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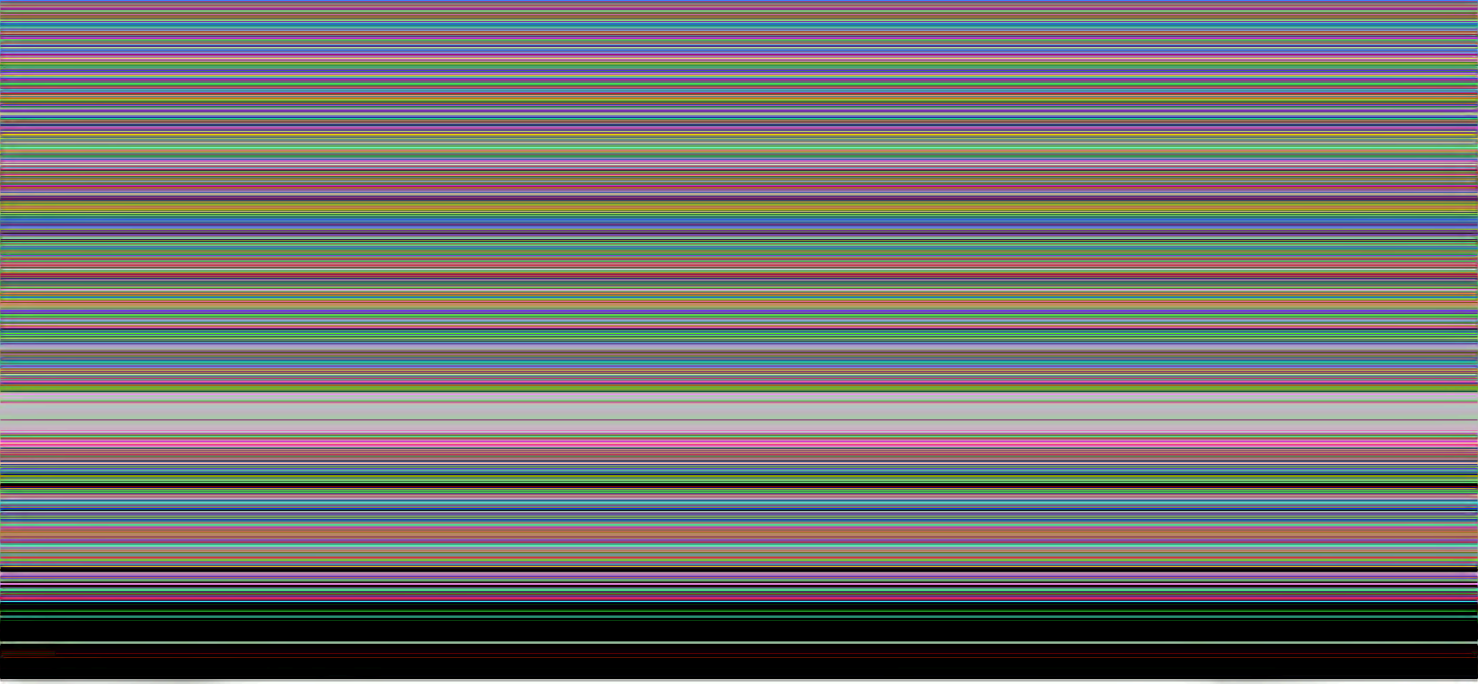

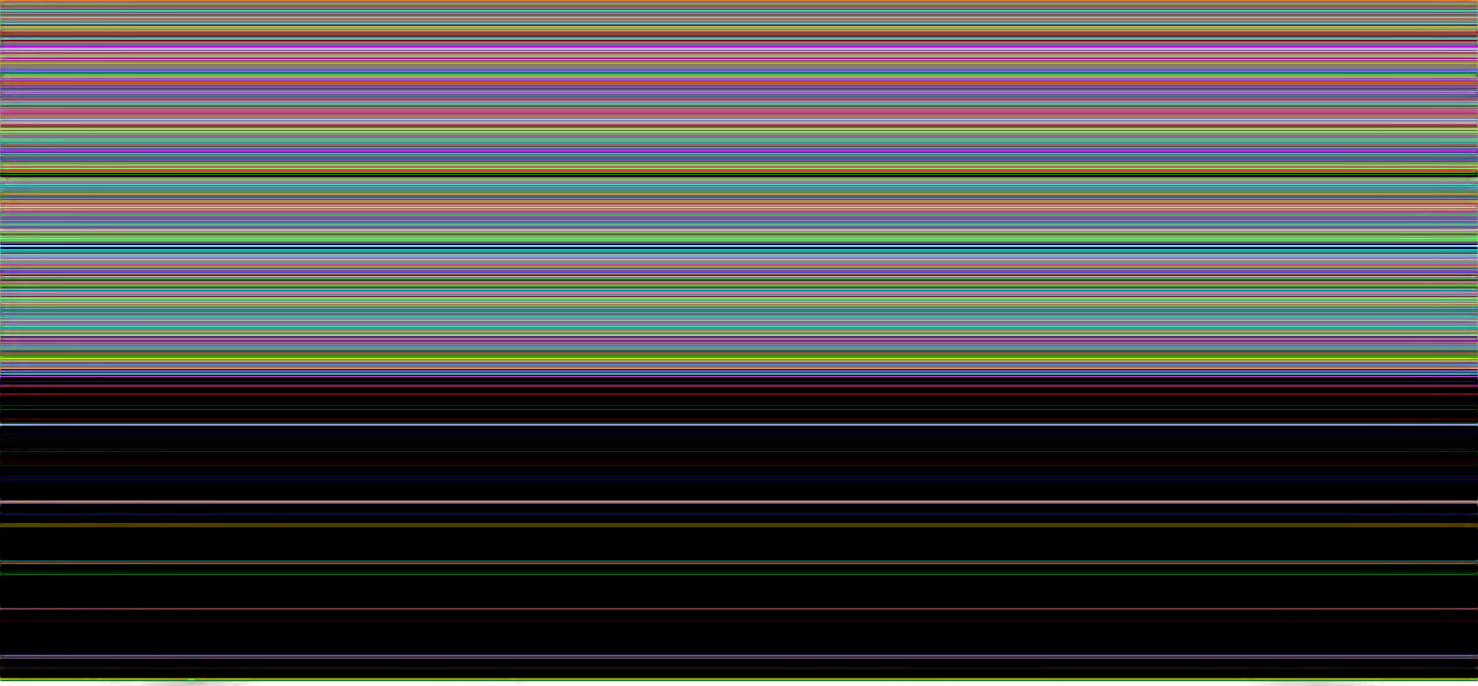

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THE INDIAN FOREST RECORDS

ON ALBIZZIA LATHAMII

BY

R. S. HOLE, F.C.H., F.L.S., F.E.S.

Botanist, Forest Research Institute, Dehra Dun.

Published by Order of the Government of India

CALCUTTA
GOVERNMENT PRINTING, INDIA
Published 1st January 1918.

FOREST RECORDS.

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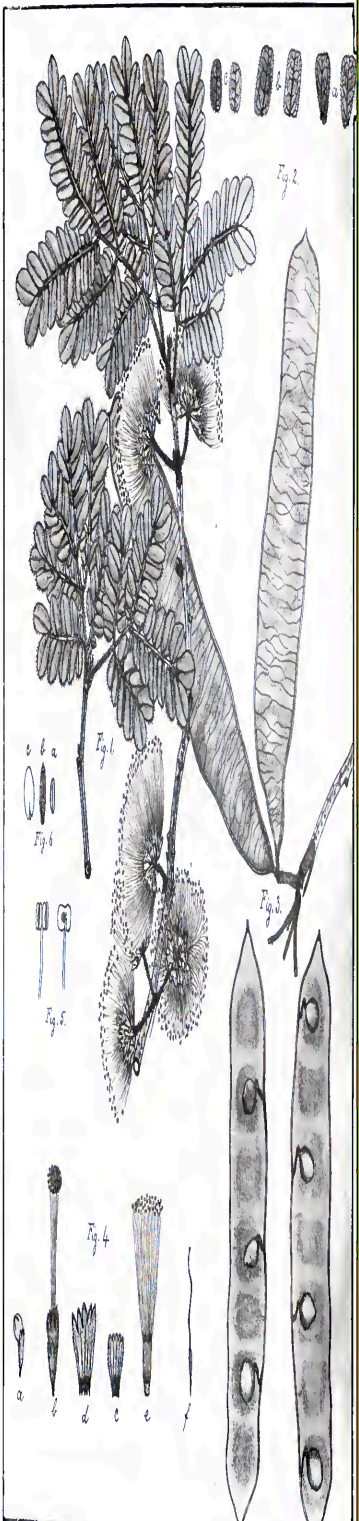

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ALBIZZIA LATHAMII. HOLE.

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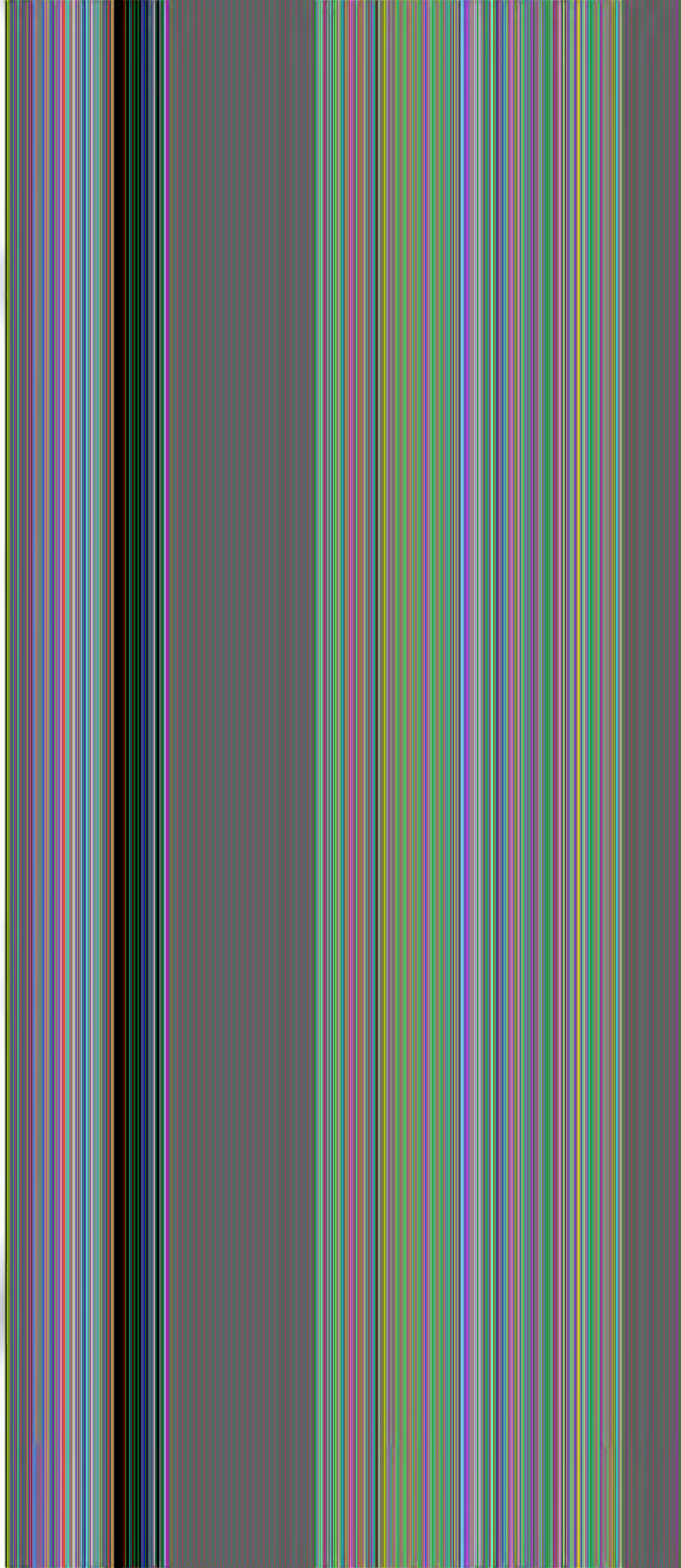

INDIAN FOREST RECORDS.

Vol. IV] 1912 [Part IV

ALBIZZIA LATHAMII, *Hole*, sp. n.

By R. S. HOLE, F.C.H, F.L.S, F.E.S.,
Botanist, Forest Research Institute, Dehra Dun.

Introduction

In April 1911, specimens of an *Albizzia* were sent to Dehra Dun for identification (from the Tinnevelly District of Madras) by Mr. H. A. Latham, Deputy Conservator of Forests. The specimens did not agree with any of the species belonging to the genus, regarding which literature or herbarium material was available at Dehra Dun. On specimens being sent to Kew, Colonel Prain, with reference to them, kindly informed the writer that they "have not been matched with any of the material in Herb. Kew." At the writer's request, Major Gage very kindly compared specimens of this tree with the material in the Calcutta Herbarium and discovered that the plant was there represented by two sheets of the Kew distribution (1866-67) of Wight's Southern Indian specimens under the No. 898. Both these sheets have been named in manuscript *Albizzia odoratissima*, Benth. One of these sheets is a mixture of the true *A. odoratissima* and the present plant, the other sheet is this plant entirely. So far as the writer can discover, 94 species appear to have been described in the genus *Albizzia* up to date, exclusive of synonyms and accepting the genus as defined in the *Genera Plantarum* of Bentham and Hooker (Vol. I, 1865) and more recently by Taubert in Engler and Prantl's *Pflanzenfamilien* (III. 3, 1891). Descriptions of all of these have been carefully checked and it is believed that the present plant is undoubtedly a new and distinct species.

The following is the description of this tree :—

Albizzia Lathamii, *Hole,* sp. n.

Description.

Hitherto confused with *A. odoratissima*, Benth., from which it differs considerably in leaves, inflorescence, flowers and pod. From the description, appears to be allied to the African *A. pallida*, Fourn., from which it differs in fewer, smaller leaflets and in the inflorescence.

An unarmed much-branched small tree, as a rule not exceeding 25 *ft.* in height and 7 *in.* in diameter.

Young shoots tawny-pubescent.

Bark of branchlets purplish-red, white-lenticellate.

Leaves alternate, evenly 2-pinnate, petiolate.

Petiole length 0·2 *in.* to 1·5 *in.* pubescent and with a large gland at ½ to ¼ its length from the base.

Primary rachis (excluding petiole) 0·8 *in.* to 3·2 *in.*, long, pubescent and with a gland below the upper 1 to 3 pairs of pinnæ.

Pinnæ opposite, 2 to 7 pairs, 0·5 *in.* to 2 *in.* long, pubescent, with, or without, a distinct gland below the upper 1—3 pairs of leaflets.

Stipules subulate, 0·1 *in.* long, pubescent, deciduous or subpersistent.

Stipels 0.

Leaflets—Opposite, subsessile, 4 to 10 pairs.

Length 0·1 *in.* to 0·55 *in.*, width 0·05 *in.* to 0·35 *in.*, obliquely oblong, base truncate, apex retuse, rounded or acute. Subcoriaceous. At base 2—4 nerved, pinnately-veined above.

Midrib central to ¼ of width from upper margin. Lateral nerves 2—5, arcuately joined near the margin, with the reticulate venation indistinct above, prominent below.

Terminal leaflets large, obovate, base emeute on upper margin, auricled on lower margin.

Basal leaflets small, often oval to elliptic with a central midrib.

When young, adpressed-pubescent above and below. When mature, sparsely adpressed-pubescent to glabrescent above, pale and more or less adpressed-pubescent below, especially on the midrib. Margin ciliate.

Flower-heads globose, 1 *in.* to 1½ *in.* in diameter, on pubescent peduncles 0·2 *in.* to 0·9 *in.* long.

Solitary, or fascicled and 2—5 together, usually at the lower leafless nodes (often on stunted leafless branches).

Very rarely in the axils of the lower leaves. (*a*)

Flowers, white, distinctly pedicelled, pedicel (*b*) 0·03 *in.*—0·05 *in.*

Calyx tubular-campanulate, valvate, 0·1 *in.*—0·18 *in.* long, mid-diameter 0·04 *in.*—0·08 *in.*, subequally 5-toothed, more or less deeply split on one side, teeth deltoid to lanceolate, 0·2 *in.*—0·04 *in.* long, puberulous or adpressed-pubescent without, especially towards the apex.

Corolla infundibuliform, 0·2 *in.*—0·3 *in.* long, subequally 5-lobed, lobes valvate, lanceolate, 0·05 *in.*—0·1 *in.* long, densely adpressed-pubescent without.

Stamens 30-50, long-exserted, filaments united at base into a tube 0·07 *in.*—0·18 *in.* long. Filaments 0·4 *in.*—0·5 *in.* long. Anthers minute, quadrate, versatile, dehiscing longitudinally.

Ovary superior, shortly stipitate, stipe (above the pedicel) 0·01 *in.* —0·03 *in.* long, glabrous to sparsely puberulous, ovules 8.

Style 0·45 *in.* long.

Pod straight or slightly curved, ligulliform, compressed, dry, 2 *in.*—5 *in.* long, ½ *in.*—1 *in.* wide, opening with straight valves. Apex mucronate, acute or acuminate, base cuneate, often more or less prolonged into a distinct stipe above the thickened pedicel. Dark brown,

---

(*a*) The inflorescence is characteristic and this alone appears to distinguish this plant from all the other Indian species of the genus. In the latter the inflorescence is developed on the leafy shoots, either in the axils of the upper leaves or at the apex above the leaves. In *A. Lathamii*, on the other hand, the inflorescence usually appears on the old wood below the leafy shoots, often on stunted leafless branches and only rarely at the lower nodes of the leafy shoots. The two following African species which belong to the same group resemble *A. Lathamii* more or less in this respect, *viz*, *A. Antunesiana*, Harms, and *A. anthelmintica*, A. Brongn. Of the former the author says "pedunculis solitariis vel geminis, ex axillis foliorum delapsorum ortis" (Bot. Jahrb. Vol. XXX, p. 75). Of the latter Bentham says "pedunculi axillares v. ad nodos vetustos breves fasciculati" (*Mimoseæ* p. 564), while Oliver (Fl. Trop. Afr. ii 357) notes "peduncles fascicled or solitary in the upper axils or from leafless nodes on the older wood."

(*b*) The pedicel consists of the constricted basal portions of the calyx, corolla and staminal-tube which adhere closely to the lower part of the stipe of the ovary. The measurements of calyx, corolla and staminal-tube given in the above description do not include this basal portion which is regarded as a part of the pedicel.

thin, flexible, sparsely pubescent especially on sutures, not septate between the seeds. Valves not separating from sutures in dehiscence, strongly transversely-reticulate without, reticulations uniform or more prominent near sutures. Sutures not prominently thickened.

Seeds 3-8, oval to sub-orbicular, compressed, 0·2 in.—0·4 in. long, 0·16 in.—0·3 in. wide, testa greenish-yellow smooth. Exalbuminous. Base of cotyledons sagittate.

Explanation of Plate.

Fig. 1, Flowering and leafy branches; *Fig. 2* Leaflets, (*a*) apical, (*b*) median, (*c*) basal; *Fig. 3*, Pod; *Figs 1–3* x ½. *Fig. 4* (*a*) bud, (*b*) flower, (*c*) calyx, (*d*) corolla, (*e*) stamens, (*f*) ovary, all x 1½; in (*c*), (*d*) and (*e*) the basal portion, which forms a part of the pedicel of the flower, is shown, in (*f*) the basal portion of the stipe forms a part of the pedicel of the flower. *Fig. 5*, stamen x 16; *Fig. 6* (*a*) cross section of seed, (*b*) longitudinal section of seed, (*c*) embryo, all x ½.

Distribution.

India:—Tinnevelly and Ramnad Districts of Madras. Elevation 300—1,300 *ft. Hohe* 2,946, 3,681; *Wight* 595 (in part). Mr. Latham has supplied the following interesting notes regarding this tree:—

Notes.

"Does not as a rule form a central stem. The general habit is that of *Albizzia amara*, but sturdier, and in the forest the tree is liable to be taken for *Albizzia amara* or one of the shrubby *Dalbergias*. Bark smooth and dark grey, not rough as in *Albizzia odoratissima*. Leaves when fully grown are bluish-green. Flowers early in March and often again, but to a less extent, about September. Young leaves appear at the same time as the flowers but chiefly in October during the N. E. monsoon. Never entirely leafless. Occurs in dry deciduous forest associated with *Chloroxylon Swietenia*, *Dalbergia lanceolaria*, *Dalbergia multiflora*, *Acacia latronum*, *Acacia leucophlœa* *Acacia Sundra*, *Tectona grandis* (stunted), *Boswellia racemosa*, *Albizzia amara*, *Balsamodendron Berryi* and *Stereospermum chelonoides*.

Grows on hard red soil containing a large quantity of disintegrating quartzite."

Acknowledgments.

In conclusion, the writer desires to express his warm thanks to the authorities at Kew, the British Museum and Calcutta Herbaria for the help given in tracing existing specimens of this plant, and in supplying copies of descriptions of species which were not available at Dehra Dun; also to Mr. Latham (after whom the species has been named) for the excellent specimens submitted.

Albizzia Lathamii, *Holz*, sp. n.

Species cum *A. odoratissima*, Benth., adhuc confusa, ab eadem tamen foliis, inflorescentia, floribus etiam legumine satis longe recedit. Description.

Ex descriptione, *A. pallidae*, Fourn., africanae affinis esse videtur sed foliolis minoribus panicnlos etiam inflorescentia differt.

Arbor parva inermis ramosissima usque ad 8 m. alta, trunci diametro ad 18 cm. Innovationes fulvo-pubescentes.

Cortex ramulorum roseo-purpureus lenticellis albis instructus.

Folia alterna pariter 2-pinnata petiolata.

Petioli 3 mm.—4 cm. longi pubescentes, glandula magna in medio vel infra medium ornati.

Rhachis 1·2 mm.—8 cm. longa petiolo exclusa, pubescens sub apice 1—5 glandulis infra-pinnalibus instructa.

Pinnae oppositae 2—7 jugae 12 mm.—5 cm. longae pubescentes, eglandulosae vel glandulis paullo infra foliolorum 1—3 paria superiora instructa.

Stipulae subuliformes 2·5 mm. longae pubescentes deciduae vel subpersistentes.

Stipellae 0.

Foliola opposita subsessilia 4—10 juga 2·5 mm.—14 mm. longa 1 mm.—9 mm. lata oblique oblonga, basi truncata, apice acuta obtusa vel retusa, subcoriacea, basi 2—4 costata deinde penninervia, costa mediana vel a superiore margine folioli latitudinis ⅓ remota, nervis lateralibus 2—5 prope marginem arcuatim junctis cum reticulatione venularum supra vix conspicuis subtus prominentibus.

Foliola summa magna obovata basi in margine superiore emarginata in margine inferiore in auriculam producta.

Foliola infima parva saepe ovalia vel ellipsoidea costa mediana.

Foliola juniora utrinque adpresse pubescentia supra demum glabrescentia subtus pallida plus minusve adpresse pubescentia praesipue in costa, marginibus ciliatis.

Capitula globosa circiter 2·5—4 cm. diametro, pedunculata. Pedunculi pubescentes 5 mm.—2·5 cm. longi, solitarii vel 2—5-atim fasciculati plerumque ad nodos inferiores aphyllos (saepe in ramulis brevibus aphyllis) perraro ex axillis foliorum infimorum orti.

Flores albi distincte sed breviter pedicellati, pedicellis 1 mm. longis.

Calyx tubuloso–campanulatus, 3·5–4·5 mm. longus, diametro mediano 1–2 mm., uno latere plus minusve profunde fissus, dentibus 5 valvatis subæqualibus triangularibus vel lanceolatis 0·5–1 mm. longis, extus puberulus vel adpresse pubescens præsertim versus apicem.

Corolla infundibuliformis 5–7 mm. longa, lobis 5 valvatis subæqualibus lanceolatis 1–2·5 mm. longis, extus dense adpresse pubescens.

Stamina 30–50 longe exserta, filamentis 1 cm. longis basi in tubum 2–4·5 mm. longum connatis. Antheræ minutæ quadratæ versatiles longitudinaliter dehiscentes.

Ovarium liberum glabrum vel sparsim puberulum breviter stipitatum 8–ovulatum, stylo 11 mm. longo.

Legumen rectum vel leviter falcatum liguliforme complanatum siccum 6–15 cm. longum 1–2·5 cm. latum, valvis rectis nec elasticis nec contortis a suturis nec distinctis dehiscens, apice mucronatum acutum vel acuminatum, basi cuneatum sæpe in stipitem productum pedicello incrassato insidens, sulcigrum tenue flexibile parce puberulum, præcipue ad suturas, intus continuum, valvis extus undique vel præsertim versus suturas conspicue transverse reticulato-venosis. Suturæ vix incrassatæ.

Semina 8–8 ovalia vel sub-orbiculata complanata 5–10 mm. longa 4–8 mm. lata. Testa levis flavo–viridis.

Albumen 0. Cotyledones basi sagittiformes.

India: Tinnevelly and Ramnad Districts of Madras. Elevation 300–1,300 ft.; *Hole*, 2,946, 3,681; *Wight*, 898 (in part).

CALCUTTA: PRINTED BY SUPDT. GOVT. PRINTING, INDIA, 8, HASTINGS STREET.

Forest Bulletin No. 16 1913

NOTE ON GUMHAR

(*Gmelina arborea*, Roxb.)

BY

A. RODGER, I.F.S.

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NOTE.

THESE notes regarding the lesser known Indian timbers have been compiled in order that all the information at present available regarding them may be easily obtainable.

For some of the best forests detailed Working-Plans have not yet been made, as the demand for timber in the neighbourhood is at present very small, but full information regarding the timbers available and means of extraction can always be obtained from local forest officers.

Application can also be made at any time to the Forest Economist, Dehra Dun, United Provinces, India, who will supply specimens of any timber free and put enquiries in communication with local forest officers.

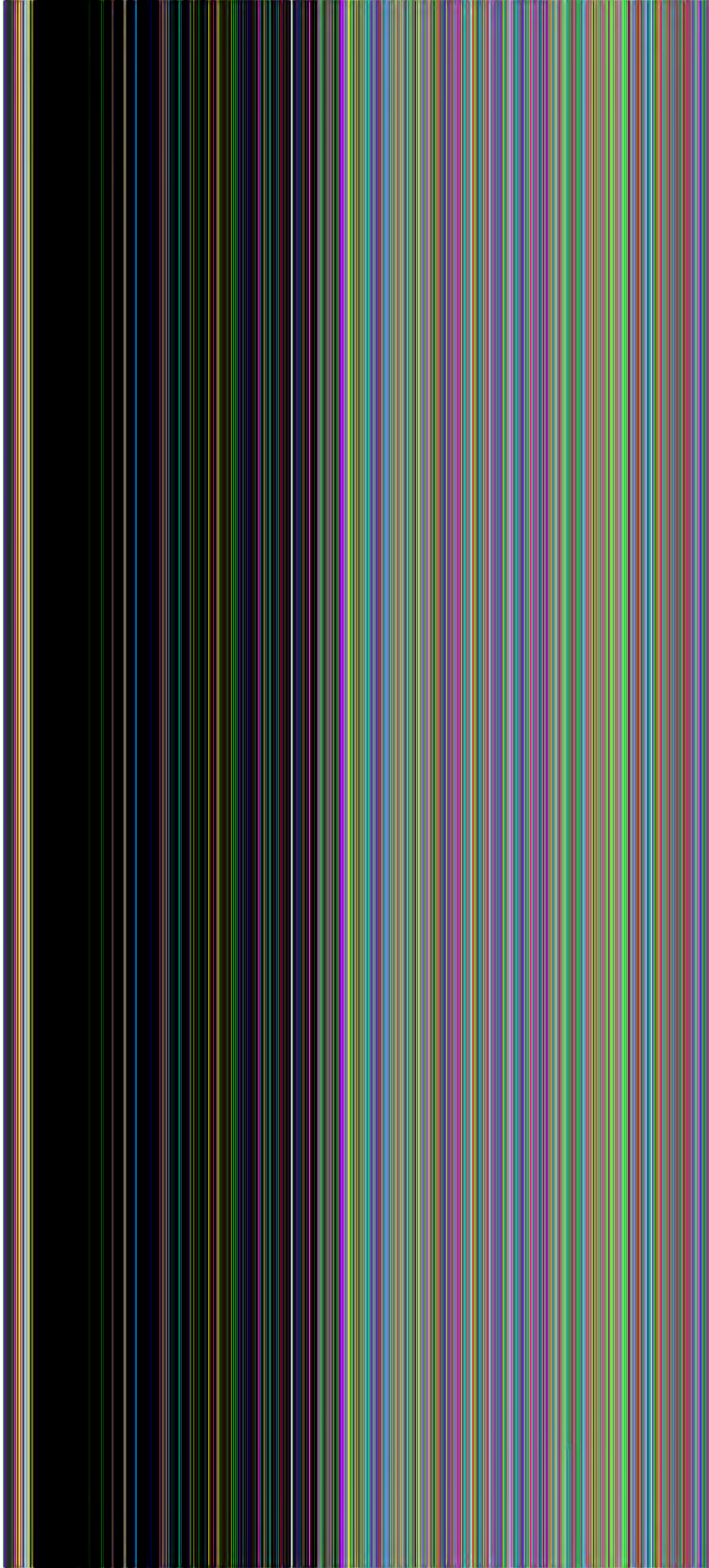
Notes on the following timbers have now appeared :—

1. Lagerstræmia tomentosa (*Lece*—Burma).
2. Dipterocarpus tuberculatus (*In*—Burma).
3. Pterocarpus dalbergioides (*Padauk*—Andaman Islands).
4. Pterocarpus macrocarpus (*Padauk*—Burma).
5. Canalia integerrima (*Maniawga*—Burma).
6. Diospyros Kurzii (*Zebra Wood*—Andaman Islands).
7. Berrya Ammonilla (*Petawa*—Southern India and Burma).
8. Terminalia tomentosa (*Saj, Sain, Taukkyan*—India and Burma).
9. Gmelina arborea (*Gumhar, Sewan*—India and Burma).
10. Ougeinia dalbergioides (*Sandan, Tinas*—India).
11. Lagerstræmia lanceolata (*Benkuk, Nana*—Southern India).
12. Anogeissus latifolia (*Bakli, Dhawra*—India).
13. Pterocarpus Marsupium (*Hesaé, Vengai*—India).

Reference is also invited to the following :—

A Manual of Indian Timbers, by J. S. Gamble, C.I.E.
(Sampson Low, Marston & Co., London.)

Indian Woods and Their Uses, by R. S. Troup.
(Superintendent, Government Printing, India, Calcutta).



Gumghar.

Gmelina arborea, Roxb.

Natural Order—Verbenaceæ.

GUMHAR.

Gmelina arborea, Roxb.

Natural Order—Verbenaceæ.

1. General Distribution.

This tree, although occurring over a large part of India, is nowhere plentiful, being more scattered probably than any other forest species of importance. It is most plentiful in Burma, becoming smaller in size and of less importance towards the west and north, so that in the United Provinces, Punjab, Bombay and Central Provinces, it is not reckoned as an important forest tree. Large supplies can only be expected from Burma, and smaller quantities from the Central Provinces and Assam where it attains a height of over 100 feet and a girth of 15 feet. In Ceylon it is fairly plentiful up to 5,000 feet in the moist region and is often cultivated, being known as *Ki-dawata*. It also occurs in the Malayan Peninsula and the Philippine Islands, but is not there regarded as an important tree.

2. Locality and Habit.

It occurs throughout deciduous forests from 300 to 3,000 feet, or even 4,000 feet occasionally, and exhibits a distinct preference for moist fertile valleys, where it grows under the most favourable circumstances straight and clean with a high rather open crown of medium-sized pointed leaves, and grey smooth bark. It loses its leaves in the hot weather and usually flowers soon after, the new leaves appearing after the flowers. Mr. H. H. Haines notes two varieties, *glaucescens* in the districts of Chota Nagpur and *cuneiformis* in the Santal Parganas.

3. Description, Properties and Uses of Timber.

The wood is yellowish or white, even-grained, not very hard, light and strong, with a handsome lustre, the annual rings being usually marked

by a white line or pores in the spring wood. It is easily worked and takes varnish well. On a vertical section the pores show as fine wavy light brown lines. The rate of growth is fast, as few as two annual rings to an inch radius having been recorded. The Dehra Dun specimens average four rings.

