



**Government of Union of Myanmar
Ministry of Forestry
Forest Department**



**Possible Substitute for Japanese Boxwood (Tsuge)
with Similar Burmese Timbers**

by

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ဂျပန်သစ်မျိုးစုကီနှင့် နီးစပ်တူညီသော မြန်မာသစ်မျိုးအချို့ကို စူးစမ်းလေ့လာခြင်း

ဦးသိန်းကြွယ်
သစ်အင်္ဂါဗေဒသုတေသနဌာနစိတ်
သစ်တောထွက်ပစ္စည်းသုတေသနဌာနခွဲ
သစ်တောသုတေသနဗိမ္မာန်

စာတမ်းအကျဉ်းချုပ်

စုကီ (Tsuge) ဟုခေါ်သော ဂျပန်သစ်မျိုး (*Buxus microphylla*) ၎င်း၊ အချို့သော မြန်မာသစ်မျိုးများကို နှိုင်းယှဉ် စူးစမ်း လေ့လာခဲ့ပါသည်။ မြန်မာသစ်မျိုး (၄)မျိုးဖြစ်သည့် သနပ်ခါး (*Limonia acidissima* Linn.)? ဒဟတ် (*Tectona hamiltoniana* wall.)? လဘကင် (*Camellia caudata* wall.) ၎င်း သန်း (*Terminalia oliveri* Brandis.) တို့သည် အရောင်၊ ဖွဲ့ယှက်သား၊ ပြုပြင်သုံးချ နိုင်မှုအရည်အချင်းနှင့်၊ သစ်အင်္ဂါဗေဒလက္ခဏာရပ်များအရ-ဂျပန်သစ်မျိုး စုကီနှင့် အနီးစပ်ဆုံး တူညီသည်ကို တွေ့ရှိရပါသည်။ ဖော်ပြပါဂျပန်သစ်မျိုးနှင့် မြန်မာသစ်မျိုး (၄)မျိုးတို့၏ အသေးစိတ် သစ်အင်္ဂါဗေဒရုပ်ဖော်ပြချက်တို့ကို နှိုင်းယှဉ်၍ တင်ပြဆွေးနွေးထားပါသည်။ ၎င်းပြင် စူးစမ်းသော သစ်များ၏ အနုဓါတ်ပုံများကိုလည်း ထည့်သွင်း တင်ပြထားပါသည်။

Possible Substitute For Japanese Boxwood (Tsuge) With Similar Burmese Timbers

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Abstract

Buxus microphylla which is called Japanese Boxwood (Tsuge) and some Burmese timber species were comparatively studied and examined. Out of those, four indigenous timber species namely Thanatkha (*Limonia acidissima* Linn.), Dahat (*Tectona hamiltoniana* Wall.), Lapet (*Camellia caudata* Wall.) and Than (*Terminalia oliveri* Brandis.) were found to be very similar to the Japanese Boxwood in colour, texture, working qualities and anatomical characteristics. Detailed descriptions of wood anatomy of the Japanese Boxwood (Tsuge) and the four indigenous timber species were discussed. Photomicrographs of the species examined have also been included in the paper.

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1. Introduction

Buxus microphylla known as Japanese Boxwood (Tsuge) belongs to the family Buxaceae. It is a small tree. The timber is stable and it is understood that in Japan, the production can scarcely meet the demand. Traditionally, the logs were imported to Japan from Cambodia and Thailand. Of late, it is also imported from the mainland China to Japan.

As the Japanese Boxwood (Tsuge) is extensively used in making combs and chessmen, Tokyo Trading Corporation from Japan has been making enquiry for either Boxwood or other Burmese timbers which are closely similar to the Boxwood. For this reason, a comprehensive study of the anatomy of Japanese Boxwood (Tsuge) and some Burmese timber species which are closely similar has been undertaken in this research.

In accordance with the examination of the anatomical structures of the collected wood samples in the wood anatomy laboratory and the literatures studied, Boxwood (Tsuge) *Buxus microphylla* has not been found throughout Burma as yet.

In the present study, the gross anatomy of the Boxwood (Tsuge) and four Burmese timber species which are closely similar in texture, colour and working qualities was investigated and grade of similarity was included.

According to the forest inventories carried out during the years 1964–1975 in 9 forest divisions, two out of four species which are similar to the Boxwood (Tsuge) are found to be available in large quantities.

2. Materials and Methods

All the specimens included in the present study except the Japanese Boxwood (Tsuge) were collected in the past and all have already been identified and authenticated in wood anatomy laboratory, Forest Research Institute, Yezin. The Japanese Boxwood (Tsuge) was sent to Burma from Tokyo Trading Corporation, Japan as a wood sample together with its enquiry.

In the present study, the anatomical characteristics of the Japanese Boxwood (Tsuge) and similar four Burmese timber species namely Thanatkha (*Limonia acidissima* Linn.)^{1/}, Dahat (*Tectona hamiltoniana* Wall.), Lapet (*Camellia caudata* Wall.) and Than (*Terminalia oliveri* Brandis.) have been presented.

For anatomical observations, Jeffrey's method of softening, staining and mounting was employed with slight modifications. All the specimens to be studied by Jeffrey's method were firstly prepared into 1 cm. cubes. The surface of each cube was corresponded to the transverse, radial and tangential planes of the structure. Then the cubes were softened by boiling in water. When the woods were sufficiently soft, it was stored in a fluid of alcohol-glycerine mixture.

With the aid of sliding microtome, sections were cut at a thickness of 15 microns to 25 microns. Heidenchain's method of staining was employed in which haematoxylin and safranin stains were used. Well-stained sections were then transferred to different alcohol grades and then cleared with xylol. After that, they were put into clove oil for further clearing and were then mounted in Fisher permount. Macerated materials were also presented by using Jeffrey's method (1917).

