

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



**Study on Some Burmese Timbers Suitable for
Pencil Making**

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ခဲတံပြုလုပ်ရန် အတွက်သင့်လျော်သည့် မြန်မာသစ်မျိုးအချို့အား
စူးစမ်းလေ့လာခြင်း

ဦးသိန်းကြွယ်၊ M.Sc. (Rgn.), M.S. (SUNY,CESF) ၊ သုတေသနမှူး
နှင့်
ဦးစိုးတင့်၊ B.Sc. (For.) (Rgn.), M.Sc. (ANU) ဌာနမှူး
သစ်တောသုတေသနဌာန

စာတမ်းအကျဉ်းချုပ်

မြန်မာနိုင်ငံတွင်၊ လွန်ခဲ့သော နှစ်ပေါင်းများစွာကပင် ခဲတံများကို နိုင်ငံခြား တိုင်းပြည်များမှ မှာယူတင်သွင်း အသုံးပြု နေခဲ့ပါသည်။ မြန်မာပြည်တွင် ထုတ်လုပ်နိုင်ခြင်း မရှိသေးသော ခဲတံအမျိုးမျိုးကို နောင်တွင် ထုတ်လုပ်နိုင်ရန် အတွက် ခဲတံစက်ရုံ တည်ထောင်ရန် စီစဉ်လျက်ရှိပါသည်။ ခဲတံပြုလုပ်ရန် သင့်လျော်သည့် မြန်မာ သစ်မျိုးများကို ရှာဖွေကြည့်ရာ ကရောဖ် (*Excoecaria agallacha* Linn.) ? ယမနေ (*Gmelina arborea* Linn.) ၊ ခူသနီ (*Hymenodictyon excelsum* Wall.) ၊ တောင်မဲအုပ် (*Alstonia sholaris* R. Brown) ? နှော (*Adina cordifolia* Hook.f.) ? ခတက် (*Crataeva religiosa* Forst.) နှင့် သစ်ကတိုး (*Cedrela toona* Roxb.) တို့သည် ခဲတံပြုလုပ်ရန် သင့်လျော်သည်ကို တွေ့ရှိရပါသည်။ ဤစာတမ်းတွင် ခဲတံပြုလုပ်ရန် သင့်လျော်သည့် သစ်သားတို့၏ အရည်အချင်း၊ သစ်အင်္ဂါဖွဲ့စည်းပုံနှင့် အပင်ပေါက်ရောက်မှုတို့ကို လေ့လာတင်ပြထားပြီး စူးစမ်းသော သစ်မျိုးများ၏ အနုစိတ်ဓါတ်ပုံများကို ထည့်သွင်း တင်ပြထားပါသည်။

Study on Some Burmese Timbers Suitable for Pencil Making

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Abstracts

Pencils are imported to Burma since many years ago. Burma has the intention to establish an industry for pencil manufacture in the future. For this reason, several Burmese timbers have been tested on their suitability as pencil wood. Out of these, Kayaw (*Excoecaria agallocha* Linn.), Yemane (*Gmelina arborea* Linn.), Kuthan (*Hymenodictyon excelsum* Well.), Taungmeoak (*Alstonia scholaris* R. Brown.). Hnaw (*Adina cordifolia* Hook. f.), Kadet (*Crataeva religiosa* Forst.) and Thitkado (*Cedrela toona* Roxb.) are found to be suitable. Detailed descriptions of the wood anatomy and wood properties of those species are investigated and the growing stock of trees are presented. The photomicrographs of the species examined have also been included.

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1. Introduction

Pencils are imported and extensively used in Burma since many years ago. At present, as the demand for pencil is increasing every year, Burma is intending to establish an industry for pencil manufacture in the near future. Wood represents the major portion of the writing pencil, and so, it is necessary to explore if some of the Burmese timbers species will be suitable for pencil wood. Wood to be used in a pencil making should have the characteristics which make the mending of the pencil easy and smooth. The Wood should not chip off and the cut surface should not show any beardedness. It should also have good machining properties to stand well the various operation of pencil manufacture. It should also be free from warpage or any warping tendency in the wood and deform the pencils. These exacting requirements are possessed only by soft, light but strong, straight and close-grained woods.

Examination of the physical and the anatomical structure of wood samples in the wood anatomy research section, had indicated that seven different species of Burmese woods namely: Kayaw (*Excoecaria agallacha* Linn), Yemane (*Gmelina arborea* Linn.), Kuthan (*Hymenodictyon excelsum* Wall.), Hnaw (*Adina cordifolia* Hook.f), Thitkado (*Cedrela toona* .Roxb), Taungmeoak (*Alstonia scholaris* R. Brown) and Kadet (*Crataeva religiosa* Forst) are likely to be suitable as pencil wood.

The present study is confined chiefly to the examination of the general characteristics of the wood and the anatomical structure to see if the timber would be suitable for pencil making. The availability of the specie considered suitable for pencil making was investigated from the data available from the forest inventory , carried out by the National Forest inventory Project. (shown in Appendies 1-6).

2. Literature Review

The wood-cased lead pencil is the most common out of the various types of writing pencils. Wood plays an important part in its manufacture and use. Along with the lead, it determines the quality and the cost of a pencil. Nicolas Jacqurs Conte (1756) a French painter, chemist and Mechanical genius devised the present shape of this pencil and the basic method of its manufacture (Rehman & Gupta, 1968).

Pencils containing a mixture of lead and tin as marking medium are reported to have been known in Italy in the fifteenth century. The forerunner of the modern pencil was first produced. In Cumberland (England) in 1554 from graphite and was popular under the name plumbago or graphite pencil. Graphite, in the form of a chunk, was used as such or after sandwiching between two sticks and tying a string around. Rods of graphite pushed into quills, tubes or metal holders came into use a little later (Anon., 1965). Pencil manufacture in India was started in 1915 at Calcutta by F.N. Gooptu & company.

There are very few species of timbers in the world available in commercial quantities which can be used for high class pencils . Originally the Eastern red Cedar (*Juniperus virginiana*) was almost exclusively used for this purpose. Later on, as supplies of this timber started dwindling, two other species, *Juniperus barbadensis* and *Librocedrus decurrens* (American pencil Cedar) were introduced slowly. East African Cedar (*Juniperus procera*) also became an important pencil wood. United states of America and East Africa thus become important slat exporting countries of the World. Even highly industrialised countries like Germany and England depended on imported slats to feed their pencil industry, though Germany was using certain indigenous timber particularly alder (*Alnus* spp.) (Rehman & Gupta, 1968).

