



**Government of the Union of Myanmar  
Ministry of Forestry  
Forest Department  
Forest Research Institute  
Yezin**



**The Morphological and Anatomical Characteristics  
of Twenty-Five Myanmar Timber Species ( Part II)**

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## မြန်မာသစ် (၂၅) မျိုး၏ ပြင်ပရုပ်သွင် နှင့် သစ်အင်္ဂါဗေဒ လက္ခဏာများ လေ့လာခြင်း ( အပိုင်း-၂ )

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### စာတမ်းအကျဉ်းချုပ်

သစ်တောထွက်ပစ္စည်းလုပ်ငန်းများ နှင့် အခြားသော သစ်အမျိုးအစား တိကျစွာ ခွဲခြားရန် လိုအပ်သော အခြေအနေများတွင် မျိုးစိတ်များကိုလည်းကောင်း၊ အထူးသဖြင့် အရေးပါသော စီးပွားရေး အသုံးဝင်ပင်များကိုလည်းကောင်း ပြတ်သားစွာ ခွဲခြားနိုင်ရန်မှာ အလွန်လိုအပ်ပါသည်။ ဤစာတမ်းတွင် မြန်မာသစ်(၂၅)မျိုး၏ သစ်ဂုဏ်သတ္တိများတွင်အရေးပါသကဲ့သို့သစ်မျိုးများခွဲခြားရာတွင်အထူးအရေး ပါသော အကုစိတ် သစ်အင်္ဂါဗေဒ လက္ခဏာများကို ပြုစုရေးသား တင်ပြထားပါသည်။ သစ်မျိုးများ၏ ထူးခြားသော ပြင်ပရုပ်သွင် လက္ခဏာများနှင့် သစ်သားများ၏ အကုစိတ်လက္ခဏာများကို နှိုင်းယှဉ်ကာ ဆွေးနွေး တင်ပြ ထားပါသည်။ သစ်အင်္ဂါဗေဒ လက္ခဏာများ၏ ကွဲပြားမှုများကို စနစ်တကျ အကျဉ်းချုပ်၍ ဇယားများဖြင့် ထည့်သွင်းတင်ပြပြီး၊ မျိုးစိတ်များကို ခွဲခြားပြသနိုင်မည့် လက္ခဏာဖွင့် (artificial dichotomous key) ကိုဖော်ပြထားပါသည်။

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### **Abstract**

In the forest product industry and in other similar cases when they need accurate identification, it is often desirable to distinguish between species, especially commercially important ones. This study was carried out to determine the important microscopic characteristics of twenty-five Myanmar timber species that are both importantly related to their wood properties and also for the accurate identification of their timbers. The salient morphological and secondary xylem characteristics of woods and uses have been studied, compared and discussed. The systematic implications of the wood anatomical diversity are summarized in tables and an artificial dichotomous key to the species is also presented.



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## 1. Introduction

Timber is one of the most valuable and versatile raw materials used by men and plays a vital role in the economic and industrial development of a nation. As is well known, wood is of plant origin and cellular in structure, being produced by thousands of different kinds of trees such as Teak (*Tectona grandis*), Padauk (*Pterocarpus macrocarpus*), Laurel (*Terminalia tomentosa*) etc., each with its own distinctive features. Like the tree, the woods produced by them also differ considerably in their appearance, structure and properties. It is always possible to select the relatively right timber for any job requiring the use of wood with the proper technical know-how, if only its correct identity is known.

With the current trend of encouraging the development of down stream timber industries, there is a need to find out more about the microscopic structures that are likely to influence the properties and thus for more effective utilization of the timber. Despite the recent growth in the popularity of new building materials, considerable amount of timber is still being used in the construction industry today. Timber is employed in such a wide variety of ways ranging from structural to decorative applications.

One of the harder things about doing wood identification is knowing to what level ( family, genus, species group, or species ) a wood can be identified and when to be satisfied with an identification ( wheeler & Baas, 1998 ). The level to which on identification can be done varies within and between families. In fact, today, knowledge of wood properties is essential to maximise the utilization of timber species. The present study is intended to compile dependable data, provide morphological and taxonomical characters, wood descriptions and evaluate the possibilities and reliability of the identification of selected timber species.

Recent studies have shown that there is published information on the wood anatomy of all the examined genera, but most of the species have not yet been described. Therefore, a much more complete unified detailed study is really necessary for applied research in the near future. In this study, qualitative and quantitative data are given and secondary xylem characters are compared for twenty-five Myanmar timber species.

The first part of study was carried out in 1983 by Thein Kywe and Kyaw Soe and the findings were presented as “The morphological and anatomical characteristics of (25) Commercial Burmese Timber (Part 1)” at the Forestry Research Congress.

In this work, attempt was being made to study some of the remaining species including those of the commercial timbers. As a matter of fact, this investigation (Part II) is a continual and organized work solely devoted to Myanmar timber species as has been in the case of the previous study (Part I).

## 2. Materials and Methods

The wood Anatomy Section of the Forest Research Institute (FRI) has been collecting wood samples throughout Myanmar since 1978. The specimens used for morphological and taxonomical descriptions in this research were collected from different localities of Myanmar during the period from 1996 to year 2000. Flowers and leaf samples were dispatched to the herbarium, FRI, for identification and authentication of the species.

The microscopic structure of each species was examined using the Olympus Universal Research Microscope Vanox model. Photomicrographs of the important microscopic structure were studied in detail and the pictures were taken for examination, assessment and comparative purposes.

The pore grouping and arrangement was assessed visually under the microscope. The pore frequency was done by manually counting pores including the multiple pores in the

microscopic screen of 1 mm<sup>2</sup> in cross section and tangential longitudinal section of each specimens. The average diameter of the pores was assessed by measuring the tangential diameter of the largest pores and smallest pores. The ray width was also assessed by counting the number of cells at the widest portion perpendicular to the ray axis. The ray height also assessed by measuring the height of the highest ray under the microscope. The other parameters of the rays, parenchyma and fibre were visually assessed in accordance with the International Association of Wood Anatomist (IAWA) standards and other hardwoods identification methods available in the literature.

In this study, the terminology used for microscopic descriptions was presented as given by Chattaway (1932) and Wheeler, Baas and Gassom (1989).

## AUKCHINSA

Botanical Name: *Diospyros ehretioides* Wall.  
(Family- Ebenaceae)

Habit and distribution: A tree, attaining 15-18 m in height and 1.5-2.0 m in girth. It occurred in the plain forests of upper and lower Myanmar. It is found in Mandalay division and Sagaing division.

Morphological and taxonomical distribution:

A tree straight stem, leaves simple, alternate, sometime subopposite, the laminae elliptic or obovate, 4.5 to 10.5 cm long, 3.5 to 7 cm wide; the bases cuneate, obtuse or rounded, the margins entire, the tips acute or acuminate, coriaceous, glabrous above, thinly hairy beneath exstipulate. Inflorescences small cymes, axillary, short-pedicelled; flower dioecious, very rarely polygamous; sometimes female flowers solitary, 4-5 merous; calyx lobed, often accrescent and plicate; corolla tubular, salver-shaped or campanulate; male flowers stamens 4-numerous, filaments distinct; paired or united; rarely short, ovary rudimentary; female flowers: stamens 0-numerous, ovary 4-5 celled; cells 1-ovuled, fruit globose, ellipsoid, or ovoid-conic seeds oblong, usually compressed.

Flowering and Fruiting period: It flowers from February to April and fruits from April to July.

Bark: Blackish brown to dark brown, 10-25 mm thick, irregular very scaly and rather fibrous, longitudinal deep fissured, small flakes exfoliating from rough surface.

General characteristics and properties of the wood:

Sapwood yellowish-grey with darker zones to dark grey; heartwood merely black streaks in the grey wood; dull to lustrous; odour and taste not distinct, moderately heavy (Sp. gr. approx 0.69); medium and even texture, straight grained, growth ring not distinct.

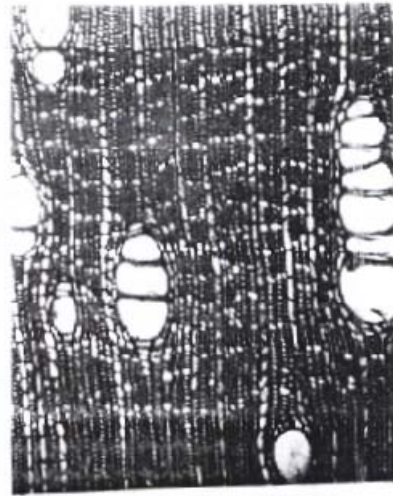
Microscopic characteristics :

Vessel elements: Diffuse porous; pores very small to medium-sized, mean tangential diameter 101.47  $\mu\text{m}$  (range 30.75- 174.25  $\mu\text{m}$ ), number per sq .mm few to moderately numerous, range 3 to 13, average solitary pore 31% (range 13 - 100 %), pores solitary, in short radial rows of 2-6, and pore cluster, oval or circular in cross section, medium thin-walled; perforation plates simple, nearly horizontal to oblique, end walls of elements truncate or abruptly or attenuate-tailed at the ends; intervascular pitting alternate, numerous, small, orbicular to oval or polygonal through crowding, 2.5 to 5.0  $\mu\text{m}$  in diameter; vessel element moderately short to medium sized, mean length 456.63  $\mu\text{m}$  (range 307.5-574  $\mu\text{m}$ ); tyloses not observed; deposits of brownish - yellow gum occasional, partially occluding some vessels.

1. AUKCHINSA (*Diospyros chretoioides* Wall.)



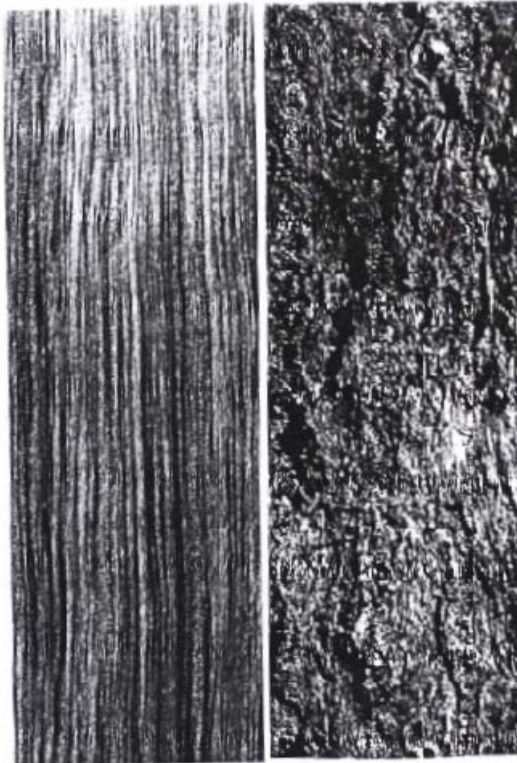
A plant in natural habit



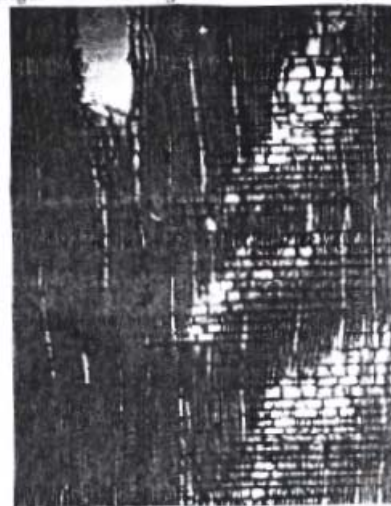
Transverse section (X 75)



Tangential & Longitudinal Section (X 75)



Timber & bark as seen



Radial & Longitudinal Section (X 75)

- Fibres : Semi-libriform, moderately short to medium sized; mean length 1032.68 $\mu$ m (range 891.75-1394 $\mu$ m), F/V ratio 2.35 (range 1.65- 4.12), mean tangential diameter 19.5  $\mu$ m ( range 12.5-25 $\mu$ m), non-septate, 2.5 to 10 $\mu$ m thickened, interfibre pits numerous, most abundant on the radial walls, bordered, with small court slit-like.
- Rays : Heterocellular, uniseriate to biseriate, very fine to numerous, 10 to 15 per mm tangentially, extremely medium sized, mean width 29.72  $\mu$ m (range 10.25- 51.25  $\mu$ m); mean height of uniseriate rays is 559.65  $\mu$ m (range 41 - 2039.75  $\mu$ m) and 1 to 62 cells high; mean height of biseriate rays is 571.95  $\mu$ m (range 266.5-1281.25  $\mu$ m) and 6 to 37 cells high; ray vessel pitting similar to intervacular pit, 2.5 to 5.0  $\mu$ m in diameter, crystals fairly abundant, large solitary, starch deposits not observed.
- Axial parenchyma: Parenchyma and metatracheal paratracheal parenchyma sparse, metatracheal parenchyma very abundant, in part diffused through fibrous tracts, for the most part in concentric, fine, close, 1-3 (mostly 1) seriate, crystal wanting; starch deposits not observed.
- Uses: It is suitable for post, beams , scantling, panelling and especially for making shuttles.

## DAHAT

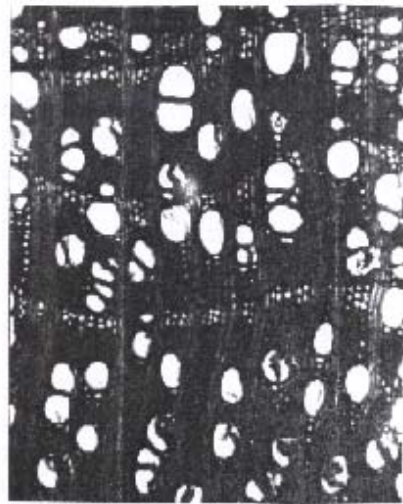
- Botanical Name *Tectona hamiltoniana* Wall.  
(Family – Verbenaceae )
- Habit and distribution A medium-sized tree, attaining a height of 10.5 – 15.5m and 1.3-2.00 m in gbh. It is largely grown in rocky hill up to 660 m of dry zone, especially intermingle with some *Acacia* sp. in dry forests of central Myanmar .
- Morphological and taxonomical characteristics :  
A deciduous unarmed tree, the stem terete , stout, with clear trunk, the branchlets 6- to 8 angular. Leaves simple, opposite and decussate, sometimes ternate-whorled at the terminal portions of branchlets, exstipulate, the laminae ovate to rhombic-ovate, 5.5-10.5 cm long and 3.0 7.5 cm wide, penninerved, the bases cuneate, the margins entire or pinnatifid, densely hairs, the tips acute to acuminate; the petiole 0.6–2.5 cm long. Inflorescences axillary or terminal, paniculate dichasial cymes, pyramidal, 8.5-21.5 cm long and 4.5-15.5 um in across. Flowers 7-8mm long 8-10 mm in wide, bisexual, regular, bracteate, fragrant; the pedicels terete, 2-3 mm long, caducous; calyx campanulate in fruits; corolla rotate funnel-shaped, 5- to 6- lobed, exceeding the calyx, pale purple or lilac colour; stamen 5, free, attached to the base of the corolla tube, the filaments filiform, the anthers sagittate-oblongoid; ovary narrowly oblongoid, composed of 2 carpels, minute, superior, the style filiform with shortly bifid stigma. Fruit drupaceous, with the acrescent urceolate calyx, oblongoid, 6-8 mm long and 4-5 mm wide, 1-4 seeded, glabrous; seed ellipsoid, glabrous, whitish grey.
- Flowering and Fruiting period: It flowers from May to June and fruits from June to up till November.
- Bark: Light brown or brownish-grey, 18-20 mm thick, outer dead bark persistent over the entire trunk, slightly fissused, irregular grey patches with orange-red seeded spots on smooth surface.
- General characteristics and properties of the wood :  
Sapwood brownish white, white faintly striated lines, heartwood light brown, odour and taste not distinct, moderately heavy; hard; straight grained; fine textured; semi-ring porous; growth ring distinct.



2. DAHAT (*Tectona hamiltoniana* Wall. )



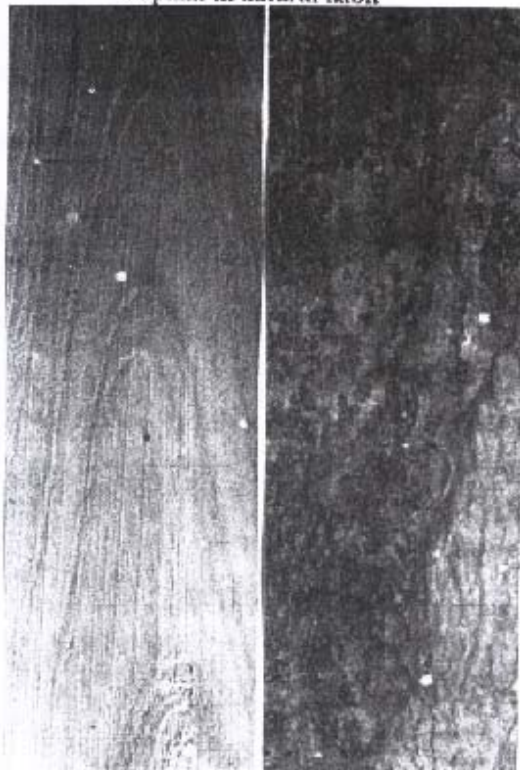
A plant in natural habit



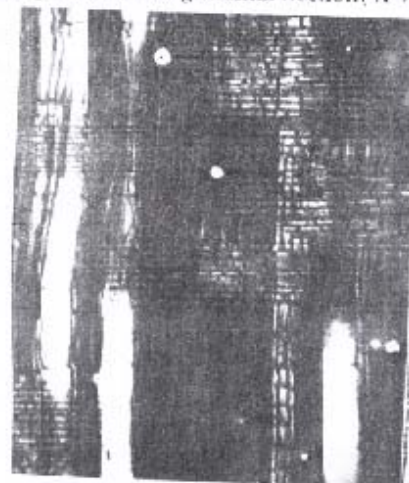
Transverse section ( X 75 )



Tangential & Longitudinal Section ( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )



### Microscopic characteristics :

- Vessel elements:** Semi-ring porous; pores very small to medium sized, mean tangential diameter 77  $\mu\text{m}$  (range 35-143  $\mu\text{m}$ ); number per sq. mm moderately numerous to very numerous (range 16-45), average solitary pores 42% (range 16 - 75%); pores solitary arranged, in oblique pattern or as radial pore multiples of 2-4 and frequently as pore clusters; circular or oval in cross section; thin-walled; lumen without gum deposits, tyloses absent; perforation plates simple; end walls of elements oblique or transverse; intervacular pitting alternate, crowded, rounded or oval, vestured, chambers with mean tangential diameter 4  $\mu\text{m}$  (range 3.5-5.0  $\mu\text{m}$ ) ; vessel elements extremely short to moderately short, mean length 225 $\mu\text{m}$  (range 87-328  $\mu\text{m}$ ).
- Fibres :** Libriform, moderately short to moderately long; mean length 1233  $\mu\text{m}$  (range 717- 1619  $\mu\text{m}$ ), F/V ratio 5.6 (range 3.3-9.1), fine to medium fine with mean tangential diameter 19  $\mu\text{m}$  (range 12.5-25 $\mu\text{m}$ ); septate; thin to thick-walled, 2.5 -7.5  $\mu\text{m}$  thick; interfibre pits minute, simple, slit-like, crystals absent.
- Rays :** Homocellular, uniseriate to tetraseriate, mostly biseriate and triseriate, 9-18 per mm. tangentially, numerous to very numerous; uniseriate rays extremely fine, mean width 12  $\mu\text{m}$  (range 5-15 $\mu\text{m}$ ), mean height 76 $\mu\text{m}$  (range 30-153  $\mu\text{m}$ ), 2-7 cells high; multiseriate rays extremely fine to medium fine, mean width 29  $\mu\text{m}$  (range 15-46  $\mu\text{m}$ ), mean height 286 $\mu\text{m}$  (range 82-1178  $\mu\text{m}$ ), 4 -34 cells high; ray vessel pitting similar to intervacular pitting, alternate, crowded, rounded or oval in shape, 2.5 to 5.0  $\mu\text{m}$  in diameter, gum deposits absent in ray cells, crystals absent.
- Axial parenchyma:** Scanty paratracheal, frequently confluent to 3- to 6 seriate tangential bands in the inception of growth rings; apotracheal occasionally diffuse or diffuse in aggregate, crystals absent; gummy infiltration present.
- Uses:** It can be used for cart shafts, yokes and agricultural implements. It is extensively employed in making of shuttle.

## GYOK

Botanical Name: *Diospyros montana* Roxb.  
(Family – Ebenaceae)

Habit and distribution: A small tree attaining 4.0-10.0 m in height and 0.5-1.0 m in gbh. This species is commonly distributed in dry forests of Myanmar especially in Mandalay division and Magwe division.

Morphological and taxonomical characteristics:

Small tree, the barks trunk and old branches sinuous, mostly armed with strong, often branched spines. Leaves distichous, the laminae ovate elliptic-oblong or subrhomboid, sometimes lanceolate, 10.5-17.5 cm long and 4.5-8.5 cm wide, penninerved, on both surfaces more or less pubescent; nerves prominent beneath; the bases obtuse rounded or subcordate base, the margins entire, the tips acute, the petioles terete, or shallowly channeled on the anterior side, 3.5-14 mm long. Inflorescence axillary, 3-7 or rarely many flowers, 4.5 to 7.5 mm long, stamens 6-20 flowered, female flowers solitary, 7-12 mm long, calyx green, corolla pale yellow; staminodes 4-12, ovary glabrous, 8- celled; style 4. Fruit cherry - like, red or brown, bitter, 1.5 to 2.5 cm diameter, fruit calyx coriaceous.

Flowering and fruiting period: It flowers from April to June and fruits from June to August.

Bark: Blackish grey to dark greyish brown, 10-20 mm thick, outer dead bark persistent over the entire trunk, often long longitudinally fissured, shallow furrowed, rough, exfoliating into flaky ridges.

General characteristics and properties of the wood:

Sapwood yellowish white, heartwood brownish-purple, streaked with black, lustrous, odour and taste not distinct, moderately heavy, medium or even texture, straight grained to interlock grained, growth ring distinct.

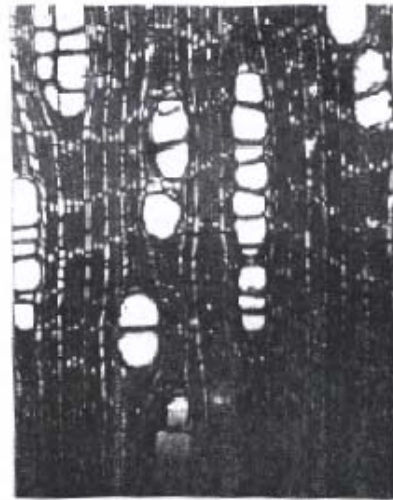
Microscopic characteristics :

Vessel elements: Diffuse porous; pores extremely small to moderately small; mean tangential diameter 47.16  $\mu$ m (range 10.25 - 71.75  $\mu$ m), number per sq. mm moderately numerous to very numerous, range 14-54, average solitary pore 27%(range 12.5-57.14%) pores solitary, multiples of 2 to 9 and sometimes in pore clusters, oval or circular in cross section, thick-walled, perforation plates simple; end walls of elements transverse, obliquely or tailed, intervacular pitting alternate, small to minute, numerous, orbicular to oval or polygonal, 1.25 to 2.5  $\mu$ m in diameter; vessel parenchyma pitting alternate, oval or rounded in shape, 2 to 5  $\mu$ m in diameter, vessel elements moderately short to medium-sized, gummy deposits present, mean length 408.92  $\mu$ m (range 287 - 481.75  $\mu$ m).