Durability.—The timber lasts well as a rule in buildings, and in fresh and tidal water and does not warp or crack readily. Until it loses the bitter principle in the wood white-ants do not seem to attack it. House posts which had been in use in Bhamo, Upper Burma, were found to be in good order after 50 years. Dug-outs are said to last about 8 years. Wood placed in the sea in Madras was found to be badly attacked by the *teredo*, so that it is not always advisable to use it in tidal water.

Weight.—The average weight of the seasoned wood per cubic foot is about 36 lbs, the specimens weighed varying little, no example weighing more than 38 lbs. (Gamble). It can be floated after drying for a short time, but should not be kept long in rafts as it absorbs water and sinks.

Strength.—The value of P, which represents the strength of a bar of timber calculated from the length between supports, breadth, and thickness of the bar, and the weight in pounds placed in the middle of this which causes it to break, is about 460 (Gamble). For Sal it is 790, for Teak 600 and for Shisham 796.

Fissility.—From tests made by Mr. R. S. Troup, the timber appears to be rather difficult to split. The tests were made with dry wood and gave an indicating figure of 0·17, Teak being easily split and giving 1·75, Deodar 1·86, *Acacia Catechu* 2·08, Padauk 3·33, Shisham 3·9, and Sal 9·33.

Calorific power.—The Forest Chemist, Mr. Puran Singh, when testing the calorific power of 36 of the commoner Indian timbers, found that *Gumbar* comes about the middle of the list. The number of British thermal Units generated by this timber is 8,075, the same as one of the Gardenias. Yew gives 7,394, *Bombax malabaricum* almost the same as *Gumbar*, and Teak, Sal, Deodar and Pines a good deal more.

Seasoning.—The timber seasons well and has long been known as a good wood to use when shrinkage is to be avoided. In the Southern Shan States the trees are girdled and left standing for some months so

that the logs will float easily, and in Orissa also girdling is sometimes carried out. It should not be used green as it shrinks to a certain extent when drying, but does not alter when seasoned.

Uses.—In Burma and Assam the wood is much used for dug-outs, and elsewhere it is in great demand for planking, furniture, panels of doors, carriages, well-work, decks of boats, toys, dolls, lacquered boxes, sandals, drums, yokes, grain-measures, plane-tables, carving, musical instruments, cattle-bells, and clogs.

In Assam it has been used for tea-boxes and it has been found suitable in match-making for sticks and inside boxes, but not for outside boxes. In the Southern Shan States it is used for bridges, and the Karens of Tenasserim use it for plates and trays. From South Tenasserim it is sent to Calcutta and Rangoon for the finer kinds of packing cases. A small consignment of timber sold in London in 1878 fetched £2 per ton. It makes fairly good unbleached wood pulp.

4. Minor Products.

The fruit, root, and bark are used in Hindu medicine and cattle and deer eat the young shoots and the fruit. The Gonds of the Satpuras protect the tree near the villages for the sake of the fruit which they eat. The leaves are sometimes used to feed the "Eri" silk worm of Assam. In Madras the juice of the root is used in dysentery and the fruit is rubbed over the scalp to cure boils, and in parts of Burma it is considered to be a mild tonic. The Karens of Tenasserim sometimes make a kind of cake of the flowers. The wood is used in India to make pearl ash (potash salts).

5. Natural Reproduction.

Seedlings are not reported to be plentiful in any of the forests, and this is doubtless due to the extent to which they are browsed down by cattle and deer. When the tree is able to get a start, as in the dense cover of old hill clearings and in thick patches of vegetation in valleys, where animals cannot reach it easily, young plants are found at times to a considerable extent. Mr. H. H. Haines considers that the species is distributed by cattle and deer which eat the fruit and reject the stones.

No difficulty is found in obtaining vigorous coppice shoots.

It is an associate of Sandal but has not been found to form root attachments with it (M. Rama Rao).

6. Artificial Reproduction.

The tree is often planted in avenues and can be readily raised from seed, the seedlings growing fast on suitable soil. In Vizagapatam about 70 per cent. of the seed put down in beds germinated. In Thana, Bombay, good results have been obtained by sowing in pits and the young plants were successfully transplanted.

7. Notes on Distribution and Extraction in different Provinces.

(i) *Burma.*

Vernacular names.—Yemané (Burm.), Mai' Saw (Kachin and Shan), Kana (Karen).

Local distribution.—In Upper Burma this tree is reported to be plentiful in a few divisions, but in most, as in almost all the forests of Lower Burma, it is scattered in small numbers through the mixed deciduous forests up to 2,000 feet. In Bassein, Arakan, Yaw and the Northern Shan States it is said to be especially scarce. It grows with teak, *Terminalia tomentosa* and various bamboos and is often found in valleys, attaining occasionally a girth of 15 feet with a clear bole of 50 feet and a total height of 100 feet. A 30 feet bole and a 7 feet girth are, however, the largest dimensions commonly met with.

Extraction will be carried out by traders or contractors, who will obtain licenses for the number of logs required, and can then fell the trees in the unclassed forests above the minimum girth prescribed, or have them marked for felling in the Reserved forests by the Forest Department. The logs will float when green and can be dragged or carted to the nearest rafting stream. No accurate estimates can be given of the amount of timber available as no enumerations of this tree have been made, but, except in the tracts close to the large rivers, where the trees have been felled to make boats, a large supply is available and arrangements can be made for purchase and extraction with the assistance of the

Divisional officers of the divisions named in the following table:—

Division.	Government royalty.		Rate for delivery.			Local price.	
	Rs.	Per	Rs.	Per	At	Rs. a.	Per
Myitkia (Mingin)	1 0	Log	12	Ton round	Alon	...	...
			25	Do.	Rangoon		
Lower Chindwin (Monywa).	1 0	Do.	12	Do.	Alon	5 8	Log.
Katha	1 8	Do.	6	Do.	Monkan	Rs 5 to Rs 8	Ton.
			5	Do.	Katha		
			10	Do.	Mandalay		
Myitkyina	1 0	Do.	13	Do.	Do.	6 4	Ton.
Mu (Shwebo)	1 0	Do.	15	Do.	Railway stations.	30 0	Ton sawn.
						13 0	Ton round.
Pyinmana	1 0	Do.	50	Ton converted.	Do.	...	...
Mandalay (Myaung)	1 0	Do.	35	Ton round	Thazi	50 0	Ton converted.
Ruby Mines (Mogok)	1 0	Do.	12	Do.	Mandalay	15 0	Ton round.
Tonngoo	1 8	Do.	10	Do.	Railway stations.	...	...
Shwegyin	1 8	Do.	12	Do.	Do.	15 0	Boat.
			12	Do.	Rangoon		
Prome	1 8	Do.	...	...	...	10 0	Ton round.
Pegu	1 8	Do.	10	Ton converted	Railway stations.	...	...
			10	Ton round	Rangoon	...	...
Rangoon	1 8	Do.	6	Do.	Railway stations.	60 0	Ton converted.
Hanzada	1 8	Do.	20	Do.	Do.	10 0	Log.
			50	Ton converted	...	...	...
Thaungyin } Mainmain. West Salween }	1 8	Do.	10	Ton round	Moulmein	45 0	Ton converted.
South Tenasserim (Tavoy).	1 8	Do.	30	Do. f. o. b.	Tavoy	12 0	Ton round.

NOTE.—"A ton" or "ton round" means 50 cubic feet in the round, the square of the quarter girth being multiplied by the length, and a "log" contains usually 40 to 70 cubic feet.

(ii) *Eastern Bengal and Assam.*

Vernacular names.—Gomari, Gamhár, Gamri, Gamkeri, Gambhár, Bolkoiak (Garo).

Local distribution.—The tree occurs in the moister forests of Assam from 300 feet elevation to 1,500 feet as a rule, though it is reported at 4,000 feet in the Garo Hills. It grows in Sal, bamboo and evergreen forests but is never abundant, and only in the Garo Hills is it classed even as fairly common.

Trees 12 feet in girth have been seen 70 feet in height, but the clear bole is as a rule not more than 30 feet long and the commonest maximum girth is 6 feet.

Extraction.—In Jalpaiguri the tree is worked on Coppice with Standards, but elsewhere trees are selected by the permit-holders subject to a girth limit and the control of the Forest Department. Little timber appears to have been extracted during the last five years, except in the Sylhet Division where the outturn is reported to have been 69,000 cubic feet, and no large quantities of the timber appear to be available annually. Some figures to help purchasers are given in the following table :—

Forest Division.	Local market rates.		Government royalty.		Rate for delivery.		
	Rs. a. p.	Per	Rs. a. p.	Per	Rs. a. p.	Per	At
Sibsagar .	...	...	0 4 0 6 0 0	c. ft. tree	1 0 0	c. ft.	Railway stations.
Chittagong .	3 0 0	c. ft.	2 or 3 annas	c. ft.	3 2 0	„	Chittagong.
Sylhet .	0 8 0	„	0 1 0	„	1 4 0	c. ft. converted	Longai.
Cachar .	0 6 0	„	0 1 0	„	1 8 0	„	Silchar.
Jalpaiguri .	...	...	0 2 0	„	0 7 0	c. ft. round	Chals.
					0 13 0	c. ft. converted	„
					1 3 0	c. ft.	Calcutta.
Goalpara .	0 14 0	c. ft.	0 6 0	„	1 2 0	„	Bisnagvon.
					1 4 0	„	Sapatgram.
					1 12 0	„	Calcutta.

(iii) *United Provinces.*

Vernacular names.—Gumhar, Kamhar, Tamhar.

Only in the Eastern Circle of the United Provinces is the tree reported to occur, and it is very scarce everywhere, especially in Pilibhit. It is found in mixed deciduous forest and is extracted when found in Gorakhpur for making drums and *pallis*, but the trade is small and local.

(iv) *Punjab.*

Vernacular name.—Ban.

It is recorded from the lower hills of Kangra and Hoshiarpur between 2,000 and 3,000 feet above the sea, but is very rare. It is rarely if ever felled and no details are known of any local uses to which it is put.

(v) *Rajputana and Central India Agency.*

In the *Marwar* State it is called *Sewan* or *Sohun* and is not common, being found scattered in the Godhwar forests in moist valleys. It is used for combs and musical instruments, but there is a very small trade in it, the price it commands being about one rupee per cubic foot.

In *Ajmer-Merwara* it occurs in small numbers in the Todgarh forests where it reaches a height of 15 feet and is extracted to make musical instruments and beds.

In *Bikanir* a few trees have been grown in the State gardens.

In the State of *Rewah* the tree is not plentiful, but occasionally attains fairly large girth. It is called *Khambar* or *Khamher* and is used for agricultural implements and furniture when available.

In *Indore* it is generally distributed but is nowhere plentiful and is seldom used, and attains good height and girth only in favourable localities near the Satpuras and Vindhyas. It is occasionally used for shoulder-poles (*Kanwár*) and for yokes. The Bhils use the wood for drums, and cattle-bells are sometimes made of it.

(vi) *Central Provinces.*

Vernacular names.—Siwan, Shewan, Kasmar (Berar), Khamer.

Local distribution.—In none of the forests of the Central Provinces or Berar is this tree common and in many it is very rare, never being more than one to ten acres, as in South Chanda. It goes up as high as 2,500 feet above sea-level and is usually found on light sandy trap soil in deciduous forests. In Raipur a few very good trees are found in Sal forest, but it rarely attains a girth of more than 3 feet and a height of more than 40 feet in the ordinary forests of these Provinces.

From the forests of South Chanda about 100 trees will be available annually which can be delivered at the nearest Railway station in rough squares for 12 annas per cubic foot, or at Cocanada *viâ* the Godavari River at 10 annas per cubic foot. The royalty is 5 annas per cubic foot.

(*vii*) *Western India.*

Vernacular names.—Shiwan, Shiwani, Shivana.

Local distribution.—Nowhere in Bombay is this tree at all common, never forming as much as 2 per cent. of the standing crop and usually less. It is said to be absent in Satara and very rare in the western division of Kanara and not to occur to the extent of one tree per square mile in Surat, where there are more trees in the Coppice than in the Dangs High Forest. It grows in moist forests up to 2,000 feet above sea-level, but prefers valleys with a fairly deep rich soil, where it occasionally reaches a height of 60 feet with a girth of 5 feet and a clear bole of 30 feet. In Kanara it is felled when it has reached a girth of 5 feet and in Central Thana the limit is 18 inches diameter.

Extraction.—The tree is commonly extracted in Coppice fellings though, often reserved as a standard and when sold with other species it goes with the coupe which is sold to purchasers. From the southern and eastern divisions of Kanara a small quantity of the timber may be available and can be delivered from the former at eight annas per cubic foot at Haveri or Bombay and four annas per cubic foot at Honawar on the sea-coast. From Eastern Kanara it can be delivered at Hubli on the Railway for Rs5 per ton of 50 cubic feet.

In *Baroda* it is very scarce and of medium size, but sells for box-making for about Rs3 per cart-load of 12 cubic feet.

(viii) *Bengal.*

Vernacular names.—Gamhari, Gambhar (Hindi), Kamare (Nepalese), Kusmar (Kol), Kasamar (Ho and Mundá).

Local distribution.—In the lower hill forests of the Tista it is reported to be fairly abundant, but is scarce in the adjoining mixed plains forests and elsewhere in Bengal and Orissa, being very often classed as rare. It ascends to 3,000 feet favouring shady ravines and attains a height of 100 feet occasionally in such places in the Tista forests where the exploitable size is 7 feet. In village lands in Singhbhum trees of 9 feet in girth may be seen. Its greatest height is 100 feet with 60 feet of clear bole. In Orissa the exploitable size is five or six feet, and trees above that are usually unsound.

Extraction.—When the timber is required trees are selected, usually in conjunction with improvement fellings for sal, according to the demand. Details of past extraction are of little value as very little has been felled and only from the Tista forests can a regular annual outturn be expected. It might amount to 60 trees, the local value of the timber being 10 annas to R1 per cubic foot or R4 per 100 running feet of 4 inch planks. The timber can be delivered at Bagracote Railway station on the Bengal Dooars Railway for 12 annas per cubic foot and at Siliguri for 13 annas. Elsewhere in Bengal the wood sells for 8 annas to R1-4 per cubic foot and the royalty is one or two annas per cubic foot.

(ix) *Southern India.*

Vernacular names.—Summadi (Telegu), Kumisha or Pokki (Malyalam), Kumili or Gumudu (Canarese), Kumbalam, Kumalamaram, Kumulu, Kolla kattadiekku (Tamil), Gombari (Uriya). Also called Gum Teak.

Local distribution.—In Ganjam and Nellore the tree is reported to be absent, and it is nowhere plentiful in the Madras Presidency. In a few of the forests in South Coimbatore and North Malabar it is found up to a maximum of 4 per cent. of the growing stock, but this is exceptional, and neither in numbers nor size does it assume an important position in Madras. From Madura trees 6 feet in girth and 80 feet in height have

been reported, but most of the trees found are much smaller, of poor height growth with little clear bole. A few large trees have been seen in Vizagapatam. In this district it is usually found in the plains outside the forests, but as a rule it grows in deciduous forests between 800 and 3,000 feet, ascending to 4,000 feet in Madura on the Palni Hills. It is fairly common in the moister portions of the hills of North Coimbatore, and was common in 1870 in Ganjam and Vizagapatam (Col. Heber Drury).

Extraction.—The tree is little in demand and is felled only in the fuel coupes nor can estimates be given of the future annual amount available which will never be worth the consideration of timber traders.

In *Coorg* the tree is known as *Kuli* in Canarese and is found throughout the deciduous forests attaining a girth of 4 feet. It is not often felled but is used sometimes by the villagers for rice-pounders and water-troughs. The Government royalty is 1½ annas per cubic foot.

In *Hyderabad* it is called *Shewan, Gumartek,* or *Gumari,* and is generally distributed but not common.

It is much used for yokes, also for furniture, planking, carts, drums and cattle-bells. It rarely attains a girth of 4 feet, and is one of the timbers granted free to agriculturists.

In *Travancore* the tree is widely distributed but not abundant between sea-level and 2,000 feet. It is rarely found larger than 1 foot in diameter and is not often used. The native names are *Muithekki* and *Kumbil* (Bourdillon).

In *Mysore* it is very sparsely distributed in all the deciduous forests, attaining in favourable localities 30 feet in height and 6 feet in girth. About 5,000 cubic feet may be obtained annually, delivered at Railway stations at R1 per cubic foot. It is called *Kuli*.

CALCUTTA: PRINTED BY SUPDT. GOVT. PRINTING, INDIA, 8, HASTINGS STREET.

Forest Bulletin No. 17 1913

NOTE ON BIJA SAL OR VENGAI

(*Pterocarpus Marsupium*, Roxb.)

BY

A. RODGER, I.F.S.

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1913

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[*Continued on p. 3 of cover.*]

Forest Bulletin No. 17 1913

NOTE ON BIJA SAL OR VENGAI

(*Pterocarpus Marsupium*, Roxb.)

BY

A. RODGER, I.F.S.

CALCUTTA

SUPERINTENDENT GOVERNMENT PRINTING, INDIA

1913

AGENTS FOR THE SALE OF BOOKS

PUBLISHED BY THE

Superintendent Government Printing, India, Calcutta.

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NOTE.

THESE notes regarding the lesser known Indian timbers have been compiled in order that all the information at present available regarding them may be easily obtainable.

For some of the best forests detailed Working-Plans have not yet been made, as the demand for timber in the neighbourhood is at present very small, but full information regarding the timbers available and means of extraction can always be obtained from local forest officers.

Application can also be made at any time to the Forest Economist, Dehra Dun, United Provinces, India, who will supply specimens of any timber free and put enquirers in communication with local forest officers.

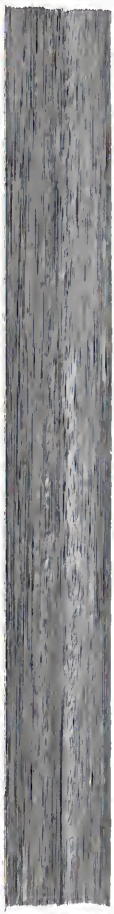
Notes on the following timbers have now appeared:—

1. Lagerstræmia tomentosa (*Lece*—Burma).
2. Dipterocarpus tuberculatus (*In*—Burma).
3. Pterocarpus dalbergioides (*Padauk*—Andaman Islands).
4. Pterocarpus macrocarpus (*Padauk*—Burma).
5. Canalli integerrima (*Manicegya*—Burma).
6. Diospyros Kurzii (*Zebra Wood*—Andaman Islands).
7. Berrya Ammonilla (*Petawa*—Southern India and Burma).
8. Terminalia tomentosa (*Saj, Sain, Taukkyan*—India and Burma).
9. Gmelina arborea (*Gamhar, Sinan*—India and Burma).
10. Ougeinia dalbergioides (*Sandan, Tinsa*—India).
11. Lagerstræmia lanceolata (*Benteak, Nana*—Southern India).
12. Anogeissus latifolia (*Bakli, Dhawra*—India).
13. Pterocarpus Marsupium (*Honné, Vengai*—India).

Reference is also invited to the following:—

A Manual of Indian Timbers, by J. S. Gamble, C.I.E.
(Sampson Low, Marston & Co., London.)

Indian Woods and Their Uses, by R. S. Troup.
(Superintendent, Government Printing, India, Calcutta.)



Bija Sal or Vengai.

Pterocarpus Marsupium, Roxb.

Natural Order—Leguminosæ (Papilionaceæ).

BIJA SAL OR VENGAI.

Pterocarpus Marsupium, Roxb.

Natural Order—Leguminosæ (Papilionaceæ).

1. General Distribution.

The eastern limit of this tree is 88° longitude, and the western 73°, but it hardly occurs to the north-west of a line joining Baroda and Shahjehanpur, and is principally a tree of the Peninsula. In Ceylon the tree is stated by Prain to occur in the central parts of the island. It does not occur in Assam, Burma, and the Punjab, and was formerly much commoner in Central and Southern India than it is now. Further details are given under the various provinces.

In Ceylon it is fairly common in dry and intermediate regions up to 3,000 feet, and rarer in the moist region on open grass land, and is called *Gammalu*.

2. Locality and Habit.

The tree is found in deciduous forests at all heights between sea-level and 3,000 feet, but is commonest between 500 and 1,500 feet and is rare at the lower levels. It prefers north and west aspects on hilly ground and grows best on a sandy or slightly clayey loam, with bamboo, Albizzias, Terminalias, Anogeissus, and Sal, reaching a height of 100 feet and a girth of 8 feet in the best localities of Chanda, and as much as 10 feet occasionally in Southern India. It is a tall tree, often not very straight, with a rather open leafy crown, the leaves being compound with five to seven alternate leaflets which are 3 to 4 inches long. The yellow or white flowers appear towards the end of the rains, and the new leaves at the end of the hot weather, but the tree is leafless for a very short time only. Several varieties have been distinguished by Prain, described in his report written in 1900 (Inspector-General of Forests' Proceedings for September 1900). Foulkes in "Notes on Timber Trees of South Kanara" says: "Grows in laterite when there is plenty of

moisture in the soil and will grow well on rocky laterite. Well suited to gneissic soils, but will not grow on the sandy soils of the coast."

3. Description, Properties and Uses of Timber.

The sapwood is narrow, soft, and white, the heartwood handsome, hard, yellowish or reddish-brown showing yellowish smooth vertical streaks on a vertical section. It is often cross-grained but takes a fine polish and seasons well. The yellow stain contained in the wood comes off when it is wet.

Durability.—It is a durable timber but should be kept dry, and is not liable to split. It has been tried for sleepers on the Mysore State Railway, twenty out of twenty-five being found to be serviceable after seven years' use, and lasts a long time as door and window frames. The Great Indian Peninsula Railway Company laid down 323 sleepers in 1879-80 and reported in 1883 that those which had been cut out of heartwood lasted very well and held the spikes firmly. Edward Balfour in "The Timber Trees, Timber and Fancy Woods," as also, "The Forests of India and of Eastern and Southern Asia," 1862, says that it was much used for buildings on the Bombay side, but should not be exposed to wet, and was not attacked by white-ants for at least twenty years. It was tried for sleepers on the Rajpipla State Railway in Bombay in 1897 and lasted for three years only. Wood placed in the sea in Madras was found to be badly attacked by the *teredo*.

Weight.—The average weight of the wood per cubic foot is about 53 lbs., the highest recorded being 63 lbs. and the lowest 47 lbs. (Gamble).

Strength.—The value of P, which represents the strength of a bar of timber calculated from the length between supports, breadth and thickness of the bar, and the weight in pounds which, when placed on the middle of the bar, causes it to break, is 718, the figure for Sal being 790, Teak 600, and Shisham 736 (Gamble).

Flexibility.—The wood is difficult to split as it is cross-grained, coming almost at the bottom of a list of 61 Indian woods tested by Mr. R. S. Troup. Teak, one of the easiest to split, is represented by the figure 1·75 in this list, Sain by 4·63, Sal by 9·88, and the timber under report by 11·88.

Calorific power.—It is used for fuel, but is not one of the best woods for the purpose, the number of British Thermal Units being about 7,824.

Only a few of the Indian woods tested by Mr. Puran Singh come below this, and Sal, Teak, and Blue and Chir pines give much higher values.

Seasoning.—In Orissa the logs are usually seasoned in tanks, and in the Central Provinces this method is also used at times or the logs are left unbarked in the forests. In Bombay the trees are sometimes girdled three years before felling. Both methods probably have their advantages depending on whether the gum resin, which stains yellow when damp and apparently repels white-ants, is to be removed or not. For ordinary purposes the timber can be well and thoroughly seasoned by stacking it in shady, airy places.

Uses.—This timber is, after teak and blackwood, the most valuable tree of Southern India, and especially of Mysore. It is much used for door and window frames, posts and beams, furniture, agricultural implements, boat and cart building, and especially spokes and felloes. When used for furniture it is heavily varnished to prevent the exudation of the strong yellow dye which may take place when wet after years of seasoning. In the Central Provinces it is also used for drums, idols, grain-measures, pit-props in the Mohpani coal-mines, and spokes and felloes of gun-carriages in the Gun Carriage Factory at Jubbulpore. In certain parts of Madras its use for building is confined to Government buildings and temples, and in Coimbatore it is not placed where it can come into contact with the feet, in deference to local superstition. In Bombay it has been used for railway carriage building, and it has been several times tried in various places for sleepers as noted above, but is not common enough to be considered as an available future source of supply. About the year 1858, 80,000 sleepers were put down in the line between Katni and Bilaspur in the Central Provinces. In 1900 a number of sleepers were supplied from Warangal to the Hyderabad-Godavary Valley Railway and lasted for seven or eight years though cut from unseasoned wood. In Balfour's work quoted above it is noted fifty years ago that the timber was apt to be unsound and to contain numerous faults of a coal black and charred appearance, thereby being often unsatisfactory for joists, but when these were not present it was a most valuable timber. Vessels built at that period in Ganjam were planked with it. It was evidently much more plentiful then than at the present day, especially on the Nilgiris and the Malabar and Kanara Ghats, large trees being common and the wood much used. Its price at Nagpur was at that date 5 annas per cubic foot.

4. Minor Products.

When the bark is blazed a red gum exudes which hardens quickly in brittle, black, shining angular pieces and is exported to Europe as "Kino" where it is used in medicine as an astringent, containing as much as 75 per cent. of tannic acid. The best season for collection is in the dry weather when the tree is in flower. It does not, however, appear to be collected to any great extent at the present time. Some notes supplied from North Malabar in the "Indian Forester" for July 1890 describe the method of collection. A number of short slanting cuts, about 1 inch wide, draining into a central vertical cut, are made in the bark, and the gum, which flows from them in about twelve hours, is caught in a bamboo tube. Only trees 6 feet in girth and above may be tapped, and they may only be tapped on one side unless they are over 8 feet in girth. The gum was dried in a wooden shed in shallow tin trays, about a fortnight being required in the dry weather. Artificial heat or exposure to the sun was found to spoil the quality. A tree 6 feet in girth was said to yield about 3 lbs. of liquid gum or 1 lb. of dry gum, and it was estimated that the trees might be tapped on alternate sides once in five years. This product is fully discussed in "Agricultural Ledger" No. 11 of 1901. In this it is noted that "*the genuine Malabar kino is an important indigenous drug in India which has been recognized many years in the British and other Pharmacopœias. An unlimited supply is now obtainable through the Forest Department at a price that will preclude all competition of other articles of a similar nature.*" Its history is traced from the year 1757, its first appearance in Europe having apparently been in the Edinburgh Pharmacopœia as *Gummi Kino*. The name Kino is probably derived from an African word *Kano*, the name of *Pterocarpus erinaceus*. In the middle of the last century the gum was extracted much more extensively, and Balfour, in the work above quoted, notes that "Dr. Cleghorn saw two thousand trees along the roads through the Wynaad, notched in a V-shaped form for the extraction of Kino which meets with a ready market on the coast, and is exported in wooden boxes to Bombay." According to the Ledger above quoted, in North Malabar alone about 2,000 lbs. can be produced annually at a cost price of not more than 4 annas per pound, but there is little demand in India except from the Government Medical Store Departments.

It is reported that the quantity available for extraction in the Quilon

Division, Travancore, is between 3,000 and 5,000 lbs. per annum, but it is not collected nor exported at present from Travancore.

In October 1874 the price of Kino in London was about 8d. per pound, but it rose in 1894 to 1s. 6d. and shortly afterwards to 1/7s., where it remained for some time. In 1896, as a result of measures taken in India through the Forest Department, the price fell to 1s. and at the end of the year 1899 to 8d. In 1900 the low price of 1s. per pound was reached. Since then it appears to have remained at much the same level and is now quoted in London at 9d. to 1s. 2d.

It is said to be used in Europe to a considerable extent in the manufacture of certain wines, but from the latest figures obtainable from the Collector of Customs in Madras and Bombay and from the Conservator of Forests at Coimbatore, it appears that the demand has recently fallen off and that collection has almost ceased. The Conservator of Forests states that the gum used to be collected in North Malabar in considerable quantities, but ceased owing to the fall in prices, and the small remainder of the stock in hand was sold in June 1908. The Collector of Customs, Bombay, reports that there were no exports of the gum from that port between 1905 and 1910. The Collector of Customs, Madras, supplies the following figures which show the export of Gum Kino from the Madras Presidency:—

Countries to which exported.	1907-08.		1908-09.		1909-10.		1910-11.
	Cwt.	R	Cwt.	R	Cwt.	R	
United Kingdom . .	37½	2,706	29½	945	24½	1,402	Nil.
United States of America .	...	...	7½	315	7½	630	Nil.
Total .	37½	2,706	30	1,260	32	2,032	Nil.

In 1909 proposals were made that tannin should be extracted on a large scale from the bark for tanning purposes. An extract of a sticky consistency prepared in Coorg from the bark after immersion in water was found to contain 38 per cent. of tannin, and the dry extract made from

this contained 91 per cent., so that the product will probably command a ready sale when it can be prepared cheaply on a large scale.

In 1907 experiments were made in Western Australia with the Kino as a means of preventing sacks from being destroyed by acid superphosphate which was shipped as a fertiliser, and gave most favourable results, the sack which had been treated with a strong solution of the gum being intact after being stored for six months full of the fertiliser. The leaves form excellent fodder for cattle and are also in demand for manure, and the tree gives good shade for coffee. The bark contains a brownish-red colouring matter which produces reddish-fawn colour with *tasar* silk. It has been noted by Mr. Rama Rao to be an associate of Sandal, but root attachments between the two have not been found.

5. Natural Reproduction and Rate of Growth.

According to Gamble the seed crop is not annual but intermittent and the seeds do not always germinate well. The pods fall in the dry season and are likely to be burnt, a danger to which Burma Padauk is also liable. Fire and grazing are great hindrances to the formation of a good crop of seedlings, to which a good start would be afforded by digging the surface soil so as to enable the seeds to obtain a lodgment, as if left on the hard surface among grass they have little chance of development. Moderately good regeneration is reported from most parts of India where the tree occurs, but seedlings as well as seeds evidently suffer much from fire, being slow-growing and requiring several years to become strong enough to resist it. As with teak seedlings, small plants when examined will frequently be found to have thick gnarled stems at ground level, representing several years' growth. The tree coppices readily.

In 1895 Mr. H. C. Hill noted in the Central Provinces that this and other species formed dense thickets wherever the beneficial influence of an old Mohwa tree was felt.

Mr. A. W. Lushington notes that in the hill forests of North Coimbatore, "Vengai" seemed to stand fire better than teak, and in places where the forests had been absolutely ruined by fire there still existed in 1902 a few dilapidated-looking trees. Excellent reproduction was to be found here and there.

Mr. R. S. Pearson records the following figures showing the rate of growth of "Honni" in the Kalmaddi slopes and Ankola High Forest in Kanara, Bombay:—

Age.	Average diameter in inches.	
	Kalmaddi.	Ankola.
10 years	19	1·65
20 „	35	3·41
30 „	54	5·41
40 „	73	7·44
50 „	91	9·27
60 „	107	11·04
70 „	124	12·85
80 „	138	13·88
90 „	154	15·66
100 „	169	17·30
110 „	185	18·57
120 „	199	19·51
130 „	212	19·73
140 „	229	20·12
150 „	238	21·02
160 „	240	20·30
170 „	258	27·20

From countings made in the Nallamalai forests, Kurnool, Madras, the average number of rings to each inch of diameter was found to be five. In the Walayar Reserve, Coimbatore, Madras, ten trees were measured annually at 4 feet from the ground, and gave the following results:—

Girth in inches.			
1887.	1888.	1892.	1898.
34½	44½	33	43
36½	44	35½	42½
33½	47	34	44½
37½	48	37½	41½
19	20	22½	42½

In the same forest coppice growth attained a girth of 1¼ inches in one year.

In the Begur Forests Working-Plan, North Malabar, Madras, 18 trees gave the following results:—

Average age at	6 inches	diameter	356 years.
„	12 „	„	698 „
„	18 „	„	1061 „
„	24 „	„	1445 „

In the Chelleth Range forests in the same district 100 trees gave the following results:—

Average age at	6 inches	diameter	327 years.
„	12 „	„	695 „
„	18 „	„	994 „
„	24 „	„	1242 „

F. Foulkes says in "Notes on Timber Trees in South Kanara":—"Yields only a moderate seed crop and apparently does not yield an annually equal crop. Does not germinate well. Reproduction is moderate therefore: one reason being that the seeds, being very light, are easily blown away by the monsoon winds and washed away by the monsoon rains before they have time to anchor themselves, and the fruit falling in the fire season, and the membranous wing becoming dry and inflammable, renders the seed very liable to damage by fire. Seeds retain their vitality for a long time."