Several Indian timbers have been tested for their suitability as pencil wood. Out of them, deodar (*Cedrus deodora*) and cypress (*Cypressus torulasa*) are suitable for pencils of good quality (Anon, 1965).

There is no literature on the previous works on Burmese timber species suitable for pencil making.

3. Materials and Methods

The materials for this study consist of wood samples collected in the past which have already been authenticated in the wood anatomy research section, Forest Research Institute, Yezin . For anatomical observations, microslides were prepared from all wood samples following Jeffery's method of softening, staining and mounting . Terminology and measurements are in accordance with the standards developed by the International Association of Wood Anatomists (IAWA, 1964). The Photomicrographs were taken with a Olympus Universal Research Microscope, Vanox model. Photomicrographs of each species were prepared showing (A) Transverse, (B) Tangential Longitudinal and, (C) Radial Longitudinal sections at an over all magnification of 83 X.

4. Observations and Recommendations

4.1 Kayaw (*Excoecaria agallacha* Linn.)

Family - Euphorbiaceae.

Habit and Distribution : A small moderate tree of normal height 9 m. and a girth of 0.75-1 m.

Mangrove swamps area is the natural habitat of this species.

General characteristics and properties of the wood : The wood is whitish Grey to yellowish Grey or pale yellow with age, frequently discoloured with sap stain; heartwood not distinct; lustrous on fresh cut section; odour or taste not distinct; very light to light (specific gravity 0.48), 25-31 lbs/cu.ft; soft and spongy; straight grained; fine to medium fine and even textured; and is a diffuse porous wood.

Microscopic characteristics : Vessel solitary and are arranged in radial multiples or in clusters; 12-28 per sq.m.m.; circular to oval, diameter, 125-185 um, vessel member length 360-1020 um. Perforations simple, end walls transverse or oblique. Intervascular pits alternate, circular or polygonal, 6-11 um. Vessel-ray and vessel parenchyma pits smaller, circular to oval or occasionally elliptical. Fibers non-septate, interfiber pits numerous on both radial and tangential walls, thin-walled, 2-4 um thick; length 480-1420 um. Rays uniseriate, homocellular to heterocellular, 9-14 per m.m; length of uniseriate rays 50-260 um. Parenchyma paratracheal, sparse, apotracheal parenchyma moderately abundant, forming uniseriate line interrupted by rays.

4.2 Yemane (*Gmelina arborea* Linn.)

Family - Verbenaceae

Habit and Distribution : A moderate sized, unarmed and unbuttressed, deciduous tree, with a clear bole of 9-15 m., on favourable sites, attaining 21-30 m. in height and 2.1-4.5 m. in girth. It is usually found scattered in the moister forests throughout Burma.

General characteristics and properties of the wood : The wood is yellowish white, greyish white or redish-white turning to light yellowish brown with increasing age; heart wood not distinct; lustrous; odour or taste; very light to light in weight (sp.gravity 0.46) 30 lbs/cu.ft., moderately hard; straight-grained or more or less irregular and interlocked grained; medium-coarse-textured; and is a semi-ring to ring porous wood.

Microscopic characteristics : Vessel solitary or are arranged in radial multiples of 2-4, sometimes in clusters, 2-4 per sq. mm; circular to oval in shape, diameter 60-320 um; lumen with thin-walled tyloses; vessel member length range from 170-620 um. Perforation simple, end walls transverse or oblique; intervacular pits alternate, crowded, pentagonal, 7 um, vessel ray and vessel parenchyma pits alternate, circular to oval. Fibers septate, interfiber pits confined to the radial walls, very thin to thin-walled, 2.5-5 um thick, length 340-1880 um. Rays uniseriate to multiseriate, usually biseriate to tetraseriate, heterocellular, 2-6 per mm. length of uniseriate rays 50-180 um and length of multiseriate rays 190-810 um. Parenchyma moderately abundant, typically paratracheal, usually vasicentric, forming a narrow uniseriate sheath around the vessel or more or less rare uniting adjacent vessels laterally or confluent connecting 2-5 pores forming tangential bands resembling marginal parenchyma.

4.3 Kythan (*Hymenodictyon excelsum* Wall.)

Family - Rubiaceae.

Habit and distribution : A large tree attaining a height of 27-30 m. and a girth of 2.5-3 m and is usually straight stemmed. Occurs in drier plains and lower hill forests of upper and lower Burma.

General characteristics and properties of the wood : The wood is white turning light yellowish Grey to light brownish Grey; heartwood is not distinct; lustrous; odour or

taste not distinct; light in weight (sp. gr. 0.50) 32 lbs/cu.ft., straight grained, medium coarse, even-textured, and is a diffuse porous wood.

Microscope characteristics : Vessel solitary and are arranged in short radial multiples or irregular clusters, 5-18 per sq. mm., diameter 220-265 um; vessel member length ranges from 340-1184 um, perforations simple, transverse to steeply oblique, abruptly or attenuate-tailed at the ends. Intervascular pits alternate, circular to oval or polygonal, 5-7 um, vessel-ray and vessel parenchyma pits alternate circular to oval. Fibers non-septate, inter-fiber pits more abundant on radial walls, thin-walled, 2-4 um thick, length 1080-2368 um. Rays uniseriate to triseriate, mostly biseriate, heterocellular, 8-11 per mm. length of uniseriate ray 51-85 um., length of biseriate ray 93-340 um. Parenchyma paratracheal sparse, vasicentric, forming a uniseriate sheath around the vessel or more or less uniting adjacent vessels laterally or confluent connecting pores forming tangential bands.

4.4 Hnaw (*Adina cordifolia* Hook. f.)

Family - Rubiaceae.

Habit and Distribution : A very large tree attaining a height of 34 m. and a girth of 1.5-3 m. , but under favourable condition attaining large dimension. It occurs in the deciduous forests in the plains and lower hill forests all over Burma.

General characteristics and properties of the wood : The wood is pale yellowish brown becoming reddish brown with age, quite lustrous with fairly smooth feel; sapwood yellowish white, rather thick, odour or taste not distinct, light to moderately heavy (sp.gr. approx. 0.65) 40-42 lbs./cu.ft; a strong and fairly hard, fairly straight grained; fine and even textured; and is a diffuse porous wood.