Photomicrographs were prepared from microtome sections and macerated materials.

^{1/} According to Backer and Bakhuizen van den Brink (1965), *Limonia acidissima* Linn. Which was the scientific name for Thanatkha has been superseded by the term *Hesperethusa crenulata* (Roxb.) Roem. However, *Limonia acidissima* Linn. Will still be used in this paper for the convenience of those who are acquainted with this term.

3. Observations

3.1 Tsuge (*Buxus microphylla*..) Family – Buxaceae

3.11 Habit and Distribution: An evergreen small much-branched tree. It is chiefly distributed in India, Canary islands, North Africa, Southern And western Europe, western Asia, China, Japan and Formosa.

3.12 General characteristics of the wood: Uniformly whitish yellow to pale creamy brown colour with little difference between sap and heart wood, ageing to brownish Yellow; without characteristic odour or taste, heavy (specific gravity approx. 0.82), straight- grained, extremely fine and very even- textured; a diffuse-porous wood.

3.13 Structure of the wood

3.131 Vessels: Growth rings distinct or fairly distinct with naked eye, narrow, generally of nearly uniform width. Vessels extremely small, numerous, the orifices barely visible with a hand lens, very evenly distributed, largest at the beginning of the ring and grading gradually to smaller vessels in the outer portion of the ring, but little variation in size within a growth ring. Mostly solitary, often appearing paired in the tangential plane, extremely fine vessel lines along the grains visible with a hand lens; vessel segments 310–685 microns in length, thick-walled, the largest 40-52 microns in diameter; spiral thickening; perforations scalariform, strongly oblique; no tyloses but vessels often contain yellow gum deposits.

3.132 Parenchyma: Not visible to the naked eye, both of paratracheal and apotracheal types present; paratracheal parenchyma sparse; apotracheal parenchyma fairly abundant; no crystal deposits in wood parenchyma.

3.133 Rays: Not distinct with the naked eye but plainly visible with a hand lens; fairly closely spaced; uniseriate to triseriate, mostly triseriate, 1-3 cells wide; hetero-geneous, 9-14 rays per mm., the average number of cells in highest rays is 14; fine, straight; vessel/ray pitting intervascular pitting, opposite; high wing present; crystals absent; ripple marks not present, non-storied wood.

3.134 Fibres: Libriform, fine, non-septate; for individual fibres 650-980 microns in length, 20-25 microns in diameter and cell walls 4-6 microns thick; inter-fibre pits minute, abundant on both radial and tangential walls with lenticular.

3.14 Working qualities: It is not difficult to saw, dense, very smooth cutting.

3.2 Thanatkha (*Limonia acidissima* Linn.) Family – Rutaceae

3.21 Habit and Distribution: A small, straight-stemmed tree. It grows 10 to 15 ft. in height and 9 to 12 in. in diameter. The plant is not widely distributed and commonly found growing as cultivated plants.

3.22 General characteristics of the wood: Light brownish yellow with age or dark yellowish brown; without characteristic odour or taste; heavy (specific gravity approx. 0.96) , straight-grained, very fine and even-textured; a ring-porous wood.

3.23 Structure of the wood

3.231 Vessels: Growth rings distinct with the naked eye. Vessels very small, appearing punctate with the naked eye, quite evenly distributed but less numerous in the outer part of the wider rings. Solitary or 2-5 of radial rows, rarely in small groups, vessel lines not evident with the naked eye along the grain; vessel segments 120-390 microns in length, thick-walled, the largest 90 –110 microns in diameter; truncate or abruptly attenuate-tailed at the end; spiral thickening; perforations simple; slightly oblique or rarely nearly horizontal; no tyloses but yellow gum deposits frequent and often plugging the perforations.

3.232 Parenchyma: Terminal parenchyma visible with the naked eye, conspicuous, forming sharply defined, even, radially 2 –5 seriate-sinuate lines in the transverse section and narrow bands along the grain; paratracheal parenchyma rather sparse; in 1 –3 seriate, mostly 1 seriate, flattened interrupted sheath, the cells contiguous to the vessel, peripherally; apotracheal parenchyma diffuse, very sparse, generally contiguous to the wood rays; no crystal deposits in wood parenchyma.

3.233 Rays: Not visible with the naked eye, fairly closely spaced, uniseriate to triseriate, mostly biseriate to triseriate, 1 –3 cells wide, homogeneous, 7 –12 rays per mm., the average number of cells in highest rays is 16; vessel/ray pitting intervascular pitting, minute; fine, straight; high wing absent; crystals absent; ripple marks not present, non-storied wood.

3.234 Fibres: Libriform, very fine, non-septate; for individual fibres 350 –1550 microns in length, 15 –20 microns in diameter and cell walls 3 – 5 microns thick; inter-fibre pits confined to the radial wall, minute, slit-like, nearly vertical.

3.24 Working qualities: It is not really difficult to saw either by hand or by machine and planes to a very smooth hard surface.

3.3 **Dahat (*Tectona hamiltoniana* Wall.) Family – Verbenaceae**

3.31 Habit and Distribution: A moderate-sized tree, 5 to 6 ft. in girth, with a 15 ft. bole. It is commonly found growing in plain forests and on rocky hills in the dry zone.

3.32 General characteristics of the wood: Light greyish brown to dark brown; without characteristic odour or taste; moderately heavy (specific gravity approx. 0.70); straight-grained, fine and even-textured; a slightly ring-porous wood.