6. Artificial Reproduction.

Sowings have been made in several parts of Bombay and Madras with fairly successful results. The hard bony covering of the seed often prevents germination during the first rains, and it may be hastened by cutting it sufficiently to expose the seed. The seedlings are only about 6 inches high after the first year's growth and must be protected from fire for a number of years depending on the soil covering. A tree planted in Chalissa was 20 feet high and 10 inches in girth after ten years. Sowings in the forest are much damaged by deer, and sowing in pits is usually more successful than broadcast sowing. From Vizagapatam a note is sent of the seeds having been steeped in camphor water, after removing the husk, for 12 hours and then sown in a flower pot, germination on the fifth day being the general result. In Central Coimbatore a plantation was made some thirty years ago, and now contains about 300 trees in excellent condition up to nearly 7 feet in girth.

In the same division a small mixed plantation was made three years ago on a dry stony soil. The seedlings were put out in split bamboo baskets in pits $1\frac{1}{2}' \times 1\frac{1}{2}' \times 1'$ and 50 per cent. of them are thriving. In Tinnevelly rows 3 feet wide are cleared in felled coupes and one or two seeds put in patches 3 feet apart and ½ inch deep. They have germinated readily but suffer from deer and do best when shaded from the morning sun.

7. Notes on Distribution and Extraction in different Provinces.

(i) *Central Provinces.*

Vernacular names.—Bija Sal, Bija, Dhoridida, Bewla, Bijra.

Local distribution.—In Berar the tree is very rare and is seldom extracted, and elsewhere in the Central Provinces its distribution is irregular. In Balaghat it is said to form about 10 per cent. of the growing stock, in Chanda, Sangor, and Damoh it is fairly common, and in most of the other forest districts it is found here and there. It grows in deciduous forests with teak, khair, and bamboo, usually on hilly ground between 500 and 2,000 feet, preferring north and west aspects, and a sandy or slightly clayey loam. In Chanda trees measuring 8 feet in girth and 100 feet in height are found at times, but 3 to 4 feet in girth, 30 feet clear bole, and 40 feet total height are the commoner measurements elsewhere.

Extraction.—Most of the forests containing the tree are worked as Coppice with Standards, a few, as in Chanda where the best trees occur, under the Selection system as a rule, mature trees being removed when required. Purchasers remove the timber from the coupes they have acquired by dragging and carting in most cases, but from South Chanda floating is possible on the Godavery, one log being moved by one teak log. Little accurate information is available regarding the amount of timber available annually, but estimates are given below as a guide to purchasers of the timber from the various forests of the Central Provinces where it is now available, or will become available when the forests are opened out.

Figures regarding Extraction.

Division.	Government royalty.		Local market rate.		Rate for delivery.		
	Rs. a. p.	Per	Rs. a. p.	Per	Rs. a. p.	Per	At
Chindwara	0 10 0	Cubic foot	1 0 0	Cubic foot	0 4 0	cubic foot squared.	Chindwara.
					1 3 0	Do.	Nagpur.
Sangor	...	...	2 0 0	Cart-load	0 3 0	Cubic foot	Kaseli.
					0 4 0	Do.	Sangor.
							Gensalganj.
					1 0 0	Do.	Bombay.
					0 8 0	Do.	Jubbulpore.
Mandla	0 3 4	Cubic foot	0 8 0	Cubic foot	0 8 0	Cubic foot round.	By stations.
					0 12 0	Cubic foot converted.	Ditto.
Damoh	...	...	...	...	0 2 0	Cubic foot	Ditto.
					0 13 0	Do.	Bombay.
					0 5 0	Do.	Jubbulpore.
Raipur	0 3 0	Cubic foot	1 0 0	Cubic foot	0 11 0	Do.	Dhamtari.
					0 12 0	Do.	Raipur, Ballarshah.
South Chanda	0 5 0	Do.	...	...	0 9 0	Cubic foot squared.	Rajahmundri near Coconada.
					0 10 0	Do.	

In the Working-Plan for Working Circle No. 1, Allapilli forests, Chanda, Central Provinces, in area 31 square miles, the following figures are given:—

Number of sound trees above 24 inches diameter . . . 906
" " " 18—24 " " . . . 1,141

The minimum limit for felling is at present fixed at 24 inches diameter.

(ii) *Rajputana and Central India Agency.*

In the *Marwar State* it is found scattered at 3,000 feet on the upper slopes of the Southern Aravali hills, but it is not plentiful or large as

it is much cut over by the villagers who use it for ploughs, flag-staffs, etc.

In *Gwalior* a few small trees occur, but it is of little importance. It is called *Bija*.

In the *Rewah* State the tree forms about 5 per cent. of the crop in 3 tehsils and grows to 4 feet in girth. It is largely used and not more than 4,000 cubic feet will be available annually in future, the royalty to be paid being 4 annas per cubic foot. The market rate near the railway line is 12 annas per cubic foot.

In *Indore* it is called *Bea* or *Bija* and was formerly fairly abundant, but owing to heavy exploitation few big trees are now to be seen except in inaccessible valleys near the Satpuras where trees of 6 feet in girth occur. It is well-distributed but abundant only near the Nerbudda in the Burwaha Range, in the south-west of Nimawar District and in parts of the Satpuras, and does not often attain a girth of more than 4 feet.

The timber is valued for building and poles of 3 feet girth are dressed and sold as shafts, the value of the timber being about R1 per cubic foot and of shafts 10 annas each.

(iii) *Southern India.*

Vernacular names.—Yegisey, Yegi, Vengai (Tamil), Benga, Netra honne, or Honne (Canarese), Pisal (Uriya).

Local distribution.—This tree is one of the most important in Madras and Mysore and occurs scattered over the deciduous forests in most districts, but very seldom grows gregariously. In the Wynaad forests of the Nilgiris the most favourable localities have as much as 10 per cent. of the total crop consisting of this tree, and this percentage is reached in a few other forest tracts, but elsewhere it is much scarcer and is of no importance in Guntur, Bellary, Chingleput, and districts where the forests generally are poor. It grows with Sal in the north, and with Albizzias, Anogeissus, and Terminalias in deciduous forests at all heights above sea-level up to 3,000 feet, but is commonest between 500 and 1,500 feet and is rare on the lowest levels. In the forests of the northern part of the Presidency it very rarely attains large size, but increases in Coimbatore, Madura, and Tinnevelly. Seven feet in girth is a good tree there, but in Coimbatore it grows occasionally to 16 feet girth and 100 feet in height, with a clear bole of 40 feet.

Extraction.—The forests are worked under Coppice with Standards and Selection systems, and the districts from which constant supplies of good timber can be expected are very few. In Madura the girth limit for felling is 7 feet, about 150 trees having been extracted during the last five years, selling for R40 each on the average. In South Kanara the exploitable size is 2 feet diameter. The information available regarding the quantities available is very vague and purchasers are advised to make enquiries direct from the forest officers in charge of the divisions mentioned in the table given below. The Malabar Timber Yards and Saw Mills quote R2 per cubic foot for scantlings and R2-2 for planks free on rail at Kallai. They call it *Wynaad Padauk*.

In *Coorg* the tree is called *Honné* in Canarese and is found throughout the deciduous forests, attaining in the south a girth of 10 feet. It is locally in great demand for house-building and agricultural implements, 150,000 cubic feet having been felled during the last five years. About 30,000 cubic feet may be obtained annually. The Government royalty is 8 annas per cubic foot. The market rate in 1892 was 10 annas as at present.

In *Hyderabad* it is known under several names, *Bija Sal*, *Bija*, *Pedda Yegi*, *Nettrani*, *Nettar*, *Hoanni*, *Ruggelbairu*, *Dorebula*, and is regarded as the most valuable timber of the State, large teak being now very scarce. It is in great demand for buildings and carts, but large trees have been destroyed in many parts for cattle fodder, and this waste is still going on, so that its disappearance, except in reserves, may be anticipated. Near the Godavery in the Mahadeopur, Pakhal, and Poloncha forests a fair number of good trees are still to be found, 6 to 8 feet in girth, but little extraction is now allowed as the forests have been overworked in the past. The royalty is R1 per cubic foot and the market price at Warangal R1-12.

In *Mysore* it is called *Honné* and is much used for building and carts, being common in the Mysore and Shimoga forests. About 40,000 cubic feet may be extracted annually. Ninety-four thousand cubic feet have been extracted during the last three years.

In *Travancore* the tree is common in deciduous forests up to 3,500 feet and stands sixth on the list of useful woods of the State. It is thought locally to be too heavy for furniture and the yellow stain from the wood prevents it being very largely used, *Terminalia tomentosa*, *Hopea parviflora*, and *Artocarpus hirsuta* being preferred, but it sells

largely for export. About 36,000 cubic feet are sold annually, its value on the coast being 12 to 14 annas per cubic foot in the log (Bourdillon).

Figures regarding Extraction.

Division or State.	Local selling rate.		Rate for delivery.		
	R a.	Per	R a.	Per	At
Lower Godavery.	1 4 to 1 10	Cubic foot round.	...	...	...
Central Coimbatore.	1 6	Do.	0 4 to 0 8	Cubic foot.	Railway stations.
South Coimbatore.	...	...	1 8	Do.	Podanur.
Madura . .	2 0	Cubic foot squared.	2 14 2 0 3 0	Cubic foot squared. Do. Do.	Anonayanaickanoor. Cumbum. Madura.
Tinnevelly .	1 12	Cubic foot scantlings.	1 12	Cubic foot in scantlings. Travancore wood.	Shenkottah.
North Malabar	0 8	Cubic foot squared.	1 2	Cubic foot	Calicut, Tellicherry, Mysore, Nanjangode.
Coorg . .	0 10	Cubic foot .	0 15	Do.	Paschamavahini Station, Mysore.
Mysore . .	1 0 to 1 6	Do. .	1 4	Do.	Railway stations.

Figures from Madras Working-Plans.

District.	Working Circle.	Area in square miles.	Number of trees Diameter in inches.							Remarks.
			1"–6"	6"–12"	12"–18"	1[illegible]–24"	24"–30"	30"–36"	Over 36"	
Coimbatore	Punachi Anamalai Hills.	4	21,000	5,000	2,300	[illegible]00	600	220	260	Annual yield 3,915 cubic feet.
South Coimbatore.	Thalingi .	8	4,500	1,900	620	170	19	9	19	

From the Coorg Working-Plans the figures given below have been taken. As, however, the Working-Plans have mostly expired, the figures must be taken merely as a guide to the amount of timber that may at present be available annually, and up-to-date figures should be obtained from the Deputy Conservator of Forests, Coorg.

Name of forest.	Area in square miles.	Quantity in cubic feet available annually.
Devamachi-Mawkal	28	2,400
Nalkeri-Hatgat	83	20,400
Anekadu-Attoor	20	8,340
Arkeri	29	2,000

(iv) *Western India.*

Vernacular names.—Bibla (Marathi), Honne, Asana, Bio (Gujarati).

Local distribution.—Five per cent. is the highest proportion of the growing stock that the species ever occupies in Bombay, and three trees per 5 acres are reported from the eastern part of Kanara, a district where it appears to be generally plentiful. In Surat as many as ten trees to the acre are occasionally found, but in Poona and Khandesh it is very scarce, and is not found in Satara, being thus a tree principally of the southern part of the Presidency. It grows best at an elevation of 1,000 feet or so and can grow in exposed situations, but occurs in most of the deciduous forests between 500 and 2,500 feet, and prefers quartzite to black soils. It attains a girth of more than 8 feet in Western Kanara and a height of 90 feet with a clear bole of 50 feet, but smaller sizes are much more common.

Extraction.—In the forests where the tree yields timber, trees are selected for felling. In Central Thana 18 inches is the minimum diameter taken, in the Eastern Divisions of Kanara 75 inches in girth, and in the Western Division 6 feet. In Kanara a good deal of extraction is done by Government agency, but coupes are sometimes sold to purchasers here as is commonly done elsewhere, most of the timber being carted from the

forests, but dragging from the stump being sometimes necessary, and boats are employed in the south. From a few divisions timber may be obtained, but reliable estimates of the amount available annually have not yet been made in most of them. Some figures regarding extraction are given below. The royalty is R8 per khandy of 12½ cubic feet in Kanara.

In the *Rajpipla* State the tree occurs in most of the hill forests, being occasionally as plentiful as 25 trees to the acre, and attaining a girth of 36 inches. During the years 1904 to 1909, 20,000 cubic feet were extracted and the quantity available annually in future is estimated at 5,000 cubic feet, the duty levied by the State being 3 annas per cubic foot. Converted timber can be delivered at about three times the rates quoted for rough timber in the table below. The logs are extracted by Bhils and when possible are floated down the Narbudda, most of them finding their way to Baroda, Ahmedabad, or North Gujrat.

In *Baroda* it is scarce, but sells for R5 per cart-load of 12 cubic feet when available.

Division or State.	Market rate.		Rate for delivery.		
	R a.	Per	R a.	Per	At
Eastern Division, Kanara.	12 0 to 15 0	Khandy of 12½ cubic feet.	1 2	Cubic foot	Hubli.
Southern Division, Kanara.	15 0	Do.	0 4	Do.	Honawar.
			0 8	Do.	Haveri, Bombay, Mangalore, Calicut.
Western Division, Kanara.	12 0	Do.	0 8	Do.	Sea-coast.
Sunsi . .	12 0 to 20 0	Do.	0 14	Do.	Rajpipla Valley Railway.
			1 0	Do.	Bulsar.
			1 1	Do.	Sunsi.
Rajpipla State.	0 12	Cubic foot round.	0 12	Do.	Nandod or Chandod.
			0 14	Do.	Ankleshwar.

Figures from Bombay Working-Plans.

District.	Working Circle.	Area in square miles.	Mature trees on the area.	Minimum size fixed for felling.	Remarks.
Kanara	Gund, Series XI.	25	880 above 24" diameter.	24 inches diameter.	
Do.	Supa, Block XX.	18	64 above 24" diameter.	6 feet girth.	
Do.	Kalinaddi slopes.	42	1,930 sound trees above 24" diameter; 120 unsound.	6 feet girth.	Annual yield 40 trees.
Do.	Murdgod High Forest.	85	1,400 above 24" diameter.	6 feet girth.	
Do.	Ambola High Forest.	70	1,500 above 24" diameter.	6 feet girth.	
Do.	Yellapur above Ghat.	137	2,800 above 24" diameter.	24 inches diameter.	
Do.	Yellapur slopes, Block XVII.	16	350 above 24" diameter.	...	
Belgaum	Nagargali Series	14	30 above 24" diameter.	...	

(c) *Bengal.*

Vernacular names.—Bija, Bija Sal, Paisar (Hind.), Hid (Kol), Murga (Santal), Bia (Kharw.).

Local distribution.—The tree is not common in Bengal, rarely of large size in the Santal Parganas and Palamau, and absent in the Kurseong, Darjeeling, and Tista forests. It is found elsewhere in deciduous plains forests with Sal and in the dry mixed hills forests up to 3,000 feet above the sea. In Orissa, Sambalpur, and Singhbhum good trees 7 feet in girth may be found, with an occasional specimen 10 feet in girth, the height reaching 100 feet and the length of clear bole 50 feet. It is the best tree for planking in Chota Nagpur and deserves to be largely planted as the supply is very limited (H. H. Haines).

Extraction.—Trees are selected for felling according to the demand and sylvicultural requirements of the forest, but no large supply can be expected from the forests in Bengal and little, if any, will be available for export. From Sambalpur about 2,000 cubic feet may be available annually, from Puri 300 cubic feet, and similar quantities from Chaibassa, Angul, and Singhbhum. The royalty is usually 4 annas per cubic foot dry and 6 annas per cubic foot green, and the local price varies from 12 annas to Rl-8 per cubic foot. At Lota Pahar Station the timber can be delivered from Chaibassa at 8 to 12 annas per cubic foot. From Sambalpur to railway stations the rate is Rl per cubic foot round and Rl-4 per cubic foot sawn and to Calcutta Rl per cubic foot in the log.

In the Raigoda Range of the Angul Division 893 trees over 3 feet in diameter were counted on an area of 30·2 square miles, in 1907, and in the Bagmunda Range, 38 square miles, the number was 901. These trees are to be felled with the mature Sal in the annual coupes.

(vi) *United Provinces.*

Vernacular name.—Bija Sal.

Local distribution.—The tree is rare in the United Provinces, only the Bundelkhand, Gorakhpur, and Pilibhit Forest Divisions reporting its presence in appreciable quantities. In Gonda three trees have been seen and in Kheri a few trees occur here and there in the alluvial areas. It does not come so far north as the Siwaliks. The largest girth it reaches is 5 feet and a small number of logs up to 20 feet long and 4 feet in girth might be obtained, the market price in Gorakhpur being about 8 annas per cubic foot.

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
8, HASTINGS STREET

Forest Bulletin No. 18 1913

NOTE ON SAIN OR SAJ

(*Terminalia tomentosa*, W. & A.)

BY

A. RODGER, I.F.S.

CALCUTTA
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[Continued on p. 3 of cover.

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(*Terminalia tomentosa*, W. & A.)

BY

A. RODGER, I.F.S.

CALCUTTA

SUPERINTENDENT GOVERNMENT PRINTING, INDIA

1913

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NOTE.

THESE notes regarding the lesser known Indian timbers have been compiled in order that all the information at present available regarding them may be easily obtainable.

For some of the best forests detailed Working-Plans have not yet been made, as the demand for timber in the neighbourhood is at present very small, but full information regarding the timbers available and means of extraction can always be obtained from local forest officers.

Application can also be made at any time to the Forest Economist, Dehra Dun, United Provinces, India, who will supply specimens of any timber free and put enquirers in communication with local forest officers.

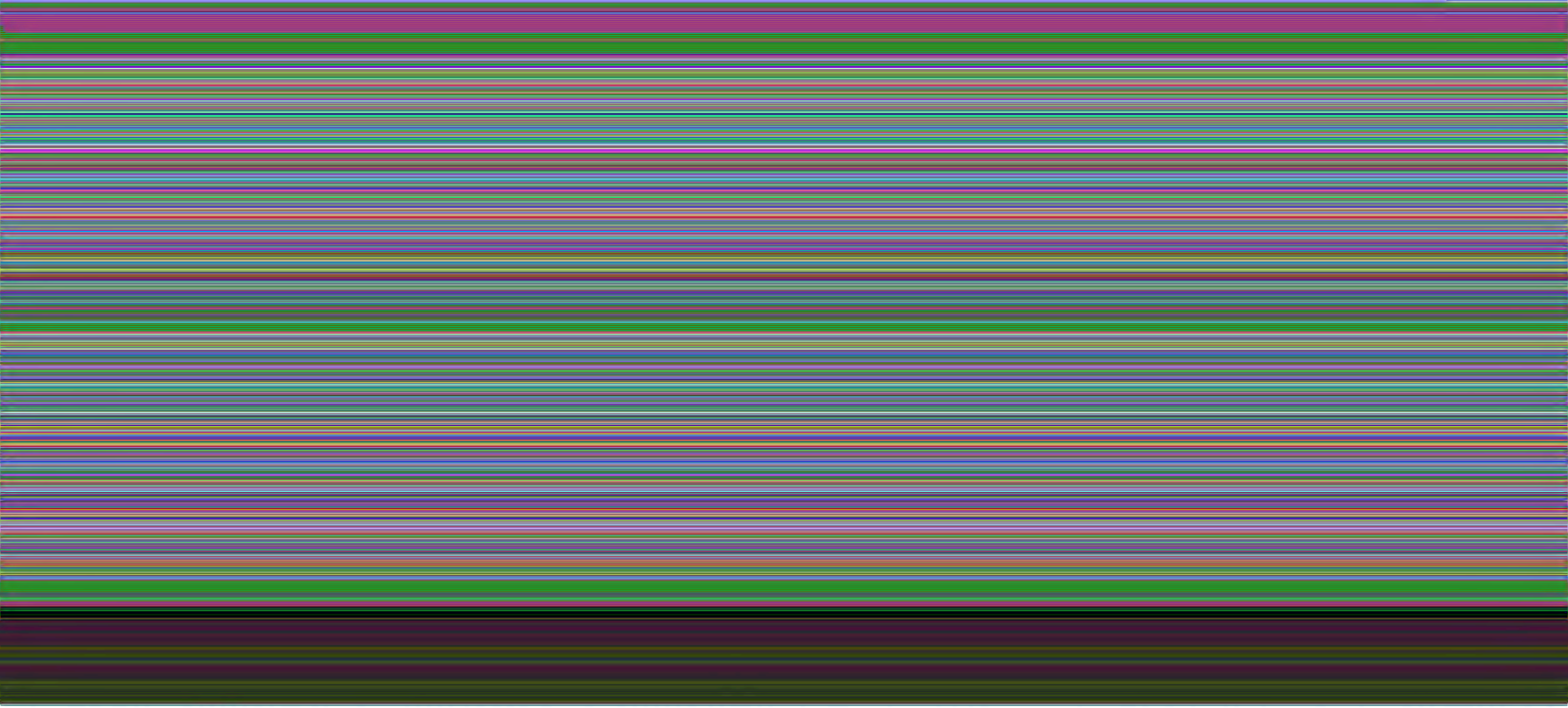
Notes on the following timbers have now appeared :–

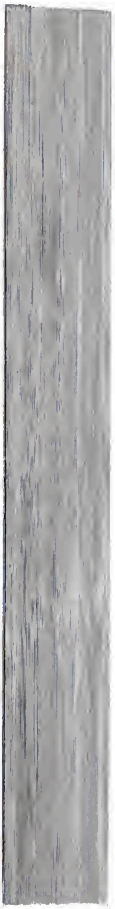
1. Lagerstroemia tomentosa (*Leza*—Burma).
2. Dipterocarpus tuberculatus (*In*—Burma).
3. Pterocarpus dalbergioides (*Padauk*—Andaman Islands).
4. Pterocarpus macrocarpus (*Padauk*—Burma).
5. Carallia integerrima (*Maniawga*—Burma).
6. Diospyros Kurzii (*Zebra Wood*—Andaman Islands).
7. Berrya Ammonilla (*Petwun*—Southern India and Burma).
8. Terminalia tomentosa (*Saj, Sain, Taukkyan*—India and Burma).
9. Gmelina arborea (*Gamhar, Sneza*—India and Burma).
10. Ougeinia dalbergioides (*Sandan, Tinas*—India).
11. Lagerstroemia lanceolata (*Benteak, Xana*—Southern India).
12. Anogeissus latifolia (*Bakli, Dhaura*—India).
13. Pterocarpus Marsupium (*Honné, Vengai*—India).

Reference is also invited to the following :–

A Manual of Indian Timbers, by J. S. Gamble, C.I.E.
(Sampson Low, Marston & Co., London.)

Indian Woods and Their Uses, by R. S. Troup.
(Superintendent, Government Printing, India, Calcutta.)





Sáh or Sáj.

Terminalia tomentosa, W. and A.

Natural Order—Combretaceæ.

SAIN OR SAJ.

Terminalia tomentosa, W. and A.

Natural Order—Combretaceæ.

1. General Distribution.

This tree is one of the commonest and most widely distributed in India, being found in abundance in the United Provinces, Bombay, Madras, Bengal, and Burma. In Eastern Bengal and Assam, South Tennasserim, Arakan, Southern Madras and North-Western India it is scarce or absent, apparently not occurring in Upper India west of 76° longitude and north of 24° latitude and ceasing in both Peninsulas about 10° latitude. Further details are given under each province.

It is recorded from Ceylon in the Flora of British India but it was probably planted.

2. Locality and Habit.

The range of this species is very wide as it is found almost from the sea-level in the Peninsulas up to 4,000 feet on the lower slopes of the Himalayas and the hills of Upper Burma. It grows best, however, between 800 and 2,000 feet, becoming stunted on the higher levels. It prefers deep fresh loams containing more clay than sand, and is often found on low-lying moist localities, and in *nalas*, as it is able to stand a good deal of water-logging. It is one of the few species which grow abundantly on black cotton soil in the Central Provinces though it remains stunted in such localities. On laterite it is found in great abundance in certain districts but is often small and crooked.

F. Foulkes in "Notes on Timber Trees—South Kanara" says :—

"Will grow in almost any soil but prefers a deep moist clayey soil of alluvial origin: the bleaker the bark, the better the factors of the locality suit the tree. When it is hollow the bark becomes an ashy grey over the spot.

It grows very thinly in dry shallow rocky laterite plains but becomes stunted on the bare dry upland laterite hills. Prefers a laterite to a gneiss soil. It is entirely absent on sandy soil. Is especially useful for regeneration of lands in which the soil has deteriorated by exposure owing to reckless grazing and fires.

It seems to stand a dry climate as well as a moist one and to require less rainfall than most other trees, but the more rain it has the more luxuriant its growth."

It is a tall straight tree with spreading branches and heavy crown, and may usually be recognised by the very thick rough dark-coloured bark which is deeply cracked longitudinally. It loses its leaves annually during the hot weather and produces a new flush after most of the surrounding species, sometimes not until the end of June, the flowers appearing during the rains. On the higher and barer slopes the leaves are rather large and are covered with down, but in the localities which suit it best they are smaller, thinner, and smooth. A variety is found in the *Dipterocarpus* forests of Burma with large fruits and leaves, and Haines notes several varieties in his Forest Flora of Chota Nagpur, page 303.

3. Description, Properties and Uses of Timber.

The sapwood is reddish-white and narrow, the heart-wood dark-brown and hard, the annual rings being indistinct and the wood marked with wavy darker streaks. It is not easy to work and is avoided by sawyers when they can get other timber, and they demand higher rates for sawing it, as the timber is often cross-grained. The cross-section shows many regularly scattered pores arranged in short wavy lines.

Durability.—It decays rapidly as a rule when used in the open, but has been found to last well occasionally in the ground as railway sleepers, and in other exposed situations. It is much more durable when used for beams inside houses and in other airy sheltered spots. In damp badly ventilated situations it is almost sure to be attacked by dry rot which soon destroys wood which has not been antiseptically treated. The variety with leaves hoary beneath which ascends to almost 4,000 feet in the moister Himalayas has been preferred to Sal for factory and bridge work. The wood has been tested in the Lower Godavari Division in Madras to determine its power of resistance to the *teredo*. The results showed that at one station the timber was badly attacked. White-ants also usually destroy it after two or three years, when they are plentiful.

Weight.—Specimens from the south of India have weighed as much as 74 lbs. per cubic foot, but the ordinary weight, calculated from 30 specimens from all parts of India is 59 lbs. very much the same as Sal (Gamble)

Strength.—The value of P, which represents the strength of a bar of timber calculated from the length between supports, breadth and thickness of the bar, and the weight in pounds which, when placed in the middle of the bar, causes it to break, is for this timber about 837 (Gamble). For Sal it is 790, for Teak 600, and for Shisham 796.

Fissility.—From tests made by Mr. R. S. Troup the timber appears to be fairly easily split. The figure given by a number of tests made in different ways is 4·63, Teak giving the figure 1·75, Chir pine 3, *Acacia Catechu* 3·95, and Sal 9·38.

Calorific power.—The heat-producing power of the timber is very high, being with Sal almost at the top of the list of 56 common Indian woods tested by the Forest Chemist, Mr. Puran Singh; only two species, both conifers, are above Sal and Sain, and it is a good fuel and charcoal wood.

Seasoning.—In Central and Southern India the timber is often soaked in water for a month or two after felling and barking which is said to increase its durability. The lighter heartwood between the centre and the outer circumference also becomes darkened in colour by this means. The timber needs slow seasoning in the shade as it is apt to crack and split badly if dried too quickly. In the Central Provinces the water method is employed, and other methods in use are to bark the logs when felled during the rains and stand them up against trees for several months, or to char the logs after barking over a light fire. In Central India the wood is much preferred when felled during the rains and the natives object to felling it at any other time.

Uses.—The timber is used all over India for building purposes usually as beams, rafters, and occasionally ceiling planks. It is also used for carts, ploughs, dolls, slippers, irrigation water-wheels, bedsteads, building machinery, and very often as fuel. In the Central Provinces poles are in great demand by the villagers and are sold to the coal mines for pit props. At Meerut scantlings and beams are sold at R1-6 per cubic foot, but planks are not considered worth offering for sale. In 1890 scantlings 12′ × 5″ × 4″ were selling at R14 per score at Cawnpore, R36 at Bareilly, and R35 at Moradabad. In 1895 the prices were R40 at Cawnpore, R45 at Bareilly, and about R50 at Moradabad. At Kalka in Malakar the price is R2 per cubic foot for scantlings and R2-2 per cubic foot for planks free on railway trucks. Some of the hill people in the United Provinces have a superstitious prejudice against the wood and

refuse to use it. A small consignment was sold in London in 1878 for £1-15 per ton. Edward Balfour, in his book on Indian Trees published in 1862, says that it was much esteemed at that time as a building timber, being very strong and heavy, but the same defects are noted by him as prevent its use in many parts at the present day. Its price at Nagpur was then 5 annas per cubic foot. It has been frequently experimented with for railway sleepers with very varying results. In South-Western India trials on the Madras and South Indian Railway led the engineers to think that the timber was not worth experimenting with further, but this was doubtless due to the sleepers being supplied almost green, to the influence of the sea air and the heavy rainfall during the monsoon. On the Eastern Bengal State Railway much better results were obtained and the timber was described as being excellent sleeper material. The average age on the Kaunia-Dhaka line of this Railway was 6½ years, when laid in earth and carrying light traffic. On the northern section the average was nearly 6 years. On the main line 10 per cent. of these sleepers had to be removed the year after they were laid, the ballast being shingle. The following notes were sent in by the Executive Engineer, Saidpur, in 1891:—

4,116	sleepers	laid in	1881	. . 89	renewed up to date
2,146	„	„	1883	. . none	„ „ „
1,404	„	„	1885-86	. . 119	„ „ „

In 1870 the Great Indian Peninsula Railway laid down 447 sleepers, of which 50 had decayed and been replaced in 1888, the engineer remarking that it seemed very liable to crack and be attacked by dry rot.

The approximate life of the timber as sleepers was given by the Chief Engineer, Madras and Southern Mahratta Railway, in 1910, as 5 to 10 years.

Some untreated sleepers laid down in 1907 in the Rangoon-Mandalay line were found to be sound but rather badly split at the beginning of 1911. The Bengal and North-Western Railway put down 2,805 sleepers in 1889, and had to replace 553 in 1903, the remainder being removed to an unimportant branch.

About the year 1880, a large number of sleepers were put down in the Bengal-Nagpur Railway between Umaria and Katni but 40 per cent. had to be renewed by 1893.

In 1886, 496 sleepers were laid down in the Rohilkhand and Kumaon Railway, and 57 per cent. remained sound in 1895.

4. Minor Products.

The bark is commonly used for tanning skins and preserving nets and an astringent gum is also obtained which sells for 4 annas per seer in the Central Provinces and is used for incense and as a cosmetic. The ashes of the burnt wood are used by dhobies in Oudh and the bark is sometimes used to poison fish in streams. Juice of the bark is used as an astringent in making palm sugar. In Mysore and South Kanara the natives burn the bark and prepare lime from it in an elaborate manner for the use of Jains and Brahmins (*Indian Forester*, August 1909) and it is used in the same manner by some wild tribes in Southern India. In extracts of the bark prepared in the forest by rough methods over 70 per cent. of tannin have been found, and by an analysis of bark made in Germany the following results were obtained:—

	I	II
Percentage of tannin agents	32·5	29·4
Non-tanning soluble substances . . .	27·1	33·4
Insoluble	6·3	21·3
Water	13·6	11·4
	100	100

The extracts were reported to be too dark in colour and to have no chance of finding a market until they were decolorised. The preparation of such extracts in a rough and ready way will probably not lead to the development of any trade in Europe, as up-to-date machinery is required.

Method of tanning with Saj bark.—In this case the hide is usually treated with *kas* or liquor five times as follows:—

The first *kas* consists of 3 or 4 seers of powdered bark mixed with 30 seers of water, the second of 5 seers of bark, the third of 7 seers, the quantity of water remaining the same throughout. The hide remains in the first *kas* for 3 days, in the second 4 days, in the third 6 days, in the fourth 7 days and in the fifth 8 days, it being taken out and rubbed 3 times daily as previously noted. It is then taken out of the *kas*, washed in clean water and dried, after which it is well rubbed by hand. The leather thus prepared is of a dark, brownish-red colour, of good quality and does not crack. [*Tanning Materials used in the Damoh District, Central Provinces*, by R. S. Hole.—*Indian Forester*, July 1908.]