Microscopic characteristics : Vessel solitary and are arranged in radial multiples; 41-75 per sq. mm., circular to oval in shape, diameter 60-75 um, vessel member length 450-1500 um, perforations simple, end walls transverse or oblique; inter vascular pits alternately pantagonal , 4 -7 um, vessel ray and vessel parenchyma pits smaller, circular or angular in shape. Fibers nonseptate, interfiber pits numerous both on radial and tangential walls, thin-walled, 2-5 um thick, length 1200-2550 um. Rays uniseriate to multiseriate, heterocellular, 14-22 per mm., height of uniseriate rays 100-3000 um and height of multiseriate rays 110-2030 um. Parenchyma sparse, apotracheal parenchyma diffuse and scattered.

4.5 Thitkado (*Cedrela toona* Roxb.)

Family - Euphorbiaceae.

Habit and Distribution : A tree attaining 24.5-27.5 m. high and 1.8-2.5 m. in girth, found in the upper Chindwin, Katha and Arakan State. It is also found growing in the upper mixed deciduous dry forests or Burma.

General characteristics and properties of the wood : Sapwood pinkish white, heartwood greyish brown to reddish brown, usually with darker streaks on the radial surface, lustrous, scented and acrid taste; light (sp.gr. 0.57) 37 lbs/cu.ft., moderately hard, straight-grained, uneven-textured; semi-ring to ring porous wood.

Microscopic characteristics : Vessel solitary are arranged in radial multiple or in clusters; 10-26 per sq. mm., circular to oval in shape, diameter 60-315 um., vessel member length 150-675 um. Perforations simple, end walls transverse or oblique. Intervascular pits alternate, pentagonal, occasional dark yellow gums deposits present in the lumen of the vessel element. Vessel-ray and vessel parenchyma pits alternate, not more than 7 um, circular in shape. Fiber non-septate, inter-fiber pits confined to the radial walls, thin-walled, 2-4 um thick; length 900-1950 um. Rays uniseriate to pentaseriate, hetrocellular to homocellular, 4-12 per mm., length of uniseriate rays 100-400 um, length of multiseriate rays 100-600 um. Parenchyma sparse, very scanty paratracheal.

4.6 Taungmeok (*Alstonia sholaris* R. Brown) Family - Apocynaceae.

Habit and distribution : A medium-sized tree sparsely scattered throughout the forests of upper and lower Burma up to 3500 feet.

General Characteristics and properties of the wood : Uniformly white turning yellowish white to pale brown with age, frequently discoloured by fungal stain; heartwood not distinct; lustrous, odour not distinct; with bitter taste when fresh; very light to light (sp.gr. 0.47), 26-30 lbs/cu.ft., soft and smooth; straight-grained; medium fine-and even-textured; and is a diffuse porous wood.

Microscopic Characteristics : Vessel Occasionally solitary, are arranged in 2-5 cells in short radial multiple or in radial clusters, 2-12 per sq.mm, circular to oval, diameter 20-85 um, vessel member length 210-720 um, perforation simple, mostly oblique. Intervascular pits numerous, alternate, oval, circular or polygonal, 5-7 um. Vessel-ray and vessel parenchyma pits smaller, circular to oval; tyloses fairly abundant. Fibers non-septate, interfiber pits numerous on the radial walls, thin-walled, 2-4 um thick; length 800-2600 um. Rays uniseriate to triseriate, heterocellular, 6-11 per mm; length of uniseriate rays 85-560 um, length of multiseriate rays 180-810 um. Parenchyma paratracheal, sparse forming 1-2 seriate sheath interrupted by rays and fiber.

4.7 Kadet (*Crataeva religiosa* Forst.) Family - Cappridaceae

Habit and Distribution : A small tree attaining a height of 9 m. and a girth of 1-1.5 m. It is found growing throughout Burma and is often cultivated.

General characteristics and properties of the wood : The wood is yellowish white to yellowish brown; odour or taste not distinct; moderately heavy (sp.gr.0.6), 42

lbs/cu.ft; moderately hard; straight grained, medium-coarse and even-textured; and is a diffuse porous wood.

Microscopic characteristics : Vessel solitary and are arranged in radial multiples or in clusters : 8-16 per sq.mm., circular oval or polygonal, diameter 50-200 um, vessel member length 125-360 um. Perforations simple, end walls transverse or oblique. Intervascular pits alternate, circular or oval, 5-9 um. Vessel-ray and vessel parenchyma pits smaller, circular to oval. Fibers non-septate, interfiber pits numerous on both radial and tangential walls, thin-walled, 2-5 um thick; length 630-1500 um. Rays uniseriate to biseriate, mostly biseriate, heterocellular, 2-6 per mm; length of uniseriate rays. 75-178 um, length of biseriate rays 145-600 um. Parenchyma apotracheal diffuse, paratracheal parenchyma sparse.

The requirements of a timber for pencil making are very exacting, such that only a very few timber can be utilized for good quality pencils. Therefore wood for pencil making should have the following properties. Timbers should be easy to saw, plane and rounded. Machined surfaces must be smooth without any tearing of grain, Timbers should not contain resins, gums, or silica to minimise the blunting of saw and knives. The timber should be soft and light but reasonably strong with straight and close grain, and should not have a tendency to warp or distort during manufacturing operations. It should not shrink too much as shrinkage will cause distortion and loss in dimension. Using an ordinary razor blade or a sharpener the timber should whittle easily and should also have straight grain. In addition it should take a smooth finish and good polish. The timber should be available in sufficient quantities to have a sustained supply in the industry.

Estimated growing stock of trees suitable for pencil industry-*

KAYAW (*Excoecaria agallacha* Linn.) Trees pre acre

Appendix - I

Divisions	Girth (in feet)									
	2'-2'.11"	3'-3'.11"	4'-4'.11"	5'-5'.11"	6'-6'.11"	7'-7'.11"	8'-8'.11"	9'-9'.1"	10' +	TOTAL
(RAKHINE)										
GWA	.01	.002	.004	0	0	0	0	0	0	.171
SANDAWAY	.006	0	0	0	0	0	0	0	0	.017
(MANDALAY)										
MANDAYA	.018	.009	0	0	0	0	0	0	0	.026
LEWE	.024	.005	0	.007	0	0	0	0	0	.142
PYINMANA	0	0	0	0	0	0	0	0	0	.005
(PEGU)										
KYAUKTAGA	0	.002	0	0	0	0	0	0	0	.002
(RANGOON)										
TAIKKYI	.032	.005	.005	.005	0.005	0	0	0	0	.112

*Preliminary results.

