Former
Madras College Magazine

VIS. No. 4. June 1931

Vol. XV. JUNE 1931. No. 4.

THE MADRAS
Forest College Magazine.

EDITED AT COIMBATORE.
MADRAS PRESIDENCY.

Published by the Principal,

MADRAS FOREST COLLEGE.

PRINTED BY S. VINCENT AT THE ELECTRIC PRINTING WORKS,
COIMBATORE.

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(PUBLISHED QUARTERLY.)

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CONTENTS.

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Types of Forest Flora in Malabar *

By G. Viswanatham, B. A.,
Curator, Forest Museum, Coimbatore.

For a study of the rich and varied flora of the forests of this fascinating district it is useful to know a bit of its geography.

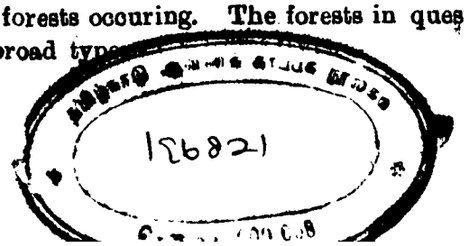
Lying between 10° 15′ and 12° 18′ north latitude, and between 75° 14′ and 76° 52′ east longitude, it is bounded on the north by South Kanara, on the east by Coorg, Mysore, the Nilgiris, and Coimbatore, on the south by the Native state of Cochin, and on the west by the Arabian Sea, the total area being about 5,700 square miles. The mountains of the Western Ghats varying from 3,000 to 5,000 ft. above sea-level on the Coorg and Wynaad slopes, and reaching 7,000 ft. and even higher on the Kunda face, run almost parallel to the coast. (The portion of the range eastward from the Kundas as far as the lofty mountains north of Palghat is comparatively low; it encloses a tract of 200 sq. miles known as the Attapadi valley where

* Paper read at the Second Provincial Geographical Association held at Palghat in May 1931

rise the headwaters of the Bhawani). "The great back-bone of the Indian peninsula" the Western Ghats, which is about a thousand miles long, rising steeply at a distance of about 50 miles from the (West) coast presents a very striking feature in this district: The long and gigantic chain is completly broken some 25 miles asunder, forming here the "Palghat gap," a singular passage through which the moisture-laden South-west monsoon is allowed to pass and give welcome showers to the parched-up country immediately east of it. The gap separates the mountains of Travancore from those to the north of them, and the flora of this regin is carried some distance across the peninsula at this point. The W. Ghats catch almost the whole rainfall of the South-west monsoon giving the district a rain of about 100 inches in the plains, and more than 150 inches in the hills. The district is thus a very moist one, so moist that during the rainy months even the exterior of walls and tiles of the roofs of houses become green!

"Malabar is singularly diversified in its configuration. The great range of the West Ghats looks down from the east on a country broken by long spurs, extensive ravines, dense forests and tangled jungles. Stretching westward, gentler slopes, rolling downs, and gradually widening valleys, closely cultivated succeed the forest clad uplands. Nearer the sea-board the low laterite table-lands shelve into rice plains and backwaters fringed with cocoannt palms."

There are three forest divisions each under a District (Divisional) Forest Officer: Palghat, Nilambur, and Wynaad. I do not propose to describe these forests separately but shall classify the growth in them according to the types of forests occuring. The forests in question fall under [illegible] broad types



I. The mixed deciduous or monsoon forests.
II. The tropical evergreen or rain forests.
III. The sub-tropical or temperate evergreen forests.
IV. Mangrove and littoral forests.

I. *The mixed deciduous or monsoon forests*:—affect regions below about 3000 ft., and where the rainfall[1] exceeds about 40 in., and are unlike the evergreen forests, composed chiefly of deciduous trees—trees which are more or less leafless for the greater part of the dry hot season, from about January to May or June. (This type is well illustrated in the Wynaad plateau). The growth is not so dense as in the evergreen type, nor are the trees so lofty. There is an adundance of woody climbers and herbaceous epiphytes, but woody epiphytes are rare. These forests merge on the one hand into the evergreen type, and on the other into the drier types of mixed deciduous forest (of the Deccan).

This mixed type is of great economic importance as it contains a large number of valuable species of trees, chief among which are detailed in appendix I.

II. *The tropical evergreen or rain forests*:—affect regions above about 3000 ft. and where the rainfall is more than 80 in. They are characterised by rank luxuriance of growth, and composed of three or more storeys. The

1 "The typical monsoon forest of Schimper's definition comprises the moister and more luxuriant forms of mixed deciduous forests which are well developed in the West Coast region, in the moister parts of the sub-Himalayan tract, and in Assam, Chittagong, Burma and the Andamans.

In the Indian region, however, monsoon forest answering the description in every respect occurs in regions with a rainfall of not more than 50 in.; and perhaps as low as 40 in.; such forest is well developed in parts of Orissa, the Central Provinces, the Circars and other localities."—Troup.

lowest consists of dense shrubby evergreen under-growth. The intermediate tiers are formed by evergreen trees struggling hard for light. The topmost storey is made of gigantic trees, often with huge buttresses, and reaching a height of 150 ft. or more. The branches are sometimes given off at such a height from the ground that one has either to shoot at twigs to obtain specimens of them, or resort to the hillman's harmful practice of driving a series of pegs right up to the first branch to serve as a ladder. The species are very numerous; gregariousness is strikingly absent. Many of the trees have a rather thin smooth bark and are only sparingly branched. The leaves are of very diverse forms, often coriaceous and glossy, seldom finely pinnate. There is an abundance of thick-stemmed climbers and climbing palms and epiyhytes (herbaceous as well as woody.)

This type is characteristic more of the southern (Palghat and Nilambur forests) than the northern forests of Malabar. It is well represented in the forests of Western Ghats generally. The chief trees of this type are given in appendix II.

III. *Sub-tropical or temperate evergreen forests* :— Still higher up, commencing at about 5000 ft. and up to about 6000 ft. the trees are much shorter than those of the evergreen type below and the forests are of the temperate evergreen type and known generally as *sholas*, which are a characteristic feature of the landscape elsewhere, as in the Nilgiris, Anamalais, Palnis etc. A glimpse of this type can be had in this district, only on the ghat forests of the Nilambur valley.

The chief trees of this zone are given in appendix III.

Above 6000 ft. the growth is characteristically stunted, the most common species being Rhododendron nilagiricum

Zenk. (Mal. Kattu-puvarasu)—with very coriaceous leaves clustered at ends of branchlets and dark crimson flowers with large silky bracts; and species of Eugenia.

The zones of *altitude* mentioned above, as marking the boundaries of the different forest types, must not be regarded as clear-cut and well defind ones. For instance, the forests on the ghats of the Nilambur valley above 3,000 ft. are entirely evergreen. On the north-western and northern aspects the evergreen type is generally met with at 2,500 ft., and on north-eastern aspects even down to 1,500 ft. Again, lower down, along the river banks there are very narrow belts of forest composed mostly of evergreen species. A similar variation is also noticeable with regard to the degree of *rainfall* as a factor determining the type of forest, as instance the regions of widely differing amounts of rainfall affected by 'monsoon forests in India. (See foot note on page 123).

IV. *Mangrove and littoral forests* :—To the above mentioned broad types of forest growth may be added those of a more local character, such as (1) mangrove forests along tidal creeks, estuaries of rivers, backwaters, etc. so characteristic especially of the Malabar coast and (2) littoral forests. These types are good examples of plant-formations caused by edaphic factors (that is, factors connected with the soil as apart from the climate). The species are 'halophytic' owing to the saline nature of the soil. Though the habitat is very wet it is physiologically dry, the plant trying to minimise transpiration to avoid an excess of salt in which the water abounds. The leaves therefore exhibit a xerophytic structure (i. e., adaptations for the drought conditions).

(1) Mangrove forests :—The component species of this type of forest show special adaptations for anchorage,

aeration, regeneration etc.: stilt roots and aerial roots decending from the branches anchor the trees in the soft mud resisting the force of the wind and the tides. Superficial roots sometimes ribbon shaped (ribbon-roots) spreading along the surface of the ground, or bending out of the mud in the form of knees (knee-roots) and erect pneumatophores (breathing roots) supply the roots with oxygen. The most ingenious of the devices exhibited is the 'vivipary' the seed commencing to germinate while on the parent plant sending down a long hypocotyl (up to 2½ feet!), and the seedling planting and establishing itself in the mud in due course.

The chief species of the mangrove swamps are :

(1) Rhizophora mucronata, Lam.

with both stilt and aerial roots, elliptic-mucronate fleshy leaves, and seeds sending long hypocotyls (2 ft. or more).

(2) Ceriops Candolleana, Arn.

(with aerial roots but without stilt roots, and hypocotyl 4-10 in. long)

(3) Brugiera gymnorhiza, Lam.

without stilt roots, but with abundant knee-roots—the largest of the mangroves.

(4) Sonneratia caseolaris, Engl. (=S. acida, L.)

with Asparagus-like pneumatophores (which are used as a cork-subsiitute), obovate dull green leaves, showy dark purple flowers.

(5) Avicennia officinalis, L.—White-mangrove.

with densely silvery-tomentose leaves and numerous preumatophores.

1. Vivipary much less pronounced is also noticeable in certain non-mangrove species, such as, Sal. Hopea parviflora, Artocarpus integrifolia. In these cases the germination of the seed while on the parent tree is very rare, but the seeds quickly lose vitality and have to be sown as soon as possible.

(6) Excœcaria Agollocha, L.—Blinding Tree.

with a poisonous acrid milky juice, grey lenticellate bark, minute yellowish fragrant flowers and very soft white wood (useful for matches)

(7) Lumnitzera racemora. Willd.

(8) Carapa obovata, Bl.

(9) Aegiceras majus Gaertn.

(2) *Littoral forests* :—found usually on raised sandy and stony beaches above the reach of high tide. These also exhibit xerophytic leaf structures. Eg. ***thick leathery leaves*** of (i) Calophyllum inophyllum, L. (Alexandrian laurel; Mal: Puna.) with shining decussate leaves and white flowers. —often also planted for the sake of the lamp oil from the seeds. (ii) Terminalia catappa, L. (The Indian almond. Mal. Adamarram) (with whorled branches, and leaves turning bright red before falling): (iii) Young shoots with a viscid resinous coat: as in Dodonæa viscosa, L. (Mal. Vrali)—with oblanceolate leaves and membranous capsules 2–3 winged. (iv) leaves much reduced and scale like as in Casuarina equisetifolia, Forst. (The casuarina or beef-wood tree)—the well known conifer like tree extensively planted on sandy coasts for fuel.

