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臺灣主要針葉樹材之構造與材性之研究(二)

蔣　福　慶

Studies on the Structure and Properties of Important Coniferous woods in Taiwan (2)

by

Fu-Ching Chiang

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提要　本研究之內容，係對本省針葉樹材之構造，作個別具系統之研究。所得結果，供諸木材利用上及學術界之應用與參考，所用材料爲華山松、臺灣冷杉、臺灣二葉松、紅豆杉、琉球松及大葉羅漢松，研究項目，包括：（1）一般特徵與材性，（2）肉眼或擴大鏡下之特徵與（3）顯微鏡下之特徵，經分別觀察、測定及詳加記載後，作成具系統之記述，並另附顯微鏡照相以資佐證。

Ⅰ.研 究 樹 種

13. 華山松 (Pinus armandi Franch.)

（版XⅢ. 圖73,74,75,76,77,78）

一般特徵與材性：

邊材與心材之區別甚顯明；邊材淡黃色，心材淡紅黃色；木理通直；木肌略粗而不均勻；材質重（比重0.50，根據全乾重量與生材容積測定），堅硬，靜力彎曲强度强，縱向壓力强度稍强，耐衝擊力略高；加工容易，膠合良好；油漆及其保留性尙佳；收縮中庸，乾燥後之狀況良好；耐朽性略强。

肉眼或擴大鏡下之特徵：

年輪略明晰，年輪間界以色較深暗之晚材帶，狹（每吋約25輪），寬度相仿。早材帶通常較晚材帶寬數倍；早晚材假導管之大小變異甚緩；晚材帶在肉眼下明晰，色較早材帶略深暗，通常狹。縱向柔組織不見。放射線甚細（橫切面上），在擴大鏡下得見之，在徑切面上，形成細，密而不顯明之斑紋。具樹脂管，在橫切面上，形略大至大而數多，在肉眼下顯明，多數單獨，分布不均勻，在弦切面上，形成褐色而略顯明之條痕。

顯微鏡下之特徵：

具縱向及橫向樹脂管；縱向樹脂管通常分布於晚材之外部，直徑 80—140μ；有假填充細胞；周邊細胞胞壁薄；橫向樹脂管較小，直徑 35—60μ。正常無樹脂細胞。早材假導管之徑向直徑20—40μ，弦向直徑 20—45μ；晚材假導管之徑向直徑 5—15μ，弦向直徑 10—30μ；假導管單位長 1250—3200μ；胞壁厚在早材中者3—4.5μ；晚材中者 4—6μ。在弦切面上，晚材假導管之重紋孔小，具線形而傾斜之紋孔口；在徑切面上之重紋孔多數爲1列，有時2列；放射線有單列與紡錘形兩式：（1）單列放射線數多，1～16，多數爲2～7細胞高；（2）紡錘形放射線散生，具一橫向樹脂管，中部細胞2～3列，漸向上下兩端尖削而成單列之放射線，11～24細胞高；放射線假導管位於放射線上下兩邊，形小而平滑，在徑切面上，有形小之重紋孔；放射線柔組織細胞，在徑切面經早材時，每橫隔具1有時2個大形之單紋孔，經晚材時，常有1個單紋孔。

14. 臺灣冷杉 (Abies kawakamii (Hay.) Ito)

(版XIV. 圖79,80,81,82,83,84.)