Estimated growing stock of trees suitable for pencil industry-*

YEMANE (*Gmelina arborea* Linn.) Trees pre acre

Appendix - II

Divisions	Girth (in feet)									
	2'-2'.11"	3'-3'.11"	4'-4'.11"	5'-5'.11"	6'-6'.11"	7'-7'.11"	8'-8'.11"	9'-9'.1"	10' +	TOTAL
(RAKHINE)										
GWA	.002	0	0	0	0	0	0	0	0	.002
SANDAWAY	.023	.014	.004	.004	0	.004	0	0	.004	.202
(MANDALAY)										
KYAUKSE	.021	.003	.003	.005	0	0	0	0	0	.086
MYITTHA	.067	0	0	0	0	0	0	0	0	.067
THABEIKKY	.012	.016	.018	.006	.002	.004	.004	0	.002	.096
MADAYA	.009	0	0	0	0	0	0	0	0	.009
MAYMYO	.068	.014	.012	0	.002	0	0	0	0	.284
LEWE	.018	.007	.012	.018	0	.002	.002	0	.002	.062
MOGOK	.089	.026	.033	0	.007	.003	0			.615
PYINMANA	.038	.025	.038	.029	.004	.004	.013	.008	.004	.339
TATKON	.021	.019	.005	.011	0	.003	.005	0	.003	.083
YEMETHIN	.018	.006	0	0	.006	0	.006	0	0	.035

* Preliminary results.

Estimated growing stock of trees suitable for pencil industry-*

YEMANE (*Gmelina arborea* Linn.) Trees pre acre

Appendix - II (Cont.)

Divisions	Girth (in feet)									
	2'-2'.11"	3'-3'.11"	4'-4'.11"	5'-5'.11"	6'-6'.11"	7'-7'.11"	8'-8'.11"	9'-9'.1"	10' +	TOTAL
(PEGU)										
GYOBINGAU	.042	.063	.073	.01	0	0	0	0	0	.303
LETPANDAN	.037	.047	.057	.047	.01	.021	.01	.016	.005	.331
MINHLA	0	.134	.058	.058	0	0	0	0	0	.25
NATTALIN	0	.009	.024	.019	.009	0	0	.005	.005	.071
THARAWADD	.011	.011	.045	.022	0	0	0	0	0	.089
ZIGON	.193	0	0	0	.193	.193	0	0	0	.578
OKPO	.054	.06	.027	.007	.034	.013	.013	.02	.013	.242
KYAUKTAGA	.063	.057	.05	.03	.024	.14	.01	.01	.009	.399
TAUNGOO	.08	.091	.042	.024	.017	.021	.007	.004	.01	.365
PYU	.061	.037	.037	.044	.022	.015	.009	.004	.009	.325
YADASHE	.052	.028	.015	.011	0	.007	.002	0	.007	.174
(RANGOON)										
HLEGU	.035	.094	.069	.02	.025	0	0	.005	00	.297
TAIKKYI	.016	.053	.026	.011	.005	.005	0	.005	0	.122

* Preliminary results.

Estimated growing stock of trees suitable for pencil industry-*

HNAW (*Adina Cordifolia* Hook.f.) Trees pre acre

Appendix - III

Divisions	Girth (in feet)									
	2'-2'.11"	3'-3'.11"	4'-4'.11"	5'-5'.11"	6'-6'.11"	7'-7'.11"	8'-8'.11"	9'-9'.1"	10' +	TOTAL
(RAKHINE)										
GWA	.002	.002	0	0	0	0	0	0	0	.025
SANDAWAY	.002	.002	0	.002	0	0	0	0	0	.006
(MANDALAY)										
KYAUKSE	.031	.021	.013	.008	0	0	0	0	0	.308
MYITTHA	.134	0	0	0	0	0	0	0	0	.134
THABEIKKY	.105	.117	.043	.038	.012	.01	.008	.006	.008	.487
MADAYA	.106	.053	.053	.018	.035	0	0	.009	.009	.425
MAYMYO	.075	.041	.012	.002	0	0	.002	0	0	.252
LEWE	.05	.03	.012	.012	0	.002	.005	.002	0	.179
MOGOK	.003	.003	.003	.003	0	0	0	0	0	.082
PYINMANA	.042	.013	.004	.008	.004	0	0	0	.004	.319
TATKON	.048	.051	.051	.029	.005	.003	.003	.008	.008	.285
YEMETHIN	0	.006	0	0	0	0	0	0	0	.071

* Preliminary results.

Estimated growing stock of trees suitable for pencil industry-*

Appendix - III (Cont.)

HNAW (*Adina Cordifolia* Hook.f.)

Trees pre acre

Divisions	Girth (in feet)									
	2'-2'.11"	3'-3'.11"	4'-4'.11"	5'-5'.11"	6'-6'.11"	7'-7'.11"	8'-8'.11"	9'-9'.1"	10' +	TOTAL
(PEGU)										
GYOBINGAU	.365	.125	.021	0	0	0	0	0	0	.562
LETPANDAN	.005	.031	.01	0	.005	0	0	0	0	.167
MINHLA	.019	.019	0	.019	0	0	0	0	0	.058
NATTALIN	.095	.038	.014	.009	.009	.005	0	0	.009	.338
OKPO	0	.007	0	.007	0	0	0	0	0	.013
KYAUKTAGA	0	0	0	.002	.002	.002	.002	0	0	.007
TAUNGOO	.035	.004	.014	0	0	.004	0	0	.007	.063
PYU	.007	.004	.004	.002	.002	0	0	0	0	.066
YADASHE	.009	.007	.004	.002	.002	0	0	.002	0	.026
(RANGOON)										
TAIKKYI	0	.005	0	0	0	0	0	0	0	.005

* Preliminary results.

