



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



**The Morphological and Anatomical Characteristics of  
(25) Commercial Burmese Timbers (Part 1)**

U Thein Kywe  
Forest Research Institute  
and  
Dr. Kyaw Soe  
Botany Department, Rangoon University  
February 1983

## **Acknowledgements**

We express our sincere thanks to U Sein Maung Wint, Director General, Forest Department, for his understanding the depth and the value of this work and his encouragement.

We also wish to express our indebtedness to U Sein Win, Director, Forest Research Institute and U Soe Tint, Deputy Director, Wood properties and Utilization Division, for their kind support and making presentation this paper possible.

We are deeply indebted to Dr. Carl H. deZeeuw, Consultant Wood Technologist, for his constructive criticisms and kind suggestions made on the dendrological characteristics particularly those of the barks.

We are thankful to U Than Tun, Research Assistant, Natural Resources Division, for given us help in taking field photographs without which this work could not be done in time.

We wish to acknowledge U Mehm Ko Ko Gyi, Deputy Director, for his kind permission and Daw Thein Kyi, Deputy Research Assistant, Silviculture Division, for her help in providing us with authenticated fruits and seeds of the trees studied in this work.

We must express our gratitude Dr. Nyan Htun, Deputy Director, for his permission, and Daw Yin Yin Kyi, Research Assistant, Tree Improvement and Forest Botany Division, for her kind help in providing us with authentic herbarium specimens.

## စီးပွားရေးအသုံးဝင်မြန်မာ့သစ်(၂၅)မျိုး၏ပင်ပြင်ရှုပ်သွင်နှင့် သစ်အင်္ဂါဗေဒလက္ခဏာများလေ့လာခြင်းအပိုင်း(၁)

ဦးသိန်းကြွယ်  
သစ်အင်္ဂါဗေဒသုတေသနဌာနစိတ်  
သစ်ဂုဏ်သတ္တိနှင့်အသုံးချမှုဌာနခွဲ  
သစ်တောသုတေသနဗိမာန်

နှင့်

ဒေါက်တာကျော်စိုး  
ရုက္ခဗေဒဌာန  
ရန်ကုန်တက္ကသိုလ်

### စာတမ်းအကျဉ်းချုပ်

စီးပွားရေးအသုံးဝင် မြန်မာ့သစ်မျိုးများကို တတ်သိနားလည်ရန်နှင့် မျိုးမည်ဖော်ထုတ်နိုင်ရန် အထောက်အကူအဖြစ် စုစည်းလုပ်ဆောင်ထားသည့် လုပ်ဆောင်မှုမှာ ယခုထိမရှိသေးပါ။ မြန်မာ့သစ်မျိုး များအား အသုံးချမှုအတွက် အနည်းငယ်သာရှိပြီးခဲ့သော လေ့လာတွေ့ရှိချက်များအပေါ်လိုအပ်ချက်များကို ဖြည့်စွက်၍ စုစည်းလုပ်ဆောင်ထားခြင်းဖြစ်ပါသည်။ ယခုစာတမ်းတွင် အပင်ကို တတ်သိနိုင်သည့် သရုပ်ဖော်စာအကျဉ်းချုပ်၊ သစ်သား၏ အရေးကြီးသော လက္ခဏာရပ်များနှင့်စီးပွားရေး အသုံးဝင်မြန်မာ့သစ် (၂၅) မျိုး၏ အသုံးဝင်မှုများကို ဓါတ်ပုံများနှင့်အတူ တင်ပြထားပါသည်။

## The Morphological and Anatomical Characteristics of (25) Commercial Burmese Timbers (Part 1)

U Thein Kywe  
Wood Anatomy Research Section  
Wood Properties and Utilization Division  
Forest Research Institute  
and  
Dr. Kyaw Soe  
Botany Department, Rangoon University

### **Abstract**

A much needed unified work, which would aid in the understanding and identification of Burmese Commercial timbers, has been still lacking. Since there has been little information devoted solely on the Burmese timbers for utilization, an attempt has been made to fulfil this need. In this paper, a brief and concise description of the plant, the important characteristics of the wood, and its uses of (25) commercially important Burmese Timbers have been given with simple illustrations.

## Contents

	Page
Acknowledgements	i
စာတမ်းအကျဉ်းချုပ်	ii
Abstract	iii
1. Introduction	1
2. Materials and Methods	1
3. Observations	2
3.1 Binga ( <i>Stephegyne diversifolia</i> Hook.)	2
3.2 Didu ( <i>Salmalia insignis</i> Schott. & Endl.)	6
3.3 Hnaw ( <i>Adina cordifolia</i> Hook.f.)	10
3.4 In ( <i>Dipterocarpus tuberculatus</i> Roxb.)	14
3.5 Ingyin ( <i>Pentacme siamensis</i> (Miq.) Kurz..)	18
3.6 Kanyin ( <i>Dipterocarpus alatus</i> Roxb.)	22
3.7 Kathit ( <i>Erythrina indica</i> Lam.)	26
3.8 Kyun ( <i>Tectona grandis</i> Linn.)	30
3.9 Ma-u ( <i>Anthocephalus cadamba</i> Miq.)	34
3.10 Nabe ( <i>Lannea grandis</i> Engler.)	38
3.11 Padauk ( <i>Pterocarpus macrocarpus</i> Kurz.)	42
3.12 Panga ( <i>Terminalia chebula</i> Retz.)	46
3.13 Pyinkado ( <i>Xylia dolabriformis</i> Benth.)	50
3.14 Sagawa ( <i>Michelia champaca</i> Linn.)	54
3.15 Sit ( <i>Albizzia procera</i> Benth..)	58
3.16 Tamalan ( <i>Dalbergia oliveri</i> Gamble.)	62
3.17 Taukkyan ( <i>Terminalia tomentosa</i> Wight.&Arn..)	66
3.18 Thingan ( <i>Hopea odorata</i> Roxb.)	70
3.19 Thinwin ( <i>Millettia pendula</i> Benth.)	74
3.20 Thitsein ( <i>Terminalia belerica</i> Roxb.)	78
3.21 Thitya ( <i>Shorea oblongifolia</i> Thw.)	82
3.22 Yemane ( <i>Gmelina arborea</i> Roxb.)	86
3.23 Yindaik ( <i>Dalbergia cultrata</i> Grah.)	90
3.24 Yinma ( <i>Chukrasia tabularis</i> A.Juss.)	94
3.25 Yon ( <i>Anogeissus acuminata</i> Wall.)	98
4. Key for the Identification of (25) Timbers of Burma	102
5. Discussion	103
6. References	

## 1. Introduction

Microscopic methods are often necessary to establish the botanical identity of commercial sample of timbers and fibres and may play an important role in checking adulterations, substitution and fraud and have on occasions been instrumental in helping to establish the guilt or innocence of suspected criminals.\*

A country like Burma, depending mainly upon one of its major natural resources such as timbers undoubtedly needs a standard work on botanical descriptions, including anatomical informations with simple illustrations.

Although Pearson and Brown (1932), in their "Commercial Timbers of India" have included some of the Burmese timbers along with those of the Indian ones, have dealt only with the selected and limited species of Burmese timbers.

So far, the little that has been written on this subject has been so scattered and it become obvious that there is a need of unified and organized work solely devoted on Burmese woods.

It is for these reasons, an attempt has been made to study on the commercially important timbers of Burma and is intended to continue and publish these works in series.

In this paper, a brief and concise morphological description, flowering and fruiting period, general characteristics of the wood, anatomical structure of the wood and uses of (25) commercially important Burmese timbers have been given. Photographic plates for sample illustration of the wood sections have also been included.

It is hoped that the informations given here are useful not only for the purposes of practical identification but also contribute towards the broader applied and academic interests.

## 2. Materials and Methods

For morphological and taxonomical descriptions, plants found growing wild in the Yemathin, Pyinmana and Taungoo forest divisions of Burma, were collected and used in this study.

Authentication of the plant specimens and wood samples were done partly at wood anatomy research section, Forest Research Institute at Yezin and partly at the Botany Department in Rangoon University.

For each tree, the habit and distribution, the morphological and taxonomical characteristics, the flowering and fruiting periods, the bark, the general characteristics and properties of the wood, the microscopic structure of the wood and uses have been given.

In this work, the microscopic sections of the wood samples were prepared according to the method as given by Jeffery, 1917. The photomicrographic plates were prepared by use of Olympus Universal Research Microscope, Vanox model.

For microscopic descriptions, the terminology used in this work was as given in the international glossary of terms used in wood anatomy, (1957).

For illustrations in morphology, photographs of the habit, the bark the inflorescence, the leaves, the fruits and the seeds were given for each plant studied.

---

\* Metcalfe and Chalk, 1950

In the photomicrographic illustrations, three sectional views, namely (A) Transverse, (B) Tangential longitudinal and (C) Radial longitudinal sections of each sample of wood for each tree, were given. The overall magnification of the plates in 83 X.

### **3. Observations**

#### **3-1 Binga**

##### **3.11 Botanical Name**

*Stephegyne diversifolia* Hook. (Family-Rubiaceae)

##### **3.12 Habit and Distribution**

A moderate sized to large tree attaining 12-15 m in height and 1.2-1.8 m in girth and is commonly found in plains forests in upper and lower Burma from the upper Chindwin to Tavoy.

##### **3.13 Morphological and taxonomical characteristics**

A moderate sized tree. Leaves orbicular-cordate, oblong or elliptic, the lower leaves 25 cm in diameter, the upper 10-15 cm long, 5-7.5 cm wide with oblique nerve, the tips rounded, glabrous or pubescent beneath, deciduous; petioles 1.8-3.7 cm long; stipules obovate-oblanceolate. Inflorescences terminal or axillary globose head, in spreading trichotomous, 2.5 cm in diameter foliar bracts long petioled. Flowers small; sepals 5-lobed, short; petals 5-lobed, infundibuliform, tubes equally the bearded lobes, valvate; stamens 5, inserted on the corolla tube; filaments short; ovaries oblongoid, 2-celled, style filiform. Capsules 3 mm long, smooth, ribbed.

##### **3.14 Flowering and fruiting period**

It flowers and fruits from September to October.

##### **3.15 Bark**

Pale brownish yellow to light brown, 10-15 mm thick; outer dead bark persistent over the whole of the trunk, occasionally irregularly furrowed, but often almost smooth surface throughout.

##### **3.16 General characteristics and properties**

Greamy white when first exposed, ageing to pale yellowish - brown, dull, with rather rough feel; without distinct odour or taste; medium light to light (sp.gr. approx 0.60); generally straight-grained but uneven-grained or broadly wavy-grained in radial plane, fine and quite even-textured; fairly hard. A diffuse-porous wood.

### **3.17 Microscopic characteristics**

#### **3.171 Tracheids and fibres**

Fibre-tracheids, thin to thick-walled, 3-6  $\mu$  thick; length ranges from 1200-2700  $\mu$ , and most frequently from 1500-2400  $\mu$ , mean length is 1860 $\mu$ .

#### **3.172 Vessel elements**

Number per sq.mm. ranges from 17-29 and most frequently ranges from 18-25; pore distribution solitary, pore multiples; diffuse-porous; pores circular as seen in cross section; thin-walled; tangential diameter ranges from 30-120  $\mu$ ; tyloses absent; perforation simple; end walls oblique to transverse oblique angles range up to 40°; intervacular pitting alternate, crowded, size of pits less than 7  $\mu$ , shape of pits circular to pentagonal; vessel parenchyma pitting alternate, pit size less than 7  $\mu$ , shape of pits usually circular or oval; length of vessel elements ranges from 300-1050  $\mu$ , and most frequently from 375-900  $\mu$ ; mean length is 783  $\mu$ ; pits to vessels opposite or alternate in arrangement, sparse or crowded, circular in shape, 4-7  $\mu$  in size; pits to parenchyma alternate to opposite, circular or oval in shape, 4-7  $\mu$  in size.

#### **3.173 Vascular rays**

Number per mm. ranges from 7-14; heterogeneous type 1,2-5 cells wide; the height of uniseriate rays range from 85-120  $\mu$  and most frequently from 95-110  $\mu$ ; multiseriate rays range from 400-2000  $\mu$  and most frequently from 525-1500  $\mu$ ; pitting between ray cells and other parenchyma cells small in size and few or many in number.

#### **3.174 Xylem parenchyma**

Sparse, apotracheal parenchyma diffuse and scattered; pitting between xylem parenchyma cell small in size and few in number.

### **3.18 Uses**

It is used for building and packing cases. It is also used for file and chisel handles; turnery, linen boxes and furnitures.

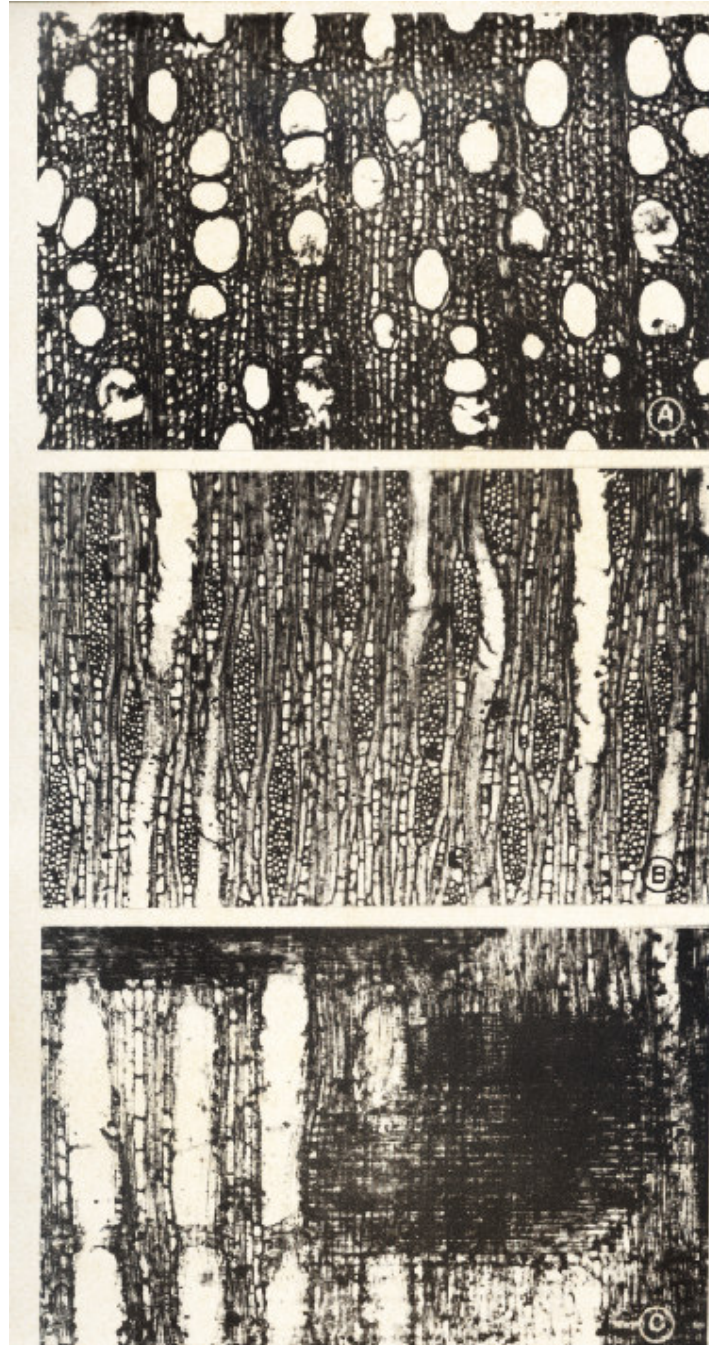


PLATE I



A. Tree    B. Bark    C. Inflorescence    D. Seeds

PLATE II



### **3-2 Didu**

#### **3.21 Botanical Name**

*Salmalia insignis* Schott. & Endl.

*Syn. Bombax insigne* Wall.

(Family-Bombacaceae)

#### **3.22 Habit and Distribution**

A large tree with a straight, long cylindrical bole buttressed at the base attaining 30 m in height and 3-3.7 m in girth. It is commonly found growing in the low and higher hills forests of lower and upper Burma.

#### **3.23 Morphological and taxonomical characteristics**

A tree, trunk marked with large leaf-scars, without prickles. Leaves digitate, deciduous, leaflets 7-9, obovate cuspidate acuminate, 12.5 cm long. Inflorescences solitary cymes. 25 cm in diameter, large scattered on leafless branches; peduncles 1.3 cm long, thick club-shaped, jointed at the top; sepals urceolate-globose, truncate or slightly 2 lobed, 3.8 cm long; petals linear oblong, 12.8-15.2 cm long, recurved, downy; stamens many; ovaries ovoid, stigma 5-lobed. Capsule loculicidally 5-valved, 25.2 cm long, elongated, curved at the apex, glabrous.

#### **3.24 Flowering and fruiting period**

It flowers and fruits from February to April.

#### **3.25 Bark**

Brownish grey to dark grey, 15-20 mm thick; outer dead bark persistent over the entire trunk, thick, shortly fibrous, deeply furrowed.

#### **3.26 General characteristics and properties**

Whitish to pale yellowish brown, without heartwood, dull to lustrous without characteristic odour or taste; very light (sp.gr. approx. 0.34); straight - grained, even- and coarse-textured; very soft. A diffuse porous wood.

#### **3.27 Microscopic characteristics**

##### **3.271 Tracheids and fibres**

Only libriform fibres are present, their walls vary from thin, thick to very thick, 4-8  $\mu$  thick; size of pits are small or minute; length of fibres ranges from 1500-2700  $\mu$  and most frequently from 1650-2400  $\mu$ ; mean length is 1942.5  $\mu$ .

### **3.272 Vessel elements**

Number per sq.mm. ranges from 0-5 and most frequently from 1-3; distribution of pores are solitary or in multiples, diffuse porous; thin-walled; tangential diameter ranges from 100-550  $\mu$  ; tyloses present but few in sections and few in individual vessels; perforation plates simple; end walls oblique to transverse; oblique angles may range up to 25°; intervascular pitting arrangement alternate, crowded, size of pits 7-10  $\mu$ , shape of pits oval to circular; vessel parenchyma pitting arrangement alternate, size more than 10  $\mu$ , shape usually vary from circular, oval to elongated; length of vessel elements ranges from 300-600  $\mu$  and most frequently from 375-450  $\mu$ ; mean length is 444  $\mu$ ; pits to vessels alternate in arrangement, crowded, circular or oval, 7-10 in size, pits to parenchyma opposite or alternate in arrangement, circular, oval or elongated in shape, may be more than 10 $\mu$  in size.

### **3.273 Vascular rays**

Number per mm. ranges from 4-16; heterogeneous type 11 A; 2-12 cells wide; the height of uniseriate rays vary from 150-600  $\mu$  and most frequently from 300-450  $\mu$ ; the height of multiseriate rays vary from 300-6000  $\mu$  and most frequently from 450-4500  $\mu$ ; pitting between ray cells and other parenchyma cell few, size of pits small.

### **3.274 Xylem parenchyma**

Abundant, apotracheal parenchyma diffuse in aggregate, a typical uniseriate metatracheal bands alternating very regularly with similar bands of fibres; pitting between xylem parenchyma cells few and size of pits is small.

### **3.275 Other features**

Typical storied structure in Xylem parenchyma.

### **3.28 Uses**

It is an established matchwood and is used also for packing cases. It is a fairly good pulp-wood and also utilized in making boats, oar blades, well curbs, drums and toys.



PLATE III



A. Tree    B. Bark    C. Flower    D. Leaf    E. Seeds

PLATE IV



### **3-3 Hnaw**

#### **3.31 Botanical Name**

*Adina cordifolia* Hook.f.  
*Syn. Nauclea cordifolia* Willd.  
(Family-Rubiaceae)

#### **3.32 Habit and Distribution**

A very large tree attaining a height of 34 m and a girth of 1.5-3 m, but under favourable conditions attaining large dimensions. It occurs in the deciduous forests in the plains and lower hills forests all over Burma.

#### **3.33 Morphological and taxonomical characteristics**

A tree shedding leaves in hot summer, all softer parts densely and shortly pubescent or tomentose. Leaves more or less rotundate-cordate, tomentose or more or less glabrescent, 7.8-12.6 cm long, and broad, the tips shortly acuminate, the margins entire, petioles 2.5-6.2 cm long, connate stipules orbicular or oblong and foliaceous. Inflorescences small, solitary globose head or 2-3. Flowers small yellowish, sessile about 1.3 cm in diameter; sepals tubular, 5 lobed; petals infundibuliform, tube long, 5 lobed; stamens 5, attached on the mouth of the corolla, filaments short; ovaries ovoid, style filiform. Capsule of two dehiscent cocci, 6 mm long, cuneate, downy, 6 seeded.