3. GYOK ( *Diospyros incana* Roxb. )



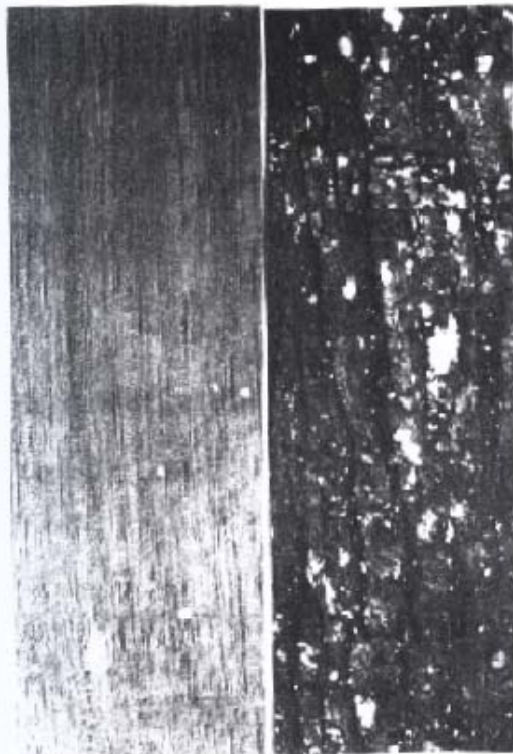
A plant in natural habit



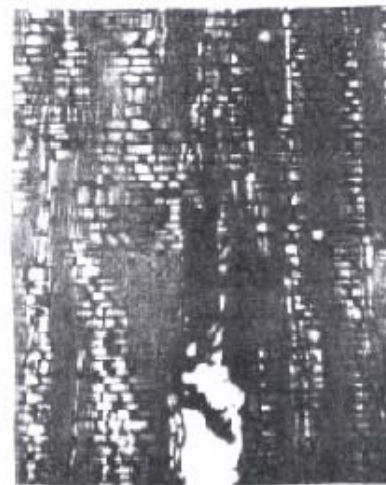
Transverse section ( X 75 )



Tangential & Longitudinal Section ( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

- Fibres : Libriform; very short to moderately long; mean length 1076.76  $\mu\text{m}$  (range 666.25-1845  $\mu\text{m}$ ), F/V ratio 2.6 (range 1.71 - 4.51), mean tangential diameter 15.12 $\mu\text{m}$  (range 7.5-22.5  $\mu\text{m}$  ); non septate, 5 -7.5 $\mu\text{m}$  thick, interfibre pits sparse, small, simple, slit-like, gummy infiltration generally abundant to copious.
- Rays : Homocellular, mostly uniseriate, very numerous, 23-29 per. mm. tangentially, extremely fine to medium sized, mean width 32.8  $\mu\text{m}$  (range 10.25-81.5  $\mu\text{m}$ ); mean height of uniseriate rays is 391.55  $\mu\text{m}$  (range 71.75-1353  $\mu\text{m}$ ) and 2 - 53 cells high; ray vessel pitting alternate, elliptical in shape, crowded, 2.5 to 10.0  $\mu\text{m}$  in diameter, crystals frequently present in the ray cells, large, solitary, often embedded in the dark gumming infiltration.
- Axial parenchyma: Paratracheal parenchyma sparse restricted to a few cells which are mostly contiguous to the tangential wall of the vessels; metatracheal parenchyma very abundant which are diffused through the fibrous tracts; pitting between xylem parenchyma cells are few in number and small size.
- Uses: The wood is used for tools handles and shuttles.

## LAUKYA

Botanical Name: *Schima wallichii* Choisy.  
(Family - Theaceae)

Habit and Distribution: A tall tree, attaining 15-35 m in height and 1.3-2.00m in gbh. It is commonly found growing in the hill forests of Myanmar and also distributed in Shan state.

Morphological and taxonomical characteristics:

A tall tree, stem terete, glabrous, young branchlets appressed pubescent; leaves spirally arranged, elliptic- oblong, lanceolate, 6.5 to 22.5cm long and 2.5 to 7.5 cm wide, thin coriaceous, the bases acute or rounded, the margins entire or obscurely crenate- serrate, the tips mostly acute or slightly acuminate; petiole 1-2.5 cm. Inflorescences short axillary or terminal racemes, peduncate 2-5 cm with minute white waste; flowers 1.5-2 cm diameter, fragrant, sepals 5, circular smaller, connate at the base; petals 5 oval-obovate, white pedicels firm, apically thickened, 1.5-4.5 cm, filaments yellow; ovary densely pubescent; style glabrous. Fruit capsule, rounded, crowned by short style-base, depressed globose, loculicidal; seeds flat, kidney-shaped, dorsally winged.

Flowering and fruiting period: It flowers from February to May and it fruits from May to July.

Bark: Greyish brown, 10-20 mm thick, longitudinal deep striate and flaky, irregular exfoliating scaly ridges separated by fissures, relatively broad.

General characteristics and properties of the wood:

Sapwood pale yellow, heartwood pinkish-red, dull, odour and taste not distinct, moderately heavy, medium coarse to medium fine texture, straight or interlock - grained, growth ring distinct.

Microscopic characteristics :

Vessel elements: Diffuse porous; pores extremely small to medium-sized, mean tangential diameter 67.13µm (range 20.5-102.5 µm), number per sq .mm numerous to very numerous, range 33- 47, average solitary pore 93.21% (range 81-100 %) mostly solitary, paired (frequently in the tangential plane), oval or circular in cross section, thin-walled; perforation plates oblique, latticed; end walls of elements with tapering oblique ends or both ends tailed; intervacular pitting oval or frequently angular and then squarish or rectangular, scalariform pits present; vessel elements moderately long to very long, mean length 1254.6 µm (range 932.75-1506.75µm); tyloses abundant.

4. LAUKYA ( *Schinus wallichii* Choisy. )



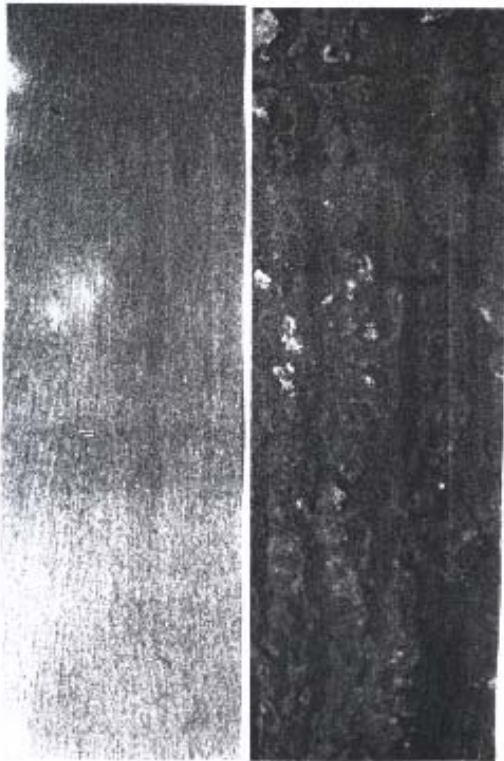
A plant in natural habit



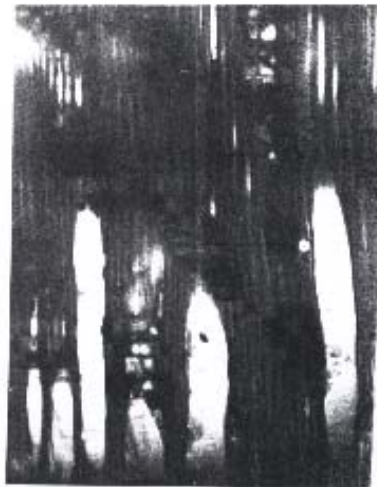
Transverse section ( X 75 )



Tangential & Longitudinal Section ( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

- Fibres : Non-libriform, medium to very long; mean length 2141.73  $\mu\text{m}$  (range 1066-2665  $\mu\text{m}$ ), F/V ratio 1.73 (range 0.89 - 2.85) mean tangential diameter 33.5  $\mu\text{m}$  ( range 25-42.5 $\mu\text{m}$ ), non-septate, 7.5 to 15  $\mu\text{m}$  thickened, interfibre pits numerous, most abundant on the tangential walls and usually in vertical strips often or more, bordered with small round pit court and long, slit-like, nearly vertical orifice; infiltration not observed, crystal abundant.
- Rays : Heterocellular, mostly uniseriate, frequently biseriate, numerous to very numerous, 33 to 47 per mm tangentially, extremely fine to moderately fine, mean width 23.57  $\mu\text{m}$  (range 10.25- 41  $\mu\text{m}$ ); mean height of uniseriate rays is 279.31  $\mu\text{m}$  (range 92.25-635.5  $\mu\text{m}$ ) and 2 to 21 cells high; mean height of biseriate rays is 521.72  $\mu\text{m}$  (range 112.75-1271  $\mu\text{m}$ ) and 4 to 39 cells high; ray vessel pitting leading to contiguous, vessels scalariform for the most part and horizontally aligned, pits alternate, oval to elliptical 7.5 to 15  $\mu\text{m}$  in diameter; reddish brown gum deposits present, crystal abundant.
- Axial parenchyma: Parenchyma abundant, metatracheal scattered or several cells contiguous forming short, uniseriate tangential lines, crystals present, infiltration abundant but not copious, light reddish-brown.
- Uses: The wood is suitable for bridges, building planking, canoes and plough shares.



## LETTOKGYI

Botanical Name: *Holarrhena antidysentrica* Wall.  
(Family- Apocynaceae)

Habit and distribution: A small deciduous tree, attaining a height of 5- 12 m and a gbh of 1.0-1.5 m. It grows in Mandalay division and Sagaing division.

Morphological and taxonomical characteristics:

A small deciduous tree, branchlets with pale bark. Leaves simple, opposite, 8.5-19.5 cm long, 3.5-9.0 cm wide; ovate or elliptic-lanceolate, the bases obovate, obtuse rounded or acute, the margins entire, the tips acuminate, glabrous above and beneath, petiole 1.5-2.5 cm long. Inflorescences cymes, many flowered, 7.5 to 15.0 cm in diameter, corymbose, sessile, terminal bracts small, ciliate; pedicel slender. Flowers small, white-coloured, liner-lanceolate, 1.5 to 2.5 mm long; corolla tube very slender, 5-8 mm long, base inflate, lobes oblong, tip rounded. Fruit follicles, broad terete, 20 to 35 cm long, 6 to 12 mm wide; seeds linear oblong, glabrous, 11 to 14 mm long.

Flowering and fruiting period: It flowers from February to May and fruits from April to July.

Bark: Bluish grey to brownish grey, 5-10 mm thick, outer dead bark persistent over the entire trunk and larger branches, relatively smooth, grooved irregular longitudinal scales separated by small and narrow fissures.

General characteristics and properties of the wood

Sapwood white to yellowish white, heartwood pale yellow, lustrous, not distinct, odour, with bitter taste when fresh, light (sp.gr. approx 0.55), fine and even texture, straight-grained, growth ring not distinct.

Microscopic characteristics :

Vessel elements: Diffuse porous; pores extremely small to moderately small; mean tangential diameter 64.52  $\mu\text{m}$  (range 20.5 - 92.25  $\mu\text{m}$ ), number per sq. mm moderately numerous to very numerous, range 12 to 56, average solitary pore 12.25 % (range 2.56-21.62 %) pores solitary; multiples of 2 to 6 rows, sometimes in pore chains, oval or circular in cross section, thick-walled, perforation plate simple; end walls of elements truncate or abruptly or attenuate-tailed, intervacular pitting numerous, small, oval to orbicular or angular through crowding; 2 to 3.7  $\mu\text{m}$  in diameter, Vessel parenchyma pitting alternate, crowded, oval or rounded in shape; vessel elements medium sized, mean length 499.17  $\mu\text{m}$  ( range 358.75 to 676.5  $\mu\text{m}$ ).



54. LETTOKGYI (*Holurhena antidysenterica* Wall.)



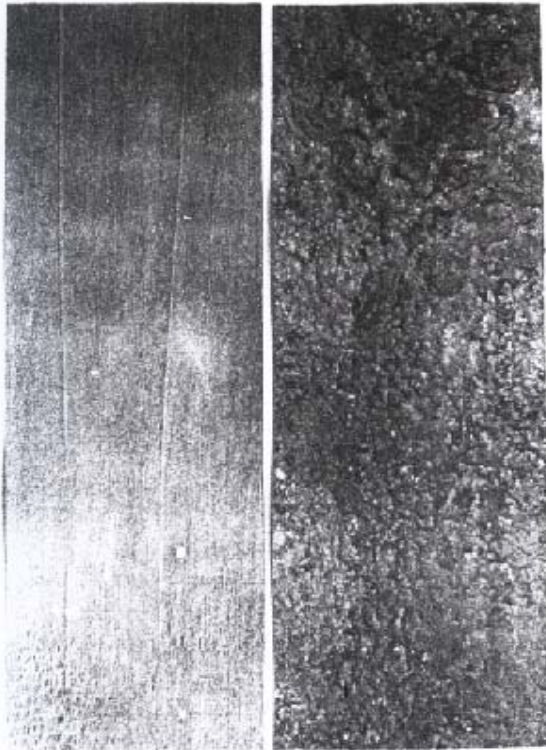
A plant in natural habit



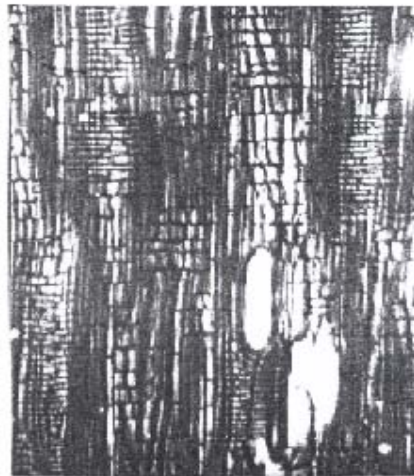
Transverse section ( X 75 )



Tangential & Longitudinal Section X 75 ]



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

- Fibres : Non libriform to semi-libriform; medium sized; mean length 1202.83  $\mu\text{m}$  (range 953.25 - 1373.5  $\mu\text{m}$ ), F/V ratio 2.5 (range 1.65 -4.64), mean tangential diameter 22.25 $\mu\text{m}$  (range 12.5-37.5 $\mu\text{m}$ ); non-septate 2.5 to 5.0  $\mu\text{m}$  thick, interfibre pits numerous, most abundant on the radial walls.
- Rays : Heterocellular, uniseriate to multiseriate, (1-3) seriate, few to very numerous, 4 to 17 per mm. tangentially; very fine to medium sized, mean width 32.29  $\mu\text{m}$  (range 15.38-51.25  $\mu\text{m}$ ); mean height of uniseriate rays is 313.14  $\mu\text{m}$  (range 51.25-809.75 $\mu\text{m}$ ); and 1 to 14 cells high; the mean height of multiseriate rays is 576.56  $\mu\text{m}$  (range 153.75-1486.25 $\mu\text{m}$ ) and 8 to 34 cells high; ray vessel pitting similar to intervascular pitting, 2 to 3  $\mu\text{m}$  in diameter, oval or elliptical in shape, yellow gummy infiltration sparse or wanting; when present; crystals wanting.
- Axial parenchyma: Paratracheal parenchyma sparse, metaracheal parenchyma abundant.
- Uses: It can be used for canoes, marts and packing cases.

## LEZA – PHYU

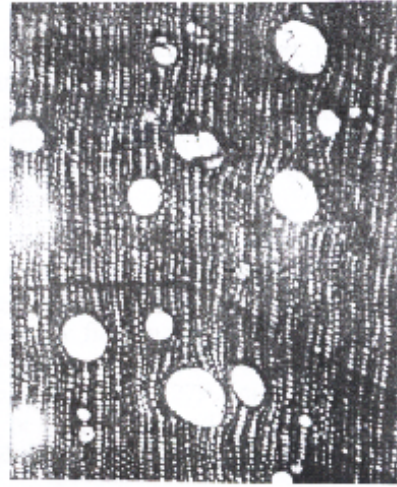
- Botanical Name *Lagerstroemia calyculata* Kurz.  
( Family - Lythraceae )
- Habit and distribution A tall tree, attaining 20 – 25 m in height and 1.8 -2.5 m in gbh. This species is commonly found in Bago Yoma as far north as Yemathin, Mandalay Division.
- Morphological and taxonomical characteristics :  
A tall tree, stem terete, branchlets semi-terete. Leaves simple, opposite and decussate, the laminae lanceolate to oblong-lanceolate, 6.5-17.0 cm long, 3.0-7.3 cm wide, the bases broadly obtuse or rounded, the margins entire, rarely undulate, the tips acute to acuminate, glabrous above, sparsely puberulous beneath, subcoriaceous; petioles semi-terete. Inflorescences paniculated cymes, pyramidal, 12.5-30 cm long; bracts oblong. Flowers 6-merous, very small, 1.0-1.5 cm in diameter; calyx tube campanulate, 3.0-4.5 mm long, 2.5-3.5 mm in wide, the lobes 6, triangular; petals 6, obovate, 4.0-5.5 mm long, 3.5- 5.0 mm wide, the limbs obscurely crispate at the margins, purple, the claws flattened; stamens numerous, uniseriate, unequal; ovary obovoid, 2.0-2.5 mm long, 1.5-2.0 mm in wide, 6 carpelled and loculed, puberulous. Fruit capsule, subglobose, 6.5-9.0 mm long, 5-8 mm wide, 6-valved, smooth, brittle; seeds ellipsoid .
- Flowering and fruiting period: It flowers from April to June and fruits from August to January.
- Bark: Light greyish white to pale greyish-brown, 8-12 mm thick, outer dead bark persistent over the entire trunk, distinctive greyish patches or spots scattered over the smooth surface.
- General Characteristics and properties of the wood  
Yellowish red or whitish red; heartwood distinct; dull; odour and taste not distinct; moderately heavy in weight ( specific gravity 0.68 green, 0.78 oven dry); hard, strong; straight grained; fine textured; semi-ring porous wood; growth ring distinct by narrow bands parenchyma.
- Microscopic characteristics :
- Vessel elements : Semi-ring porous; pores extremely small to medium sized, mean tangential diameter 67  $\mu\text{m}$  (range 20 - 170  $\mu\text{m}$ ); number per sq . mm few to numerous, ( range 5-20), average solitary pore 58.5% ( range 28.57-100 %) pores solitary, as radial pore multiples of 2-4 and occasionally as pores clusters, circular or oval in cross sections; thin walled; lumen with thin and thick-walled tyloses; perforation plate simple end walls of element oblique or transverse; intervascular pitting opposite or alternate, circular or oval or elliptical in outline, vestured, chambers with mean tangential diameter 6  $\mu\text{m}$  (range 4-8 $\mu\text{m}$ ); vessel elements very short to medium sized, mean length 445  $\mu\text{m}$  (range 250 - 670  $\mu\text{m}$ ).



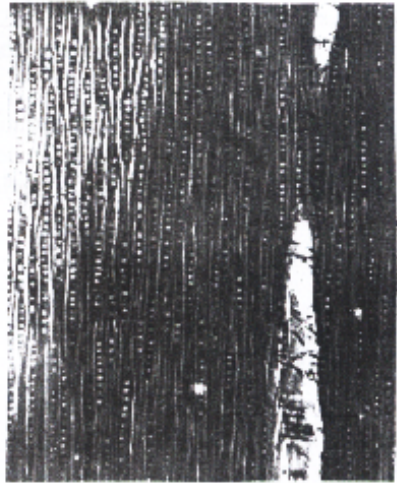
6. LEZA - PHYU ( *Lagerstroemia calyculata* Kurz. )



A plant in natural habit



Transverse section ( X 75 )



Tangential & Longitudinal Section( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

- Fibre : Libriform to semi-libriform, moderately short to medium sized, mean length 1190  $\mu\text{m}$  (range 800-1460  $\mu\text{m}$ ), F/V ratio 4.86 (range 1.78-4.13 ), fine to medium fine with mean tangential diameter 22  $\mu\text{m}$  (range 15-35  $\mu\text{m}$ ); septate, thin to thick walled, 3.8 –8.8  $\mu\text{m}$  thick, inter -fiber pits numerous, small, simple, slit-like; crystals in short to long crystaliferous chains.
- Rays : Homocellular, 1-2 cell wide, uniseriate to biseriate; 15- 22 per mm tangentially, very numerous; the uniseriate rays is extremely fine to very fine, mean width 9  $\mu\text{m}$  (range 5-12  $\mu\text{m}$ ), mean height 210  $\mu\text{m}$  (range 40-670  $\mu\text{m}$ ) and 2-35 cells high; the biseriate rays is extremely fine to very fine, mean height 279  $\mu\text{m}$  (range 100 -1150  $\mu\text{m}$ ) and 3-51 cells high; opposite or alternate, rounded, oval or mostly angular in shape, simple, 2.5 –7.5  $\mu\text{m}$  in diameter; crystal wanting.
- Axial parenchyma : Paratracheal parenchyma abundant, aliform or confluent forming 2-13 (mostly 8) seriate lines, prismatic crystals frequently in 3-16 chambered axial parenchyma.
- Uses: The wood is used for building and for many other purposes. It can be used for furniture such as cabinet, table and chairs.

## LINYAW

Botanical Name: *Dillenia pulcherrima* Kurz.  
(Family - Dilleniaceae)

Habit and distribution: A tree, attaining 15-23 m in height and 1.5-2.0 m in girth. This species is found growing in central part of Myanmar, and commonly in Mandalay division.

Morphological and taxonomical characteristics:

A tree stem terete, leaves grey broad with conspicuous lateral veins, densely fascicled, 7.5 to 15 cm long and 3.5-8.0 cm wide, coriaceous; elliptical or broadly obovate, glabrous above, glossy, the bases, rounded, the margins entire or obscurely serrate, the tips acute or obtuse, shining above, puberulous on the nerves beneath; petiole 2.5 to 5.0 cm, deeply channelled. Inflorescences solitary, short axillary-flowered, 7.5-10 cm in diameter, sepals 5 spreading, elliptic; petals 5, broad narrowly obovate pale yellow or white; stamens free, dehiscing by small slits or pores. Fruits globose, formed of the matured indehiscent carpels.

Flowering and fruiting period: It flowers from February to April and fruits from April to July.

Bark: Bluish grey to greyish brown, 8-12 mm thick, flaky, rough, irregular scales separated by narrow fissures.

General characteristics and properties of the wood

Sapwood pale red, heartwood reddish-brown with occasional white lines, lustrous, odour and taste not distinct, moderately heavy, even and coarse textured, twisted-grained, growth ring scarcely distinct.

Microscopic characteristics :

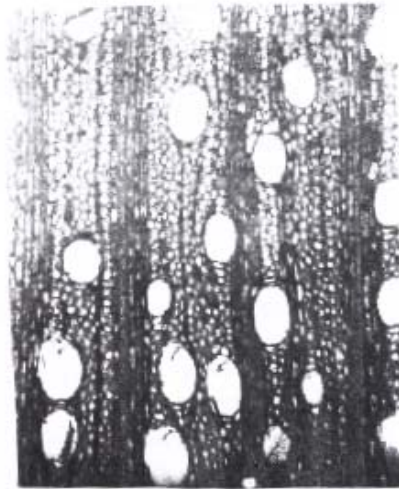
Vessel elements: Diffuse porous; pores very small to moderately sized; mean tangential diameter 99.93  $\mu\text{m}$  (range 41 - 153.75  $\mu\text{m}$ ), number per sq. mm moderately few to numerous, range 7 - 23, average solitary pores 90.8% (range 46.6-100%); pores mostly solitary and sometimes pores multiple, 2 to 3, oval or circular in cross section, gum deposits present, perforation plates simple; end walls of elements oblique, transverse or tailed vessel elongated; intervascular pitting alternate, crowded, elliptical, oval or rounded in shape, 2 - 15  $\mu\text{m}$  in diameter, vessel parenchyma pitting opposite, 5 to 7  $\mu\text{m}$  in diameter, circular or oval in shape; vessel elements medium-sized to very long, mean length 885.6  $\mu\text{m}$  (range 604.75 - 1168.5  $\mu\text{m}$ ).