Estimated growing stock of trees suitable for pencil industry-*

KUTHAN (*Hymenodictyon excelsum* Well.) Trees pre acre

Appendix - IV

Divisions	Girth (in feet)									
	2'-2'.11"	3'-3'.11"	4'-4'.11"	5'-5'.11"	6'-6'.11"	7'-7'.1"	8'-8'.11"	9'-9'.1"	10' +	TOTAL
(RAKHINE)										
GWA	.002	0	0	0	0	0	0	0	0	.002
SANDAWAY	0	.002	0	0	0	0	0	0	0	.013
(MANDALAY)										
KYAUKSE	0	.005	0	0	0	0	0	0	0	.005
MYITTHA	.045	.022	0	0	0	0	0	0	0	.067
THABEIKKY	.018	.02	.012	0	0	0	0	0	0	.123
MADAYA	.035	.026	0	0	0	0	0	0	0	.062
MAYMYO	.02	.01	.008	0	0	0	0	0	0	.181
LEWE	.092	.039	.025	.025	.016	.002	.005	0	0	.335
MOGOK	.003	0	0	0	0	0	0	0	0	.003
PYINMANA	.029	.021	.017	.008	.008	0	0	0	.004	.271
TATKON	.099	.075	.037	.011	.008	0	0	0	0	.518
YEMETHIN	.006	0	0	0	0	0	0	0	0	.006

* Preliminary results.

Estimated growing stock of trees suitable for pencil industry-*

KUTHAN (*Hymenodictyon excelsum* Wall.) Trees pre acre

Appendix - IV (Cont.)

Divisions	Girth (in feet)									
	2'-2'.11"	3'-3'.11"	4'-4'.11"	5'-5'.11"	6'-6'.11"	7'-7'.11"	8'-8'.11"	9'-9'.1"	10' +	TOTAL
(PEGU)										
GYOBINGAU	.021	.021	.031	.01	0	0	0	0	0	.187
LETPANDAN	.026	.026	.016	.005	.005	.005	0	0	0	.083
MINHLA	.038	.019	0	.019	0	0	0	0	0	.058
NATTALIN	.157	.085	.043	.005	.005	0	0	0	0	.494
THARAWADD	.022	.022	.011	0	0	0	0	0	0	.427
OKPO	.067	.013	.013	.007	0	0	0	0	0	.101
KYAUKTAGA	.004	.007	.007	.002	.002	0	0	0	0	.021
TAUNGOO	.038	.01	.007	.01	.004	.004	.004	0	0	.077
PYU	.004	.004	.004	.007	.004	0	0	0	0	.024
YADASHE	.015	.015	.018	.004	.004	0	.002	0	0	.205
(RANGOON)										
HLEGU	.005	.005	0	0	0	0	0	0	0	.01
TAIKKYI	.005	.016	0	.011	0	0	0	0	.005	.156

* Preliminary results.

Appendix - V

[illegible]

Estimated growing stock of trees suitable for pencil industry-*

THITKADO (*Cedrela toona* Roxb.) Trees pre acre

Appendix - V (Cont.)

Divisions	Girth (in feet)									
	2'-2'.11"	3'-3'.11"	4'-4'.11"	5'-5'.11"	6'-6'.11"	7'-7'.11"	8'-8'.11"	9'-9'.1"	10' +	TOTAL
THARAWADD	.011	0	0	0	0	0	0	0	0	.011
OKPO	.007	.007	0	.007	0	0	0	0	0	.053
KYAUKTAGA	.004	.014	.009	.009	0	0	.002	0	.002	.065
TAUNGOO	.01	.007	0	.007	0	.004	0	0	0	.028
PYU	.013	.029	.022	0	.002	0	0	0	0	.112
YADASHE (RANGOON)	.013	.004	.009	.004	.002	0	0	0	0	.033
HLEGU	0	.005	.005	0	0	0	0	0	0	.01
TAIKKYI	0	.011	0	.005	0	0	0	0	0	.016

* Preliminary results.

Estimated growing stock of trees suitable for pencil industry-*

KADET (*Crataeva religiosa* Forst.) Trees pre acre

Appendix - VI

Divisions	Girth (in feet)									
	2'-2'.11"	3'-3'.11"	4'-4'.11"	5'-5'.11"	6'-6'.11"	7'-7'.11"	8'-8'.11"	9'-9'.1"	10' +	TOTAL
(RAKHINE)										
GWA	.002	0	0	0	0	0	0	0	0	.002
SANDAWAY	.006	0	0	0	0	0	0	0	0	.041
(MANDALAY)										
MAYMYO	.002	0	0	0	0	0	0	0	0	.025
LEWE	.009	.007	0	.002	0	0	0	0	0	.018
MOGOK	0	0	.007	0	0	0	0	0	0	.007
PYINMANA	.004	0	0	0	0	0	0	0	0	.004
TATKON	.003	0	0	0	0	0	0	0	0	.003
YAMETHIN	0	.006	0	0	0	0	0	0	0	.006
(PEGU)										
GYOBINGAU	0	.01	0	0	0	0	0	0	0	.01
MINHLA	.019	0	0	0	0	0	0	0	0	.019
NATTALIN	.014	.005	0	0	0	0	0	0	0	.019

Estimate growing stock of trees suitable for pencil industry-*

KADET (*Crataeva religiosa* Forst.)

Trees pre acre

Appendix - VI (Cont.)

Divisions	Girth (in feet)									
	2'-2'.11"	3'-3'.11"	4'-4'.11"	5'-5'.11"	6'-6'.11"	7'-7'.11"	8'-8'.11"	9'-9'.1"	10' +	TOTAL
THARAWADD	.033	0	0	.011	0	0	0	0	0	.1
KYAUKTAGA	.004	.004	.004	0	0	0	0	0	0	.011
YEDASHE	.009	0	.002	0	0	0	0	0	0	.011
(RANGOON)										
HLEGU	.005	.01	0	0	0	0	0	0	0	.015
TAIKKYI	.011	0	0	0	0	0	0	0	0	.011

* Preliminary results.

Estimated growing stock of trees suitable for pencil industry-*

TAUNGMEOK (*Alstonia scholaris* R. Brown.) Trees pre acre

Appendix - VII

Divisions	Girth (in feet)									
	2'-2'.11"	3'-3'.11"	4'-4'.11"	5'-5'.11"	6'-6'.11"	7'-7'.11"	8'-8'.11"	9'-9'.11"	10' +	TOTAL
(RAKHINE)										
GWA	.004	.01	.002	0	0	.002	0	0	.004	.021
SANDAWAY	0	0	.004	.002	0	0	0	0	0	.006
(MANDALAY)										
KYAUKSE	.073	.01	.003	0	0	0	0	0	0	.173
THBEIKKY	.002	0	0	0	0	0	0	0	0	.002
MAYMYO	0	0	0	.002	0	0	0	0	0	.002
LEWE	.007	.002	.005	0	0	0	.002	0	0	.016
PYINMANA	0	.004	.004	0	0	0	0	0	0	.008
(PEGU)										
KYAUKTAGA	.004	.002	0	0	0	0	0	0	0	.005
TAUNGOO	.004	0	0	0	0	0	0	0	0	.004
PYU	0	0	0	0	0	0	0	0	.002	.002
YEDASHE	0	.004	0	0	0	0	0	0	0	.004

* Preliminary results.