#### **3.34 Flowering and fruiting period**

It flowers and fruits from June to August.

#### **3.35 Bark**

Whitish grey, pale grey to light brownish grey, 10-15 mm thick; outer dead bark persistent over the whole trunk, rough and longitudinally fissured, the surface of the approximately rectangular scale nearly smooth, scaly ridges separated by narrow fissures, inner bark with layered fibres.

#### **3.36 General characteristics and properties**

Pale yellowish, becoming reddish brown with age, quite lustrous, with fairly smooth feel; sapwood yellowish white, rather thick, grading gradually into the heartwood; without characteristics odour or taste; light to moderately heavy (sp.gr. approx. 0.65); fairly straight grained, interlocked grained or somewhat spiralled grained is occasionally found, fine-and even-textured; fairly hard. A diffuse porous wood.

### **3.37 Microscopic characteristics**

#### **3.371 Tracheids and fibres**

Fibre tracheids; thin, thick, or very thick-walled, 4-8  $\mu$ . thick; size of pits small; the length ranges from 1200-2550  $\mu$ . and most frequently from 1350-2400  $\mu$ .; mean length is 1710  $\mu$ .

#### **3.372 Vessel elements**

Number per sq.mm. ranges from 41-75, and most frequent number per sq.mm. ranges from 44-71; pore distribution solitary or pore multiple; diffuse porous; pores circular as seen in cross section; thin-walled; tangential diameter ranges from 60-75 $\mu$ ; tyloses absent; perforation plate simple; end walls oblique to transverse; oblique angle range up to 70°; intervacular pitting alternate, crowded, size of pits less than 7  $\mu$ , shape of pits pentagonal; vessel parenchyma pitting alternate, size less than 7  $\mu$ , length of vessel elements range from 450-1500  $\mu$  and most frequently from 750-1275  $\mu$ ; mean length is 895.5  $\mu$ ; pits to vessels alternate in arrangement, crowded, circular or angular in shape, 4-7  $\mu$  in size, pits to parenchyma opposite to alternate arrangement, circular or oval in shape, 5-7  $\mu$  in size.

#### **3.373 Vascular rays**

Number per mm. ranges from 14-22; heterogeneous type 1,1-2 cells wide; height of uniseriate rays range from 100-3000  $\mu$  and most frequently from 150-2700  $\mu$ ; height of multiseriate rays range from 110-2020  $\mu$  and most frequently from 150-1500  $\mu$ ; pitting between ray cells and other parenchyma cells small in size and few in number.

#### **3.374 Xylem parenchyma**

Sparse; apotracheal parenchyma diffuse and scattered; pitting between xylem parenchyma cells small in size and few in number.

### **3.38 Uses**

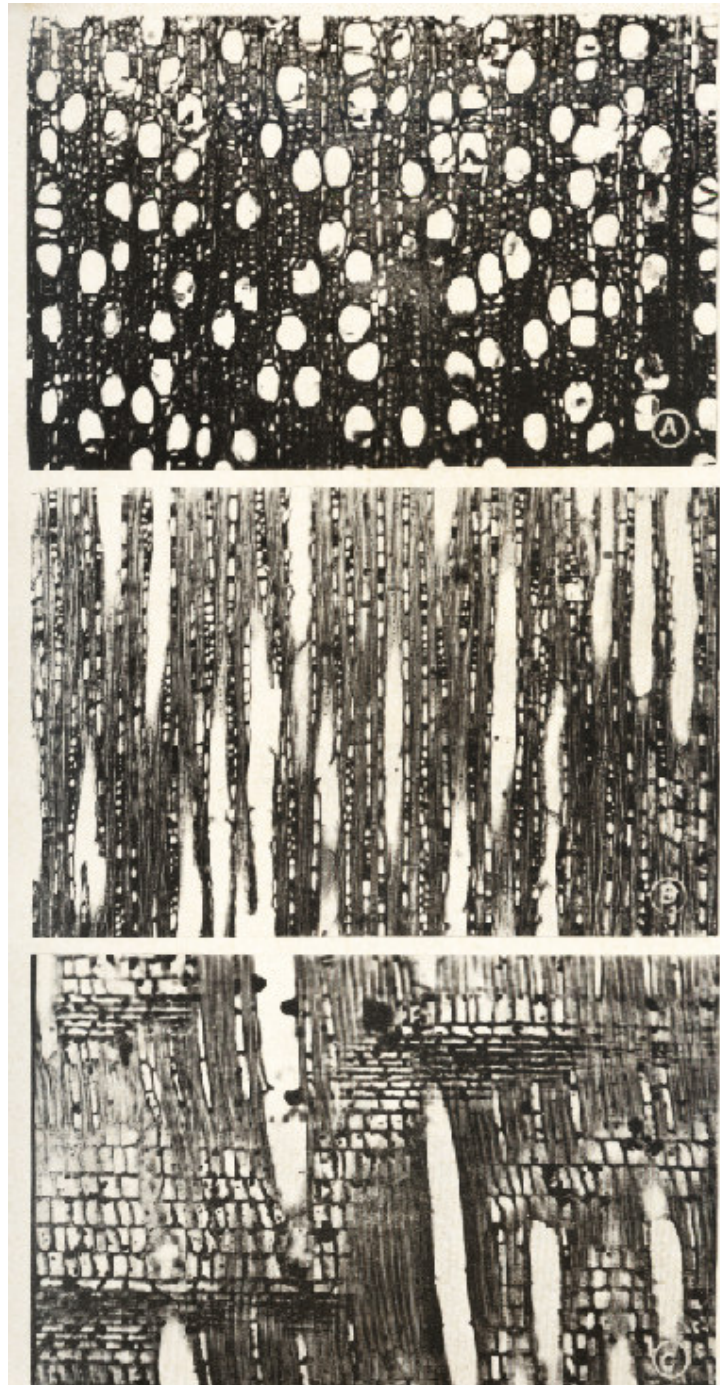
It is largely used also for interior construction such as boards, scantling and decorative panelling. It is an excellent turnery wood and suitable for furniture, cabinet work and joinery. It is used for curving especially for ornamental casket and picture frames. It is suitable for brush backs, printing blocks, and house hold boxes.





A. Tree    B. Bark    C. Inflorescence    D. Seeds

PLATE -VI



**3-4 In**

**3-41 Botanical Name**

*Dipterocarpus tuberculatus* Roxb.  
(Family-Dipterocarpaceae)

**3-42 Habit and Distribution**

A large tree usually reaching a height of 24-37m and a girth of 1.5-3 m, but under favourable conditions attaining larger dimensions. Clear bole of 18m is often found. It is commonly found in association with Ingyin and Thitya all over Burma.

**3-43 Morphological and taxonomical characteristics**

A large tree, young branches compressed, glabrous or canescent. Leaves cordiform acute, 25.3-45.5 cm long, 12.7-40.5 cm wide, the bases cordate or truncate, the margins sinuate-crenate undulate; petioles 10.2-12.8 cm long; stipules 7.6-12.7 cm long. Inflorescences racemes 12.8 –15.3 cm long, simple or 2 did, 4-7 flowered. Flowers large, red-coloured; sepals free; petals usually pubescent especially on the outer margin; stamens numerous; ovaries obovoid, 3 celled, style filiform. Fruit nutlike one seeded inclosed in the accrescent calyx tube, free, wings 2, 11.5-12.8 cm long, 3.2-3.8 cm wide, linear elliptic, obtuse 3 nerved.

**3-44 Flowering and fruiting period**

It flowers from March to April and it fruits from April to May.

**3-45 Bark**

Greyish brown to brownish grey, 20-25 mm thick, outer dead bark persistent over the entire trunk, deeply furrowed, breaking up into deep irregular vertical rough fissures..

**3-46 General characteristics and properties**

Sapwood greyish white or reddish white, medium thick; heartwood reddish brown, dull, with rather rough feel; without distinct odour or taste; moderately heavy (sp.gr. approx. 0.73); fairly straight or interlocked grained, even and coarse-textured; hard. A diffuse-porous wood.

### **3-47 Microscopic Characteristics**

#### **3-471 Tracheids and fibres**

Tracheids vasicentric; thick walled; size of pits small; the length ranges from 450-900  $\mu$ . and the most frequent length ranges from 600-750  $\mu$ .. Fibres tracheids with circular bordered pits, thick or very thick-walled, 8-13 $\mu$ . thick; the length range from 1050-2100  $\mu$ . and most frequently from 1200-1500  $\mu$ .; mean length is 1485  $\mu$ ..

#### **3-472 Vessel elements**

Number per sq.mm. ranges from 2-7 and most frequently from 4-6; pore distribution solitary; diffuse porous; circular in cross section; tangential diameter ranges from 105-300  $\mu$  ; tyloses present; perforation plates simple; end walls oblique to transverse; the oblique angle ranges up to 20°; length of vessel ranges from 450-750  $\mu$  and most frequently from 525-600  $\mu$ ; mean length is 585  $\mu$ ; pits to tracheids opposite or alternate arrangement; crowded; circular or angular in shape. borders narrow, size 7-10  $\mu$ ; pits to ray cells opposite or alternate in arrangement, oval or elongated in shape, and size more than 10  $\mu$ .

#### **3-473 Vascular rays**

Number per mm. range from 6-13; heterogeneous, type 1, number of cells 2-6 cells wide; height of uniseriate rays range from 150-600  $\mu$  and most frequently from 225-525  $\mu$ ; height of multiseriate rays ranges from 300-1300  $\mu$  and most frequently from 450-1200  $\mu$ .

#### **3-474 Xylem parenchyma**

Sparse; apotracheal parenchyma diffuse, scattered, more towards formation of uniseriate bands; paratracheal parenchyma aliform; pitting between xylem parenchyma cells small and few.

#### **3-475 Other feature**

Resin canals occur abundantly.

### **3-48 Uses**

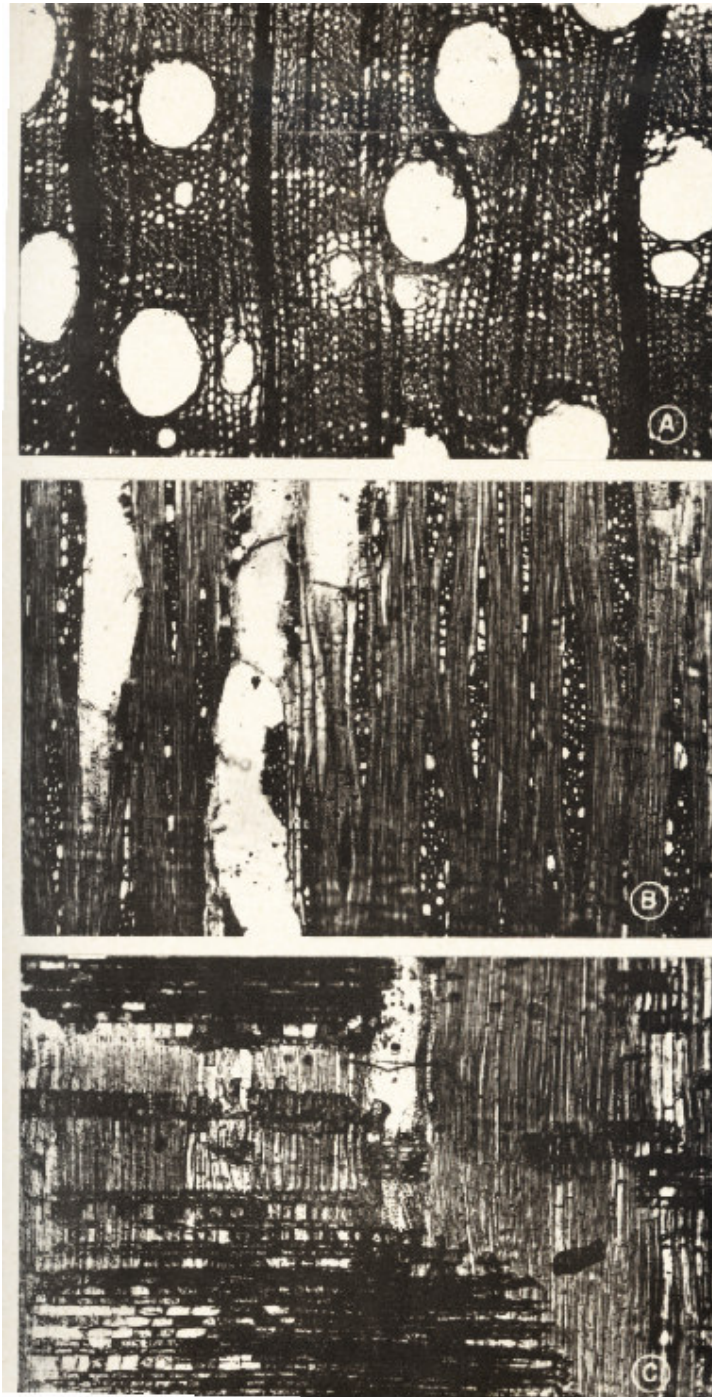
It is an excellent internal structural timber, especially as beams, posts, rafters, scantlings, partition boards and flooring. It is used as sleepers after treatment. Creosoted In is very satisfactory for wharves and other heavy structures and is extremely resistant to the teredo. This timber is used also for boats, low grade furniture, carts, and pit props. It can be used for making shingles and agricultural implements.



PLATE - VII



A. Tree    B. Bark    C. Inflorescence    D. Seeds



**3-5 Ingyin**

**3-51 Botanical Name**

*Pentacme siamensis* (Miq.) Kurz.  
Syn. *Pentacme suavis* A. DC.  
(Family-Dipterocarpaceae)

**3-52 Habit and Distribution**

A large tree, attaining a height of 24m and a girth of 1.5-1.8 m. It occurs throughout Burma often in dry forests together with *In* and *Thitya*

**3-53 Morphological and taxonomical characteristics**

A large tree, leafless during flowering, branchlets with smooth bark. Leaves oblong or ovate-oblong, 12.8-15.2 cm long, 7.6-10.2 cm wide, the tips obtuse or subacute, the bases truncate or cordate, glabrous above and beneath. Inflorescences terminal or axillary panicles, 15.3-22.8 cm long, lax, branches divaricate; pedicels 1.3 cm long. Flowers sweet-scented; sepals ovate, 6 mm long; petals 1.3 cm long, pale citroncoloured; stamens 15, filaments very short; anthers about 3 mm long, lobes slightly unequal, connective with a subulate prolongation, ultimately bend outwards; ovaries ovoid, style 1.2 cm long, filiform. Capsule indehiscent, bases of fruiting calyx-segments ovate, thickened, wings linear-oblongate, 7.6 cm long, obtuse.

**3-54 Flowering and fruiting period**

It flowers and fruits from March to April.

**3-55 Bark**

Dark grey to brownish grey, 20-25 mm thick, outer dead bark persistent over the entire trunk, deeply furrowed, vertically and transversely with irregular rough surface.

**3-56 General characteristics and properties**

Light yellowish brown to pale greyish brown with white tangential lines at irregular intervals, rather dull, medium smooth; without characteristic odour or taste; moderately heavy to heavy (sp.gr. approx. 0.82); broadly and usually shallowly interlocked-grained, even and medium coarse-textured; very hard and strong. A diffuse porous wood.

**3-57 Microscopic Characteristics**

**3-571 Tracheids and fibres**

Tracheids abundant and vasicentric; thick walled; length ranges from 225-450 $\mu$ . and the most frequent length ranges from 300-375  $\mu$ .. Libriform fibers abundant, thick to very thick-walled, 5-9 $\mu$ . thick; pits usually small; the length

ranges from 600-1800  $\mu$ . and most frequently from 900-1500  $\mu$ .; mean length is 1267.5 $\mu$ .

### **.3-572 Vessel elements**

Number per sq.mm. ranges from 2-9, and most frequently from 4-7; pore distribution usually solitary but occasional pore multiples may be found; diffuse porous; circular as seen in cross section; thick-walled; tangential diameter ranges from 105-260  $\mu$  ; tyloses present; perforation plate simple; end walls oblique at angles ranging from 10°-25°, or transverse; intervascular pitting alternate, crowded, size of pit less than 7  $\mu$ ., shape of pits circular; vessel parenchyma pitting arrangement alternate, not more than 7  $\mu$ ; length of vessel elements range from 150-450  $\mu$  and most frequently from 300-375 $\mu$ ; mean length is 325.5 $\mu$ ; pits to vessels alternate in arrangement; crowded; circular in shape, less than 7 $\mu$  in size, ; pits to parenchyma opposite or alternate in arrangement, circular or oval in shape, 7-10  $\mu$  in size.

### **3-573 Vascular rays**

Number per mm. ranges from 5-13; homogeneous type IIA, 2-6 cells wide; the height of uniseriate rays ranges from 60-300  $\mu$  and most frequently from 75-225  $\mu$ ; height of multiseriate rays ranges from 150-900  $\mu$  and most frequently from 300-750  $\mu$ ; pitting between ray cells and other parenchyma cells small to large, the number of pits few to many.

### **3-574 Xylem parenchyma**

Abundant; distribution of apotracheal parenchyma diffuse and metatracheal, the metatracheal bands form uniseriate bands, though dominantly apotracheal there are some occasional paratracheal vasicentric tendencies; pitting between xylem parenchyma cells few, size of pits small.

### **3-575 Other feature**

Vertical resin canals abundantly forming bands as seen in cross section.

### **3-576 Uses**

Thitya and Ingyin are classed and marketed together are used in heavy construction where strength and durability are of great importance. Largely used as railway sleepers without preservative treatment. It is also used in building, bridges, boats, carts, bows tool handles and ploughs. Ingyin is the first class timber for railway carriage and wagon construction. It is also suitable for all classes of buildings and bridge construction.





A. Tree    B. Bark    C. Inflorescence    D. Fruits



**3-6 Kanyin**

**3-61 Botanical Name**

*Dipterocarpus alatus* Roxb.  
Syn. *Dipterocarpus costatus* Gaertn. f.  
(Family-Dipterocarpaceae)

**3-62 Habit and Distribution**

A very large tree with long straight cylindrical stem attaining a height of 36-45 m with 21-30 m of clean bole and a girth of 4.5 m. Kanyin is applied to smooth barked species of *Dipterocarpus*, usually found as isolated individuals in evergreen and moist deciduous forest throughout the country.

**3-63 Morphological and taxonomical characteristics**

A large tree, young branches compressed, pubescent. Leaves ovate or elliptic acute, about 14 cm long, 7.6 cm wide, more or less pubescent beneath, the margins ciliate, lateral nerves 15 pairs; petioles 3.8 cm long, pubescent. Inflorescences racemes about 7 flowered, flowers large, pale-red coloured; sepals free; petals usually pubescent; stamens numerous, anthers linear, ovaries obovoid, 3-celled, style filiform. Fruit nut like, 1 seeded; wings 2, linear - ovate or spatulate, 10.2-12.7 cm long, 2.5 cm wide 3 nerved, unenlarged lobes orbicular.

**3-64 Flowering and fruiting period**

It flowers from April to May and it fruits from May to June.

**3-65 Bark**

Greyish brown, 20-25 mm thick, outer dead bark persistent on the entire trunk, rather smooth, forming long narrow, scaly plates separated by shallow fissures, on the basal parts of mature trees inner bark with layered fibres.

**3-66 General characteristics and properties**

Sapwood pale greyish white or reddish white, narrow to fairly wide, about 5-8.6 cm, heartwood red to reddish brown or greyish brown, becoming darker when exposed, often with lighter broken bands containing resin canals, dull with rough feel, without distinct odour or taste, moderately heavy to heavy (sp.gr. 0.81); fairly straight grained, even and very coarse textured, strong wood. A diffuse porous wood.

### **3-67 Microscopic Characteristics**

#### **3-671 Tracheids and fibres**

Tracheids vasicentric; thin walled, 5-7  $\mu$ . thick, the length ranges from 300-750 $\mu$ . and the most frequently from 450-600  $\mu$ .. Fiber tracheids and libriform fibres abundant, thick to very thick-walled, 5-7 $\mu$ . thick; size of pits small; the length ranges from 1125-1950  $\mu$ ., and most frequently from 1350-1650  $\mu$ .; mean length is 1525.5 $\mu$ ..

#### **3-672 Vessel elements**

Number per sq.mm. ranges from 2-9, the most frequent number per sq.mm range from 4-7; pore distribution solitary or in clusters, diffuse porous; circular as seen in cross section; tangential diameter ranges from 90-270  $\mu$  ; tyloses absent, perforation plate simple; end walls oblique and the angle may vary from 20-50; intervacular pitting opposite to alternate, size of pits usually less than 7  $\mu$ ., shape of pits circular; vessel parenchyma pitting opposite, between 7-10 $\mu$  in size, shape varies from circular to oval; length of vessel elements ranges from 225-750  $\mu$  and most frequently from 450-675 $\mu$ ; mean length is 570; pits to tracheids opposite or alternate in arrangement, crowded, circular in shape and size 7-10  $\mu$ ; pits to parenchyma opposite in arrangement, circular or oval in shape, and size more than 10  $\mu$  .

