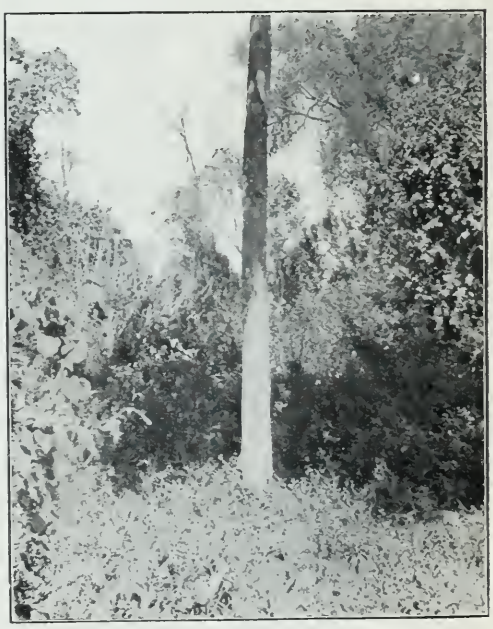
The Tàna River at its lowest. Kenia timber might be floated down this river to the sea.

Eldoma Ravine forest, near North Caravan Road.

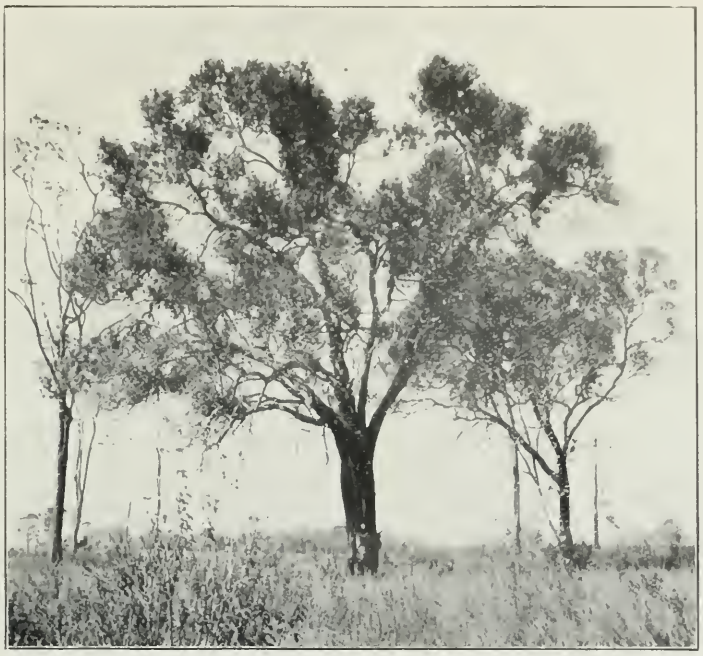
Cedar Stems. Eldoma Ravine forest.

The Forest path, South side, Kenia.

m'Ona tree, Aberdare, the forest around destroyed by Kikuyu.



Trunk of Pillar-wod (Sayiza), near Elburgon.

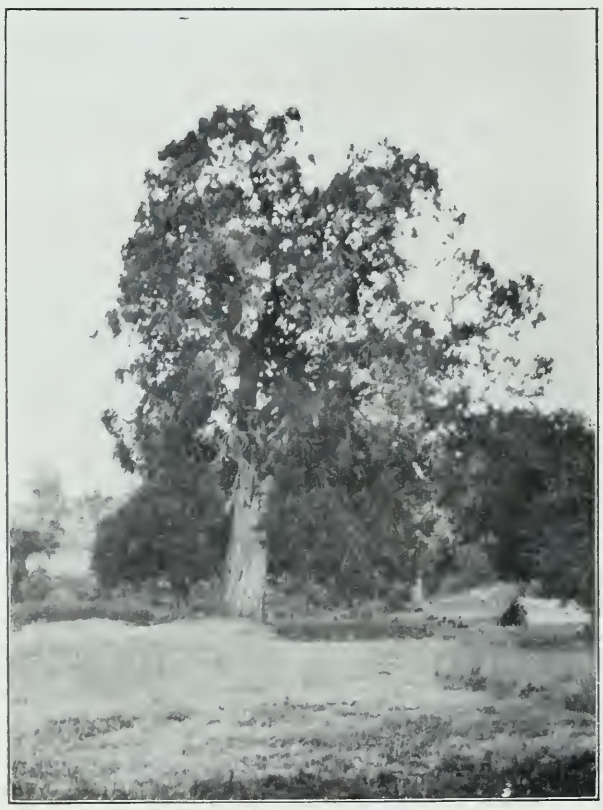


Wild Olive trees, near Nairobi.

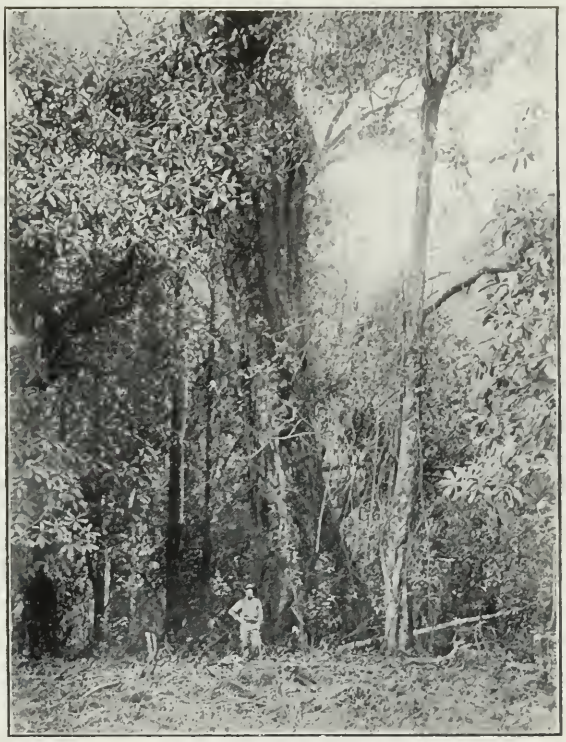
Cedar forest, destroyed by the Masai grazing fires. Aberdare-setima

Our camp in the Kenia forest, Christmas Day, 1906.