7. LINYAW (*Dillenia pulcherrima* Kurz.)



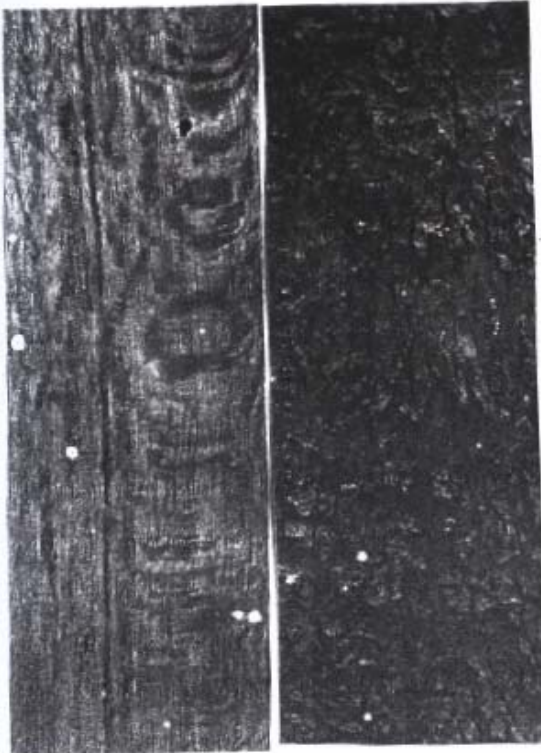
A plant in natural habit



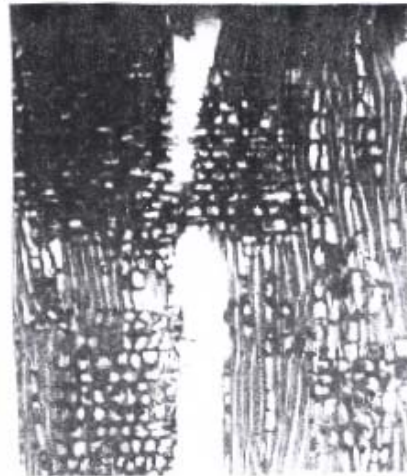
Transverse section ( X 75 )



Tangential & Longitudinal Section ( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

Fibres : Semi-libriform to libriform; medium sized to very long; mean length 1814.25  $\mu\text{m}$  (range 1271-2388 $\mu\text{m}$ ), F/V ratio 2.1 (range 1.49-3.0), mean tangential diameter 28.37 $\mu\text{m}$  (range 15 - 42  $\mu\text{m}$ ); non septate, 5 to 12  $\mu\text{m}$  thick, inter fibre pits sparse, small, simple, slit-like, reddish-brown gummy infiltration occasional in the lumina.

Rays : Heterocellular, uniseriate to multiseriate, (1-6 ) seriate, moderately, few to numerous; 7 to 23 per mm. tangentially; extremely fine to moderately broad, mean width 92.76  $\mu\text{m}$  (range 10.25-153.75 $\mu\text{m}$ ); mean height of uniseriate ray is 585.78 $\mu\text{m}$  (range 153.75 - 1752.75  $\mu\text{m}$ ) and 2 to 33 cells high; the mean height of multiseriate rays is 1428.33  $\mu\text{m}$  (range 276.75 - 3618.25  $\mu\text{m}$ ) and 12 to 132 cells high; ray vessel pitting similar to intervascular pitting, 5 to 12  $\mu\text{m}$  in diameter, oval or rounded or elliptical in shape, reddish-brown gummy infiltration abundant, starch deposits frequently present.

Axial parenchyma: Paratracheal parenchyma sparse, forming narrow, wavy, more or less continuous, occasionally forming ragged, metatracheal parenchyma present, crystals occasional, solitary or occasionally two in the locules, starch deposits not observed; intercellular spaces frequent.

Uses: The timber is used for general inferior carpentary work.



## MANIAWGA

Botanical Name: *Carallia integerrima* DC.  
(Family - Rhizophoraceae.)

Habit and distribution: Evergreen tree, attaining 15-28 m height and 1.5-2.00 m in gbh. It is commonly found growing throughout Myanmar especially in Mandalay division, Sagaing division and Mon state.

Morphological and taxonomical characteristics:

Evergreen tree, stem terete, glabrous; lenticles present. Leaves simple, opposite and decussate, the laminae elliptic –ovate or oblong, 4-8 cm long, 2-5 cm wide, the bases cuneate, the margins entire, the tips acute, both surface glabrous; petioles 3-7 mm; stipulate, caducous. Inflorescences short axillary 2-4 dichotomous branching cymes, 0.8-2.4 cm long, peduncles cylindrical, about 1.3-4 cm long. Flowers white, about 0.2-0.4 cm long 0.2-0.5 cm wide, ebracteate, sessile, bisexual, epigynous; sepals 5-8, free, ovate petals 5-8, free, ovate; stamens twice the number of the petal, filaments flattened, inserted about 0.25-0.4 cm long, hairy; ovary inferior, globoid, about 0.2 cm in diameter, one carpelled, the style filiform; the stigma 4-lobed. Fruit achene, globoid; seed one, globose.

Flowering and fruiting period: It flowers from December to February. The fruiting begins from February and continues up to April.

Bark: Light yellowish brown to dark brownish grey, 10-15 mm thick, outer dead bark persistent over the entire trunk, shortly fibrous, shallowly furrowed, scaly flakes separated by narrow fissures.

General characteristics and properties of the wood:

Sapwood light yellowish-grey, heartwood yellowish red; odour and taste not distinct; hard; medium-textured; straight-grained; diffuse-porous wood; growth rings not distinct.

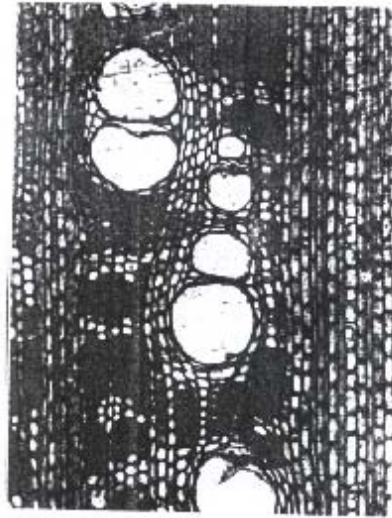
Microscopic characteristics :

Vessel elements: Diffuse porous; pores moderately small to moderately large, mean tangential diameter 168  $\mu\text{m}$  (range 51 - 277  $\mu\text{m}$ ), number per sq. mm moderately few to moderately numerous (range 4-13), average solitary pores 50% ( range 20-100% ); pores solitary or as radial pore multiples of 2-4 or sometimes pore clusters; circular or oval in cross section; thin walled; tyloses present; perforation plates simple, end walls of elements oblique or transverse, truncate or tailed one end or both ends; intervascular pitting alternate, crowded, oval or rounded or angular or elliptical, chambers with mean tangential diameter 9.3  $\mu\text{m}$ (range 8-10  $\mu\text{m}$ ); vessel elements medium-sized to very long, mean length 899  $\mu\text{m}$  (range 564-1333  $\mu\text{m}$ ).

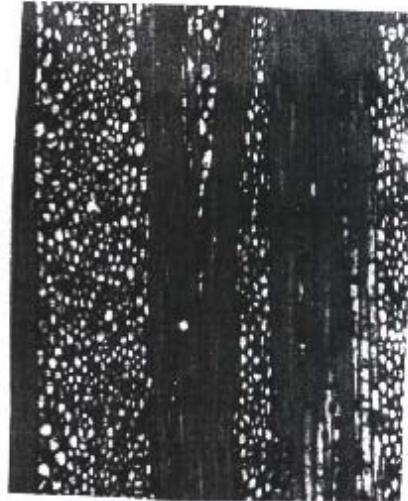
B. MANIAWGA ( *Carollia integrissima* DC. )



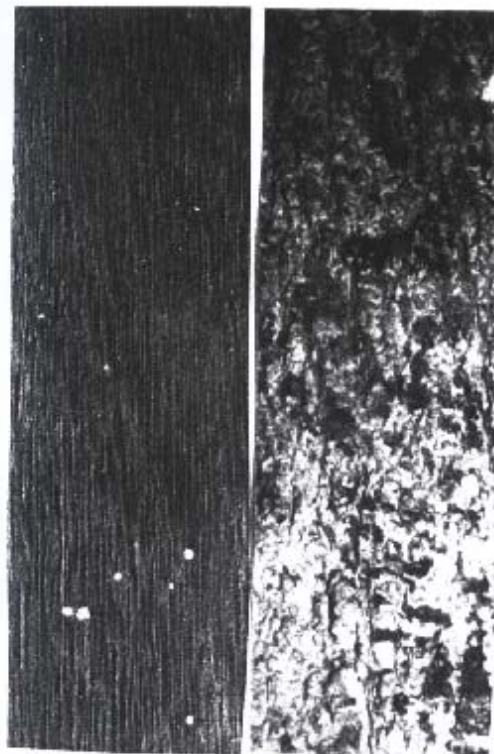
A plant in natural habit



Transverse section ( X 75 )



Tangential & Longitudinal Section ( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

Fibres : Libriform, medium sized to extremely long, mean length 2493  $\mu\text{m}$  (range 1210 - 3536  $\mu\text{m}$ ), F/V ratio 2.9 (range 1.6 - 5.1), mean tangential diameter 28 $\mu\text{m}$  (range 15-38  $\mu\text{m}$ ); non septate, very thick-walled, 6-15  $\mu\text{m}$  thick, interfibre pits minute, simple, slit-like, gum deposits absent.

Rays : Heterocellular, uniseriate to multiseriate, (2- 25 cells wide), 5-12 per mm. tangentially; moderately numerous to very numerous; uniseriate rays extremely fine to moderately fine, mean width 17  $\mu\text{m}$  (range 8-45 $\mu\text{m}$ ); mean height 474 $\mu\text{m}$  (range 82-1179  $\mu\text{m}$ ), 1-24 cells high; multiseriate rays very fine to very broad, mean width 107  $\mu\text{m}$  (range 18-313  $\mu\text{m}$ ), mean height 1588 $\mu\text{m}$  (range 190-5996  $\mu\text{m}$ ), 10-178 cells high; ray vessel pitting alternate, oval or angular or rounded in shape, 8-13  $\mu\text{m}$  in diameter; pale brownish-yellow gum deposits in some ray cells, crystals frequently present.

Axial parenchyma: Paratracheal banded with 3-9 seriate bands and frequently forked; apotracheal diffuse and diffuse in aggregate, sometimes forming short tangential bands containing 1-5 seriate; pale brownish yellow gum deposits in some parenchyma, crystals present in axial parenchyma.

Uses: The timber is used for construction as flooring, panelling, furniture, ceiling boards, planks, handles and rice powder.

## MA-U-KA-DON

Botanical Name: *Sarcocephalus cordatus* Miq.  
(Family - Rubiaceae.)  
Syn. *Nauclea stipulaceae* Roxb.

Habit and distribution: A tree, attaining 9.5 to 21.5 m in height and 1.0-1.8 m in girth. This species is occasionally found in the dry forest and usually along the river banks or stream-sides in upper and lower Myanmar. It is also scattered in Mandalay, Sagaing and Bago Division.

Morphological and taxonomical characteristics:

A large deciduous tree, the crown subumbrelliform; stem terete; branches also terete, laxly spreading around the stem, branchlets usually slightly quadrangular with a longitudinal groove at each side. Leaves simple, opposite and decussate, the laminae ovate or obovate or elliptic oblong, sub coriaceous to membranous, 2-4 cm long, 1.3-2.5 cm wide, the bases rounded or acuminate, the margins entire, the tips obtuse; pedicels terete, 2.2- 4.5 cm long. Inflorescences terminal, pedunculate, globose heads, numerous – flowered, 3.0-3.5 cm in diameter, the peduncles terete, 2-3 cm long, articulated at the basal portion, bracteate; flowers bisexual epigynous regular, 8-9 mm long and 5-6 mm across; calyx 4-6 lobed, persistent, lobes clavate; corolla 4-6- lobed, tubular-funnel shaped, white or pale yellow; stamens 4-6 inserted on the mouth of the corolla tube; ovary inferior, fused and enclosed by the fleshy receptacle, subglobose to obovoid, style terminal, filiform, fruit composite, confluent into a fleshy mass of pyrenes, subglobose or irregular, 3.0-3.5 cm in diameter. Seeds cylindrical or elongated globose, black, minute.

Flowering and fruiting period: It flowers from April to June and fruits from May to November.

Bark: Dark grey, 2.0-2.5 cm thick, longitudinally fissured, smooth, the bark retains inscriptions for long period, transversely peeling off.

General characteristics and properties of the wood :

Sapwood light yellow, heartwood bright yellow; odour and taste not distinct, light (oven-dry density 32.5 lb /ft<sup>3</sup> ) ; soft; straight-grained; fine-textured; diffuse porous; growth ring not distinct.

Microscopic characteristics :

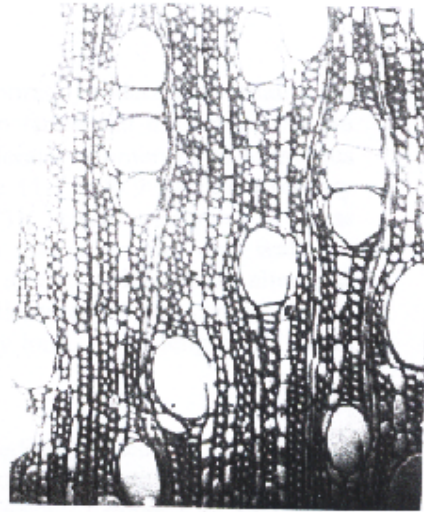
Vessel elements: Diffuse porous; pores moderately small to medium size, mean tangential diameter 100  $\mu$ m (range 51.3 -184.5  $\mu$ m), number per sq. mm moderately numerous to numerous (range 9-23), average solitary pores 55.4% (range 11.1 - 90.9%); pores solitary or as radial pore multiples of 2-5 (mostly 2- 3); circular or oval in cross section; thin walled; tyloses absent; perforation plates simple; end walls of elements oblique or transverse, tapered both ends; intervacular pitting alternate, crowded, circular or oval, chambers with mean diameter 5.7  $\mu$ m (range 2.5-7.5  $\mu$ m); vessel elements medium-sized to moderately long, mean length 781.1  $\mu$ m (range 410.0-1076.3  $\mu$ m).



9. MA-U-KA-DON (*Sarcocephalus cordatus* Miq.)



A plant in natural habit



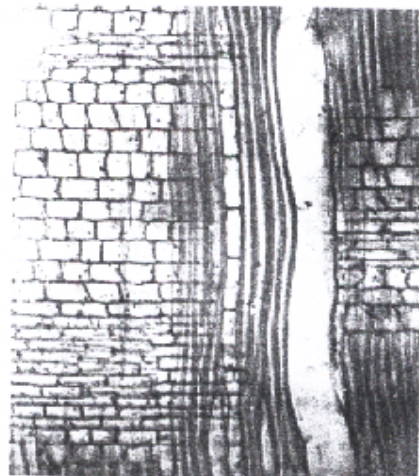
Transverse section ( X 75 )



Tangential & Longitudinal Section( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

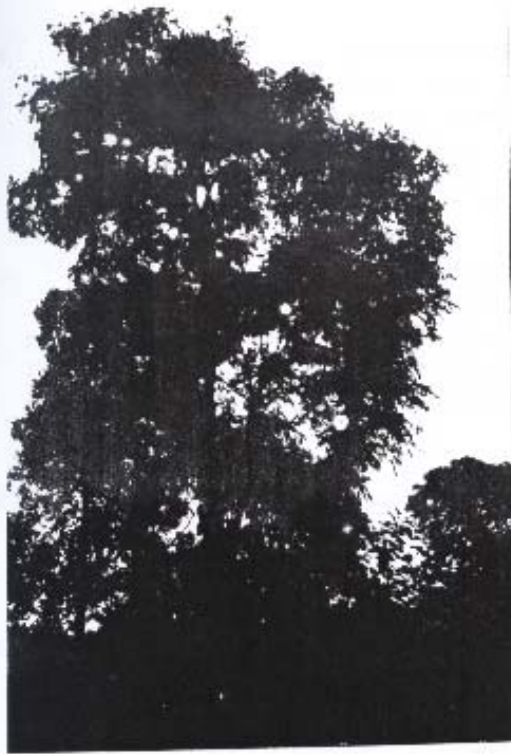
- Fibres : Non-libriform, medium sized to moderately long, mean length 1602.7 $\mu$ m (range 1127.5-1998.8 $\mu$ m), F/V ratio 2.2 ( range 1.3- 3.6), mean tangential diameter 32.7 $\mu$ m (range 25 - 45  $\mu$ m); non septate, (2.5 -5.0 $\mu$ m) thick, interfibre pits minute, bordered, slit-like, crystals and gum deposits absent.
- Rays : Heterocellular, uniseriate to triseriate, mostly biseriate, 10-16 per mm. tangentially, numerous to very numerous; uniseriate rays extremely fine to moderately fine, mean width 25.5  $\mu$ m (range 12.5-45.0 $\mu$ m), mean height 462.5  $\mu$ m (range 102.5-1148.0  $\mu$ m), 2-16 cells high; multiseriate rays moderately fine, mean width 33.2  $\mu$ m (range 25-45 $\mu$ m), mean height 618.1 $\mu$ m (range 184.5-1178.8  $\mu$ m), 6-19 cells high; ray vessel pitting similar to intervacular pitting, alternate, crowded, circular or oval in shape, 2.5-7.5  $\mu$ m in diameter, gum deposits and crystals absent.
- Axial parenchyma: Scanty paratracheal; moderately abundant apotracheal diffuse, crystals absent.
- Uses : The wood is suitable for making pencil, furniture and door frame.

## NWAPADI

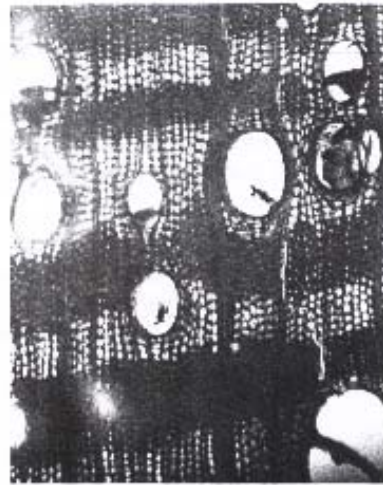
- Botanical Name:** *Sapindus rarak* D.C.  
(Family- Sapindaceae.)
- Habit and distribution:** A tall tree, attaining 8-25 m in height and 1.0-2.0 m in girth. It is usually found growing in the evergreen and moist forests of southern Myanmar.
- Morphological and taxonomical characteristics:**  
A tall tree, widely branched. Leaves compound, alternate, paripinnate; leaflets 14-30, the laminae ovate-oblong or oblong-lanceolate, 4.5 to 15.5 cm long, 1.5-4.00 cm wide; the bases acute, oblique, the margins entire, the bases acute or obtuse glabrous; petiolules 1.5-5 mm, leaf rachis 9-18 cm. Inflorescences panicles 15-35 cm; flowers 5 mm high, pedicels 1-2 mm; calyx and corolla densely appressed-pubescent on the outside; sepals 2-3 mm long; sepals shortly clawed, oblong, 3.5-4.5 mm long; ovary glabrous, style terminal, stigma 2-4 lobed; ovule solitary, fruit cocci, globose, indehiscent, dry, 2-2.5 cm in diameter; wrinkled; seed with a crustaceous testa.
- Flowering and fruiting period:** It flowers from February to April and it fruits from April to June.
- Bark:** Yellow and greenish brown to light brown, 6 – 15 mm thick, outer dead bark persistent over the entire trunk, small brown dotted ridge spot separated from fissured scaled patches.
- General characteristics and properties of the wood:**  
Sapwood pale yellow, heartwood pale yellowish-red, with darker zones denoting seasonal increments, dull, odour and taste not distinct, moderately heavy, medium texture, straight-grained, growth ring not distinct.
- Microscopic characteristics :**
- Vessel elements :** Diffuse porous; pores very small to medium sized; mean tangential diameter 164.0  $\mu\text{m}$  (range 30.75 – 184.5  $\mu\text{m}$ ), number per sq. mm very few to moderately numerous, range 1-12, average solitary pores 40% (range 0-75% ); pores solitary or in radial rows of 2-5, oval or circular in cross section, perforation plates simple, end walls of elements oblique or transverse or tailed, intervacular pitting alternate, crowded, oval in shape, 2-5  $\mu\text{m}$  in diameter; vessel elements extremely short to medium sized, mean length 257.1  $\mu\text{m}$  (range 153.75 – 399.75  $\mu\text{m}$  ).
- Fibre :** Libriform, moderately short to moderately long; mean length 1187.97  $\mu\text{m}$  (range 748.25 - 1773.25  $\mu\text{m}$ ), F/V ratio 2.37 ( range 1.08-4.77 ), mean tangential diameter 15.69  $\mu\text{m}$  (range 7.5 - 27.5  $\mu\text{m}$ ); septate, 2.5 -5.0  $\mu\text{m}$  thick, interfibre pits mostly confined to the radial walls, simple by reduction, with short, slit like, nearly vertical orifices; crystal abundant.



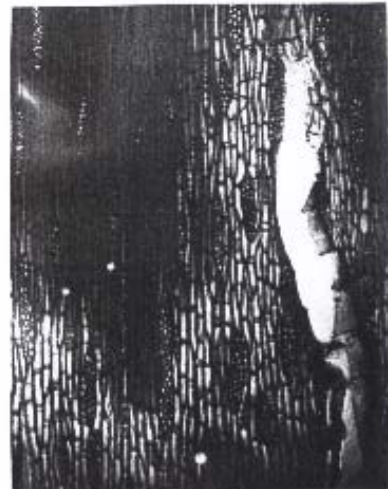
10. NWAPADI ( *Sapindus rarak* D.C. )



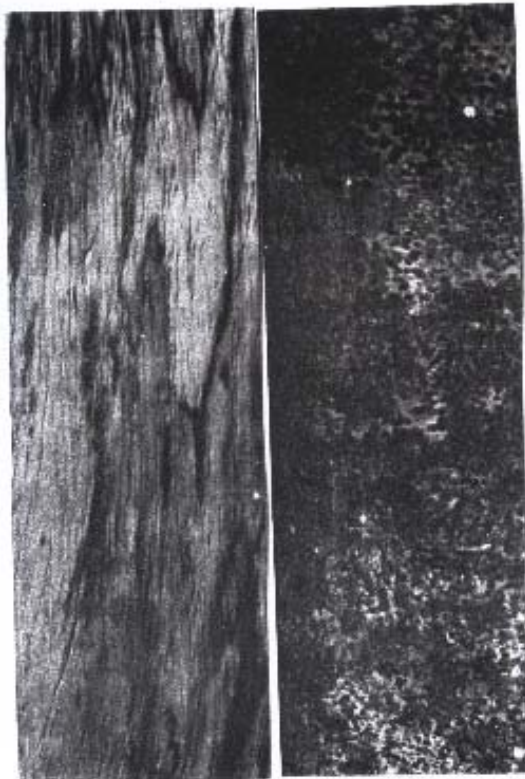
A plant in natural habit



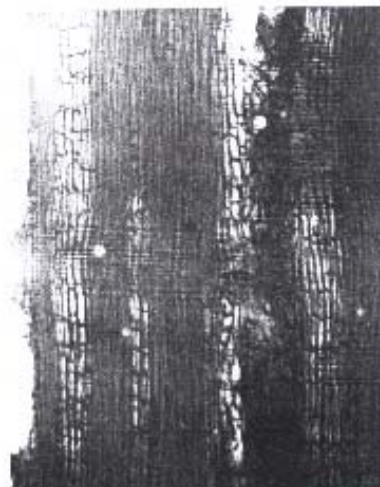
Transverse section ( X 75 )



Tangential & Longitudinal Section ( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )



Rays : Heterocellular, mostly multiseriate ( 1-4 ) seriate, moderately numerous to very numerous, 7-11 per mm tangentially, very fine to medium sized, mean width 31.26  $\mu\text{m}$  (range 20.5- 51.25  $\mu\text{m}$ ), mean height of multiseriate rays is 195.28  $\mu\text{m}$  (range 41- 430.5  $\mu\text{m}$ ) and 2-27 cells high; ray vessel pitting alternate, oval or elliptical in shape, 2-5  $\mu\text{m}$  in diameter.