#### **3-673 Vascular rays**

Number per mm. ranges from 5-16; heterogeneous type I, 2-5 cells wide; height of uniseriate ray ranges from 80-1050  $\mu$ ; height of multiseriate ray ranges from 20-400  $\mu$  and most frequently from 30-360  $\mu$ ; pitting between ray parenchyma cells small and the number few to many, oil cells frequent in multiseriate cells.

#### **3-674 Xylem parenchyma**

Abundant; apotracheal parenchyma diffuse, scattered irregular metatracheal parenchyma forming uniseriate bands, paratracheal parenchyma aliform, pitting between xylem parenchyma cells few to many and size of pits usually small.

#### **3-675 Other feature**

Resin canals occur abundantly.

### **3-68 Uses**

It is used for construction timber. If treated, it ranks high for buildings, sleepers bridges and other forms of general construction. It is also used for railway constructions, telegraphic cross arms, framing, rafters, posts and beams in building. It is suitable for boats, boxes, and low grade furniture. It is also a good flooring timber with high resistance to wear.



PLATE - XI



A. Tree    B. Bark    C. Inflorescence    D. Fruits

PLATE - XII



**3-7 Kathit**

**3-71 Botanical Name**

*Erythrina indica* Lam.  
Syn. *Erythrina variegata* Linn..  
(Family-Papilionaceae)

**3-72 Habit and Distribution**

A moderate sized tree, attaining a height of 22.2 m and a girth of 1.5 m. It is commonly found in the dry forests or upper and lower Burma.

**3-73 Morphological and taxonomical characteristics**

A moderate sized tree, leafless during hot summer; the trunk and branches armed with short sharp prickles arising from woody tubercles, the very young shoots more or less mealy puberulous. Leaves 3 foliate, 29.8-40.2 cm long, leaflets broadly ovate, 10.1-13.7 cm long, 5.4-14.1 cm wide, the lateral ones oblique, the tips bluntish acuminate, the margin entire, glabrous. Inflorescences terminal or axillary racemes. Flowers rather large, purplish scarlet, sepal 2.3 cm long, spathaceous, petals very unequal, standard much exerted and considerably exceeding the keel and wing, standard obovate lanceolate, narrowed at the base, acute 3.8 cm long; wings and keels obovate, 1.3 cm long; stamens connate with the others half way up the filaments, anthers uniform, ovaries stalked, many ovuled. Pod 1.3-2.5 cm long, distinctly torulose.

**3-74 Flowering and fruiting period**

It flowers and fruits from March to May

**3-75 Bark**

Brown to greyish brown, 10-15 mm thick, outer dead bark persistent over the whole trunk, thick, deeply furrowed, longitudinally and irregularly in a transverse direction, scaly ridge separated by deep irregular fissure.

**3-76 General characteristics and properties**

White or pale yellowish- grey; without characteristic odour or taste, extremely light (sp.gr. 0.20-0.30), straight-grained, extremely coarse-textured, soft. A diffuse porous wood.

### **3-77 Microscopic characteristics**

#### **3-771 Tracheids and fibres**

All libriform fibres, cell walls thin, thick to very thick 3-7 $\mu$  thick, size of pits small, length ranges from 1050-2100  $\mu$ . and most frequently from 1350-1950  $\mu$ .; mean length is 1582.5 $\mu$ ..

#### **3-772 Vessel elements**

Number per sq.mm. ranges from 0-4 and most frequent number per mm. ranges from 1-2; pore distribution solitary and pore multiples; diffuse porous; pores circular as seen in cross section; thin-walled; tangential diameter 75-390  $\mu$ ; tyloses absent; perforation plates simple; end walls transverse and very rarely oblique; intervacular pitting alternate, crowded, size of pits 7-10  $\mu$ . or larger than 15  $\mu$ ; shape of pits pentagonal, vessel parenchyma pitting alternate, size of pits range from 7-10  $\mu$ , shape of pits oval or elongated length of vessel elements range from 120-375 $\mu$  and most frequently from 150-300  $\mu$ , mean length is 228  $\mu$ ; pits to vessels alternate in arrangement; rounded or angular in shape, 7-10  $\mu$  in size, pits to parenchyma alternate, oval or elongated in shape, may be more than 10  $\mu$  in size.

#### **3-773 Vascular rays**

Number per mm. ranges from 1-3; homogeneous type II, 3-12 cells wide; multiseriate rays range from 200-2000  $\mu$  and most frequently from 525-1950  $\mu$ ; pitting between ray cells and other parenchyma cells few to many, size of pits small.

#### **3-774 Xylem parenchyma**

Abundant; apotracheal parenchyma form metatracheal, bands which are 2-14 cells wide, pitting between xylem parenchyma cells usually are clustered and the size of pits are large.

#### **3-775 Other feature**

Storied structure in xylem parenchyma cells.

### **3-78 Uses**

It is used for planks, boats, packing cases, water troughs and lacquered boxes.

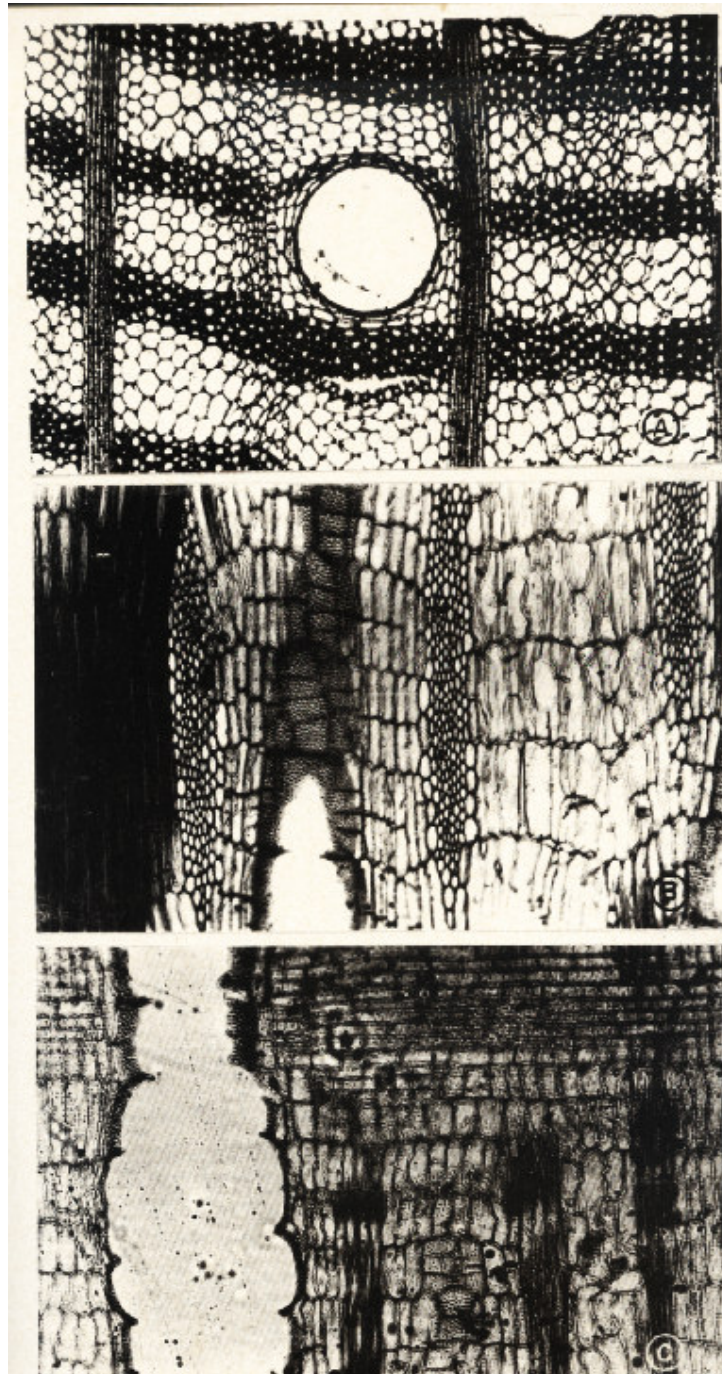


PLATE - XIII



A. Tree      B. Bark      C. Inflorescence      D. Leaves      E. Seeds

PLATE - XIV



**3-8 Kyun**

**3-81 Botanical Name**

*Tectona grandis* Linn.  
(Family-Verbenaceae)

**3-82 Habit and Distribution**

A large tree attaining a height of 30m and a girth of 2.4 m and a clear bole of 11 m is common. It reaches upto a height of 45 m, a girth of 3.7-4.2 m and a clear bole of 25 m under favourable conditions. It is commonly found growing gregariously in mixed deciduous forests of the plains and lower hills throughout the country below the 920 m level.

**3-83 Morphological and taxonomical characteristics**

A large deciduous tree, branchlets quadrangular, stellately tomentose. Leaves ovate-oblong to obovate, 15.3-45.6 cm long, 12.2 – 20.4 cm wide, decusately opposite, the tips acute or rarely shortly acuminate, the margins entire, the bases rhomboid or obtuse; shortly and densely stellate pubescent. Inflorescences panicles 45.8 cm in diameter. Flowers very numerous, but only a few fertile; sepals 2-4 mm long, 5-6 lobed, campanulate stellately white tomentose, petals small, tubes shorts, 7 mm long white, glabrous in the upper part of corolla tube, stamens as many as corella lobes, ovaries globose, 4 celled, cells 1 ovuled. Drupe 1.2 cm long, enclosed in the calyx.

**3-84 Flowering and fruiting period**

It flowers from August to September and fruits from September to November.

**3-85 Bark**

Light brown to grey, 10-15 mm thick; outer dead bark persistent over the trunk and branches, with interlacing pattern of narrow longitudinal ridge and shallow furrows, fibrous texture.

**3-86 General characteristics and properties**

Sapwood white to pale yellowish brown, narrow to medium wide, heartwood dark golden yellow, turning brown, dark brown and finally almost black with age, dull, with rather rough oily feel; strongly and characteristically scented when fresh, without distinct taste, light to moderately heavy to heavy (sp.gr. 0.55-0.70); straight-grained, or wavy-grained, very coarse and uneven- textured, moderately elastic and hard, strong. A ring porous wood.

### **3-87 Microscopic characteristics**

#### **3-871 Tracheids and fibres**

Libri-form fibres very thin to thick walled, 3-7  $\mu$ . thick, deposits in fibres, size of pits small, length ranges from 1050-1950 $\mu$ . and most frequently from 80-110  $\mu$ .. Mean length is 1516.5 $\mu$ ..

#### **3-872 Vessel elements**

Number per sq.mm. ranges from 4-12 and most frequently from 5-10; pore distribution solitary, pore multiples and pore chains, ring porous, pores circular as seen in cross section, thick wall, tangential diameter ranges from 75-330  $\mu$  ; tyloses present, few in sections and many in individual vessels, perforation plates simple, end walls oblique or transverse oblique angles range up to 50°; intervascular pitting alternate, crowded, size of pits range between 7-10  $\mu$ ., shape of pits pentagonal, vessel parenchyma pitting alternate, crowded size of pit not more than 7  $\mu$ , shape of pit oval or elongated; length of vessel elements range from 120-525  $\mu$  and most frequently from 150-450 $\mu$ ; mean length is 240 $\mu$ ; pits to vessel alternate in arrangement; crowded; circular or angular in shape 7-10 in size; pits to parenchyma opposite or alternate in arrangement, oval or elongated in shape, 3-7  $\mu$  in size.

#### **3-873 Vascular rays**

Number per mm. from 4-10; homogeneous type II, 2-4 cells wide; the height of multiseriate rays ranges from 150-2000  $\mu$  and most frequently from 25-1350  $\mu$ ; pitting between ray cells and other parenchyma cells variable in size, few in number.

#### **3-874 Xylem parenchyma**

Abundant, terminal and confluent, pitting between xylem parenchyma cells variable in size, few in number.

#### **3-875 Other feature**

Storied xylem parenchyma cells.

### **3-88 Uses**

According to its durability, strength, moderate weight, ease of working, stability and attractive appearance, it is widely used in ship building, for decking, launches, boats, deck houses and weather doors. It is suitable for excellent furniture, carvings and interior fittings for ships, offices, and public buildings in house construction makes fine doors, frames, window frames, stair-cases, floors, panelling, cupboards and fittings. It is widely used also for gates, fencing, varandahs, garden furniture and exterior joinery. As it is one of the best all round timber of the world. It can be used in heavy construction, like bridges and it makes high grade veneers and plywoods.





A. Tree      B. Bark      C. Inflorescence      D. Leaf      E. Fruits

PLATE - XVI



**3-9 Ma-u**

**3-91 Botanical Name**

*Anthocephalus cadamba* Miq.  
Syn. *Nauclea cadamba* Roxb.  
(Family-Rubiaceae)

**3-92 Habit and Distribution**

A large tree attaining 12.2-21.3 m in height and 1.2 – 1.5 m in girth. It is commonly found growing beside streams in the plains forest of upper and lower Burma.

**3-93 Morphological and taxonomical characteristics**

A large leaf-shedding tree branches spreading, the younger shoot more or less pruinose. Leaves elliptic-oblong acute or ovate cordate acute, thin coriaceous, 12.7-22.9 cm long, 4.8-7.6 cm wide, shining above, pubescent beneath, the tips acute, the margins entire or wavy, the bases rounded; petioles 1.9-2.2 cm long. Inflorescences terminal and solitary globose head; without bracteoles, 2.5-5.1 cm in diameter; peduncle stout. Flowers orange-coloured; sepals 5-lobed, the lobes oblong-spathulate, tubular, petals 5 lobed; infundibuliform; stamens inserted in the middle of the corolla, filaments short; ovaries globose, stamens spindle shaped; ovules numerous. Capsule fleshy, connate into a fleshy spherical syncarp, glabrous; seeds minute, wingless.

**3-94 Flowering and fruiting period**

It flowers and fruit from March to April.

**3-95 Bark**

Light grey to brownish grey, 10-15 mm thick; outer dead bark persistent on the trunk and larger branches; longitudinally fissured, exfoliating in small rectangular scaly plates with a yellowish brown blaze.

**3-96 General characteristics and properties**

Yellowish to creamy white or light yellowish grey with age; heartwood wanting; lustrous when exposed; with smooth feel; without characteristic odour or taste; light (sp.gr.approx. 0.53-); straight grained, medium and even textured; soft. A diffuse porous wood.

### **3-97 Microscopic characteristics**

#### **3-971 Tracheids and fibres**

Fibre tracheids, thin, thick or very thick walled, 5-11  $\mu$ . thick; size of pits small, length ranges from 1050-3000 $\mu$  and most frequently from 1500-2700  $\mu$ ; mean length is 2227.5 $\mu$ .

#### **3-972 Vessel elements**

Number per sq.mm. ranges from 5-12 and most frequently from 6-10; pore distribution solitary, pore multiples and pore clusters, diffuse porous; pores circular as seen in cross section, thin walled, tangential diameter ranges from 60-225  $\mu$  ; tyloses absent, perforation plates simple, end walls oblique to transverse, oblique angles range up to 70°, intervascular pitting alternate, crowded, size of pits less than 7 $\mu$ ., shape of pits pentagonal, vessel parenchyma pitting alternate, size not more than 7  $\mu$ , length of vessel elements ranges from 600-1500  $\mu$ , most frequently from 675-1350  $\mu$ ; mean length is 990 $\mu$ ; pits to vessel alternate in arrangement; crowded, circular or angular in shape, 4-7  $\mu$  in size; pits to parenchyma opposite or alternate in arrangement, circular or oval in shape, 7-10  $\mu$  in size.

#### **3-973 Vascular rays**

Number per mm. ranges from 9-16, heterogeneous type I, 2 wings extremely long; 2-3 cells wide; the height of multiseriate rays range from 200-425 $\mu$  and most frequently from 300-3750  $\mu$ ; height of uniseriate ray ranges from 250-3500  $\mu$ ; aggregate rays present.

#### **3-974 Xylem parenchyma**

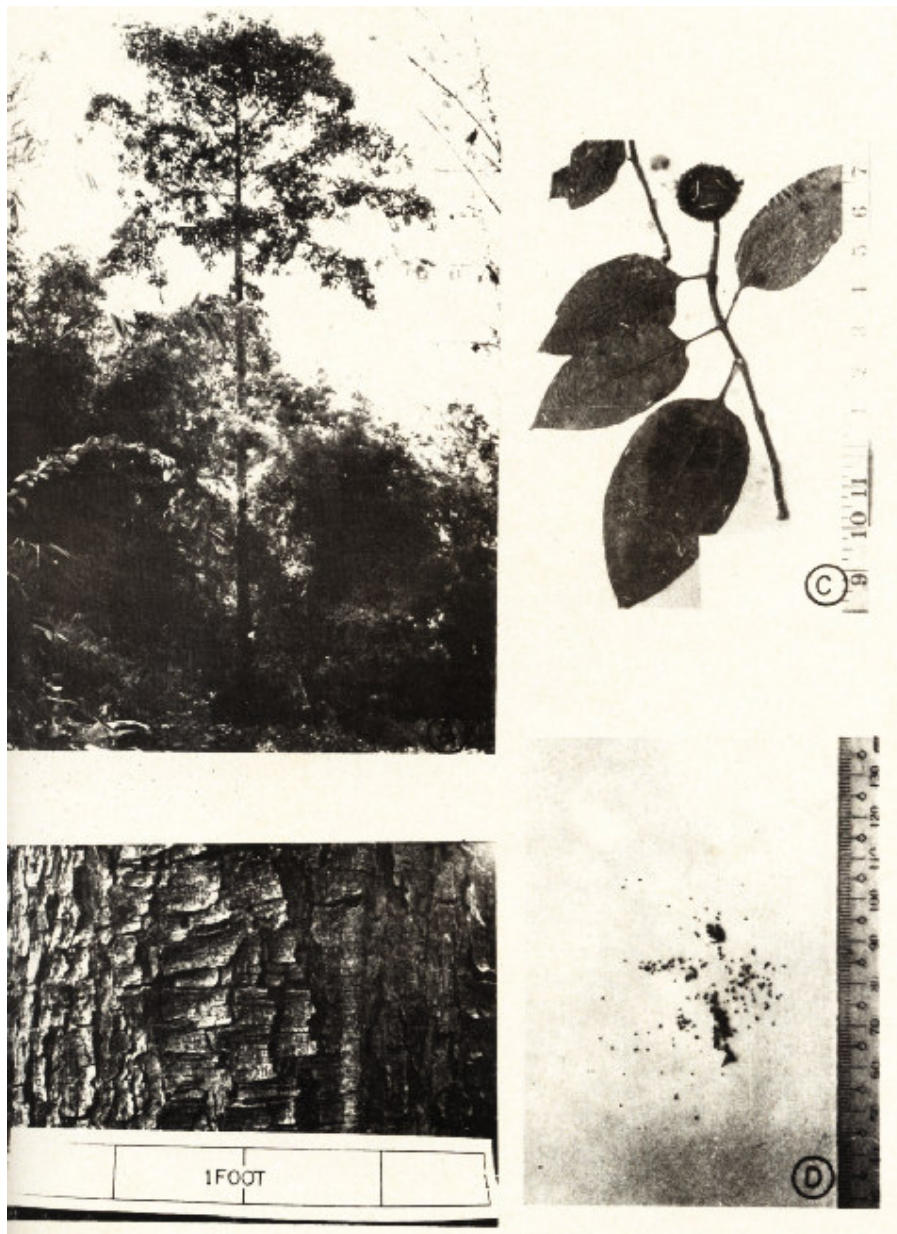
Sparse; apotracheal parenchyma, diffuse scattered, paratracheal parenchyma scanty; pitting between xylem parenchyma cells small in size and few or many in number.

### **3-98 Uses**

It is used for building as beams and rafters, boxes, canoes, yokes and dry goods packing cases. It is used also for match wood and fair quality of paper pulp.



PLATE - XVII



A. Tree      B. Bark      C. Inflorescence      D. Seeds



**3-10 Nabe**

**3-101 Botanical Name**

*Lannea grandis* Engler.  
Syn. *Odina wodier* Roxb.  
(Family-Anacardiaceae)

**3-102 Habit and Distribution**

A deciduous tree attaining 21.3-24.3 m in height and 2.1-2.4 m in girth. It is found in plains and lower hills forests of Burma.