The fruit has been found to contain 4 per cent. of tannic acid. In Western Bengal and Hyderabad the tree is the mainstay of the *tasar* silk industry, being pollarded before the rains to provide young leaves for the caterpillars. Mr. T. F. Catania writing to the *Indian Forester* in 1899 laid great stress on the future that probably awaited the *tasar* silk industry in Hyderabad, favoured by the fact that natural jungles of *Terminalia tomentosa* extend for miles as if they had been created for the propagation of this industry. He compared the planting of millions of mulberry trees which would have had to be undertaken to feed the Univoltine variety of the silk-worm, eggs of which had been offered to the Nizam by the Indian Government. In parts of Bombay the tree is extensively lopped for ash manure for crops, the process being continued from year to year until the hills, for example in Satara, along the line of the Ghats, are studded with huge pollards (Brandis). Lac is occasionally gathered on the branches and in Oudh and the United Provinces the leaves are lopped for cattle fodder (Brandis). A number of experiments made in the United Provinces to determine the proportion of bark to wood by weight gave the following results:—

With 6 trees of 1st and 2nd girth classes, the weight of wood fit for timber and fuel being 100, the weight of dry bark was 16·5; with 6 trees between 4′ 6″ and 8′ 9″ in girth the proportions of dry timber and dry bark were 100 to 14·6: with 6 trees between 3′ 4″ and 8′ 0″ in girth the proportions of green wood to green bark, which in this case included the weight of unbarkable branches, was 100 to 25.

5. Natural Reproduction and Rate of Growth.

Few trees show better natural reproduction than this, both from seed and coppice shoots. Reports from nearly all districts describe it as being fair to good, and it has the advantage that young seedlings are not overcome by the coarse grass that often covers the moist flats where it attains a large size. From the United Provinces alone do the reports indicate that seedlings are not plentiful, and this may be due to the extent to which seed-bearers have been removed in order to benefit Sal. Cattle and monkeys eat it and where heavy grazing is the rule, the young trees are usually destroyed. H. H. Haines states that in the Central Provinces coppice reproduction is somewhat uncertain, especially when trees are felled in the rains, but shoots may grow to 6 feet in two

years. On the other hand numerous shoots are sometimes produced which remain small and weak and may only be a few feet high after 10 years' growth. He also makes the following note: "In the Central Provinces the main stem is frequently a sympodium made up of the lower parts of repeated leaders which have bent over at the top while lateral buds have in their turn assumed leadership." In 1895 Mr. H. C. Hill noted that this and other species formed dense thickets of seedlings in the Central Provinces where the beneficial influence of an old *mahua* tree was found. Mr. J. W. Best notes as follows on the growth in the Bhandara Division, Central Provinces, in the *Indian Forester* for November 1909:—

"Another phenomenon due to excessive grazing is the curious growth of young *Saj* trees. I have in many places seen considerable areas of forest, the soil of which is completely covered by young *Saj* trees up to 18 inches in height, very much bended and stunted in growth. On being dug up these plants will be found to have a thick and distorted stem at or just beneath the surface of the ground. It is possible to ascribe this condition of growth solely to forest fires.

I think that excessive grazing has more to do with it, however, because the phenomenon is as common inside forests which have been successfully protected from fire for a number of years as it is in forest where protection has not been attempted, and one would expect these young trees to recover after protection from fire for a number of years. Our best forests in Bhandara are always protected from fire, but with the exception of the small area taken up by the high forest working circle in Gaikhuri Range, none of our forests are protected against cattle-grazing for a greater period than 10 years.

In the high forest circle, where protection from cattle has been carried out for the last 11 years, this condition of the *Saj* regeneration although present is not common; it must, however, be borne in mind that previous to protection the ground was probably grazed as heavily as elsewhere.

In places such as steep hills where, owing to their inaccessibility, cattle never graze, stunted growth of young *Saj* is absent and incidentally the regeneration of all species is in a considerably more satisfactory condition than in forests situated on level ground.

The cause of this abnormal growth of *Saj* can be ascribed not so much to the browsing of animals as to their continuous trampling. This would account for the thick stem at the surface of the ground. If stems are continually, year after year, trodden down and mutilated, they could not be expected to send out a strong leading shoot, more particularly as the soil over the roots becomes hard through continuous trampling.

On the sides of steep hills where cattle seldom if ever graze there are usually a sufficient number of shoots to prevent the trampling down of the seedlings as well as of the soil, hence the comparatively good regeneration on the hillsides."

Mr. L. K. Martin is inclined to think that the above growth is produced by the persistence of the annual shoots giving a bushy appearance to the tree till eventually the root is sufficiently established and able to throw up a large strong leading shoot, which grows fast and straight, the previous shoots dying down.

Bourdillon says the rings run about 6 to an inch.

Caccia records measurements taken on 300 trees in sample plots in the United Provinces during a varying number of years, of which 17 was the most, which indicate that the mean annual girth increment varies from nil to 1·75 inches. The latter was recorded on trees between 1½ and 4½ feet in girth and is quite exceptionally high.

Experiments in coppice growth made by Mr. H. Murray in Belgaum in 1894 gave the following results. Three or four trees were examined and the date determined for all ages, mature trees between 38 and 44 years being selected.

Age.	Diameter in Inches.		Height in Feet.		Number of shoots per stump.	Length of bole.
	Total.	Mean yearly.	Total.	Mean yearly.		
10	4·2	·42	19	1·9	...	...
20	6·0	·30	29	1·45	...	...
30	7·8	·26	40	1·33	...	...
40	9·0	·225	50	1·25	...	30
1	...	...	...	...	9	...
40	...	...	...	...	1 to 2	30

These figures were obtained at Nagargali at 2,500 feet above sea-level: the rainfall was about 80 inches and the soil laterite with some humus. The rock was laterite overlying gneiss. The crop, in density ·9, had been fire-protected for six years and the other species were mostly *Lagerstroemia lanceolata*, *Terminalia paniculata*, and *Lagerstroemia lanceolata*.

Mr. D. A. Thomson records the following average diameters in his Working-Plan for the Supa Fuel Reserves, Northern Kanara, Bombay :—

Age	5 years	diameter	1·130 inches.
10	„	„	2·21 „
15	„	„	3·23 „
20	„	„	4·2 „
25	„	„	5·23 „
30	„	„	6·27 „
35	„	„	7·265 „
40	„	„	8·21 „
45	„	„	9·14 „
50	„	„	10·06 „
55	„	„	10·98 „
60	„	„	11·6 „
65	„	„	11·89 „

In the Karwar Fuel Reserves he calculated that the average girth at 40 years was 33·93 inches.

Mr. R. S. Pearson gives the following figures obtained in the Ankola High Forest and Kalinadi Slopes Forest, Kanara, Bombay :—

Age.	Average diameter in inches.	
	Ankola.	Kalinadi.
10	2·18	2·4
20	4·0	6·7
30	5·76	8·4
40	7·46	9·9
50	9·05	12·2
60	10·55	14·2
70	11·73	15·9
80	12·8	17·6
90	14·13	18·9
100	15·51	20·4
110	16·82	21·9
120	18·1	23·2
130	19·21	24·4
140	20·75	25·6
150	21·96	26·5
160	23·10	27·3

Mr. N. D. Satarawala gives the following figures in his Working-Plan for the Khanapur Fuel Reserves, Belgaum, Bombay :—

Average girth at 40 years, 2256 inches.
Age of coppice shoots and mid-girth in inches—

1	year	40 inches.
2	years	46 „
3	„	58 „
4	„	68 „
5	„	83 „
6	„	92 „
7	„	86 „
8	„	93 „
9	„	119 „
10	„	101 „
11	„	91 „
12	„	101 „
13	„	106 „
14	„	136 „

From cuttings made in the Nallamalai forests, Kurnool, Madras, the average number of rings to each inch of diameter was found to be 5.

In the Begur forest, North Malabar, Madras, 25 trees were measured and gave the following results :—

Average age at	6	inches	diameter	265 years.
„	12	„	„	578 „
„	18	„	„	853 „
„	24	„	„	1166 „

In the Chedleth Range forests in the same district 77 trees gave the following results :—

Average age at	6	inches	diameter	2695 years.
„	12	„	„	4902 „
„	18	„	„	7436 „
„	24	„	„	10001 „

Mr. H. Murray records the following measurements of Coppice shoots in Belgaum, Bombay :—

Age.	Height. Feet.	Diameter. Inches.
5	11	23
10	19	41
15	26	51
20	30	61
25	35	69
30	40	77
35	45	84
40	50	90

Mr. F. Foulkes in "Notes on Timber Trees—South Kanara" says :—

"Except in rigidly fire-protected areas, very little of the January seed crop survives as the hot weather fires destroy it. Apart from the fact that it is a strong shade-bearer and has large annual seed crops, the exceptional facility with which this tree reproduces itself is due to the July seed crop.

The rains begin in the middle of May and culminate in July, consequently there are no fires anywhere then.

The chief danger the seed runs is from rotting and not being able to secure a lodgment owing to the torrents of water which come down. Cattle must be rigidly excluded from areas under reproduction, and in the plains forests, fires also.

Seedlings become established in 3 to 5 years.

This species coppices excellently, but unless cut quite flush with the ground, the shoots are apt to grow horizontally instead of straight up."

6. Artificial Reproduction.

Sowing and planting has been tried in all provinces with good results on the whole. There seems to be no difficulty in obtaining a high percentage of germination, and the seedlings may reach a height of 18 inches after the first rains. In the Bombay Presidency in order to fill up blanks in coupes, small pits have been dug and the seed sown in them has germinated well. Where transplanting of one-year old seedlings has been tried, many of them have died and white-ants have attacked the roots. In plantations made in Burma deer at once selected the young seedlings in the forests for food, and in Bombay pig did an equal amount of damage.

7. Notes on Distribution and Extraction in different Provinces.

(*i*) *Burma.*

Vernacular names.—Taukkyan (Burmese), Dap (Kachin), Mai'hok-lpa (Shan), Thay-lpay-kala (Karen), Taukkan (Arakanese).

Local distribution.—This tree is one of the commonest in the Province and occurs in considerable quantities almost everywhere except in the Northern Shan States, Arakan and the South of Tenasserim where it is scarce. In Upper Burma it seems to ascend commonly to a much greater height than in Tenasserim, being reported from an elevation of 4,000 feet in the Southern Shan States and 3,000 feet from

Bhamo. In the sea-coast districts it does not appear to go beyond 1,000 feet, but on the whole it grows best at 500 to 1,500 feet above the sea.

A stiff clay suits it well but it grows on many other varieties of soil, stunted but in considerable numbers on laterite and in dry stony *Indaing*, straight and tall on well-drained ridges with *Dendrocalamus strictus* and *Bambusa polymorpha* and in plains forests, and fairly densely on moist flats. Excellent groups may be found in most of the Pegu Yoma and Upper Burma bamboo and teak forests, containing trees up to 12 feet in girth, with a clear bole of 60 feet and height up to 120 feet, but the size of tree principally in evidence has a girth of 5 to 8 feet.

Extraction.—Except in the dry zone and a few of the more remote divisions, little difficulty will be found in extraction to the Railway or a floating stream, the logs being dragged by buffaloes or elephants from the hills and thence carted. With the aid of bamboos the timber can be rafted down the Chindwin or the Irrawaddy as well as smaller streams, and it is still to be found in Upper Burma close to the banks of these rivers in large quantities. No extraction is done by Government, and in nearly all the Government Reserves, trees will be marked to suit the convenience of purchasers, the duty never totalling more than R6 per tree. In unreserved forests also little restriction is placed on extraction, except in some districts where the best trees in the easily accessible forests have all been felled. The amount extracted up to date cannot be correctly estimated, no separate records for this timber having been kept, but an ample supply is still available in all the divisions named in the table below. A few estimates of quantities in the forests obtained from their Working-Plans are given below. In most districts will be found traders who are well acquainted with the best method of arranging for the extraction of timber to a floating or railway station and the purchaser can always get into touch with them through the divisional officers whose address is given in the table below. Divisions in which extraction is very difficult are not entered. The log referred to in the table measures over 4′ 0″ in mid-girth without bark and may be of any length that the buffaloes and carts can manage. The ton represents 50 cubic feet in the round, unless "converted" is entered. The figures given under local market rates and rates for delivery are in many cases only estimates, the timber having been little extracted up to date over the greater part of Burma. The duty must usually be added, but it is hardly ever more than R3 per ton for round logs, and R4 per ton for sawn timber.

Division.	Government duty per log.	Local market rate.		Rate for delivery.			Head-quarters of Divisional Forest officer.
	R a.	R	Per	R	Per	At	
Upper Chindwin.	1 0	...	...	10	ton	Alon . . .	Kindat.
Lower Chindwin.	1 0	...	...	10	ton.	Alon . . .	Monywa.
Myittha .	1 0	...	...	14 30	ton ton	Alon . . . Rangoon . .	Mingin.
Ehamo . .	1 0	...	...	20 25 35 40	ton	Katha . . . Mandalay . . . Rangoon . .	Ehamo.
Katha . .	1 0	10	ton	10 15 35	ton	Katha . . . Mandalay . . . Rangoon . .	Katha.
Mu . .	1 0	12 30	log ton converted.	15 40	ton ton converted	Kanlein Wuntho.	or Shwebo.
Ruby Mines .	1 0	6	log	13	ton	Mandalay . .	Mogok.
Mandalay .	1 0	50	ton converted.	35 45 35	ton ton converted ton	Tsagi . . . Mandalay . .	Monywa.
Minbu . .	1 0	...	...	25	ton	Irrawaddy bank.	Minbu.
Pyinmana .	1 0	35	ton converted.	33	ton	Pyinmana and other stations.	Pyinmana.
Thayetmyo .	1 8	...	...	12 15	ton ton	Irrawaddy bank. Rangoon .	Thayetmyo.
Prome . .	1 8	...	...	6	ton	Prome and other stations.	Prome.
Henzada .	1 8	10	log	20 50 25 35	ton ton converted ton ton converted	Kyungin and other stations. Rangoon . .	Henzada.
Bassein .	1 8	9	log	9	log	Bassein .	Bassein.

Division.	Government duty per log.	Local market rate.		Rate for delivery.			Head-quarters of Divisional Forest officer.
	R a.	R	Per	R	Per	At	
Zigon . .	1 8	...	...	3	log	Zigon . .	Tharrawaddy.
				14	ton	Rangoon . .	Tharrawaddy.
Tharrawaddy .	1 8	7	log	40	ton converted.	Letpadan and other stations.	Tharrawaddy.
				53	do.	Rangoon . .	Tharrawaddy.
Arakan .	1 8	75	ton converted.	75	ton converted.	Kyaukpyu or Chittagong.	Akyab.
Rangoon .	1 8	6	log	5	log	Palôn and other stations.	Rangoon.
		40	ton converted.	40	ton converted.	Do. .	Rangoon.
				50	do.	Rangoon .	Rangoon.
Pegu . .	1 8	20	ton	20	ton	Pegu . . .	Pegu.
Toungoo .	1 8	35	ton	8	ton	Toungoo and other stations.	Toungoo.
Shwegyin .	1 8	45	ton converted.	15	ton	Railway stations	Shwegyin.
				10	ton	Shwegyin .	Shwegyin.
Ataran . .	1 8	...	...	50	ton converted.	Martaban or Moulmein.	Moulmein.
Thaungyin .	1 8	...	...	11	ton	Martaban or Moulmein.	Moulmein.

Figures from Burma Working-Plans.

District.	Working Circle.	Area in square miles.	Trees on the area. Girth in feet.				Remarks.
			Above 7.	6–7.	$4\frac{1}{2}$–6.	3–$4\frac{1}{2}$.	
Tharrawaddy .	Satpok . .	8	3,158	3,023	5,881	8,756	The minimum girth limit fixed for felling is 6 feet.
Do. .	Sitkwin . .	2	347	271	725	1,250	
Do. .	Thindawyo .	10	762	779	906	1,509	
Do. .	Kangyi . .	8	2,537 (Above 7 and 6–7 together)				

(ii) *Central Provinces.*

Vernacular names.—Ain (Marathi), Saj, Saja or Barsaj (Hindi), Maddi kara (Telegu).

Local distribution.—This tree occurs in almost all the forest tracts of the Central Provinces and is often the commonest. It is inclined to be gregarious and attains large girth in the moist fertile flats and especially affects *nalas*. Where Sal occurs it is found with it and thrives between 500 and 2,000 feet above sea-level, small trees ascending to 3,000 feet, and is also found in teak forest in some districts. It often forms 10 to 30 per cent. of the standing crop and occasionally as much as 50 per cent. and stunted trees are abundant on black cotton soil, which many species do not like.

Extraction.—The forests containing this species are nearly always worked under the Coppice with Standards method, but in Mandla, part of South Chanda, part of Seoni, Chindwara, and Hoshangabad the yield is principally derived from Improvement fellings. The sizes of timber obtainable accordingly vary much and rates for different kinds are given in the table below. At present the market value of the timber is not great enough to bear the cost of transport from the more remote forests, and roads or tramways would be able to tap rich areas still almost untouched. The Coppice with Standards coupes are usually sold as they stand to purchasers, but departmental extraction is carried on in a few districts.

From the figures given in the table will be seen the approximate amount of timber available, but no accurate returns for past extraction, and no further estimates of any value for future outturn can be given at present.

Very little has been exported from these Provinces up to date.

Division.	Government duty.			Local market.			Rate for delivery.			
	R. a. p.	Per		R. a. p.	Per		R. a. p.	Per		At
Mandla . .	0 2 9	c. ft.		0 4 0	c. ft.		1 15 0	c. ft.		Bombay.
							2 3 0	round. c. ft. converted.		Bombay.
							0 3 0	c. ft.		Railway stations.
							0 12 0	round. c. ft. converted.		Railway stations.
Damoh . .	...	...		12 0 0 to 25 0 0	100 poles		0 2 0	c. ft.		Railway stations.
							0 5 0	„		Jubbulpore.
							0 13 0	„		Bombay.
Saugor . .	...	...		0 4 0 to 0 12 0	pole		0 4 0	c. ft.		Railway stations.
							1 0 0	„		Bombay.
Narsingpore .	...	...		2 0 0 to 60 0 0	100 poles		1 0 0	c. ft.		Railway stations.
Seoni . .	...	...		0 1 6 to 3 4 0	pole		...	...		...
S. Chanda . .	0 2 0	c. ft.		...	...		0 7 0	c. ft.		Rajahmundri or Coconada.
							0 11 0	„		Nagpur.
							0 14 0	„		Carnpore or Bombay.
Nagpur Wardha	...	...		7 8 0 to 50 0 0	100 poles		0 2 6	c. ft.		Railway stations.
Bhandara . .	...	...		2 0 0 to 10 0 0	100 poles		0 6 0 to 0 12 0	c. ft.		Railway stations.
Balaghat . .	0 0 9 to 0 10 0	pole		...	...		20 0 0 to 25 0 0	100 poles		Railway stations.
							0 12 0	c. ft.		Lanjha station.
Raipur . .	...	...		7 0 0 to 60 0 0	100 poles		0 5 0	c. ft.		Dhamtari or Rajim.
				0 3 0	c. ft.					

In Working Circle No. 1, Allapili Forests, Chanda, Central Provinces, the following figures are given, the area being 31 square miles:—

Number of sound trees above 24 inches diameter . . . 7,473
„ „ „ 18–24 „ „ . . . 15,888

The minimum limit for felling is 24 inches diameter.

(iii) *Central India Agency.*

In the State of *Rewah* the tree is common, and grows to about 4 feet in girth. It is used by the villagers for building, but little has been

exported. The royalty is 2 annas per cubic foot and about 10,000 cubic feet are available annually near the Railway line.

In *Gwalior* the tree occurs with teak and other species over a large area, but only as coppice shoots from old stumps. It is much in demand by villagers and the royalty charged is R3 per cart-load or 2 annas per cubic foot. It is called *Saj* in Malwa and *Sader* in other parts.

In *Indore* it is abundant everywhere, but attains large dimensions only in a few favoured localities along the Satpura Hills on the borders of Khandesh, where tall straight trees of 7 feet girth are sometimes found. It grows to 4 or 5 feet in girth in the south-west of Nimawar, near the Chandgurh Reserve, Central Provinces, but such trees contain little heart-wood. The timber always commands a fair price for local building purposes and is valued for shafts. Small poles of a girth of less than 18 inches are scarcely saleable, but it is used for ploughs, agricultural implements, fuel and charcoal and the bark is valued for tanning. It is called *Sadar*, *Saj*, or *Sajada*.

(*ix*) *Berar.*

Vernacular names.—Sajar, Saj, Sadora, Ain.

Local distribution.—Only in Betul, Nimar and Melghat does this tree grow to a large size, 6 to 8 feet in girth with a 50 feet bole, but individuals of this size are not common, and it is frequently stunted and shrubby owing to the poverty of the soil. It is however fairly abundant, forming up to 20 per cent. of the crop in favourable valleys. On the flat plateaux on the basalt it is little more than a shrub.

Extraction.—Most of the wood is felled small in Coppice forests but large timber is removed in Improvement fellings from Betul and Melghat in the north of Berar, and it may be anticipated that a fairly large quantity of timber will be available for export from these forests when the new railway in the north of Berar has been built. Most of the extraction will be done by carts, dragging from the stump being necessary in the hilly tracts. In Betul an estimate has been made that 30,000 cubic feet will be available annually, two annas per cubic foot royalty being charged on the outturn, all work being done by the purchaser. From the Melghat forests timber can be delivered at Amraoti for R11 per cart-load of 6 maunds, the rate for the same to Ellichpur being R8. From the Betul forests timber can be carted to Itarsi in the Hoshangabad district for R5 per cart-load of 15 cubic feet.

(*v*) *Punjab and Kashmir.*

Vernacular names.—Sain, Assam.

Local distribution.—In the Kangra and Simla forest divisions only is this tree reported to occur to any extent and even there it is not important at present. From the Submontane forest of the Simla Division the cost of carriage is so high that even Sal has not so far been much exported and in the Kangra hills it is confined to scrub forests and has rarely been extracted. It can be delivered at Jagadhri for about 10 annas per cubic foot, at Jullundur for R1 and at Hoshiarpur for 12 annas per cubic foot of sawn timber.

In *Jammu* and *Kashmir* it is called *Bakera* and is found in the outer valleys of the Jammu Province below 2,000 feet, usually scattered in cultivation and rare in forests. It attains a girth of 6 feet, occasionally more, and is used in the construction of village houses and for agricultural implements.

(*vi*) *Eastern Bengal and Assam.*

Vernacular names.—Amari, Asna, Sain, Paka Saj, Asan.

Local distribution.—The tree is rare almost all over this province, and does not occur in many of the forests at all. It appears to be common only in the Habiganj forests adjoining north-eastern Bengal and is there found up to 700 feet above sea-level, usually in mixed forests and rarely with Sal, trees 8 feet in girth being found with a clear bole of 40 feet. It can be extracted to railway stations for about 8 annas per cubic foot in the round, and to Calcutta for about R1-4 per cubic foot in the round and R1-10 sawn, but very little indeed has been sold up to date.

(*vii*) *United Provinces.*

Vernacular names.—Saj, Asna, Sain, Asaina, Hasna, Tuna (Bundelkhand).

Local distribution.—The Asna trees is, after Sal, one of the most important timber trees of the United Provinces, and occurs in considerable numbers in almost all the Sal and many of the mixed forests and in the lower hills up to an altitude of 4,000 feet. It usually favours clayey localities on which it produces its best growth, and occasionally occurs pure over small areas. In the best Sal forests of these provinces Asna attains at times a girth of 12 feet with a clear bole of 50 feet, and many good trees of 6 to 8 feet in girth may be found. Under the various Working-Plans in force the exploitable size is fixed at 6 or 7 feet, the number of Asna trees

estimated to be available being very large. They are shown in the tables below.

Extraction.—Trees are felled almost entirely under the Selection method, being chosen either specially for purchasers or in the course of Improvement fellings undertaken in order to favour the Sal. All trees marked on certain defined areas are sold annually to purchasers who pay either a lump sum only, or a lump sum combined with royalty on outturn, exporting the timber partly in the round and partly converted, by coolies or buffaloes to the nearest cart-road. Sawyers must often be imported and get R10 to 15 per month and food. It is accordingly necessary for purchasers to inspect the coupes before purchase in each case. Except Naini Tal, Chakrata, Bundelkhand, and Pilibhit, each forest division can supply a considerable quantity of *Sain* timber annually for some time to come, the estimated cost and amount available being given below:—

Forest Division.	Rate for delivery without royalty.			Amount available annually.	Amount extracted during last 5 years.
		Per	At	C. ft.	C. ft.
Gorakhpur	4 annas	c. ft.	Pharenda	1,20,000	6,00,000
	7 do.	do.	Siswa Bazar		
	8 do.	do.	Gorakhpur		
Gonda	5 do.	do.	Railway stations	20,000	91,000
Bahraich	6 do.	do.	Nishangara	50,000	2,16,000
	8 do.	do.	Raibojha		
	10 do.	do.	Bahraich		
	13 do.	do.	Bahramghat		
Kheri	8 do.	do.	Sarota Phanta	1,00,000	5,40,000
	5 do.	do.	Chandan Chowki		
Haldwani	3 to 5 annas.	do.	Haldwani and Lalkua.	40,000	2,00,000
Lansdowne	......	...	.. ...	60,000	1,00,000
Ramnagar	10 to 12 annas.	do.	Nagina, Dhampur, Seonara, Ramnagar.	...	25,000
	8 to 10 annas.	do.			
Siwaliks (Dehra Dun)	8 annas sawn.	do.	Railway stations	12,000	61,000

Figures from Working-Plans in the United Provinces.

Forest Division.	Working Circle.	Area in square miles.	Number of sound trees on the area. Girth in feet. Over 6 feet.	4½ to 6 feet.	Minimum girth fixed for felling.	Annual yield.
Haldwani .	Sarkhet .	37	5,094	8,350	6 feet.	141 trees.
	Nandhaur .	66	15,847	28,709	„	440 „
	Kalaunia .	59	19,438	24,945	„	544 „
Ramnagar .	Tarai . .	64	18,717	32,543	„	964 „
	Ramgunga .	26	11,540	9,456	„	...
	Kotah . .	35	555	2,002	„	...
Lansdowne .	Pokhri .	44	3,817	8,304	„	106 trees.
	Sona Nadi .	21	1,032	1,836	„	...
	Kohiri .	14	1,629	3,021	„	...
Bahraich .	Motipur Sal .	64	5,040	15,101	„	...
	Chakia Sal .	6	544	1,202	6 feet	...
	Sisheiwa Sal .	18	6,683	6,271	6 feet	...
Siwaliks (Dehra Dun).	Experimental	8	464	680	...	...

(viii) *Western India.*

Vernacular names.—Matti, Sadad or Saldado (Gujarati), Kari-Matti (Dhárwar), Ain (Thana and Kolaba) or Ains.

Local distribution.—The tree is reported to be abundant in all the forest tracts except Satara and Belgaum forming up to 50 per cent. of the crop in parts of the Thana district and occurring to the extent of 30 mature trees per acre in parts of the Dangs forests in Surat. In Kolaba lopping for ash manure for rice cultivation has almost exterminated it in certain parts. Its northern limit seems to be 24° as it does not occur in Sindh and Rajputana, but in Kanara it is very plentiful. From the Dangs forests in Surat it forms the bulk of the yield of jungle-wood. Although apparently attaining its largest size, 8 feet in girth, 100 feet in height, with clear bole of 60 feet, only on flat fertile areas, it is found in almost all classes of forest from 100 to 3,500 feet above sea-level. It is generally smaller than this, and is usually much less of a timber tree near its northern limit.

Extraction is carried on by dragging with bullocks and carting, the work being done partly by contractors and partly by Government agency. The outturn is obtained under the various methods of treatment under the Selection, Coppice, or Coppice with Standards systems, but the latter appears to be the commonest, the amount of large timber available being therefore not great. In Khandesh, Panch Mahals, Dharwar, South Thana and Kolaba the wood is principally disposed of as fuel. From three of the Kanara divisions the annual total average outturn of recent years has been about 50,000 cubic feet. In the table given below the figures available for timber have been entered, fuel not being included. A ton means 50 cubic feet.

In the *Rajpipla* State the tree is common, attaining a girth of 42 inches, and being at times as plentiful as 30 trees to the acre. The quantity available annually in future is estimated at 15,000 cubic feet. It is extracted by the Bhils and a good deal can be floated down the Narbada. The rates given for this State in the table below refer to rough logs and should be quadrupled for converted timber. It is at present exported to Baroda, Ahmedabad and North Gujarat.

In *Baroda* it sells for Rs 3 per cart-load of timber, and six annas per cart-load of fuel.

Division or State.	Government duty.		Local market rate.		Rate for delivery.			Outturn.	
	Rs a.	Per	Rs a.	Per	Rs a.	Per	At	Quantity.	During
W. D. Kanara	... ...		33 0	Ton	5 0	Khandy	Sea-coast	20,000 c. ft.	Last 4 years.
E. D. „	24 0	Ton	40 0	„	55 0	Ton	Hubli or Haliyal.	20,000 c. ft.	„ 5 „
S. D. „	24 0	„	1 0	C. ft.	0 8	C. ft.	Bombay, Calicut, Honawar.	...	...
					0 4	„			
N. D. „	24 0	„	1 0	„	0 4	„	Haveri . .	45,000 c. ft.	Last 3 years.
Dharwar (small timber only).	... ...		2 0	Pole	0 2	„	Hubli	7,000 poles.	„ 5 „
			0 12	stack of fuel 6′ × 6′ × 4′.					
Surat . .	... ...		15 0	Khandy	11 0	Khandy	(Tapti Valley Railway.	85,000 c. ft.	„ 5 „
					12 0	of 192			
					13 0	c. ft.	(Dahanu Surat.		
Rajpipla State	0 2	C. ft.	0 8	C. ft.	0 8	C. ft.	Nandod or Chandod Ankleshwar.	80,000 c. ft.	1904 to 1909.
					0 10	„			

Figures from Bombay Working-Plans.

District.	Working Circle.	Area in square miles.	Trees on the area.	Minimum size fixed for felling.	Remarks.
Kanara . .	Gund, Series X and XI.	47	1" to 24" diameter . 100,000 Above 24" diameter . 12,000	24 inches diameter.	
" . .	Supa, block XX	18	10" to 24" diameter . 57,000 Above 24" " . 2,000	6 feet girth.	
			sound. unsound		
" . .	Kalinadi slopes, block XXVI.	42	7" to 27" diam. 84,000 15,000 Above 27" " 3,500 1,000	7 feet "	Annual yield 110 trees.
" . .	Mundgod High Forest.	85	4" to 24" diameter . 900,000 Above 24" " . 19,000	6 " "	
			sound. unsound.		
" . .	Ankola High Forest.	70	7" to 27" diam. 229,000 53,000 Above 27" " 9,900 13,300 (The value of the unsound trees is 10 to 15 per cent. less than that of the sound trees.)	7 feet on best locality, 6 feet elsewhere.	Annual yield 470 trees. Total number available: 1st quality 13,732, 2nd quality 4,756.
" . .	Yellapur above ghat.	137	10" to 24" diameter 1,200,000 Above 24" " 96,000	7 feet girth.	
" . .	Yellapur slopes	37	1" to 24" " 140,000 Above 24" " 11,000	...	
Belgaum. .	Nagargali Series.	14	1" to 24" " 23,000 Above 24" " 600	24 inches diameter.	Annual yield 24 trees.

(ix) Bengal.

Vernacular names.—Paka Saj (Nepalese), Asan (Hindi), Hatana (Ho, Kol, Mundari, Santali).

Local distribution.—In Bengal and Orissa the tree is not as abundant as further south. It was formerly found often with Sal but has been killed out here and there to favour the latter. There is still, however, a great deal of marketable timber available growing usually on clay soils but ascending into the drier gravelly hill areas up to 3,000 feet above sea-level. In the Tista forests the girth reaches 16 feet with a clear bole of

70 feet but this is rare, and in the south of the province the girth is much less, rarely going above 3 feet in Palamau, and in Singhbhum being usually not more than 6 feet, with a bole of 50 to 100 feet.