Axial parenchyma : Paratracheal parenchyma vasicentric, aliform to concentric band, (3-10 seriate), crystal abundant.

Uses: The timber can be used for beams, scantling, flooring and joints.

## NYAN

Botanical Name: *Quercus serrata* Thunb.  
(Family - Fagaceae.)

Habit and distribution: A large deciduous tree, attaining 15-20 m in height 1.4-1.8 m in gbh. This species is found in Shan hills of the upper Myanmar, Assam- Myanmar hills at the elevation of 1000 m-2500 m and Naga hills.

Morphological and taxonomical characteristics:

A large deciduous tree, stem terete and stout, rough, the branchlet terete, stellate-pubescent. Leaves simple, alternate, stipules caducous, the laminae broadly lanceolate or oblong lanceolate or elliptic lanceolate, 5.5 –20.0 cm long and 2.5 –8.5 cm wide, pinninerved with 9-17 pairs of lateral veins, glabrous and shining above and puberulous beneath, the bases rounded, acute or obtuse; the margins serrate, the tips acute to acuminate, the lateral veins ending in long bristle-like pale yellow appendages on the margin, leaf-gall present. Inflorescences axillary, stellate tomentose, male spikes pendulous, 2.0-4.5 cm long, female ones erect, 0.5-4.5 cm long. Flowers small, bracteate, unisexual, monoecious; the male flowers 2-3 mm long and 2 – 4 mm wide, regular, pale yellow; sessile or subsessile; perianth 2- to 5- lobed, stamens 3-5, free, the filaments filiform; the female flowers 2-5 mm long, 1.5-6.0 mm wide, solitary or fasciculated with 2 – 4 flowers at each point of attachment on the spike, each flower enclosed by an involucre of numerous scaly minute bracts, free; carpels 3; ovary ovoid, tomentose, trilocular, 2 ovules in each locule. Fruit indehiscent one-seeded nut ( acorn ) one third or half of the nut sunk in a cup with tentacle-like bracts, cup hemispherical, 13-16 mm long, 16-20 mm wide; seeds globose, basally compressed, 7-16mm long and 6-15 mm wide, yellowish-brown.

Flowering and Fruiting periods: It flowers from January to March and fruits from June to up till September.

Bark: Reddish brown to light brownish-grey, 15-25 mm thick, outer dead bark persistent over the trunk and larger branches, irregular flaky ridges exfoliating into finely fissures.

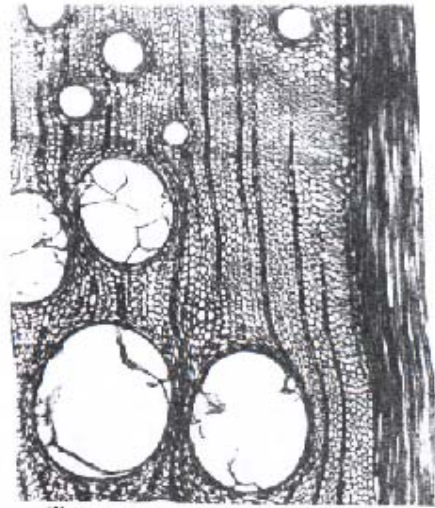
General Characteristics and properties of the wood :

Sapwood pale brownish-white, heartwood light greyish-brown; odour and taste not distinct; hard; medium- texture; straight-grained; ring porous wood; growth ring distinct.

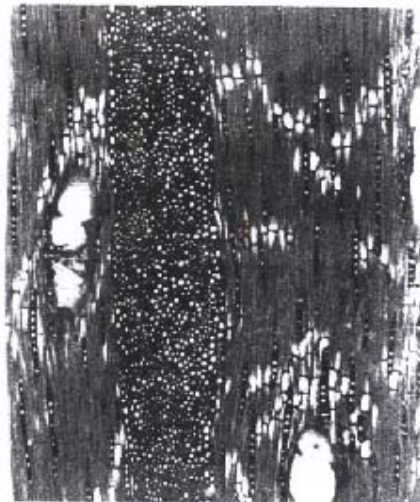
11. NYAN (*Quercus serrata* Thunb.)



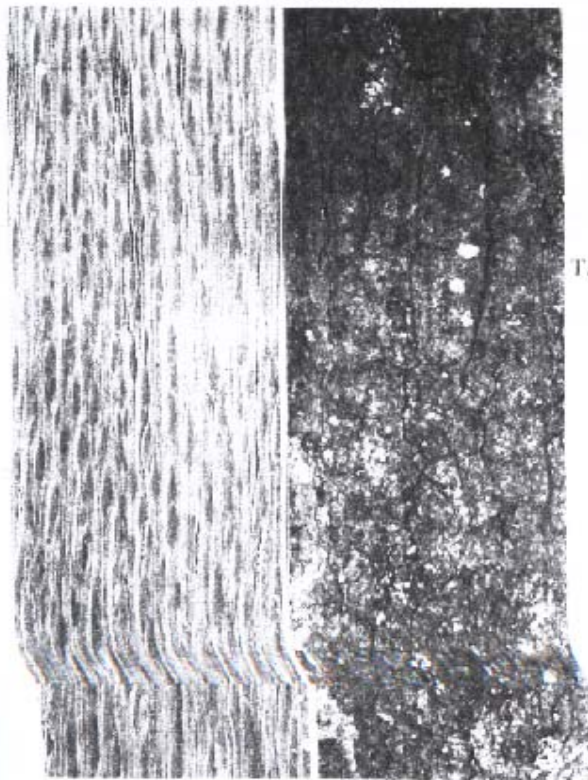
A plant in natural habit



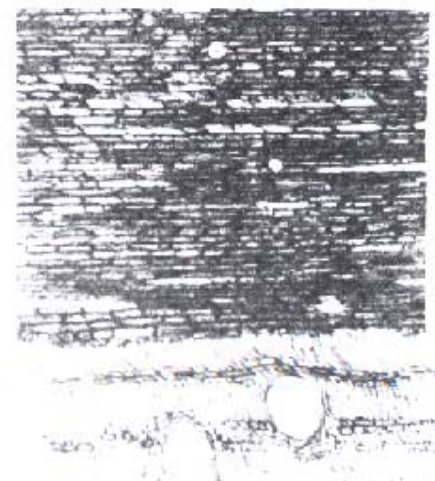
Transverse section ( X 75 )



Tangential & Longitudinal Section ( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

## Microscopic characteristics :

**Vessel elements :** Ring porous, pores very small to very large; mean tangential diameter 180  $\mu\text{m}$  (range 31 - 349  $\mu\text{m}$ ); number per sq. mm moderately few to moderately numerous (range 5-16); average solitary pore 100%, pores exclusively solitary; circular or oval in cross section, thick-walled; tyloses present; perforation plate simple, end walls of elements oblique or transverse, tailed one or both-ends; intervascular pitting opposite to alternate, rounded or oval, bordered, chambers with mean diameter 6  $\mu\text{m}$  (range 4-9  $\mu\text{m}$ ); vessel elements moderately short to medium-sized, mean length 390 $\mu\text{m}$  (range 267-564  $\mu\text{m}$  ).

**Fibre :** Libriform, very short to medium-sized, mean length 930  $\mu\text{m}$  (range 646 - 1312  $\mu\text{m}$ ), F/V ratio 3 (range 1-4); mean tangential diameter 18  $\mu\text{m}$  (range 10-28  $\mu\text{m}$ ), non-septate, thin to thick-walled, 3-10  $\mu\text{m}$  thick, interfibre pits minute, simple, slit-like, crystals absent.

**Rays :** Homocellular, 1-31 cells wide, mostly uniseriate to large rays, rarely bi-to tetra-seriate; 9-22 per mm. tangentially, numerous to very numerous; uniseriate rays extremely fine to moderately fine, mean width 16  $\mu\text{m}$  (range 10-26 $\mu\text{m}$ ), mean height 296  $\mu\text{m}$  (range 62-820 $\mu\text{m}$ ), 3-33 cells high; multiseriate rays moderately broad to extremely broad, mean width 274  $\mu\text{m}$  (range 144 -441 $\mu\text{m}$ ), mean height 1443  $\mu\text{m}$  (range 133-5709 $\mu\text{m}$ ), 5-302 cells high; ray vessel pitting opposite to alternate, rounded or oval, elliptic in shape, bordered 4-14  $\mu\text{m}$  in diameter; gum deposits present; crystals present.

**Axial parenchyma :** Abundant, paratracheal unilateral or vasicentric or confluent connecting 2-5 pores; apotracheal parenchyma relatively sparse, diffuse, or diffuse in aggregate; prismatic crystals abundant, frequently in 1 to 20 chambered axial parenchyma, gum deposits sparse.

**Uses:** The timber is used for building purposes.

## ONDON

Botanical Name: *Litsea glutinosa* (Lour.) C.B. Robins.  
(Family - Lauraceae).

Habit and Distribution: A tree, attaining 6.5-16.5 m in height in 1.2- 1.7 m in gbh. It is found growing in hill forests of Myanmar and commonly in Shan state.

Morphological and taxonomical characteristics:

A moderate sized tree, leaves spirally arranged or opposite, mostly pinnately nerved, the laminae elliptic oblong or obovate, 10-13 cm long, 3-12.5 cm wide, coriaceous, pitose beneath, rarely glabrous, the bases oblique or acute, the margins entire, the tips acute or obtuse; petiole 1.5-2.5 cm. Inflorescences axillary, flower arrange in few-flowered heads; umbels, few or many, 8-16 mm in diameter, single pedicels clustered on a stout or slender common peduncle; perianth mostly caducous; tubes short; fertile stamens 5-12 or rarely more than 12, filaments distinct; ovary enveloped by perianth tube. Fruit berry, sessile, sometimes seated on more or less cup or disk.

Flowering and Fruiting period: It flowers from April to June and it fruits from June to August.

Bark: Yellowish brown to light pale brown, 12-18 mm thick, outer dead bark persistent over the entire trunk, thin flaky, irregular small patches, separated by shallow fissures.

General characteristics and properties of the wood:

Sapwood yellowish-grey, heartwood greyish brown, lustrous, odour and taste not distinct, moderately heavy, medium and even texture, straight grained, growth ring distinct.

Microscopic characteristics :

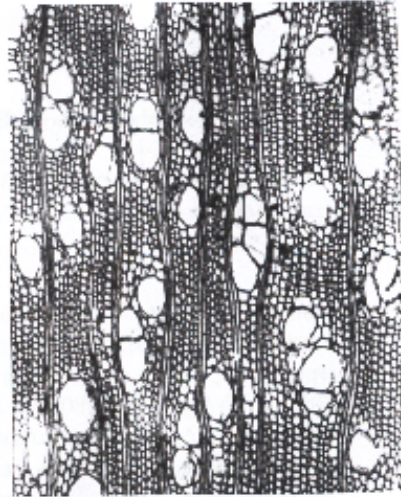
Vessel elements : Diffuse porous; pores very small to medium-sized, mean tangential diameter 76.87  $\mu\text{m}$  (30.75 - 133.25  $\mu\text{m}$ ), number per sq.mm moderately numerous to numerous, range 11 to 24, average solitary pore 38.95 % (range 22.7 - 62. 5%), less frequently solitary , in short double rows multiple 2 to 5, or several clustered, oval or angular in cross section, medium-thin walled; perforation plates simple; nearly horizontal to oblique; end walls of elements truncate or abruptly or attenuately tailed at one or both ends, intervacular pitting alternate to opposite, crowded, oval or elliptical, 7.5 to 27.5  $\mu\text{m}$  in diameter; vessel elements moderately short to medium sized, mean length 514 .03  $\mu\text{m}$  (range 348.5 -717.5  $\mu\text{m}$ ); pale yellowish- brown, rarely with starch grains or yellowish-brown gummy inclusions; reddish or yellowish brown deposits sometimes present along the vessel walls.



12. ONDON (*Litsaea glutinosa* (Lour.) C.B. Robins. )



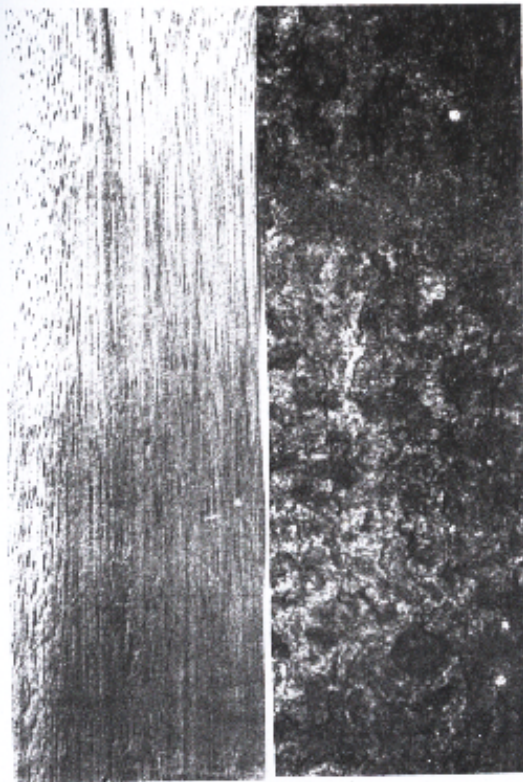
A plant in natural habit



Transverse section ( X 75 )



Tangential & Longitudinal Section ( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

- Fibre : Semi-libriform to libriform, moderately short to medium-sized; mean length 1144.92  $\mu\text{m}$  (range 779– 1435  $\mu\text{m}$ ), F/V ratio 2.32 (range 1.54- 2.69); mean tangential diameter 27.25  $\mu\text{m}$  (range 12.5 – 32.5  $\mu\text{m}$ ), non-septate, 2.5 to 7.5  $\mu\text{m}$  thickened, interfibre pits simple, slit-like.
- Rays : Heterocellular, uniseriate to triseriate, moderately numerous to numerous, 6-13 per mm tangentially, extremely fine to moderately fine, mean width 27.67  $\mu\text{m}$  (range 10.25 - 41  $\mu\text{m}$ ); mean height of uniseriate rays is 106.08  $\mu\text{m}$  (range 61.5 -287  $\mu\text{m}$ ) and 1 to 9 cells high; mean height of multiseriate rays is 411.53  $\mu\text{m}$  (range 112.75 - 881.5  $\mu\text{m}$ ) and 3 to 38 cells high; ray vessel pitting alternate to opposite, crowded, oval to elliptical, 5 to 45  $\mu\text{m}$  in diameter; gum deposits present. Pith flecks abundant.
- Axial parenchyma : Paratracheal parenchyma vasicentric to aliform, 1-2 (mostly 1) seriate sheath about the vessel or vessel groups which is frequently interrupted by rays & fibres contiguous to the vessel, yellowish-brown gummy infiltration occasionally present; crystals not observed; starch deposits frequent.
- Uses: It is used for house building, agricultural implements, furniture and oars.



## PANTAMA

Botanical Name: *Melia birmanica* Kurz.  
( Family- Meliaceae.)

Habit and distribution: A large deciduous tree, attaining 20- 40 m in height and 1.5-2.3 m in gbh. It is commonly found in Sagaing division, Kachin State and Southern Shan state, occasionally in Yangon Division.

Morphological and taxonomical characteristics:

A large deciduous tree, stem terete, woody, hard; branchlets reddish-brown, terete, stout, with scattered distinct numerous leaf- scars. Leaves bipinnate or imperipinnately compound, alternate, mostly crowded at the top of branchlets, exstipulate, petiole 7-10 cm long, pulvinous leaflets 23-41, opposite, 3-7 cm long, 1-3 cm wide, the bases rounded or slightly oblique, the margins entire young, serrated old, the tips acuminate. Inflorescences axillary panicles; peduncle terete, 14-20 cm long, flowers actinomorphic, purplish white, fragrant, barctate; pedicels green, sepals 5, ovate-lanceolate; petals 5, oblanceolate, stamens 10, monadelphous, connect into a distinct tube, the tube 10- ribbed and 20- toothed at the apex, 8-9 mm long, ovary pentacarpellary , pentaloculous, one ovule in each locule; style thick, 4 mm long , glabrous. Fruit drupe, globose to ovoid, 2.5-2.8 cm long, dark green to yellowish brown, 5-7 seeded. Seeds 5-7, linear- lanecolate, black.

Flowering and fruiting period: It flowers from February to March and fruits from March to May.

Bark: Yellowish brown to pale brown, 10-20 mm thick, rough, longitudinally ridges and wavy striations breaking up into deep fissures.

General characteristics and properties of the wood:

Heartwood light pink to light red, sharply defined from the yellowish-white sapwood, coarse-textured, straight-grained, growth ring distinct.

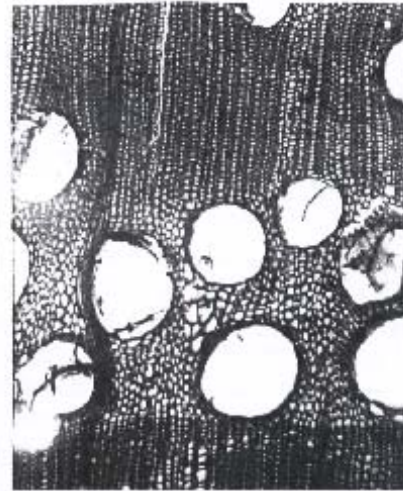
Microscopic characteristics :

Vessel elements: Ring porous; pores very small to moderately large, mean tangential diameter 194  $\mu\text{m}$  (range 51- 308  $\mu\text{m}$  ), number per sq. mm. few to moderately few, range 2- 9, average solitary pore 52 % ( range 20 -83%), pores solitary, and in short radial multiples of 2- 4; oval or circular in cross section, thin - walled; perforation plates simple; nearly horizontal to oblique; end walls of elements oblique to transverse, tailed both end; intervascular pitting alternate, crowded, rounded to oval, pits bordered, 3 - 10  $\mu\text{m}$  in diameter; vessel elements extremely short to medium - sized, mean length 252.15  $\mu\text{m}$  (range 164- 430.5 $\mu\text{m}$ ); lumen with abundant reddish brown gum deposits.

13 . PANTAMA ( *Melia birmanica* Kurg. )



A plant in natural habit



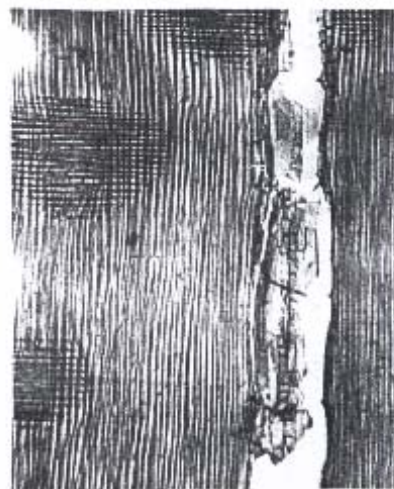
Transverse section ( X 75 )



Tangential & Longitudinal Section( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

Fibres : Non - libriform, extremely short to medium sized; mean length 779.5  $\mu\text{m}$  (range 440.75 - 1281.25 $\mu\text{m}$ ), F/V ratio 3.26 (range 1.79 -4.88); mean tangential diameter 15.37  $\mu\text{m}$  (range 10 - 22.5  $\mu\text{m}$ ), non - septate, 2.5 to 5  $\mu\text{m}$  thickened, interfibre pits small bordered pits restricted to the radial walls.

Rays : Homocellular, uniseriate to multiseriate, (1 - 5 seriate), moderately numerous to numerous, 5 to 10 per mm tangentially, extremely fine, mean width 39.97  $\mu\text{m}$  (range 2.5 - 12.5 $\mu\text{m}$ ); mean height of uniseriate rays is 83.53  $\mu\text{m}$  (range 41- 153. 75  $\mu\text{m}$ ) and 2 to 7 cells high; mean height of multiseriate rays is 385.4  $\mu\text{m}$  (range 112.75 - 789.25 $\mu\text{m}$ ) and 7 to 42 cells high; ray vessel pitting alternate, oval or circular, 2.5 to 5.0  $\mu\text{m}$  in diameter; reddish brown gum deposits in ray cells.

Axial parenchyma: Parenchyma apotracheal sparse, paratracheal parenchyma scanty and vasicentric to confluent, tangential bands in the inception of growth ring, the cells usually tangentially flattened, prismatic crystals abundant in axial parenchyma, crystalliferous strands containing 5 to 16 crystals, one crystal per chamber, occasionally reddish brown gum deposits in some parenchyma cells.

Uses: It is used for posts, beams, scantlings and musical instruments.

## SAGASEIN

Botanical Name: *Cananga odorata* (Link.) Hook .f. & Thoms.  
(Family - Annonaceae )

Habit and distribution: Medium sized trees with straight stems attaining a height of 15-20 m and a gbh of 1.0-1.8 m. It is commonly distributed in Mandalay division and Bago division.

Morphological and taxonomical characteristics:

A medium-sized tree, ultimate twigs often drooping, finely pubescent at the ends, older branches usually glabrous. Leaves simple, opposite distichous, exstipulate pinnately nerved; the laminae ovate-elliptic –oblong, 10 to 16.5 cm long and 5.5 to 8.00 cm wide, the bases more or less oblique, rounded-cordate, the margins entire, undulate the tips acuminate, mature one glabrous above, the lower surface mostly sub-glabrous or velvety, the petioles cylindrical, 1 to 1.5 cm. Inflorescences axillary, flowers in pendulous, umbelliform, short- peduncled, cymes 1-3 in axils of persistent or fallen leaves, on mostly leafless stalks 1-4 cm long, 2-5 flowered. Flowers very fragrant; petals at first green, later yellow, densely finely pubescent the stamens numerous, appendage of connective broad, acute; the ovaries numerous, glabrous; ovules numerous, style slender, stigma agglutinated, discoid. Fruit pendulous; ripe carpels 7-15, long stalked, 1.5- 2.5 cm long, ellipsoid- obovoid, 3-13 seeded.

Flowering and fruiting period: It flowers from January to March and it fruits from April to July.

Bark: Purplish grey to light brownish grey, 7-10mm thick, outer dead bark persistent over the entire trunk, relatively smooth, without fissures, slightly dimple, irregular shaped-coloured flakes appeared on the trunk.

General characteristics and properties of the wood:

Sapwood pale yellow, heartwood reddish-brown, lustrous; odour and taste not distinct, moderately heavy, medium and even texture, straight grained, growth ring distinct.