**3-103 Morphological and taxonomical characteristics**

A deciduous tree, trunk very thick; branches few; young parts clothed with stellate down. Leaves 30.2-45.7 cm long, alternate, petioles terete, leaflets 3-4 pairs, petiolulate, 7.6-15.2 cm long, oblong- ovate, the tips acuminate, the margins entire. Inflorescences racemes. Flowers tetramerous, deciduous, fascicled; bracts ciliate; sepals obtuse; petals oblong, purplish and greenish yellow; stamens equalling the petals in the male flower; ovaries oblongoid, sessile. Drupe small 1.1-1.3 cm long, 5.9 mm wide, compressed, reniform, red.

**3-104 Flowering and fruiting period**

It flowers and fruits from March to April.

**3-105 Bark**

Brownish grey to grey, 10 mm thick, outer dead bark on all or most of the trunk; furrowed longitudinally and transversely, shed in thin irregular round flakes from the stems and branches, leaving a smooth brown surface.

**3-106 General characteristics and properties**

Sapwood white or pale yellowish white when exposed, turning light brownish grey, very wide; heartwood light pinkish - red to light red, turning darker red to brownish red with age, small, rather lustrous; without characteristic odour or taste; light to moderately heavy (sp.gr.approx. 0.55); straight grained, or narrowly interlocked grained, medium and even textured; fairly hard. A diffuse porous wood.

### **3-107 Microscopic characteristics**

#### **3-1071 Tracheids and fibres**

All septate fibres, septa clear and thick; usually thin walled, 2-5  $\mu$ . thick, size of pits small, the length ranges from 600-1800 $\mu$ . and the most frequently from 750-1650  $\mu$ .. Mean length is 1443  $\mu$ ..

#### **3-1072 Vessel elements**

Number per sq.mm. ranges from 6-15; and most frequent number per sq. mm. ranges from 7-11; pore distribution solitary or pore multiples, diffuse-porous, pores circular in cross section; thin walled, tangential diameter ranges from 90-180  $\mu$ ; tyloses present, many in sections and many in individual vessels; thick walled; perforation plates simple, end walls oblique and angles ranging up to 80°; intervacular pitting alternate, crowded, size of pits between 7-10  $\mu$ ., shape of pits pentagonal, vessel parenchyma pitting alternate, size of pits 7-10  $\mu$ , shape of pits circular or oval; length of vessel elements ranging from 300-900  $\mu$  and most frequently from 375-750  $\mu$ ; mean length is 526.5  $\mu$ ; pits to vessel alternate in arrangement, crowded, circular or angular in shape 7-10  $\mu$  in size; pits to parenchyma opposite or alternate, circular, oval or elongated in shape, more than 10  $\mu$  size.

#### **3-1073 Vascular rays**

Number per mm. ranges from 4-12; homogeneous type II, 2-5 cell wide; the height of rays range from 150-900  $\mu$  and most frequently from 225-780  $\mu$ ; pitting between ray cells and other parenchyma cells few and the size of the cells small.

#### **3-1074 Xylem parenchyma**

Very sparse.

#### **3-1078 Uses**

It is used for house building chiefly as planks, packing case, cheap furniture, plough shafts, water troughs and well construction. It is used also for corts, boats, bowls, wooden jars, carving and turnery.



PLATE - XIX



A. Tree

B. Bark

C. Inflorescence

D. Fruits



PLATE - XX



### **3-11 Padauk**

#### **3-111 Botanical Name**

*Pterocarpus macrocarpus* Kurz.  
(Family-Papilionaceae)

#### **3-112 Habit and Distribution**

A moderate sized-tree, with a cylindrical straight stem attaining 18-24 m in height and 2-2.5 m in girth. It is commonly found growing in the upper mixed deciduous dry forests of Burma.

#### **3-113 Morphological and taxonomical characteristics**

An erect leaf shedding tree, the young shoots more or less tauny pubescent. Leaves un-paired-pinnate, 15.2-20.3 cm long; leaflets 7-11, ovate-oblong, 3.8-6.4 cm long; the rachis rusty puberulous. Inflorescence axillary simple racemes. Flowers yellowish, bracts and bracteoles minute; pedicles as long as the calyx; sepals 6 mm long, velvety; petals undulate-crispate, exserted with long claws, slightly exceeding the calyx; stamens diadelphous; ovaries globoid, stalked, villous, 2-ovuled. Pod canescent, roundish, 3.8 –5.0 cm in diameter, unequally sinuate-rounded at the base; wings subplicate.

#### **3-114 Flowering and fruiting period**

It flowers from March to April and it fruits from April to May.

#### **3-115 Bark**

Light brownish grey to blackish grey, 10-15 mm thick, outer dead bark persistent over the trunk and larger branches, separating at the surface and peeling vertically into thin, curly strips, eventually breaking up into brown irregular plates on mature trunks, exuding when blazed a bright-red astringent gum similar in appearance to the kino.

#### **3-116 General characteristics and properties**

Sapwood light yellowish brown to grey, narrow; heartwood bright yellowish red to dark brick-red often streaked with darker lines and mottled with brown, lustrous when exposed, ageing to dull yellowish brown; without distinct odour or taste, moderately heavy (sp.gr. approx. 0.78); interlock grained in narrow bands, medium coarse textured heaviest, hardest and strongest timber and South East Asia. A semi-ring porous wood.

### **3-117 Microscopic characteristics**

#### **3-1171 Tracheids and fibres**

Only libriform fibres, thin or thick walled, 2-5  $\mu$ . thick; size of pits small; length ranges from 750-1500  $\mu$  and most frequently from 900-1350  $\mu$  ; mean length is 1141.5  $\mu$ .

#### **3-1172 Vessel elements**

Number per sq.mm. ranges from 3-9 and most frequent number per sq. mm. ranges from 4-7; pore distribution solitary or pore multiples; semiring porous; pores circular in cross section; thick walled, tangential diameter ranges from 75-300  $\mu$  ; tyloses occasionally present, perforation plates simple; end walls transverse; intervascular pitting opposite or alternate, crowded, size of pits less than 7  $\mu$ ., shape of pits pentagonal; abundant dark yellow deposits in the lumen of the vessels; vessel parenchyma pitting alternate, size of pit less than 7  $\mu$ , shape of pit circular or oval; length of vessel elements ranges from 120-375  $\mu$  and most frequently from 150-300  $\mu$ ; mean length is 220.5  $\mu$ ; pits to vessel opposite or alternate in arrangement, crowded, circular or angular, 4-7  $\mu$  in size; pits to parenchyma opposite or alternate in arrangement, circular, oval or elongated in shape, more than 10  $\mu$  in size.

#### **3-1173 Vascular rays**

Number per mm. ranges from 10-16; homogeneous type III, only one cell wide; the height of uniseriate rays range from 30-320  $\mu$  and most frequently from 45-210  $\mu$ ; pitting between ray cells and other parenchyma cells usually are few and sizes of pit is small.

#### **3-1174 Xylem parenchyma**

Sparse; paratracheal parenchyma in various forms, ranging from scanty paratracheal to vasicentric, aliform and confluent metatracheal bands present, the most characteristic is either confluent paratracheal parenchyma or metatracheal parenchyma forming bands of 1-2 cells wide; pitting between xylem parenchyma cells few and size of the pits small.

#### **3-1175 Other features**

Storied nature of xylem parenchyma is typical.

### 3-118 Uses

It is chiefly used in heavy construction and buildings. It makes a decorative flooring and has high resistance to wear. It is an excellent parqueting timber and it is used also for beautiful furniture and high class joinery works. It can be made fancy turnery, carvings, tool and knife handles, and decorative cabinets. It is used also for under framing of vehicles and for shafts. It makes veneers for utility plywood.

#### PLATE - XXI



A. Tree

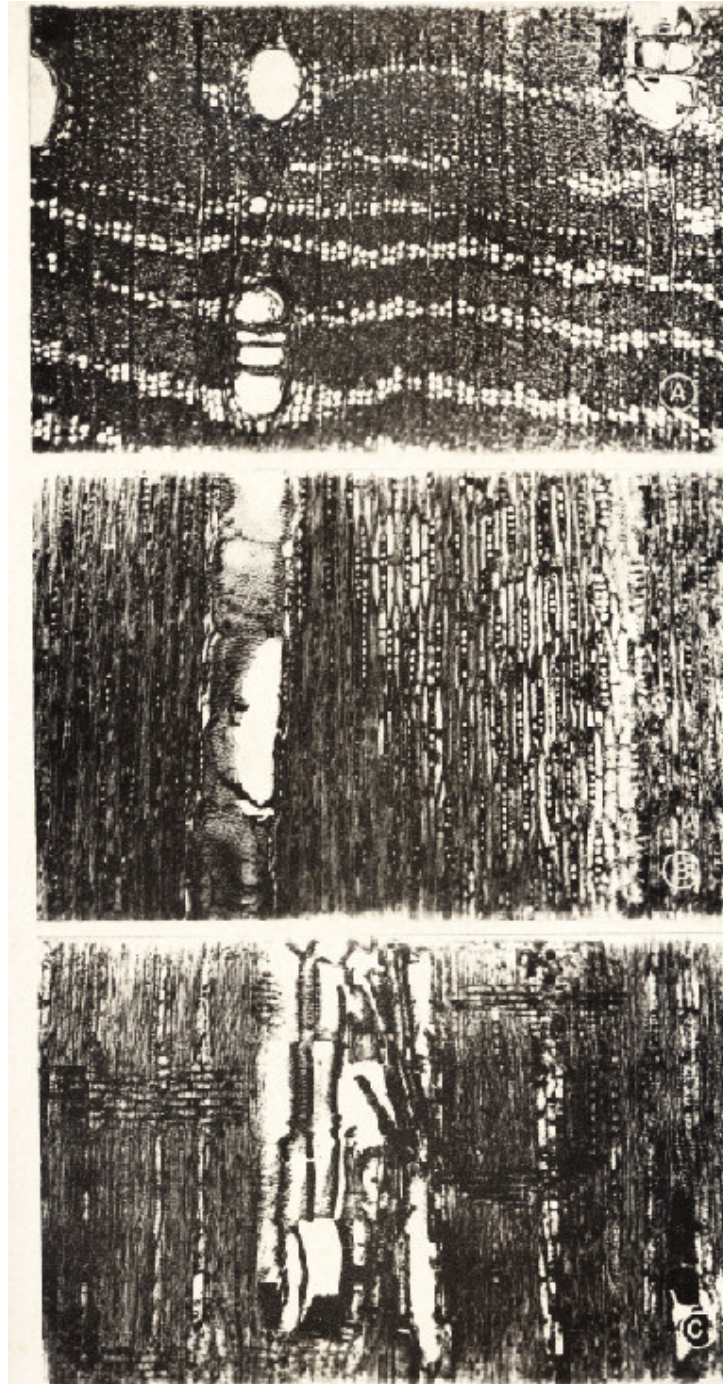
B. Bark

C. Inflorescence

D. Fruits and seeds



PLATE - XXII





### **3-12 Panga**

#### **3-121 Botanical Name**

*Terminalia chebula* Retz.

Syn *Terminalia tomentella* Kurz.

(Family-Combretaceae)

#### **3-122 Habit and Distribution**

A large tree attains 21-24 m in height and 1.8-2 m in girth. It is commonly found growing in the deciduous and dry forests throughout Burma.

#### **3-123 Morphological and taxonomical characteristics**

A large tree, shedding leaves in hot summer; the younger parts rusty villous. Leaves ovate or elliptic, not clustered often sub-opposite, 10.1-15.5 cm long, 5.2-7.9 cm wide, the tips acute, the margins entire, the bases rounded; petioles about 2.5 cm long, often with two glands. Inflorescences terminal spikes often paniced, 4.2-5.6 cm long. Flowers small, dull-white; sepals 5 short valvate triangular lobed, deciduous; petals absent; stamens 10, inserted on the calyx tube; ovaries ovoid, 1 celled, inferior; style long, simple. Drupes ellipsoidal or obovoid from a broad base, 2.5-3.8 cm long, 1.2- 1.7 cm wide, absolutely 5 angular smooth, greenish yellow.

#### **3-124 Flowering and fruiting period**

It flowers from May to June and it fruits from June to July.

#### **3-125 Bark**

Brownish grey to grey, 10-15 mm thick, outer dead bark persistent over the whole trunk; shallowly furrowed, vertically and transversely, leaving short sharp ridges of cork.

#### **3-126 General characteristics and properties**

Sapwood yellowish grey or brownish grey; heartwood dark purple, small, irregular, rather dull to lustrous, with smooth feel; without characteristics odour or taste; heavy to very heavy (sp.gr. 0.80-2.03); interlocked grained in fairly narrow bands and often twisted grained or curly grained in the radial plane, medium fine textured; very hard. A diffuse porous wood.

### **3-127 Microscopic Characteristics**

#### **3-1271 Tracheids and fibres**

Tracheids present, thick walled, length ranges from 150-750  $\mu$ , the most frequent length ranges from 225-675  $\mu$ . Libriform fibres, thick or very thick walled, 3-10  $\mu$ . thick; pits minute or small; length ranges from 1050-1800  $\mu$  and most frequently from 1200-1650  $\mu$  and mean length is 1450.5  $\mu$ .

#### **3-1272 Vessel elements**

Number per sq.mm. ranges from 3-13 and most frequently from 4-10; pore distribution solitary, pore multiples or pore clusters; diffuse porous; pore circular as seen in cross section; thick walled, tangential diameter ranges from 90-225  $\mu$ ; tyloses present, few in sections and many in individual vessels; thin walled; perforation plates simple; end walls oblique or transverse; oblique angle range up to 50; intervacular pitting alternate, crowded, size of pits not more than 7  $\mu$ ., shape of pits square or pentagonal; vessel parenchyma pitting opposite to alternate, size of pit more than 10  $\mu$ , shape of pits circular, oval or elongated; length of vessel elements ranging from 300-600 $\mu$  and most frequently from 375-525  $\mu$ ; mean length is 267.5  $\mu$ ; pit to vessels alternate in arrangement, crowded, circular or angular in shape, 4-7  $\mu$  in size, pits to parenchyma opposite or alternate in arrangement, circular, oval or elongated in shape, more than 10  $\mu$  in size.

#### **3-1273 Vascular rays**

Number per mm. ranges from 4-10; homogeneous type II, 2-6 cells wide; the height of multiseriate rays ranges from 150-750  $\mu$  and most frequently from 225-600  $\mu$ ; pitting between ray cells and other parenchyma cells few in number, small in size, oil cells abundantly present.

#### **3-1274 Xylem parenchyma**

Abundant, apotracheal parenchyma diffuse, scattered, metatracheal bands irregularly present; paratracheal parenchyma scanty to vasicentric and aliform, pitting between xylem parenchyma cells medium in size and few in number.

### **3-128 Uses**

It is used for house building, furniture, carts, bolsters in timber carts, cars and tool handles. It is used also in construction as posts and beams.

PLATE - XXIII



A. Tree      B. Bark      C. Inflorescence      D. Fruits

PLATE XXIV



### **3-13 PYINKADO**

#### **3-131 Botanical Name**

*Xylia dolabriformis* Benth.  
(Family-Mimosaceae)

#### **3-132 Habit and Distribution**

A very large tree attains 30-37 m in height and 2.4-3.7 m in girth. It occurs almost throughout Burma, chiefly in upper mixed deciduous forests in association with teak, but also in evergreen and low mixed deciduous forest..

#### **3-133 Morphological and taxonomical characteristics**

A tall unarmed tree, the young shoot yellowish pubescent, leaves abruptly bipinnate; the single pair of pinnae on a long petiole, while very young pubescent, soon glabrescent; leaflets 4-5 pairs, opposite, on a thick long petiolule, ovate to ovate oblong, often oblique, 3.8-7.5 cm long, glabrous. Inflorescence globose head, 1.3-2.1 cm in diameter. Flowers small, sessile, yellowish; sepals 5 lobed, tubular; petals 5, slightly united at the base, little longer than the calyx, 6 mm long, stamens 10, free; ovaries sessile, many ovuled; style filiform; stigma minute, terminal. Pod 10-15 cm long; 2.5-6.3 cm wide, 6 seeded, oblong-falcate, flat.

#### **3-134 Flowering and fruiting period**

It flowers from March to April and it fruits from April to May.

#### **3-135 Bark**

Light brown, brownish grey to reddish grey, about 8-10 mm thick, outer dead bark persistent over the entire trunk, longitudinally striate, irregular exfoliating scaly ridges separated by narrow fissures.

#### **3-136 General characteristics and properties**

Sapwood pale reddish-white, narrow, heartwood uniform reddish-brown, dull; without characteristic odour or taste; very heavy (sp.gr. approx. 1.00); straight grained, wavy grained or broadly interlocked grained, medium-textured; hard and extremely strong. A diffuse-porous wood.



### **3-137 Microscopic characteristics**

#### **3-1371 Tracheids and fibres**

Libriform fibres only, (but there may be short septate fibres very occasionally); thin or thick walled, 4-7  $\mu$ . thick; size of pits small; length ranges from 1050-1500  $\mu$ ; mean length is 1239  $\mu$ ..

#### **3-1372 Vessel elements**

Number per sq.mm. ranges from 3-12, and most frequent number per sq. mm. ranges from 5-11; pore distribution solitary, in multiples or in clusters, diffuse porous; pores circular as seen in cross section; tangential diameter ranges from 30-195  $\mu$ ; tyloses absent, perforation plates simple; end walls oblique or transverse, oblique angle range up to 70°; intervascular pitting alternate, crowded, size of pits 7  $\mu$ ., shape of pits circular; length of vessel elements 150-750  $\mu$  and most frequently from 375-675  $\mu$ ; mean length is 547.5  $\mu$ ; pits to vessel alternate in arrangement, crowded, angular in shape, less than 7  $\mu$  in size; pits to parenchyma alternate in arrangement, circular or oval in shape, less than 7  $\mu$  in size.

#### **3-1373 Vascular rays**

Number per mm. ranges from 9-18; homogeneous type I, 1-2 cells wide; the height of uniseriate rays range from 70-800  $\mu$  and most frequently from 90-600  $\mu$ ; the height of multiseriate rays range from 95-850  $\mu$  and most frequently from 105-750  $\mu$ ; pitting between ray cells and other parenchyma cells small in size, many in number and are clustered.

#### **3-1374 Xylem parenchyma**

Abundant; paratracheal parenchyma vasicentric, some incompletely vasicentric; pitting between xylem parenchyma cells small in size and few in number.

### **3-138 Uses**

It is the most important timber in Burma, after teak, for constructional purposes. It is used as rafters, scantlings, beams, and especially as posts for bridges and houses. It is used also for heavy structural work, especially as piles, bridge girders, harbour work and wharf decking. It is one of the best sleepers. It is also used for railway wagon construction, telegraphic posts, cart wheels, tool handles, boat buildings and pit props.

PLATE -XXV



A. Tree

B. Bark

C. Inflorescence

D. Seeds

PLATE - XXVI



### **3-14 Sagawa**

#### **3-141 Botanical Name**

*Michelia champaca* Linn.  
(Family-Magnoliaceae)

#### **3-142 Habit and Distribution**

A large evergreen tree attains 24-30m in height and 2.4-3 m in girth. A straight, clean and cylindrical bole of 18-21m is often found. It is commonly found growing in the plains and lower hills forests of Burma.

#### **3-143 Morphological and taxonomical characteristics**

A tall tree, branchlets pubescent. Leaves ovate-lanceolate tapering to a long point, 20-25 cm long, 6.3-10.2 cm wide, shining above, pale and glabrous or puberulous beneath; the tips acute, the margins undulate, entire, the bases obtuse; petioles 2.5-3.8 cm long. Inflorescences solitary cymes. Flowers 2.5-6.1 cm in diameter, very fragrant, pale yellow to yellow; peduncle short; sepals oblong, acute; petals linear, sepals and petals similar; segments of perianth 15-20; 3.8-4.6 cm long, 1.3-1.6 cm wide; stamens numerous, many-seriate; ovaries pubescent; filaments flattened; anthers adnate, introrse; ovaries pubescent, carpels in a loose spike; stigma decurrent. Fruit a lax or dense elongate spike, 19.2-21.6 cm long; carpels sessile; seeds pendulous from the carpel by a long cord.

#### **3-144 Flowering and fruiting period**

It flowers from April to June and it fruits from May to July.

#### **3-145 Bark**

Greyish brown to dark greyish brown, 15-20 mm thick; outer dead bark persistent over the entire trunk and larger branches, vertically, transversely or irregularly deeply furrowed; flaky ridges exfoliating into deep fissures.

#### **3-146 General characteristics and properties**

Sapwood white to pale yellowish grey; heartwood light yellowish brown to olive brown; lustrous; without characteristic odour or taste; light (sp.gr. approx. 0.53); straight grained; even and medium textured; soft. A diffuse-porous wood.