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1. Anon, 1965. The wealth of India. Industrial Products Part VI. Council of Scientific and Industrial Research, New Delhi. 201-207.
2. Lopez, D.T, 1981. Malaysian Timbers For Pencil Manufacture. Malaysian Forest Service. Trade Leaflet No. 49;1-3.
1. Rehman, M.A. and Jai Kishen, 1951. Deodar as Pencil wood. Indian Forests Bulletin No. 149. (New Series). Wood seasoning. 1-7.
4. Rehman, M.A. and P.G. Gupta, 1968. Timber for pencil slats, its conversion, seasoning and treatment. Indian Forest Leaflet No. 188. Wood seasoning. 1-8.
5. Soe Tint, U, Thein Kywe, U and Soe Myint Thein, U. 1981. Study on Burmese timbers similar to Kayaw and Yemane suitable for pencil making. Technical document No. 1/81-82 : 1-9.

PLATE I

Excoecaria agallacha Linn. (Kayaw).

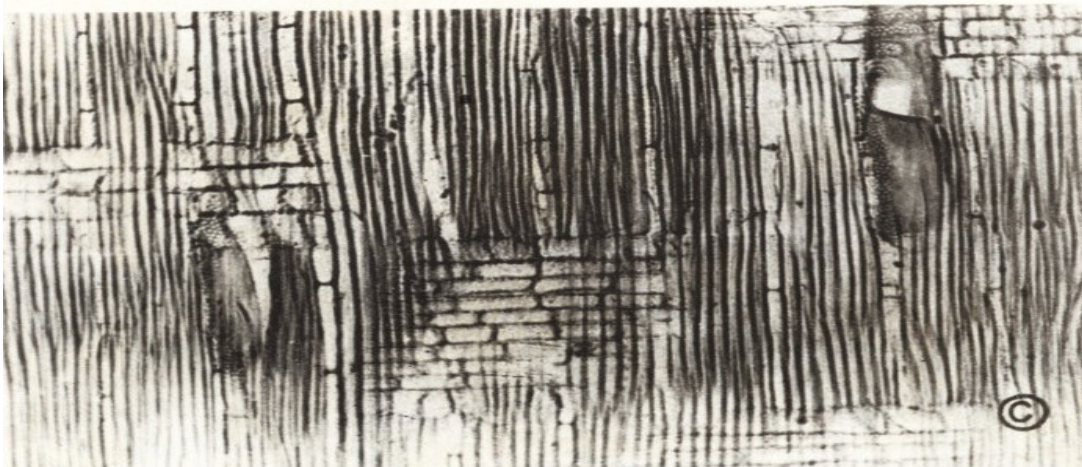
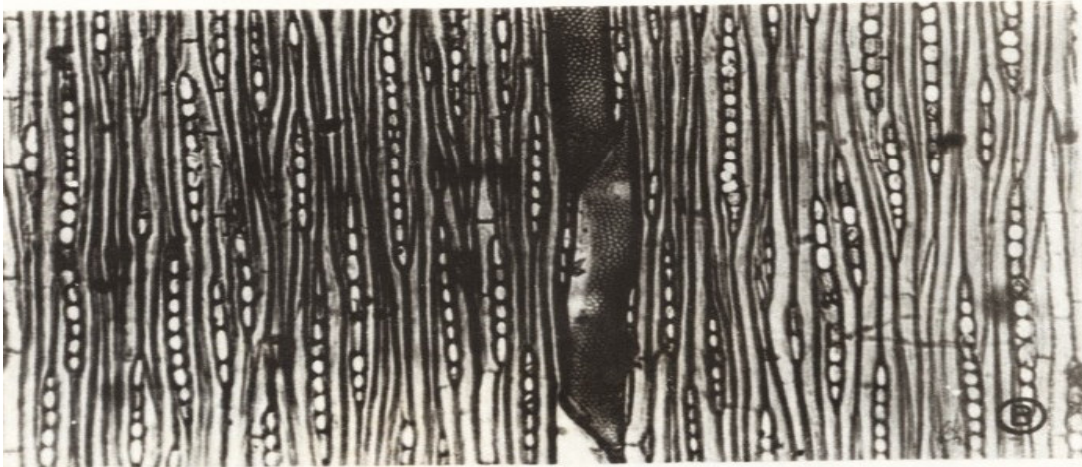
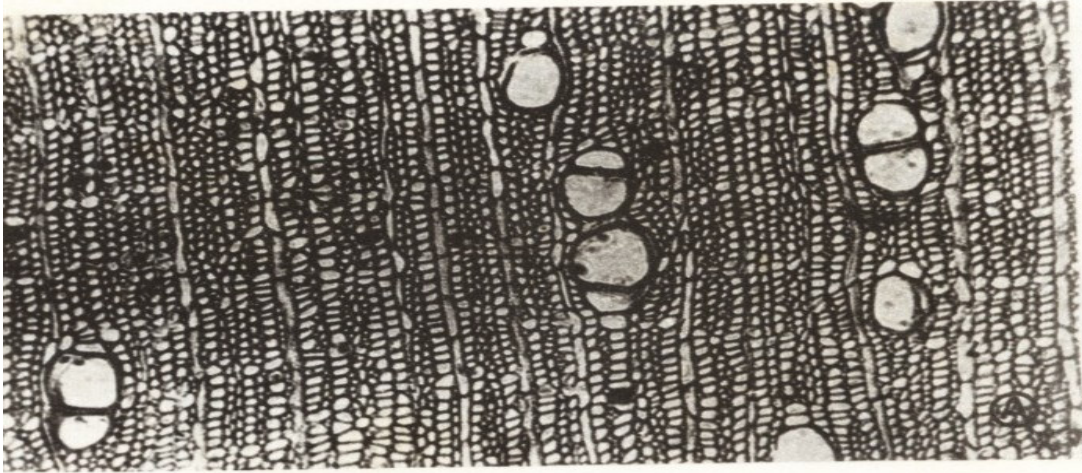