Microscopic characteristics :

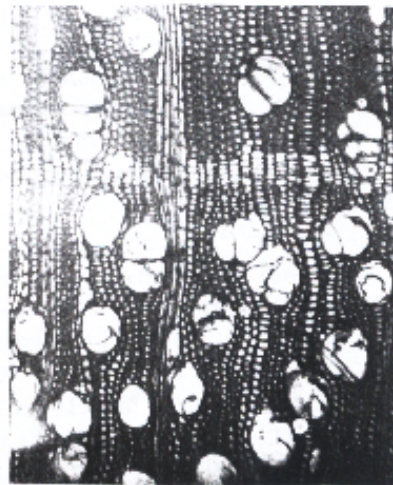
Vessel elements: Diffuse porous; pores moderately small to medium-sized, mean tangential diameter 89.68µm (range 51.25-123 µm), number per sq. mm moderately numerous to numerous, range 13 - 26, average solitary pore 68% (range 42-89 %), pores solitary, multiples of 2-3, sometimes in pore chains, oval or circular in cross section, thin-walled; perforation plates scalariform 5 to 21 bars; end walls of elements transverse or one-end tailed; intervacular pitting scalariform, 7.5 to 60µm in diameter; vessel element moderately short to moderately long, mean length 710.83 µm (range 358.75-1127.5µm ); tyloses present.



14. SAGASEIN (*Cananga odorata* (Lamk.) Hook .f. & Thoms. )



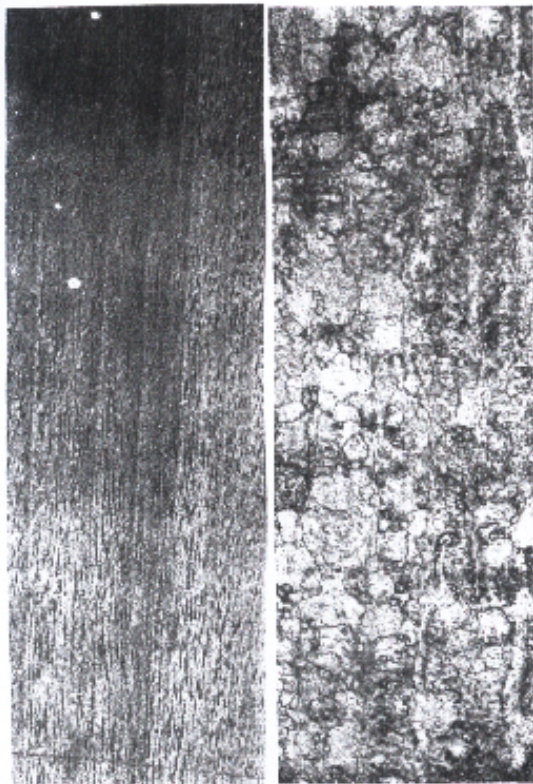
A plant in natural habit



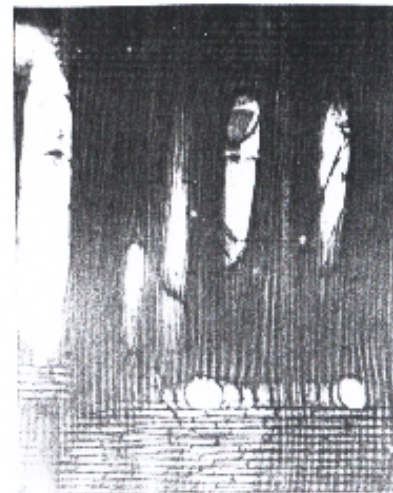
Transverse section ( X 75 )



Tangential & Longitudinal Section( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

- Fibres : Semi - libriform to libriform, very short to moderately long; mean length 1427.31 $\mu$ m (range 686.75-2173 $\mu$ m), F/V ratio 2.2 (range 1.3-5.74), mean tangential diameter 21.37 $\mu$ m ( range 5-32.5 $\mu$ m), non-septate, 5 - 25  $\mu$ m thickened, inter-fibre pits numerous, bordered & simple, slit-like.
- Rays : Heterocellular, uniseriate to tetraseriate, few to moderately numerous, 4 to 9 per mm tangentially, extremely fine to medium sized, mean width 41  $\mu$ m (range 10.25- 71.75  $\mu$ m); mean height of uniseriate rays is 229.08  $\mu$ m (range 112.75- 522.75 $\mu$ m) and 2 to 11 cells high; mean height of multiseriate rays is 581.68  $\mu$ m (range 225.5-1137.75  $\mu$ m) and 7 to 36 cells high; ray vessel pitting opposite, oval, orbicular or elliptical in shape, 5 - 25  $\mu$ m in diameter; reddish -brown gum deposits present, crystal wanting, oil cells in margin of ray cell.
- Axial parenchyma: Paratracheal parenchyma sparse, metatracheal parenchyma 2 to 6 seriate bands, gum deposits present, crystal wanting.
- Uses: It is suitable for second class furniture and flooring.



## SAGAWA

Botanical Name: *Michelia champaca* L.  
(Family - Magnoliaceae)

Habit and distribution: A tree attaining a height of 16-30 m and a gbh of 1.5-2.5 m. It occurs throughout the plains and lower hills forest of Myanmar, chiefly found in Mandalay division, Sagaing division and Magwe division.

Morphological and taxonomical characteristics:

A tree, the stem clear, straight, the bark comparatively thick, the branches terete, glabrous, sparsely pubescent. Leaves simple, spirally arranged, penninerved, coriaceous, stipulate, early caducous, leaving a circular scar on the twig and often also on the petiole, the laminae ovate, lanceolate 9.5-26.5 cm long and 4.00-10.5 cm wide; with acute or cuncate base, the margins entire, the tips acuminate or acute, the underneath patently pubescent, petiole 2-4 cm long. Inflorescence axillary, or subaxillary on short, solitary or paired, fragrant: Flowers orange sepals oblong, ovate; petals linear; perianth lobes 2.5-4 cm, in 2 or more series, stamens 20, carpels 1-8, separated from the stamens by naked parts of receptacle; ovules 1-2; carpels dehiscent along the dorsal suture; fruit 7.5-10.0 cm long, dorsally dehiscent follicles, seeds protruding from the fruit, hanging at elastic funicles.

Flowering and fruiting period: It flowers from March to May and fruits from June to August.

Bark: Light bluish-grey or greyish brown, about 8-12 mm thick, coarsely flaky, outer dead bark persistent over the entire trunk, irregular patches leaving a whitish yellow or brownish surface.

General characteristics and properties of the wood:

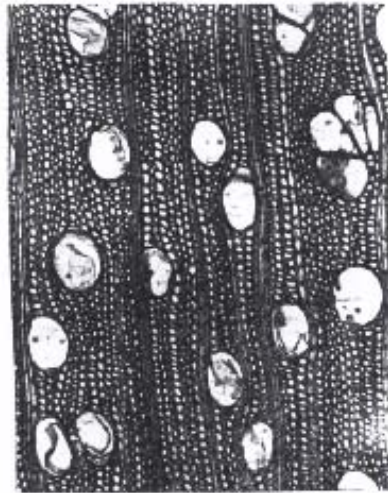
Sapwood white; heartwood light yellowish-brown to olive-brown; somewhat lustrous, odour and taste not distinct, light (sp.gr. approx 0.53), soft, medium and even texture, straight-grained; growth ring distinct.

Microscopic characteristics :

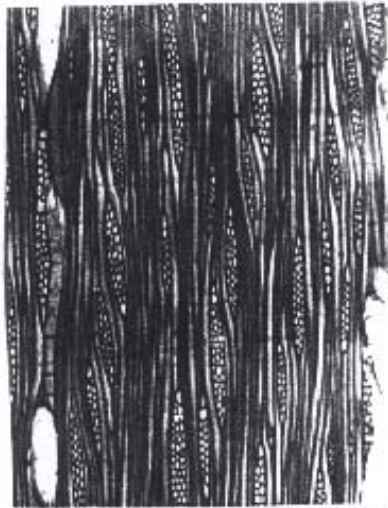
Vessel elements : Diffuse porous; pores very small to medium sized; mean tangential diameter 87.63  $\mu$ m (range 30.75 - 143.5  $\mu$ m), number per sq. mm. moderately few to numerous, range 9 - 21, average solitary pore 34.93% (range 13.33-66% ) pores solitary, multiples or clusters, oval or circular in cross section, perforation plates scalariform; end walls of elements oblique or transverse or tailed, intervacular pitting mostly scalariform, alternate, crowded, elliptical in shape, 7.5 to 77.5  $\mu$ m in diameter; vessel parenchyma pitting alternate, crowded, 5 to 15  $\mu$ m in diameter, elliptical in shape; vessel elements medium sized to moderately long, mean length 687.77  $\mu$ m (range 461.25 - 973.75  $\mu$ m), tyloses present.

15. SAGAWA (*Mechelia champaca* L.)

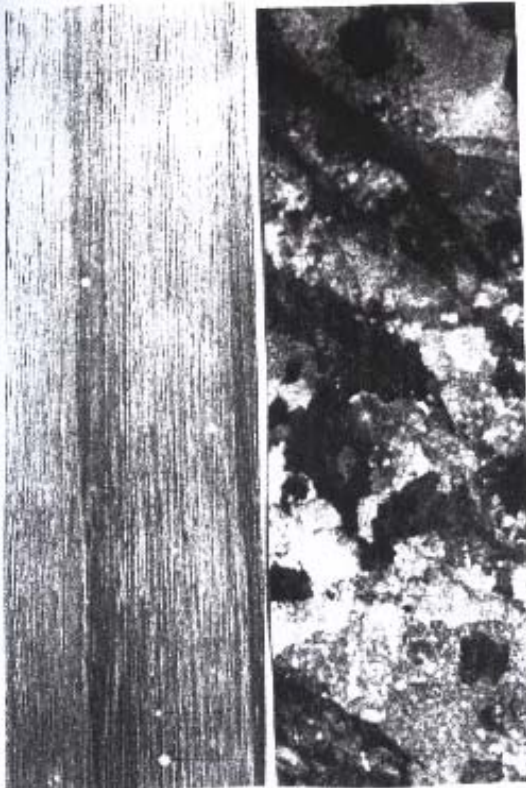
A plant in natural habit



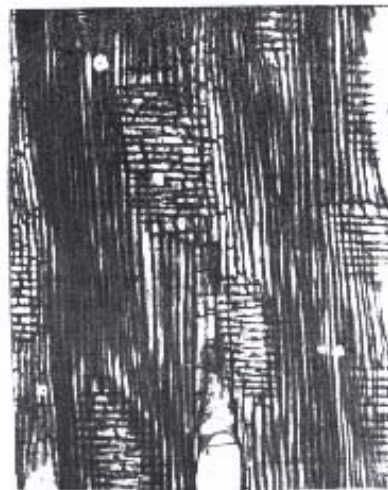
Transverse section ( X 75 )



Tangential &amp; Longitudinal Section ( X 75 )



Timber &amp; bark as seen



Radial &amp; Longitudinal Section ( X 75 )

- Fibre : Non-libriform, medium-sized to moderately long; mean length 1533.4  $\mu\text{m}$  (range 1158.25 - 1916.75  $\mu\text{m}$ ), F/V ratio 2.32 ( range 1.25-3.54 ), mean tangential diameter 19.5  $\mu\text{m}$  (range 7.5 -32.5 $\mu\text{m}$ ); non septate, interfibre pits abundant, most numerous on the radial walls, slit -like, oblique orifice; infiltration wanting.
- Rays : Heterocellular, uniseriate to triseriate, moderately numerous to numerous 6 to 10 per mm. tangentially, very fine to medium sized, mean width 33.31  $\mu\text{m}$  (range 20.5 - 51.25  $\mu\text{m}$ ); mean height of uniseriate rays is 180.91  $\mu\text{m}$  (range 82.0 –369.0 $\mu\text{m}$ ) and 2-9 cells high; the mean height of multiseriate rays 260.32  $\mu\text{m}$  (range 92.25 - 471.5  $\mu\text{m}$ ) and 5 to 36 cells high; ray vessel pitting alternate, crowded, elliptical in shape, 17.5 - 30  $\mu\text{m}$  in diameter, crystals absent.
- Axial parenchyma : Parenchyma terminal, paratracheal, and metatracheal. Terminal parenchyma forming a broad 2-8 seriate, more or less ragged band delimiting the growth ring. Paratracheal parenchyma & metatracheal parenchyma very sparse, difficult to distinguish from the fibres in the transverse section; infiltration scanty, pale lemon-yellow; crystals wanting; starch deposits frequently present in the outer rings.
- Uses: It is used for house building, furniture, carriages, yokes, canoes, oars, plough, carving and turning.

## SANDAWA

Botanical Name: *Cordia fragrantissima* Kurz.  
(Family-Boraginaceae)

Habit and distribution: A tree, attaining 15-20 m in height and 1.5-1.8 m in girth. It is commonly distributed in the lower hill forests of lower Myanmar. It is also found growing in Mandalay division and Bago division.

Morphological and taxonomical characteristics:

A tree, leaves alternate, the laminate ovate, the bases obtuse or rounded, the margins entire or repand-serrate, the tips obtuse, acute to acuminate; scabrous above, grey-tomentose beneath, exstipulate. Inflorescences corymbs, terminal; flowers usually dichotomous scorpioid; calyx 5, toothed or lobed; corolla often with scales in the throat; stamens as many as the corolla - lobes. Ovary cells 2, 2 ovuled; style terminal, stigma capitate or 2-lobed. Fruit drupaceous or dividing into 2-4 nutlets. Seeds erect or oblique.

Flowering and fruiting period: It flowers from January to March and it fruits from March to May.

Bark: Bluish grey to brownish grey 10 – 15 mm thick, outer dead bark persistent over the entire trunk, smooth dimple flakes scattered over the surface.

General characteristics and properties of the wood:

Sapwood light brown, heartwood dark brown, dull, somewhat lustrous odour and taste not distinct, moderately heavy to heavy, medium fine to texture, straight-grained, growth ring distinct.

Microscopic characteristics :

Vessel elements : Diffuse porous; pores moderately small to very large, mean tangential diameter 170.66  $\mu\text{m}$  (range 61.5 – 382  $\mu\text{m}$ ), number per sq. mm few to moderately few, range 4 to 9, average solitary pore 63% (range 11- 100%), most part solitary, less commonly in radial rows of 2, 2-3 contiguous in the tangential plane, oval or circular in cross section, thin to medium-thick walled; perforation plates simple; nearly horizontal to oblique; end walls of elements truncate or transverse, intervascular pitting circular or oval, opposite to alternate, numerous, 2.5 – 6.25  $\mu\text{m}$  in diameter; vessel elements extremely short to medium-sized, mean length 237.28  $\mu\text{m}$  (range 71.75 – 369  $\mu\text{m}$ ); tyloses abundant in the vessel pores, gummy deposits not observed.

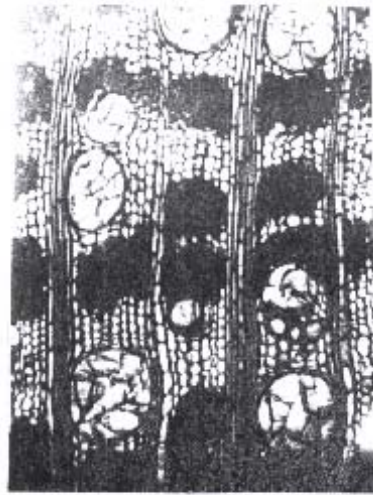
Fibre : Libriform, medium-sized to moderately long; mean length 1780.93  $\mu\text{m}$  (range 1506.75-2173  $\mu\text{m}$ ), F/V ratio 9.2 (range 5.16 - 27.28); mean tangential diameter 18.37  $\mu\text{m}$  (range 12.5 -27.5  $\mu\text{m}$ ), non-septate, 12.5-27.5  $\mu\text{m}$  thickened, inter fibre pits fairly numerous, quite evenly distributed on the longitudinal walls, simple, with slit-like.



16. SANDAWA (*Cordia fragrantissima* Kurz.)



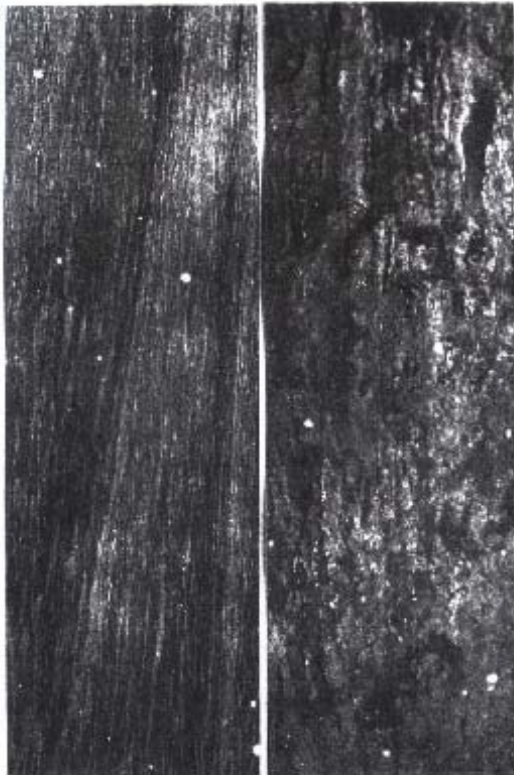
A plant in natural habit



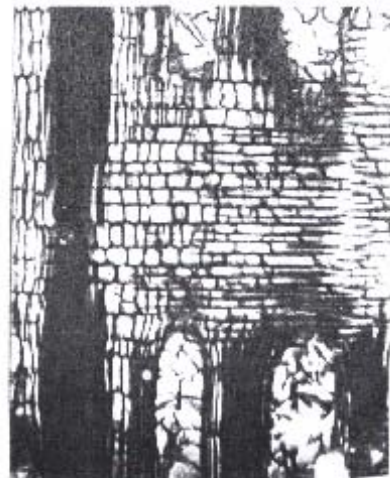
Transverse section ( X 75 )



Tangential & Longitudinal Section ( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

Rays : Heterocellular, uniseriate to multiseriate, ( one to 6 seriate), few to moderately numerous, 3 to 5 per mm tangentially, extremely fine to medium-sized, mean width 57.4  $\mu\text{m}$  (range 10.25 - 92.75  $\mu\text{m}$ ); mean height of uniseriate rays is 92.25  $\mu\text{m}$  (range 41 - 225.5  $\mu\text{m}$ ) and 1 to 4 cells high; mean height of multiseriate rays is 801.04  $\mu\text{m}$  (range 164 - 1588.75  $\mu\text{m}$ ) and 5 to 53 cells high; ray vessel pitting opposite to alternate, circular or oval in shape, 5 to 10  $\mu\text{m}$  in diameter; crystals present in the ray cell, gum deposits not observed.

Axial parenchyma : Paratracheal and metatracheal, paratracheal parenchyma vasicentric, confluent to banded, 2 to 14 seriate band, metatracheal parenchyma very sparse, Gum canals occasionally present. Substitute fibre frequent scattered among.

Uses: It is a first class furniture wood because of its dark and handsome colour.



## TAUNGTAMA

Botanical Name: *Cedrela serrata* Royle.  
(Family - Meliaceae.)

Habit and distribution: A tree attaining 15-25 m in height and 1.5-2.0 m in girth. It is usually found in hilly regions of upper Myanmar and it is commonly distributed in southern Shan state.

Morphological and taxonomical characteristics:

A tall tree leaves compound, alternate, paripinnate, leaflets 8-30, ovate, the laminae oval-lanceolate, the bases obliquely ovate or semi-cordate base, the margins serrate, the tips cordately or acutely acuminate, glabrous. Inflorescences panicles, densely or finely pubescent, terminal or subterminal oblong; flowers pentamerous; sepals short 5 cleft; petals sub-erect, ovate; stamens 5, free, inserted at the top of the disk, sometimes alternating with staminodes; anthers widely oblong; disk thick, 4-6 lobed; ovary sessile, 5-celled; style filiform, stigma dicoid. Fruit capsule, coriaceous.

Flowering and fruiting period: It flowers from May to August and it fruits from July to September.

Bark: Light greyish brown to pale brown, 12-18 mm thick, rough, narrow fissured scale patches separated on rough surface.

General characteristics and properties of the wood:

Sapwood pinkish or greyish white, heartwood light red, lustrous, odour and taste not distinct, light (Sp. gr. approx. 0.44), coarse and uneven texture, straight grained, growth ring distinct.

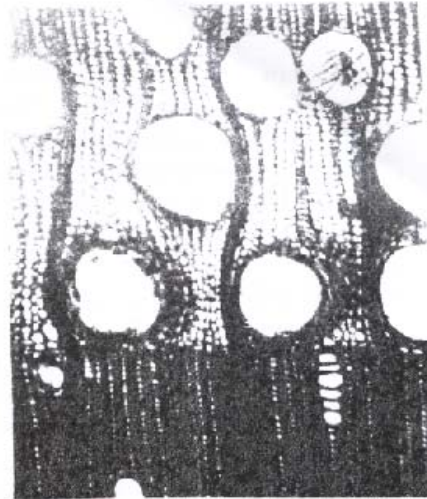
Microscopic characteristics :

Vessel elements: Ring porous; pores moderately small to very large, mean tangential diameter 162.46  $\mu\text{m}$  (range 51.25 - 338.25  $\mu\text{m}$ ), number per sq. mm few to moderately few, range 3 to 9, average solitary pore 58 % (range 0 - 100 %), pores solitary, multiples of 2 to 6, oval or circular in cross section, thin -walled; perforation plates simple; nearly horizontal to oblique; end walls of elements truncate or abruptly tailed on one or both ends, intervacular pitting numerous, crowded, orbicular to oval, 2.5 to 7.5  $\mu\text{m}$  in diameter; vessel elements moderately long to medium -sized, mean length 431.52  $\mu\text{m}$  (range 328 - 553.5  $\mu\text{m}$ ); tyloses absent, deposits of reddish - brown gum frequent, forming plugs occluding the perforations and parietal.

17. LAUNGLAMIA (*Cedreha serrata* Royle.)



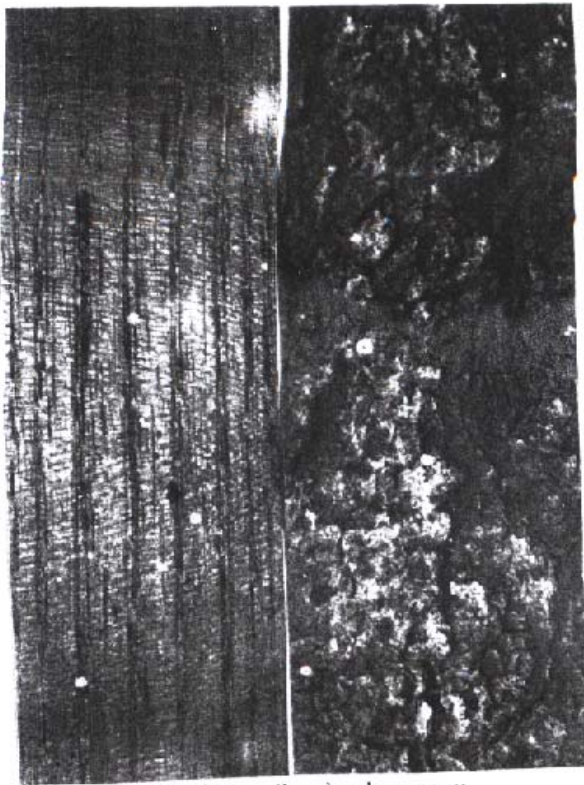
A plant in natural habit



Transverse section ( X 75 )



Tangential & Longitudinal Section ( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

Fibres : Non- libiform, medium -sized to moderately long; mean length 1353.0  $\mu\text{m}$  (range 1148 - 1670.75  $\mu\text{m}$ ), F/V ratio 3.22 (range 2.5 - 4.65 ); mean tangential diameter 25.12  $\mu\text{m}$  (range 15 - 35  $\mu\text{m}$ ), non-septate, 2.5 - 5.0  $\mu\text{m}$  thickened, interfibre pits minute, with narrow border and nearly vertical linear lenticular orifice; small globules of reddish - brown gum frequently present.