Malabar is known as the 'the land of plenty.' This is because of the rich vegetation not merely of the forests but of the plains: Almost every house has its own spacious garden with a number of trees, shrubs and climbers of economic value; chief among the cultivated species are Teak, Jack, cashewnut, cocoanut, Areca, Corypha umbraculifera, varieties plantain, Mango,[1] Dioscorea Spp. (yams)—,climbers with large tuberous roots which are generally acrid, the acridity being removed by cooking, Amorphophalus campanulatus (Senai-kilangu), Pepper, ginger, cardamoms, Manihot utilissima (the Tapioca).

The almost total absence of Prickly pear in this district is noteworthy. The district is unique in having a very large variety of medicinal herbs in the plains and in the forests. The number medicinal plants (whether herbs, shrubs, climbers or trees) known and used by the people of this district is remarkably great. Even the forest department realise some revenue from medicinal plants here and there. Last month I learnt from the District Forest Officer Palghat that a few hundreds of rupees were realised from the auction of the Cucurbitaceous climber 'Pei-podal' (Trichosanthes cucumerina, L[1]) from Walayar forests.

The flora of Malabar is not unlike that of Travancore but the number of endemic species is rather small when compared to Travancore where a fairly large number of species occur which are peculiar to that state and to Tinnevelly. (The appendices to this paper will show the species which are abundant in the district. Shrubs and climbers are not included in the lists.)

I am indebted to Mr. J. C. Wrench, I. F. S., Principal, Forest College, for permitting me to read this paper, and for valuable suggestions made.

1. "A slender annual climber with rather shortly laciniate small white flowers, deeply 5-lobed leaves and an ovoid fusiform fruit, green and striped when fresh, scarlet or orange when ripe upto 3 in. long.—Deccan and West coast, in plains country and in lower hills"—Gamble.

APPENDIX I.

Mixed deciduous or monsoon forests :

The chief trees of this type of forest are :—

(1) **Tectona grandis,** L[1] (Teak).

with quadrangular channelled branchlets, large decussate leaves and erect terminal panicles.

(2) **Dalbergia latifolia,** Roxb.[2] (Rosewood, *Mal*: Karu-vetti)

with odd-pinnate leaves, whitish flowers in corymbose panicles fascicled on old wood, and narrow thin lanceolate pods.

(3) **Terminalia tomentosa,** W. and A.[3] and **T. crenulata,** Roth. } (The Indian Laurel.)

with greyish-black, deeply-fissured thick bark and large 5-winged fruits.

(4) **Pterocarpus Marsupium,** Roxb (The kino-tree.)

with bark exuding a red juice, 5—7 coriaceons leaflets, terminal panicles of orange sweet-scented flowers and round flat thin winged fruits.

(5) **Xylia xylocarpa,** Roxb.

with leaves bipinnate with only one pair of pinnae, glandular rachis, cream coloured flowers in globose heads and large woody flat falcate-oblong brown pods.

(6) **Grewia tiliaefolia,** Bedd.
(G. letopetala, sp. nov.)

with variable leaves—broadly cordate to obliquely ovate, serrate, stipules linear to foliaceous and broadly falcate, flowers in fascicles of 2—6 (petals without a claw), and 2-lobed fruits of the size of a pea.

1. This, the monarch of timbers, is also to be found in the famous and most valuable *plantations* in the Nilambur valley.

2. D. sissoides, Grah. (Mal: Vel-veeti) with obovate acute leaflets and loose terminal panicles is also common in moister (?) areas.

3. "Figured" logs of 'karumarudu' are supposed to characterise the species *T. crenulata*, Roth. for which there is a great demand in the western markets. This species is practically confined to the W. Ghats, and is common enough in the Malabar forests.

(7) **Lagerstroemia lanceolata**, Wall. (Venteak.)

with white bark exfoliating in large papery strips, leaves bluish-white beneath, (especially when dry), and small 4-valved capsules with many winged seeds.

(8) **Adina cordifolia**, Hook. f.

with orbicular-cordate leaves, stipules concealing the upper-most pair of leaf-buds, flowers in small heads, and seeds very minute.

(9) **Terminalia paniculata**, Roth.

with small flowers in large spreading panicles and fruits with 3 wings two of which are much smaller than the third.

(10) **Terminalia belerica**, Roxb. (The beleric myrabolan.)

with greyish-green leaves on very long petioles clustered at ends of branchlets, and obscurely 5-angled fruits.

The chief bamboos are :

(11) **Bambusa arundinacea**, Willd. (Thorny bamboo.)

with big hollow culms, branchlets with short sharp spines, and flowers in panicles.

(12) **Dendrocalamus strictus**, Nees. (Male bamboo)

with culms unarmed and nearly solid, (i. e., with very thick walls and flowers in dense globose heads.

(13) **Ochlandra Rheedii**, Benth. *Mal*. Ammei.
(**also, O. travancorica**, Benth.) Elephant grass } *Mal*: Etta.

(shrubly reed-like gregarious bamboos with culms very thin-walled and leaves fairly large. Fruits large, long-beaked and fleshy.)

(14) **Oxytenanthera monostigma**, Bedd.

(culms velvety tomentose and yellowish when young and grey when old; internodes and culmsheaths 15—18 in. Flowers in spicate heads.)

In the drier types of mixed deciduous forests the following are common :

(15) **Anogeissus latifolia**, Wall. (Axle-wood.)

with very thin grey-white bark, copper-coloured young foliage, flowers in globose heads, and fruits small, yellowish-brown, nearly round, flat, and packed in dense heads.

(16) **Albizzia**, spp.

unarmed trees with evenly bipinnate leaves, globose heads of flowers and large flat straight pods.

(17) **Bridelia retusa**,

(18) **Kydia calycina**.

with 3-valved capsules borne on connate accrescent bracteoles, hanging on the tree for months.

(19) **Acacias**

usually armed with stipular or scattered spines; bipinnate leaves with small leaflets, and flowers in heads or spikes.

(20) **Bombax malabaricum**, Dc., (The red silk-cotton tree.)

with digitately compound leaves and large scarlet fllowers.

APPENDIX II.

Tropical evergreen or rain forests.

The chief trees of this type of forest are :

NOTE:—Species marked with an asterisk are fairly abundant in the evergreen forests of the Palghat Division.

(1) * **Calophyllum tomentosum**, T. Anders. (The poonspar).

with shining dark green coriaceous leaves and deeply cracked bark.

(2) * **Palaquium ellipticum**, Engl.[1] (Pali.)

with copious milky juice, and elliptic glabrous leaves.

(3) * **Mesua ferrea**, Linn. (Iron wood.)

with the underside of leaves usualiy bluish grey and young foliage bright red, and flowers white and fragrant.

(4) * **Hopea parviflora**, Bedd. (Iron-wood of Malabar)

with leaves having glands in nerve axils underneath. and fruits with a pair of straw-coloured wings.

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1. In fact, some trace the name "Palghat" to the occurrence in great abundance of various kinds of *Pali* or *Palai* of which Palaquium is the most abundant. (Pali-kadu—Pal-ghat.)

(5) * **Canarium strictum**, Roxb. (Black dammer).

with young foliage like red-velvet and very large compound leaves 1—4 ft. long.

(6) **Artocarpus hirsuta**, Lam. (Wild jack.)

Leaves with long yellow hairs beneath; entire in adult, and often lobed in young, trees and coppice shoots.

(7) **Artocarpus integrifolia**, L. (Jack.)

well-known for its huge fruits with yellow edible flakes.

(8) **Acrocarpus fraxinifolius**, Wt.

with very large bi-pinnate leaves and bright red young foliage.

(9) **Cullenia excelsa**, Wt.

with greyish white smooth bark and leaves clothed beneath with silvery or orange coloured peltate scales; the fruits covered with long prickles.

(10) **Dysoxylum malabaricum**, Bedd. (The white cedar.)

with grey bark studded with white warts, oblique pale green leaflets and yellow tubercled capsules.

(11) **Poeciloneuron indicum**, Bedd.

with glossy dark-green lanceolate leaves, nerves close-set and parallel with fine reticulation between them.

(12) **Vateria indica**, L.[1] (The Piney-varnish or Indian Copal tree; White-dammer.)

with large leaves having prominent secondary nerves. lax panicles of white fragrant flowers, and seeds with large fleshy and oily cotyledons.

(A new species of Vateria viz., V. macrocarpa, B. L. Gupta, has recently been found in Muthikulam, Palghat Division—probably endemic. *Vide, Indian Forester* p. 232 April 1929).

(13) **Hydnocarpus Wightiana**, Bl.

with crenulate or serrate leaves and large brown woody tubercled fruits.

1. This tree is commonly planted as an *avenue* tree in the West Coast for the sake of the fragrant flowers.

(14) **Tetrameles nudiflora**,[2] R. Br.

A *deciduous* tree with spongy greyish white bark, broadly ovate serrulate leaves and coriander-like fruits (this tree occurs also in *deciduous* forests).

(15) **Myristica** spp. (Nut-megs).

(16) Many of the **Lauraceae**, such as Cinnamomum spp. (Cinnamon.)

APPENDIX III.

Sub-tropical or temperate evergreen forests :

(1) **Michelia nilagirica**, Zenk. the 'champak' of the hills, differing from that of the plains in having large white flowers instead of the yellow.

(2) **Eugenia**, spp.

(3) **Hydnocarpus alpina**, Wt.

with large *entire* leaves and very large tomentose fruits (without tubercles).

(4) **Ilex** spp.

(5) **Ternstroemia japonica**, L.

with entire obovate leaves with red petioles.

(6) **Gordonia obtusa**, Wall.

with pale green crenate lancelate leaves, large white flowers, and brown 5-angled capsules with winged seeds.

(7) Also species of **Symplocos**, **Meliosma**, **Glochidion** and various **Lauraceae**.

Among Bamboo, Oxytenanthera Thwaitesii is common with a sprinkle of Arundinaria Wightii, Teinostachyum Wightii, and Ochlandra spp.

2. Evergreen forests may contain certain deciduous species as well,

Notes on Lac Cultivation.

By, S. Rangasamy,
Research Ranger.