3.33 Structure of the wood

3.331 Vessels: Growth rings distinct with the naked eye, but inconspicuous. Vessels small to very small and extremely small, not distinct with the naked eye, close and evenly distributed. Solitary and 2–5 of radial rows, extremely fine straight vessel lines not distinct with the naked eye along the grain; vessel segments 156-360 microns in length, medium thick-walled, the largest 126-140 microns in diameter, sometimes tailed at the end; spiral thickening; perforations simple, nearly horizontal to oblique, intervessel pits numerous; tyloses occasionally in the heart wood plugging some vessels; brownish-yellow or reddish-brown gum abundant in the heart wood.

3.332 Parenchyma: Paratracheal parenchyma relatively sparse, confined to occasional cells contiguous to the vessels and forming a sheath: apotracheal parenchyma extremely sparse; no crystal deposits in wood parenchyma.

3.333 Rays: Not distinct with the naked eye, closely spaced, uniseriate to tetraseriate, mostly triseriate, 1-4 cells wide, heterogeneous, 6-10 rays per mm., the average number of cells in the highest rays is 28; vessel/ ray pitting intervacular pitting, minute; fine straight; high wing absent; crystals absent; ripple marks present, storied-wood.

3.334 Fibres: Libriform, medium-coarse septate for individual fibres 480-1460 microns in length, 24-32 microns in diameter and cell walls 2-6 microns thick; inter-fibre pits numerous, simple, slit-like.

3.34 Working qualities: It saws without much difficulty and works to an exceptionally dense, smooth surface.

3.4 Lapet (Camellia caudata Wall.) Family – Theaceae

3.41 Habit and Distribution: A small evergreen tree attaining 30 ft. in height, with a clear bole 10 ft. and 2 ft. in girth. It is found growing only Shan state and Kachin state and especially found in myitkyina and Bhamo.

3.42 General characteristics of the wood: Pale grey to yellow turning light brown, brown to greyish brown on ageing; without characteristic odour or taste; moderately hard and moderately heavy (specific gravity approx. 0.66 – 0.72); straight to twisted- grained; very fine and even-textured; a semi-ring-porous wood.

3.43 Structure of the wood

3.431 Vessels: Growth rings fairly distinct with the naked eye, uniform growth ring. Vessels small to very small, visible only under hand lens, very numerous, unevenly distributed, early pores comparatively bigger and arranged in concentric rows, forming pore zones transition from early to late wood, usually gradual. Mostly solitary, occasionally in oblique pairs, shape of pores not distinctly visible under hand lens, vessel lines not visible to the naked eye along the grain; vessel segments 720-1690 microns in length, medium thick-walled, the largest 120-160 microns in diameter, with tapering oblique ends; spiral thickening; perforations scalariform, oblique; tyloses lacking.

3.432 parenchyma: Predominantly apotracheal, diffuse, occasionally in short tangential lines; no crystal deposits in wood parenchyma.

3.433 Rays: Not distinct to Just visible under hand lens, fairly closely spaced, uniseriate to triseriate, mostly biseriate, 1-3 cells wide, sheath cells present, heterogeneous, 9-17 rays per mm. , the average number of cells in highest rays is 18, vessel/ray pitting similar to the intervacular pitting, scalariform; fine to very fine, straight; high wing absent; swollen ray cells contain solitary crystal; ripple marks not present, non-storied wood.

3.434 Fibres: Libriform, coarse, non-septate; for individual fibres 980-2268 microns in length, 14-18 microns in diameter and cell walls 4 - 7 microns thick; inter-fibre pits numerous, with conspicuous bordered pits on all walls.

3.44 Working qualities: It is not difficult to saw, dense, smooth cutting.

3.5 **Than (*Terminalia oliveri* Brandis.)** **Family – Combretaceae**

3.51 Habit and Distribution: A moderate-sized tree, 5 to 6 ft. in girth with a 25 ft. to 50 ft. straight cylindrical stem. It is commonly found in the lower hill forests of upper Burma, between Maymyo and Mandalay. It is localized in certain parts of the dry zone.

3.52 General characteristics of the wood: Pale yellowish grey or dark purple; without characteristic odour or taste; heavy (specific gravity approx. 0.84); fairly straight-grained; very fine and even-textured; a ring-porous wood.

3.53 Structure of the wood

3.531 Vessels: Growth rings distinct but inconspicuous, most evident at low magnifications. Vessels very small to extremely small, closely and evenly distributed. Solitary and 2-6 of radial rows, forming extremely fine straight vessel lines along the grain; vessel segments 180-596 microns in length, thick-walled, the largest 68-82 microns in diameter; truncate or abruptly tailed at the end; perforations simple, nearly horizontal to oblique; tyloses occasionally present; pale lemon-coloured gum deposits present.

3.532 Parenchyma: Paratracheal parenchyma most abundant in the early portion of ring, confined to 1-several rather large cells contiguous to the vessels and never forming a complete sheath; apotracheal parenchyma sparse, restricted to scattered cells in the fibrous tissues; crystals occasionally present, large, solitary.

3.533 Rays: Not visible with the naked eye, appearing extremely fine under hand lens, closely spaced, uniseriate to rarely in part biseriate, mostly uniseriate, 1-2 cells wide, heterogeneous, 16-19 rays per mm., the average number of cells in highest rays is 18; vessel very variable in height; vessel/ray pitting similar to the vested intervacular pitting; fine, straight; high wing absent; crystals confined to upright cells, large solitary; ripple marks not present, non-storied wood.

3.534 Fibres: Libriform, very fine, septate; for individual fibres 380-1570 microns in length, 16-20 microns in diameter and cell walls 4-8 microns thick; inter-fibre pits sparse, small, simple, slit-like, vertical.

3.54 Working qualities: A difficult timber to saw, it is difficult to plane to a good surface when finished, it presents a good surface.