Extraction.—As in Burma, the tree has been left alone in the more remote forests, having no saleable value in the Kurseong and other forests of the north. The limit of girth to be felled has been fixed as low as five feet in parts of Orissa, rising to seven feet in the north, and at these limits trees are marked for purchasers as they are required, only a small amount being available from regular fellings of Coppice and Coppice with Standards. The logs are usually dragged by buffaloes to country cart-roads, and thence carted, but occasionally they are floated lashed to boats. The estimates given of the timber now standing in the forest are extremely vague, but when the wood becomes readily saleable, a certain amount will be available annually. Two or three days' inspection of the forests of a division would suffice to enable the purchaser to decide whether the trade was worth embarking on, in any of the divisions named in the following table:—

Division.	Government duty.		Local market rate.		Rate for delivery.			Amount extracted during last 5 years.
	₹	Per	₹	Per	₹	Per	at	Cubic feet.
Angul . .	9 pies to 3 annas.	cubic foot	8 to 10 annas.	cubic foot	8 to 10 annas.	cubic foot in the round.	Cuttack .	21,000
Chaibassa .	...	...	...	...	8 to 12 annas.	do.	Lota Pahar .	...
Kurseong .	3 annas	cubic foot	...	...	12½ annas	do.	Siliguri .	...
Tista , . .	1 anna 6 pies to 2 annas according to locality.	cubic foot	10 annas to R1.	cubic foot	14 annas to R1.	cubic foot converted.	Bagrakote, Dam Dim, or Mal Bazaar, Siliguri.	15,000
Darjeeling .	...	...	...	...	8 to 10 annas.	cubic foot in the round.	Siliguri .	...
Sambalpur .	4 annas	cubic foot	12 annas	cubic foot	R1 12 annas.	cubic foot. do.	Calcutta Railway stations.	...

(x) Southern India.

Vernacular names.—Karimaruda (Malayam), Matti or Banapu (Canarese) Nallamaddi or Inamaddi (Telegu), Sahaja (Uriya).

Local distribution.—In the Madras Presidency the tree is fairly well distributed, but in the south it only occurs along hills to any extent, being absent in Tanjore and Trichinopoly. Though not so common as in Bombay, it forms in some districts up to 12 per cent. of the growing stock being fairly plentiful in the Wynaad and ascending to 4,300 feet in the Nilgiris. The girth seems not to exceed 9 feet and the length of bole 50 feet, and this size is only attained on the best favourable localities, as in Bellary, Cuddapah, Nellore, Kistna and South Kanara the best trees are much smaller. In Guntur it is absent. Mr. A. W. Lushington notes that in the hills of North Coimbatore it is chiefly confined to the higher and damper localities. It was tried for sleepers but most of the trees were found to contain heart-shakes, probably caused by the devastating fires.

Extraction.—In Kistna, Coimbatore and South Kanara a certain amount of the wood is felled in Coppice and Coppice with Standards forests as fuel, and elsewhere felling up to date has been confined to scattered Selection fellings as desired by purchasers. No large quantities have however been extracted nor can a heavy annual outturn be expected in future. From most of the forest divisions the estimates of future outturn are too small to be worth considering, but for such as have supplied details the figures in the following table may be useful. The Malabar Timber Yard and Saw Mills Limited quote R2 per cubic foot for scantlings and R2-2 per cubic foot for planks free on rail at Kallai. They call it Malabar walnut.

In *Coorg* the tree is known as *Matti* and is the predominant species in the deciduous forests everywhere, attaining in the south a girth of 10 feet. The timber is very largely used for house building and carts. About 20,000 cubic feet are estimated to be available annually, Government royalty being imposed at 3½ annas per cubic foot.

In *Hyderabad* it is called *Nalla maddy, Sabora, Saj, Yen, Kari Maddy, Kari Matti* and it is very largely used for house building. The bark is much used for tanning and the tree is pollarded for *tasar* silk cultivation by jungle tribes. It attains 6 feet in girth in Telingana and 8 feet in Aurangabad. At Warangal railway station the market rate is about R1-4 per cubic foot. From the Warangal, Karimnagar and Adilabad forests about 10,000 cubic feet have been and can be obtained annually.

In *Mysore* the tree is widely distributed and is called *Karimatti*. It is very largely used in building, for agricultural implements, and for ships and boats, and grows to a large size in Malnad. The leaves are used for manure.

About 100,000 cubic feet may be extracted annually, the price being 12 annas per cubic foot.

In *Travancore* the tree is usually called *Thembavu* and is in great demand for house building, carts, furniture, fuel, and charcoal. It is very common throughout the State between sea-level and 2,000 feet. About 150,000 cubic feet are felled annually and its value in the log on the coast is 12 to 14 annas per cubic feet (Bourdillon).

Division or State.	Local market rate.		Rate for delivery.			Amount extracted during last 5 years.
	R	Per	R	Per	At	Cubic feet.
North Malabar	...	...	10 annas	cubic foot	Calicut, Tellicherry and Mysore.	22,000
South Malabar	...	...	4 annas	do.	Ferok, Beypore, Calicut. Add duty on or value of timber.	84,000
North Coimbatore.	12 annas to R1.	cubic foot do.	10 annas	do.	Railway stations .	...
			R1 ,	do.	Coimbatore, Palghat. Calicut, Bangalore.	...
South Coimbatore.	7 to 10 annas.	do.	R1 .	do.	Podanur . .	50,000
Nilgiris .	11 annas in 1900.	cubic foot squared.	R1 .	cubic foot sawn.	Nanjangud . .	3,000
			R1-4 .	cubic foot sawn.	Ferok . . .	...
Vizagapatam	12 annas	cubic foot round.	15 annas	cubic foot	Narasapatam Road.	...
	R1-2 .	cubic foot squared.	R1-2 .	do.	Vizagapatam .	...
Coorg . .	4 annas.	cubic foot	11 annas	do.	Paschimavahini Station. Mysore . .	94,000 ...
Mysore .	12 to 13 annas.	do.	13 annas	do.	Railway stations.	250,000 (5 years).

From the Coorg Working-Plans the figures given below have been taken. As, however, the Working-Plans have mostly expired, the figures must be taken merely as a guide to the amount of timber the forest can produce, and up-to-date estimates should be obtained from the Deputy Conservator of Forests, Coorg.

Name of Forest.	Area in square miles.	Quantity in cubic feet available annually.
Devamachi-Mowkal	28	3,000
Nalkeri-Hatgal	83	34,109
Anahalu-Attoor	20	800
Arkeri	99	3,000

CALCUTTA: PRINTED BY SUPDT. GOVT. PRINTING, INDIA, 8, HASTINGS STREET.

Forest Bulletin No. 19 1913

NOTE ON BENTEAK OR NANA WOOD

(*Lagerstroemia lanceolata*, Wall.)

BY

A. RODGER, I.F.S.

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1913

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CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1913

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12. Anogeissus latifolia (*Bakli, Dhaura*—India).
13. Pterocarpus Marsupium (*Honné, Venga*—India).

Reference is also invited to the following :—

A Manual of Indian Timbers, by J. S. Gamble, C.I.E.
(Sampson Low, Marston & Co., London.)

Indian Woods and Their Uses, by R. S. Troup.
(Superintendent, Government Printing, India, Calcutta.)

Benteak or Nana Wood.

Lagerstræmia lanceolata, Wall.

Natural Order—Lythraceæ.

BENTEAK OR NANA WOOD.

Lagerstroemia lanceolata, Wall.

Natural Order—Lythracee.

1. General Distribution.

This valuable tree is only found over a small part of the forest area of India, being confined to the southern and central parts of Bombay and the southern and western parts of Madras, and to Mysore. It is not recorded from Hyderabad or the Northern districts of Madras, and only scattered trees are found in Kolaba and Surat on the West Coast. In Satara and Baroda it does not occur and in East Khandesh it is very rare. In Coorg it is fairly plentiful and large in deciduous forests.

2. Locality and Habit.

The tree occurs in mixed deciduous forests up to about 4,000 feet above sea-level and grows fast in moist localities, forming as much as 10 per cent. of the stock. It grows best as a rule between 1,000 and 3,000 feet above sea-level, but in South Malabar it is reported to be plentiful between 100 and 500 feet.

It is a tall straight tree with rather an open crown of small leaves, the small white flowers appearing in the dry season at the end of the branchlets in large panicles. The bark is smooth and white and peels off in papery flakes.

"Is readily distinguishable in the forest from other trees by the peculiar colour and smoothness of its bark. Young Benteak also stands out very conspicuously from the surrounding growth by the white under-surface of the leaves showing when ruffled by the wind." (*Notes on Timber Trees in South Canara*—F. Foulkes.)

3. Description, Properties and Uses of Timber.

The heartwood is red or reddish-brown of very uniform appearance on a vertical section, moderately hard and close-grained. The annual rings may usually be distinguished, the spring wood being marked by

numerous large pores and pale colour and the autumn wood by its darker colour and short pale lines of tissue containing pores. It is straight-grained and easily worked.

Durability.—The wood is not much attacked by white-ants, specimens tested being almost sound after 2½ years in the ground.

Weight.—The wood is not very heavy, the weight per cubic foot when dry averaging about 44 lbs. Coimbatore and Malabar specimens have been found as heavy as 50 lbs. (Gamble).

Strength.—The value of *P*, which represents the strength of a bar of timber calculated from the length between supports, breadth, and thickness of the bar, and the weight in pounds which when placed in the middle of the bar causes it to break, is about 560 (Gamble). Sal gives 790, Teak 600 and Sisham 796.

Fissility.—The wood can be fairly easily split. The figure representing its place in a list of 62 woods tested is 4, about the same as Padauk, Toon and *Terminalia tomentosa*. Sal is represented by 9·93 and Teak, which is very easily split, by 1·75.

Calorific power.—No figures are available for this species, but two other species of *Lagerstræmia* tested by Mr. Puran Singh gave fairly good results, being placed about half-way on the list of 56 Indian species tested. It makes good fuel and charcoal.

Seasoning.—In Kanara the tree has been girdled three years before felling, but this has not been found very successful in preventing cracking. The timber is very liable to this defect and slow and careful seasoning must be undertaken to prevent it. Much better results have been obtained by felling the trees ten months after girdling and storing them for eighteen months in a depôt before sale. Only 67 out of 297 trees thus treated were cracked. This was done in Kanara, Bombay (W. A. Miller).

Uses.—This timber is much in request wherever it can be obtained, for buildings, ships and furniture. In Northern Bombay small timber is converted into charcoal in the forest or exported as firewood. In Kanara straight poles sell well for masts, and it has been used for railway goods wagons. In Madras it is also used for agricultural implements and carts. Arabs buy it from Malabar for dhow-building, and it makes good coffee-cases. In Travancore it is used for oil casks.

A small consignment was sold in London in 1878 for £9 per ton,

4. Minor Products.

In an analysis of liquid extract obtained from the bark from Coorg the percentage of dry extract was found to be 1·1, the percentage of tannin ·31, and the percentage of tannin in the dry extract 28·1. It is noted by M. Rama Rao as an associate of Sandal, but root attachments between the two have not been found.

5. Natural Reproduction and Rate of Growth.

Natural reproduction is reported to be generally good, though often scattered. Foulkes in "Notes on Timber Trees in South Kanara" says:—"Natural reproduction uncertain and this species must be rigidly protected from fire as the seeds fall in the middle of the fire season: the seedlings too are especially susceptible to damage from this cause. Will not germinate in poor soil exposed to the sun but requires one that is deep, moist, and stiff: owing to the minuteness and consequent lightness of the seed it would seem to be advantageous to remove all dead leaves prior to the fruiting season in order that the seed may come into immediate contact with the mineral soil. The seedlings appear to require three years to establish themselves, and once established, are hardy."

Bourdillon says the growth is fast in favourable circumstances, young trees showing as much as 10 inches diameter in 11 years.

Experiments on coppice growth made by Mr. H. Murray in Belgaum in 1894 gave the following results. Three or four trees were examined and the data determined for each age, mature trees between 38 and 44 years being selected.

Age.	Diameter in inches.		Height in feet.		Number of shoots per stump.	Length of bole.
	Total.	Mean yearly.	Total.	Mean yearly.		
10	3·7	·37	19	1·9	...	...
20	5·5	·275	26	1·3	...	...
30	8·4	·28	34	1·13	...	...
40	9·7	·242	39	·97	...	27
1	...	...	...	...	7	...
40	...	...	...	...	2 to 3	27

These figures were obtained at Nagargali at 2,300 feet above sea-level: the rainfall was about 80 inches and the soil laterite with some humus: the rock laterite overlying gneiss. The crop, in density ·9, had been fire-protected for six years and the other species were mostly *Lagerstroemia lanceolata*, *Terminalia tomentosa* and *T. paniculata*. Mr. D. A. Thomson gives the following average diameters in his Working-Plan for the Supa Fuel Reserves, North Kanara, Bombay:—

Age	5	years: diameter	1·182 inches.
„	10	„ „	2·239 „
„	15	„ „	3·278 „
„	20	„ „	4·438 „
„	25	„ „	5·68 „
„	30	„ „	6·75 „
„	35	„ „	7·89 „
„	40	„ „	8·947 „
„	45	„ „	9·79 „
„	50	„ „	10·8 „
„	55	„ „	11·62 „
„	60	„ „	12·34 „
„	65	„ „	13·51 „
„	70	„ „	13·35 „

In the Kanara Fuel Reserves he estimated that the average girth at 40 years was 30·72 inches, while in the Khanapur Fuel Reserves in the Belgaum district Mr. N. D. Satanawala gives the average girth at the same age as 19·68 inches only. Mr. Satanawala also gives the following figures for coppice shoots in the same forests:—

Age	4	years; girth at centre of log in inches			8
„	6	„	„	„	8·3
„	7	„	„	„	9·5
„	8	„	„	„	10·7
„	10	„	„	„	13·5
„	13	„	„	„	17·3

Mr. R. S. Pearson gives the following figures showing rate of growth of "Nana" in his Working-Plans for the Kalinaddi and Ankola Forests in Kanara, Bombay :—

Age in years.	Average diameter in inches.	
	Kalinaddi.	Ankola.
10	29	27
20	53	49
30	75	67
40	97	85
50	119	103
60	142	118
70	159	133
80	175	148
90	190	162
100	203	175
110	217	188
120	229	189
130	239	206
140	250	215
150	261	226
160	265	230
170	276	242
180	281	247
190	290	256
200	313	259

In the Chelleth Range Forests, North Malabar, Madras, 30 trees gave the following results :—

Average age at 6 inches diameter, 27·8 years.
" " 12 " " 49·6 "
" " 18 " " 71·8 "
" " 24 " " 103·4 "

Mr. H. Murray records the following measurements of coppice-shoots in Belgaum, Bombay :—

Age.	Height in feet.	Diameter in inches.
5	105	23
10	19	36
15	23	46
20	27·5	58
25	31·5	69
30	34·5	80
35	37	90
40	39	97·5

6. Artificial Reproduction.

In South Coimbatore a small plantation made in bamboo forest shows much the same growth as teak planted at the same time. Seedlings are apparently rather tender to transplant.

7. Notes on Distribution and Extraction in different Provinces.

(i) *Southern India.*

Vernacular names.—Venteak, Venteku (Tamil), Benteak, Ventek (Malayam), Bli-nandi, Benteku (Canarese).

Local distribution.—In the Madras Presidency the tree is practically confined to the eastern and southern forests adjoining Travancore, being plentiful in Malabar and occurring in fair quantities in Madura, Coimbatore and South Kanara. It is usually found in moist deciduous forests up to 4,000 feet above sea-level, but is rare on the lower levels and from some districts is reported to be common only between 2,000 and 3,000 feet. Ten feet in girth, 100 feet in height and 60 feet clear bole have been recorded in the most favourable situations.

Extraction.—Trees are selected as required by purchasers, a minimum girth being fixed which is usually about 7 feet. Felling and extracting is carried out by Government or by purchasers, by dragging, carting, floating, and sometimes in Coimbatore by means of a tram-line. In the table below are given such details as are available to help purchasers, further information being obtainable from the divisional officers. About 12,000 cubic feet can be extracted annually from South Coimbatore and 6,000 cubic feet from South Malabar.

The Malabar Timber Yards and Saw Mills Limited quote R1-15-6 per cubic foot for scantlings and R2-1-6 for planks, free on rail at Kallai.

In *Coorg* the tree is called *Nandi* (Canarese) and is found throughout the deciduous forests, reaching in favourable localities a girth of 10 feet. During the last five years about 50,000 cubic feet have been extracted, and the amount available annually in future is estimated at 16,000 cubic feet, Government royalty being paid at 9 annas per cubic foot. It is used locally in house-building.

In *Mysore* it is known as *Nandi* and is common in the Kadur and

Shimoga forests, often growing to a large size, and being extensively used for building, carts, coffee-cases and furniture. About 60,000 cubic feet may be extracted annually, the price being 12 to 15 annas per cubic foot. Sixty-six thousand cubic feet have been extracted during the last three years.

In *Travancore* the tree is called *Venka* in Tamil and is very common in the deciduous and drier evergreen forests up to 3,000 feet. The wood is much in demand for foreign boat-building and is usually brought out in the form of large planks. About 10,000 cubic feet are sold annually, the value in the log being 10 to 12 annas per cubic foot (Bourdillon).

Figures regarding Extraction.

Division or State.	Market price.		Rate for delivery.		
	R a.	Per		Per	At
Central Coimbatore.	12 0	Candy of 12½ c.ft.	7 annas 8 annas (exclusive of value of timber).	Cubic foot	Palghat, Coimbatore.
South Coimbatore.	0 12	Cubic foot at forest depôts.	8 annas (exclusive of value of timber).	Do.	Pollachi.
North Malabar	0 4	Cubic foot squared.	13 annas .	Do.	Calicut, Tellicherry, Mysore.
South Malabar	5 0 to 15 0	Candy of 13 c.ft.	4 annas (exclusive of value of timber).	Do.	Ferokh, Beypore, Calicut.
Coorg . .	3½ annas	Cubic foot .	1½ annas .	Do.	Poochimavadium station, Mysore.
Mysore . .	12 to 15 annas.	Cubic foot .	14 annas .	Do.	Railway stations.

From the Coorg Working-Plans the figures given below have been taken. As however the Working-Plans have mostly expired, the figures must be taken merely as a guide to the quantity of timber the forest can produce, and up-to-date estimates should be obtained from the Deputy Conservator of Forests, Coorg.

Name of Forest.	Area in square miles.	Quantity in cubic feet available annually.
Devamachi-Mawkal . .	28	1,000
Nalkeri-Hattgat . . .	83	7,500
Anekadu-Attoor . . .	20	800
Ariari	29	500

(ii) *Western India.*

Vernacular names.—Nana (Marathi and Gujrati), Nandi (Canarese).

Local distribution.—In the Bombay Presidency the home of this tree is in Kanara where it is common, occurring at all altitudes up to 2,500 feet. It prefers a well-drained slope and has some of the habits of teak, with which it is often associated. Like teak too it is found sometimes in evergreen forests, where it overtops the evergreen species. Foulkes in "Notes on Timber Trees in South Kanara" says: "*It prefers gneiss soils to laterite and does best in the low Ghat forests where the rainfall is fairly heavy,*" but in the Western Division of Kanara the finest specimens are reported to be found in dry deciduous forest on steep slopes.

In the north of the Presidency it is smaller and rarer, but is reported to occur to the extent of 5 per cent. in South Thana and 2 per cent. in Kolaba, but timber is not available.

Good trees have been seen in Kanara 10 feet in girth and 100 feet in height with a clear bole of 50 feet.

Extraction.—The size at which the tree may be felled in Kanara is usually 6 to 7 feet in girth. The forests containing the best trees are worked under the Selection system as a rule, mature trees being chosen for felling, and the trees are extracted either by purchasers or departmentally. The logs are dragged or carted from the forests, as the nature of the country allows, and are sometimes floated down to the sea-coast.

The duty charged by Government in Kanara is Rs per *khandy* of 12½ cubic feet, and the local selling price is about Rs in Eastern, Rs-8 in Western, and R10 in Southern Kanara.

Details are given in the following table :—

Division.	Quantity available annually.	Rate for delivery.		
		₹	Per	At
Kanara Western Division.	330 seven-foot trees besides others from forests near Ankola.	4 to 5	Khandy .	Sea-coast.
Kanara Eastern Division.	1,500 cubic feet .	₹ a. 1 0	Cubic foot	Hubli station.
Kanara Southern Division.	.....	8 annas.	Do.	Haveri station.
		4 Do.	Do.	Honawar.

Figures from Bombay Working-Plans.

District.	Working Circle.	Area in square miles.	Mature trees on the area.	Minimum size fixed for felling.	Remarks.
Kanara	Gumi, Series X and XI.	47	21,500 above 24 inches diameter.	24 inches diameter.	
Do.	Supa, Block XX	18	48 above 24 inches diameter.	6 feet girth.	
Do.	Kalmadki slopes, Block XXVI.	49	6,300 sound above 27 inches diameter, 400 unsound.	7 feet girth .	The annual yield is 230 trees.
Do	Mundgod High Forest.	85	500 above 24 inches diameter.	6 feet girth.	
Do.	Ankola High Forest.	70	11,000 above 27 inches diameter.	7 feet on best locality, 6 feet elsewhere.	Annual yield 330 trees.
Do.	Yellapur above Ghat.	137	7,000 above 24 inches diameter.	24 inches diameter.	
Do.	Yellapur slopes .	37	11,500 above 24 inches diameter.	...	
Belgaum .	Nagargali Series	14	900 above 24 inches diameter.	24½ inches diameter.	Annual yield 98 trees.

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
8, HASTINGS STREET

Forest Bulletin No. 20

1913

NOTE ON SÁNDAN

(*Ougeinia dalbergioides*, Benth.)

BY

A. RODGER, I.F.S.

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[*Continued on page 3 of cover*.

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SUPERINTENDENT GOVERNMENT PRINTING, INDIA
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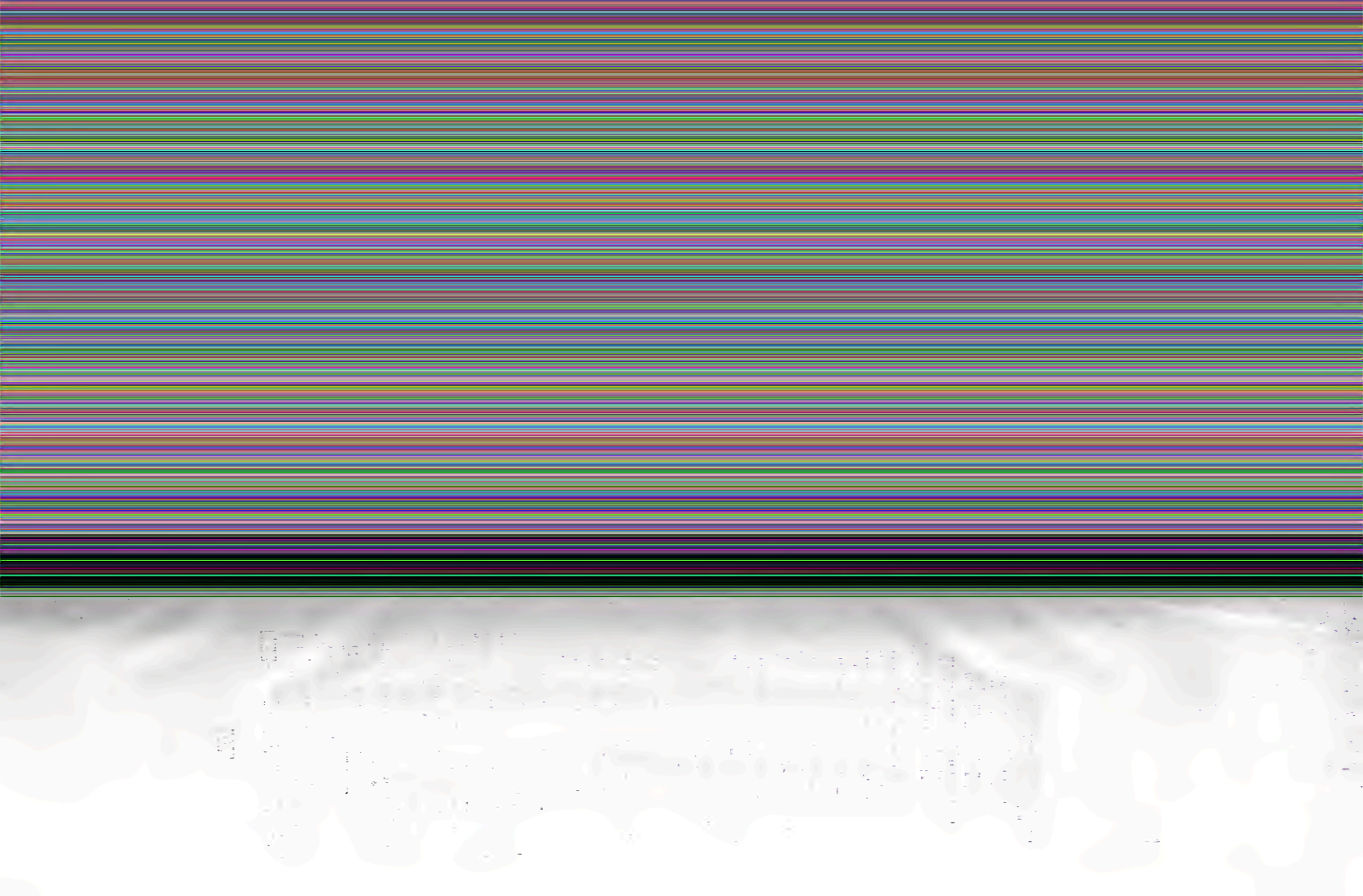
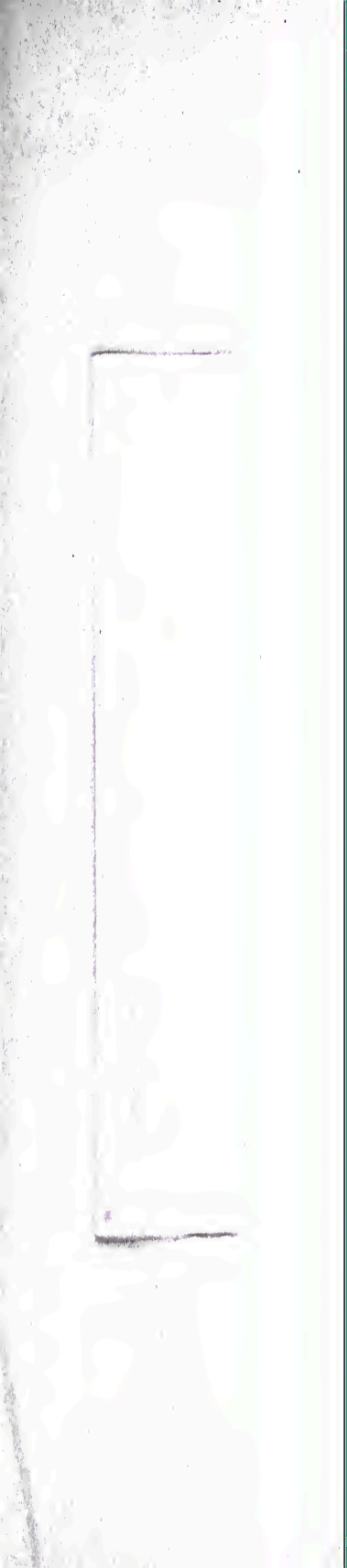
Reference is also invited to the following :—

A Manual of Indian Timbers, by J. S. Gamble, C.I.E.
(Sampson Low, Marston & Co., London.)

Indian Woods and Their Uses, by R. S. Troup.
(Superintendent, Government Printing, India, Calcutta.)





Sundan.

Ougeinia dalbergioides, Benth.

Natural Order—Leguminosæ (Papilionaceæ).

SÁNDAN.

Ougeinia dalbergioides, Benth.

Natural Order—Leguminosæ (Papilionaceæ).

1. General Distribution.

Sándan is a tree of Central India, being common in the Central Provinces and becoming less plentiful in each direction outwards from the centre, in Bengal, the United Provinces, Bombay and Madras. Its northern limit is the Dehra Dun and its southern limit, the Palni Hills in Madura.

It does not occur in Ceylon, Assam or Burma, nor in the Punjab, except perhaps to a small extent near the Jumna at the western end of the Siwaliks.

Further details are given under the various provinces.

2. Locality and Habit.

It is found much scattered in deciduous forests between a few hundred and 4,000 feet above sea-level, reaching the latter height in the Palni Hills in Southern Madras and in the Lower Himalayas, where it goes a long way up the valleys and mixes with Chir pine. It prefers fertile loams and clays, but will grow, though small and stunted, on shallow ridges. Further details are given under the various provinces.

It is a moderate-sized tree rarely attaining a girth of 7 feet and a height of 60 feet, the smaller classes being much the most numerous. The bark is thin and greyish and the trunk frequently short and irregularly shaped, but the tree, especially when in full flower, is very handsome, and is accordingly grown in gardens. It flowers between February and May about the same time as the leaves are changed, the flowers being purple, pink or white.

3. Description, Properties and Uses of Timber.

The sap-wood is narrow and grey and the heart-wood reddish or pale brown, mottled. It is hard and close-grained, durable and tough, and takes a good polish. It shows vertical bands of close-grained pale brown wood, alternating with more open tissue, on a vertical section, and the cross

section shows numerous fine concentric lines, with pores in short pale wavy bands arranged concentrically.

Durability.—The wood is not usually proof against white-ants, but has been found to last as long as 9 years in the ground without deterioration.

Weight.—The wood is fairly heavy, the mean of recorded figures being 55 lbs. From the Darjeeling *terai* a weight of 67 lbs. has been recorded (Gamble).

Strength.—The value of P, which represents the strength of a bar of timber calculated from the length between supports, breadth, and thickness of the bar, and the weight in pounds which when placed on the middle of the bar causes it to break, has been calculated at 895. This is a high figure as Sal gives 790, Teak 600 and Shisham 796 (Gamble).

Fissility.—The wood is very difficult to split being placed by Mr. R. S. Troup at the foot of a list of 61 Indian woods tested by him, its index figure being 44·78, Teak giving 1·75, Toon 4·25, and Sal 9·38.

Calorific power.—If available in quantity for fuel it would be good, as its calorific power is high, the number of British Thermal Units recorded by Mr. Puran Singh being 8,505, Shisham giving 8,313, Teak 8,560 and Sal 8,881.

Seasoning.—In the Central Provinces the trees of this species, with others, are usually felled during the rains and the stems left unbarked leaning against others for a month or two. A paste of cowdung is also used at times and the timber is sometimes immersed in water, but it can be seasoned very well by being kept in the shade for a few months after felling, as it is not liable to split badly.

Uses.—It is in great demand for ploughs, shafts of carts and of wheels, handles of tools, bed-legs, yokes, spindles and other purposes requiring strength and toughness. The supply is not equal to the demand for these purposes and much more could be disposed of than is at present available. It has been tried at Naini Tal for casks for beer and was found to be very suitable. A small consignment was sold in London in 1875 for £3 per ton.

4. Minor Products.

When blazed the tree yields an astringent red gum and a decoction of the bark is used in Chota Nagpur when the urine is too dark coloured (H. H. Haines). The bark is pounded and used to intoxicate fish and the twigs are lopped for cattle fodder. In the Yeotmal Division of Berar lac is grown on the trees, which are soon killed by it. The flute is

occasionally used for making ropes. During the famine of 1896-97, the flower was in great request as food in Oudh, being eaten boiled.

5. Natural Reproduction and Rate of Growth.

Seedlings are usually fairly plentiful and the tree can be readily propagated by means of root-suckers. In 1895, Mr. H. C. Hill noted in the Central Provinces that dense thickets of this and other trees were to be found wherever the beneficial influence of an old Mohwa tree was felt. Suckers produce small pure patches of young growth in many parts. In the Dehra Dun seedlings and root-shoots are plentiful where slopes and banks of nullahs let light into the dense sal forests.

Cagzis records measurements taken on 90 trees in sample plots in the United Provinces over periods of years varying up to 19. The mean annual girth increment varied from .01 to .33 of an inch, the latter figure being exceptionally high.

6. Artificial Reproduction.

Sowings have been made in pits in Bombay with but moderate results. In the Central Provinces sowings in lines have been fairly successful, and broadcast sowings unsuccessful. The seed usually germinates easily.

7. Notes on Distribution and Extraction in different Provinces.

(i) *Central Provinces.*

Vernacular names.—Tinas, Tinsa, Timas.

Local distribution.—The tree is very widely distributed in the Central Provinces but rarely attains a large size. It grows up to 2,500 feet above sea-level scattered through the Sal, Teak and other deciduous forests, occasionally forming as much as 5 per cent. of the crop, preferring clay and deep heavy soils, and being found at times in small pure patches. In Berar it is reported to be found often on light red soils up to 3,800 feet above sea-level, on hill-tops and abandoned cultivation, and at other times on black cotton soil. In South Chanda it occasionally reaches a girth of 5 feet, with 60 feet height and 30 feet clear bole, but this is exceptional and in many districts it rarely attains a girth of 3 feet. The largest trees are found in South Chanda, Balaghat, Bilaspur, Narsingpore, Mandla, Seoni, Betul. In the last named it is held to be quite as valuable as Teak for local purposes.