These notes on lac cultivation are written in the hope that they may be of use to all Range Officers who are likely to start cultivation in their ranges in view of the fact that the Chief Conservator has issued orders that the work should be carried out as a part of the territorial works. They are based on the writer's personal experience of lac cultivation for 2½ years in the North Salem Division. The notes claim to have only a local application i.e., to Hosur plateau.

Localities suitable for lac cultivation.

Places which are neither very hot nor very cold and where the annual rainfall is not less than 30 inches are suitable for lac cultivatson. Moisture is a great necessity for the successful development of the insect but if it is in excess it affects the crop injuriously.

Areas where lac is at present abundantly grown are generally over 1000 ft. above sea level and enjoy a fairly temperate climate. The annual rainfall is 30 to 60 inches The general humidity is low.

Strong and dusty winds and heavy rain cause serious loss at critical periods of larval and male emergence. Insects are affected far more than we are and are unable to live a healthy life or even live at all outside their own particular limits of temperature and humidity. So, as a test of the suitability of the place for lac cultivation only a few trees should be inoculated in the beginning, and if on these, the lac flourishes throughout the year the operation may be extended on a commercial scale. Subject to the

requisite climatic conditions the ideal area for lac cultivation should satisfy the following points:—(1) Hosts should be plentiful and vigorous, (2) There should be no scarcity for labour.

Trees on which lac is grown.

There are several species which support lac insect but the important ones are *Schleichera trijuga, Shorea talura* and *Zizyphus jujuba.*

Each species of lac insect has its own favourite host plant on which it thrives best for generations without any deterioration. On some, the insect can maintain itself but does not grow to maturity. Some hosts help the insect to build up an appreciable quantity of resin but do not reproduce a virile generation and others maintain the lac insects but no appreciable quantity of resin is excreted. The ideal host is one which harmoniously promotes the four activities of the lac insects, viz., maintenance, growth secretion and reproduction. These notes deal with the cultivation on one of such species i. e., *Shorea talura* on which Mysore brood is cultivated.

The trees, if found growing crowded in groups, should be thinned out so as to let in more air and sun-shine. The yield of lac from crowded trees has been found to be much less than from those situated in the open with plenty of light and air around them. Small and decripit trees should be avoided and old trees should be coppiced to replace them by coppice regrowth.

Repeated and heavy inoculation eventually kills the trees. Heavy inoculation is admissible when the number of host trees is sufficiently large to allow of a rotation for their rest and recovery. Rest will restore the vitality of the trees and prolong their life.

Crops.

The species of insect we are dealing with, is called the 'Mysore brood' and is the smallest but most prolific of lac insects, being the only trivoltine species known, with three life cycles during 13 months. The three crops obtained are called premonsoon, monsoon, and postmonsoon. The period of each crop is given in Appendix A. The dissimilarity and fluctuation noticed in the crops is explained by Mr. M. Sreenivasaya in the following lines :—

"Like a true parasite the insect cannot go through its life cycle without the aid of its host. It deflects in its own favour not only a part of the nutrition of the host but also a part of its energy to draw its food. There is evidence to show that the mechanism by which the insect feeds is one of capillary rise through the fine bore of its proboscis, which is controlled by the molecular forces in the plant. Seasonal variation of the pressure of the plant sap, therefore directly influences the capillary supply of nutrition to the insect and as a result, the insect is not fed at the same rate and to the same degree in all seasons of the year. This explains the dissimilarity and fluctuation of lac crops.

Nutritional requirement of the insect.

It is stated that "a heavy crop of lac from an area of forest containing about 100 trees produce 5000 lbs. of brood lac. Such a crop removes from the soil 93 lbs. of nitrogen, 82–87 lbs. of phosphorous ($P^2 O_5$), 62 lbs. of potash and 23 lbs. of lime. The continuous and heavy depletion of the inorganic constituents of the soil, if not adequately replenished from time to time will prove disastrous both to the insect and the host plants.

Pruning.

The object of pruning of lac hosts is to facilitate the supply of the chief requirements of the lac production by

creating a frame work of tender shoots. This frame work is not easily obtained, but depends on the varying conditions of nutrition, age, vigour, food supply, temperature, humidity, and the depth and fertility of the soil. As very little literature is available on this subject, experiments were carried out in the *Shorea* areas of North Salem District from July 1927. Similar trees were selected and lopped every month in different degrees i. e., some trees were lopped of all their branches of 3 inches in diameter, some of branches 3—6 inches in diameter, some from 6—9 inches and some from 9 inches up to about 15 inches. Pollarding and coppicing were also resorted to in the case of dying trees. The length and condition of the shoots obtained from various loppings were recorded frequently with the result, that the trees lopped in July and August and again in November and December, gave the best results. Pollarding and coppicing done almost in every month gave rise to good shoots but this method should not be resorted to, unless the trees are old and decrepit and unfit for lopping, as otherwise the availability of the trees for inoculation will be minimised by such a procedure. Therefore the scheme now prepared for North Salem District for putting the lac cultivation on a commercial basis provides for pruning in the above 4 months only. The following points observed during the pruning operations will be worth noting.

(1) New shoots are seen usually on the upper side of a branch, rarely on the lower. They seem to come out through cracks and holes in the thick bark mostly on forks, joints and where the dead shoots were.

(2) Shoots do not generally spring at cut ends.

(3) Branches growing straight have fewer and smaller shoots closer to the cut end and some none at all.

(4) Branches which are slanting or horizontal have a larger number of shoots which are much larger and are more evenly distributed over the whole length which conditions approximately approach the ideal.

(5) Branches between 3 inches to 8 inches in girth have always good and better shoots.

In the light of the above observations the following rules are framed for the guidance of those who do the lopping of *Shorea* trees for lac cultivation :—

(1) No tender shoots should be lopped. (2) Branches of 6 inches girth are preferable for lopping. (3) All dead branches and sticks should be removed. (4) Lopping should be done about 6 inches above the fork to allow for the drying up of the cut ends and also to facilitate putting of brood bundles on the fork. All slanting or horizontal branches may be lopped as near the end as possible. (6) Lopping should be complete.

I can not definitely emphasise the last point because by completely lopping the tree we are more or less putting an end to the functions of the root system, because the foliage which is the store house for the photo-synthetic activity, is removed and there is no demand for the large quantity of food materials that can be absorbed and supplied by the root system. This opens the field for various experiments to find out the best method of preparing the tree for inoculation without depriving it of its foliage, or making the roots functionless. The pruning will have to be regulated in accordance with the nature of the tree, for example, young vigorous trees may be pruned a bit lightly and old trees rather heavily. All the pruned branches should be dressed with tar or cowdung. The object of lopping or pruning is not only to get a series of shoots but also to prevent the plants from flowering and seeding as a

flowered tree has got much less vitality than an unflowered one. This is very essential in the postmonsoon crop as the vegetative sap conducing to lac insects is not available and the reproductive sap is to be utilised for the growth of the insects.

Brood or Seed lac

The shoots should be from 2½ to 3 years of age when the reddish brown tinge of the tender shoots is transforming into a whitish color. Experiments were conducted to cultivate lac on tender shoots. The insects themselves do not like to settle on the tender shoots of reddish brown tinge. Probably the carbo-hydrates present are in the form of a mucilage unsuitable for the insects. The bark of the much older shoots is too thick for the proboscis of the insects for penetration.

(2) ***Cutting, selection and cleaning of brood lac :—***

(1) Only healthy brood with good thick and continuous encrustation and numerous white filaments should be selected.

(2) All parasitised and immature lac encrustations and dried up portions should be carefully removed.

(3) Empty sticks should be removed by cutting as close to the encrustation as possible.

(4) The brood should be cut only when the insects have swarmed out and on no account before.

Mr P. S. Negi M. sc, recommends the removal of the brood 8–12 days prior to the emergence of larvae but from my practical experience of the last 13 crops and from a few field experiments conducted by me, the best results are obtained only when the brood is cut after actual emergence.

When the brood is cut before its swarming time, the mother insect is cut off from her food supply. Circum-

stances may therefore compel a premature delivery with the death of the mother insect. The resultant brood are weak and sickly and lacking in vitality.

Selection and cleaning of shoots for inoculation :—

This operation is very important as the quantity of is greately minimised. The following rules should be observed :—

(1) All wiry and dead shoots should be removed. (2) Shoots with dead ends or otherwise damaged by borer or other insect attacks should be rejected. (3) Shoots with leaf fungs should also be rejected. This leaf fungus can be detected by black spots on leaves. A cut section of a shoot will reveal if there is any borer or other attack inside. Presence of wood grains ejected out by borers is also an indication of the unsound condition. (4) Shoots with poor foliage should be rejected. (5) A taller tree is much better than a stunted tree, because crown is representative of the root system, which will be able to take food from a greater area and supply the tree and the insects. (6) Light and aeration are also necessary for successful cultivation ; wherever the leaves are crowded in a shoot it is an advantage to remove a few of the leaves. (7) Shoots from the main trunk are preferable to shoots from branches as the rising sap is easily available for such shoots. (8) The shoots should not be too small or too close to the ground especially in the postmonsoon season as the radiated heat melts the resin and clogs the breathing pores. (9) An inclined shoot is always better than a vertical shoot. This has been obsrved by me in almost every one of my crops and has been definitely proved by Mr. M. Sreenivasaya in his potculture experiments. He explains that "it is more economical to maintain insects on inclined shoots both from the point of view of resin production and larval development. It is better to have a few well-fed colonies

than a great number of them maintained at the critical point of starvation. In the case of vertical shoots which are colonised all round by the insects, the growth of lac is comparatively poor. In the case of inclined shoots, the insect colonising their lower portions, gets its food with ease and in abundance, since the capillary flow is aided by gravity. When cuts or incisions are made on the lower portions of an inclined shoot, they exude gums or resins while the upper portions of the same shoot respond but slightly to similar injuries. This experimental evidence is in support of the above hypothesis."

The insect is entirely dependent upon its host not only for its food but also for the energy required to draw its nutrition from the region of food supply. Once it inserts its proboscis, the insect is fixed for its life and makes use of the molecular forces of the plant to feed itself and the plant has to supply nutrition to the region of attack. The plant is therefore required not only to give food for the insects but also to meet the wasteful matter—honey—and it has also to contend with its own transpiration. Therefore a perfectly sound internal condition of the host is very essential.

Inoculation.

The cleaned brood lac should be cut into lengths of 8" to a foot and tied into bundles of 3 to 4 sticks to each. Good and thick encrusted sticks of a foot in length may be kept without bundling. Aloe fibre should not be used fresh for bundling as it appears to have a bad effect on the insects and moreover if the fibre is green some of the insects settle on the fibre and are lost. Country twine obtained is shops comes in very useful and it can be used for 2 or 3 seasons if proper care is taken.