3.6 **Grade of similarity of the four species are mentioned below:**

Species	Texture	Colour	Density, Working qualities	Rank order
<i>Limonia acidissima</i>	3	1	1	I
<i>Tectona hamiltoniana</i>	3	2	2	II
<i>Camellia caudate</i>	1	3	4	III
<i>Terminalia oliveri</i>	2	4	3	IV

(1, 2, 3 & 4) =Grade of similarity with Boxwood (Tsuge) 1 is the nearest and 4 is the furthest.

4. Discussion

Buxus microphylla which is commonly known as Japanese Boxwood (Tsuge) and four Burmese timber species namely Thanatkha (Tsuge) and four Burmese timber species namely Thanatkha (*Limonia acidissima* Linn.), Dahat (*Tectona hamiltoniana* Wall.), Lapet (*Camellia caudata* Wall.) and Than (*Terminalia oliveri* Brandis.) were comparatively studied and examined.

From the comparative studies in texture, *Camellia caudata* was found to be most similar to *Buxus microphylla*, while *Limonia acidissima* was found to be the closest in colour and working qualities. However, overall microscopic characteristics of all the timber species studied were found to be very closely similar to each other. Relatively very few differences existed.

The vessels were mostly solitary in all species and arranged in radial rows in *Limonia acidissima*, *Tectona hamiltoniana* and *Terminalia oliveri*, but in *Buxus microphylla*, it often appeared paired in the tangential plane while in *Camellia caudata*, it was occasionally arranged in oblique pairs.

In the study of the arrangement of wood parenchyma in the cross section of the wood, paratracheal parenchyma were sparse in *Buxus microphylla*, *Limonia acidissima* and *Tectona hamiltoniana* while apotracheal parenchyma was fairly abundant in *Buxus microphylla* and mostly abundant in *Terminalia oliveri*. Diffuse parenchyma was present in *Limonia acidissima* and *Camellia caudata* and terminal parenchyma was present only in *Limonia acidissima*.

Component cells of xylem rays, as seen in tangential longitudinal section, were found to be heterogeneous in *Buxus microphylla*, *Tectona hamiltoniana*, *Camellia caudata* and *Terminalia oliveri* and homogeneous only in *Limonia acidissima*.

Xylem rays, as seen in tangential longitudinal section, were uni-to tri-seriate in *Buxus microphylla* (mostly triseriate), *Camellia caudata* (mostly biseriate) and *Limonia acidissima* (mostly bi-to tri-seriate) while those of *Tectona hamiltoniana* were uni-to tetra-seriate and mostly triseriate. Xylem rays in *Terminalia oliveri* were only uniseriate rarely in part biseriate.

The average number of cells in the highest rays was 14 in *Buxus microphylla*, 16 in *Limonia acidissima*, 18 in *Camellia caudata* and *Terminalia oliveri* and 28 in *Tectona hamiltoniana*.

High wings were entirely absent in *Limonia acidissima*, *Tectona hamiltoniana*, *Camellia caudata* and *Terminalia oliveri* and was present only in *Buxus microphylla*. Ripple marks was also present in *Tectona hamiltoniana* and entirely absent in *Buxus microphylla*, *Limonia acidissima*, *Camellia caudata* and *Terminalia oliveri*.

5. Conclusion

The anatomical characteristics of *Buxus microphylla* Japanese Boxwood (Tsuge) and four Burmese timber species namely *Limonia acidissima* Linn., *Tectona hamiltoniana* Wall., *Camellia caudata* Wall. and *Terminalia oliveri* Brandis. were described in detail and compared.

Overall morphological and anatomical characteristics of four Burmese timber species studied were found to be closely similar to Japanese Boxwood (Tsuge)

As such, the author sincerely hopes that market may be developed for the export of those timber species to Japan. The present investigation is part of an attempt to promote better utilization of some Burmese timbers in the near future and to earn more foreign exchange for the welfare of the country.

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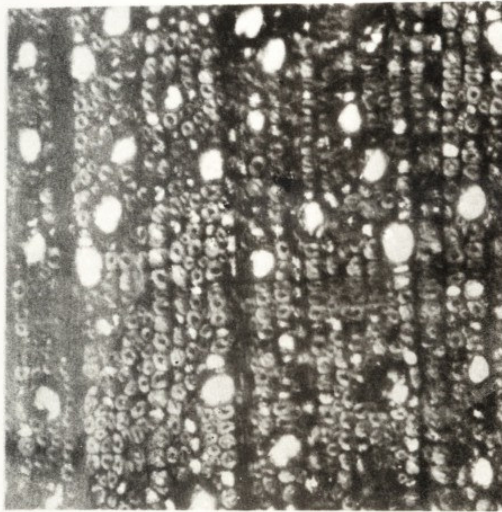
Explanation of the Plate

PLATE I

TSUGE (*BUXUS MICROPHYLLA*) (all x 125)

- a. Transverse section showing solitary pores.
- b.
- b. Tangential longitudinal sectional view of xylem rays with high wing.
- c. Radial longitudinal section showing scalariform perforation plates.