Rays : Heterocellular, uniseriate to tetraseriate, few to moderately numerous, 2 to 7 per mm tangentially, extremely fine to medium-sized, mean width 42.02  $\mu\text{m}$  (range 10.25 - 61.5  $\mu\text{m}$ ); mean height of uniseriate rays is 158.87  $\mu\text{m}$  (range 61.5 - 287  $\mu\text{m}$ ) and 1 to 9 cells high; mean height of multiseriate rays is 404.36  $\mu\text{m}$  (range 143.5 - 707.25  $\mu\text{m}$ ) and 5 to 28 cells high; ray vessel pitting crowded, alternate, orbicular to oval, 2.5 to 7.5  $\mu\text{m}$  in diameter, reddish - brown organic infiltration very sparse; crystals frequent, solitary in the ray cells.

Axial parenchyma: Paratracheal and metatracheal in cambiform rows, paratracheal parenchyma relatively scanty, forming a 1 - several (mostly 1) seriate, metatracheal parenchyma abundant, most frequent on the outer face of the preceding ring, pale brown or reddish -brown gummy globular deposits present in some cells; crystals not observed.

Uses: The wood is suitable for planking and making furniture for decorative purposes. It is also used for parts of musical instrument.

## TAWTHIDIN

Botanical Name: *Mallotus philippinensis* Muell.Arg.  
(Family - Euphorbiaceae)

Habit and Distribution: A small tree, attaining 8.5-10 m in height and 1.2-1.6 m in girth. It is found growing in the dry forests of Myanmar up to 1000 m elevation.

Morphological and taxonomical characteristics:

A small tree, branch slender. Leaves ovate 5-14.5 cm long and 1.5-6.00 cm wide, mostly spirally arranged, rhomboid or oblong lanceolate, mostly spirally arranged the bases cuneate-rounded, the margins sub-entire, the tips acute to acuminate stipule caducous; petiole 2.5-5.0 cm. Inflorescences spikes, terminal solitary, or paniced, sub-sessile, male clustered, mostly fascicles, stamens numerous, mostly 20-30; female solitary, perianth lobe 5, often subcennate; ovary stellate hairy, 3-celled, stigma thick, hairy-linear, sessile. Fruit capsule, depressed globose, 3-lobed, loculicidally 3-valved, 8 mm-12 mm long; seed globose, smooth, black.

Flowering and fruiting period: It flowers from February to May and it fruits from May to August.

Bark: Light brown to brown, 4-8 mm thick, outer dead bark persistent over the entire trunk, relatively smooth, irregular large brown patches intermingled with greyish spots, longitudinally shallow furrowed.

General characteristics and properties of the wood:

Sapwood white to pale yellow; heartwood light brownish grey to light greyish red and frequently with darker streaks; dull; somewhat lustrous; odour and taste not distinct, moderately heavy (sp.gr. approx 0.74), medium fine and even texture; fairly straight-grained; growth ring distinct.

Microscopic characteristics :

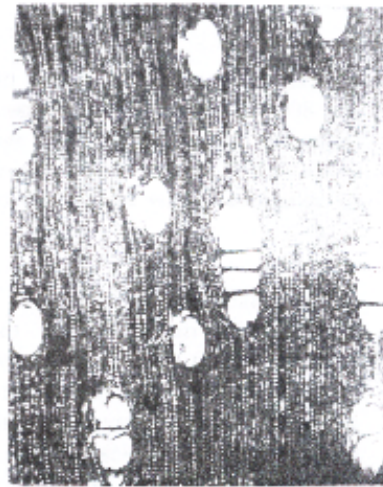
Vessel elements : Diffuse porous; pores very small to medium-sized, mean tangential diameter 81.48  $\mu\text{m}$  (range 30.75 – 133.25  $\mu\text{m}$ ), number per sq. mm moderately few to moderately numerous, range 8 to 19, average solitary pore 27 % (range 6 - 75 %), pores solitary and in radial rows of 2-10, oval or circular in cross section, medium-thin walled; perforation plates simple; nearly horizontal to oblique; end walls of elements truncate or abruptly or attenuately tailed on one or both ends, intervacular pitting numerous, alternate to opposite, crowded, orbicular to oval or angular, 7.5 – 10  $\mu\text{m}$  in diameter; vessel elements moderately short to medium-sized, mean length 462.27  $\mu\text{m}$  (range 307.5–625.25 $\mu\text{m}$ ); tyloses abundant, vessels occasionally occluded with granular deposits.



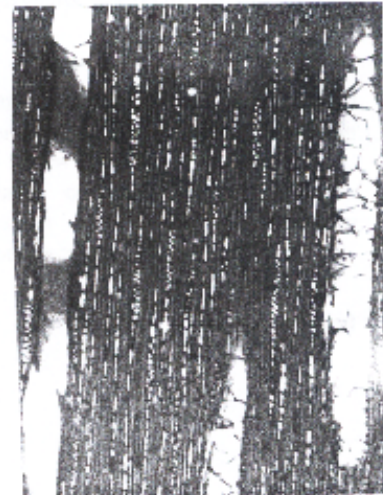
18. TAWTHIDIN (*Mallotus philippinensis* Muell.Arg.)



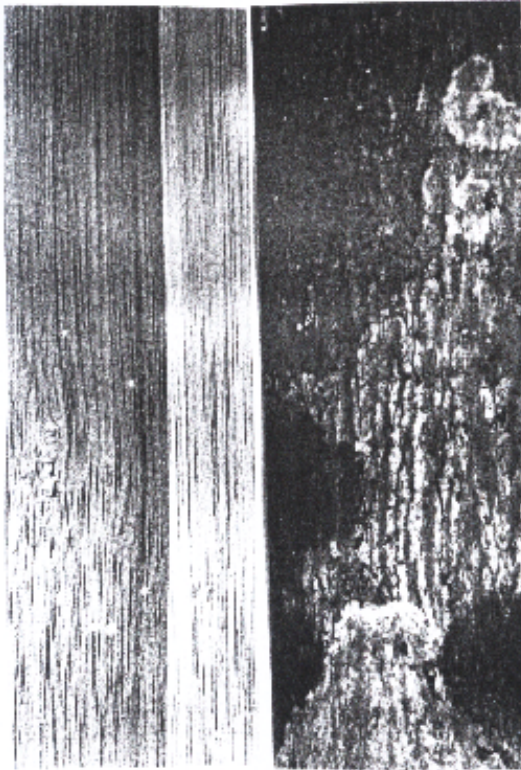
A plant in natural habit



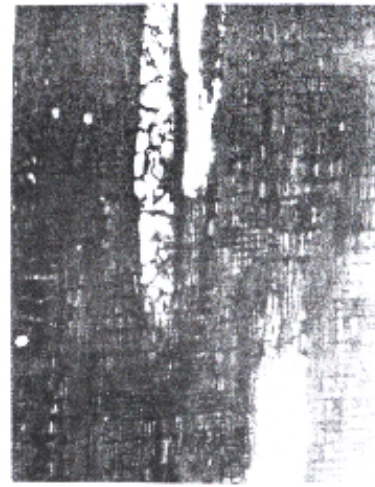
Transverse section ( X 75 )



Tangential & Longitudinal Section( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

**Fibre :** Non libriform to semi libriform, moderately short to medium-sized; mean length 844.08  $\mu\text{m}$  (range 615 – 1055.75  $\mu\text{m}$ ), F/V ratio 1.9 (range 1.2 – 2.76); mean tangential diameter 14.87  $\mu\text{m}$  (range 10 – 37.5  $\mu\text{m}$ ), non-septate, 2.5 to 5  $\mu\text{m}$  thick, interfibre pits numerous, largely confined to the radial walls, orbicular to bordered pits, black deposits occluded.

**Rays :** Heterocellular, uniseriate to triseriate, very numerous, 12 to 26 per mm tangentially, moderately fine to moderately broad, mean width 19.25  $\mu\text{m}$  (range 30.75 – 143.5  $\mu\text{m}$ ); mean height of uniseriate rays is 547.86  $\mu\text{m}$  (102.5 – 1537.5  $\mu\text{m}$ ) and 2 to 26 cells high; mean height of multiseriate rays is 740.56  $\mu\text{m}$  (range 164-1875.75  $\mu\text{m}$ ) and 10 to 70 cells high; ray vessel pitting alternate to opposite, fairly numerous to each ray cell, rounded, frequently oval and horizontally orientated, 5 to 7.5  $\mu\text{m}$  in diameter; yellow or yellowish-brown gummy deposits abundant in the ray tissue; crystals abundant in the upright cells (ray cells); starch deposits not observed.

**Axial parenchyma :** Paratracheal, and metatracheal, paratracheal parenchyma sparse, forming a uniseriate sheath which is frequently interrupted by rays and fibres contiguous to the vessels, metatracheal parenchyma extremely abundant, concentric, yellowish or yellowish-brown globular gummy infiltration fairly abundant in the parenchyma, crystal wanting, starch deposits not observed.

**Uses:** It is used for tool handles and agricultural implements.



## THAN

Botanical Name *Terminalia oliveri* Brandis.  
( Family – Combretaceae )

Habit and distribution: A tall tree, attaining 8-22 m in height and 1.4 to 1.8 m in girth. It is widely distributed in dry regions of Ayeyawady Valley, the lower part of Chindwin near the upper top of Sittaung. It is usually found together with *Tectona halmiltoniana* on rocky hills in dry forest of Myanmar.

### Morphological and taxonomical characteristics

A tall deciduous tree, the stem clear, terete, straight. Leaves simple, subopposite exstipulate, the laminae elliptic-oblong to ovate, 3.5 to 8.5 cm long and 2.5-5.5 cm wide, pinninerved, glabrous on both surfaces, the bases obtuse to rounded, the margins entire, the tips acute. Inflorescences terminal or axillary, dense panicle spikes, the terminal ones 4.0-8.5 cm long, erect to subpendulous, the peduncles terete, smooth. Flowers 4.5-6.0 cm long and 3.5-5.0 mm wide, bisexual, regular, pentamerous, apetalous, epigynous, bracteate; calyx cup-shaped, 5-lobed, the lobes 1.2-1.4 mm long and 1.1-1.3 mm wide, abruptly widened above the tip of the ovary; stamens 10, free, unequal in length, the longer five opposite the calyx lobes, arising from the base of disc, the shorter five alternating with the calyx lobes, arising from the rim of the calyx tube, the filament filiform, 3.5-5.0 mm long; ovary ellipsoid, with three united carpels, inferior, unilocular, with one to two pendulous ovules, the styles filiform, erect, stigma simple. Fruit indehiscent, with 4 to 6 thin and flexible wings, 1 to 2 seeded; seeds ellipsoid, 3-5 mm long and 2-3 mm wide, smooth, grey.

Flowering and fruiting period: It flowers from June to July and fruits from July to October.

Bark: Light grey to pale greyish brown, 15-20 mm thick, the outer dead bark persistent on the entire trunk, various pattern of patches and whitish or coloured spots scattered on the smooth surface.

### General characteristics and properties of the wood :

Sapwood pale yellowish white, heartwood dark purple; odour and taste not distinct; heavy; very hard; fairly straight-grained; very fine textured; diffuse porous; growth rings not distinct.

19. THAN ( *Terminalia oliveri* Brandis. )



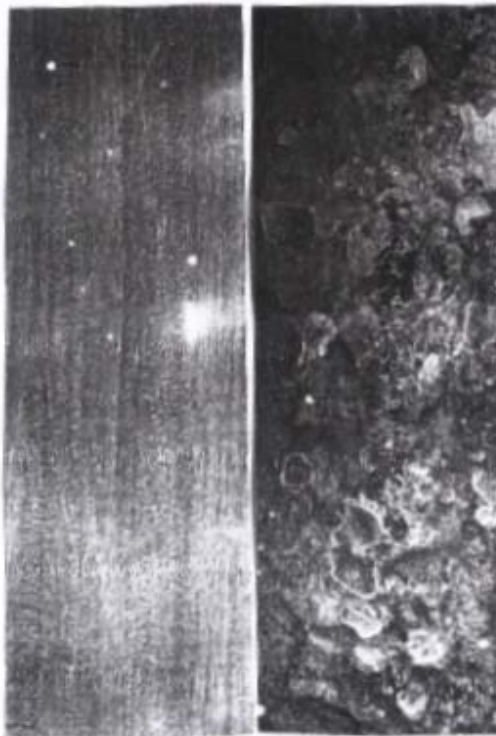
A plant in natural habit



Transverse section ( X 75 )



Tangential & Longitudinal Section ( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

# Microscopic characteristics :

**Vessel elements :** Diffuse porous; pores very small to moderately small, mean tangential diameter 63  $\mu\text{m}$  (range 31-82  $\mu\text{m}$ ), number per sq. mm very numerous (range 66 - 153), average solitary pores 13 % (range 6 -23%), pores solitary or as radial pore multiples of 2 –16 and occasionally as pore clusters; circular or oval in cross section; thick-walled; lumen with gum deposits or tyloses; perforation plates simple; end walls of elements oblique or transverse; intervascular pitting alternate, crowded, oval to elliptic, vestured, chambers with mean diameter 3  $\mu\text{m}$  (range 2.5-5 $\mu\text{m}$ ), vessels extremely short to medium sized, mean length 338  $\mu\text{m}$  (range 174 - 533 $\mu\text{m}$ ).

**Fibre :** Libriform, extremely short to medium sized, mean length 1060  $\mu\text{m}$  (range 461 - 1466  $\mu\text{m}$ ), F/V ratio 3.4 (range 1.3-5.7), fine to medium fine with mean tangential diameter 15  $\mu\text{m}$  (range 10 - 25  $\mu\text{m}$ ), non-septate, thin to thick-walled, 4 - 9  $\mu\text{m}$  thick, interfibre pits minute, simple, slit-like.

**Rays :** Heterocellular, uniseriate, moderately numerous to very numerous 6-24 per mm. tangentially, extremely fine to moderately fine, mean width 19  $\mu\text{m}$  (range 10 - 31  $\mu\text{m}$ ), mean height 571  $\mu\text{m}$  (range 82-1609  $\mu\text{m}$ ), 2- 53 cells high; ray vessel pitting similar to intervascular pitting, alternate, rounded to oval in shape, 3-5  $\mu\text{m}$  in diameter; gum deposits in ray cell; large solitary crystal present in ray cells.

**Axial parenchyma :** Scanty paratracheal, mostly restricted to tangential side of vessel, forming 1- or 2- seriate, apotracheal diffuse or diffuse in aggregate, 2-6 cells; prismatic crystals absent.

**Uses:** Wood is used for shaft in cart making and sometimes used as house-posts.

## THANTHAT

Botanical Name: *Albizzia lucida* Benth.  
(Family - Mimosaceae )

Habit and Distribution: A moderate-sized tree, attaining 10 – 20 m in height and 1.2-1.8 m in girth. It is commonly found in the plain forests of upper and lower Myanmar.

Morphological and taxonomical characteristics:

A medium sized tree, leaves pinnately compound, pinnae 1-2 pairs; top most or only pair with 1-3 pairs of leaflets, sometimes 2-4 rarely 6, leaflet oblong, acuminate, glabrous, shining above, 2.5-12.0 cm long. Inflorescences heads, partly 1-3 in topmost leaf axils, partly in corymbose cyme, heads on stalks of 2-3.5 cm length, 6-15 flowered; pedicels 0.5 - 1.0 mm; calyx 1.5-2.0 mm long, faintly toothed; corolla 4.5-6.00 mm long, teeth lanceolate, white, turning yellow; stamens 10-15; filaments 2.0-2.5 cm long. Fruit pod, 6-25 cm long, 2.5-3.5 cm wide, thin, flexible, pale brown, 4-10 seeded.

Flowering and Fruiting period: It flowers from March to May and it fruits from May to July.

Bark: Yellowish brown to bluish brown, 5-12 mm thick, outer dead bark persistent over entire trunk, smooth, occasionally stained, irregular blue greyish patches featuring on entire surface.

General characteristics and properties of the wood:

Sapwood white; heartwood brown with darker streaks, lustrous, odour and taste not distinct, moderately heavy (sp.gr. approx 0.67), coarse texture, interlock grained, growth ring distinct but inconspicuous.

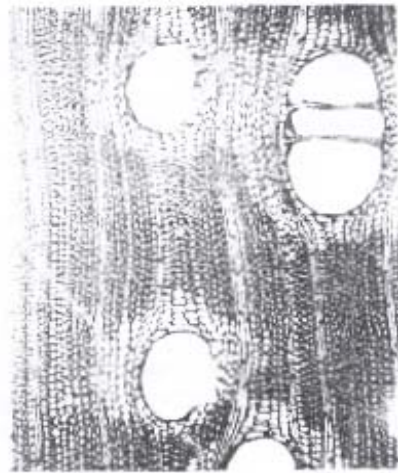
Microscopic characteristics :

Vessel elements: Diffuse porous; pores moderately small to moderately large; mean tangential diameter 165.53  $\mu\text{m}$  (range 51.25-256.2 $\mu\text{m}$ ), number per sq. mm few to moderately few range 3-6, average solitary pores 66%(range 50-100%), pores solitary or in radial rows of 2-3 (mostly 2), oval or circular in cross section, thin walled, perforation plates simple, horizontal to oblique, end walls of element truncate or abruptly tailed, intervascular pitting alternate, crowded, circular to elliptical in shape, 5-7.5 $\mu\text{m}$  in diameter, vessel parenchyma pitting rounded, alternate, 2.5-5 $\mu\text{m}$  in diameter, vessel elements moderately short to medium sized, deposits of reddish-brown gum present, mean length 376.17 $\mu\text{m}$  (range 275.75 - 471.5  $\mu\text{m}$ ).

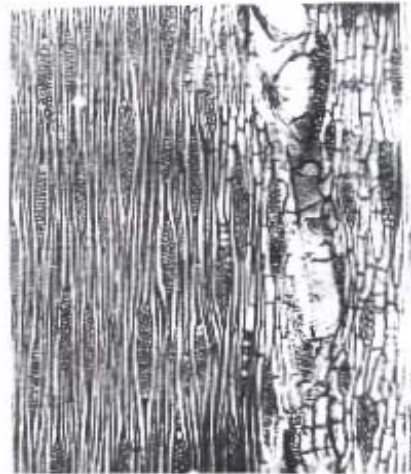
20. THANTHAT ( *Albizia lucida* Benth. )



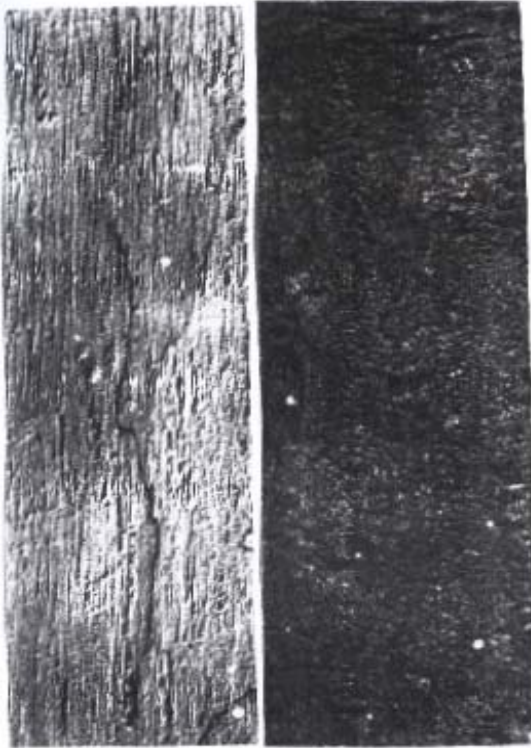
A plant in natural habit



Transverse section ( X 75 )



Tangential & Longitudinal Section( X 75



Timber & bark as seen



Radial & Longitudinal Section ( X 75



- Fibres : Non libriform to semi libriform; medium sized to very long; mean length 2014.12  $\mu\text{m}$  (range 1455.5- 2716.25 $\mu\text{m}$ ), F/V ratio 5.1(range 4.0-7.57), mean tangential diameter 21.5 $\mu\text{m}$  (range 12.5-35 $\mu\text{m}$ ); septate, 2.5-7.5  $\mu\text{m}$  thickened, interfibre pits minute, simple, slit-like, steeply oblique, deposits of reddish-brown gum present.
- Rays : Homocellular, uniseriate to tetraseriate, numerous to very numerous 8-12 per mm. tangentially; extremely fine to moderately fine, mean width 23.75 $\mu\text{m}$  (range 7.5-37.5  $\mu\text{m}$ ); mean height of uniseriate rays is 85.07  $\mu\text{m}$  (range 30.75-133.25 $\mu\text{m}$ ) and 2-30 cells high; the mean height of multiseriate rays is 295.17  $\mu\text{m}$  (range 71.75-440.25 $\mu\text{m}$ ) and 12-31 cells high, ray vessel pitting alternate, orbicular to oval, pits 5-10  $\mu\text{m}$  in diameter, reddish-brown gummy infiltration relatively abundant, crystals wanting; starch grains abundant.
- Axial parenchyma: Paratracheal parenchyma abundant and aliform type, metatracheal parenchyma sparse, diffuse, scattered in the broad tracts of fibres of reddish-brown gum occasional in the parenchyma, scanty, starch deposits abundant.
- Uses: As the timber is difficult to saw and work, it can only be used for bridge flooring and general construction.

## THET-YIN-GYI

Botanical Name: *Croton oblongifolius* Muell.Arg.  
(Family – Euphorbiaceae)

Habit and Distribution: Small deciduous tree, attaining a height of 10- 8 m and a gbh of 1.0-1.6 m. It usually occurs in plains and low hill of forests. It is also found growing in Bago division, Mandalay and Sagaing division.

### Morphological and taxonomical characteristics:

Small deciduous tree, young branches compressed, pubescent, branches rather stout. Leaves simple, alternate; 12.5-28.8 cm long 4-8.5 cm wide ovate or elliptic-lanceolate; petiole 2.5-4.5 cm, the bases acute, the margining serrate, the tips acute or obtuse; rather coriaceous, very pale green when dry. Inflorescences racemes often fascicled, erect; pedicels rather long. Flowers smaller, clustered with small bracts. Sepals of male flower, broadly oblong; petals as long as the sepals, woolly; disk-glands 5, rounded; stamens 12, glabrous, sepals of female flower oblong; petals small, linear, disk depressed; ovary 3-celled, oblong, ovule one in each cell, style long and slender. Capsule 5-7 mm in diameter, globose 3-lobed, top depressed.

Flowering and fruiting period: It flowers from February to April and fruits from March to May.

Bark: Light greyish brown, 6-12 mm thick, longitudinal fissured, soft and slightly flaky when rubbed, exfoliating into irregular scaly plates with brownish blaze.

### General characteristics and properties of the wood:

Sapwood yellow, heartwood brownish-grey, with darker streaks, somewhat lustrous, odour and taste not distinct, light, medium fine texture, straight-grained, growth ring not distinct.