Experiments have been carried out with various kinds of encrustation to work out the area covered by insects.

(Please *vide* Appendix B). While doing the inoculation the area available for the insects should be considered. Settlement takes place only on one side in the case of horizontal branches and on all sides in the case of vertical ones and this point should be remembered in estimating the space. Enough brood should be taken to fill the available space with insects. Practically this work will be difficult to start with, but by practice, it will automatically come. The following points should be remembered during inoculation :—

(1) The bundles should be placed on forks in such a way as to touch all the suitable shoots. (2) The upper ends of sticks should be in contact with the shoots as the insects have always got a tendency to move upwards. (3) Tying should always consist of $1\frac{1}{2}$ knots so that removal may be easier. (4) The number of bundles and sticks put on each tree should be counted and entered in a tabulated from (Please vide Appendix C). This is very important as it facilitates correct removal of bundles later on. (5) Small pieces which cannot be tied into bundles will have to be put in small bamboo basket and hung up on suitable shoots.

Some writers advise inoculation with fairly big bundles and transfer them when the original shoots get full. This method I adopted in 4 seasons and the transferred shoots were almost a failure due to the following:—

(1) Males are usually separated from females because it is Nature's contrivance that during emergence females should come first to occupy the best portions of shoots, males come subsequently and occupy the top portions above that occupied by females. By transfer, the separation of insects come in. Opinions on this point vary considerably. But I got actual samples of the upper parts of

shoots with pure male colonisation from several transferred cases. Samples have also been preserved.

(2) A lot of predators and parasites come on transferred shoots and in two seasons I had to destroy all the inoculated shoots. Therefore it is a great advantage to regulate the quantity of brood rather than effecting transfers.

Swarming, settlement and removal of stick lac:—

As soon as the insect emerges from the body of the mother insect, it wanders along the shoots of the host trees until it finds a place, where the bark is of a suitable succulence and thickness, inserts its proboscis and begins to suck the juices on the phloem layer; as soon as it begins to suck, it begins to secrete lac and form a protective cell for itself. Of the two sexes the females emerge first from the mother cell and annexes the more desirable sites for adhesion for which their more important physiological function entitles them; these in the case of the horizontal shoots are on the lower side in the middle part of the shoot the males emerge later and have to be content with less desirable sites at the bottom end and the end of the shoots. The male and female cells differ in shape, the male cell being longer than it is broad, while the female cell is nearly spherical with a white dot.

As inoculation is carried on with the swarmed brood, settlement will be noticed on the same day. This goes on vigorously for 15 days but from the 15th day afterwards a few insects will still be coming out: but these insects are usually so weak that they do not survive. Moreover the general emergence of predators and parasites takes place from about 20th day. So, it is very essential to remove the bundles from the trees as early as possible after the 15th day. The loss of insects sustained by such removal

is amply compensated by the good and clean brood we get in next crop. Settlement on nearly half the portion of suitable shoots may be considered sufficient and lighter inoculation is always preferable to heavier. Further during the rainy season when the pressure of sap is high a a given length of shoot can accomodate a larger number of insects than it does during winter. Consequently heavily inoculated shoots during winter record a heavy mortality of the brood and the surviving insects build up only a small quantity of resin. One can raise however a more intensive crop during the rainy season. These are very important points to be noted in practical work as great care and sound judgment are to be exercised, in controlling the colonisation of larvae on shoots during different seasons.

The inoculated shoots should be lifted up for examination by leaves and by no means by holding the base of the shoots, as one is likely to crush the settled insects. The settlement is detected on the branches of big trees by the reddish appearance, The inoculated areas should be inspected almost daily for a fort night to note any damage by rats, monkeys etc. and to replace any fallen brood sticks in their place.

The bundles should be removed very carefully without damaging the settled insects.

Growth and Secretion.

After fixation on the twigs, there is usually a heavy mortality among the insects. The following appear to be the causes of such mortality :—

(1) The larvae that emerge and settle 15 days after emergence usually die.

(2) If the brood is cut earlier than the date of emergence, the greater is the percentage of mortality.

Very little mortality is obtained when good vigorous brood that is already swarming is put on the trees.

The female insects after fixation, begin to produce the waxy and resinous mattler "lac" as well as the sugary honey dew. This honey dew is a wasteful matter which is ascertained to be 1 C. Cm. for every two inches length of encrustation in a period of 3 hours. The amount of excretion till the time of male emergence which takes place from 6 to 8 weeks after settlement is small, but once the fertilisation takes place the excretion increases.

The males emerge usually from 6 to 8 weeks. The elongated cell in which the male is enclosed is intended to facilitate its movement and come out. The cell is broken open by its hind portion which contains a spinelike end and the insect wriggles backwards and forwards and comes out. When once the insect is outside, it sits quiet for about 15 minutes probably to get its skin hardened and then begins its functional work. The fertilisation goes on only during sunlight but the insect takes complete rest during nights. As the male does not feed during this period, it does its functional work only for 2 days and on the 3rd day it dies of exhaustion.

The sex ratio is again a factor of vital importance to the cultivator because "it is only the female that builds up a maximum amount of resin. The male contributes but an insignificant quantity of resin to the general encrustation of lac. A preponderance of males would mean a poor crop while that of the other sex would result in heavy crops. Field experiments have shown that the sex ratio is controlled by the seasonal variations of temperature, humidity and moisture supply. Dry seasons and high temperature tend towards the creation of females while abundant moisture supply results in a preponderance of

males. Calcium favours the production of males while phosphorous favours the determination of female sex. Mothers developing during the rains yield a brood with preponderating male progeny while those fed during the following winter period, give rise to broods possessing a larger percentage of females, so that the following summer crop is comperatively better than the previous winter crop. During winter, mothers are fed more on fats than on carbohydrates while during the monsoons they are fed with a food containing a small percentage of fat. Fatty nutrition therefore appears to favour the determination of the female sex."

The period of male emergence is from 7 to 8 weeks but the actual number of days for various crops is given in Appendix A. The duration of male emergence is from 20 days to a month and this is another critical period in the life of the insects. The males are delicate creatures and succumb easily to adverse conditions of weather and the attack of predators and parasites. All females should be fertilised. If not, practically very little lac is produced. After fertilisation, the resin is exoreted at a fast rate. The demand on the host plant at this time is tremendous and a heavy rain at this critical period is very essential. In 1927 post monsoon crop a heavy rain in February saved the crop which was almost a bumper. The 1928 post-monsoon crop was a failure for want of this timely rain.

The honey dew drips down and the lac produced during the first stage is small in amount and very transparent. The insect, however, now proceeds to moult i. e., cast its skin, and in doing so loses its legs and all power of locomotion. It becomes a pear shaped sac, the head and the proboscis at one end and at the other end is a spine, two breathing holes and the anus and in another 7 to 8 weeks time, the full development takes place.

The growth of insects is well described by Mr. M. Sreenivasaya in one of the articles published in the Journal of the Science Association, Maharaja's college, Vizianagaram. He says "The life history of the insect falls into 3 periods so far as its nutrition is concerned. The first period is from its settlement to the emergence of males, which is about 8 weeks. The second period is from the emergence of males to the day when the insect stops drawing its nutrition, which is about 6 to 7 weeks. The third period is only about 1½ to 2 weeks long, depending upon the climatical conditions prevalent, during which time the maturation of the eggs is affected.

It is during the second period the insect becomes highly voracious and develops its vital activities to the highest degree. The following data regarding the secretory activity of the insect, roughly shows the rapid rise in the activity after impregnation.

During the first period of 8 weeks a thousand insects build up only 1.3 grams of lac while during the second period of the next 6 weeks they build up 15 grams of lac.

During the third period the secreting glands are practically dormant and we get only a very slight increase.

The monsoon season yields the richest harvest of lac, while the postmonsoon the poorest. Please see Appendix A. The following table gives the actual yield worked out by Mr. Sreenivasaya of the Indian Institute of Science for various crops at various stages from the 27th and 28th day after settlement.

Monsoon Crop. June—October 1922.		Postmonsoon Crop. October 1922—March 1923.		Premonsoon Crop. March—July 1923.	
Days after settlement of larvae.	Grams of lac per thousand insects.	Days after settlement of larvae.	Grams of lac per thousand insects,	Days after settlement of larvae.	Grams of lac per thousand insects.
28	0.183	27	0.189	30	9.198
35	0.294	34	0.213	41	0,264
42	0.432	41	0.296	52	0,489
49	0.638	51	0.310	59	0,970
56	1.36	63	0.453	66	2.26
63	2,87	70	0.562	73	3.93
70.	6.64	77	0.712	80	6.01
77.	9.65	84	0.867	87	7.69
85	11 72	91	1.13	98	10.34
92	13.19	98	1.56	105	11.29
99	14.44	104	1.98	112	11.70
105	15 50	111	3.29	119 @	11.90
112	16.11	118	5.27	—	—
119	16.30	125	6.31	—	—
125 @	16,30	132	7.44	—	—
—	—	139	7.99	—	—
—	—	146	8.30	—	—
—	—	153 @	8.41	—	—

@ Swarming of larvae occurred.

The maturation of the eggs is indicated by the formation of orange spots on the encrustation. The larvae usually emerge within a week or 10 days. The area should be inspected daily to note the swarming.

Certain writers advise cutting of brood immediately after the orange sports are noticed i. e., about 15 to 20 days before larval emergence. Mr. P. S. Negi M. Sc. states "the mother insect does not die until practically all the living fully developed larvae have passed out from her ovaries into the incubating chamber. The mother can control to some extent the emergence of larvae from her body at the time of unfavourable atmospheric conditions by closing the sexual orifice by the contraction of longitudinal muscles of the oviduct and vagina.

It becomes therefore incumbent on the cultivators in their own interests, to allow the full development of the mother on the host-plant, and to remove the crop (especially that portion to be used as brood lac) not more than 8 to 12 days prior to the emergence of larvae."

From my own experience in the field I consider that even this early cutting is extremely harmful and unless the brood is to be transported to places far distant, it is advantageous to cut the brood 2 or 3 days after actual emergence of larvae.

Scraping and storing of lac.

If the brood is not required for inoculation purposes, it should be cut and soaked in water for a period of 6 to 10 days during which time all larvae are killed out. The stick lac may then be taken out and scraped.