Plate 1



a



b



c

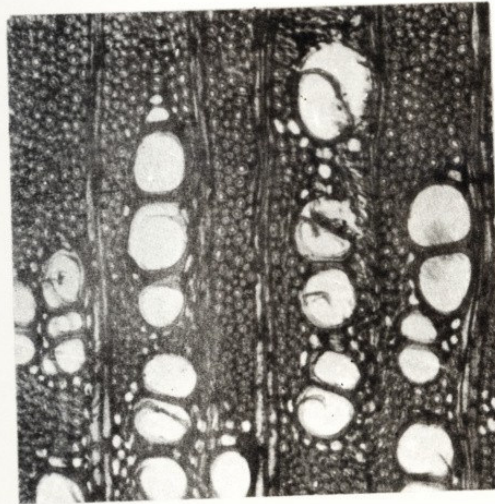
Explanation of the Plate

PLATE II

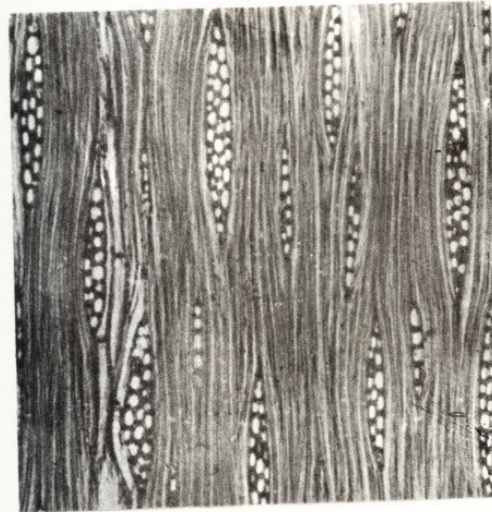
THANATKHA (*LIMONIA ACIDISSIMA*) (all x 125)

- a. Transverse section showing pores pattern dominated by radial multiples of 2 or more.
- b. Tangential longitudinal sectional view of homogeneous xylem rays.
- c. Radial longitudinal section showing vessels with slightly oblique or horizontal perforations.

Plate 2



a



b



c

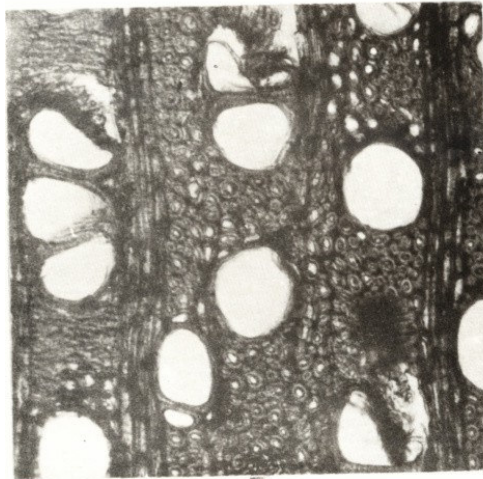
Explanation of the Plate

PLATE III

DAHAT (*TECTONA HAMILTONIANA*) (all x 125)

- a. Transverse section showing pores predominantly in radial multiples of 2 to 5.
- b. Tangential longitudinal sectional view of rays storied.
- c. Radial longitudinal section showing rays-pit to vessel small.

Plate 3



a



b



c

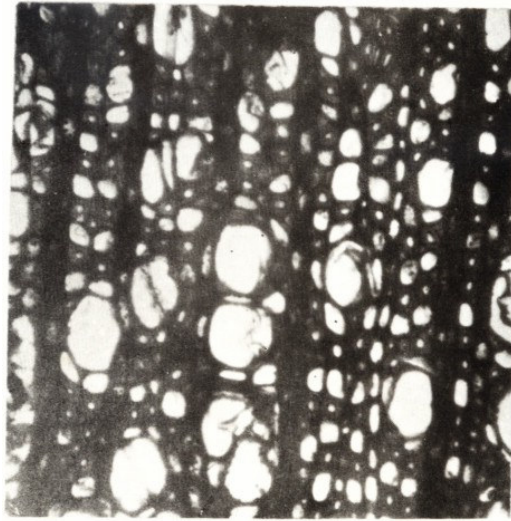
Explanation of the Plate

PLATE IV

LAPET (*CAMELLIA CAUDATA*) (all x 125)

- a. Transverse section showing pores pattern of oblique pairs.
- b. Tangential longitudinal sectional view of biseriate xylem rays with gummy deposits.
- c. Radial longitudinal section showing vessels with scalariform perforations.

Plate 4



a



b



c

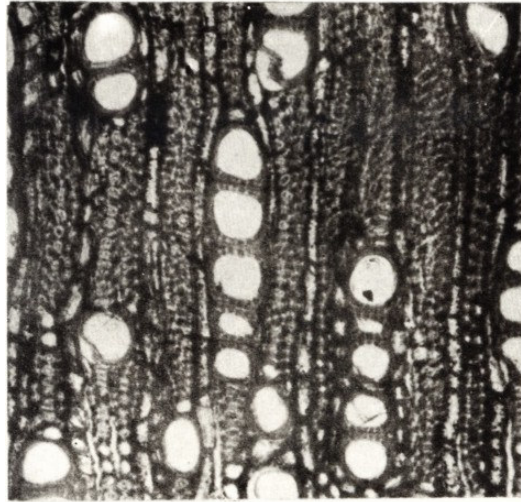
Explanation of the Plate

PLATE V

THAN (*TERMINALIA OLIVERI*) (all x 125)

- a. Transverse section showing pores in radial groups and thick-walled fibres.
- b. Tangential longitudinal sectional view of uniseriate xylem rays.
- c. Radial longitudinal section showing vestured intervacular pitting.