Extraction.—The forests in which it grows are usually worked as Coppice with Standards, but in a few districts as High Forest, the mature trees being removed after reaching two or three feet in girth in Selection and in Improvement Fellings. The coupes are usually sold to purchasers, who remove the timber by means of carts or coolies who carry it on their heads where no cart-roads are available. From South Chanda about 100 trees over 3 feet in girth would be available annually, from Narsingpore about 5,000 cubic feet in the form of poles of varying sizes, from Mandla about 25,000 cubic feet, and from Betul 8,000 cubic feet. The royalty in South Chanda is 3 annas per cubic foot.

Figures regarding Extraction.

Forest Division.	Local market rate.			Rate for delivery.			At
	R. a. p.		Per	R. a. p.		Per	
South Chanda .	1 8 0		cubic foot in log.	0 8 6		cubic foot .	Billarshah.
				0 6 0		Do.	Coconada.
Balaghat .	1 8 0		pair of thirty	10 0 0		hundred poles one foot in girth.	Railway stations.
	1 0 0	to 2 0 0	planed pole 36" in girth.	35 0 0		hundred poles 1' 6" in girth.	
Bilaspur .	...		...	0 5 0		cubic foot .	Kargi Road station.
Narsingpore .	1 0 0	to 30 0 0	hundred poles.	1 0 0		Do.	Railway stations.
Mandla . .	0 1 9		cubic foot .	1 15 0		cubic foot round.	Bombay.
				2 3 0		cubic foot converted.	Do.
				0 8 0		cubic foot round.	Railway station.
				0 12 0		cubic foot converted.	Do.
Betul . .	0 2 0		cubic foot .	0 3 3		cubic foot .	Itarsi.

(ii) *Rajputana and Central India Agency.*

In the *Marwar* State in Rajputana it is known as *Tinsá* or *Tenasá*, but is rare and does not grow to a large size. It is much in demand locally at about one rupee per cubic foot for tool handles, etc., but there is little available.

In *Gwalior* it is found, but as a small and unimportant tree.

In the State of *Rewah* it is called *Sandan* and occurs to the extent of 3 per cent. in the Bondi and Singrouli forests, not being often found of greater girth than two feet. It is useful for agricultural implements and house-building.

In *Indore* it is found throughout the State, generally crooked and seldom attaining a great height or more than 2 feet in girth. In some of the best mixed forests, especially on the Satpuras, it attains occasionally a girth of 4 feet, but straight trees are the exception. From the more remote forests on the Khandesh borders, etc., most of the best trees have been extracted, generally illicitly. No timber is so much valued locally, and cultivators will pay any price to secure it for shafts, carts and agricultural implements. A pair of poles will sell for R8 to R10 dressed to 18" girth 12 feet long, in the Khargone Division. In the Indore Division poles sell for R1-8 to R7. It reproduces itself profusely by root-shoots in old fields, etc., and the forests are full of young growth.

(iii) *Southern India.*

Vernacular names.—Bandhano (Uriya), Kallu Mokke (Tamil), Betta-honné (Canarese), Asavuni or Manimatha (Madura).

Local distribution.—This tree is not common anywhere in Madras and does not occur in many of the districts. In Central and North Coimbatore, Ganjam and Madura it is reported to be scattered, occurring to the extent of 4 trees over 3 feet in girth per hundred acres, and reaching a girth of 4 feet and a height of 80 feet in Ganjam. In Madura the girth is sometimes as large as 6 feet, and the tree usually occurs at 3,000 to 4,000 feet above the sea, on the Palni Hills. Elsewhere it grows in mixed deciduous forests between 500 and 3,000 feet above sea-level.

Extraction.—From the hills of Madura about 500 cubic feet may be extracted annually, delivered at Kodaikanal Railway station at R1-12, and at Madura at R1-14 per cubic foot.

In *Ganjam* the wood is sold for hubs of wheels and carriage poles at 8 annas per cubic foot.

In *Hyderabad* it is known as *Tewas, Dargu, Tunnz, Tella-Modgu* or *Kodi-Mudsu* and is reported to be common at Aurangabad and in the Reserves along the Godavery. It is rarely large enough to yield a 9-inch plank, but is much used for agricultural implements and poles, being granted free to agriculturists.

In *Coorg* the tree is called *Malé Honné* and grows to a small extent in the eastern zone of the Southern forests, attaining a girth of 4 feet. It is not used locally and is not an important tree. The Government duty is 1½ annas per cubic foot.

In *Mysore* the tree is not plentiful and attains occasionally 30 feet in height and 5½ feet in girth. It is little used, but 500 cubic feet can probably be obtained annually, delivered at Railway stations at R1-4 per cubic foot. It is called *Kal-honné*.

(iv) *Bengal.*

Vernacular names.—Bandhan, Pandan, Ruta (Kol), Rot (Santali), Sandan (Hindi).

Local distribution.—The tree does not occur in the Kurseong, Santal Parganas, Darjeeling and Tista forests, and small trees only are found in Sambalpur, though apparently it was at one time a useful tree there. It is common in the hills of Chota Nagpur but is seldom larger than 3½ feet in girth (H. H. Haines). In Orissa it is commoner in Angul than in Puri, and trees 7 feet in girth with a total height of 50 feet and a clear bole of 25 feet are met with in the dry hill forests in open spots up to 3,000 feet above the sea. It is also found less often in the mixed sal forests of the plains.

Extraction.—In Angul the exploitable size under the Working-Plan is 4½ feet girth and in Puri 5 feet, but few sound trees above 3 feet in girth are obtainable. It is in considerable demand in Bengal for cart-wheels, selling in Cuttack and Puri at an average price of R1 per cubic foot and in Chaibassa for rather more. Trees are usually selected when required by purchasers. In Chaibassa about 100 trees per annum would probably be available and the timber can be delivered at Lota Pahar for 8 to 12 annas per cubic foot.

(c) *Western India.*

Vernacular names.—Tiwas (Marathi), Tanach (Gujarati), Karimutial (Canarese).

Local distribution.—Only in Surat is this tree reported to be at all common, and elsewhere it is irregularly scattered as in Madras, being reported from Central and South Thana, the eastern and southern divisions of Kanara and both divisions of Khandesh. In West Kanara and Satara it is said not to occur. When found it is in deciduous forests up to 3,000 feet above sea-level, usually in open spots, rarely attaining a girth of more than 3 feet and frequently being much stunted. In the eastern division of Kanara and in Surat 5 feet trees are sometimes found with a 35 ft. bole, but the ordinary trees are much smaller. Enumerations were made for 8,000 acres in Central Thana and gave the total number of trees over 18½ inches in diameter as 172, and of trees 12 to 18½ inches in diameter as 1,545, the exploitable size for these forests being fixed at 18·5 inches.

Extraction.—Little annual outturn can be expected except from the Dangs and Mandvi forests in Surat where it pays to extract almost any kind of this timber as the worst logs fetch over R10 per *khandy* and good timber commands a high price. The future annual supply from these forests will be about 500 *khandies* yearly, a *khandy* being 12½ cubic feet. The cost of delivering the timber to the Tapti Valley Railway stations will be about R11 per *khandy*, to Bulsar R12 and to Surat R13. The local price in Kanara is R15 per *khandy*, and in Surat it varies from R16 to R20.

In *Baroda* it is scarce and of medium size and sells for about R8 for 12 cubic feet.

In the *Rajpipla* State it is fairly common in the hill forests, attaining a girth of 8 feet, and being estimated to be available in future to the extent of 4,000 cubic feet annually. 30,000 cubic feet were extracted between 1904 and 1908, the State duty being 3 annas per cubic foot and the local price about R1-8 per cubic foot in the round. It is extracted by Bhils and a good deal is floated down the Narbudda. It can be delivered at Nandod or Chandod for R1-8 per cubic foot and at Ankleshwar for R1-10, the rates for converted timber being double.

Figures from Bombay Working-Plans.

District.	Working Circle.	Area in square miles.	Trees on the area.	Minimum size fixed for felling.
Kanara .	Sopa, Block XX	18	6,200, 1½′ to 21′ diameter. Above 21′ diameter, nil.	8 feet girth.
Do.	Yellapur above Ghat, Blocks XIII and XIV.	35	24,700, 1′ to 21′ diameter. Above 21′ diameter, 360.	5 feet girth.
Do.	Yellapur Slopes, Block XVII.	16	540, 1′ to 21′ diameter. Above 21′ diameter, 36.	...
Belgaum .	Nagargali Series .	14	2,800, 1′ to 21′ diameter. Above 21′ diameter, 85.	...
Thana .	Tahasi . .	29	680, 18½′ diameter and over. 2,600, 12′—18′ diameter.	18 inches diameter.

(*e*) *Northern India.*

Vernacular names.—Sandan, Chanjan or Panan (Oudh), Tinsa (Bundelkhand).

Local distribution.—It occurs in the Dehra Dun, outer Himalayas and Oudh forests with Sal and ascends the valleys up to 4,000 feet growing with Chir pine, preferring good soil in the valleys and becoming crooked and stunted at the higher elevations. In Pilibhit and Bundelkhand the trees are small and of little value at present. Five feet is the largest girth attained, with a height of 40 feet and a clear bole of 15 feet, but the smaller classes are much commoner, and it is quite a common tree in many parts.

Extraction.—Most of the forests in which it occurs are under the Selection system and the tree is often removed in Improvement Fellings carried out to favour Sal, a small quantity also being cut out in coupes of Coppice with Standards. No large quantity of timber is available, the most important estimate of 3,000 cubic feet per annum being supplied

from the Siwalik Division. Timber can be delivered at Railway stations from the Dehra Dun forests for about 4 annas per cubic foot roughly converted, the market price at the stations being 7 annas. In Kheri billets 3 feet long and 3 feet in girth are sold at the Railway line for 12 annas or one rupee each for bed-legs, delivery at the Railway station from the forest costing 8 annas each. In Gorakhpur delivery to Railway stations costs 8 to 13 annas per cubic foot, the market rate of the same being 8 to 10 annas.

In *Jammu* and *Kashmir* it is called *Sannan* and is found in the lower ranges of hills below 300 feet. It rarely attains a girth of more than 2 feet and is much lopped and browsed but not much used otherwise.

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
8, HASTINGS STREET

Forest Bulletin No. 21 1913

NOTE ON DHAURA OR BAKLI

(*Anogeissus latifolia*, Wall.)

BY

A. RODGER, I.F.S.

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
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[*Continued on page 3 of cover.*

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CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1918

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NOTE.

THESE notes regarding the lesser known Indian timbers have been compiled in order that all the information at present available regarding them may be easily obtainable.

For some of the best forests detailed Working-Plans have not yet been made, as the demand for timber in the neighbourhood is at present very small, but full information regarding the timbers available and means of extraction can always be obtained from local forest officers.

Application can also be made at any time to the Forest Economist, Dehra Dun, United Provinces, India, who will supply specimens of any timber free and put enquirers in communication with local forest officers.

Notes on the following timbers have now appeared :—

1. Lagerstroemia tomentosa (*Leza*—Burma).
2. Dipterocarpus tuberculatus (*In*—Burma).
3. Pterocarpus dalbergioides (*Padauk*—Andaman Islands).
4. Pterocarpus macrocarpus (*Padauk*—Burma).
5. Canalia integerrima (*Maniunga*—Burma).
6. Diospyros Kurzii (*Zebra Wood*—Andaman Islands).
7. Berrya Ammonilla (*Petwan*—Southern India and Burma).
8. Terminalia tomentosa (*Saj, Sain, Taukkyan*—India and Burma).
9. Gmelina arborea (*Gumhar, Sinwa*—India and Burma).
10. Ougeinia dalbergioides (*Sandan, Tinsa*—India).
11. Lagerstroemia lanceolata (*Benteak, Nana*—Southern India).
12. Anogeissus latifolia (*Bakli, Dhawra*—India).
13. Pterocarpus Marsupium (*Honné, Pengai*—India).

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(Superintendent, Government Printing, India, Calcutta.)

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Anogeissus latifolia, Wall.

Natural Order—Combretaceae.

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Natural Order—Combretaceæ.

1. General Distribution.

This tree occurs principally in Central and Southern India, and is absent in Burma and Eastern Bengal and Assam. It is most numerous between 70° and 84° longitude running from Dehra Dun in the north through the Central Provinces to Tinnevelly and Ceylon in the south, and extends through Chota Nagpur and the northern part of Madras. In Bombay it is not so plentiful on the whole, and in Sindh it is absent, but a few trees grow in Ajmer-Merwara. Further details are given under each province.

In Ceylon it is found on open grass lands in the dry country, and is plentiful in certain localities, but not on the whole. It is called *Dawa*.

2. Locality and Habit.

This species is able to grow at all altitudes between 200 and 4,000 feet and attains its largest size in deep loams at the foot of hills as in Ganjam and Madura, Madras, where specimens 10 feet in girth occur. It is more commonly found on slopes between 1,500 and 2,500 feet where it grows on laterite and granite soil, not demanding much from them and standing exposure, though remaining much smaller than at the lower levels. On such localities it forms at times as much as 50 per cent. of the crop. In the Central Provinces it is also found on deep trap soil.

Its companions are usually Sal, *Terminalia tomentosa*, *Butea frondosa*, *Diospyros Melanoxylon* and similar trees, and occasionally Teak. It is a tall straight tree with smooth mottled bark and numerous moderate-sized leaves which become red or brown in November and December and fall in February, the new leaves appearing in May and the flowers during the rains. A variety called *Anogeissus tomentosa* is reported by H. H. Haines from parts of Chota Nagpur.

3. Description, Properties and Uses of Timber.

The wood is grey or yellowish in colour with numerous very small pores, and close-grained. It shows handsome shining horizontal bands on a vertical section and is sometimes cross-grained. The heart-wood is small, irregular, hard, and purplish in colour. It often contains small knots and flaws and is accordingly unsuitable for such purposes as the manufacture of fishing rods.

Durability.—It is not durable unless kept dry and is very apt to split when seasoning. It has been tried for sleepers but large trees are not plentiful enough to make it very useful for this purpose. Eighteen sleepers were tried on the Mysore State Railway and 14 of them were found to be serviceable after 7 or 8 years. It is often attacked by white-ants so that it must be treated with antiseptics when it is wanted for house posts, etc. Some rafters used in a bungalow at Surada in northern Madras are quite good after 30 years' use. The wood was found when tested in Madras to have little power of resistance to the attacks of the *teredo*, and it proved unsuitable for sleepers on the South Indian Railway in 1899.

Weight.—The weight given in Gamble's "Manual of Indian Timbers" is 62 lbs. per cubic foot dry, and 75 to 80 lbs. when green. This is calculated from specimens collected all over India.

Strength.—The value of P, which represents the strength of a bar of timber calculated from the length between supports, breadth and thickness of the bar, and the weight in lbs. which when placed on the middle of the bar causes it to break, is for this timber about 900, the figures for Sal being 790, Teak 600 and Shisham 796 (Gamble). Very varying results have been recorded, one being as high as 1,430, but 550 to 900 is probably correct, this high figure accounting for the toughness and consequent great usefulness of the wood.

Fissibility.—The wood is not very easy to split, experiments made by Mr. R. S. Troup giving the figure 0·33, the corresponding figure for Teak being 1·75, for *Anogeissus Calycina* 2·98, and for *Terminalia tomentosa* 4·63.

Calorific power.—The wood has been tested by Mr. Puran Singh, Forest Chemist, and his results placed it rather low on the list, beside Bael, and a long way below Sal, Teak, and Blue and Chir pines. The number of British Thermal Units is given for the last-named as 9144, and for *dhaura* as 7451. It is commonly however used as fuel and gives good charcoal.

Seasoning.—In the Central Provinces the people usually prefer to cut

it during the rains, as in the case of Sain, and it is often left unbarked in the forest to season during the rains, or put into water for a month or two. It is also sometimes barked and plastered with cow-dung, and in parts of Bombay it is steeped in salt water after felling. It must be seasoned very slowly as it is very apt to split and warp.

Uses.—It is a favourite wood for shafts and especially axles of carts, plough and tool handles and yokes, and is also used by the poorer class of cultivators for building. In Madras it is used in the Kolar Gold Mines, and in Orissa for sugar-cane presses. It is very largely used for fuel, being sold in Bombay for R4 to R6 per *khandy* of 784 lbs. and is a very popular wood for charcoal. It polishes well, without absorbing much polish.

4. Minor Products.

The most important minor product is the gum which is collected in many parts of India and sold at from one to two annas per lb. It is used for native sweatmeats, as an adhesive in cloth printing and by the Santhals in Chota Nagpur for cholera. The gum is reported from northern Madras to exude in appreciable quantities only once in 3 years, not every year, and not to be obtainable from the largest trees. It forms the bulk of the *Gum Katti* sold in Bombay, the prices at the beginning of 1912 being as follows:—

	R	R	
Uncleaned . . .	10	to 18	per cwt. according to quality.
Cleaned . . .	18	„ 25	do. do.

The leaves are largely used for tanning, the skin usually being made into a bag and the leaves placed inside with water. The leaves have been found to contain 15·5 per cent. of tannic acid. A number of liquid extracts were roughly prepared in the forest and analysed by Mr. D. Hooper, Curator of the Economic Section, Indian Museum, in 1898 and 1899. The extracts prepared from the bark and leaves from the Central Provinces gave the following results:—

Part used.	Percentage of dry extract.	Percentage of tannin.	Percentage of tannin in the dry extract.
Bark	60	30·8	51·3
Leaves	34·2	10·0	29·4

The methods of tanning principally employed in Damoh, Central Provinces, are as follows :—

Method of tanning with ghaunt (Zizyphus xylopyra) and dhaura leaves.—The first liquor or *kas* is prepared from 5 to 6 seers of *ghaunt*, which has been dried and powdered, mixed with 20 seers of clean cold water in a *nand* (wide-mouthed jar). This is left standing for about one hour, when the colour of the *ghaunt* diffuses into the water. The hide remains in this liquor for 3 days, it being taken out twice to thrice every day and rubbed with the hand for about one hour. At the end of the third day the hide is taken out of the *nand*, rubbed, wrung out, and spread to dry for about 3 hours.

The second *kas* or liquor is prepared from 7½ to 8 seers of *ghaunt* mixed with 20 seers of clean water, in which the hide remains for four days, it being taken out, rubbed and worked three times daily. After 4 days it is taken out, wrung out and dried as before and is then put into the third *kas*. This consists of 6 to 7 seers of *dhaura* leaves mixed with 20 seers of water and the hide remains in this for 2 days, being rubbed daily as before and on the third day it is wrung out and dried. Some *Chamârs* mix *dhaura* leaves with the *ghaunt* in the second *kas*, the proportions being 3 seers of *dhaura* leaves or *kaspatti*, 3 seers of *ghaunt* and 20 seers of clean water. In this case a third *kas* is not always necessary. A piece is cut from the edge of the hide to see if the colour has passed right through the skin, and if it is found that the hide is whitish in the interior, it is considered to be insufficiently tanned and a third *kas* is accordingly given, it being a repetition of the second.

Other *Chamârs* again mix no *ghaunt* in the second *kas* which consists of 5 to 6 seers of *dhaura* leaves or *kaspatti*, and 20 seers of water; and in this case no third *kas* is given.

In all cases, however, after treatment with the *kas* (or liquor) as described, the hide is sewn up like a bag with the bark of *kulu* (*Sterculia urens*) root of *chheola* (*Butea frondosa*) or leaves of *khajuri* (*Phœnix sylvestris* and *P. acaulis*), leaving an aperture of about a span's width at one end. It is then hung up on a pole, the opening being uppermost, and is filled half with *dhaura* leaves and half with water. The quantity of leaves used depends on the size of the skin and kind of leaves used. About 4 or 5 seers are necessary for a goat's skin and from 16 to 17 seers for half a hide of a buffalo or cow. Also if the leaves are young, more is used than is the case if the leaves are old. A *nand* is placed

below the hide so that the solution which filters through the skin is collected in it. The contents of this *nand* are poured back into the hide 4 times during the day and 4 times during the night. This continues for 2 days, when the aperture is sown up, the bag reversed and an opening made in the bottom of the bag, which is now uppermost, and the process continues as before for one day and a night, the object of this being to get both the upper and lower portions of the skin thoroughly impregnated with the solution. The hide is then taken down, opened, washed in clean water and dried. It is then rubbed well for about half an hour, with ½ seer of salt mixed with one seer of curds, when it is left to dry and the operation is complete. The leather produced by this method is of a yellow colour.

Method of tanning with dhaura leaves alone.—The process is much the same as described above in the *ghaval-dhaura* method. The first *hau* in this case consists of about 6 seers of *dhaura* leaves and the second and third of 8 seers, the quantity of water used being the same in each, *i.e.*, about 30 seers. The hide remains in the first *hau* for 3 days, in the second 4 days and in the third 2 days. After treatment with the *hau* the hide is hung up and filled half full with *dhaura* leaves and half with water and is treated just as described above. The leather produced by this method is of a greenish yellow colour and is very liable to crack. To prevent this the leather is rubbed with the *tilli* oil.

Method of tanning with dhaura leaves and harra (myrabolans).—This is exactly the same as the last with the exception that half the quantity of *dhaura* leaves is used mixed with an equal quantity of *harra*. The leather produced is of a brighter yellow than the last, but is also liable to crack.

[*Tanning materials used in the Damoh District, Central Provinces*, by R. S. Hole.—*Indian Forester*, July 1899.]

The *tasar* silk-worm is sometimes fed on the leaves.

The white wax insect (*Ceroplastes ceriferus*) has been reported as found on this tree.

It has been noted by M. Rama Rao to be an associate of Sandal but root attachments between the two have not been found.

5. Natural Reproduction and Rate of Growth.

Natural reproduction is reported to be fairly plentiful in most forests. Heavy grazing and fire do much to keep it back, but it responds to

fire-protection as may be seen on the slopes of the Siwaliks, the outer Himalayan slopes and similar localities in Central and Southern India (Gamble).

The tree usually coppices readily. Mr. R. S. Pearson wrote a detailed report in the *Indian Forester* for May 1907 on a good crop found in the Panch Mahals in Bombay. He decides that well-drained situations and good light are necessary, and records his opinion that the tree, though producing seed yearly, rarely produces great quantities of fertile seed except under special conditions which depend on the temperature and rainfall of the year. Mr. A. K. Desai, Ranger, Godra Range, Panch Mahals, notes that *dhaura* seedlings were found in great abundance in his forests after the dead timber killed by the drought of 1899-1900 had been removed. A great opening out took place, the seeds accumulated in the soil during the drought, and the young plants filled up many of the blanks when the rain came.

Bourdillon and Gamble say the rate of growth is moderate, about 7 rings per inch of radius.

Cecil gives measurements taken on 52 trees in sample plots in the United Provinces, some of which extended over 17 years, which indicate that the mean annual girth increment varies from ·14 to ·63 of an inch.

From countings made in the Nallamalai Forests, Kurnool, Madras, the average number of rings to an inch of diameter was found to be 7.

6. Artificial Reproduction.

Sowing and planting have been tried in Bombay, the former when done in patches giving the best results. Broadcast sowing is more uncertain, but dibbling has given a fair number of seedlings, about 30 per cent. of the seed producing plants. Mr. H. H. Haines states that the fruits should not be gathered until they begin to separate from the heads. The seed requires a perfectly clean soil for germination and is excessively impatient of weeds or water-logging. The best results were obtained on mounds of gravel. Broadcast sowing has been tried in a number of forest divisions, almost always without success.

7. Notes on Distribution and Extraction in different Provinces.

(1) *Central Provinces.*

Vernacular names.—Dhamora, Dhaura, Dhawa.

Local distribution.—Over the greater part of the Central Provinces the tree is not very plentiful, but in the west it occurs to a larger extent than elsewhere, being reported from Raipur to form sometimes 20 per cent. and from Jubbulpur 15 per cent. of the whole crop. It grows best on low-lying land up to 1,500 feet but occurs up to 2,500 feet in smaller sizes. Very exposed dry slopes do not suit it but it thrives on the lower slopes on north and west aspects in mixed deciduous forests. On plateaux and high slopes it is dwarfed, much branched and early becomes hollow. In South Chanda girths of 6 feet are recorded with a total height of 90 feet and a clear bole of 60 feet, but two or three feet is a much more common girth measurement, with 40 feet height and in some divisions 25 feet is more usual. In Berar the tree produces chiefly fuel being felled in Coppice with Standards and sometimes pollarded. In parts of Nimar it produces timber. In 1892 and 1897 the tree suffered greatly in the Damoh forests from the ravages of a small caterpillar which devoured the whole leaf. New leaves were produced in July (R. C. Thompson).

Extraction.—The forests containing the tree are almost everywhere worked under the system of Coppice with Standards so that large timber is not available as a rule, except in the more remote forests of a few districts. Extraction is done almost entirely by carting by the purchasers of the annual coupes, who undertake the whole of the work in most cases. Government has to cut back the unmarketable stems left on the ground. The coppice is largely used for fuel, but the larger stems are very useful in cart-building. When some of the inaccessible forests are opened up by roads, a large quantity of this timber will be available and will be in good demand on account of its strength and toughness. In the following

table figures are given for each district from which timber may become available :—

Forest Division.	Local Market Rate.		Government Royalty.		Rate for delivery.		
	Rs. a. p.	Per	Rs. a. p.	Per	Rs. a. p.	Per	At
Sangor . .	0 0 6 to 0 6 0	pole	0 2 0	c.ft.	2 to 6 annas	c.ft.	Railway stations.
					1 0 0	c.ft.	Bombay.
					0 6 6	c.ft.	Cawnpore. Agra.
Mandla . .	0 1 9	c.ft.	0 0 9	c.ft.	1 15 0	c.ft. round	Bombay.
					2 3 0	c.ft. converted	
					0 8 0	c.ft. round	Railway stations.
					0 12 0	c.ft. converted	
Raipur . .	4 0 0 to 24 0 0	hundred poles.	2 annas	c.ft.	0 5 0	c.ft.	Dhamtari and Rajim.
					0 7 0	„	Raipur.
South Chanda	..	..	2 annas	c.ft.	0 7 6	c.ft.	Ballarshah.
					0 5 6	in rough squares	Bajahmandri, Cocanada.
Damoh . .	8 to 20	hundred poles.	2 annas	c.ft.	0 2 0	c.ft.	Railway stations.
					0 13 0	„	Bombay.
					0 5 0	„	Jubbulpore.

(ii) *Central India.*

In *Gwalior* the tree is common, being called *Dhakra* or *Safed Dhaw*, and frequently occurs as underwood in *Boswellia* forests. It does not often exceed 9 feet in girth but is extracted for shafts, poles, etc. The royalty is R3 per cart-load or one anna six pies per cubic foot.

In the State of *Rewah* the tree forms about 2 per cent. of the forest

growth in most parts, but does not grow larger than 2 feet in girth. It is a useful fuel and is used for axe-handles, etc.

In *Indore* it is widely distributed but seldom grows tall and straight or attains any great girth, except in the Satpuras and in the south-west of Nimawar where it grows to 4 or 5 feet in girth. It is usually crooked and stunted, but is much in demand as poles for agricultural implements and tool handles, and as fuel and charcoal. The leaves are used for tanning and the gum is collected for sale. It is called *Dhawa*.

(iii) *Western India.*

Vernacular names.—Dhauda, Dindal, Dindiga, Dhavada, Dhaura, Dhamodo (Gujrati).

Local distribution.—This species is fairly common in the northern forests of Bombay being reported to form about 10 per cent. of the crop in parts of South Thana, and a considerable proportion in Nasik, Khandesh, and the Panch Mahals. In the southern forests it is very local being abundant for example in the Eastern Division of Kanara and almost absent in the Western and Southern Divisions. It is found in deciduous forest and ascends as high as 3,000 feet, preferring the higher slopes as a rule and disliking flat lands and black soils. A tree of five feet in girth with a height of 50 to 60 feet, is considered large, the majority of trees growing rather crooked with short poles, and being felled at 8 feet in girth or less. Large trees are frequently hollow.

Extraction.—Trees are felled under the system of Coppice with Standards in most divisions and the coupes sold standing to purchasers who remove the timber or fuel in carts, but almost the whole outturn seems to be converted into fuel so that figures for delivering timber will not be of value. The fuel sells easily in Bombay for R1-4 to R3 per *khandy* of 784 lbs., and the charcoal sells for R15 per *khandy*. The cost of delivering 50 cubic feet of poles at Hubli in Kanara from the forest is R4-0. In Surat axles sell in the towns for R1 to R1-8 each, and are in good demand, the duty in the forests being 3 annas per axle, no tree below 18 inches in girth at breast-height being felled, and the trees yielding one to three axles each.

In *Baroda* it was formerly abundant but little is now available. Cart-axles sell for one anna six pies each.

(*ii*) *Southern India.*

Vernacular names.—*Tamil.*—Nawai, Velnagai, Vekkali.

Telugu.—Chirimawe, Chirimamidi, Chirumanu, Chiriman, Velama, Elama.

Canarese.—Bejjal, Dindiga, Dindal, Dindi.

Malayalam.—Vella-naga.

Uriya.—Dhau.

Local distribution.—The Madras Presidency appears to be the most important home of this tree, only a few districts, among which are Guntur, Anantapur, and South Kanara, reporting it to be scarce. It is pre-eminently a tree of south-eastern India, being abundant in Madura, and in Tinnevelly, where it forms as much as fifty per cent. of the forest growth on the dry upper slopes. It is not exacting as regards elevation being found at from 200 feet to 4,000 feet. It is reported at the latter altitude in the southern portion of the Presidency. It descends lower on the East than on the West Coast.

Dry deciduous forests are usually its home, and it can grow in poor soil and on exposed slopes, on laterite and on granite soil, though its largest dimensions are attained in the deep loams at the foot of the hills, as in Ganjam, where trees 6 feet in girth, 70 feet in height with a 40 feet bole are found, but the tree is considered as "inauspicious," and is not used for building. In most of the favourable localities the girth is 3 to 5 feet, but small stunted trees, coppice shoots, or poles are the commonest in Nellore, Kistna, West Kurnool, Cuddapah, Trichinopoly, Coimbatore, Tinnevelly, Bellary, South Salem and Guntur. From Madura trees 10 feet in girth and 60 feet high are reported and 8½ feet girth is recorded from South Salem.

Mr. A. W. Lushington notes that the tree forms large patches all over the hills of North Coimbatore except in the parts which contain *Acacia Sundra*. It grows to 6 feet in girth, but is usually met with as a pole.

In few localities is it sound, the constant fires having made it knotty externally and full of heart-shakes and dry rot internally.

Extraction.—Where fuel is much in demand in Madras the forests are usually worked as Coppice with Standards. In the more remote hill timber forests the tree is selected as required by purchasers who drag the logs to the nearest cart-road. From most of the forests little timber will be available for some time to come and figures are given below for those divisions which will be able to provide it.

In *Coorg* the tree is called *Dindiga* and is found extensively in the eastern forests, attaining a girth of six feet in favourable localities. It is not used locally but is exported for use as props in the Kolar Gold Mines. The Government royalty is 2½ annas per cubic foot, and about 10,000 cubic feet will be available annually, 30,000 cubic feet having been extracted during the last three years.

In *Hyderabad* the tree is called *Dhaura, Tiruman, Dhamora, Sirriwal, Dhownda, Sirward, Gondi* and is one of the most useful trees of the State. Good poles sell readily for R2 each, and are used very largely for cart axles and ploughs. Smaller poles are much used as props in sugar-cane plantations. Near Hyderabad city it is made into charcoal. It is generally distributed but does not attain any size in the southern or western divisions. In the Telingana forests near the Godavery it sometimes attains a girth of 4 feet but it is seldom that a sound log of more than twelve inches in diameter is obtained. About 500,000 poles have been and can be extracted annually from the Warangal, Karimnagar and Adilabad forests.

In *Mysore* it is called *Dindiga* and is common and often gregarious in the forests of the Mysore, Kadur and Shimoga districts. It is used for axe-handles, axles, furniture, etc., and in the Kolar Gold Mines. About 75,000 cubic feet may be extracted annually. During the last three years 192,000 cubic feet have been extracted.

In *Travancore* the tree is called *Vekkali* or *Maru Kanchiram* and is very abundant in parts of the southern portion of the State, on the Cardamon Hills, and elsewhere in the drier deciduous forests up to 4,000 feet, always avoiding the wetter parts of the country. It attains a diameter of two feet, yielding axe-handles, poles, etc., and is much cut for fuel and charcoal in South Travancore where it rarely attains a large size on the dry slopes (Bourdillon).