In the case of brood used for inoculation the stick lac, that is, the sticks bearing the encrustation after all the larvae had emerged out, are removed from the infected

trees. In so removing care should be taken to go through the area tree by tree with the list given in Appendix C and see that all sticks and bundles are removed, as otherwise the stick lac also becomes the breeding places of predators and parasites. It will be a great advantage to cut the twine with which the bundles are tied with a knife tied on to a pole, from the ground alone; because the coolies who climb the trees for untying the bundles rub themselves or carelessly handle the inoculated shoots and damage the insects.

The Ari lac i. e., the lac cut before emergence of larvae will be wet and living and so it should be dried very carefully by spreading it out in thin layers and raking it frequently as otherwise it will ferment and block.

The stick lac should be scraped immediately after removal as otherwise the larvae and pupae of predators emerge out as moths, which become a source of danger to the new crop on trees.

Further the stick lac also gets spoiled by the attack of other insects. The scraping is done by beating the encrustation with a wooden hammer and scraping sticks with a pen knife. The scraped lac is then ground into uniform grains either in a coffee grinder or in stone grinders. It is then winnowed and all bits of wood, bark, stone, sand etc., are removed.

It is important to note that the lac should never be dried in the sun as the grains melt and form what is called the agglutinated or blocky lac which is useless commercially.

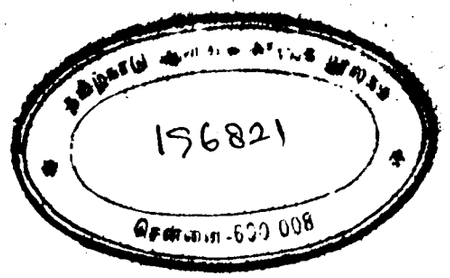
The cleaned lac now obtained is called unwashed grain lac (Kachha chaori) and is then soaked in water either in a stone or wooden tub for 12 to 24 hours. It is then taken out and washed. This is done usually by a cooly

getting into the tub and trampling the lac with his feet. The operation is repeated until all the dye is extracted and the water becomes clear.

If the dye is to be collected, the crimson coloured solution is taken out, mixed with a small quantity of Calcium chloride and filtered through a thick cloth kept over a heap of sand. The sand absorbs all water and the dye is left on the cloth as a thick layer which is then taken out and dried in shade.

The grain lac obtained after thorough washing is dried in shade and sorted out by sieves of different meshes into large, small and fine grains which are called Chaori, Karola and Molamma respectively.

(To be continued.)



EXTRACTS.

1. Chenat Nair Exploitation Division :

The concern started as an experiment in exploiting Shola (ever green) species of which nothing was known.

During the first stage logs were extracted to meet a demand in the Kolar Gold Field and no conversion into scantling attempted except on a very small scale.

The second stage witnessed the introduction of mechanical means of logging by tractors and utilization by conversion at the saw mill and so placing a finished product on the market.

The third stage evolved out of stage two by the repeated critisism of the concern as a losing unit and is a stage in which the concern worked as would a commercial firm, employing the cheapest means of carrying out each operation with a view to one item and one item only, namely, profit. It witnessed the introduction of indigenous methods into the operation, viz., hand-sawing in the forest and elephant yarding, also a cutting down of overheads by the employment of contractors to a small extent. It becomes therefore a combination of many methods of exploitation. It is perhaps a matter for regret that one or two important methods could not be experimented on, viz., aerial ropeways, timber slides, forest railroad or tramways. Experience in such methods would have been valuable. Against this, however, valuable experience has been gained which enables a comparison to be effected between various possible methods which may be required in future schemes for exploitation of forest areas.

The following matters attract attention :—

(1) ***Health.***—While working in the lower foot-hills malaria was very prevalent. Until 1927, subordinates and

crew lived in good quarters at Sappal with an excellent water-supply. The height of the settlement was about 1,200 feet.

Despite this a record shows that in some months well over 30 per cent of time was lost through malaria. Such a loss of time has a direct effect on overhead costs. Not only this, a further indirect loss arises through the subordinate being unable to work at full capacity for sometime after he has had fever.

Anti-malarial measure were attempted and considerable sums spent in clearing undergrowth round the quarters to keep down mosquitoes. It is noted, however that for a period of three years after clearing at any rate, the incidence of malaria did not appreciably decrease. A special investigation party had extreme difficulty in catching a mosquito at the site of the settlement.

This seems to indicate that some factor other than the mosquito is to blame. It has been suggested that an increase of suspectibility to chill consequent on the cool evening wind may have been responsible.

What is important is the fact that malaria has to be taken into consideration in such localities.

In this case the solution was one of despair and subordinates were transferred to the plains and taken out to work in motor buses. After this health improved considerably.

(2) The failure to sell logs in quantity throughout the history of the concern is adequate proof of lack of demand for log at the present time. This is a most important factor in dealing with evergreen species and the reason is not far to seek.

After felling, the average evergreen species degrades rapidly due to either fungoid attack, insect attack or to cracking.

Fungoid attack in the case of Cullenia excelsa alone cost the concern over Rs. 50,000 in 1926–27 and a very large quantity of useless log had to be sold for fuel. Other species similarly affected are ***Holigarna Arnottiana, Elaeocarpus tuberculatus, Polyalthia fragrans*** and ***Sterculia alata.*** All these species will be rendered useless for good timber if left in the log for over six weeks to two months in a damp climate such as exists on the West Coast.

Sterculia alata is badly attacked by insects if left for more than two months without conversion.

Dichopsis is the worst species so far as cracking is concerned. Cases are innumerable in which a Dichopsis log felled in the hot whether has developed cracks 10 feet long within ten days of felling. ***Sterculia alata*** is also bad.

Dichopsis elliptica and ***Cullenia excelsa*** are two of the commonest shola species and where they occur very often form up to 60 per cent of the stand. The limitations of these species influence considerably any scheme for their exploitation. They must be converted within one month of felling.

It is to be noted that if Cullenia is converted fresh, the scantlings obtained rarely get badly attacked by fungus. A case is on record where a fresh log was converted and the scantlings stacked outside through a West Coast monsoon. Degrade due to fungus was practically nil and the scantlings were sold after having been in the open for three months for Rs. 1–3–0 per cubic foot,

As pointed out Rs. 50,000 was lost through ignorance of this fact on ***Cullenia*** extracted from a small areas of 200 acres.

(3) Experience in mechanical logging has, so far as Madras is concerned, gone to indicate that tractor-logging is to be applied only in areas where country methods cannot be economically applied, i. e., hill areas with steep

slopes. Experience in the concern shows that elephant yarding in the lower areas was appreciably cheaper than the tractor.

So far as tractor yarding in itself is concerned, little use has been found in hilly areas for the Caterpillar tractor as such. Our Caterpillar tractor has almost invariably been used as a skidder by utilizing the winch attachment. By far the most efficient and economical work has been done by the skidder proper. This is natural. The Caterpillar tractor is primarily designed for haulage and not for skidding. The skidder is designed for the work and does it effectively and quickly.

Even the skidder has its limitation—a limitation which has gone to increase costs at Chenat Nair. Time lost in moving from one setting to another is time wasted so far as outturn is concerned. The more often a skidder has to move therefore the more the waste of time. During the time occupied in moving the full cost of running the tractor is incurred and this has to be carried by the outturn. Hence the more moves made the higher the yarding costs.

The number of times a tractor moves is determined by the stand of timber on an area. In this concern we have dealt with stands varying from 200—500 cubic feet per acre of utilizable log. Compare this with the yields of 4,000 to 6,000 cubic feet per acre of conifer forest and it is easy to realize why tractor charges are high. The average yarding costs by tractor are given below including all charges of crew, fuel, oil, spares and depreciation :—

	Rs.	A.	P.
1925—26	0	3	2
1926—27	0	2	5
1927—28	0	2	8
1928—29	0	2	3
1929—30	8	4	10

These figures form a useful basis for future estimates of costs.

(4) It has been proved beyond doubt that hand-sawing at site of all produce for which there is a sale is preferable to carting in log and conversion at the mill. In some cases however this is not possible.

This concern was the first unit to realize the existence of indigenous timber units, viz , the kolmaram and chattam (Malabar) and the vittam (Coimbatore). In 1926–27–28 it was proved that the production of these units was a profitable business even including overhead charges. In this respect it is worthy of note that the cross section of kolmaram and chattams varies with the species, viz., Dichopsis kolmaram 16 ft by 6 in. by 4 in. Acrocarpus kolmaram 16 ft. by 7 in. by 3½ in.

Again in the case of sleepers, hand-sawing at site has proved a most profitable proposition.

Certain species however are much easier to sell and make better prices in boards and planks. Some are in fact unsaleable as scantling. Hand-sawing of boards and planks is not a good proposition and a mill is a necessity if we have to cater for this market. Species which come under this class are chiefly soft woods, though hard woods such as Poon and White Cedar are better utilized through a mill. Among soft woods which cannot be utilized by sawing at site are *Polyalthia fragrans, Elaocarpus tuberculatus, Holigarna Arnottiana, Myristtica attenuata, Machilus macrantha, Sterculia alata, Alstonia scholaris*, and *Bombax malabaricum.*

(5) *Communications.*—It has been proved once again that the cheapest form of transport by land is the country cart. It is necessary however to construct extraction roads to tap the dumps yarded by tractors. Here again the poor stand per acre has been largely responsible for high costs. Overheads due to roads alone amount to

As. 2 per cubic foot of timber extracted. This is equivalent to As. 3–6 per cubic foot of scantling produced in the mill. It must be emphasized that with a medium stand of 1,000 cubic feet per acre the resultant saving to the concern would have been Rs. 10,000 per annum on cost of timber.

The total loss on the concern up to 31st October 1929 is Rs. 9,83,395–11–5. Against this loss the concern has done most valuable work in bringing to the notice of the most important consuming authorities, e. g., Public Works Department and railways, the various species which exist in evergreen jungles which will in the future become of importance.

So far as the department is concerned a great deal of valuable experience has been gained both as regards suitable methods of exploitation and utilization of previously unknown species. It is essential that the information gained should not be lost sight of, as it has a great potential value.

2. Lac operations :

Lac cultivation on Shorea talura—North Salem division.—Shorea talura occurs in patches which are widely distributed on the North Salem plateau. These patches were roughly stock-maped, enumerated and divided into two series of nine coupes each to be worked in a systematic manner.