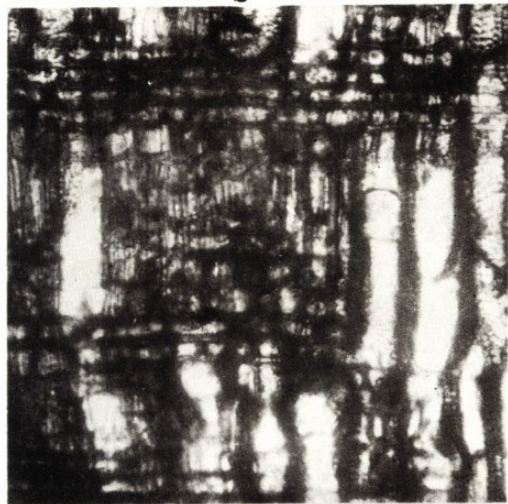
Plate 5



a



b



c

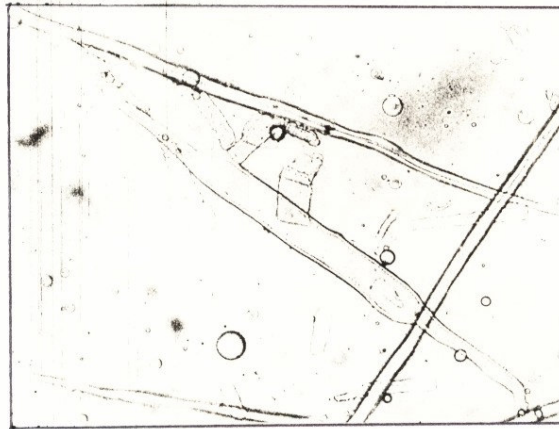
Explanation of the Plate

PLATE VI

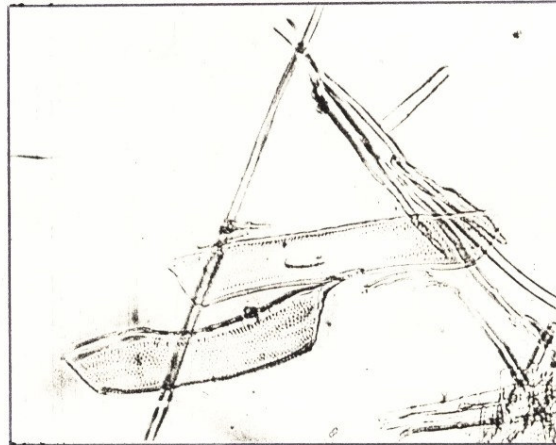
Macerated materials of woods showing vessels and fibres. (all x 125)

- a. *BUXUS MICROPHYLLA*.
- b. *LIMONIA ACIDISSIMA*.
- c. *TECTONA HAMILTONIANA*.

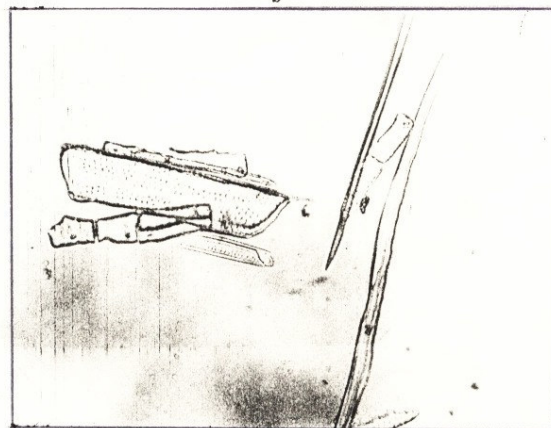
PLATE VI



a



b

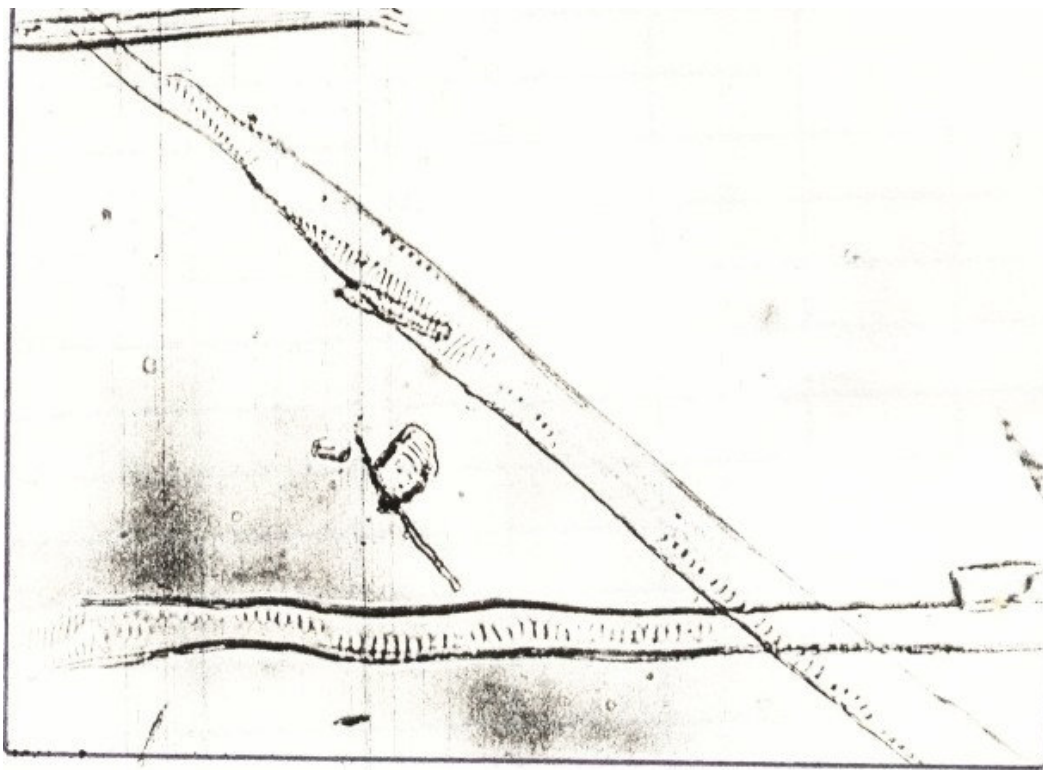


Explanation of the Plate

PLATE VII

Macerated materials of woods showing vessels and fibres. (all x125)