一般特徵與材性：

邊材與心材之區別不顯明；材黃白或淡黃褐色；木理通直而均勻；木肌中庸；材質稍輕（比重0.40，根據全乾重量與生材容積測定），略軟，靜力彎曲與縱向壓力強度弱，耐衝擊力低；加工容易；膠合簡便；油漆及其保留性尚佳；收縮大，乾燥後之狀況良好；耐朽性弱。

肉眼或擴大鏡下之特徵：

年輪明晰，年輪間界以色較深暗之晚材帶，寬至甚寬（每吋約4～6輪），寬度頗均一。早材帶通常寬，占年輪中之大部分，早晚材假導管之大小變異甚緩；晚材帶在肉眼下明晰，色較早材帶略深暗，通常狹。縱向柔組織不見。放射線甚細（橫切面上），在擴大鏡下得見之，在徑切面上，形成細，密而不顯明之斑紋。無樹脂管。

顯微鏡下之特徵：

樹脂管及樹脂細胞（縱向柔組織）正常不見。早材假導管之徑向直徑 25—60μ， 弦向直徑 25—50μ；晚材假導管之徑向直徑 8—30μ，弦向直徑 20—40μ；假導管單位長3000—5500μ；胞壁厚在早材中者 1.5—2μ，晚材中者 3—6μ。在弦切面上，假導管之重紋孔形小而稀少，具橢圓形之紋孔口；徑切面上之重紋孔，多數爲1列，其在早材中者，具圓形之紋孔口，在晚材中者，紋孔口爲橢圓形。放射線單列，少有二列者，1～24，多數爲4～15細胞高；放射線假導管不見；放射線柔組織細胞，在徑切面經早材時，每橫隔1～4，多數爲2或3個形圓之半重紋孔，經晚材時，具橢圓形之半重紋孔1個。

15. 臺灣二葉松 (Pinus taiwanensis Hay.)

(版XV. 圖85,86,87,88,89,90.)

一般特徵與材性：

邊材與心材之區別甚顯明，邊材黃白色，心材淡黃褐色；木理通直；木肌略粗而不均勻；材質重（比重0.56，根據全乾重量與生材容積測定），堅硬，靜力彎曲強度甚強，縱向壓力強度稍強，耐衝擊力略高；加工略感困難；膠合良好；油漆與保留性尚佳，惟心材中之樹脂常使油漆褪色；收縮大，乾燥後之狀況良好；耐朽性尚強。

肉眼或擴大鏡下之特徵。

年輪明晰，年輪間界以色暗而顯明之晚材帶，狹至略寬（每吋約12～25輪），寬度不均。早材帶狹；早晚材假導管之大小急變；晚材帶通常寬，占年輪中二分之一或略多，在肉眼下顯著，較早材帶色暗而質緻密。縱向柔組織不見。放射線細（橫切面上），在肉眼下分明，在徑切面上，形成細、密而較顯明之斑紋。具樹脂管，在橫切面上，形略大，而數略多，以肉眼觀察，在早晚材中，現白色之斑點，單獨或偶有2至數個連接而成弦列者，在弦切面上，形成褐色而顯著之條痕。

顯微鏡下之特徵：

具縱向及橫向樹脂管；縱向樹脂管在早晚材中，均勻分布，直徑 100—140μ，有假瘤充細胞；周邊細胞胞壁厚；橫向樹脂管較小，直徑 35—45μ。樹脂細胞正常不見。早材假導管之徑向直徑35—80μ，弦向直徑 25—45 ；晚材假導管之徑向直徑 10—30μ，弦向直徑 15—45μ；假導管單位長2200—7000μ；胞壁厚在早材中者 3—4μ，晚材中者4.5—7.5μ。在弦切面上，晚材假導管之重紋孔小，具圓形之紋孔口；在徑切面上，早材假導管之重紋孔爲1～2列，晚材假導管之重紋孔常爲1列。放射線有單列與紡錘形兩式：（1）單列放射線數多，1～22，多數爲2～9細胞高；（2）紡錘形放射線散生，具一橫向樹脂管，中部細胞2～3列，漸向上下兩端尖削而成單列之放射線，12～20細胞高，

放射線假導管位於放射線上下兩邊，形小，胞壁薄，不成鋸齒狀，在徑切面上，有形小之重紋孔；放射線柔組織細胞，在徑切面經早材時，每橫隔具1或2個大形單紋孔，經晚材時，具單紋孔1個。

16. 紅豆杉 (Taxus chinensis Rehd.)