Before actual lac cultivation is started the lac host has to be pruned to produce young succulent shoots. Shorea talura responds best to pruning done during two short seasons in a year, and it takes 18 to 24 months to produce shoots suitable for lac infection. During the two pruning seasons in 1929 all the trees in the first three coupes of each series, 10,650 trees in all, were pruned. Lac cultivation on an extended scale will start in 1931 when these pruned trees would become fit for inoculation.

For want of sufficient trees with suitable shoots the actual cultivation had to be restricted during 1929–30 and was carried on a few trees chiefly to conserve and develop the brood and to train up the local staff in the work.

Two crops were raised since April 1929. The pre-monsoon crop which was started in April matured in July 1929. It took about sixteen weeks to develop. One hundred and twenty two and a half pounds of brood lac was used which due to its poor quality and parasitic attacks yielded only 43 lb. The monsoon crop commenced in August and was harvested in December 1929. The brood took 17 to 19 weeks to swarm out. One hundred and sixty pounds of selected and cleaned brood lac collected after swarming had commenced, was used for inoculatiou. It developed successfully, free from parasetic attacks, and gave a good harvest of 1,025 lb.

More brood lac than could be utilized in the district was harvested. In the absence, at present, of a local market for it a temporary arrangement was come to with Mysore Darbar and Indian Institute of Science to lend them the surplus stock which will be returned to us whenever needed. Since April 1929, 509 lb. of brood lac was lent to them, 535 lb. supplied to Central Salem, 15 lb. sent to the Lac Research Institute, Namkum (Bihar and Orisa) and the rest scrapped.

It can now be said that lac cultivation has become established in South Salem. It has already commenced supplying good Shorea brood lac, a rare commodity, for starting lac operations in other districts where Shorea talura occurs. During the year lac work was entrusted to the district staff. The Research Ranger carried it out successfully under the control of the District Forest Officer,

Central Salem division.—On the Chitteris in Central Salem division over 10,000 Shorea talura trees exist. It was decided to try lac experiments at Chitteri where 50 trees already pruned were available to make a start. Brood lac was taken from North Salem and put on the pruned trees found suitable for inoculation. The present crop is reported to be coming up well.

Districts where Shorea occurs.—The Shorea talura areas in Madura, Kollegal and North Coimbatore districts were inspected. Conditions appear to be suitable for trying lac cultivation in Madura and North Coimbatore, but in Kollegal it seems doubtful.

—Forest Administration Report, Madras Presidency, 1929–30.

3. The Importance of Acidity in Forest Soil:

The humus in forest soils has been for a long time and form different points of view a favourite subject of study among scientific forestry experts. It is still to day thought desirable to continue research work in order to discover how vegetable refuse becomes absorbed in forest soil and how forest litter and organic matter become transformed into substances which are valuable as foods to the forest growth. In recent years science has progressed very far in this field and biochemical methods have been introduced into the research work. In the consideration of the effective and potential acidity of the soil these methods throw quite a new light on the study of forest soils.

This kind of research work is being very actively pursued in all the countries of the world in which forestry is highly developed. At present our knowledge of forest biology is not yet in any way complete. It is however the fact that, as the result of the experiments so far carried out the humus layer is no longer considered as formerly

simply as a mass of organic substances, the nature of which is largely unknown, but mainly as the seat of processes, such as the formation of carbonic acid and nitrogen metabolism, which are of the highest importance as regards plant nutrition.

Soil layers.—Before discussing the importance of soil acidity for plant biology it is desirable to consider at what levels of the forest soil and exactly in what way the various phases of the transformation of organic substance do in fact take place.

Mr. HESSELMAN, the Swedish scientist, when recently essaying to describe the types of forest humus, drew distinction between the three following layers in forest soils; (1) The upper layer wherein is to be found vegetable litter in practically the same condition as when it dropped from the tree. This is the true point at which the humification process, already in its earliest stage, makes its real beginning, the results differing according to the varying contents of the components of the litter. In this layer the proportion of CO_2 is higher than in the other two and to it Mr. HESSELMAN gives the name "litter" in English and "débris" in French—(2) The layer immediately below mainly consists of vegetable substances in process of decomposition and transformation; here the metabolism of nitrogen is most conspicuous. In English this layer is known as "mouldering layer", in French as "couche d'humification"—(3) The third layer wherein are to be found the latest results of humification and the mineralisation of the plant residues takes place, which is also already more or less combined with mineral soil, is called "humic matter" in English and "couche humifiée" in French.

From the point of view of plant nutrition the first two layers (between which it is not possible to determine any

precise limits) are much more important than the third. It is true that plants also derive a certain amount of nutritive material from the lowest layer, but the first two are the chief storage places of the reserves of nutriment, the utilization of which by forest trees is effected in accordance with the type and rapidity of the humification process, which later differs in relation to the degree of soil acidity.

Classification of soils in relation to acidity.—Many scientists in different countries accept a classification of soils in terms of acidity. Messrs FEHER and VAGI (Hungary) follow the usually accepted classification method based on the concentration of hydrogen ions, which is as follows: alkaline soil pH = 7; neutral soil pH = 6-7; slightly acid soil pH = 5-6; acid soil pH = 4-5; strongly acid soil pH = 3-4. The question of the influence of soil acidity on plant growth in agricultural soils comes up for discussion at a much earlier stage than its influence on forest soils and it is the case that agricultural plants are much more affected by modifications in pH than are forest trees. The experiments of Messrs. HANTMANN (Germany), NEMEC and KVAPH (Czechoslovakia) prove the fact and it is further confirmed by the work of Messrs. FEHER and VAGI, who have recently made tests covering 25 species of forest trees. These tests have shown that stands of silver fir, larch, spruce, Austrian and Scots pine, birch, hornbeam, ash, Turkey, pedunculate and sessile oak showed excellent growth in soil where the pH was so low that field crops could not be grown. Hence in the case of forest soils the poverty of the soil alone is not such an important factor as in the case of arable soils. At the same time the fact, that soil acidity is a valuable element for the growth of forest trees cannot be disputed, even though its influence is neither so obvious nor so direct as in agriculture. In forestry this influence

is rather to be seen indirectly as connected with certain of the biological and physiological factors in plant growth, such as the physical properties of the soil, metabolism of nitrogen, production and utilisation of carbonic acid and the development of micro-organisms which are of such high importance in the decomposition of organic matter.

Influence of the acidity on the physical and machnical properties of the soil.—It is already a thing of the past to consider that the chemical properties, as such, are alone capable of expressing the degree of fertility of a soil; recently BURGER (Switzerland); NEMEC and KVAPH, FEHER vnd VAGI have shown the great importance of the relationships which exist between the physical properties the mechanical structure, the chemical properties and the fertility of forest soil. With an increase of acidity, the physical properties of the soil also generally change in such a manner that these changes may become injurious to the growth of plants, even if the increase of acidity is not the immediate cause of the change.

Increased acidity in the soil is generally accompanied by a corresponding diminution of the capacity for air. Want of air seriously hinders the circulation of moisture in the soil and so decomposition cannot be complete; the soil becomes rich in colloidal clay, it becomes poorer in lime and from all this results feeble fertility of the soil and failure of natural regeneration by seeds.

The absolute capacity for moisture varies inversely with the capacity for air. It increases and decreases with the increase and decrease of acidity. An excessive amount of moisture may also be very injurious to growth, especially when, being unable to soak into the lower layers, it saturates the upper layers.

The well known influence of moist climate is, on the other hand, as Mr. MESS (Switzerland) explains, due to

the fact that by its action neutralization of the soil is effected from above downwards, the upper layers being carried by water into the lower layers. The upper layers first of all lose alkaline matter, next Fe and Al, and the soil thus becomes more acid. On the other hand, the general effect of a very dry climate is that the moisture (since the rainfall is less than the surface evaporation) ascends by capillarity into the upper layers and the latter becomes enriched in alkaline matter.

As regards the porosity of the soil, it may also be noted that there are indirect relations, but less marked, between it and the hydrogen ion concentration of the soil. The increase of porosity is more or less inversely proportional to the increase of pH.

Forest soils generally have a greater porosity than agricultural soils; this is not only a consequence of the acidity, but rather a result of the fact that the leaf canopy of the trees and the litter of dead leaves deaden the force of the rain on the soil.

Nitrogen metabolism.—No direct relationship can be shown to exist between the nitrate contents, the most important factor in the soil for plant physiology, and the acidity of the soil. Messrs. HESSELMAN (Switzerland), WEIS (Denmark), and later Messrs. AALTONEN (Finland), NEEEC (Czechoslovakia) and PEHER (Hungary) have investigated the course of nitrification, but they only found an indirect relationship between it and the acidity of the soil. Mr. AALTON explains this indirect relationship as follows:—The formation of nitrates is effected, as is well known, by means of the formation of ammonia. The ammonianising power of the soil depends to a great extent on its degree of acidity. When the amount of organic matter in the two upper layers and pH are large (that is to

say acidity is less) the ammonianising power also increases. A better quality soil is also richer in nitrogen and the humus contains more ammonia. In a more acid soil, on the other hand, the ammonianisation of organic nitrogen is also less. Mr. CHODZIKI (Poland) in his researches, only found nitrifying bacteria fairly abundant in a soil the upper layers of which had a pH greater than 5. FEHER shows, by his experiments made in level sandy soils under Robinia, that the maximum percentage of total nitrogen and of nitric nitrogen coincides in these soils with the maximum pH and the minimum number of bacteria.

As the decomposition of organic matter in very acid soil is incomplete, the impeded decay gives rise to crude humus; percentage of assimilable mineral matter (phosphoric acid, potash, lime and magnesia) becomes less in it, the fixation of atmospheric nitrogen decreases considerably and the decomposition of the cellulose is also less complete.

Microbiology of the soil.—The acidity of the soil seems to be (as is proved by researches of Messrs AALTONEN (Finland) and BOKOR (Hungary)) in close relationship not only with the above mentioned biophysical and biochemical properties but also with the bacterial life in the soil. The various groups of different bacteria require, apparently, a certain optimum acidity in the soil which may also vary according to circumstances. In forest soils the number of bacteria is considerably less than in arable soils. This fact is probably explained by the acid reaction of the former. When there is a growth in the forest soil, even with pH = 4.3, it results that the bacteria in the forest soil behave differently in this respect from those in agricultural soil. The bacteria which utilize atmospheric nitrogen stand an acidity certainly greater in the forest soil than in the arable soil. According to Mr. BOKOK the existence of 1 germ per 10 g. of soil can be shown in forest soil, even

in the presence of pH = 4.8; although in arable soils pH = 5.6 is the admitted limit for the existence of bacteria. The number of bacteria generally increases with an increase of pH, that is to say with the decrease of soil acidity. The acidity, as is known, decreases, also with the depth of the soil, but this has no influence on the number of bacteria. It is that the other conditions of life become worse in the depth and anaerobic bacteria preponderate. Messrs FEHER and VAGI note the large decrease in the number of bacteria especially when pH falls below 4.4, and they also show that the decrease in bacterial life favours the formation of peat.