### **3-147 Microscopic characteristics**

#### **3-1471 Tracheids and fibres**

Fibre tracheids and non-septate fibre thin to thick-walled, 3-4  $\mu$ . thick; inter-fibre pits abundant, most numerous on the radial wall, bordered; slit-like, oblique orifice; length ranging from 395-2540 $\mu$  and most frequently from 1260-2380  $\mu$ ; mean length is 1644 $\mu$ .

#### **3-1472 Vessel elements**

Number per sq.mm. range from 10-13, and most frequently from 10-12; pore distribution solitary or in multiples or pore clusters; diffuse porous; pores oval, pentagonal or hexagonal as seen in cross section, medium thin-walled; tangential diameter ranges from 50-140  $\mu$  ; tyloses present, scanty; perforation plates scalariform with 2-5 horizontal bars separated by wide opening; end walls oblique which may range up to 70°; intervascular pitting mostly scalariform, crowded, size of pits less than 8  $\mu$ .; vessel parenchyma pitting alternate, size not more than 7  $\mu$ ; length of vessel elements 610-1280  $\mu$ ; most frequently from 750-960  $\mu$ ; mean length is 900  $\mu$ ; intervascular pits alternate or opposite, crowded, bordered, oval or angular; size of pits less than 7  $\mu$ ; pits to parenchyma opposite or alternate in arrangement, oval or elongated in shape and size 2-6  $\mu$  .

#### **3-1473 Vascular rays**

Number per mm. ranges from 6-7; heterogeneous, type IIA, number of cells 2-4 wide; height of uniseriate rays range from 95-420  $\mu$  and frequently from 105-240  $\mu$ ; height of multiseriate rays ranges from 120-650  $\mu$  and most frequently from 210-490  $\mu$ ; pitting between ray cells and other parenchyma cells few and size of pit small.

#### **3-1474 Xylem parenchyma**

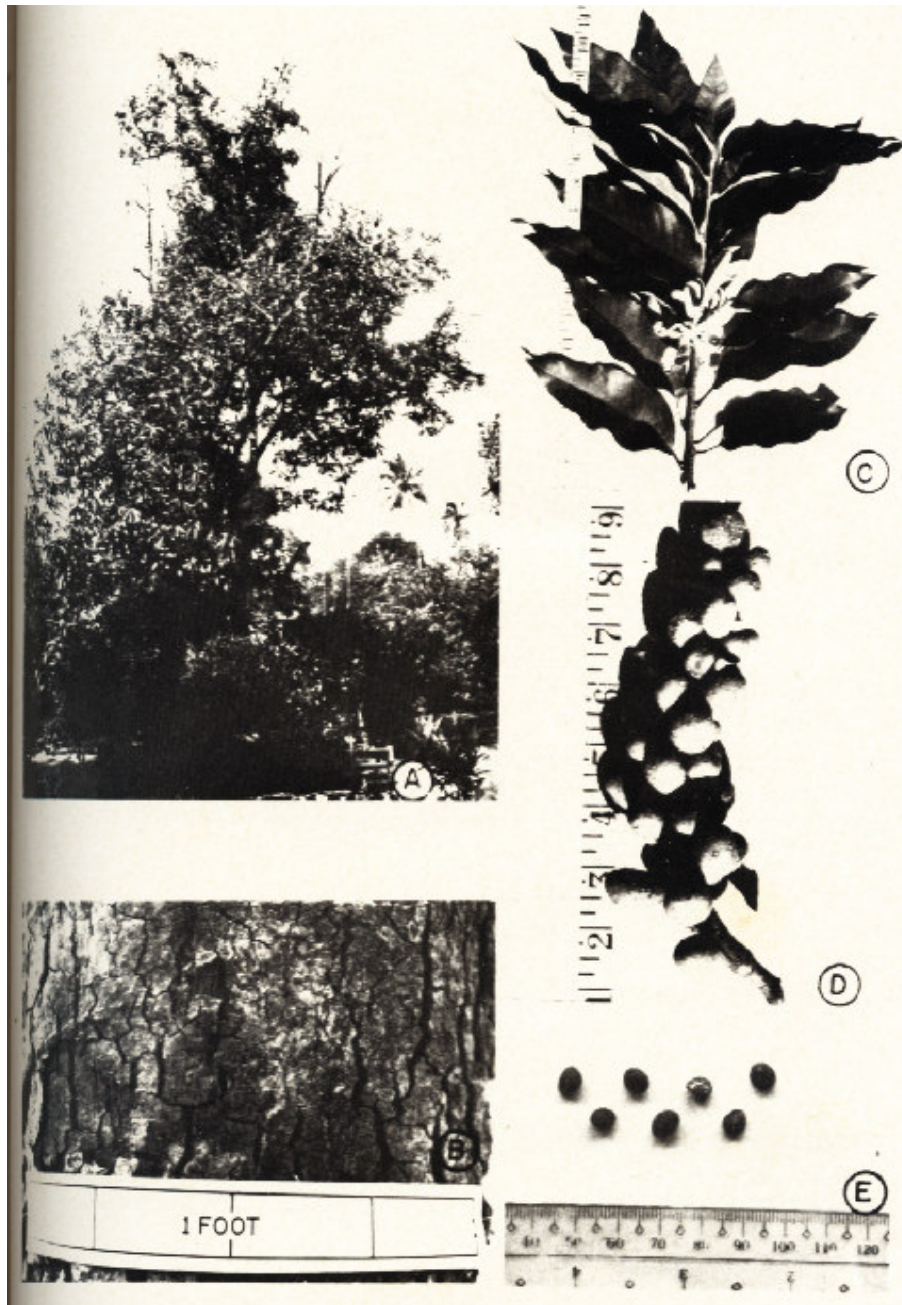
Sparse, terminal parenchyma forming a broad 2-8 seriate, cells arranged in radial rows, angular in transverse section; paratracheal and metatracheal parenchyma very sparse; pitting xylem parenchyma cells few, size of pits small.

### **3-148 Uses**

It is used for house-building, furniture, carriages, joinery works, ploughs, cabinet making, carving and general carpentry. It makes excellent veneers for utility plywood.



PLATE XXVII



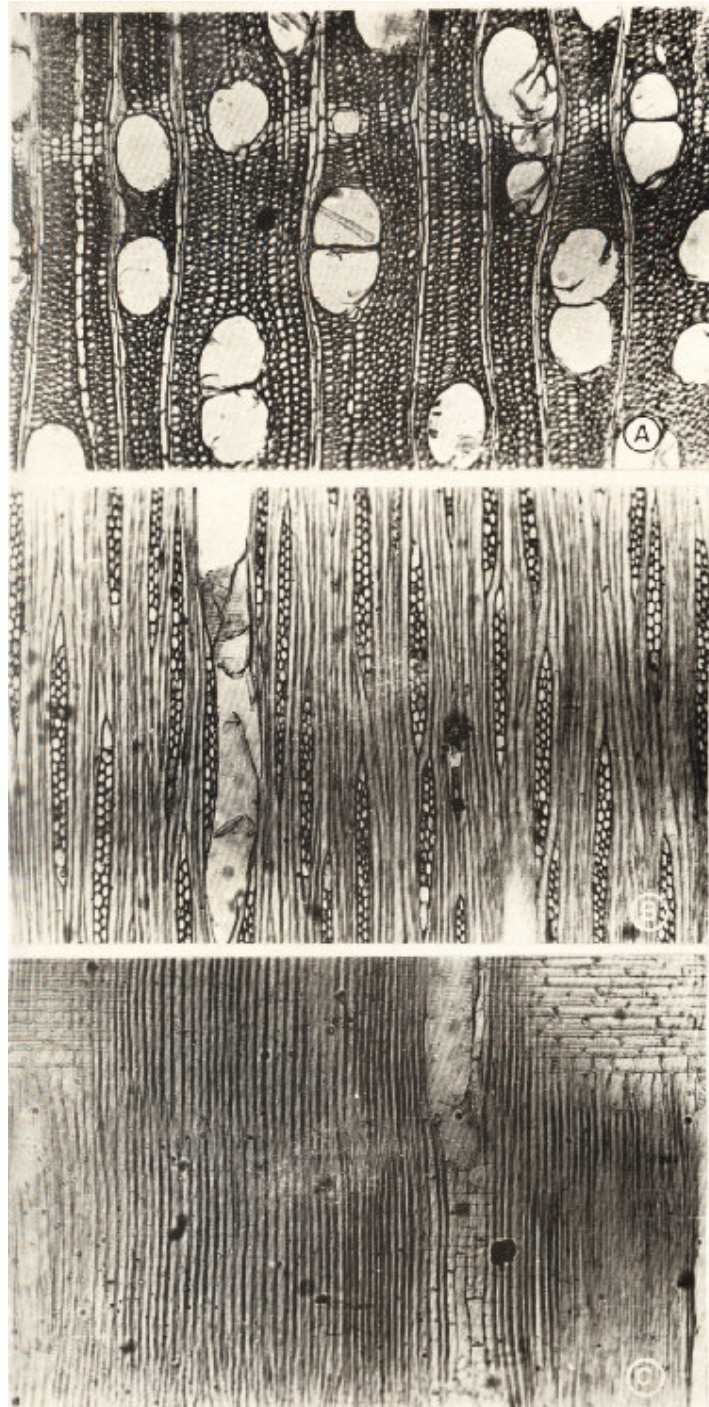
A. Tree

B. Bark

C. Inflorescence

D. Fruits

PLATE - XXVIII



**3-15 Sit**

**3-151 Botanical Name**

*Albizzia procera* Benth.  
(Family-Mimosaceae)

**3-152 Habit and Distribution**

A large straight stemmed tree attaining a height of 24-27m and a girth of 1.5-1.8 m. It occurs in swampy bands in the plains all over Burma.

**3-153 Morphological and taxonomical characteristics**

A deciduous tree, all parts glabrous or the young shoots slightly pubescent. Leaves abruptly bipinnate, 2-5-3.8 cm long with 4-12 pinnae; leaflet 6-9 pairs on a very short puberulous or glabrous petiolule, obliquely oval to oval-oblong, unequal. Inflorescences globose head, small; sepals shortly toothed, 2-3 mm long, petals twice the length of the calyx, funnel-shaped, deeply cleft; stamens indefinite, monadelphous at the base; anthers minute, not gland-crested; ovaries sessile or shortly stalked; style filiform; stigma capitate, minute. Pods 10.1-20.2 cm long, 1.3-2.5 cm wide, thin brown, glabrous, finally dehiscent 8-12 seeded.

**3-154 Flowering and fruiting period**

It flowers and fruits August to September.

**3-155 Bark**

Yellowish white bark often stained with brown spots, 7-10 mm thick; outer dead bark persistent over the entire trunk, shed in small flakes, irregularly cracked, leaving a whitish yellow surface, often with patches of different shapes.

**3-156 General characteristics and properties**

Sapwood white, wide, heartwood brown with lighter and darker bands, lustrous, without characteristic odour or taste; light to moderately heavy (sp.gr. approx. 0.45-0.06); straight or broadly and shallowly interlocked grained, very coarse and even textured; hard. A diffuse-porous wood.

### **3-157 Microscopic characteristics**

#### **3-1571 Tracheids and fibres**

Libriform fibres only, thin to thick walled, 8-10  $\mu$ . thick; pits minute to small; length ranges from 900-1950  $\mu$  and most frequently from 1050-1800  $\mu$ ; mean length is 1261.5  $\mu$ .

#### **3-1572 Vessel elements**

Number per sq.mm. ranges from 0-6, and most frequent number per sq. mm. ranges from 1-4; pore distribution solitary, pore multiples, or pore clusters, diffuse porous; pores circular, as seen in cross section; thick walled; tangential diameter ranges from 60-270  $\mu$  ; tyloses absent, perforation plates simple, end walls usually transverse; intervascular pitting alternate, crowded, size of pits 7-10  $\mu$ ; shape of pits pentagonal; dark yellow deposits common in the lumen of the vessels, vessel parenchyma pitting alternate, size of pits 7  $\mu$ , or less, shape of pits circular or oval, length of vessel elements ranges from 120-450  $\mu$ , and most frequently from 150-375  $\mu$ , mean length is 315.5  $\mu$ , pits of vessels alternate in arrangement, crowded, angular in shape, 7-10  $\mu$  in size, pits to parenchyma opposite or alternate in arrangement, circular, oval or elongated in shape 7-10  $\mu$  in size.

#### **3-1573 Vascular rays**

Number per mm. ranges from 5-11; homogeneous type II, where uniseriate rays are rare; 2-4 cells wide; the height of the multiseriate rays ranges from 60-200  $\mu$  and most frequently from 75-165  $\mu$ ; pitting between ray cells and other parenchyma cells few in number and small in size.

#### **3-1574 Xylem parenchyma**

Abundant; apotracheal parenchyma is uniseriate, terminal and paratracheal parenchyma very typically vasicentric, sometimes some tendencies of aliform may be seen; pitting between xylem parenchyma cells few or many in number and size usually are small.

#### **3-1575 Other features**

Xylem parenchyma cells show storied nature.

### **3-158 Uses**

It is a good furniture wood and used for carts, wheels, boxes and agricultural implements. It is also suitable for flooring, gun stocks and curving. It is used also in construction for bridges, posts, beams, scantlings, planks and boards.



PLATE - XXIX



A. Tree      B. Bark      C. Inflorescence      D. Seeds



PLATE - XXX



### **3-16 Tamalan**

#### **3-161 Botanical Name**

*Dalbergia oliveri* Gamble  
(Family-Papilionaceae)

#### **3-162 Habit and Distribution**

A medium size tree attaining a height of 18-24 m and a girth of 1.5-1.8 m. It is commonly found in dry deciduous and Indaing forests from Pegu Yoma Northwards.

#### **3-163 Morphological and taxonomical characteristics**

A medium size tree. Leaves odd-pinnate 11.4-12.6 cm long, exstipulate leaflets 9-11 obovate-oblong or elliptic oblong, 1.7-3.4 cm long, 1.3-1.6 cm wide, alternate, entire, with pellucid dots and short streaks. Inflorescences terminal or axillary racemes or corymbs, 5.8-10.7 cm long. Flowers small, sepals 5 lobed, 3-4 mm long, about 2 mm wide, campulate, distinct, usually short, two upper ones broadest, connate at the base, limb of standard without tubercles or inflex auricles, petals yellowish white at the apex, sometimes suffused with red, the large one 9-12 mm long, stamens 9-10, connate into a tube which is split on the vascillar side and sometimes divided into two parts; anthers minute, basifixed, the slits mostly short and apical; ovaries stalked, few ovuled, incurved, glabrous, stigma capitate. Pod oblong or strap shaped, 6.2-7.8 cm long, 1.6-1.8 cm wide, usually thin or flat, 1-4 seeded indehiscent, not thickened.

#### **3-164 Flowering and fruiting period**

It flowers from March to April and it fruits from April to May.

#### **3-165 Bark**

Blackish bright yellow, 8-10 mm thick, outer dead bark persistent over the whole of the trunk and larger branches, rough, irregularly shallow furrowed; scaly plates separated by shallow fissures.

#### **3-166 General characteristics and properties**

Sapwood white or yellowish white; narrow, heartwood ranging from shades of lemon pink or red scarlet to reddish brown with distinctly darker lines, lustrous when first exposed, but soon becoming dull; pleasant odour, without distinct taste, very heavy (sp.gr. approx. 1.00); straight grained or slightly inter-locked grained, medium coarse textured, very hard and strong. A diffuse-porous wood.

### **3-167 Microscopic characteristics**

#### **3-1671 Tracheids and fibres**

Fibre tracheids are sparsely present, libriform fibres with thin, thick or very thick walled, 4-8  $\mu$ . thick, interfibre pits simple, slit-like, length ranges from 510-1500  $\mu$  and most frequently from 900-1340  $\mu$ ; mean length is 1050  $\mu$ .

#### **3-1672 Vessel elements**

Number per sq.mm. ranges from 0-11, and most frequently from 2-8, pore distribution solitary or in multiples, diffuse porous; pores oval or elliptical as seen in cross section; thick walled; tangential diameter ranges from 50-290  $\mu$  ; tyloses absent, perforation plates simple, end walls horizontal or nearly so, intervascular pitting alternate, crowded, size of pits less than 10  $\mu$ ; shape of pits pentagonal, vessel parenchyma pitting opposite to alternate, size of pits 7-10  $\mu$ . shape of pits circular, oval or sometimes elongated; length of vessel elements range from 200-350 $\mu$  and most frequently from 220-310  $\mu$ , mean length is 270  $\mu$ , pits to vessels opposite or alternate in arrangement, crowded, oval or elliptical in shape, 7-10  $\mu$  in size, pits to parenchyma opposite or alternate in arrangement, oval or elongated in shape, 2-6  $\mu$  in size.

#### **3-1673 Vascular rays**

Number per sq.mm. ranges from 8-10; homogeneous type I, 1-3 cells wide; height of uniseriate rays ranging from 140-270  $\mu$  and most frequently from 160-250  $\mu$ , the height of multiseriate rays 230-460  $\mu$ , most frequently from 250-360  $\mu$ , pits between ray cells and other parenchyma cells few and size of pits small.

#### **3-1674 Xylem parenchyma**

Paratracheal parenchyma confluent, relatively abundant, forming a 1-several layered sheath which is only interrupted by rays, paratrachealzone parenchyma very abundant, forming concentric, mostly continuous, undulate to nearly straight, metatracheal parenchyma very sparse; restricted to the connective bands of fibrous tissues, pits between xylem parenchyma cells small and many.

#### **3-1675 Other features**

Storied xylem parenchyma cells.

### **3-168 Uses**

It is suitable for high class cabinet work and very good for turnery and carving. As the colour and the figure are highly ornamental and attractive, it is used for fine decorative panels, parqueting and furniture. It is used also for making handles, brush backs, wheels and musical instruments. It is excellent for use in making high grade veneer and plywood.

PLATE - XXXI



A. Tree

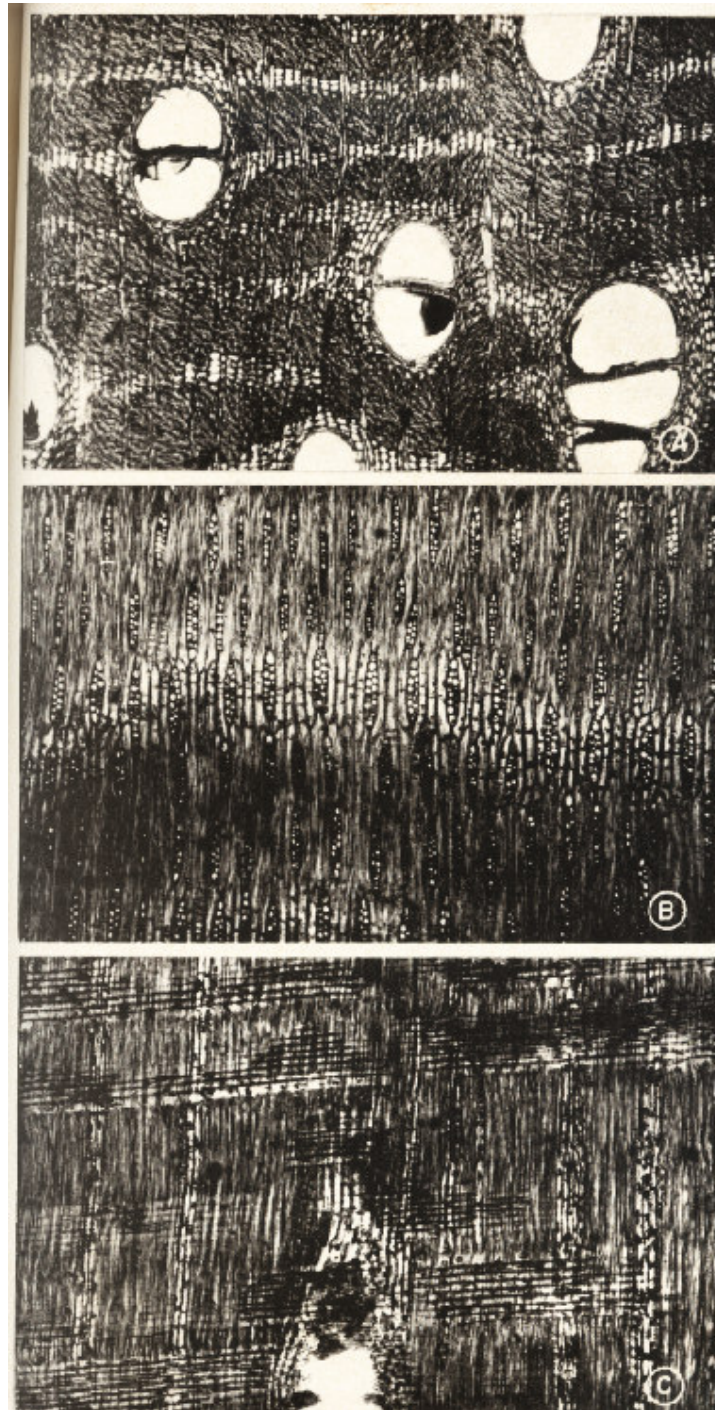
B. Bark

C. Inflorescence

D. Fruits and Seeds



PLATE - XXXII





### **3-17 Taukkyan**

#### **3-171 Botanical Name**

*Terminalia tomentosa* Wight.& Arn.  
(Family-Combretaceae)

#### **3-172 Habit and Distribution**

A moderate-sized tree attains 24-34 m in height and 3.6-4.5 m in girth. It is widely distributed throughout the country. It occurs both in the moist and dry deciduous forests of Burma.