(版XVI. 圖91,92,93,94,95,96.)

一般特徵與材性：

邊材與心材之區別甚顯明；邊材通常狹，黃白色至黃褐色，心材紅褐色；木理橫斜；木肌甚細、緻密而均勻；材質重（比重0.58，根據全乾重量與生材容積測定），甚堅硬，靜力彎曲與縱向壓力強度甚強，耐衝擊力甚高；加工略感困難；膠合尚便；油漆及其保留性頗佳；收縮大，乾燥狀況良好；耐朽性甚強。

肉眼或擴大鏡下之特徵：

年輪略明晰，年輪間界以材質緻密晚材之暗色線或帶；通常成波浪形，狹至甚狹（每吋約25～40輪），寬度不均；具假年輪（常有2或3個年輪重疊者）。早材帶占年輪中之大部分；早晚材假導管之大小變異甚緩；晚材帶在肉眼下明晰，色較早材帶略深暗，通常狹。縱向柔組織不見。放射線甚細（橫切面上），在擴大鏡下得見之，在徑切面上，形成細、密而不顯著之斑紋。無樹脂管。

顯微鏡下之特徵：

無樹脂管及樹脂細胞（縱向柔組織）。早材假導管之徑向直徑25—40μ，弦向直徑 30—45μ；晚材假導管之徑向直徑 15—20μ，弦向直徑 25—35μ； 假導管單位長 2200—4000μ；胞壁厚在早材中者 3.5—4μ，晚材中者 4—4.5μ；；早晚材假導管之內壁，具螺旋狀加厚。在弦切面上，假導管之重紋孔形小而數少；在徑切面上；早材假導管之重紋孔爲1列，有時成對排列，晚材假導管之重紋孔1列，具橢圓而傾斜之紋孔口。放射線單列，少有二列者，1～38，多數爲2～18細胞高；放射線柔組織細胞，在徑切面經早材時，每橫隔具2或3個圓形半重紋孔，其紋孔口爲橢圓形；經晚材時，具線形紋孔口之半重紋孔1或2個。

17. 琉球松 (Pinus luchuensis Mayer)

(版XVII. 圖97,98,99,100,101,102.)

一般特徵與材性：

邊材與心材之區別有時明晰有時則否，邊材淡黃褐色，心材紅黃褐色；木理通直，木肌略粗而不均勻；材質甚重（比重0.61，根據全乾重量與生材容積測定），甚堅硬，靜力彎曲與縱向壓力強度甚強，耐衝擊力高；加工略感困難；膠合良好，油漆及其保留性佳，惟心材中之樹脂常使油漆變色；收縮大，倘乾燥不當，則易生乾裂；耐朽性強。

肉眼或擴大鏡下之特徵：

年輪明晰，年輪間界以色暗而顯明之晚材帶，略寬至寬，（每吋約8～15輪），寬度不均。早材帶狹；早晚材假導管之大小急變；晚材帶通常寬，占年輪中二分之一或略多，在肉眼下顯著，顯較早材帶色暗而質緻密。縱向柔組織不見。放射線細（橫切面上），在肉眼下得見之，在徑切面上，形成細、密而較顯明之斑紋。具樹脂管，在橫切面上，形稍大，以肉眼觀察，在色暗之晚材中，現白色之斑點，數略多，單獨或2個連接而成弦列者，在弦切面上，形成褐色而顯明之條痕。

顯微鏡下之特徵：

具縱向及橫向樹脂管；縱向樹脂管多數分布於晚材中，直徑90—110μ；有假填充細胞；周邊細胞胞壁薄；橫向樹脂管較小，直徑 30—45μ。正常無樹脂細胞。早材假導管之徑向直徑 25—45μ，弦向直徑 20—40μ；晚材假導管之徑向直徑 8—15μ，弦向直徑 15—30μ；假導管單位長 2500—5100μ；胞