Camphor tree, near Forest Station, South Kenia.



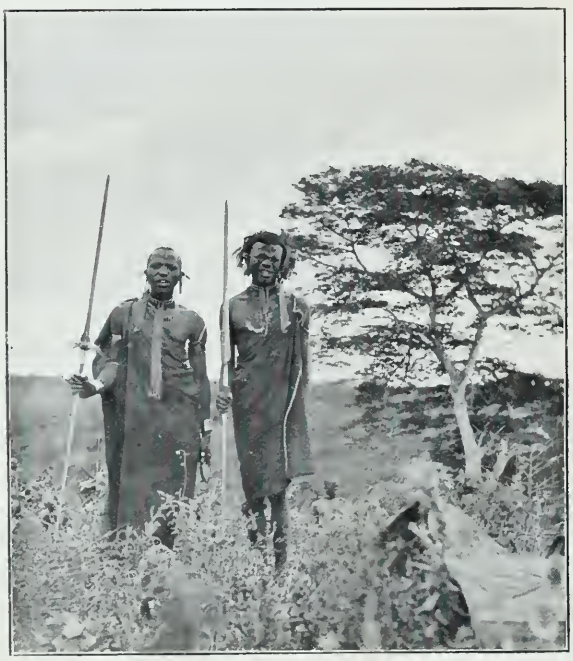
Old Cedar on the plains, near Kenia.



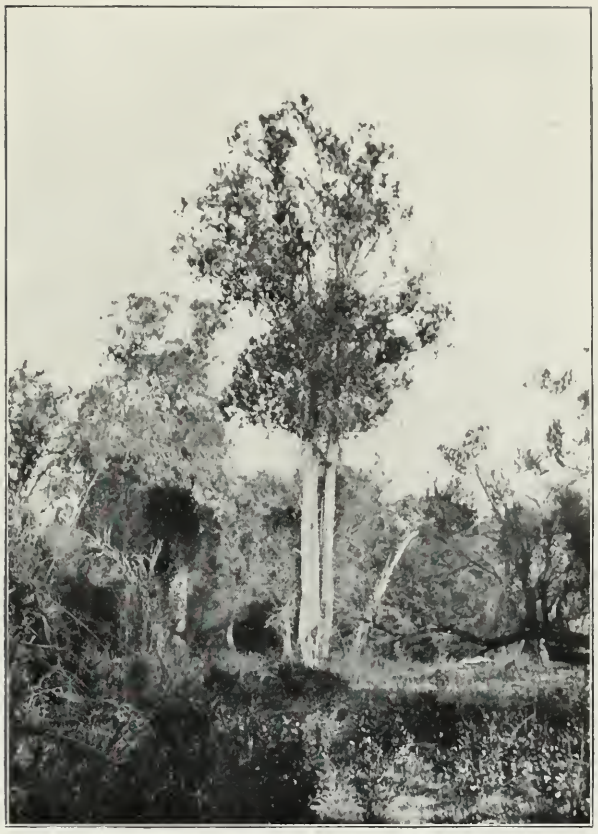
Camphor tree, Southern Kenia.

Second class Yellow-wood forest, Eldoma Ravine.

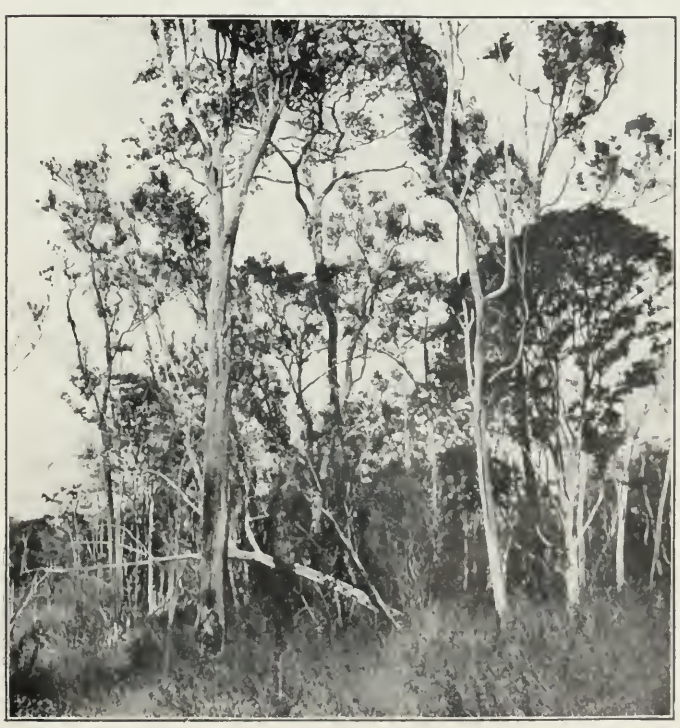
Albizia tree, Southern Kenia (Karioki's).



The forest destroyers, Kikuyu of Southern Kenia.



Cedar trees in 3rd class forest at the dry northern end of the Aberdare (Setima) Range.



Sandal (Muhúgu) trees, near Nairobi.