#### **3-173 Morphological and taxonomical characteristics**

A moderate- sized to large deciduous tree. Leaves simple, elliptic or ovate, 10.2-20.5 cm long, 5.2 – 6.8 cm wide, subopposite or upper most alternate, glabrous or very hairy beneath; petioles 1.3 cm long. Inflorescences small spicate, 6.3-8.8 cm long. Flowers small, bracteate, bracteolate, sepals 5 short triangular lobes, valvate, deciduous; petals absent; stamens 10, inserted on the calyx tube, attached at the base of the densely hairy epigynous disc; ovaries ovoid, 1 celled, inferior, style long, simple. Fruits obovoid-oblong, 3.6-10.1 cm long, 3.4 -7.6 cm wide, glabrous or hoary, wings broad striations carried horizontally to the edge, indehiscent, coriaceous.

#### **3-174 Flowering and fruiting period**

It flowers from May to June and it fruits from June to July.

#### **3-175 Bark**

Light grey, blackish grey to dark brown, 8-12 mm thick, outer dead bark persistent over the entire trunk, often longitudinally fissured, exfoliating into flaky ridges..

#### **3-176 General characteristics and properties**

Sapwood reddish white; heartwood varying from light brown to deep chocolate, finely streaked with darker lines to dark brown or brownish black, often beautifully banded with streaks of darker colour; dull to lustrous; without characteristic odour or taste; moderately heavy to heavy (sp.gr.. 0.70-0.94); fairly straight-grained, coarse-textured; hard and strong. A diffuse-porous wood.

### **3-177 Microscopic characteristics**

#### **3-1771 Tracheids and fibres**

Libri-form fibres, thin to thick walled, 2-6  $\mu$ . thick, pits minute or small in size, length ranges from 300-2100  $\mu$ , and frequently from 1050-1800  $\mu$ , mean length is 1838  $\mu$ .

#### **3-1772 Vessel elements**

Number per sq.mm. ranges from 4-12, and most frequent number per sq.mm ranges from 6-10; pore distribution solitary, pores multiples or pore clusters; diffuse porous; pores circular in cross section; thick-walled; tangential diameter ranges from 45-270  $\mu$  ; tyloses present, perforation plates simple, end walls oblique or transverse, oblique angles ranges up to 30°; intervascular pitting alternate, crowded, size of pits 7-15  $\mu$  or above, shape of pits square or pentagonal; vessel parenchyma pitting alternate, size of pits circular or oval; length of vessel elements ranges from 22.5-675  $\mu$  and most frequently from 300-600  $\mu$ , mean length is 433.5  $\mu$ , pits to vessels alternate in arrangement, crowded, circular or angular in shape 7-15 $\mu$  in size; pits to parenchyma opposite or alternate in arrangement, oval or elongated in shape, more than 10  $\mu$  in size.

#### **3-1773 Vascular rays**

Number per mm. ranges from 9-20; homogeneous type III, all uniseriate rays; the length of which ranges from 100-775  $\mu$  and most frequently from 150-675  $\mu$ , rays cells with black deposit in them.

#### **3-1774 Xylem parenchyma**

Abundant, paratracheal parenchyma, vasicentric, characteristically aliform and confluent; pitting between xylem parenchyma cells few in number and small in size.

### **3-178 Uses**

As it is excellent timber for decorative purposes, it is used for cabinet work, interior finish, flooring, furniture and veneers. It can be made also for instrumental cabinets and interior fittings for ships and offices.

PLATE - XXXIII



A. Tree

B. Bark

C. Inflorescence

D. Fruits

PLATE - XXXIV



### **3-18 Thingan**

#### **3-181 Botanical Name**

*Hopea odorata* Roxb.  
(Family-Dipterocarpaceae)

#### **3-182 Habit and Distribution**

A large, tall straight tree with a large crown attaining a height of 39-45 m, a girth of 3.6-4.3 m. The bole is cylindrical and a clear length of 21-24 m is common. It is usually found growing in the evergreen and moist forests of southern Burma .

#### **3-183 Morphological and taxonomical characteristics**

A evergreen tree; the young shoots greyish puberulous. Leaves ovate-oblong or lanceolate-oblong, 10-15 cm long; 3.8-5 cm wide, the tips acute or abtusely acuminate, the margins undulate, the bases rounded often suboblique, glabrous on both surfaces; petioles 1.8 cm long. Inflorescences terminal or axillary panicles, 10.2-15.4 cm long. Flowers small, fragrant, yellow, on very short pedicels; sepals ovate, obtuse, adnate to the receptacle; petals oblong, falcate puberulous; stamens 15, slightly connate; anthers ovate, connective subulate-suspidate; ovaries ovoid, 3-celled, style short, cylindrical. Nut 1- seeded, ovoid, 6 mm long, apiculate, glabrous; wings of fruiting calyx-segments linear, obtuse.

#### **3-184 Flowering and fruiting period**

It flowers from February to March and it fruits from March to April.

#### **3-185 Bark**

Blackish brown, 2-4 mm thick; outer dead bark persistent on the entire trunk and larger branches, longitudinally and deeply furrowed, rough, blaze pale or salmon-red.

#### **3-186 General characteristics and properties**

Greyish yellow or yellowish brown, with white tangential lines at irregular intervals; lustrous to dull with age, medium smooth; without characteristic odour or taste; moderately heavy (sp.gr. approx. 0.65); broadly and shallowly interlocked-grained; medium-textured; hard and strong. A diffuse porous wood.



### **3-187 Microscopic Characteristics**

#### **3-1871 Tracheids and fibres**

Tracheids vasicentric; thin-walled, 2-7 $\mu$  thick, the length ranges from 250-750  $\mu$  and most frequently from 450-600  $\mu$ . Libriform fibres abundant, thick or very thick-walled, 2-7  $\mu$  thick; size of pits usually small or minute; the length ranges from 1050-1875  $\mu$ ; mean length is 1432.5  $\mu$ .

#### **3-1872 Vessel elements**

Number per sq.mm. ranges from 2-9, and most frequently from 2-7, pore distribution solitary, in multiples or in clusters; diffuse-porous; circular as seen in cross section; thick-walled; tangential diameter ranges from 45-260  $\mu$  ; tyloses present, perforation plate simple, end walls oblique at the angle ranging up 30°; intervacular pitting alternate and crowded, size of pits less than 7  $\mu$ ; shape of pits circular; vessel parenchyma pitting opposite, shape of pits vary from circular oval or elongated; the length of vessel elements range from 150-676 $\mu$  and most frequently from 225-525  $\mu$ , mean length is 405  $\mu$ ; pits to tracheids alternate in arrangement, crowded, circular or angular in shape, size not more than 7  $\mu$ , pits to ray cells opposite in arrangement, circular or oval in shape; and size usually small and less than 7 $\mu$  .

#### **3-1873 Vascular rays**

Number per mm. ranges from 4-26; heterogeneous type IIB, very rarely a uniseriate is seen; 2-6 cells wide; the height of rays ranges from 75-900  $\mu$  and most frequently from 120-600  $\mu$ .

#### **3-1874 Xylem parenchyma**

Abundant, apotracheal parenchyma diffuse, terminal or uniseriate metatracheal bands. Occasionally paratracheal parenchyma show tendencies of vasicentric nature; pits between xylem parenchyma; many and size usually are small.

#### **3-1875 Other features**

Resin canals occur abundantly.

#### **3-188 Uses**

It is used for boats, masts, piles, carts, shingles, furniture and agricultural implements. It is used also for bridge construction ship building and railway sleepers. It is also suitable for flooring and rollers for textile industry.

PLATE - XXXV



A. Tree

B. Bark

C. Inflorescence

D. Fruits

PLATE - XXXVI



### **3-19 Thinwin**

#### **3-191 Botanical Name**

*Millettia pendula* Benth.  
(Family-Papilionaceae)

#### **3-192 Habit and Distribution**

A moderate-sized tree attaining a height of 21-24 m and a girth of 1.8-2.1 m. It is commonly distributed in the dry forests of Burma.

#### **3-193 Morphological and taxonomical characteristics**

An erect tree, with thinly silky branchlets. Leaves odd-pinnate, 16.1 cm long; leaflets 7, ovate oblong 5-7.6 cm long, 3.6-4.9 cm wide, the tips acuminate, the margins entire, the bases acute, cuspidate, membranous, exstipulate, dull green, when mature densely clothed with grey silky pubescent below; petiole 6 mm long. Inflorescences axillary dense racemes. Flowers showy; pedicels densely fascicled, 3-4 mm long; sepals campanulate, 4-5 mm long, short grey-silky; teeth deltoid, shorter than the tube; petals with long claws; standard broad, glabrous; stamens monadelphous or diadelphous, filaments filiform; anthers uniform; ovaries sessile, linear; style filiform; stigma capitate. Pod oblong, 7.5 – 12.5 cm long, 3.1 cm wide, tubercled, 1-3 seeded.

#### **3-194 Flowering and fruiting period**

It flowers and fruits from April to May.

#### **3-195 Bark**

Greyish yellow to yellow, 6-10 mm thick, outer dead bark persistent over the entire trunk, and larger branches; irregular grey patches on the smooth surfaces.

#### **3-196 General characteristics and properties**

Purplish-brown to dark chocolate brown, striated with dark and light tissue zones that make the timber handsome; dull, with faint odour of tar, without distinct taste, heartwood small; heavy to very heavy (sp. gr. 0.95-1.03); straight or narrowly and shallowly interlocked-grained, medium coarse textured; very hard and strong. A diffuse -porous wood.

### **3-197 Microscopic characteristics**

#### **3-1971 Tracheids and fibres**

Libriform fibres, medium fine, wall extremely thick, 5-9 $\mu$  thick, non separate, inter fibre pits simple, slit-like, length ranges from 540-2150  $\mu$ , and most frequently from 960-1890  $\mu$ , mean length is 1425  $\mu$ .

#### **3-1972 Vessel elements**

Number per sq.mm. ranges from 0-14, and most frequently ranges from 3-11; pore distribution solitary or in multiples, diffuse porous; oval or mostly circular as seen in cross section; thin walled; tangential diameter ranges from 65-220  $\mu$ ; tyloses absent, perforation plate simple, end walls horizontal or nearly so; intervacular pitting alternate or opposite, crowded, size of pits less than 10  $\mu$ ; shape of pits circular or oval, vessel parenchyma pitting alternate or opposite, size of pits 8-12 $\mu$ , shape of pits usually circular or oval; length of vessel elements ranges from 150-325  $\mu$  and most frequently from 180-310  $\mu$ , mean length is 200  $\mu$ , pits to vessel opposite or alternate in arrangement, crowded, circular in shape 7-11 $\mu$  in size; pits to parenchyma opposite or alternate, not crowded, circular or oval in shape, 7-11 $\mu$  in size.

#### **3-1973 Vascular rays**

Number per mm. ranges from 9-12; heterogeneous type I, 1-4 cells wide, the height of uniseriate rays range from 90-250  $\mu$  and most frequently from 120-210  $\mu$ , the height of multiseriate rays range from 250-680  $\mu$  and most frequently from 320-640  $\mu$ ; pitting between ray cells and other parenchyma cells small in size and few of many in number.

#### **3-1974 Xylem parenchyma**

Paratracheal parenchyma confluent, scanty terminal parenchyma forming 1 to numerous seriate bands, metatracheal parenchyma sparse and scattered in the broad concentric bands of fibrous tissues, pitting between xylem parenchyma cells few and the size of pit is small.

#### **3-1975 Other features**

Storied xylem parenchyma cells.

### **3-198 Uses**

It is used for heavy construction like bridges and residential buildings. It makes beautiful carving, turnings, ornamental panels and furniture. It is used also for agricultural implements, joinery work, ornamental flooring and cabinet making.



PLATE - XXXVII



A. Tree      B. Bark      C. Inflorescence      D. Seeds

PLATE - XXXVIII



### **3-20 Thitsein**

#### **3-201 Botanical Name**

*Terminalia belerica* Roxb.  
(Family-Combretaceae)

#### **3-202 Habit and Distribution**

A large tree attains 18-24 m in height and 1.8 – 2.0 m in girth. It is commonly found in hills and plains of upper mixed deciduous forest and semi-evergreen forest.

#### **3-203 Morphological and taxonomical characteristics**

A large straight-stemmed tree. Leaves elliptic-obovate, 10-20 cm long, 5.3–0.6 cm wide, thin-coriaceous, finely pellucid-dotted above, glabrous, the tips shortly obtusely acuminate, rarely rounded, the bases acute, alternate; petioles 2.5–3.8 cm long. Inflorescences solitary and axillary spikes, 10.1-17.2 cm long. Flowers small, upper flowers of the spikes male, lower bisporangiate; sepals 5 lobes, deciduous; petals absent; stamens 10, inserted on the calyx tube, the lower ones opposite the calyx lobes, alternating with the 5 longer, protruding upper ones; ovaries globoid, 1- celled, inferior; style long, ovules 2. Fruits globose and 5-angular, 3-7.2 cm long, 2.3-5.2 cm wide, minutely stipitate at base, densely very finely pubescent.

#### **3-204 Flowering and fruiting period**

It flowers from May to June and it fruits from June to July.

#### **3-205 Bark**

Pale brown to brown, 10 – 15 mm thick; outer dead bark persistent on the entire trunk, irregularly shallow fissures separated by narrow interlacing ridges, eventually breaking up into brown plates on mature trunk.

#### **3-206 General characteristics and properties**

Yellowish grey; heartwood lacking; lustrous, with rough feel; without characteristic odour or taste; light to moderately heavy (sp. gr. 0.57 – 0.75 ); fairly straight-grained and sometimes curly-grained in the radial plane, very coarse textured; fairly strong and touch. A diffuse porous wood.

### **3-207 Microscopic characteristics**

#### **3-2071 Tracheids and fibres**

Almost all are fibre tracheids, thin to very thin-walled, 3-6  $\mu$ . thick, size of pits small to large; length ranges from 525-1650  $\mu$ , the most frequent length ranges from 600-1500  $\mu$ , mean length is 1000.5  $\mu$ .

#### **3-2072 Vessel elements**

Number per sq.mm. ranges from 5-15 , the most frequent number per sq.mm ranges from 7-13; pore distribution solitary or pore multiples, diffuse porous; pores circular as seen in cross section; thin walled; tangential diameter ranges from 45-210  $\mu$  ; tyloses absent, perforation plates simple, end walls oblique and the angles may range up to 50°; intervascular pitting alternate, crowded, size of pits over 10  $\mu$ ; shape of pits pentagonal; vessel parenchyma pitting more than 10 $\mu$ , shape circular, oval or elongated ; length of vessel element ranges from 225-600  $\mu$  and most frequently from 300-525  $\mu$ ; mean length is 408  $\mu$ ; pits to vessels alternate in arrangement, sparse or crowded, angular in shape, more than 10 $\mu$  in size; pits to parenchyma opposite or alternate in arrangement, circular, oval or elongated in shape, 7-35 $\mu$  in size.

#### **3-2073 Vascular rays**

Number per mm. ranges from 10-15; heterogeneous type II A; 2-5 cells wide, the height of uniseriate rays range from 100-605  $\mu$  most frequently from 150-525  $\mu$ , height of multiseriate rays range from 120-900  $\mu$  and most frequently from 150-525  $\mu$ ; aggregate rays occasionally present.

#### **3-2074 Xylem parenchyma**

Abundant; paratracheal parenchyma vasicentric, aliform or confluent; terminal parenchyma forming a narrow, ragged, 1-3 seriate; metatracheal parenchyma sparse; pitting between xylem parenchyma cells larger in size and few in number.

### **3-208 Uses**

It is used for house building, packing cases, canoes, plough shafts, carts and barrels. It also makes rafters, boards and good tool handles.



PLATE - XXXIX



A. Tree    B. Bark    C. Inflorescence    D. Leaves    E. Fruit and Seeds

PLATE - XL



### **3-21 Thitya**

#### **3-211 Botanical Name**

*Shorea oblongifolia* Thw.  
Syn. *Shorea obtusa* Wall.  
(Family-Dipterocarpaceae)

#### **3-212 Habit and Distribution**

A large tree attaining a height of 24-30 m and a girth of 2.4-3.0 m. It occurs in the low hill forests of Burma and it is often associated with Ingyin in the dry forests.

#### **3-213 Morphological and taxonomical characteristics**

A large tree. Leaves oblong, 10-15 cm long, 2.6-6.3 cm wide, the tips shortly acuminate, the bases truncate or emarginate, both surfaces glabrous; lateral nerve about 15 pairs, petioles 1.3-2.2 cm long. Inflorescences terminal and axillary panicles, 13.8-15.2 cm long. Flowers yellow, odorous, shortly pedicelled, sepals ovate or lanceolate, imbricate; stamens 80-100, anthers oblong, connective subulate-cuspidate; ovaries ovoid, 3-celled, 2-ovuled; style subulate. Capsule ovoid, 2.1 cm long, silky pubescent; base of the fruiting calyx-segments half as long as the capsule, oblong, puberulent; wings 5 cm long; 2.2 cm wide, spatulate, obtuse.

#### **3-214 Flowering and fruiting period**

It flowers and fruits from April to May.

#### **3-215 Bark**

Grey to brownish-grey, 10-15 mm thick; outer dead bark persistent over the entire trunk, longitudinally deeply furrowed; cracked, separated by transverse shallow fissures.

#### **3-216 General characteristics and properties**

Sapwood pale brownish white, narrow; heart-wood brown turning to dark brown or reddish brown often with darker markings with light tangential lines at irregular intervals; dull, without distinct odour or taste; very heavy (sp. gr. approx. 1.05); interlocked grained in narrow bands; even and medium textured; hard and strong. A diffuse porous wood.

### **3-217 Microscopic characteristics**

#### **3-2171 Tracheids and fibres**

Tracheids mostly vasicentric; thick walled, length ranges from 225-450  $\mu$  and most frequently from 300-375  $\mu$ . Libriform fibres abundant, thick to very thick walled, 6-10  $\mu$  thick; size of pits minute; length ranges from 900-1800  $\mu$  and most frequently from 1050-1500  $\mu$ ; mean length is 1237.5  $\mu$ .

#### **3-2172 Vessel elements**

Number per sq.mm. ranges from 2-9 and most frequently from 2-7; pore distribution very solitary pores, pore multiples to pore clusters; diffuse porous; circular as seen in cross section; thick walled; tangential diameter ranges from 120-300  $\mu$ ; tyloses present and are abundant, many in sections and many in individual vessels; perforation plates simple; end walls oblique and the angle ranges up to 50°; or transverse; intervascular pitting alternate; size between 7-10  $\mu$ ; shape usually circular or oval; length of vessel elements ranges from 150-450  $\mu$  and most frequently from 300- 375  $\mu$ ; mean length is 294.5  $\mu$ ; pits to vessels alternate in arrangement, crowded, circular or angular in shape, size less than 7  $\mu$ ; pits to ray parenchyma cells opposite or alternate, with no clear borders, circular, oval or elongated and size between 7-10  $\mu$ .

#### **3-2173 Vascular rays**

Number per mm. ranges from 5-11; homogeneous type II; 3-6 cells wide, height of the rays ranges from 150-1050  $\mu$  and most frequently from 300-900  $\mu$ ; pitting between ray cells and other parenchyma cells few to many, size of pits small, black deposits present in the ray cells; intercellular canals may be occasionally present in the rays.

#### **3-2174 Xylem parenchyma**

Sparse; apotracheal parenchyma diffuse and metatracheal parenchyma forms groups of uniseriate bands; some tendencies of paratracheal parenchyma assuming aliform nature may occasionally be present; size of pits between xylem parenchyma cells small, number or pits few.

#### **3-2175 Others features**

Both vertical and horizontal resin canals present.