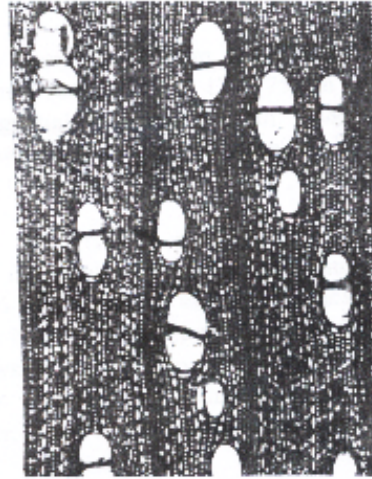
### Microscopic characteristics :

Vessel elements: Diffuse porous; pores very small to medium sized; mean tangential diameter 114.8  $\mu\text{m}$  (range 41.0 - 164.0  $\mu\text{m}$ ), number per sq. mm moderately few to moderately numerous range 8 to 19, average solitary pores 31% (range 12.5-62.5%), pores solitary or in radial pore multiples of 2 to 9, oval or circular in cross section, perforation plates simple; end walls of elements oblique, one end or both end tailed; intervascular pitting rounded, alternate, crowded, simple, 5.0 - 6.3  $\mu\text{m}$  in diameter, vessel parenchyma pitting rounded, 2-3.8  $\mu\text{m}$  in diameter; vessel elements moderately short to medium sized, mean length 481.23  $\mu\text{m}$  (range 287.0 to 686.75  $\mu\text{m}$ ).

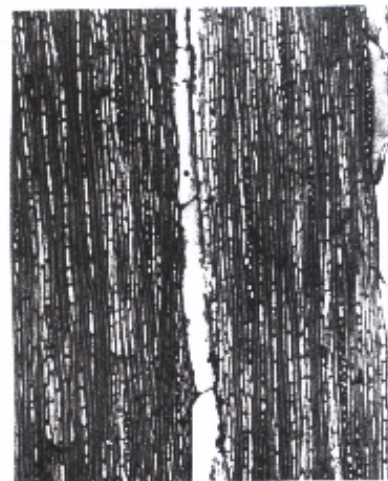
21. THET-YIN-GYI ( *Croton oblongifolius* Muell.Arg. )



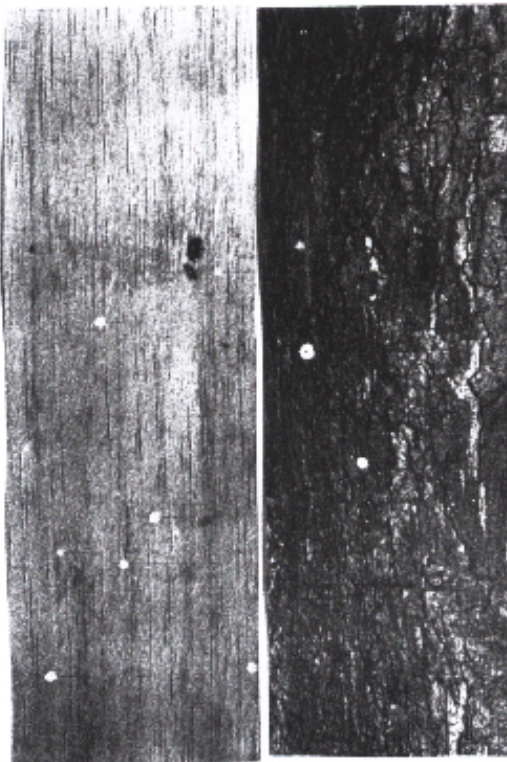
A plant in natural habit



Transverse section ( X 75 )



Tangential & Longitudinal Section ( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

Fibres : Libriform; very short to medium sized; mean length 867.15  $\mu\text{m}$  (range 574 -1219.75  $\mu\text{m}$  ), F/V ratio 1.9 (range 0.94-3.68), mean tangential diameter 20.25 $\mu\text{m}$  (range 12.5-27.5 $\mu\text{m}$  ); septate, 2.5-5.0  $\mu\text{m}$  thick, inter fibre pits simple, minute, slit- like.

Rays : Heterocellular, uniseriate to multiseriate, (1-2 seriate) very numerous, 16 to 29 per mm. tangentially; extremely fine; mean width 5.06  $\mu\text{m}$  (range 2.5 to 7.5  $\mu\text{m}$ ); mean height of uniseriate rays is 484.31  $\mu\text{m}$  (range 61.5 - 1404.25  $\mu\text{m}$ ); and 1 to 22 cells high; mean height of multiseriate rays is 641.25  $\mu\text{m}$  (range 153.75- 1158.25  $\mu\text{m}$  ) and 6 to 26 cells high; ray vessel pitting rounded or oval, alternate, crowded, 5 - 6.25  $\mu\text{m}$  in diameter, gum deposits and crystals not observed.

Axial parenchyma: Apotracheal diffuse, paratracheal scanty.

Uses: It is used for general carpentary work and packing cases.

## THITSI

Botanical Name: *Melanorrhoea usitata* Wall.  
(Family- Anacardiaceae.)

Habit and distribution: Large deciduous tree, attaining 15-20 m in height and 1.3-2.0 m in girth. It is distributed in upper and lower Myanmar, chiefly in Indaing forest. It is also scattered in Southern Shan State, Sagaing division, chiefly in Katha, Myitha and upper Chindwin and some part of Mandalay division.

Morphological and taxonomical characteristics:

A large tree with sub-cylindrical crown; stem terete with clear trunk, woody with varnish juice. Leaves simple, alternate, the laminae oblong or obovate - cuneate, 19-30 cm long, 6-10 cm wide, the bases cuneate or attenuate, the margins entire, the tips acute to obtuse, coriaceous; petioles slightly flattened and winged, 2.0-3.5 cm. Inflorescences terminal and axillary panicles with many flowers; terminal peduncles, erect, 15-32 cm long. Flowers bisexual, actinomorphic, white, 12-15 mm long, bracteate; pedicel 5-12 mm long, softly tomentose; sepals 5 lobed, cohering into a pointed cap, calyptriform, beaked, caducous; petals 5, free, linear-oblong, persistent, modified into large wings in fruits; stamens numerous in three whorls, free; the filament filiform, 4 mm long; ovary monocarpellary, ovoid or globose with stalk, about 2 mm in diameter, superior, unilocular with one ovule in the locule on pendulous placenta; style sub-lateral, stout, 1-2 mm long; stigma simple. Fruit drupe, indehiscent, 1.5-2.0 cm long and 1.5-2.5 cm wide, glabrous; seeds solitary, sub-globose.

Flowering and fruiting period: It flowers from February to December. The fruits appear from February to May.

Bark: Dark greyish brown to brownish grey, 8-12 mm thick, outer dead bark persistent over the trunk, slightly rough, irregularly cracked, shallow flakes retained on the surface.

General Characteristics and properties of the wood :

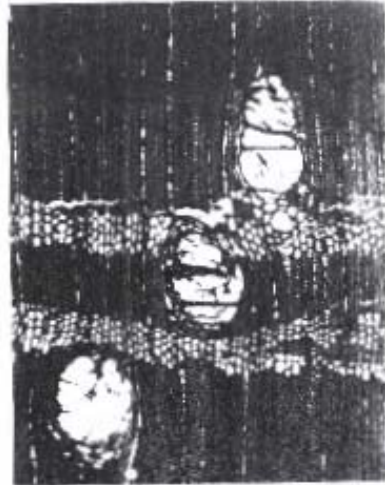
Sapwood brownish-yellow to golden yellow, heartwood reddish-brown to dark red; odour and taste not distinct; heavy (specific gravity (Green 0.73); hard, medium textured; straight-grained; diffuse-porous wood; growth ring distinct.



22. THITSI (*Melastomaceae usitata* Wall. )



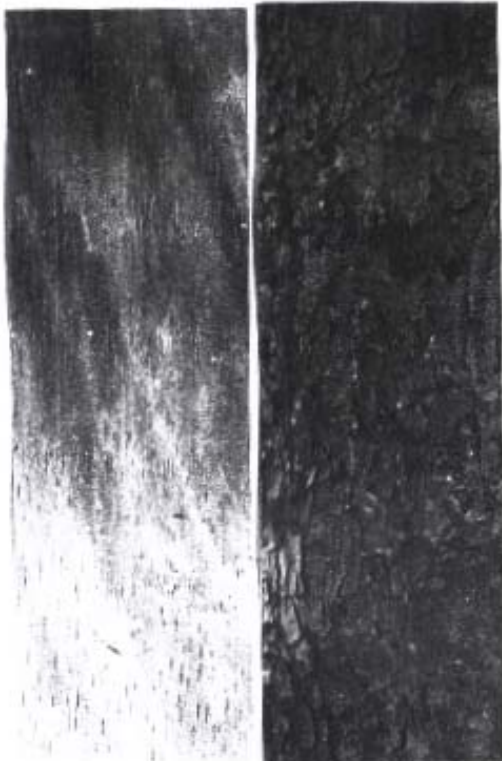
A plant in natural habit



Transverse section ( X 75 )



Tangential & Longitudinal Section ( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

## Microscopic characteristics :

**Vessel elements :** Diffuse-porous; moderately small to moderately large, mean tangential diameter 160  $\mu\text{m}$  (range 72-246  $\mu\text{m}$ ); number per sq. mm few to moderately numerous (range 3-13); average solitary pore 49% (range 25 - 75%); pores solitary or as radial pore multiples of 2-10 or pore clusters; circular or oval in cross section; thin-walled; tyloses abundant, dark red gum deposits present; perforation plate simple, end walls of elements oblique or transverse, truncate; intervascular pitting alternate, crowded, oval or rounded or angular, chambers with mean diameter 7 $\mu\text{m}$  (range 5-10 $\mu\text{m}$ ); vessel elements moderately short to medium-sized, mean length 513  $\mu\text{m}$  (range 308-687 $\mu\text{m}$ ).

**Fibres :** Libriform, moderately short to medium-sized, mean length 1011  $\mu\text{m}$  (range 820 - 1271  $\mu\text{m}$ ), F/V ratio 2.1 (range 1.2 – 3.3), mean tangential diameter 17  $\mu\text{m}$  (range 10 - 25  $\mu\text{m}$ ), non-septate, thin to thick-walled, 2.5-8.0  $\mu\text{m}$  thick, interfibre pits minute, simple, slit-like, gum deposits present.

**Rays :** Homocellular, uniseriate to tetraseriate, mostly uniseriate, very numerous 12-17 per mm tangentially, uniseriate rays extremely fine to moderately fine, mean width 21  $\mu\text{m}$  (range 10 -31  $\mu\text{m}$ ), mean height 316  $\mu\text{m}$  (range 72 - 492  $\mu\text{m}$ ), 2- 20 cells high; multiseriate rays moderately fine to medium-sized, mean width 50  $\mu\text{m}$ (range 31-72  $\mu\text{m}$ ), mean height 373 $\mu\text{m}$  (range 236-533  $\mu\text{m}$ ), 8 - 19 cells high; ray vessel pitting alternate, oval or circular in shape, 5-8  $\mu\text{m}$  in diameter; gum deposits present; occasionally gum canals in multiseriate rays; silica bodies present; tile cells absent.

**Axial parenchyma :** Abundant, paratracheal scanty, banded, connecting vessel pores forming 2 –13 seriate bands, apotracheal diffuse in aggregate; gum deposits in some parenchyma.

**Uses:** The chief use of the tree is to extract the varnish obtained from the bark and used in Myanmar lacquer work. The wood is used for tool-handles, anchor stock, railway sleepers and gun stock.

## YEBADON

Botanical Name: *Bischofia javanica* Bl.  
( Family - Euphorbiaceae ).

Habit and distribution: A round-headed more or less deciduous leaved tree, attaining 9.5 to 12.5 m in height and 1.6-2 m in gbh. It is commonly found in the dry forests of upper Myanmar. It is also occurred in southern Shan state, Chin state and Taninthayi division.

Morphological and taxonomical characteristics:

A tall tree, branchlets glabrous. Leaves simple, alternate, palmately 3- foliate, leaflets often crenate, stalked, mostly ovate, leaflet 2.5- 8.5 cm long, oblong-lanceolate, the bases obovate, the margins repand-toothed, the tips acuminate, leaflets often unequal sided. Inflorescences in axillary panicles; male panicles profusely flowering 9-18.5 cm long , on a 2-4 cm long peduncle, bracts ovate-oblong , 1-3 mm long; rudiment of pistil subterete, dentate; female panicles rather lax, 13.5-26 cm long on a 2-8.5 cm long peduncle; bracts 3; thin, pedicels articulate, thickened at apex, 1.5-4 mm long; ovary glabrous, shining. Fruit slightly depressed, globose, fleshy, small, indehiscent, 1-1.5 cm long; seeds turgidly oblong.

Flowering and fruiting period: It flowers from February to May and it fruits from April to August.

Bark: Pinkish brown to greyish brown, 10 -18 mm thick, outer dead bark persistent over the entire trunk, slightly simple, irregular ridged patches on smooth surface.

General Characteristics and properties of the wood :

Sapwood light cream-coloured to reddish brown, heartwood red to dark reddish-brown(or) chocolate-brown; dull to somewhat lustrous; odour and taste not distinct; moderately heavy (sp. gr. approx. 0.74), fairly coarse and even texture; straight or irregularly interlocked grained; growth rings not distinct.

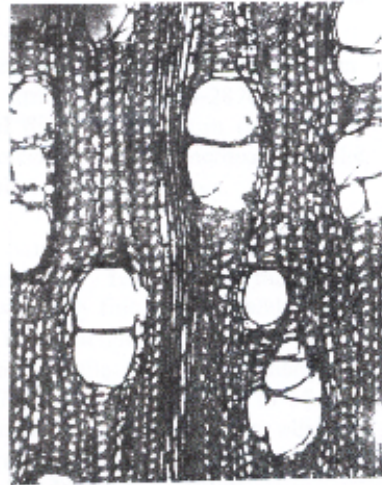
Microscopic characteristics :

Vessel elements : Diffuse porous; pores moderately small to moderately large, mean tangential diameter 116.85  $\mu\text{m}$  (range 41- 215.25  $\mu\text{m}$ ), number per sq. mm. moderately few to moderately numerous, range 6 to 14, average solitary pore 13.62% (range 7.69-33.33%), occasionally solitary, more often in radial rows of 2-3, oval or circular in cross section, medium thin - walled; perforation plates simple, nearly horizontal to oblique, end walls of elements truncate or abruptly or attenuately tailed at 1 or both ends; intervacular pitting numerous, crowded orbicular to oval or rarely elliptical, 10-13  $\mu\text{m}$  in diameter; vessel element medium-sized to very long, mean length 1015.26  $\mu\text{m}$  (range 594.5-1537.5  $\mu\text{m}$ ); tyloses abundant.



23. YEBADON (*Bischofia javanica* BL.)

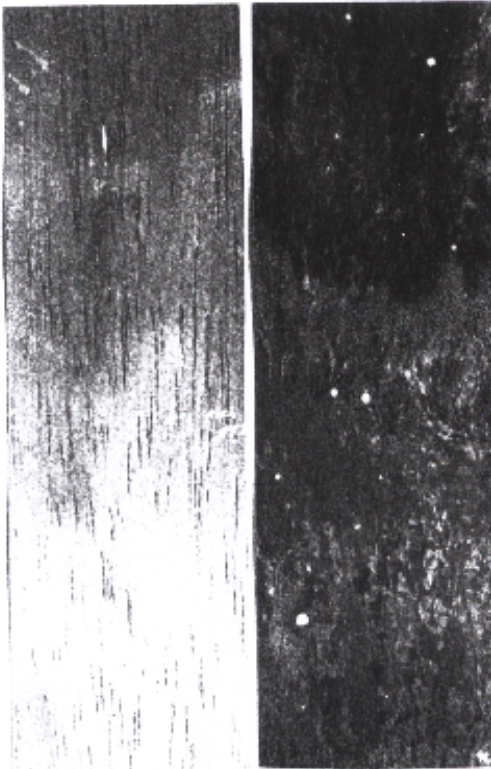
A plant in natural habit



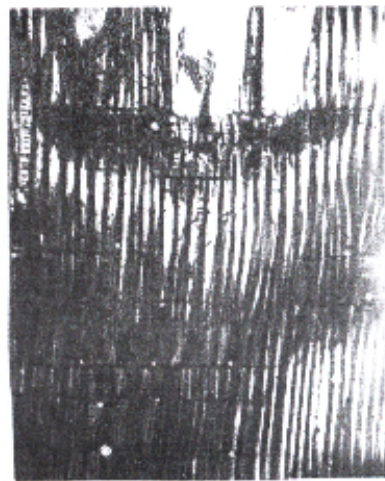
Transverse section ( X 75 )



Tangential &amp; Longitudinal Section ( X 75 )



Timber &amp; bark as seen



Radial &amp; Longitudinal Section ( X 75 )

- Fibre : Libriform, moderately long to very long; mean length 2259.1  $\mu\text{m}$  (range 1886-2870 $\mu\text{m}$ ), F/V ratio 2.42 ( range 1.3-4.3 ); mean tangential diameter 43.37 $\mu\text{m}$  (range 22.5-62.5 $\mu\text{m}$ ), septate, 5 to 12.5  $\mu\text{m}$  thickened, interfibre pits numerous, slit-like, reddish or orange-brown gummy infiltration abundant in the fibres.
- Rays : Heterocellular, uniseriate to triseriate, (1 to 6 seriate), moderately few to moderately numerous, 6 to 14 per mm. tangentially, extremely fine to moderately broad; mean width 83  $\mu\text{m}$  (range 5 to 184.5  $\mu\text{m}$ ); mean height of uniseriate rays is 554.01  $\mu\text{m}$  (range 123-1435  $\mu\text{m}$ ) and 1 to 23 cells high; mean height of multiseriate rays is 1128.52  $\mu\text{m}$  (range 317.75-2224.25  $\mu\text{m}$ ) and 7 to 55 cells high; ray vessel pitting opposite to alternate, oval to elliptical or linear elliptical in shape, 12.5 to 52.5  $\mu\text{m}$  in diameter; reddish or orange-brown gummy infiltration abundant in the ray cells, crystals abundant in the ray cell.
- Axial parenchyma : Paratracheal in cambiform rows along the grain, very sparse, restricted to occasional cells contiguous to the tangential walls of the vessels; reddish or orange-brown gummy deposits frequent; crystals rarely present, solitary; starch grains not observed.
- Uses: It is used for second class building materials as post, beams, scantling and it can be used for sleepers.



## YEME

Botanical Name : *Salix tetrasperma* Roxb.  
( Family – Salicaceae )

Habit and Distribution : A small tree, attaining 8-13.5 m in height and 1.2-2.0 m in girth. It is found growing in Southern Shan state especially in Yangon township.

Morphological and taxonomical characteristics:

A small tree, trunk stout, branch sub erect. Leaves broadly ovate-lanceolate, or ovate-oblong-lanceolate, with yellow nerves sometimes elliptic to linear, 8-24 cm long and 2.5 to 5.5 cm wide sparsely hairy or glabrous above, lower surface glaucous and densely white pilose to glabrous; the bases obtuse, the margins entire, the tips acute to acuminate; petiole 1-3.5 cm, stipules ovate or orbicular, deciduous. Inflorescences catkins; male 5-12 cm long on leafy branchlets, pendulous, sweet-scented stamens 4-10, bracts obovate or spatulate, pale, hairy; female 4-15 cm long, bracts small; ovary on stipe 1-1.5 mm long, 1-celled, ovoid, conical, rather densely grey pilose. Fruit capsule, very variable in length and breadth.

Flowering and fruiting period: It flowers from January to April and it fruits from April to July.

Bark: Greyish brown, 15-25 mm thick longitudinally furrowed, flaky, rough scales separated by deep fissures.

General Characteristics and properties of the wood:

Sapwood white; heartwood light red to light reddish-brown; lustrous in sapwood but becoming dull with age; odour and taste not distinct; light; (sp. gr, approx 0.37); medium fine and even texture; straight or somewhat interlock-grained; growth ring distinct.

Microscopic characteristics :

Vessel elements : Diffuse porous; pores extremely small to moderately small; mean tangential diameter 47.66  $\mu\text{m}$  (range 20.5 – 71.75  $\mu\text{m}$ ); number per sq. mm numerous, range 20 to 40, average solitary pore 26.55% ( range 13.79-42.85 % ), pores solitary or multiples, oval or circular in cross section, thin walled, perforation plates simple; end walls of elements transverse or abruptly or attenuately tailed, or rarely truncate, vascular pitting alternate, crowded, circular in shape, 5- 7  $\mu\text{m}$  in diameter, vessel parenchyma pitting alternate, crowded, 3 to 5  $\mu\text{m}$  in diameter, circular in shape; vessel elements moderately short to medium sized, mean length 453.07  $\mu\text{m}$  (range 256.25 – 594.5  $\mu\text{m}$ ), tyloses very sparse, gummy infiltration absent.

24. YEME (*Salix tetrasperma* Roxb.)



A plant in natural habit



Transverse section ( X 75 )



Tangential & Longitudinal Section( X 75 )



Timber & bark as seen



Radial & Longitudinal Section ( X 75 )

- Fibre : Non libriform, medium sized to very long; mean length 157.85  $\mu\text{m}$  (range 97.75 – 246.0  $\mu\text{m}$ ), F/V ratio 3.7 (range 1.73 – 9.23 ) mean tangential diameter 20.62  $\mu\text{m}$  (range 5-30  $\mu\text{m}$ ); non septate, thin walled, 2.5 – 7.5  $\mu\text{m}$  thickened, interfibre pits simple, slit-like, crystal present.
- Rays : Heterocellular, uniseriate to triseriate, numerous to very numerous 9 to 18 per mm. tangentially, extremely fine to moderately fine, mean width 37.12  $\mu\text{m}$  (range 7.5 – 42.5  $\mu\text{m}$ ); mean height of uniseriate rays is 440.18  $\mu\text{m}$  (range 164 –1281.25  $\mu\text{m}$ ) and 2 to 8 cells high; the mean height of multiseriate rays is 670.80  $\mu\text{m}$  (range 215.25 –1055.75  $\mu\text{m}$  ) and 8 to 30 cells high; ray vessel pitting alternate, circular in shape, similar to intervascular pitting, yellowish –brown gummy infiltration relatively sparse in the ray tissue, most abundant in the upright cells, crystals wanting; starch deposits not observed.
- Axial parenchyma : Paratracheal, metatracheal, and terminal in cambiform rows (often of 2- 4 units) along the grain, each with a solitary crystal, paratracheal parenchyma, very sparse, confined to occasional cells, cells flattened to conform to the vessel wall, metatracheal parenchyma extremely sparse in all types of parenchyma, yellowish - brown; starch deposits not observed.
- Uses: It is used for planking, boxes, packing cases, crates and kitchen utilities.

## ZINBYUN

Botanical Name: *Dillenia pentagyna* Roxb.  
(Family - Dilleniaceae)

Habit and distribution: A deciduous tree, attaining 20-30 m in height and 1.5-2.0 m in gbh. It usually occurs in central Myanmar especially found in Mandalay division and Bago division.

Morphological and taxonomical characteristics:

Deciduous tree, the branches terete, glabrous or finely pubescent. Leaves simple, 22.5 to 45.5 cm long, 13.5 to 25.5 cm wide; the bases obovate or ovate, the laminae oblong-obovate or lanceolate, the margins sharply serrate, the tips acuminate, petiole 3-6 cm. Inflorescences racemiform, 3-10 flowered fascicles on defoliate branches, 2.5 to 8.5 cm in cross, sepals 4-6, accrescent after anthesis; petals 4-6, obovate, usually white or yellow; outer most stamens 3-4 mm long, 10 inner most ones 6-5 mm long, recurved over outer ones; carpels 5, style patent; fruit drooping, indehiscent, 1.5 to 2.0 cm diameter; seeds exarillate, glabrous.