壁厚在早材中者1.5—2μ，晚材中者 3—8μ。弦切面上之重紋孔小而稀少， 具圓形之紋孔口；在徑切面上，早材假導管之重紋孔多數爲1列，偶有成對排列者，晚材假導管之重紋孔爲1列。放射線有單列與紡錘形兩式：（1）單列放射線數多，1～30，多數爲2～15細胞高；（2）紡錘形放射線散生，具一橫向樹脂管，中部細胞2～3列，漸向上下兩端尖削而成單列之放射線，13～28細胞高；放射線假導管位於放射線上下兩邊，形小，胞壁薄，不成鋸齒狀，在徑切面上，有形小之重紋孔。放射線柔組織細胞，在徑切面經早材時，每橫隔有1大形之單紋孔，經晚材時，具裂隙狀單紋孔1個。

18. 大葉羅漢松 (Podocarpus macrophyllus (Thunb.) Lamb.)

(版XVIII. 圖103,104,105,106,107,108.)

一般特徵與材性：

邊材與心材之區別不顯明；材色黃褐；木理通直，木肌細、緻密而均勻；材質稍重（比重0.46，根據全乾重量與生材容積測定），略堅硬，靜力彎曲與縱向壓力强度强，耐衝擊力略高；加工容易；膠合與油漆保留性均佳，收縮小，乾燥後之狀況良好，不爲白蟻蠹蝕，耐朽性甚强。

肉眼或擴大鏡下之特徵：

年輪略明晰，年輪間界以材質緻密晚材之暗色線或帶，狹至略寬，（每吋約10至20輪），寬度不均；具假年輪（常有2或3個年輪重疊者）。早材帶通常占年輪中之大部分；早晚材假導管之大小變異甚緩，晚材帶在肉眼下略明晰，色較早材略深暗，通常狹。縱向柔組織不見。放射線甚細（橫切面上），在擴大鏡下得見之，在徑切面上，形成細、密而不顯明之斑紋。無樹脂管。

顯微鏡下之特徵：

縱向柔組織細胞（樹脂細胞）稀少，成單獨之細胞，散布於假導管間，含暗色之樹脂。早材假導管之徑向直徑15—30μ，弦向直徑 15—30μ；晚材假導管之徑向直徑 6—15μ，弦向直徑10—30μ；假導管單位長 1000—4000μ；胞壁厚在早材中者 2.5—3μ，晚材中者 4—5μ；在弦切面上，晚材假導管之重紋孔形小而數少；在徑切面上，早晚材假導管之重紋孔，均爲1列，具交叉凸透鏡形之紋孔口；放射線單列，1～21，多數爲2～10細胞高；放射線柔組織細胞，在徑切面經早材時，每橫隔具1～3凸透鏡形而傾斜之半重紋孔；經晚材時，有狹凸透鏡形而傾斜之半重紋孔1個。

II. English Description

13. Pinus armandi Franch.

Plate. XIII. Figs. 73,74,75,76,77,78.

General Characteristics and properties :

Heart-wood sharply differentiated from sap-wood; sap-wood light yellow, heart-wood light rosy yellow; straight-grained; moderately coarse and uneven-textured; heavy (Sp. gr. 0.50, based on ovendry weight and green volume), hard, strong in bending, moderately strong in endwise compression, moderately high in shock resistance; works easily under tools; glues well; takes and holds paint moderately well, shrinks moderately, stays in place well after seasoning; moderately durable under conditions favorable to decay.

Macroscopic Characteristics:

Growth rings barely distinct, delineated by a band of darker late wood, narrow (approx. 25 per in), nearly uniform in width. Early wood zone usually several times wider

than the band of late wood; trasition from early-to late-wood very gradual; late wood zone distinct to the naked eye, somewhat darker than the early wood, generally narrow. Longitudinal parenchyma not visible. Rays very fine (x), visible with a hand lens, forming a fine, close, incospicuous fleck on the radial surface. Resin canals present, numerous, moderately large to large (x), conspicuous to the naked eye, mostly solitary, unevenly distributed, forming fairly conspicuous brownish streaks along the grain (t).