In the following table are given the figures available:—

Division or State.	Local prices.		Rate for delivery.		
	R a. p.	Per	R a. p.	Per	At
Madura . .	0 8 0	c. ft. squared.	1 10 0	c.ft.	Ammayanaicka-noor.
Vizagapatam .	0 12 0	c.ft. round.	0 15 0	c.ft.	Narsapatam Road.
	1 2 0	c. ft. squared.	1 2 0	c.ft.	Vizagapatam.
South Coimbatore.	..	..	0 8 0	c.ft.	Podanur.
North Malabar .	0 10 0	c.ft. at Kolar.	0 11 0	c.ft.	Nanganagode.
Coorg . .	0 4 6	c.ft.	0 11 6	c.ft.	Paschimavahini station, Mysore.
Mysore . .	10 to 12 annas	c.ft.	12 annas	c.ft.	Railway stations.

Figures from Madras Working-Plans.

District.	Working Circle.	Area in square miles.	Number of trees. Diameter in inches.						
			1″–6″	6″–12″	12″–18″	18″–24″	24″–30″	30″–36″	Over 36″
Coimbatore .	Punachi, Anamalai Hills.	4	44,000	19,500	14,000	5,000	900	140	22
South Coimbatore.	Thalingi .	8	59,000	22,100	5,000	400	9	...	...

(c) Punjab.

Vernacular names.—Dhau, Chhál.

Local distribution.—This tree is abundant in the Kangra and Simla Hills Divisions but is not reported from any other. It grows between

1,500 and 3,000 feet above sea-level in mixed forests and forms sometimes 50 per cent. of the crop, and is as plentiful in places as 10 trees to the acre. It is however nearly always stunted, with girth rarely exceeding three feet and trunk often hollow, so that it is of little commercial importance, but yields a certain amount of small timber for local villagers' use, the rate they pay being 8 annas per tree.

In the *Marwar State* it is called *Goria Dhaw* or *Golia Dhao* and is found throughout the higher zone of the Aravali Hills at 2,000 to 3,000 feet, where it is one of the most important species and grows with *Boswellia serrata* and *Odina Wodier*, and sometimes pure on plateaux and gentle slopes. Towards the north it occurs to a less extent. It is much used by the villagers for agricultural implements, tool-handles, etc. The Government royalty is about 7 annas per cubic foot and the market rate about 14 annas. Timber is not available for export.

In *Ajmer-Merwara* it is called *Golia dhaw* and is found in small numbers in the Todgarh forest where it reaches a height of 15 feet and is extracted for fuel.

In *Bikaner* a few trees have been grown in the State garden.

(vi) *United Provinces.*

Vernacular names.—Bakli, Dhau, Dhura, Dhoti, Dho.

Local distribution.—*Dhaw* is very local in the United Provinces, being absent from Pilibhit and Kheri, and fairly plentiful in the submontane tracts and plain forests elsewhere. It grows in the mixed deciduous forests and at times as an associate of Sal, where it has like other trees suffered in operations carried out in order to favour the more valuable species. Sound trees up to 6 feet in girth are not uncommon, and logs 40 feet in length and 4 feet in girth can usually be obtained. In Bundelkhand the trees are usually smaller. Small trees are found in great numbers on the lower slopes of the Himalayas near Dehra Dun, forming at times a pure forest, but these do not grow to a large size. Mr. T. Carr reports a tree in the Sarda Range, Haldwani Division, measuring 9' 3" at breast-height and quite sound, with a straight bole 24 feet long.

Extraction.—Most of the trees felled come out in Improvement fellings or are specially selected for traders in the most accessible parts of

the forests. In Gonda the tree is considered mature on attaining a girth of six feet. Logs are exported in the round as it is difficult to saw by hand, the copses being sold to contractors, as usual in these Provinces.

The following table gives the available details :—

Division.	Royalty.		Rate for delivery.		
	R a. p.	Per	R	Per	At
Haldwani . .	...	...	3 to 5 annas.	c. ft.	Haldwani or Lalkua.
Bahraich . .	0 2 0	c. ft.	7 annas.	do.	Bahraich.
Gonda . .	0 3 0	c.ft. round.	6 annas.	do.	Railway stations.
	0 4 0	c.ft. rough squared.			
Siwaliks (Dehra Dun).	...	...	6 annas.	do.	Railway stations.

(vii) *Bengal.*

Vernacular names.—Dhaura, Hosel (Santal Parganas), Dhau, Dhaunta, Sala.

Local distribution.—The tree is fairly common in all the forests of Bengal and Orissa except in Kurseong, Tista and Darjeeling in the north where it is not found. It favours the drier hills forming a large proportion of the growing stock in Chota Nagpur, and ascending as high as 3,000 feet growing usually with Sal, Terminalias and other deciduous trees. In Orissa trees 7 feet in girth are occasionally found, but further north the limit is usually 5 feet and the commonest size 3 to 4 feet. Its greatest height is 60 feet with a clear bole of 40 feet.

Extraction.—In Samalpur, Santal Parganas and Puri Coppice fellings are carried out and elsewhere trees are selected as required, a

limit of girth usually being observed. Purchasers buy the marked trees and extract them usually with carts, occasionally also by dragging and floating, slung to boats, as in Orissa.

The following table shows the figures available:—

Division.	Royalty.		Market value.		Rate for delivery.		
	₹	Per	₹ a. p.	Per	₹ a. p.	Per	At
Angul . .	1 to 3 annas. 2 pies to 2 annas.	c. ft. green. c. ft. dry.	0 4 0	c. ft.	0 6 0	c. ft.	Cuttack.
Chaibasa .	...	...	...	...	0 10 0	c. ft.	Lohardaga.
Puri . .	1 anna	c. ft.	0 5 0	c. ft.	0 4 0 0 6 0	c. ft. c. ft.	Balugan. Cuttack.
Sambalpur .	2 annas	c. ft. green.	...	...	0 10 0	c. ft.	Railway stations.
	1 anna	c. ft. dry.	...	...	1 10 0	c. ft.	Calcutta.

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
8, HASTINGS STREET

NOTE ON RED SANDERS

Pterocarpus santalinus, Linn. f.

BY

T. A. WHITEHEAD, I.F.S.,

District Forest Officer, East Coddapah.

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1917

Price As. 9 or 10d.

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[*Continued on page 3 of cover.*

Forest Bulletin No. 34 1917

NOTE ON RED SANDERS

Pterocarpus santalinus, Linn. f.

BY

T. A. WHITEHEAD, I.F.S.,

District Forest Officer, East Cuddapah.

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1917

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The Red Sanders.

Pterocarpus santalinus, Linn. f.

Telugu.—Chandanam.

THE RED SANDERS.

Pterocarpus santalinus, Linn. f.

Telugu.—*Chandanam.*

1. Distribution.

Red Sanders is found on the slopes of the hills of the Cuddapah District and on those hills of the neighbouring Districts which are found near the Cuddapah District boundary. The accompanying map shows the distribution of located Red Sanders areas in the East Cuddapah Division. Gamble in his "Manual of Indian Timbers" remarked that Red Sanders was only found in this locality, but it has since been reported to exist naturally in forests in the Bombay Presidency. The Divisional Forest Officer of the South Thana Division in the latter Presidency reported in 1914, that it occurred scattered sparsely throughout the forests of this division which comprises 181,400 acres. Only one to two trees per acre are, on an average, found in these forests. The dimensions attained seem to be similar to those to which the tree grows in Cuddapah; but the market value is not so high.

In some of the hill blocks in East Cuddapah, areas containing more than 10 per cent. of Red Sanders have been accurately located and working-plans prepared, and these areas have been marked on the map in red. In other blocks both in the East and West Divisions, the Red Sanders areas have not yet been accurately located. The total area covered by Red Sanders, above and below 10 per cent., in the forests of both Divisions, is estimated to be about 1,000 square miles.

2. Climate.

The climate is dry and hot. From March to the middle of June the maximum shade temperature varies from 95 to 115 degrees Fahrenheit. The South-West Monsoon in July brings some 10 to 15 inches of rain, the temperature falling to an average of 92 degrees. During the latter part of August and the whole of September, the temperature rises to an average of 102 degrees, and it is then generally very sultry. With the break of the North-East

Monsoon, the temperature again falls to an average of about 90°, gradually falling to 70° during the latter part of December and the beginning of January. The rainfall during October, November and December varies from 20 to 30 inches. January and February are usually dry and cool. The minimum temperatures are from 15 to 25 degrees lower than the maxima noted above.

3. Geology and Soil.

The Red Sanders forests under discussion are found growing above rocks of the Kurnool and Cuddapah formations (Palæozoic) consisting of quartzites, slates and limestones. The rocks of these two formations are true sedimentary rocks and show all the characters of such in a very clear manner; but they have been altered or metamorphosed to some extent, in such a way that the original sandstones and conglomerates are now hardened and vitrified as quartzites. The shales and clays have been turned into clay slates, and in some cases porcellanized, and the limestones have been rendered more or less crystalline. This is the general character of the rocks, but it is often found that they are all weathered back again into their originally more sedimentary appearance. The ordinarily compact, flinty, homogeneous quartzites turn out after weathering to be the coarsest sandstones or the roughest conglomerates. The limestones become earthy and clayey, and the porcellainous beds are again ordinary soft pipe clay-looking shales. The soil formed by the disintegration of the above-named rocks is poor, well-drained and very stony.

4. Past History.

In former days, the wood of the Red Sanders tree was chiefly valued for its red colouring principle "Santalin," which is soluble in alcohol and ether but not in water. It was very extensively used as a dye, and large quantities of "Red Wood" were exported to Europe for this purpose. The shipments continued until comparatively recent times, when this natural dye was entirely superseded by the introduction of artificial substitutes. The earliest account of this trade was brought to light by the editor of *Nature* (Calcutta), who published an interesting article in the issue of May 4, 1911, of which the following are extracts:—

"During the preparation for the press in 1895, of the 'Diary and Consultation book of Agent, Governor and Council of Fort St. George,' for 1682-85, Mr. A. T. Pringle, the Editor, enquired if

I could throw any light on the origin of 'Caliature,' a name of Red wood (*Pterocarpus santalinus*), frequently referred to as an article of trade in Madras. Presuming the name to be that of a Port of the East Coast, it has evidently disappeared from nearly all the available Gazetteers and Modern Atlases. Inquiries were made in London, Holland and Java with no results; but recent researches in the libraries of Calcutta have been more successful, and the following notes on the early trade of the country form an interesting chapter on the History of Red Sanders wood:—

"To Rumphius belongs the credit of giving the origin of the term 'Caliature.' In 'Herbarium Amboinense,' 1750, Vol. II, 48, he speaks of 'Santalum rubrum' being known in his country and in Europe, and as coming from a tree from which 'lignum calitour' is derived. The wood is very hard, solid and dull red, which, he says, could be obtained in great abundance from the northern parts of the Coromandel Coast. Various kinds of furniture were made of it, as benches and elegantly carved chairs. Only the mature trees afforded good Sandalwood, as was shown in letters sent to him in 1689. The wood was also used as a tincture in the arts, and the Armenians in Shiraz and Ispahan added it to distilled spirit of wine to give it a beautiful and intense red colour. The identity of the town by Rumphius I will quote in the original Latin:—

"Hisce addo ex iisdem literis locum Calitour quondam dictum, hodie in ora Coromandelensi hoc nomine non amplius esse notum, sed tempore mutatum fuisse in Krusjnapatanum, seu Kisjna Paten, it a ut primi nominis memoria inter Europeos tantum conservetur."

"The town of Kistnapatam, referred to in this paragraph, is in the Nellore District of the Madras Presidency. It is now a village, situated at 14° 17' North Latitude, 82 miles north of Madras; it has a fine back-water of great depth, and is a Shelter for native craft during the Monsoon. In an old glossary it is said to be the Greek Sopatma, and 'title otherwise Caliore.' In a map accompanying 'a true and exact description of the most celebrated East India Coasts of Malabar and Coromandel' (1672), by Philips Baldens, Calletur is shown between Armagon and Penne (Pennar River). In a map of the 'Peninsuladeli India' (dated 1663), by Giacoms, Cantelli da Vilmola, a Portuguese, the town is indicated as 'Caletur.' It is evident that while the town was known to foreigners as Calétore and Caletur, it was not recognised by that name by the British factors.....

"The earliest English factory was planted in 1625 at Masulipatam, where trade was carried on with varying fortune for several

years. In 1628 the Agent, pressed by the Dutch rivalry, migrated southwards to Armegam. In 1639 Armegam in its turn gave way to Fort St. George, Madras, which in 1653 was raised to the rank of an independent Presidency. Between this young growing factory and the court of the Honourable East India Company there was considerable correspondence, and interesting extracts are made in the Diary and Consultation Book of the Agent and Governor. In their despatch, dated February 8, 1681, the Court wrote as follows:—

"And we do further order that you make the like provision of 300 tones Red wood for our next year's shipping. The Dutch called this Red wood by the name of Calliature wood, and we do per the Nathaniall and Willamson send a pattern thereof which came from India. We are informed that it costs about 2½ pagodas per candy, they are usually in pieces of about 3 yards long but you may have it sawed into pieces of about 2 feet more or less as the Commanders shall desire for conveniency, it being to be ground to powder here and used in dyeing.

"Contracts for the supply of the wood were negotiated by the Governor, and the question of advances was settled with merchants. In September 1682, the following entry in the diary occurs:—'The Calliature or Red wood merchants having made a contract with ye Agent, etc., for candy of Red wood, declared that without they might have half the money beforehand they could do comply with their contract which upon their promise of giving security was granted them.'

"Red wood was frequently used as ballast in home going ships. A specific case is recorded in the diary for 1682:—Captain Willshow of the 'Resolution,' complained that he would not be able to ride out ye storm without sufficient Quintelage (ballast) therefore ordered that the warehouse keeper doe lade on board him 100 tons saltpetre and what Calliature wood can be got to stiffen his ship and inable him the better to ride out ye storm".....

"In 1685 as much as 1937 pagodas were paid to the local Red wood merchants in 7 instalments during the year. Calculating the pagoda at 9, this amounts to £605. This, however, indicates only a portion of the trade for the year.

"Reference to the private Diary of Ananda Ranga Pillai from 1736 to 1761" proves that the trade in Red Sanders wood was still brisk. In 1739 the Ship "Fleury" sailed for France with 1,000 candies (candy 500-lb.) and the 'Phenix' with 2,000 candies of Red wood. It might be mentioned that 'James and Mary' that

gave its name to the dreaded Sand Bank in the Hughly and was wrecked on September 24, 1694, carried a cargo of Red wood taken up at Madras.

"In the letters received from the East India Company from its servants in the East, 1602-1617, there are numerous references to the various kinds of Sanders wood but they are easily distinguished. The Red Sanders wood always came from the Madras Coast, and was sent to Europe for dyeing purposes."

Gamble in his "Manual of Indian Timbers" records that, in the 5 years ending with 1888-89, 12782 tons were exported to the United Kingdoms, 1116 tons to France and 1687 tons to other Indian and Ceylon ports. The whole valued at 3½ lakhs of Rupees. From 1882 to 1901 Red Sanders timber and fuel was extracted by contractors for the department without restriction as to the locality from which the produce was to be got. This of course was detrimental to the forests since little supervision could be exercised by the department over the Contractors. They were permitted to work over extensive areas and helped themselves to the plums. The Act of 1882 was not vigorously enforced and the deterioration of the Forest continued. In 1909, a Timber working-plan for the Seshachellams in the East Division was sanctioned. An attempt to work it was made till 1912. It was then proved to be unworkable owing to the impossibility of carrying out its prescriptions with the inadequate staff sanctioned. During this period unregulated timber fellings took place in the other forests of the District. These fellings were put a stop to in the year 1912-13, since they had degenerated into the extraction of only the best trees from the most promising and accessible localities."

5. Present Condition of the Forest.

The extraction of Red Sanders wood in the past had not been confined to stem and branch-wood only. The roots were also extracted. It is a matter for surprise that the tree has survived total extermination. The damage done in the past can only be fully appreciated by seeing the present state of the forests. A Mature Red Sanders tree is difficult to find, although old blackened stumps up to 7 feet in girth are still in existence. A large proportion of the growth is in the pole stage and a great many trees have been mutilated by fire and by man. It, however, reproduces itself vigorously in coppice by suckers and from seed, and to this innate vigour it owes its existence.

6. Present System of Management.

The present state of the forest has necessitated the introduction of Improvement fellings. No sound timber is therefore now being extracted except illicitly. The number of tons of Red Sanders wood extracted under this system annually will be found in the statement "Appendix A." The present system provides for the improvement and subsequent rigid protection of areas sufficiently small to ensure detailed work and thorough supervision. It was devised to encourage the growth and protect the existing stock of sound Red Sanders trees, and work is therefore confined within the limits of the Red Sanders belt or zone, i.e., between 800 feet and 2,400 feet above sea-level. The area of the annual coupe in each felling series is at present limited to about 100 acres. The trees to be retained are marked departmentally and the coupes are worked by contractors. Five Working Circles, consisting of 22 Felling Series of 20 coupes each, are now under working. Thus, Improvement fellings over an area of some 2,200 acres are carried out annually in the East Division. Working-plans are being prepared in the West Division and there is room for still further development in the former Division. Plates I and II (figs. 1–4) show the nature of the fellings.

7. Appearance of the Tree.

It is a very pretty, moderate-sized tree with an upright clean bole and rounded crown. The wood is dark claret red in colour and is extremely valuable.

8. Habits.

It flowers from April to June, seeding the following February and March. The seedlings die off annually during the hot weather, while the root system increases, until the shoots are large and strong enough to resist the drought, the heat of the sun and at times also fire. It prefers an *eastern aspect* on stony hills. It forms the greater percentage of the growing stock on the lower slopes where it is in places found pure. The usual associates of Red Sanders are:—In the lower elevations, *Hardwickia binata*, *Anogeissus latifolia* and *Chloroxylon Swietenia*; and in the higher elevations *Terminalia tomentosa*, *Buchanania latifolia*, *Shorea Tumbuggaia* and *Talura*, *Eugenia alternifolia* and *Anogeissus latifolia*. In the south of Seshachellam hills in the south of the

Whitehead :—*Pterocarpus santalinus* (Red Sanders).

Fig. 1.

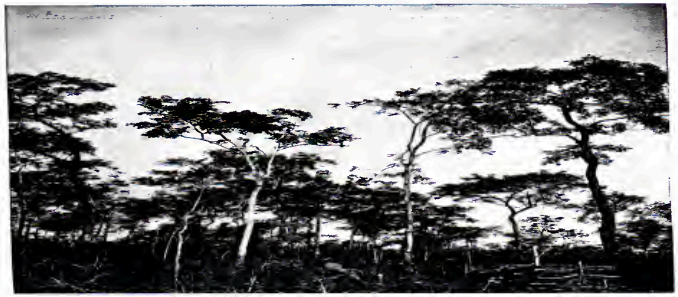

Photo.-Mechl. Dept., Thomason College, Roorkee.

Fig. 2.

Halupalli Tinaler Improvement Felling Series, Coupe I (1914). Just after felling.
Red Sanders, Satinwood, *Dungalasia latifolia* and *Hardwickia binata* mixed.

District, the percentage of Red Sanders is small, generally 10 per cent., but the size and quality of the trees here are superior to those found in other portions of the forests where the percentage of Red Sanders is greater, namely, in the northern portion of the Seshachellam hills, the Palakondas and the Lankamalais. In the last-named localities, it is in places found pure, and generally forms over 90 per cent. of the growing stock.

9. Heart-wood.

A seedling commences to form heart-wood at the age of about 18 years or when it has attained a girth of 6" to 9" at breast-height, while a coppice shoot shows signs of forming heart-wood at the age of 15 years and when it had attained a girth of 9 to 15 inches. Pseudo heart-wood or a premature deposit of the red colouring principle "Santalin" is often found around natural wounds and artificial injuries. The Red Sanders tree of 70 to 80 years of age which, as a rule, averages 40" to 50" in girth at breast-height, may be said to have attained an exploitable age or, in other words, an age at which it is capable of yielding a special post. A local tradition maintains that a Red Sanders tree, after attaining a girth of 40", becomes rotten at the heart. This is no doubt at present true but it is hardly due to old age and over-maturity as is generally supposed. It is probably due to injuries received during the period of the tree's life resulting from repeated scorching. Another tradition maintains that there are two varieties of Red Sanders trees. One variety which has comparatively a smooth bark and light heart-wood is known to the wood-cutter as the "female," the other with the rougher bark and the darker heart-wood as the "male." Botanically there is no difference, and the variety is not due to a difference in the quality of the soil since the two kinds are found mixed. The contention that the smooth barked tree generally has a lighter coloured heart-wood, appears to be true. The scientific reason for this is still to be discovered.

10. Its Uses and Value.

The Red Sanders is principally used now-a-days for construction of house-posts. An important factor in their value is that they are never attacked by white-ants. The best posts are usually bought in pairs for verandah pillars, and are often sold at R40 or R50 per pair of 1½ cubic feet each. Such posts are known as "Specials." One very large post of 2½ cubic feet was recently

sold for ₹75 or, in other words, at ₹30 per cubic foot. This post was grown in the Kodur Red Sanders plantations and was 51 years of age. The dimensions of a "Special" are 15′ to 18′ in mean girth and 10′ to 12′ long. This represents the measurement of the heart-wood after removal of the bark and sap-wood. A tree capable of yielding a "Special" post measures, as it stands in forests, from $3\frac{1}{2}$′ to $4\frac{1}{2}$′ in girth at height of $4\frac{1}{2}$′ above the ground. In addition to the required dimensions, a special post must be without defect and must taper uniformly from base to top. A defective post which, but for the defect, would be classified as a "Special" falls into the first class. The figures in the margin show the average prices of each class. The rates obtained, it will be observed, fall very rapidly. The charcoal obtained from this tree is excellent and fuel of the best quality is obtained from badly formed and diseased trees. Small pieces of the heart-wood are carved by the Settigunta doll-makers into dolls and idols which are in great demand among pilgrims to Tirupati. The wood is also used for agricultural implements and the leaves for fodder. The very high prices paid for "Special" posts are largely due to sentiment.

Special — R10-15-9.
1st class— R5-0-0.
2nd class— R2-13-11.
3rd class R1-2-4.
4th class— R1-6-3.

II. The Dye.

For dyeing cloth a decoction of the wood is prepared, into which the cloth is dipped and the whole is then boiled. In this way, the cloth is dyed a beautiful salmon pink colour. In Europe the dye-stuff was employed by pharmaceutists as a colouring agent. It has also been used for dyeing leather red, but was principally applied in wood-dyeing and calico-printing. From a report of 1881 by S. Liotard, it is seen that in the Bombay Presidency the wood was cultivated in the Barsi Taluk to the extent of about 300 acres. It was sown in September and the plants were allowed to grow for 3 years when they were pulled up by the roots and the small roots were cut off and dried in the sun and yielded the dye. The cost of cultivation was about ₹1¼ per acre and the profit ₹3. About 600 maunds were annually thus produced at Barsi. Of this quantity, about 30 maunds were absorbed locally and the rest forwarded to Sholapur, Poona and Ahmadnagar. The value of Red Sanders wood annually sold at Sholapur was reported by the District Officer to be ₹50,000 and at Barsi ₹800. The price was from 3 annas to 4 annas a seer. In the Ratnagiri District the tree was not cultivated. It grew in the woods and the dye-stuff was brought into the town whence it was exported to Bombay.

Fig. 3.

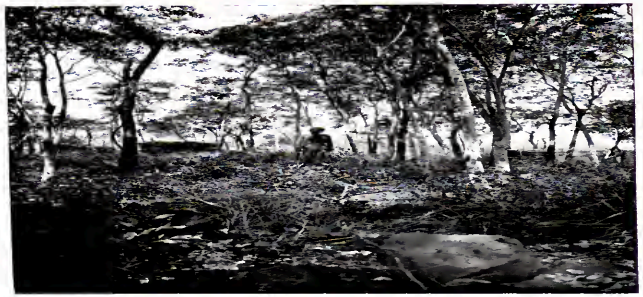

Photo:-Meehl Dept., Thomason College, Roorkee.
Kodivengammalhavi South Timber Improvement Felling Series, Coupe I (1914). After felling.
Red Sanders and *Anogeissus latifolia* mixed.

Fig. 4.

Kodivengammalhavi North Timber Improvement Felling Series, Coupe II (1914). After felling.
Red Sanders and *Anogeissus latifolia* mixed.
Red Sanders marble wood.

12. Points of Interest.

The following extract from the "Dictionary of the Economic Products of India" by Dr. George Watt, is of some interest:—

"According to U. C. Dutt, Sanskrit writers describe several varieties of sandal or *chandana*. Of these, *srikhanda*, white; *gitachandana*, yellow; and *raktachandana*, red; are best known. The first two are simply the wood of the true sandal, *Santalum album*, of different shades. It has long been a matter of question, how woods differing so entirely in character as Sandal-wood and Red Sanders wood should have come to bear the same Sanskrit name of *chandana* and the same English appellation. On this subject Dutt remarks, 'I am inclined to think that the name is owing to the similarity in the uses to which Hindus put both these articles. Both Sandal wood and Red Sanders wood are rubbed on a piece of stone with water and the emulsions are used for painting the body after bathing and in religious services."

Kodur Red Sanders plantations.—Red Sanders seedlings were planted by Mr. H. H. Yarde, Deputy Conservator of Forests, in 1865 on an area of 38 acres along the banks of the "Gunjana" stream close to the Madras and Southern Mahratta Railway line near the Kodur station. The plants were put out in rows as nearly as possible 8 feet by 9 feet. From the year of planting to the year of 1883, no information was recorded in regard to this plantation. In 1883, a sample area of $\frac{3}{4}$ of an acre was selected and the girth measurements of all the trees on this plot were recorded. From 1883, reference has been made to the plantation in various Administration Reports with reference to creeper-cuttings and thinnings. The trees are now 51 years of age and average about 26 inches in girth and 50 feet in height. The largest tree is 52" in girth and about 60' in height. The dead and dying trees are now being taken out. The expenditure on this plantation since 1865 up to date has been nearly ₹6,000. Some ₹2,000 revenue has been derived from a few thinnings during the past 5 years and the value of the growing stock at present will not be far short of ₹1,00,000.

APPENDIX A.

Statement showing the quantity of Red Sanders timber and fuel extracted from the forests of the Cuddapah District.

Forest Division.	1912-13.		1913-14.		1914-15.		1915-16.		Remarks.
	Timber (tons.)	Fuel (tons.)	Timber (tons.)	Fuel (tons.)	Timber (tons.)	Fuel (tons.)	Timber (tons.)	Fuel (tons.)	
East Cuddapah Division.	B 154	B 14,939	B 601	B 12,433	B 1,092	B 17,074	B 2,171	B 57,596	
West Cuddapah Division.	A 1,940	B 9,974	A 908	B 7,819	A 648	B 9,727	A 640	B 6,494	

NOTE:—A. Red Sanders species.

B. No information is available to show what quantity of Red Sanders timber and fuel was extracted. The figures represent the total quantity of timber and fuel extracted during these years. At least 50 per cent. will be Red Sanders. As the Forests are being worked under the Improvement system the bulk of the produce extracted is fuel, being Red Sanders and other species mixed.

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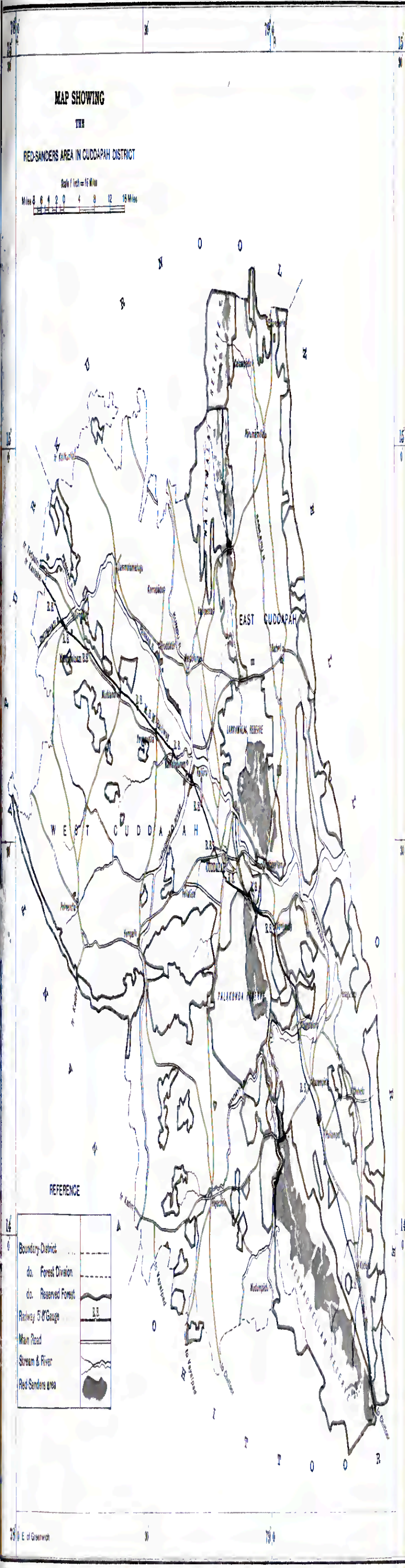

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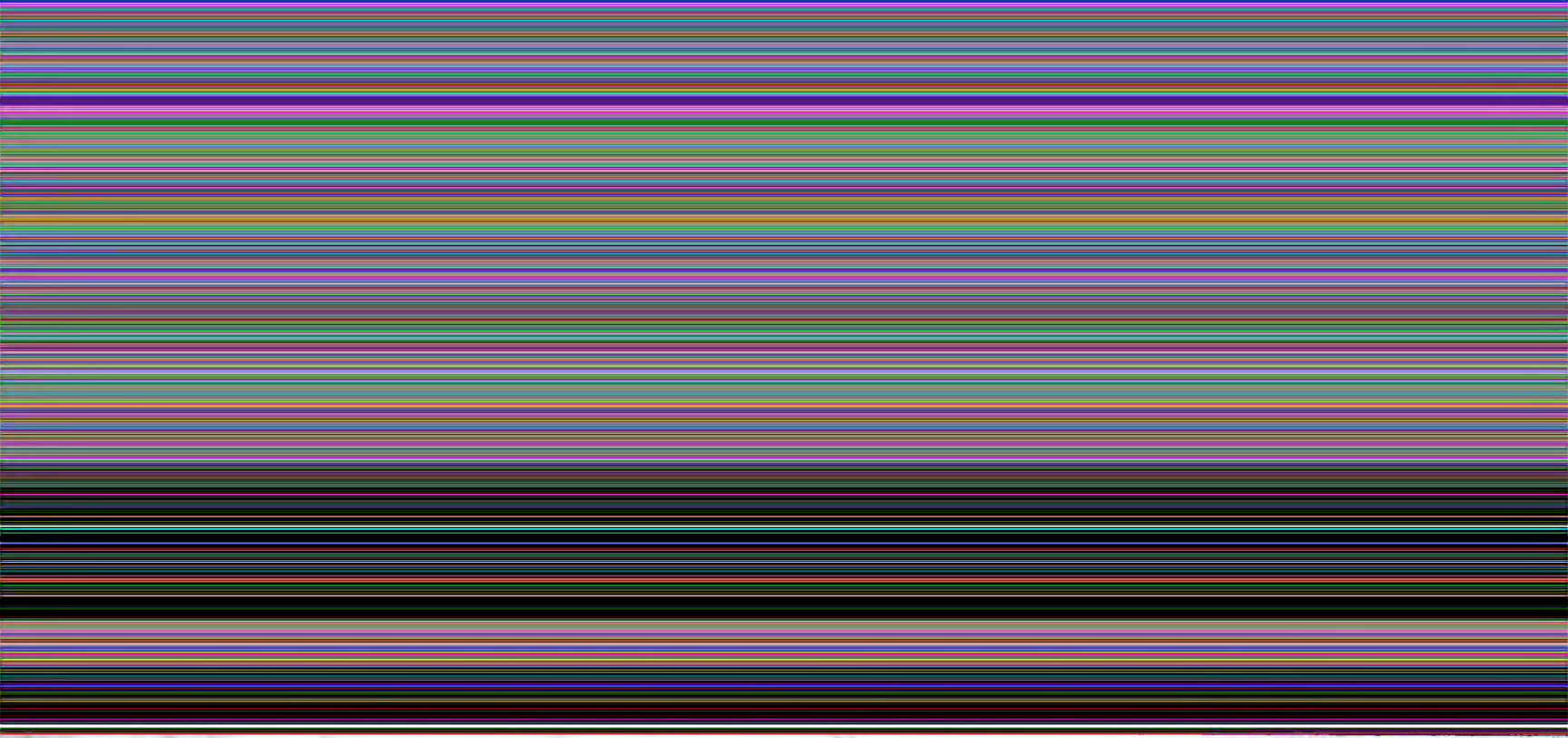

Forest Bulletin No. 35 1917

NOTE ON BABUL

Acacia arabica, Willd.