### **3-218 Uses**

It is excellent for heavy construction like bridges and wharves. It is used for sleepers, piles, boat works, wagons, heavy duty flooring and spools in textile factories.

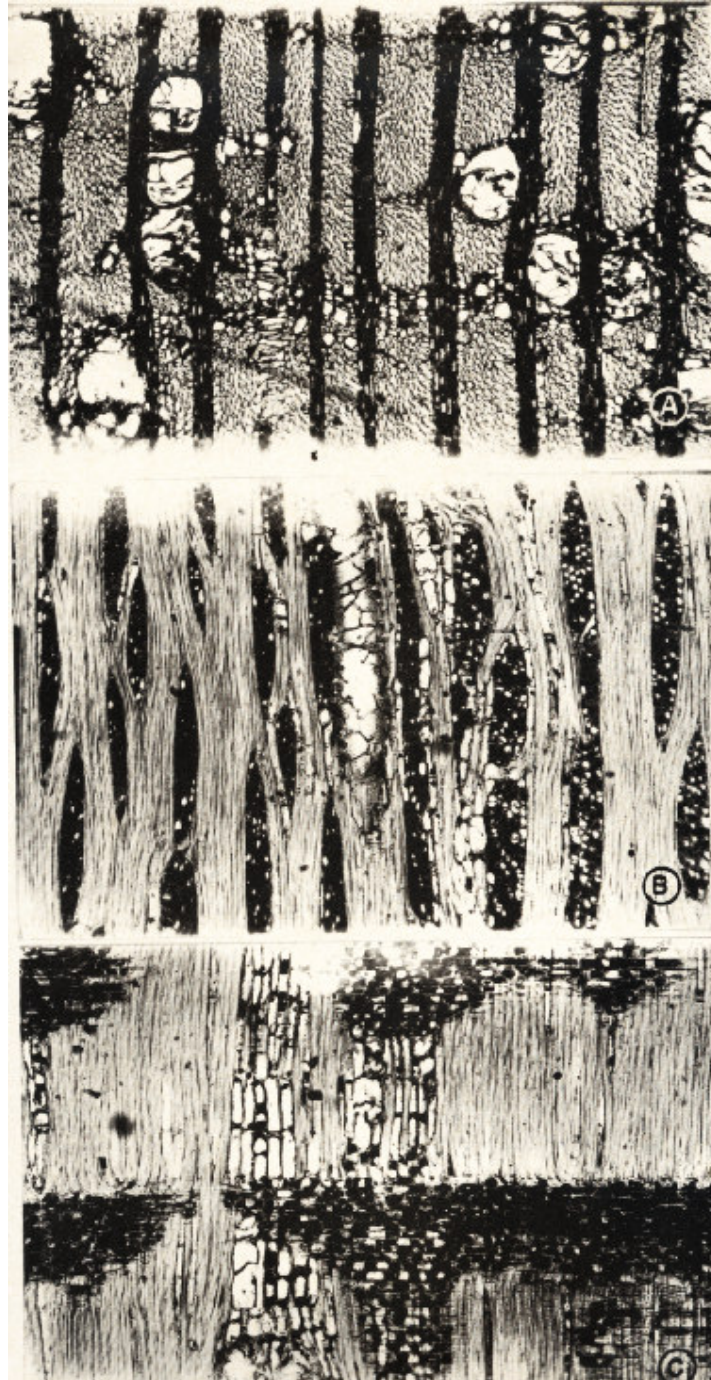


PLATE - XLI



A. Tree      B. Bark      C. Inflorescence      D. Fruits

PLATE - XLII



### **3-22 Yemane**

#### **3-221 Botanical Name**

*Gmelina arborea* Roxb.  
(Family-Verbenaceae)

#### **3-222 Habit and Distribution**

A moderate sized tree attaining 21-30 m in height and 2.1-4.5 m in girth. A clean bole of 9 m is common. It is usually found scattered in the moister forests throughout Burma.

#### **3-223 Morphological and taxonomical characteristics**

A moderate sized to large deciduous tree. Leaves ovate to cordate-ovate, 15.2-22.5 cm long, the tips acuminate, the margins entire, glabrate above, stellately hairy beneath, petioles 7.5 cm long. Flowers showy, on short yellowish puberulous pedicles, sepals 5 lobed, 4 mm long, campanulate, shortly 5 toothed, petals 5 lobed 3.8 cm long, brownish yellow, upper lip shortly bifid, longer than the lower, stamens 4, didynamous, exserted, anthers cells oblong, pendulous; ovaries ovoid, 4 celled, 4 ovuled; style cylinder, shortly bifid. Drupe obovoid to ovoid, 1.8 cm long, fleshy usually 2-1 seeded, smooth and glossy, yellow.

#### **3-224 Flowering and fruiting period**

It flowers and fruits from February to March.

#### **3-225 Bark**

Light grey to brownish grey, 10-20 mm thick, outer dead bark persistent over the entire trunk and larger branches; longitudinally shallowly furrowed; relatively smooth, without fissures; exfoliating in irregularly shaped flakes leaving lighter-coloured patches beneath.

#### **3-226 General characteristics and properties**

Yellowish white, greyish white or reddish white when first exposed, turning light russet or yellowish brown with age; heartwood not distinct; lustrous; with a smooth oil feel; without distinct odour or taste; very light to light (sp.gr. approx. 0.47); straight grained or more or less irregular and interlocked-grained; medium coarse textured; moderately hard. A ring porous wood.

### **3-227 Microscopic characteristics**

#### **3-2271 Tracheids and fibres**

Septate wood fibres; thick, , thin or very thin – walled 2-5  $\mu$ . thick, size of pits small; length ranges from 600-2100  $\mu$  and most frequently from 750-1800  $\mu$ , mean length is 1350  $\mu$  .

#### **3-2272 Vessel elements**

Number per sq.mm. ranges from 2-12 , and most frequently from 3-10; pore distribution solitary; pore multiples and pore clusters; ring porous; pores circular as seen in cross section; thin walled; tangential diameter ranges from 75-300  $\mu$  ; tyloses present, few in sections and many in individuals, thin walled; perforation plates simple, end walls oblique or transverse, oblique angles ranges up to 50°; intervacular pitting alternate, crowded, size of pits 7  $\mu$ ; shape of pits pentagonal; vessel parenchyma pitting alternate, size of pit between 7- 10 $\mu$ ; shape of pits circular or oval; length of vessel element ranges from 150-600  $\mu$  and most frequently from 225-450  $\mu$ , mean length is 337.5  $\mu$ , pits to vessels alternate in arrangement, crowded, circular or mostly angular in shape, 7-15 $\mu$  in size; pits to parenchyma opposite or alternate in arrangement, circular or oval in shape 7-10 $\mu$  in size.

#### **3-2273 Vascular rays**

Number per mm. ranges from 2-6; homogeneous type II; 2-5 cells wide, the height of multiseriate rays ranges from 195-1025  $\mu$  and most frequently from 225-325 $\mu$ ; pitting between ray cells and other parenchyma cells few in number and small in size.

#### **3-2274 Xylem parenchyma**

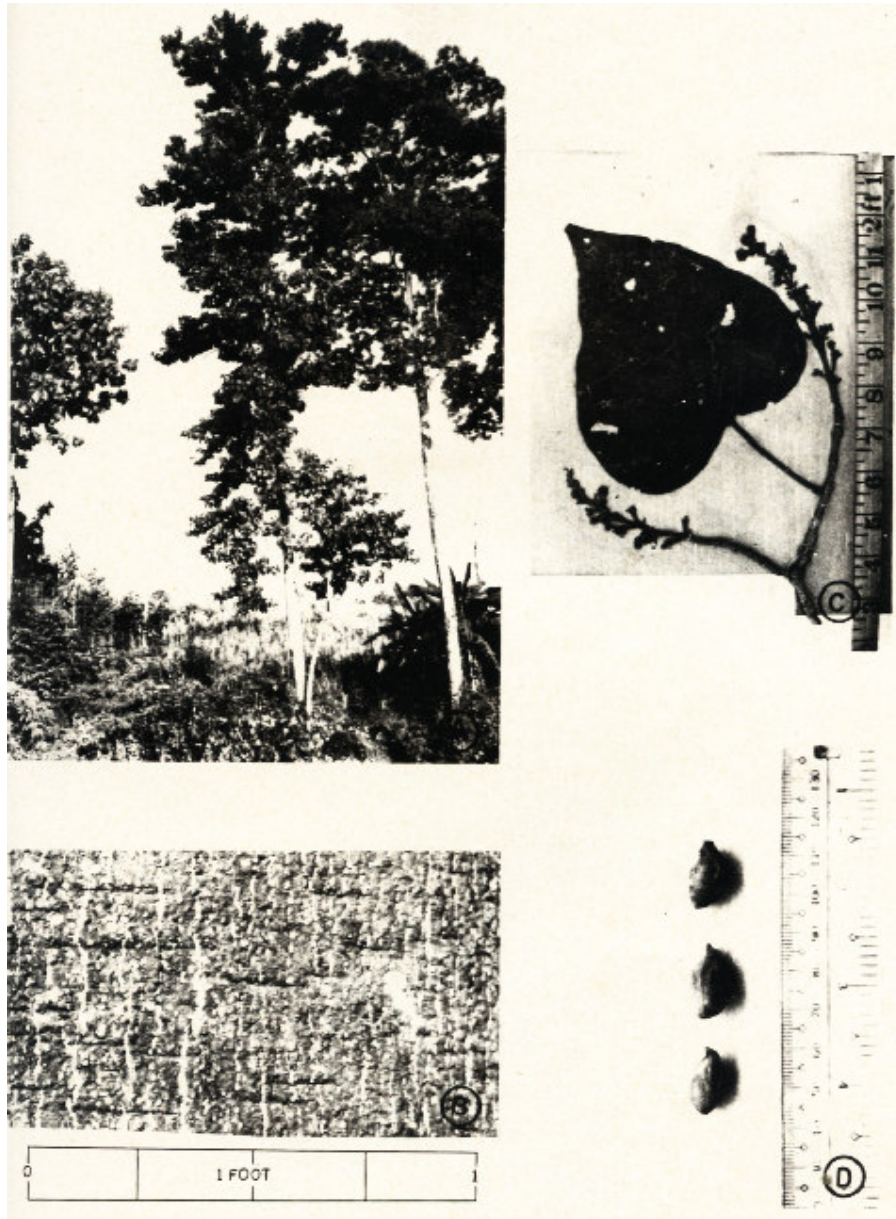
Abundant; terminal; paratracheal parenchyma confluent; pitting between xylem parenchyma cells small in size and few in number.

### **3-228 Uses**

It is used for boat and ship building, carriages and carts, panels, furniture and cabinets. It is a favorite wood for lacquered boxes, carving and sound boards for musical instruments. It is used also for construction timber, especially for door frames, weather boardings and flooring. It makes plywood of utility grade.



PLATE - XLIII



A. Tree      B. Bark      C. Inflorescence      D. Fruit

PLATE - XLIV



### **3-23 Yindaik**

#### **3-231 Botanical Name**

*Dalbergia cultrata* Grah.  
(Family- Papilionaceae)

#### **3-232 Habit and Distribution**

A small to medium sized tree attaining 16-18 m in height and 1.2-1.5 m in girth. It is commonly growing in the plains and lower hills forests of Burma.

#### **3-233 Morphological and taxonomical characteristics**

A medium sized tree; branches and leaves glabrous. Leaves with alternate subcoriaceous leaflets, 17.8-22.4 cm long, leaflets 7-10, obovate-oblong; 3.8-5 cm long, 1.6-2.1 cm wide, moderately firm, the tips obtuse, the margins entire, the base oblique, green on both sides. Inflorescences axillary fascicled panicles, 7.6-10.9 cm long. Flowers small; pedicles 2 mm long; sepals 5 lobed, campandulate, about 2 mm long, sub-glabrous, teeth short; petals twice the length of the sepals, claws short; stamens 9-10, monadelphous or the sheath slit down the keel, anthers minute; ovaries stalked, few-ovuled, style short, stigma capitate. Pod 3.8-10 cm long, 1.5-1.8 cm wide, 1-3 seeded, bright brown 3.3-3.6 cm long, 1.4-1.6 cm wide, flexible, narrow to the point and gradually at the base into a long stalk.

#### **3-234 Flowering and fruiting period**

It flowers and fruits from May to June.

#### **3-235 Bark**

Light brown to dark brown , 10 – 15 mm thick, outer dead bark persistent over the whole trunk and larger branches; shallowly furrowed, vertically, irregular exfoliating scaly ridges separated by narrow fissures.

#### **3-236 General characteristics and properties**

Sapwood greyish white to pale brown, heartwood brown with purplish streaks with long, fine parallel yellowish brown lines; dull; with fragrant scent; without distinct taste; very heavy to extremely heavy ( sp. gr. 0.89-1.14 ); fairly straight grained; medium to coarse textured; moderately hard. A diffuse porous wood.

### **3-237 Microscopic characteristics**

#### **3-2371 Tracheids and fibres**

Fibre tracheids very sparse; libriform fibres thick-walled 4-7  $\mu$ . thick, inter fibre pits simple, slit like, non-septate, length ranges from 270-1355 $\mu$  and most frequently 400-1150 $\mu$ , mean length is 794  $\mu$ .

#### **3-2372 Vessel elements**

Number per sq.mm. ranges from 1 - 20, and most frequently from 2-16; pore distribution solitary, frequently pore multiples; diffuse porous; pores circular, oval or radially elongated, thick walled; tangential diameter ranges from 40-300  $\mu$ ; tyloses lacking; perforation plates simple, horizontal to oblique and the angles range up to 40°; intervacular pitting alternate or opposite, size of pits 7-10  $\mu$ , shape of pits oval or elliptical, vessel parenchyma pitting alternate to opposite, size of pits 4-8  $\mu$ , shape of pits elliptical, length of vessel elements ranges from 130-240  $\mu$  and the most frequent length ranges 140-220  $\mu$ , mean length is 185 $\mu$ ; pits to vessels alternate to opposite in arrangement, sparse elliptical or oval, size of pits 7-10  $\mu$ ; pits to parenchyma opposite or alternate in arrangement, oval or elongated in shape, 4-8 $\mu$  in size.

#### **3-2373 Vascular rays**

Number per mm. ranges from 12-17; homogeneous type I; multiseriate rays 1-4 cells wide; the height of uniseriate rays ranges from 140-215  $\mu$ , most frequently from 160-210  $\mu$ ; height of multiseriate rays ranges from 200-620  $\mu$  and most frequently 260-540  $\mu$ ; pitting between ray cell and other parenchyma cells few and size of pits small.

#### **3-2374 Xylem parenchyma**

Paratracheal parenchyma relatively abundant, forming 1 several seriate sheath which is only interrupted by rays, cells peripherally flattened; paratracheal zoned parenchyma very abundant, forming wavy concentric bands which alternate with bands of fibrous tissues; metatracheal parenchyma very sparse, mainly restricted to the margins of the zones of fibrous tissue; pitting xylem parenchyma cells small in size and few in number.

#### **3-2375 Others features**

Storied xylem parenchyma cells.



### 3-238 Uses

It is used for ornamental furniture, walking sticks, ash trays and interior fitting. It is used also for constructional purposes and joinery. It is very good for ornamental turnery and carving.

#### PLATE - XLV



A. Tree

B. Bark

C. Inflorescence

D. Fruits and Seeds

PLATE - XLVI



### **3-24 Yinma**

#### **3-241 Botanical Name**

*Chukrasia tabularis* A.Juss.  
(Family-Meliaceae)

#### **3-242 Habit and Distribution**

A tall with a cylindrical straight bole and heavy crown attains a height of 21-24 m and a girth of 2.4-2.7 m. It occurs in the northern and south eastern parts of the country.

#### **3-243 Morphological and taxonomical characteristics**

A large tree. Leaves paripinnate, 30.2 – 45.7 cm long; leaflets 10-16, ovate, 5.1-15.2 cm long, 3.1-6.8 cm wide, the tips acuminate, the bases obtuse, glabrous, shortly petiole. Inflorescences terminal panicles. Flowers 1.3 – 1.5 cm long, yellowish or red; sepals short, dentate; petals oblong, free; stamens 10 crenate, anthers erect, inserted with in the creatures, short; ovaries globoid, shortly stipitate, 3 celled, each cells with numerous biseriate ovule; style stout; stigma capitate. Capsule ellipsoid, 5 cm long, 3 celled, septicidally 3 valved, woody; valves consisting of two plate, separating from the 3 winged axis. Seeds numerous, flattish.

#### **3-244 Flowering and fruiting period**

It flowers and fruits from September to October.

#### **3-245 Bark**

Blackish brown to greyish brown, about 20 mm thick; outer dead bark persistent over the entire trunk, deeply furrowed, irregularly or vertically; ultimately breaking up into thick rough ridges separated by shallow irregular fissures and becoming nearly dark grey on mature tree.

#### **3-246 General characteristics and properties**

Sapwood pale yellowish white or brownish white; heartwood yellowish red to red, ageing to yellowish brown to reddish brown; lustrous, without distinct odour or taste; light to moderately heavy ( sp. gr.approx. 0.62); irregularly interlocked grained; even and medium fine-textured; moderately strong and hard. A semi-ring porous wood.

### **3-247 Microscopic characteristics**

#### **3-2471 Tracheids and fibres**

Only libriform fibres, thin walled, 2-5  $\mu$ . thick; size of pits small; the length ranges from 450-1500  $\mu$ ; and most frequently from 600-1350  $\mu$ ; mean length is 1005.5  $\mu$ .

#### **3-2472 Vessel elements**

Number per sq.mm. ranges from 8-19 , and most frequently from 9-17; pore distribution solitary and pore multiples, semi-ring porous; pores circular as seen in cross section; thin walled; tangential diameter ranges from 30-150  $\mu$  ; tyloses absent; perforation plates simple, end walls oblique or transverse, oblique angles range up to 40°; intervascular pitting alternate, crowded, size of pits less than 7  $\mu$ ; shape of pits circular; dark yellow deposits in the lumen of the vessels, vessel parenchyma pitting alternate, size not more than 7 $\mu$ , shape of pit circular to oval; length of vessel elements range from 150-600  $\mu$  and most frequently from 225-525  $\mu$ , mean length is 375  $\mu$ ; pits to vessels alternate in arrangement, crowded, circular or oval in shape, less than 7 $\mu$  in size; pits to parenchyma opposite or alternate in arrangement, circular, oval or elongated in shape, less than 7 $\mu$  in size.

#### **3-2473 Vascular rays**

Number per mm. ranges from 6-11; homogeneous type II; showing some tendencies of type I; 2-5 cells wide, the height of the uniseriate rays range from 60-250  $\mu$  and most frequently from 90-180  $\mu$ ; the height of multiseriate rays range from 100-400  $\mu$  and most frequently from 180-300  $\mu$ ; pitting between ray cells and other parenchyma cells few and size of pits small.

#### **3-2474 Xylem parenchyma**

Sparse; apotracheal parenchyma diffuse, scattered; and terminal, pitting between xylem parenchyma cells few and size of pits small.

### **3-248 Uses**

It is used for construction as house posts, beams, scantlings, planking and for carving. It makes an excellent for first class furniture and turnery wood.