- a. *CAMELLIA CAUDATA*.
- b. *TERMINALIA OLIVERI*



a



b

est

Inventory Data*

Tectona hamiltoniana – DAHAT

No.	Forest Division	Girth Class (Tree)								Total
		2'-2'.11'	3'-3'.11'	4'-4'.11'	5'-5'.11'	6'-6'.11'	7'-7'.11'	8'-8'.11'	9' & above	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1.	North taungoo									
2.	Shwe bo									
	(1970-71)									
3.	West Katha									
4.	Upper Chindwin									
	Myittha									
	(1971-72)									
5.	East Katha									
6.	Yamethin									
7.	Mandalay Depot	5328	4059	3419	2507	1540	661	332	286	18132
	Maymyo									
8.	Upper chindwin									
	Myittha									
	(1969-70)									
9.	Prome									
10.	Shwebo		144						76	220
	(1972-73)									
11.	Pyinmana									
	Total									18352

- According to Forest inventories (1964-1974) carried out in 9 forest divisions, namely North Toungoo, Shwebo, West Katha, Upper Chindwin, Myittha, East Katha, Yamethin, Mandalay Depot Maymyo, Prome, Pyinmana

Forest Inventory Data*

Tectona hamiltoniana - DAHAT

No.	Forest Division	Girth Class (Tree)								Total
		2'-2'.11'	3'-3'.11'	4'-4'.11'	5'-5'.11'	6'-6'.11'	7'-7'.11'	8'-8'.11'	9' & above	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1.	Ywathit Reserve	-	-	-	-	-	-	-	-	-
2.	Singu Reserve	870	683	576	469	292	119	70	55	3134
3.	Singu Extension Reserve	584	491	422	366	228	86	57	42	2276
4.	Upper Madaya Reserve	-	-	-	-	-	-	-	-	-
5.	Kadetchin Reserve	801	652	565	462	287	116	74	52	3009
6.	Lower Madaya Reserve	1055	619	513	218	141	112	29	24	2711
7.	Lower Madaya Extension	1007	856	740	642	398	150	102	74	3969
8.	Taung gyun Resene	1011	758	603	350	194	78	-	39	3033
9.	Sakargyi Reserve	-	-	-	-	-	-	-	-	-
10.	Baw & Baw Extension	-	-	-	-	-	-	-	-	-
	Total									18132

* According to Forest inventories (1967-68) carried out in Mandalay Depot Maymyo forest divisions.

Forest Inventory Data*

Tectona hamiltoniana - DAHAT

No.	Forest Division	Girth Class (Tree)								Total
		2'-2'.11'	3'-3'.11'	4'-4'.11'	5'-5'.11'	6'-6'.11'	7'-7'.11'	8'-8'.11'	9' & above	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1.	Budaung Thaw									
	Outte Reserve									
	Compartment 1	-	-	-	-	-	-	-	-	-
	Compartment 2	-	-	-	-	-	-	-	-	-
	Compartment 3	-	-	-	-	-	-	-	-	-
	Compartment 4	-	-	-	-	-	-	-	76	76
	Compartment 5	-	-	-	-	-	-	-	-	-
2.	Sadwingyi; Zinn									
	Gongla Reserve									
	Compartment 1	-	-	-	-	-	-	-	-	-
	Compartment 2	-	-	-	-	-	-	-	-	-
	Compartment 3	-	144	-	-	-	-	-	-	144
	Compartment 4	-	-	-	-	-	-	-	-	-
3.	Hlwe seik									
	Sabe; Nantha									
	Reserve									
	Compartment 1									
	Compartment 2									
	Compartment 3									
	Total									220

* According to Forest inventories (1972-73) carried out in Shwebo forest divisions.

Forest Inventory Data*

Terminalia oliveri - THAN

No.	Forest Division	Girth Class (Tree)								Total
		2'-2'.11'	3'-3'.11'	4'-4'.11'	5'-5'.11'	6'-6'.11'	7'-7'.11'	8'-8'.11'	9' & above	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1.	North Taungoo	-	-	-	-	-	-	-	-	-
2.	Shwebo	-	-	-	-	-	-	-	-	-
3.	West Katha	77	38	19	-	-	-	-	-	134
4.	Upper Chindwin	-	-	-	-	-	-	-	-	-
	Myittha	-	-	-	-	-	-	-	-	-
5.	East Katha	-	-	-	-	-	-	-	-	-
6.	Yamethin	-	-	-	-	-	-	-	-	-
7.	Mandalay Depot									
	Maymyo	16139	11209	6271	3669	2332	956	556	368	41500
8.	Upper Chindwin									
	Myittha									
	(1969-70)									
9.	Prome	221	85							306
10.	Shwebo									
	(1972-73)	80207	90568	66198	47600	26551	14754	4412	2173	332463
11.	Pyinmana	-	-	-	-	-	-	-	-	-
	Total									374403

* According to Forest inventories (1964-1975) carried out in 9 forest divisions, namely North Taungoo, Shwebo, West Katha, Upper Chindwin, Myittha, East Katha, Yamethin, Mandalay Depot Maymyo, Prome, and Pyinmana.

Forest Inventory Data*

Tectona hamiltoniana - DAHAT

No.	Forest Division	Girth Class (Tree)								Total
		2'-2'.11'	3'-3'.11'	4'-4'.11'	5'-5'.11'	6'-6'.11'	7'-7'.11'	8'-8'.11'	9' & above	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	West Katha									
1.	Nampe Reserve									
2.	Name & Name									
	Extension Reserve									
3.	Myauk letan									
	Reserve									
4.	Name letan									
	Reserve	77	38	19						134
5.	Taung letan									
	Reserve									
6.	Gale Reserve									
	Total									134

* According to Forest inventories (1971-1972) carried out in West Katha Forest Division.