The total number of bacteria in the soil changes also with the seasons. The fact that it reaches its maximum, as FEHER describes it, with that of the temperature and of the intensity of light in the months of June and July, and that it again shows a secondary maximum in spring, appears to agree with Mr. AALTONEN'S assertions which show that the soil is generally more acid in autumn than in spring.

—*International Review of Agriculture Nov: 1930.*

(To be continued.)

REVIEW.

" A handbook of Systematic Forest Botany for Madras."

Pages 174 + xxv (Revised Edition) 1931.

By, G. Visvanatham, B.A.,

Curator, Forest Museum, Coimbatore.

Price, Rs. 5.

The first edition of this book was published in 1927. It dealt with the more important arborebscent species of the Madras Presidency and was intended for the use of the Madras Forest Officers in general and the students of the Forest College in particular.

The scope of the present edition has been much enlarged. It deals with twice as many species as the previous one, and contains more information on the economic value of the species. More vernacular names are given. A very useful synopsis of the natural orders, and a glossary of botanical terms have been added. The arrangement of the matter has been much improved. The addition of an index to the vernacular names would enhance the usefulness of the book.

The publication will no doubt be found very useful by those for whom it is intended, and the author deserves congratulations on his removing the long-felt want of a pocket book containing information, in a concise form, on the identification, distribution and uses of the chief woody species of the presidency. I would recommend the book to every Forest officer.

C. M. Belliappa, B.A., M.F.S.,
Instructor, Madras Forest College.

Notifications of Rangers.

31—3—'31. With effect from 19th September 1930 in the chain of promotions vice Ranger C. Ramaswami Naidu, I grade retired.

(1) M. R. Ry., T. P. Kavundar from sixth grade sub protem to VI grade permanent. (2) M. R. Ry., S. V. Nagalingam Pillai from VII grade permanent to IV grade sub protem. (3) M. R. Ry., T. M. Krisnnamacharya, Supernumerary Ranger to VII grade permanent. (4) M. R. Ry., K. O. Anandan, Supernumerary Ranger to VII grade sub protem.

II. With effect from 14th October 1930 in the chain of promotions vice Ranger L. R. Narayana Ayyar, II grade retired.

(1) M. R. Ry., B. Krishna Rao, from VI grade sub protem to VI grade permanent. (2) M. R. Ry., B. Kotilingam, from VII grade permanent to VI grade sub protem. (3) M. R. Ry., S. Nageswara Ayyar, Supernumerary Ranger to VII grade permanent. (4) M.R.Ry., P. Gopalan, Supernumerary Ranger to VII grade sub protem.

III. With effect from 27th November 1930 in the chain of promotions vice Ranger C. M. Narayanan III grade retired.

(1) M. R. Ry., A. Vyasalu from VII grade permanent VI grade permenant. (2) M. R. Ry', T. S. Ramalingam Ayyar, Supernumerary Ranger to VIIth grade permanent.

IV. With effect from 27th November 1930 in an existing vacancy in the VII grade.

M. R. Ry., A. Tirupati Rayadu, Supernumerary Ranger to VII grade permanent.

V. With effect from 2?th November 1930 vice Ranger T. S. Ramalingam Ayyar deputed to foreign service in the Pudukottai States under G. O. No. 2114 dated November 1930.

M. R. Ry., P. Madhavan Nair, Supernumerary Ranger to VII grade sub protem.

VI. With offect from 6th August 1929 to 5th August 1930 vice Ranger G. Krishnaswamiah reduced from the sixth to the seventh grade.

M. R. Ry., A. Vyasalu from VII grade permanent to VI grade sub protem.

VII. With effect from 25th April 1930 to 14th November 1930 in the chain of promotions vice Ranger I. Z. Robert Paul reduced from the V to the VII grade.

To VI grade sub protem.

(1) M. R. Ry., S. V. Nagalingam Pillai from 25-4-30 to 18-9-1930. (2) M. R. Ry., B. Kottilingam from 19-9-30 to 13-10-30. (3) M. R. Ry., M. S. Krishnaswami Ayyar from 14-10-30 to 14-11-30.

VII. With effect from 25th April 1930 to 9th August 1930 in the chain of promotions vice Ranger T. Sriramulu Nayadu, VII grade reduced as Forester.

M. R. Ry., T. M. Krishnachaya, Supernumerary Ranger to VII grade sub protem.

13—5—'31. With effect from 11-4-1931, in the three temporary posts sanctioned by Government.

(1) M. R. Ry, S. Narayanaswamy Ayyar, Supernumerary Ranger to VII grade *sub protem.*

(2) M. R. Ry., T. S. Sankaranarayana Ayyar, Supernumerary Ranger to VII grade *sub protem.*

(3) M. R. Ry., A. Subamanyam, Supernumerary Ranger to VII grade *sub protem.*

2. The Conservator, First Circle is requested to transfer temporary Ranger A. Subramanyam to the Fourth Circle.

3. The Conservator, Fifth Circle is requested to transfer one of the temporary Rangers, S. Narayanaswamy Ayyar or T. S. Sankaranayayana Ayyar, to the Fourth Circle and report the fact to this office. Until the agreement with Mr. Kuruvilla is signed the Ranger for the Ulandy Range should not join duty.

4. The Conservator, First Circle is informed that as the sanctioned cadre of Rangers for his Circle provides a permanent post for the Golgonda Range, another Ranger should be posted to that Range in place of A. Subramanyam.

First Circle.

1—4—'31. M. R. Ry., G. Rama Rao, Ranger V grade on return from leave (15-4-31) is posted to charge of Mojjogoda Range Ganjam District.

23—4—'31. Mr. S. A. Dawson, Ranger V grade in charge of Pondakhal Range, Ganjam District is granted leave on average pay on medical certificate for 4 months with effect from 1-4-1931.

5—5—'31. The leave on average pay for four months granted to M. R. Ry., C. G. Krishna, Ranger III grade, is extended by leave on average pay on medical certificate for 4 months from 8-5-1931.

11—5—'31. M.R.Ry., R. Jagannatham Naidu, Ranger VI grade granted leave on average pay on medical certificate for two months from date of relief.

5—6—'31. (1) M. R. Ry., V. N. Leapingwell, Supernumerary Ranger to act as Ranger VII grade from 11-4-31 to 7-9-31 vice Ranger C. G. Krishna on leave.

(2) M. R. Ry., A. Neeladri Rao, Forester I grade, *Sub protem* to act at Kanger VII grade from 11-4-31 to 29-8-31 vice Ranger T. Balaramaswamy Naidu on leave.

(3) M. R. Ry., P. Gopalakrishna Rao, Forester I grade, to act as Ranger VII grade from 11-4-31 to 12-8-31 vice Ranger C. T. Tiruvengadam on leave.

(4) Mr. Abdul Razack, Forester I grade to act as Ranger VII grade from 11-4-31 to 31-7-31 vice Ranger S. A. Dawson on leave.

(5) M. R. Ry., A. Arogyaswami Pillai, Supernumerary Ranger to act as Ranger VII grade from 23-4-31 to 22-7-31 vice Ranger B. Kotilingam on leave.

6—6—'31 M. R. Ry., P. Doraswami Iyer, Ranger III grade, Nellore District granted leave on average pay for 4 months with effect from date of relief.

Second Circle.

17—4—'31. M. R. Ry., N. C. Mahadevan Pillai Ranger II grade Turimella Range Kurnool East Division granted leave on average pay for 23 days and leave on half pay for two months and 7 days on medical certificate from the date of relief.

2. M. R. Ry., S. Varadarajulu Reddi Forester I grade attached to South Cuddapah Division posted to Turimella Range of Kurnool East Division to relieve No. 1 as expeditiously as possible.

18—4—'31. M. R. Ry., A. Bhaviah Ranger V grade in charge of Porumamilla Range of North Cuddapah transferred to Hospet Range of Anantapur Division.

2. M. R. Ry., K. Raghuraman Ranger VI grade in charge of Hospet Range of Ananthapur Division transferred to Porumamilla Range of North Cuddapah Division.

3. M. R. Ry., A. Seetharamiah Range Officer Badval of North Cuddapah Division to relieve No. 1 and be in additional charge of Porumamilla Range till he is relieved by No. 2.

20—4—'31. 1. Mr. A. K. Sheriff Ranger in charge of Vonipenta Range, North Cuddapah Division posted to Kurnool Range of Kurnool West Division on his relief by Mr. B. Venkata Rao Forester II grade.

(This cancels his posting to Gundlakamma Range of Kurnool South Division and the Posting of M. R. Ry., K. R. Viswanatha Ayyar Range Officer Gundlakamma Range of Kurnool South Division to Kurnool Range.

2. Mr. A. V. Sundaram, E. A. C., attached to Kurnool West Division to be in charge of Kurnool Range of Kurnool West Division temporarily till relieved by No. 1 and relieve *at once* Mr. B. Venkata Rao Forester II grade (now in charge of Kurnool Range) to enable him to take charge of Vonipenta Range.

8—6—'31. 1. M. R. Ry., P. V. Krishna Rao Nayudu in charge of Cuddapah Range granted leave on average pay for two months from date of relief.

2. M. R. Ry., Y. Peddalakshmayya Nayudu in charge of Sidhout Range of North Cuddapah Division granted leave on average pay for 2 months from 24th June 1931 or date of relief.

3. M. R. Ry., A. Ranganayakalu Nayudu (Cuddapah South Division) on return from leave i.e., on 28th June 1931, posted to Vonipenta Range of North Cuddapah Division.

4. M. R. Ry., H. Thammiah (Kurnool South Division) on return from leave, i.e., on 24th June 1931, is posted to Sidhout Range of North Cuddapah Division to relieve No. 2.

5. Mr. B. Venkata Rao Forester II grade (M. R. H') in charge of Vonipenta Range of North Cuddapah Division on relief by No. 3, posted to Cuddapah Range of South Cuddapah Division to relieve No. 1.