BY

J. D. MAITLAND KIRWAN, I.F.S.,

Deputy Conservator of Forests,

AND

Instructor, Forest Research Institute and College, Dehra Dun.

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[*Continued on page 3 of cover.*

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SUPERINTENDENT GOVERNMENT PRINTING, INDIA
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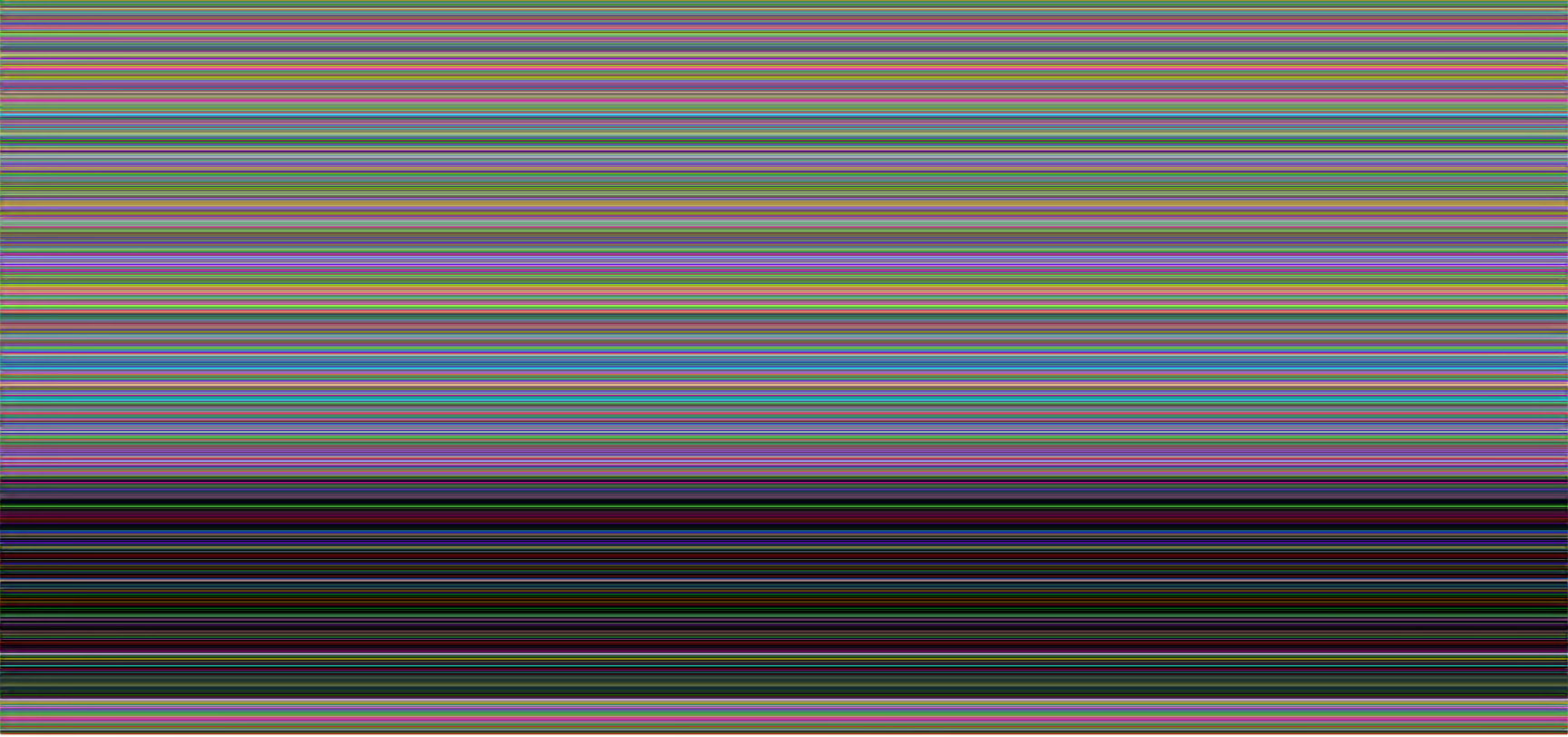

Babul.

Acacia arabica, Willd.

Natural Order.—*Leguminosæ* (*Mimoseæ*).

BABUL

Acacia arabica, Willd.

Natural Order.--*Leguminosæ* (*Mimoseæ*).

Vernacular names.—Babul (Hind.); Kikar (Pb.); Babur (Sind); Gabur bakar (Santhal); Babola (Mal Pahari); Karuvelam (Tam.); Tuma, tamma, nella tuma (Tel.); Gobli, gobalu, jali, karijali, jaligida (Kan.); Bamura (Jubbulpore); Babli (Hyd.); Karu velagum (Mal.); Babulo, kikoro (Uriya).

Introduction.

The data, on which this note is based, are those collected by the Forest Economist, and consist chiefly of reports from Divisional Forest Officers, and extracts from works of reference, and from articles which have appeared from time to time in the "Indian Forester." The subject will be dealt with under four heads: I.—Distribution, II.—Silviculture and Management, III.—Timber, and IV.—Minor Products. As the series of bulletins, of which this note forms a part, is designed to treat of forest trees, chiefly from a commercial point of view, the silviculture of the tree will be dealt with as shortly as possible.

I. Distribution.

Babul is indigenous in Sind, Rajputana, Berar and the Central Provinces, Gujarat, and the North Deccan, but it is also cultivated and grown in the drier parts of India and, to a small extent, in Upper Burma.

It occurs as far north as Jammu, etc., where it is found at the lower elevations, especially near cultivated lands, and extends to the very south of the Peninsula. This does not mean that there are large Babul forests all over India. On the contrary, a large proportion of the growth occurs in Revenue lands in the form of small patches of isolated trees. The District Forest Officer, Guntur, Madras Presidency, for instance, states that "isolated trees are everywhere met with"; and he estimates the Babul-bearing area in his district at 19,003 acres, of which only 4,817 acres are reserved forest—a state of affairs which must be typical of many Indian districts.

The only Provinces in which Babul forests of any extent occur are Bombay (including Sind), Berar (Central Provinces) and Madras. By far the finest and most extensive forests are found in Sind which may, in fact, be termed the home of the Babul. The Hyderabad Division alone contains 90,000 acres of Babul forest and the Jermuk Division follows close with 80,000 acres. Several divisions of the Bombay Presidency proper contain fairly large tracts, notably Poona with 12,440 acres, and East Khandesh, 4,220 acres. Three of the four Berar districts, namely, Amraoti, Buldana and Akola also furnish substantial Babul-bearing tracts, while important tracts also occur in some Madras districts.

The following statement gives roughly the areas of Babul forest in the provinces above referred to:—

Bombay	Sind Circle . .	172,000 acres.
	Central Circle .	32,000 acres.
Central Provinces	Berar . . .	15,000 acres.
Madras	All Circles . .	77,000 acres.

It does not seem necessary to give detailed information regarding the numberless small areas of Babul occurring in the various provinces. Enough has been said to indicate where the tree is at present growing on a commercial scale, and further details regarding its distribution would no doubt be gladly furnished by the Conservators of the various Circles.

II. Silviculture and Management.

(a) Locality.

Babul is seen at its best on alluvial soil in riverain areas which are subject to annual inundation. The truth of this is very evident from an examination of the Sind forests. These forests fringe the banks of the Indus, and areas which benefit by the inundation, and of which the soil is not too salty, produce excellent crops of Babul; whereas areas which are too high or too far from the river to benefit from the inundation either bear no forest at all or forests of other species, such as *Prosopis spicigera*, in which Babul is largely or wholly absent.

Next to alluvium—black cotton soil is most favoured by the tree; Babul may, in fact, be said to be the tree most typical of black cotton soil areas. It is also very generally found growing in tank beds; in

cultivated land, and along ravines, and it is also a common road-side tree.

As a rule, Babul requires the subsoil moisture to be near to the surface, as it is a shallow-rooted species, and it is no uncommon sight in Sind to see crops of Babul dying of drought, owing to the river having changed its course, thus depriving the trees of the moisture to which they had been accustomed. The tree is, however, satisfied with a very moderate rainfall, and can of course dispense with rainfall altogether if subject to annual inundation. Babul prefers very low elevations and rarely grows above 2,000 ft. above sea-level.

(b) Shape and Development.

Babul is a small to moderate-sized tree with a large spreading crown and a comparatively short bole. Its dark brown bark is much fissured, its leaves are bipinnate, and its flowers, which appear in the rains in axillary globose heads, are yellow and fragrant. A distinctive feature of the tree is its straight, white, sharply pointed spines which are often half an inch long and sometimes even longer. It is, generally speaking, a shallow-rooted tree and, as such, subject to danger from wind-fall. Although reliable figures are not available, Babul may be said to be a fast growing tree, at any rate during the first twenty years or so of its life. The Divisional Forest Officer, Hyderabad, Sind, states that in less than 5 years the tree, under favourable conditions of soil and moisture, attains a girth of 1½′ at breast-height, while its average girth at 35 years is about 4′. It attains its highest development in Sind, where trees often reach a height of between 50 and 60 feet, with a clear bole of 20 to 25 feet, in favourable localities, and where girths of from 8 to 10 feet are not uncommon. Berar and some of the Deccan divisions also contain well-developed Babul, but the height-growth is on an average considerably less than that in Sind; while in Madras the growth is much poorer, the height being rarely over 20 feet, and usually considerably less. The above remarks apply to localities suited to the tree; in unsuitable localities such, for instance, as stony shallow dry soils, the development is very poor, the tree having a stunted appearance and being of very slow growth.

It may here be stated, on information kindly supplied by the Forest Botanist, that the three following varieties of Babul are commonly recognized:—

(1) *Telia* or *Goli*. Bark blackish brown, slightly cracked, spines short, pod distinctly constricted between the seeds.

(2) *Kawia* or *Teli*. Bark grey brown, deeply cracked, spines long, pod very little constricted between the seeds.

(3) *Ramkanta, Kabuli Kikar, Kikori*, a broom-like tree with close ascending branches, somewhat like a cypress.

In this note Babul is, however, treated as one species, the question of varieties being ignored; because although these varieties are commonly recognized, their constancy and detailed botanical characteristics have not yet been finally determined, and consequently precise information regarding the distribution and relative economic importance of the different forms is not yet available. At the same time, it may be noted that Brandis states that the wood of Tella is prized while that of Kaurie is only fit for firewood. The matter is, however, under study by the Forest Botanist.

(c) REPRODUCTION.

In localities favourable to the growth of Babul, the question of its regeneration presents little difficulty. Although natural regeneration is said to be excellent in some districts, yet it is generally found that to collect and sow seed which has passed through cattle, sheep or goats (which eat the pods greedily), gives the best results; or the animals may be fed on the pods and stalled on the area which it is wished to regenerate. The frequent failure of green seed to germinate is believed to be due to insect damage.

In favourable areas such, for instance, as the best Sind forests, it is quite sufficient to broadcast the seed, but in localities which are not so suitable, sowing in pits and patches and on ridges and mounds have all been tried with more or less success. In places where broadcast sowing is not successful, however, some form of ploughing before sowing, where this is feasible, will usually give the best results. The area may be full ploughed, ploughed in single lines, or cross ploughed, and the seed broadcasted (in the case of full ploughing), or sown in the furrows; provided that the seed used has passed through cattle, this method should ensure success. The agri-silvicultural method of regenerating Babul has been tried with great success in various districts, and especially in Berar. According to this method, Babul seedlings are raised with field crops, and thus obtain all the advantages of ploughing, while the latter is carried out without expense to the Department.

Many forest officers look on Babul as a non-coppicer, and it is a fact that, in most of the important forests, the tree is, for all practical purposes, a non-coppicer.

In several districts, however, among which may be mentioned several Madras districts, notably Anantapur and Guntur, the Jhansi district of the United Provinces, the Surat district of Bombay, and the Ajmer-Merwara district, the tree is said to coppice well, but it does not appear to send up good shoots after it has passed about 15 years of age.

It may here be mentioned that the tree pollards well. Young Babul seedlings are fairly hardy, and it is never necessary to raise them in a nursery. They suffer a good deal from frost in districts where this occurs, but more often than not, put out fresh shoots.

Another foe to young plantations is a Lamiid beetle, *Celosterna scabrata*, Fab., commonly known as the Babul root-boring longicorn. The Forest Zoologist states that this is a pest of the first importance, since it is capable of obtaining a complete mastery over a young plantation. It attacks the stems and roots of young plants, usually in the second or third year, and plants seriously attacked are certain to die. The Sind forests do not appear to suffer from the attack of this insect, details of whose life-history together with instructions for preservative and remedial measures, can be obtained from the Forest Zoologist.

(d) Management.

Seeing that Babul tends to form pure even-aged crops, and that the regeneration of the species, as has been explained above, usually presents no difficulty, the management of such forests is quite simple. Typically, the clear felling method, with a rotation of 30 or 40 years, followed by artificial regeneration, is applied, and this gives excellent results. In cases where the primary object of management is the production of bark for tanning purposes, the rotation should be much less, say, 10 or 15 years.

In districts where the tree coppices well, the coppice-with-standards method has been adopted with varying success. Surat and Anantapur are examples of such districts, and the Guntur and Tinnevelly forests were also worked according to this method, for some years, on a 20-year rotation, but the treatment was found unsatisfactory, and abandoned in favour of selection fellings.

III. Timber.

(a) Description and Properties of the wood.

Heart-wood and Sap-wood.

The heart-wood is pink, and turns reddish-brown on exposure, being mottled with dark streaks. It polishes well without absorbing much polish. The sap-wood is yellowish white in colour, and, in mature trees, forms a small proportion, say, less than 20% of the total volume. The annual rings are not very distinctly marked.

Durability.

The heart-wood is hard and very durable; if well seasoned, it is tough and somewhat difficult to work. It is said to be not readily attacked by insects; whereas the sap-wood is soft, is readily attacked by insects, and decays rapidly.

Weight.

The average weight of the timber is 54 lbs. per cubic foot.

Strength.

The value of P., which represents the strength of a bar of timber, calculated from the length between supports, breadth, and thickness of the bar, and the weight in pounds, which, when placed in the middle of the bar, causes it to break, is from 875 (Cunningham) to 884 (Skinner). As the same coefficient for teak is 600, for Sal 790, and for Shisham 796, it will be realized what a very strong wood Babul is.

Fissibility.

No experiments, as regards the fissibility of Babul timber, have yet been made.

Calorific Power.

The following table gives the calorific value of Babul charcoal and fuel:—

Charcoal prepared in	Calories.	Br. Thermal Unit.	Water evaporated at 212° F. by 1 lb. of charcoal or fuel
(a) Open kilns . .	6,675	12,015	12·47
(b) Closed kilns . .	6,831	12,295	12·71
Fuel	4,814	8,665	8·95

Seasoning Power.

The timber seasons well without much warping or splitting. Various methods of seasoning, such as immersing in water and burying in the

ground, have been tried, but natural seasoning in the air seems to be quite satisfactory. The bark should be removed first in order to minimise the chances of insect damage, and large logs should be roughly squared.

(b) Felling and Extraction.

Babul coupes are, as a rule, sold standing to contractors, who usually fell small trees with the axe, and sometimes use the saw for larger ones. As the tree typically grows on comparatively level land, its extraction presents no difficulty; carts or camels being the usual means employed in conjunction with carriage by boat, where, as in Sind, a suitable river is available.

(c) Size of Timber obtainable.

The wood forms such an excellent fuel, and is, therefore, so extensively used for fire-wood that Babul forests are worked under a short rotation, usually roundabout 30-40 years, which is long enough to produce the class of material most in demand, such as, in addition to fuel, small timber pieces for agricultural implements and the like. The consequence is that the only large logs available (and many of these are unsound) are those cut from the old trees which are gradually being removed, and whose place will be filled by much smaller stuff. The supply of large Babul timber is thus being rapidly exhausted, and it is significant of this that, in discussing the uses to which the timber may be put, the Divisional Forest Officer, Jerruck (Sind) states that while his Division used to supply timber for the Gun-Carriage Factory, timber of the necessary dimensions is not now available. Should, however, a supply of large Babul timber be required, there would be no difficulty in growing it, and selected areas could be set apart for that purpose.

(d) Outturn and Price.

It is not possible to give figures of outturn in any detail, as these are generally either not available or unimportant. The table below contains statistics supplied by the officers in charge of the divisions, in which the most important Babul-bearing areas are situated. These statistics are entered as received, and no attempt has been made to convert them to a uniform standard of measurement; they are merely intended to indicate roughly the quantities of Babul wood available from Government forests at these centres. No details are to hand as regards the outturn in Revenue lands, but it may be remarked that neither from forest nor from Revenue lands does there appear to be any appreciable quantity of timber available for export.

Outturn and Prices of Babul in different localities.

Division.	Outturn during last five years.		Estimated future annual outturn.		Price.	Remarks.
	Timber.	Fuel.	Timber.	Fuel.		
Bombay and Sind.						
Hyderabad . .	141,979 (c. ft.)	..	60,000 (c. ft.)	1,640,000 (c. ft.)	Average price of timber 0-11-0 per c.ft.	
Jerruck . .	150,058 (c. ft.)	..	31,611 (c. ft.)	..	Average price of timber 0-14-0 per c.ft.	Estimated outturn of fuel not stated.
Poona . . .	1,777,980 (c. ft.)		300,000 (c. ft.)		Rs. 12-0 to Rs. 14-0 per Khandy of 20 maunds.	Figures give gross outturn of timber and fuel.
Berar.						
Amraoti . .	7,157 (tons.)	..	1,450 (tons.)	..	Rs. 17-0 per ton for split fuel.	Figures probably include fuel.
Buldana . .	92,809 (c. ft.)	..	14,605 (c. ft.)	..	Rs. 10-0 per ton green. Rs. 13-0 per ton dry.	Figures probably include fuel.
Akola . .	..	366,209 (c. ft.)	..	73,242	Rs. 9-0 to Rs. 15-0 per ton of fuel.	Not sold as timber.
Madras.						
Guntur . .	..	6,23,320	..	..	Rs 15-0 to Rs. 20-0 per ton.	No estimates of future outturn have been made.
Tinnevelly-Romnad	9,000 (tons.)	..	..	..	Rs. 10-0 to Rs. 14-0 per ton.	Pieces useful for agricultural implements sell at higher rates.

(*e*) Uses of Timber.

The timber is used chiefly for firewood, and a good deal of it is made into charcoal. It is also used for a large variety of agricultural and domestic purposes, such as the following:—Posts, rafters, beams, door-frames and other parts of houses, bodies of carts and carriages, yokes, axles, shafts, naves, spokes and felloes, solid wheels, boat-building, oars, sugar and oil-presses, rice-pounders, ploughs, harrows, clod-crushers, Persian wheels, well-curbs, cattle-yokes, tent-pegs, boat-handles, bedsteads, cooperage, packings of buffers of railway rolling-stock, carving and turning, including carved dies for cloth-stamping, etc. The Divisional Forest Officer, Sukkur, states that it is used as pit-props in the Khost coal-mines in Baluchistan.

As explained above, the timber was formerly used in the Gun-Carriage Factory, and it has also been tried as a Railway sleeper wood, but in

small quantities only. The sleepers are reported to have had a life of about ten years, if laid in places where they are not liable to attack by white-ants, and to have been supplied by contractors at the rate of Rs. 2-12-0 each. The Port Engineer, Karachi, states that in Karachi Babul sleepers, measuring about 10'×10"×5", were laid down for the Port Trust yard Railway lines, but as they were found to be subject to early destruction by white-ants their use was discontinued.

IV. Minor Products.

(a) Leaves.

The leaves form a useful cattle-fodder and are sometimes farmed out, together with the pods, for the purpose. They also yield a dye.

(b) Pods.

The pods form an important item of cattle-fodder, and the late Mr. C. S. McKenzie, when he was Divisional Forest Officer of Jerruck, wrote that, in that Division, they were almost solely used for that purpose. He says: "The pods are sold annually as they stand on the trees.... Cattle eat Babul pods in their green state, and, in years of very plentiful pod crops, the seed is sometimes stored, to be used as fodder at a later date. When their use is so postponed the pods are usually boiled before being given to the cattle."

In some divisions, the sale of pods for fodder forms an important item of revenue, but in others, notably in Madras, their collection is allowed free. The Divisional Forest Officer, Poona, writes that, in that division, the right to collect pods is sold with the condition attached that a proportion of the undigested seed is returned for sowing purposes; while the Divisional Forest Officer, Tinnevelly, states that though the collection of pods is now allowed free, they fetched as much as Rs. 6,800 per annum before the privilege was granted.

Babul pods also form a tanning and dyeing material, but Mr. McKenzie writing from Jerruck stated that "they yield an inferior tan, and Babul bark is preferred for this purpose." According to Watt's *Commercial Products of India* "Babul pods impart a beautiful colour to leather, and mainly on that account enjoy a certain local reputation as a weak tanning and dyeing material, useful in conjunction with other substances. At the Cawnpore tanneries, the pods are employed almost exclusively for the purpose of removing the lime from skins and hides, before the leather is tanned with Babul bark or other substances. The dyers of India often use Babul pods to obtain certain shades that are admired in calico-printing."

The following is the result of an analysis of these pods made by the Technical College in 1913 :—

	Whole pod. Per cent.	Husk only. Per cent.
Tannin matter absorbed by hide powder	12·6	21·0
Soluble non-tannin matter . . .	13·4	25·6
Moisture	13·0	
Insoluble	54·0	
	100·0	

Since the seeds were said to form 40 per cent. and the bark 60 per cent. of the whole pod, it will be seen that, according to this analysis, 60 per cent. of the bark contains 21 per cent. of tan.

(c) Gum.

The gum of *Acacia arabica* is an important minor product. It is not the true gum arabic, which is obtained from *Acacia Senegal*, but is the Indian gum arabic of commerce or "gum ghati." The gum exudes spontaneously, or is procured by incisions in the bark in the form of small lumps varying in form and size. A good tree is stated to yield about 2 lbs. of gum in a year. The gum is extensively used for calico printing and sizing paper, for fixing paint and whitewash, as a mucilage, and to a limited extent in medicine. It is also eaten, and used in preparing sweet-meats. The price varies according to quality and colour : large light coloured tears from Sind Babul fetch the highest prices, a fair average being about 4 annas per lb., while the fine qualities fetch as much as 8 annas per lb.

The gum is not, as a rule, collected departmentally, but by contractors, as in Tinnevelly, and can generally be purchased in large Bazaars. In the latter case, however, it will very likely be mixed with that of other species, for, as the *Dictionary of Economic Products* states, "the gums designated 'gum Ghati' would embrace very possibly a wide range of gums (besides those obtained from species of Acacia), and very often it is believed degrees of quality must denote the extent of admixture rather than the nature of specific variations.

There is a considerable export trade in Indian gum arabic, and the latest figures available, those for the year 1913-14, show that 44,691 cwts. valued at £62,463, were exported from India to the United Kingdom and various foreign countries. Practically the whole of the amount came from Bombay.

(*d*) Bark.

Babul bark is used to some extent as a dye, and, according to *Dyes and Tans of Bengal* by H. McCann, the following is a recipe for dyeing cloth a dark brown colour:—

"For dyeing a yard of cloth, a pound of the bark is cut or broken into very small chips, and is boiled in about 3 lbs. of water until about 2 lbs. of water remains. The solution is then allowed to cool. A nice weight of alum (about ½ oz.) is then pounded and mixed with the solution. The cloth to be dyed is washed in pure water, and the moisture well wrung out of it. It is then steeped in the above solution, and is afterwards put to dry in the shade. This steeping and drying is repeated two or three times."

It is, however, chiefly as a tanning agent that the bark of *Acacia arabica* is of value.

Properties.

Although Babul bark is a good tan bark, it is stated that it can only be used alone for certain purposes, such as for the soles of boots, for it is a "harsh" bark, that is, it produces brittle leather. If, however, the bark of *Cassia auriculata* is added to the Babul bark this brittleness is overcome.

The following figures, from the analysis made by an English firm on raw hides sent home, are of interest as showing, in the case of Babul and other well-known tan bark trees, the amount of tannin matter absorbed by a hide, or, in other words, the percentage of tannin in the bark which can be utilized:—

	Trunk bark. Per cent.	Twig bark. Per cent
Acacia arabica	17·1	11·7
„ *leucophlœa*	13·6	9·8
Shorea robusta	8·2	9·0
Cassia auriculata	18·7	..
Terminalia Chebula	30·0	..

Method of Tanning.

Mr. Perbe, Extra-Assistant Conservator of Forests, Bombay, gives an interesting account of the method of tanning adopted in Poona, of which the following is the substance:—

The bark of the best, or "Goli," variety of Babul only is used for tanning, and this bark is removed from the tree as soon as possible after felling, and before it has had time to dry up. The only instrument used for removing the bark is a wooden mallet which loosens it until

it is easily stripped from the tree. After removal the bark is allowed to dry, and is then beaten up into small pieces by the same mallet; it cannot be kept in this state for more than a year; for, if kept longer than this, it begins to lose its tanning colour. The prepared bark is then mixed with myrabolans, which have also been broken up into small pieces, in the proportion of 100 lbs. of Babul bark to 100 lbs. of myrabolans. The object of this mixture is stated to be to ensure a good colour, since if Babul bark alone is employed the resulting colour is deep yellow instead of brown. A sufficient quantity of water (exact proportion not stated) is added to the mixture, and into this preparation the skin to be tanned, which has already been soaked in lime for about 15 days, is dipped. It remains immersed for three or four days, and is then taken out and sewn into a sort of bag with aloe fibres. It is then filled with the same preparation and hung up for four or five days, by the end of which time the tanning process is complete.

Quality of Bark.

Mr. Pethe states that bark from the branches, trunks and roots are all valued for tanning, but bark from the branches is the best. This does not agree with the analysis given above, in which trunk bark is shown to contain the largest percentage of tannin. Probably Mr. Pethe had in mind large trees with very thick trunk bark, for it is generally agreed that young trees yield the best bark for tanning purposes.

The late Mr. C. S. McKenzie writing from Sind says: "although the quantity of tannin in the bark increases with the size and age of the tree, old bark yields a darker coloured tannin, and for this reason the barks of younger trees and branches is preferred." Mr. Pethe says: "young trees of 5 to 10 years old give the best bark for tanning." In contrast with these statements, the author of an article entitled "Tannin Materials" in Volume XXI of the "Textile Journal" writes: "the larger the tree, the greater the tannin contents of the bark become, and it also becomes a little darker in colour, and consequently in some districts, where Babul is very plentiful, the local tanners only use the bark of the larger branches, as they get a better coloured leather from this than the trunk bark." Both Messrs. Gamble and the author of the *Dictionary of Economic Products*, however, agree that eight to ten years would probably be the most profitable rotation under which to grow Babul for tanning purposes; and Messrs. Cooper Allen & Co., of Cawnpore, who probably have more experience in the matter than any other firm, state, in a note on Babul planting drawn up by them, that "the best age for a tree from which bark is to be taken is ten years." Their opinion may be accepted as final.

Outturn and Price.

That there is a large demand for Babul bark in India is evidenced by the fact that the Cawnpore tanneries alone are stated to consume 500,000 maunds annually, and, since the local supply is declining, the establishment of plantations within an economic radius of Cawnpore has been mooted.

It is also stated that in Hyderabad and Kolri, which are the chief centres of the bark trade in Sind, some 115,000 maunds of Babul bark are sold annually for tanning purposes and also for making country liquor.

It is exceedingly difficult to obtain any reliable figures regarding outturn and price; for Babul trees are, as a rule, sold standing to contractors, and the bark trade is therefore not in the hands of the Department. The Chief Conservator of Forests of the Central Provinces in 1913, however, gave it as his opinion that arrangements could be made to sell the bark separately, if necessary.

The price will obviously depend largely on the local labour supply and the distances from the Railway. Although no general figures can be quoted, the following statistics may be of interest:—

Forest Division.	Amount of bark available annually (in maunds).	Cost of extraction to rail per maund.
Central Provinces.		Rs. a. p.
Amraoti	....	0 14 0
Akola	204	1 2 0
Buldana	1,400	1 12 0
Sind.		
Jerruck	15,000	0 12 0
Sukkur	300	0 10 0
Hyderabad	7,000 to 8,000	0 4 0 to 0 7 0

From an experiment carried out in the Berar Circle of the Central Provinces it was estimated that the cost of collection alone, without carriage to rail, or railway freight, would be Rs. 0-10-6 per maund in the Amraoti Division, and Rs. 0-13-3 per maund in the Akola Division.

In his *Forest Economic Products of India* published in 1912, Mr. Pearson states: "The prices vary in different localities from 10 annas to Re. 1-4-0 per maund of 82 lbs. In Cawnpore the ruling prices at

present are from 13 to 14 annas per maund. Watt states that the bark fetches from 8 annas to Rs. 2-4-0 per 100 lbs." No statistics collected since the publication of the above materially alter the statement quoted.

(*e*) Lac.

In conclusion, it may be stated that the Babul tree forms an excellent host tree for the lac insect, and the Sind Babul forests, particularly those of the Hyderabad Division, constitute one of the chief lac-producing areas of India.

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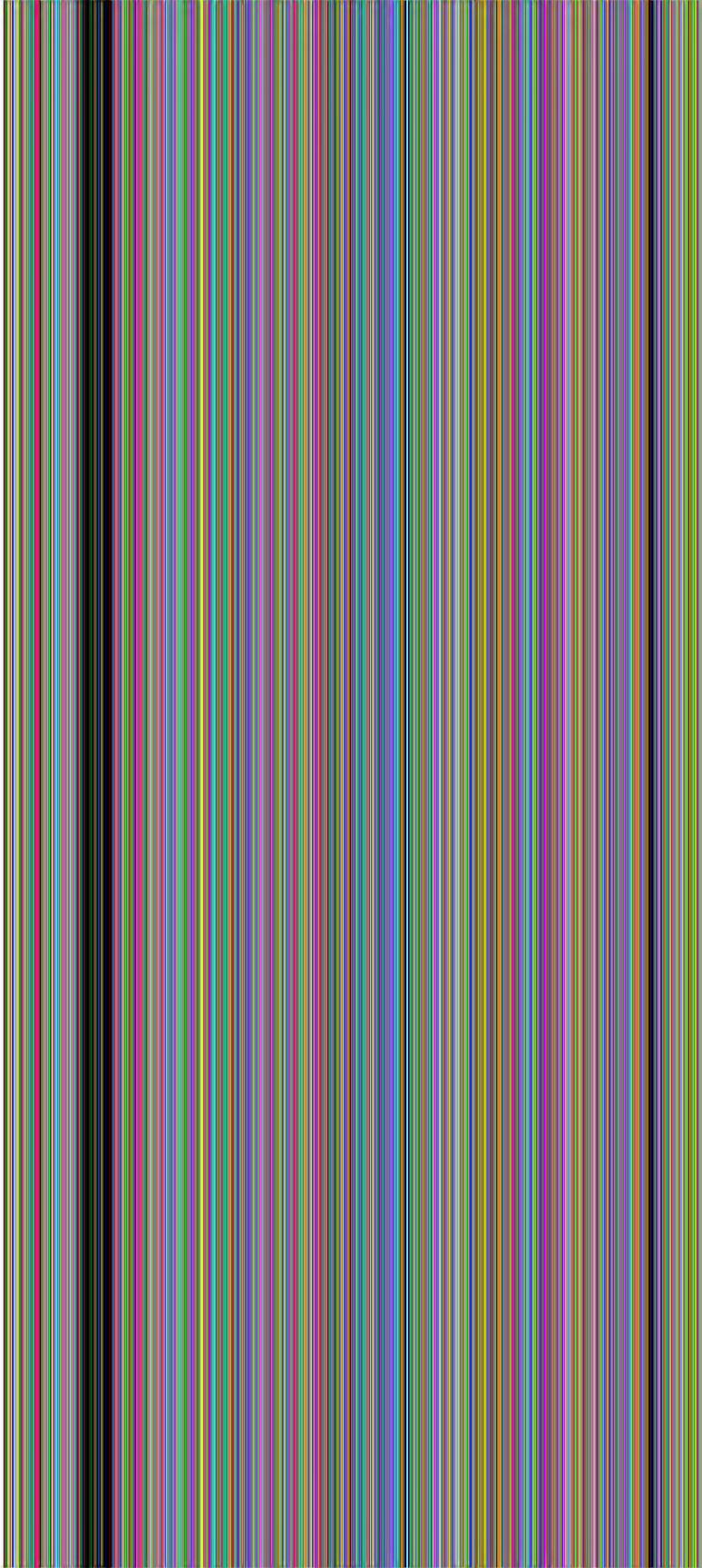

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