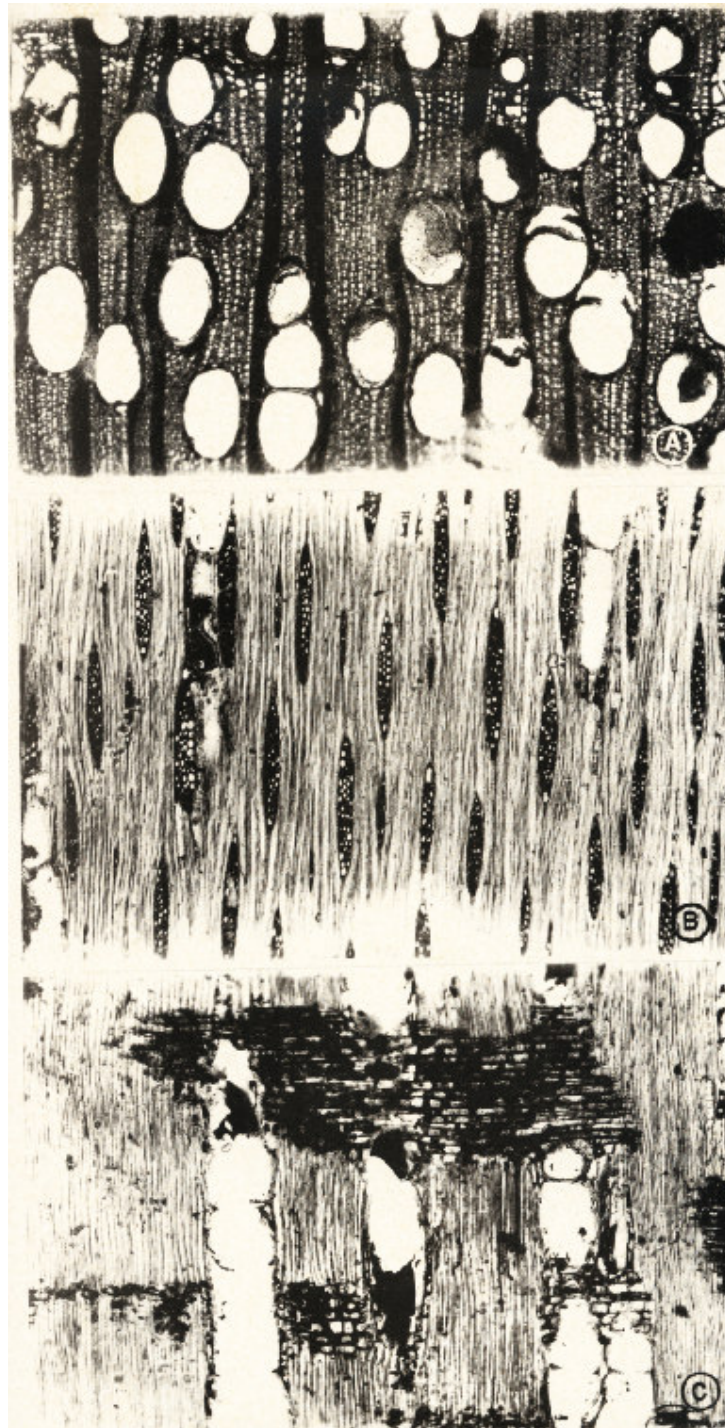


PLATE - XLVII



A. Tree      B. Bark      C. Inflorescence      D. Leaves      E. Seeds

PLATE - XLVIII



**3-25 Yon**

**3-251 Botanical Name**

*Anogeissus acuminata* Wall.  
(Family-Combretaceae)

**3-252 Habit and Distribution**

A large tree attaining 25.5-30 m in height and 2.4-2.7 m in girth. Straight cylindrical bole of 9 m is frequently found. It is commonly found growing in the moist deciduous forest throughout Burma.

**3-253 Morphological and taxonomical characteristics**

A leaf shedding tree, the trunk armed with numerous long spine when young. Leaf lanceolate or ovate lanceolate to elliptic or linear-lanceolate, 2.7-7.8 cm long, 1.9-2.3 cm wide, the tips acuminate or acute, the margins entire, the bases obtuse, chartaceous, while young more or less densely pubescent, more or less glabrescent. Inflorescences axillary dense globose head, 8-15 mm in diameter, peduncles much shorter than the leaves. Flowers small, yellowish, crowded and sessile on the spherically thickened apex, sepals 5 lobed, calyx tube long attenuate above the ovary, petals absent, stamens 10 in. two series, ovaries inferior, 1 celled, style filiform, simple. Fruits small, 1.2-1.4 cm in diameter, coriaceous.

**3-254 Flowering and fruiting period**

It flowers from March to April and it fruits from April to May.

**3-255 Bark**

Dark grey to greyish brown, 10 mm thick, outer dead bark persistent on the basal part of the trunk, with narrow, flat topped ridges and shallow fissures, on the upper trunk and small stem, with irregular rough surface shedding to leave a rough brown surface.

**3-256 General characteristics and properties**

Sapwood light whitish grey to pale greenish grey often with light grey bands, turning light greyish brown with age, heartwood chocolate brown, small, lustrous with smooth feel, without distinct odour or taste, moderately heavy to heavy (sp. gr. approx. 0.80); fairly straight-grained to irregularly interlocked grained, medium fine textured, fairly hard. A ring porous wood.

### **3-257 Microscopic characteristics**

#### **3-2571 Tracheids and fibres**

Fibre tracheids and libriform fibres with thin to thick-walled 3–6  $\mu$ . thick, occasionally septate, inter-fibre pits sparse, simple, slit like, nearly vertical orifice, length ranging from 340-1600  $\mu$ , and most frequently from 565-1240  $\mu$ , mean length is 670  $\mu$ .

#### **3-2572 Vessel elements**

Number per sq.mm. ranges from 13-40 , and most frequently from 18-32; pore distribution solitary , pore multiples, ring porous; circular or oval as seen in cross section; medium thick walled, truncate or tailed at the end, tangential diameter ranges from 150-175  $\mu$ ; tyloses absent, perforation plates simple, end walls nearly horizontal to oblique, oblique angles range up to 50°; intervacular pitting alternate or opposite, crowded, size of pits less than 10  $\mu$ ; shape of pits oval or pentagonal; vessel parenchyma pitting alternate, size of pits not more than 8  $\mu$ , shape of pits circular or oval, length of vessel elements ranging from 175-600  $\mu$  and most frequently from 215-520  $\mu$ , mean length is 378  $\mu$ , pits to vessels alternate in arrangement, crowded, oval in shape 6-8  $\mu$  in size; pits to parenchyma opposite or alternate in arrangement, oval or elongated in shape, 3-7 $\mu$  in size.

#### **3-2573 Vascular rays**

Number per mm. ranges from 15-18; heterogeneous type III; 1-3 cells wide, height of uniseriate rays ranging from 160-480  $\mu$ , the height of multiseriate rays range from 220-650  $\mu$  and most frequently from 245-520  $\mu$ ; pitting between ray cells and other parenchyma few or many in number, small in size.

#### **3-2574 Xylem parenchyma**

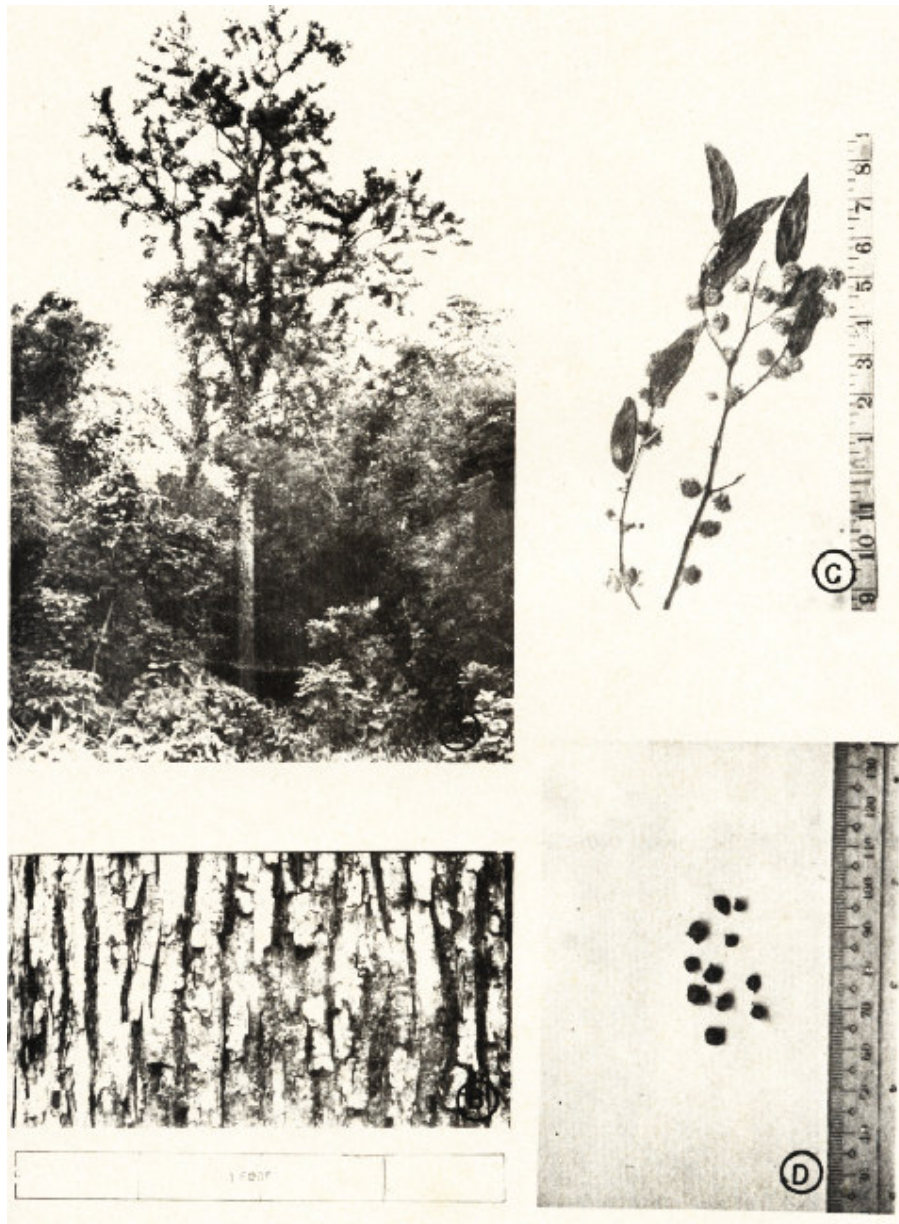
Paratracheal parenchyma abundant; paratracheal zoned parenchyma and uniting 2 several adjacent groups of vessels never forming definite tangential bands, terminal parenchyma in conspicuous, sometimes interrupted; undulate; metatracheal parenchyma fairly abundant, scattered through the tracts of dense fibrous tissue; pits to xylem parenchyma cells few in number and small in size.

### **3-258 Uses**

It is used for constructional purposes, agricultural implements, shutters, scaffolding for concrete building and piles. It is used also for hammer axe and other tool handles.



PLATE - XLIX



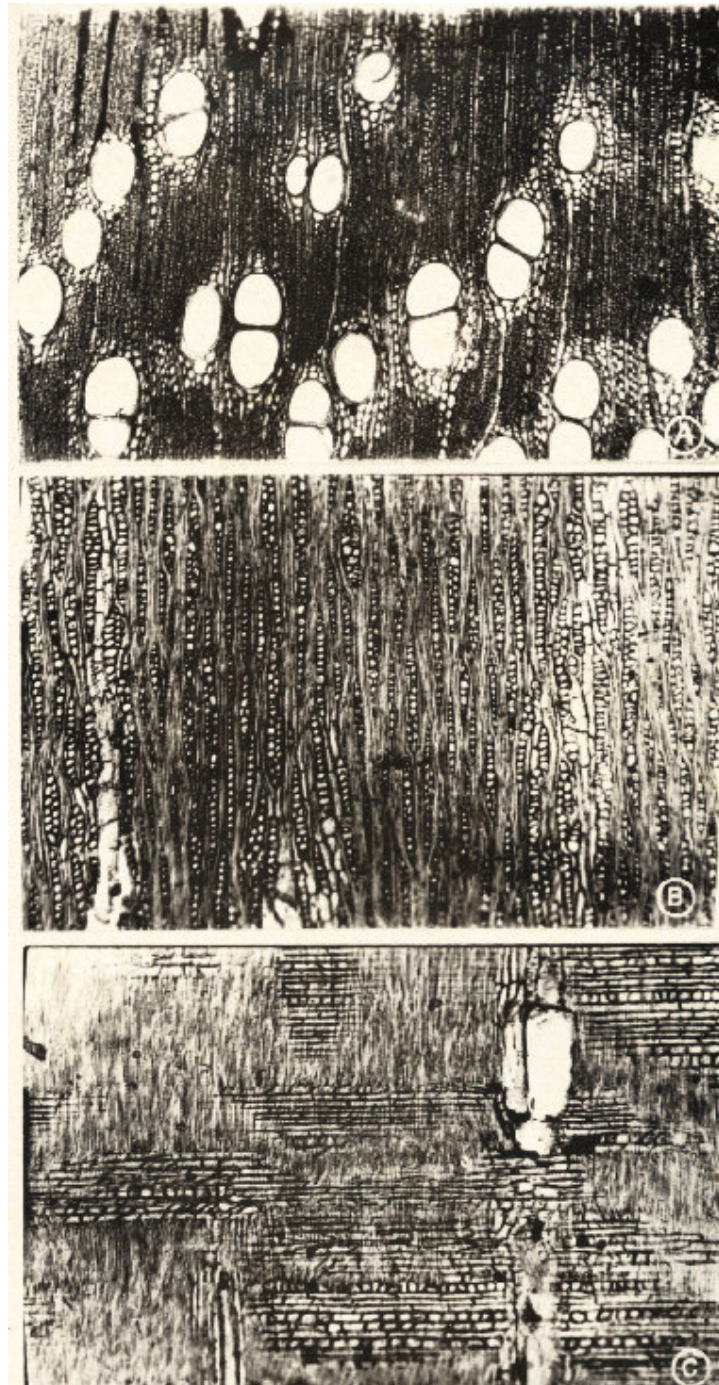
A. Tree

B. Bark

C. Inflorescence

D. Fruits

PLATE - XLX



# Key for the identification of (25) timbers of Burma

1. Wood diffuse –porous ----- 2.
1. Wood ring-porous or semi-ring-porous ----- 3.
2. Resin canals present ----- 4.
2. Resin canals absent ----- 5.
3. Rays multiseriate only or uniseriate rays very scarce----- 6.
3. Rays uniseriate only or multiseriate rays very scarce ----- 7.
4. Rays with high wings, uniseriate rays distinctly present ----- 8.
4. Rays without high wings, uniseriate rays absent or very scarce----- 9.
5. Rays or parenchyma storied ----- 10.
5. Rays and parenchyma non storied ----- 11.
6. Semi-ring porous, tyloses absent,  
black deposits present in the ray cells-----*Chukrasia tabularis*
6. Ring porous, tyloses present, black deposits absent in the ray cells -----12
7. Metatracheal parenchyma in 1-2 seriate bands distinct,  
rays storied ----- *Pterocarpus macrocarpus*
7. Paratracheal parenchyma scattered and restricted  
only near the pores, rays non storied ----- *Anogeissus acuminata*
8. Long high wings distinctly present,  
tyloses occasionally present ----- *Dipterocarpus tuberculatus*
8. Long high wings scarcely present,  
tyloses absent ----- *Dipterocarpus alatus*
9. Ray cells strictly multiseriate, black deposits present  
in ray cells ----- *Shorea oblongidolia*
9. Multiseriate rays mixed with few  
uniseriate rays, black deposits absent  
in ray cells ----- 13
10. Ray cells not more than 5 seriate ----- 14
10. Ray cells more than 6 seriate ----- *Erythrina indica*
11. Rays multiseriate only ----- 15.
11. Rays both multiseriate and uniseriate or uniseriate only ----- 16
12. Rays bi-to tetraseriate, height of rays  
mostly above 1030μ ----- *Tectona grandis*
12. Rays mostly tri-to pentaseriate; height of rays  
mostly below 1025μ ----- *Gmelina arborea*
13. Cells of multiseriate rays of two distinct kinds -----*Hopea odorata*
13. Cells of multiseriate rays almost  
homogenous ----- *Pentacme suavis*
14. Metatracheal bands 2-4 seriate distinct ----- *Dalbergia oliveri*
14. Metatracheal bands 4-10 seriate distinct ----- *Dalbergia cultrata*
15. Perforation scalariform ----- *Michelia champaca*
15. Perforation simple ----- 17
16. Ray cells distinctly homogenous ----- 18
16. Ray cells more or less heterogeneous ----- 19
17. Paratracheal parenchyma typically vasicentric and some tendencies of aliform present;  
tyloses absent ----- *Albizzia procera*

17. Paratracheal parenchyma scarce or indistinct; tyloses present-----	20
18. Paratracheal parenchyma mostly aliform, uniseriate rays only with black deposits -----	<i>Terminalia tomentosa</i>
18. Paratracheal parenchyma only vasicentric, biseriate rays dominant without black deposits-----	<i>Xylia dolabriformis</i>
19. High wings distinctly present -----	21
19. High wings absent -----	22
20. Cells of multiseriate rays of two kinds -----	<i>Terminalia chebula</i>
20. Cells of multiseriate rays almost homogeneous -----	<i>Lannea grandis</i>
21. Number of ray cells mostly uni or biseriate -----	23
21. Number of ray cells mostly 5-seriate -----	<i>Stephegyne diversifolia</i>
22. Distinct metatracheal parenchyma bands present-----	24
22. Metatracheal parenchyma bands absent -----	<i>Terminalia belerica</i>
23. Vessels mostly solitary, number of ray cells mostly uniseriate -----	<i>Adina cordifolia</i>
23. Vessels mostly grouped, number of ray cells mostly biseriate -----	<i>Anthocephalus cadamba</i>
24. Uniseriate metatracheal band of parenchyma alternate with uni or biseriate bands of fibres-----	<i>Salmalia insignis</i>
24. Two to many seriate metatracheal band of parenchyma alternate with many seriate bands of fibres -----	<i>Millettia pendula</i>

## 5. Discussion

The plants studied were mainly of those growing wild in moist upper mixed deciduous forests. The trees studied were moderate to large sized.

All the trees studied have been regarded as economically important. Twenty five types of trees studied in this work were members of the (10) families, in which the families Dipterocarpaceae, Combretaceae and Papilionaceae were distinctly rich with species.

The flowering and the fruiting periods of the trees studied ranged from March to October, but mostly occurred around March to June.

As experienced in this study, the barks of the trees, within limits, were found to be useful as an aid in identification of the trees.

Microscopic characteristics of the wood such as pore distribution, type of perforation, abundance and pattern of parenchyma, resin canals and tyloses (as seen in transverse section); types, nature of component cells, the height and cell inclusions of the rays (as seen in tangential longitudinal section) were found to be much dependable characters for identification.



## References

1. Anonymous (1953). Bulletin No.26 "An Atlas of End-grain Photomicrographs for the Identification of Hardwoods". Forest Products Research Publication (H.M.S.O).
2. Anonymous (1961). Bulletin No.46 "Identification of Hardwoods: A Microscopic Key" Forest Products Research Publication (H.M.S.O).
3. Anonymous (1980). Some commercial Timbers of Burma, 1<sup>st</sup> Edition. A joint Publication of Forest Research Institute, Yezin and Timber Corporation, Rangoon.
4. Anonymous (1957). Tropical Woods. International Glossary of terms used in Wood Anatomy. Committee on Nomenclature. International Association of Wood Anatomists.
5. Berni, C.A. Eleanor Bolza and F.J. Christensen (1979). "South American Timbers- The Characteristics; Properties and Used of 190 species". Commonwealth Scientific & Industrial Research Organization, Australia.
6. Brown H. P. and A.J. Panshin (1940). Commercial Timbers of the United State 1<sup>st</sup> Edition, McGraw-Hill Book Company. New York and London.
7. Chowdhury, K.A. and S.S. Ghosh. (1958). Indian Woods. Volume I, Northern Circle Survey of India, Dehra Dun.
8. Core, H.A., W.A. and A.C. Day (1979) Wood Structure and Identification. 2<sup>nd</sup> Edition.
9. Dastur, J.F.(1964). "Useful Plants of India and Paskistan" D.B. Taraporevala Sons & Co.PVT. Lid Bombay 1.
10. Desch, H.E.(1977). Timber, Its Structure and Properties 5<sup>th</sup> Edition. Unwin Brothers Ltd.
11. Gamble, J.S.(1922). A Manual of Indian Timbers. Reprinted. Sampson Low, Marston and Company Ltd. London.
12. Hall, N., R.D. Johnston and G.M. Chippendale (1970). "Forest Trees of Australia". Austalian Government Publishing Service, Canberra.
13. Harlow, W.H. and E.S. Harrar (1969). "Text Book of Dendrology". 5<sup>th</sup> Edition, McGraw-Hill Book Company, New York, U.S.A.
14. Hooker, J.D.(1980). The Flora of British India. Vol. I to VII. London, L.Reeve & Co.
15. Johansen. D.A.(1940). Plant Microtechnique. New York and London. McGraw-Hill Book Company.
16. Kribs, D.A. (1959). "Commercial Foreign woods of the American market". 2<sup>nd</sup> Edition, Penn State University, U.S.A.
17. Kurz, S.(1877) . Forest Flora of British Burma. Vol.II. Calcutta: Superintendent of Government Printing and Stationary.
18. Kyaw Soe, Maung. (1955). Microscopic Study of Burmese Timbers. M.Sc Thesis- Dept. of Biology. University of Rangoon, Burma.
19. Metcalfe, C.R. and L.Chalk (1957). Anatomy of the Dicotyledons. Vol I & II, London: E.C.4. Oxford University Press, Amen House.
20. Pearson, R.O. and H.P.Brown(1932). Commercial Timbers of India. Vol I & II. Government of India, Central Publications Branch, Calcutta.
21. Rodger, Alex (1951). A Handbook of the Forest Products of Burma. Supdt. Govt. Printing and Stationary, Burma.