PLATE II

Gmelina arborea Linn. (Yemane)

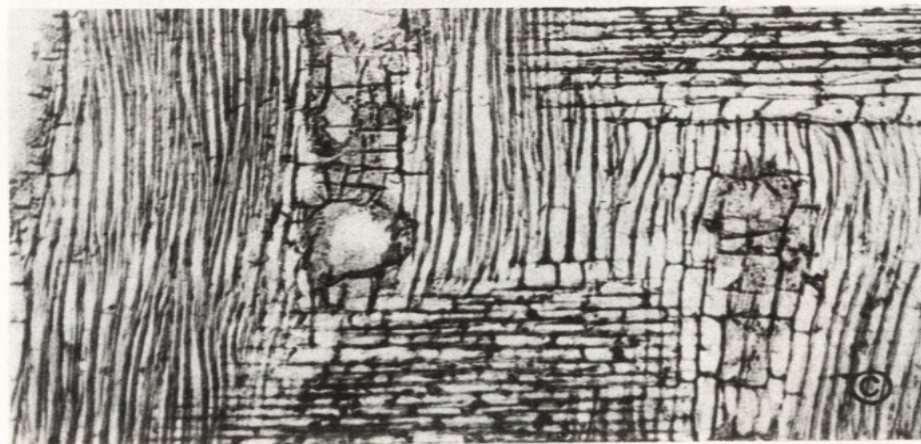
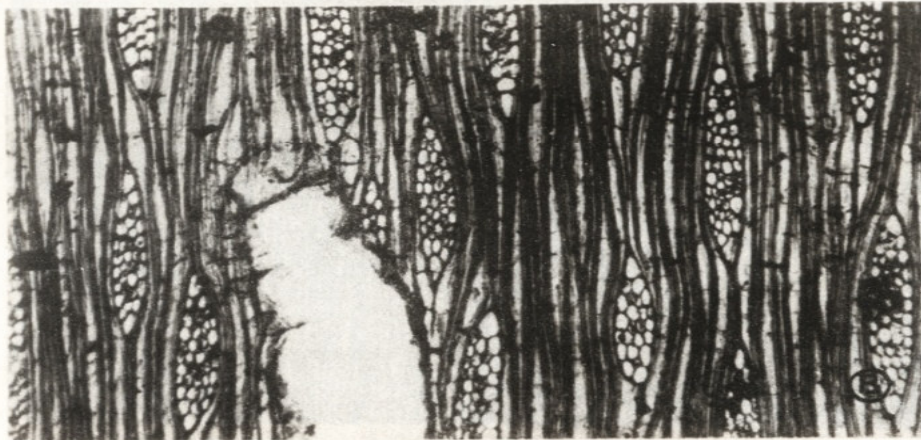


PLATE III
Hymenodictyon excelsum Wall. (Kuthan)

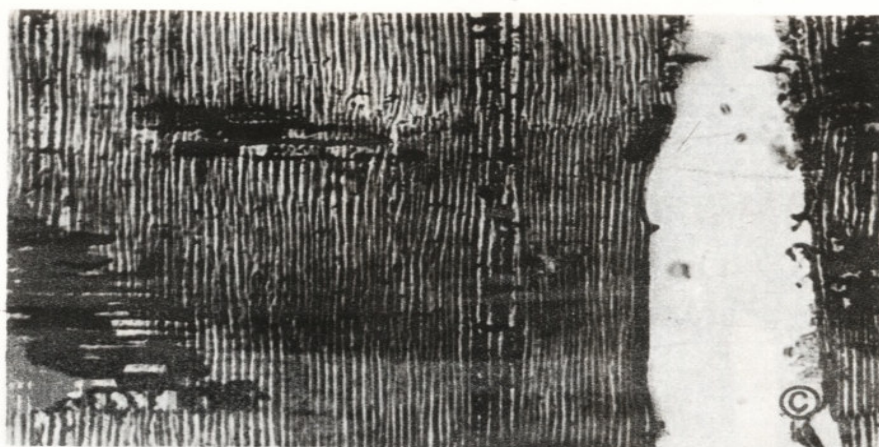
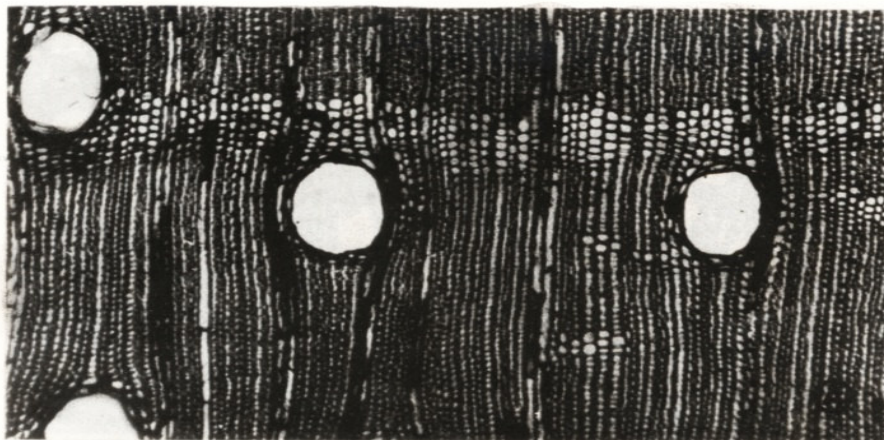


PLATE IV
Adina cordifolia Hook. F. (Hnaw)

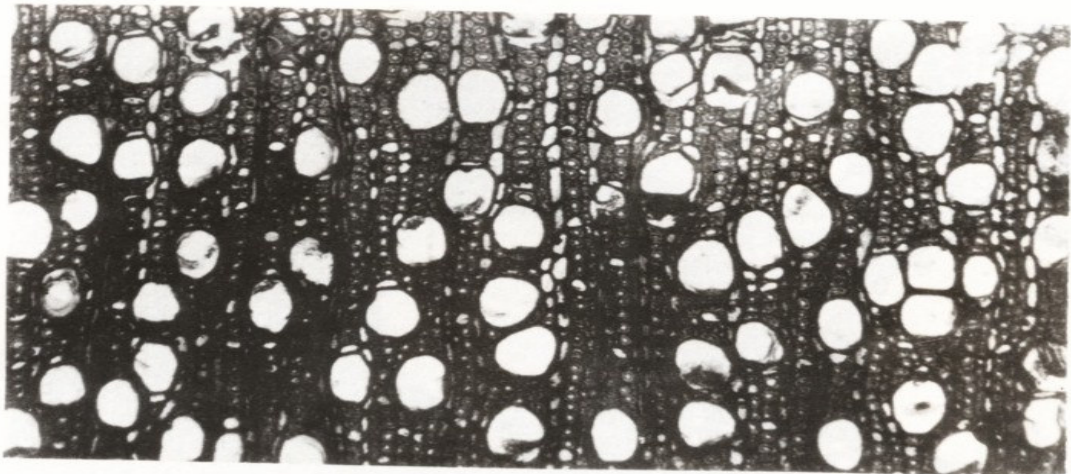


PLATE V
Cedrela toona Roxb. (Thitkado)