Third Circle.

Forester M. Rajaram Pillai I grade, Working Plans Division North Coimbatore, is granted an extension of leave on half average pay with Medical certificate from for 3 months from 1-4-31 to 20-6-31 (both days inclusive).

23—5—'31. M. R. Ry., J. D. Theodore, Ranger VI grade, Working Plans duty, Satyamangalam is granted leave on average pay without certificate for 13 days from 7-5-31 to 19-5-1931.

Fourth Circle.

13—5—'31. M R. Ry., K. M. Gopalachari Ranger IV grade is on return from leave transferred from Vellore to Central Salem Division and posted to the charge of Shevroys South Range.

17—5—'31. M.R.Ry., Narayanaswami Ayyar, Ranger IV grade is charge of Shevaroys South Range Central Salem Division is on relief by Ranger K. M. Gopalachari granted leave on average salary on medical certificate for 3 months.

23—5—'31. M. R. Ry., T. E. Varadachari Ranger, III grade is granted further extension of leave on medical certificate for 4 months on half average salary in continuation of the leave granted to him.

25—5—'31. M. R. Ry., P. K. Subbanarayana Ayyar Supernumerary Ranger, North Salem Division granted leave on average salary for 2 months from 1st June 1931 or date of relief.

Fifth Circle.

22—4—'31. 1. M. R. Ry., U. Virthachalam Pillai, Ranger V grade, on expiry of his leave, posted to charge of Punahi Range South Coimbatore District.

2. M. R. Ry., C. R. Regunathan, Ranger V grade, on relief by No. 1 is posted to charge of Udamalpet Range.

3. M. R. Ry., T. S. Sankaranarayana Ayyar on relief by No. 2 will go back to topslip.

19—5—'31. M. R. Ry., M.P. Philip, Ranger VI grade, Kollegal Range, granted leave on average pay on Medical Certificate for three months with effect from date of relief.

2. M. R. Ry., S. Nagalingam Pillai, Ranger VI grade, Ramapuram Range, is transferred to charge of Kollegal Range Vice No. 1.

3. R. Rama Ayyar, Forester I grade (trained in Madras Forest College) is posted to charge of Ramapuram Range, Vice No. 2.

23—5—'31. M. R. Ry., P. Sankunni Nair, Ranger, Palni Range is granted L. A. P. on M. C. for 6 months from date of relief.

2. M. R. Ry., A. M. Srinivasulu Naidu, Ranger, V grade, North Coimbatore, is, on expiry of his leave, transferred to charge of Palni Range in Madura District.

23—5—'31. M.R.Ry., A. M. Srinivasulu Naidu Ranger, V grade North Coimbatore is granted extension of leave on average pay on medical certificate for one month with effect from 5-5-1931. On the expiry of this leave he is posted to charge of Palni Range Madura District.

24—5—'31. Mr. A. B. Fenn, Ranger V grade, on expiry of leave, is posted to charge of Kollegal Range.

2. M. R. Ry., S. Nagalingam Pillai, Ranger VI grade, on relief of Kollegal Range charge is posted to charge of Ramapuram Ronge.

3. Forester R. Rama Ayyar (M. F. C. Trrined 1927) on relief of Ramapuram Range charge is transferred to South Coimbatore.

29—5—'31. Mr. B. M. Coates Ranger V grade South Coimbatore, granted extension of leave on average pay on medical certificate for 3 months with effect from 24-5-1931.

2. The Ranger will on the expiry of this leave, rejoin duty in the Ulandi Range, South Coimbatore Division.

30—5—'31. M. R. Ry., T. S. Sankaranaraysna Ayyar, Ranger VII grade S. P. T. on relief of Udamalpet Range charge is transferred to IV Circle.

2—6—'31. Mr. Myers Ranger III grade Tinnevelly District granted leave on average pay on medical certificate for 3 months from date of relief.

Sixth Circle.

8—4—'31. M. R. Ry., K. Kunhiraman Menon, Ranger VI grade granted an extension of leave on average pay medical certificate for three months from 26th March 1931.

8—4—'31. M. R. Ry., K. R. Krishnan Nair, Ranger II grade in charge of Mudumalai Range, is granted leave on average pay for four months from date of relief.

8—4—'31. 1. M. R. Ry., T. P. Gounder, Ranger VI grade, S.P.T., posted to the charge of Uppinangady Range, South Mangalore Division, on relief from the Working Plan Circle.

2. Mr. K. P. Benjamin, Ranger I grade, in charge of Uppinangady Range, posted to the charge of Mudumalai Range, The Nilgiris, on relief by No. 1. (Vice Ranger K. R. Krishnan Nair granted leave).

3. M. R. Ry., K. Dooma Shetty, Ranger V grade, in charge of Puttur Range, posted to Coondapoor Range, North Mangalore Division on relief by No. 4.

4. M. R. Ry., A. Rama Hebbar, Ranger II grade, in cearge of Coondapur Range, North Mangalore Division posted to Puttur Range. South Mangalore Division on relief by the Range Officer, Shankaranarryana Range (M. N. Raman Pillai) who will attend to the current duties of Coondapur Range also until No 3 joins.

9—4—'31. Mr. A. Joseph, Ranger, VI grade, granted further extension of leave on average pay on medical certificate for two months from 27th March 1931.

28—4—'31. M. R. Ry., P. Kannan, Ranger VI grade, on return from leave on 3rd May 1931. posted to the charge of Kannoth Range, Wynaad Division (vice Mr. V. S. Krishnaswamy, Assistant Conservator, granted leave).

29—5—'31. 1. M. R. Ry., R. Alagiriswamy Naidu, Ranger III grade, posted to the charge of Bolampatty Range, Palghat Divisfon.

2. M. R. Ry., M. Rama Rao Kini, Ranger V grade, in charge of Bolampatty Range on relief by No. 1 posted to South Mangalore Division for special duty (Vice Banger S. V. Doraiswamy Ayyar to be granted leave).

29—5—'31. Mr. J. A. Aranha, Ranger I grade, is granted extension of leave on half average pay without medical certificate for 10 months and 15 days from 12-5-1931 preparatory to retirement.

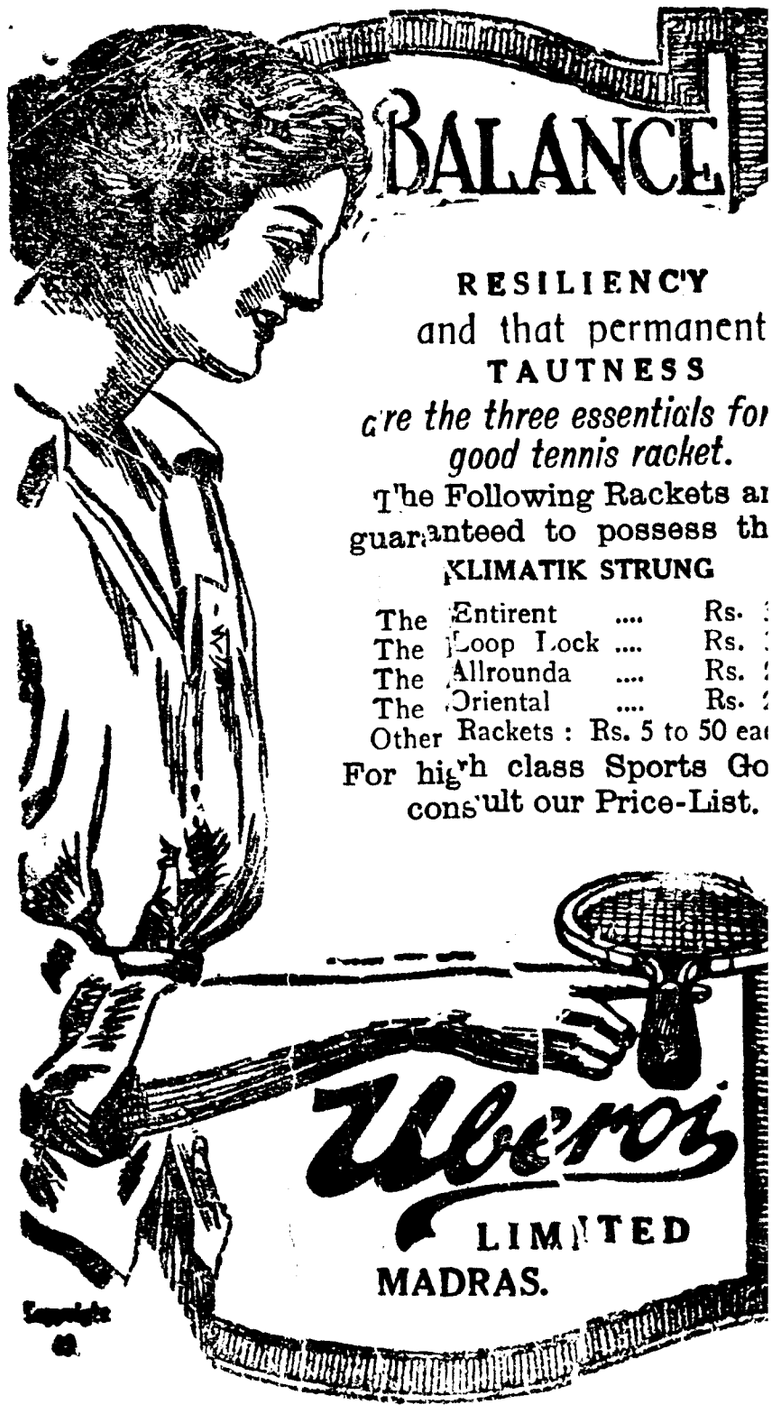
4—6—'31. M. R. Ry., S. V. Doraiswamy Ayyar, Ranger VI grade, is granted leave on average pay for three months from 11th May 1931.

4—6—'31. Mr. J. S. Rowland, Ranger III grade, in charge of Ootacamund Range, the Nilgiris Division, is transferred to Coonoor Range of relief. The transfer will be *at his own expense.*

2. Mr. T. D. Ponniah, Ranger IV grade, in charge of Coonoor Range, is transferred to Ootacamund Range.

No. 2 will relieve No. 1 and hold additional charge of Coonoor Range till No. 1 joins.

12—6—'31. M. R. Ry., V. Viraswami Naidu, M.R.H., Forester I grade S. P. T., attached to Palghat Division is promoted to act as Ranger VII grade at Rs. 80 per mensem from 1st June 1931 until further orders (vice J. A, Aranha granted leave),



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