Forest Inventory Data*

Terminalia oliveri - THAN

No.	Forest Division	Girth Class (Tree)								Total
		2'-2'.11'	3'-3'.11'	4'-4'.11'	5'-5'.11'	6'-6'.11'	7'-7'.11'	8'-8'.11'	9' & above	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1.	Ywathit Reserve	253	57	23	11	-	-	-	-	344
2.	Singu Reserve	1760	1269	810	570	412	177	166	79	5193
3.	Singu Extension Reserve	848	723	499	385	309	128	86	59	3037
4.	Upper Madaya Reserve	-	-	-	-	-	-	-	-	-
5.	Kadetchin Reserve	2012	1507	920	644	457	185	124	77	5926
6.	Lower Madaya Reserve	3605	2213	1213	648	306	136	74	43	8238
7.	Lower Madaya Extension Reserve	1292	1189	839	658	540	221	147	101	4987
8.	Taung gyun Reserve	2023	1381	564	233	126	58	-	-	4385
9.	Sakargyi Reserve	37	19	-	-	-	-	-	-	56
10.	Baw & Baw Extension	4307	2851	1403	520	182	51	9	9	9332
	Total									41498

* According to Forest inventories (1967-68) carried out in Mandalay Depot/ Maymyo forest divisions.

Forest Inventory Data*

Terminalia oliveri - THAN

No.	Forest Division	Girth Class (Tree)								Total
		2'-2'.11'	3'-3'.11'	4'-4'.11'	5'-5'.11'	6'-6'.11'	7'-7'.11'	8'-8'.11'	9' & above	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	East of Irrawaddy	-	-	-	-	-	-	-	-	-
	River									
1.	Chaung Sauk									
	Reserve	-	-	-	-	-	-	-	-	-
2.	Ohleswe									
	Reserve	-	-	-	-	-	-	-	-	-
3.	Central Nawin									
	Reserve	-	-	-	-	-	-	-	-	-
4.	South Nawin									
	Reserve	-	-	-	-	-	-	-	-	-
5.	Shapyin									
	Reserve	-	-	-	-	-	-	-	-	-
6.	Shwele Yoma									
	Reserve	221	85	-	-	-	-	-	-	306
7.	Boot Reserve	-	-	-	-	-	-	-	-	-
	Total			-	-	-	-	-	-	306

* According to Forest inventories (1974-1975) carried out in Prome forest division

Forest Inventory Data*

Terminalia oliveri - THAN

No.	Forest Division	Girth Class (Tree)								Total
		2'-2'.11'	3'-3'.11'	4'-4'.11'	5'-5'.11'	6'-6'.11'	7'-7'.11'	8'-8'.11'	9' & above	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	West of Irrawaddy									
	River	-	-	-	-	-	-	-	-	-
1.	Phangabin									
	Reserve	-	-	-	-	-	-	-	-	-
2.	Letyehut									
	Reserve	-	-	-	-	-	-	-	-	-
3.	Thanlegyi									
	Reserve	-	-	-	-	-	-	-	-	-
4.	Thanichaung									
	Reserve	-	-	-	-	-	-	-	-	-
5.	Buyo Reserve	-	-	-	-	-	-	-	-	-
6.	Kyaukphu									
	Reserve	-	-	-	-	-	-	-	-	-
7.	Thuyeton									
	Reserve	-	-	-	-	-	-	-	-	-
8.	Padaung									
	Total	-	-	-	-	-	-	-	-	-
	East of Irrawaddy									
	River	221	85	-	-	-	-	-	-	306
	Total (Prome)			-	-	-	-	-	-	306

* According to Forest inventories (1974-1975) carried out in Prome Forest Division.

Forest Inventory Data*

Terminalia oliveri - THAN

No.	Forest Division	Girth Class (Tree)								Total
		2'-2'.11'	3'-3'.11'	4'-4'.11'	5'-5'.11'	6'-6'.11'	7'-7'.11'	8'-8'.11'	9' & above	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1.	Budaung									
	Thaw: Out te									
	Reserve									
	Compartment 1									
	Compartment 2									
	Compartment 3									
	Compartment 4	3570	1747	532	684	157	76	-	-	6761
	Compartment 5	304	607	380	152	76	76	-	-	1595
2.	Sadwingyi									
	Zinn: Gongla									
	Reserve									
	Compartment 1	15912	13887	8101	6726	3255	2749	868	434	51932
	Compartment 2	12286	12802	11211	8173	5869	3110	868	434	54753
	Compartment 3	4340	4267	3833	2676	1302	1013	145	72	17648
3.	Hlweseik									
	Sabe: Nantha									
	Reserve									
	Compartment 1	13109	10837	9735	7398	4098	1882	1233	519	48811
	Compartment 2	9540	15900	15900	10837	5328	2985	154	195	61139
	Compartment 3	20702	20377	16289	10448	6425	2790	844	519	78394
	Total									321033

* According to Forest inventories (1972-73) carried out in Shwebo forest divisions.

Forest Inventory Data (Summary)

No.	Species	Girth Class (Tree)								
		2'-2'.11'	3'-3'.11'	4'-4'.11'	5'-5'.11'	6'-6'.11'	7'-7'.11'	8'-8'.11'	9' & above	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1.	<i>Tectona hamiltoniana</i>	5328	4203	3419	2507	1540	661	332	362	18352
	(Dahat)									
2.	<i>Terminalia oliveri</i>									
	(Than)	96644	101900	72488	51269	28883	15710	4968	2541	374403