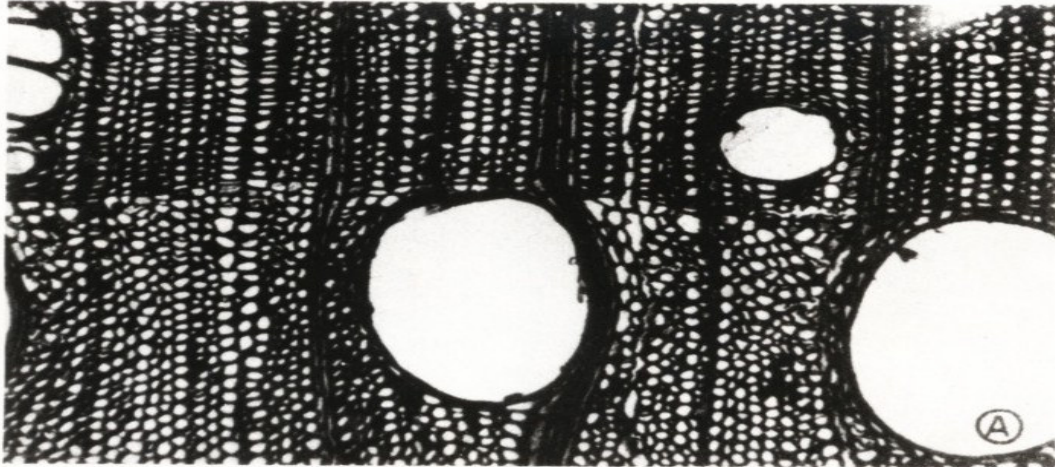


PLATE VI

Alstonia scholaris R. Brown. (Taungmeok)

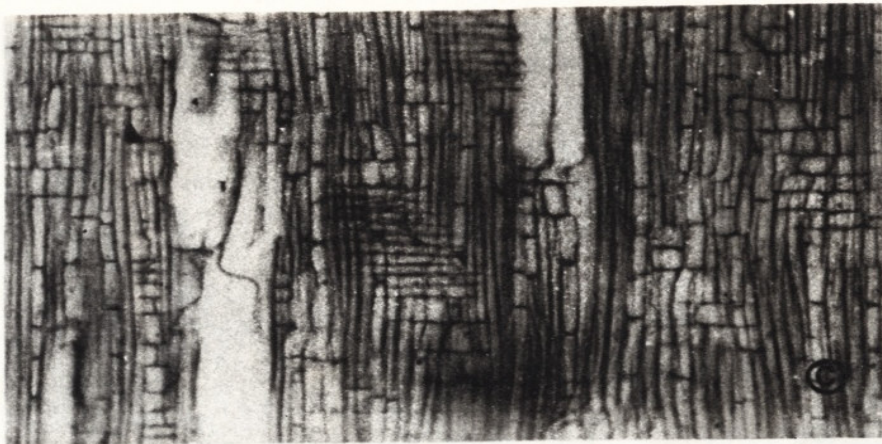
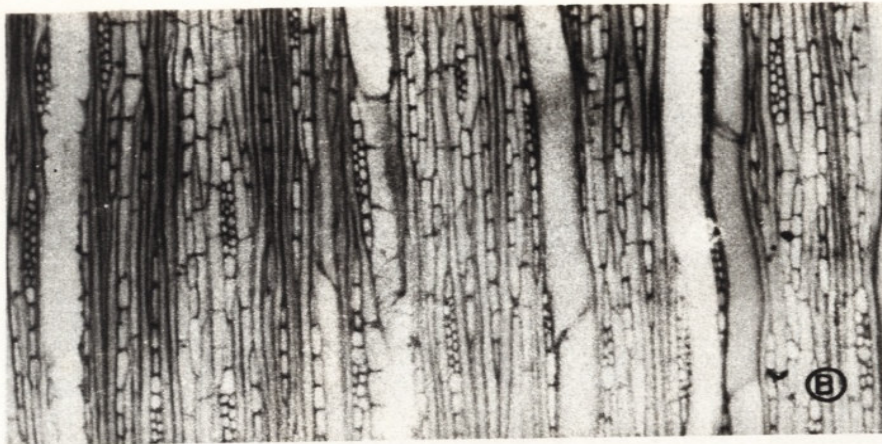
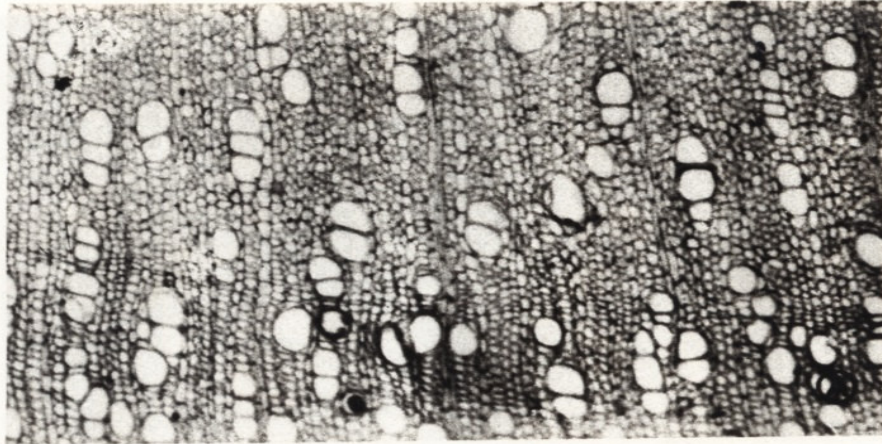


PLATE VII
Crataeva religiosa Forst. (Kadet)