Flowering and fruiting period: It flowers from May to July and fruits from July to September.

Bark: Blackish brown to grey bluish brown, 8-12 mm thick, slightly, smooth surfaced, often pocket-marked especially on old trees, dull-grey.

General characteristics and properties of the wood:

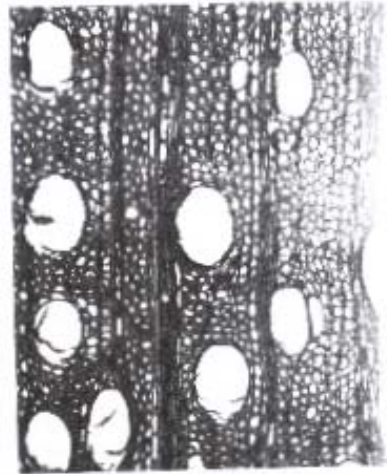
Sapwood pale red; heartwood reddish grey; with occasional white line (chalky deposits in the vessels); somewhat lustrous; odour and taste not distinct, moderately heavy (sp.gr. approx 0.68); moderately hard, even and rather coarse-texture; twisted-grained; growth ring scarcely distinct.

Microscopic characteristics :

Vessel elements: Diffuse porous; pores very small to medium-sized, mean tangential diameter 117.36  $\mu\text{m}$  (range 41-194.75  $\mu\text{m}$ ), number per sq. mm few to moderately numerous, range 4 - 12, average solitary pore percentage 100%, mostly solitary, rarely two contiguous and then mostly contiguous in the tangential plane, oval or circular in cross section, thin walled; perforation plates scalariform; end walls of elements attenuately tailed at both end; intervascular pitting oval to linear, opposite to alternate, crowded, 3.8 to 27.5  $\mu\text{m}$  in diameter, vessel elements medium-sized to extremely long, mean length 1098.28  $\mu\text{m}$  (range 461.25-2152.5  $\mu\text{m}$ ); tyloses wanting; gum deposits present in the vessels.

25. ZINBYUN (*Dillenia pentagyna* Roxb.)

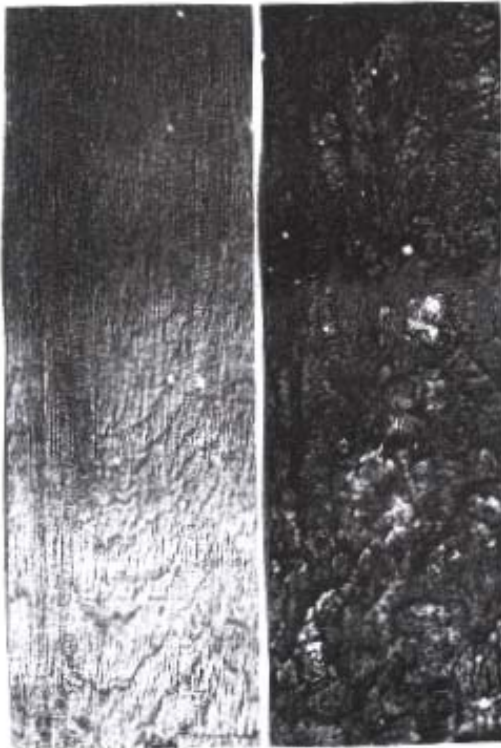
A plant in natural habit



Transverse section ( X 75 )



Tangential &amp; Longitudinal Section ( X 75 )



Timber &amp; bark as seen



Radial &amp; Longitudinal Section ( X 75 )



Fibres : Semi-libriform to libriform, medium sized to very long; mean length 2260.12  $\mu\text{m}$  (range 1189- 2972.5  $\mu\text{m}$ ), F/V ratio 2.48 (range 0.92- 5.38 ); mean tangential diameter 32.62  $\mu\text{m}$  (range 22.5-42.5  $\mu\text{m}$  ); non septate 5 to 15  $\mu\text{m}$  thickened, interfibre pits numerous, simple, slit- like.

Rays : Heterocellular, uniseriate to multiseriate, (8 seriate), few to moderately numerous, 4 to 12 per mm tangentially; extremely fine to very broad, mean width 85.07  $\mu\text{m}$  (range 10.25-205  $\mu\text{m}$ ); mean height of uniseriate rays is 847.16  $\mu\text{m}$  (range 102.5-1691.25 $\mu\text{m}$ ); and 2 to 23 cells high; mean height of multiseriate rays is 3654.63  $\mu\text{m}$  (range 635.5 to 9532.5  $\mu\text{m}$ ) and 15 to 158 cells high; ray vessel pitting opposite to alternate, similar to intervascular pitting 3.75 to 7.5 $\mu\text{m}$  in diameter; reddish- brown gumming infiltration copious; crystal wanting.

Axial parenchyma: Paratracheal and metatracheal; paratracheal parenchyma sparse, metatracheal parenchyma fairly abundant, reddish-brown gumming infiltration copious.

Uses: It can be used for flooring.

**An artificial key for the identification of twenty-five  
Myanmar timber species**

- 1 (a) Wood semi-ring or ring porous .....  
 (b) Wood diffuse porous .....
- 2.(a) Semi-ring porous; intervacular pit vestured .....  
 (b) Ring porous; intervacular pit simple to bordered .....
- 3 (a) Rays homocellular .....  
 (b) Rays heterocellular .....
- 4 (a) Paratracheal parenchyma scanty, 3-6 seriate tangential  
 bands; rays uniseriate to tetraseriate; tyloses absent ..... *Tectona*  
*hamiltoniana*
- (b) Paratracheal parenchyma abundant, aliform or  
 confluent forming 2-13 (mostly 8) seriate, rays  
 uniseriate to biseriate; tyloses present ..... *Lagerstroemia*  
*calyculata*
- 5 (a) Pores exclusively solitary; rays uni-to multiseriate; fibre  
 libriform ..... *Quercus*  
*serrata*
- (b) Pores solitary, multiples of 2-6; rays uni-to pentaseriate;  
 fibre non-libriform .....
- 6 (a) Fibre septate, paratracheal parenchyma abundant;  
 average fibre/vessel ratio more than 5 ..... *Albizzia*  
*lucida*
- (b) Fibre non-septate, paratracheal parenchyma scanty;  
 average fibre/vessel ratio less than 3 .....
- 7 (a) Intervacular pitting scalariform; tyloses present; rays  
 heterocellular .....
- (b) Intervacular pitting alternate to opposite; tyloses present or absent; rays  
 heterocellular to homocellular .....
- 8 (a) Rays homocellular; crystal absent in ray cell;  
 the maximum length of the fibre less than 1300 µm ..... *Melia*  
*birmanica*
- (b) Rays heterocellular; crystals present in ray cell;  
 the maximum length of the fibre more than 1300 µm ..... *Cedrela*  
*serrata*

- 9 (a) Tangential diameter of largest pores less than 90  $\mu\text{m}$ , average solitary pore percentage 27; tyloses absent; crystals present in ray cell ..... *Diospyros montana*
- (b) Tangential diameter of largest pore more than 90  $\mu\text{m}$ , average solitary pore percentage 49; tyloses present; crystals absent in ray cell ..... *Melanorrhoea usitata*
- 10 (a) Pore per sq.mm. more than 30; crystals present in parenchyma and fibre; and rays uniseriate to biseriate ..... *Schima wallichii*
- (b) Pore per sq. mm. less than 30; crystals absent in parenchyma and fibre; rays uniseriate to tetraseriate .....
- 11 (a) Rays exclusively uniseriate or uni-to biseriate .....
- (b) Rays uni-to tri-to multiseriate .....
- 12 (a) Pores solitary, multiples or pore chains, average solitary pore percentage more than 60; fibres semi-libriform to libriform; presence of oil cells in the margin of ray cell ..... *Cananga odorata*
- (b) Pores solitary, multiples or clusters, average solitary pore percentage less than 40; fibres non-libriform; absence of oil cells in the margin of ray cells ..... *Michelia champaca*
- 13(a) Rays exclusively uniseriate; average solitary pore percentage less than 20, average pore tangential diameter less than 70  $\mu\text{m}$ ..... *Terminalia oliveri*
- (b) Rays uni-to biseriate; average solitary pore percentage more than 30; average pore tangential diameter more than 90  $\mu\text{m}$  .....
- 14(a) Tyloses present .....
- (b) Tyloses absent .....
- 15(a) Fibre septate; metatracheal parenchyma sparse ..... *Croton oblongifolius*
- (b) Fibre non-septate; metatracheal parenchyma abundant..... *Diospyros ehretiodes*
- 16(a) Crystals present; average vessel length more than 600  $\mu\text{m}$  ..... *Crallia integerrima*
- (b) Crystals absent; average vessel length less than 500  $\mu\text{m}$  .....
- 17(a) Fibre septate. ....
- (b) Fibre non septate. ....

- 18(a) Presence of yellowish-brown gummy deposit  
in ray cell .....
- (b) Absence of yellowish-brown gummy deposits  
in ray cell ..... *Cordia  
fragrantissima*
- 19(a) Average solitary pore percentage less than 20; absence  
of crystals in fibre ..... *Bischofia  
javanica*
- (b) Average solitary pore percentage more than 30; presence  
of crystals in fibre ..... *Sapindus  
rarak*
- 20(a) Pores exclusively solitary; maximum pore per  
sq. mm less than 15, ..... *Dillenia  
pentagyna*
- (b) Pores solitary, multiples, clusters or pore chains;  
maximum pore per sq. mm more than 20, .....
- 21(a) Pore per sq. mm. less than 20; presence of yellowish brown  
globular gum infiltration in parenchyma; presence of  
crystals in ray cells ..... *Mallotus  
philippinensis*
- (b) Pore per sq. mm. more than 20; absence of yellowish  
brown globular gum infiltration in parenchyma; absence of  
crystals in ray cells ..... *Salix  
tetrasperma*
- 22(a) Maximum pore per sq. mm more than 50; average  
solitary pore percentage less than 20; ..... *Holarrhena  
antidysentrica*
- (b) Maximum pore per sq. mm less than 30; average  
solitary pore percentage more than 30; .....
- 23 (a) Rays uni-to multiseriate, average height of multiseriate ray  
more than 900 um ..... *Dillenia  
pulcherrima*
- (b) Rays uni-to triseriate, average height of multiseriate ray less  
than 700 um .....
- 24(a) Fibre non-libriform; average height of uniseriate  
ray more than 350 um; paratracheal parenchyma  
scanty ..... *Sarcocephalus  
cordatus*
- (b) Fibre semi-libriform to libriform; average height of  
uniseriate ray less than 250 um; paratracheal  
parenchyma vasicentric to aliform ..... *Litsaea  
glutinosa*

## 5. Discussion

The observed anatomical characteristics for the timber species studied agree with the descriptions for these species as given in the literature. The wood descriptions focus on the most important diagnostic general and macroscopic and microscopic features which make identification very helpful. The key in this study bears no relationship to the general description of the wood. As experienced in this study, timber colour, grain, texture of the species and the barks of the trees, within limits, were found to be dependable characters for identification. Bark characters are certainly worth further investigation, and likely will prove to contain some features of systematic significance. The systematic implications of the wood anatomical diversity are summarized in tables.

Vessel distribution among these species studied, ranges from ring-porous, semi-ring porous to diffuse-porous. As observed in this study, the vessels are solitary and in radial multiples, occasionally in clusters and more rarely pore chains. The percentage of each category can sometimes be helpful in identification. All vessel pits are alternate and bordered to distinctly bordered. All samples of *Tectona hamiltoniana*, *Lagerstroemia calyculata* and *Terminalia oliveri* show vestured pits with the exception of the other timber species.

All the species studied showed that the vessels are exclusively solitary in *Quercus serrata* and *Dillenia pentagyna* but the pattern is usually dominated by radial multiples in other species studied except *Cananga odorata* and *Holarrhena antidysentrica* not only those have solitary, and in radial multiples but also pore chains are found.

The radial multiples in *Diospyros montana*, *Mallotus philippinensis*, *Terminalia oliveri*, *Croton oblongifolius* and *Melanorrhoea usitata* consist of (2-9) (-16) vessels, the clusters in *Diospyros ehretioides*, *Tectona hamiltoniana*, *Lagerstroemia calyculata*, *Carallia integerrima*, *Litsaea glutinosa* and *Michelia champaca* consists of (3-6) (-18) vessels. These values are not diagnostic. The vessels frequency varies from (2-9) to (66-153) per sq. mm. Average tangential diameter ranges from 47  $\mu$ m in *Diospyros montana* to 194  $\mu$ m in *Melia birmanica*. There is a correlation between vessel frequency and vessel diameter, the species with higher vessel frequency generally tend to have a narrow vessel diameter, and vice versa. The solitary vessels are usually round to oval, but slightly angular vessels were also found in some species.

Average vessel element length varies from 225  $\mu$ m in one specimen of *Tectona hamiltoniana* to 1254  $\mu$ m in *Schima wallichii*. This feature usually varies greatly within species. The longest individual vessel elements ( up to 1537  $\mu$ m) can also be found in *Bischofia javanica*, the shortest (only 87  $\mu$ m long) in *Tectona hamiltoniana*.

The fibres of all species are libriform, semi-libriform to non-libriform. Non libriform fibres are found in *Schima wallichii*, *Sarcocephalus cordatus*, *Melia birmanica*, *Cedrela serrata* and *Salix tetrasperma* except *Mallotus philippinensis* and *Albizia lucida*, those can also be found both non-libriform to semi-libriform. All the rest of the species are semi-libriform to libriform. In the present study, the fibre are non-septate and have distinctly bordered pits except *Tectona hamiltoniana*, *Lagerstroemia calyculata*, *Sapindus rarak*, *Albizia lucida*, *Croton oblongifolius* and *Bischofia javanica*, those have septate fibres. Fibre wall thickness is good character to classify the woods into three groups (light, medium and heavy).

The feature of axial parenchyma is of great diagnostic value. The pattern of axial parenchyma distribution are scanty to abundant paratracheal, vasicentric, aliform, confluent to banded with 2-13 seriate. The other pattern is apotracheal, diffuse.

In general, rays are found to be vary from low to high and uniseriate and aggregate to large rays. The uniseriate and multiseriate to broad rays forms 1-6 ( -31 ) are found and with a frequency range of 2-7 to 33-47 / mm. Rays up to 31 cells wide are only found in *Quercus*



*serrata*. The average uniseriate rays vary from 76-847  $\mu\text{m}$  in height. The multiseriate rays are also found to be vary from 195-3654  $\mu\text{m}$  in height. Rays over 3 mm high are usually found in *Dillenia pentagyna*.

Crystals are present in chambered or non-chambered axial parenchyma and ray cells, but usually more common in axial parenchyma cells except a number of species. The frequency and location of prismatic crystals are variable from very infrequent to abundant.

## **6. Conclusion**

In this study morphological and taxonomical characters, wood descriptions, qualitative and quantitative data of secondary xylem characters, uses and an artificial dichotomous key to the species are presented. It is thus hoped that the present work contributes towards the better understanding of the microscopic characteristics related to the properties of the timber and also of their role played in the authentication to the level of the species of the timber.

**Variation of selected wood anatomical characters of twenty-five Myanmar timber species**

No	Species	Characters										
		GR	Po	PP	VF	VD	ASP	VL	T	SF	FL	FD
1	<i>Diospyros ehretioides</i>	-	D	++ +	3-13	101	31	456	-	-	1032	19
						30-174	13-100	307-574			891-1394	12-25
2	<i>Tectona hamiltoniana</i>	+	S	+++	16-45	77	42	225	-	+	1233	19
						35-143	16-75	87-328			717-1619	12-25
3	<i>Diospyros montana</i>	+	D	+++	14-54	47	27	408	-	-	1076	15
						10-71	12-57	287-481			666-1845	7-22
4	<i>Schima wallichii</i>	+	D	++	33-47	67	93	1254	+	-	2141	33
						20-102	81-100	932-1506			1066-2665	25-42
5	<i>Holarrhena antidysentrica</i>	-	D	+++	12-56	64	12	499	-	-	1202	22
						20-92	2-21	358-676			953-1373	12-37
6	<i>Lagerstroemia calyculata</i>	+	S	+++	5-20	67	58	445	+	+	1190	22
						20-170	28-100	250-670			800-1460	15-35
7	<i>Dillenia pulcherrima</i>	±	D	++	7-23	99	90	885	-	-	1814	28
						41-153	46-100	604-1168			1271-2388	15-42
8	<i>Carallia integerrima</i>	-	D	+++	4-13	168	50	899	-	-	2493	28
						51-277	20-100	564-1333			1210-3536	15-38
9	<i>Sarcocephalus cordatus</i>	-	D	++	9-23	100	55	781	-	-	1602	32
						51-184	11-90	410-1076			1127-1998	25-45
10	<i>Sapindus rarak</i>	-	D	++	1-12	164	40	257	-	+	1187	15
						30-184	1-75	153-399			748-1773	7-27
11	<i>Quercus serrata</i>	+	R	+	5-16	180	100	390	+	-	930	18
						31-349		267-564			646-1312	10-28

**Variation of selected wood anatomical characters of twenty-five Myanmar timber species**

No	Species	Characters										
		GR	Po	PP	VF	VD	ASP	VL	T	SF	FL	FD
12	<i>Litsea glutinosa</i>	+	D	+++	11-24	76	38	514	-	-	1144	27
13	<i>Melia birmanica</i>	+	R	++	2-9	194	52	252	-	-	779	15
						51-308	20-83	164-430			440-1281	10-22
14	<i>Cananga odorata</i>	+	D	+++	13-26	89	68	710	+	-	1427	21
						51-123	42-89	358-1127			686-2173	5-32
15	<i>Michelia champaca</i>	+	D	++	9-21	87	34	687	+	-	1533	19
						30-143	13-66	461-973			1158-1916	7-32
16	<i>Cordia fragrantissima</i>	+	D	++	4-9	170	63	237	+	-	1780	18
						61-382	11-100	71-369			1506-2173	12-27
17	<i>Cedrela serrata</i>	+	R	++	3-9	162	58	431	-	-	1353	25
						51-338	1-100	328-553			1148-1670	15-35
18	<i>Mallotus philippinensis</i>	+	D	++	8-19	81	27	462	+	-	844	14
						30-133	6-75	307-625			615-1055	10-37
19	<i>Terminalia oliveri</i>	-	D	+++	66-153	63	13	338	+	-	1060	15
						31-82	6-23	174-533			461-1466	10-25
20	<i>Albizzia lucida</i>	±	D	++	3-6	165	66	376	-	+	2014	21
						51-256	50-100	275-471			1455-2716	12-35
21	<i>Croton oblongifolius</i>	-	D	++	8-19	114	31	481	-	+	867	20
						41-164	12-62	287-686			574-1219	12-27
22	<i>Melanorrhoea usitata</i>	+	D	+++	3-13	160	49	513	+	-	1011	17
						72-246	25-75	308-687			820-1271	10-25
23	<i>Bischofia javanica</i>	-	D	++	6-14	116	13	1015	+	+	2259	43
						41-215	7-33	594-1537			1886-2870	22-62
24	<i>Salix tetrasperma</i>	+	D	++	20-40	47	26	453	+	-	1157	20
						20-71	13-42	256-594			973-2460	5-30
25	<i>Dillenia pentagyna</i>	±	D	+	4-12	117	100	1098	-	-	2260	32
						41-194		461-2152			1189-2972	22-42

Characters								
No	Species	AFV	APa	PPa	RT	RCC	RN	RW
1	<i>Diospyros ehretioides</i>	2	<i>m</i> <sup>*</sup>	<i>s</i>	<i>he</i>	<i>1-2</i>	<i>10-15</i>	<i>29</i> <i>10-51</i>
2	<i>Tectona hamiltoniana</i>	5	d	s	ho	1-4	9-18	20 5-15
3	<i>Diospyros montona</i>	2	<i>m</i> <sup>*</sup>	s	ho	1	23-29	32 10-81
4	<i>Schima wallichii</i>	1	m	-	he	1-2	33-47	23 10-41
5	<i>Holarrhena antidysenterica</i>	2	<i>m</i> <sup>*</sup>	s	he	1-3	4-17	32 15-51
6	<i>Lagerstroemia calyculata</i>	4	-	<i>+</i> <sup>*</sup>	ho	1-2	15-22	9 5-12
7	<i>Dillenia pulcherrima</i>	2	<i>m</i> <sup>*</sup>	s	he	1-6	7-23	92 10-153
8	<i>Carallia integerrima</i>	2	a,d	a	he	1-8	5-12	17 8-45
9	<i>Sarcocephalus cordatus</i>	2	d	s	he	1-3	10-16	25 12-45
10	<i>Sapindus rarak</i>	2	-	+	he	1-4	7-11	31 20-51
11	<i>Quercus serrata</i>	3	a, d	+	ho	1-31	9-22	145 10-441
12	<i>Litsea glutinosa</i>	2	-	+	he	1-3	6-13	27 10-41

Characters								
No.	Species	AFV	APa	PPa	RT	RCC	RN	RW
13	<i>Melia birmanica</i>	3	+	s	ho	1-5	5-10	9 2-12
14	<i>Cananga odorata</i>	2	m	s	he	1-4	4-9	41 10-71
15	<i>Mechelia champaca</i>	2	m	+	he	1-3	6-10	33 20-51
16	<i>Cordia fragrantissima</i>	9	m	+	he	1-6	3-5	57 10-92
17	<i>Cedrela serrta</i>	3	m*	s	he	1-4	2-7	42 10-61
18	<i>Mallotus philippinensis</i>	2	m*	s	he	1-3	12-26	19 30-143
19	<i>Terminalia oliveri</i>	3	a,d	s	he	1	6-24	19 10-31
20	<i>Albizia lucida</i>	5	m	+	ho	1-4	8-12	23 7-37
21	<i>Croton oblongifolius</i>	2	d	s	he	1-2	16-29	5 2-7
22	<i>Melanorrhoea usitata</i>	2	a	s	ho	1-4 1*	12-17	35 10-72
23	<i>Bischofia javanica</i>	2	-	s	he	1-6	6-14	83 5-184
24	<i>Salix tetrasperma</i>	3	m	s	he	1-3	9-18	37 7-42
25	<i>Dillenia pentagyna</i>	2	m*	s	he	1-8	4-12	85 10-205



**GR** = Growth ring: + = present, - = absent, ± = scarcely distinct

**PP** = Pore pattern: + = solitary, ++ = solitary, multiples,  
+++ = solitary, multiples & clusters or  
pore chains.

**VD** = Tangential vessel diameter (µm)

**VL** = Vessel element length (µm)

**SF** = Septate fibre: + = present, - = absent

**FD** = Fibre diameter (µm)

**APa** = **Apotracheal parenchyma:** **a** = diffuse in aggregate,  
**d** = diffuse, **m** = metatracheal,  
**m\*** = metatracheal abundant  
+ = present, - = absent

**RT** = **Ray type of cells:** **ho** = homocellular, **he** = heterocellular

**RN** = **Ray number (per mm)**

**Po** = Porosity: D = diffuse-porous, S = semi-ring-porous,

**R** = **ring-porous**

**VF** = Vessel frequency (per sq.mm)

**ASP** = Average solitary pore percentage

**T** = Tyloses: + = present, - = absent

**FL** = Fibre length (µm)

**AFV** = Average F/V ratio

**PPa** = Paratracheal parenchyma: s = scanty, + = present  
\* = abundant, - = absent

**RC** = Rays width (composed of cells)

**RW** = Ray width (µm)

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