Microscopic Characteristics:

Resin canals present, longitudinal and transverse; longitudinal canals distributed usually in the outer portions of late wood, 80-140μ in diameter; tylosoids present; epithelium thin-walled; transverse resin canals much smaller, 35—60μ in diameter. Resin cells normally absent. Radial diameter of early wood tracheids 20—40μ, tangential diameter 20—45μ; radial diameter of late wood tracheids 5—15μ, tangential diameter 10—30μ; length 1250—3200μ; wall of tracheids in early wood 3—4.5μ, in late wood 4—6μ thick. Tangential bordered pits of late wood small, with linear and slanting aperture; radial bordered pits mostly in one, sometimes two rows; Rays of two types, uniseriate and fusiform; (1) uniseriate rays numerous, 1—16, mostly 2—7 cells high; (2) fusiform rays scattered, with a transverse resin canal, 2-3-seriate through the central portion, tapering above and below to uniseriate margins similar to the a rays, 11-24 cells in height; marginal ray tracheids present, small and smooth, with small bordered pits on the radial wall; with large simple pits in each cross-field, one sometimes two in early wood, always one in late wood.

14. Abies Kawakamii (Hay.) Ito

Plate. XIV. Figs. 79,80,81,82,83,84.

General Characteristics and properties:

Without clear colour demarcation between sap-and heart-wood; wood yellowish white or light yellowish brown; straight-and even-grained; medium-textured; moderately light (Sp. gr. 0.40, based on ovendry weight and green volume), moderately soft, weak in bending and endwise compression, low in shock resistance; easy to work with tools; takes glue readily; takes and holds paint moderately well; shrinks considerably, stays in place well after seasoning; not durable when in situations favorable to decay.

Macroscopic Characteristics:

Growth rings distinct, delineated by a darker band of late wood, wide to very wide (approx. 4—6 per in), and quite uniform in width. Early wood zone generally wide, occupying most of the ring; transition from early-to late-wood very gradual; late wood zone distinct to the naked eye, somewhat darker than the early wood, generally narrow. Longitudinal parenchyma not visible. Rays very fine (x), visible with a hand lens, forming a fine, close, inconspicuous fleck on the radial surface. Resin canals wanting.

Microscopic Characteristics:

Resin canals and resin cells (longitudinal parenchyma) normally absent. Radial diameter of early wood tracheids 25—60μ, tangential diameter 25—50μ; radial diameter of late

wood tracheids 8 —30μ, tangential diameter 20—40μ; length 3000-5500μ; wall of tracheids in early wood 1.5—2μ, in late wood 3—6μ thick. Tangential bordered pits small and scarce, with elliptic aperture; radial bordered pits mostly in one row, with round aperture in early wood, elliptic in late wood. Rays uniseriate, rarely biseriate, 1—24, mostly 4—15 cells high; marginal ray tracheids absent; ray parenchyma cells in early wood with 1-4, mostly 2 or 3 round semi-bordered pits in each cross-field, with one elliptic semi-bordered pit in late wood.

15 Pinus taiwanensis Hay.

Plate. XV. Figs. 85,86,87,88,89,90.

General Characteristics and properties:

With sharp demarcation in colour between sap-and heart-wood; sap-wood yellowish white, heart-wood light yellowish brown; straight-grained; moderately coarse and uneven-textured; heavy (Sp. gr. 0.56, based on ovendry weight and green volume), hard, very strong in bending, moderately strong in endwise compression, moderately high in shock resistance; somewhat difficult to work with tools; glues well; takes and holds paints moderately well, but the resin in heart-wood tends to discolor paint; shrinks considerably, stays in place well after seasoning; moderately durable under conditions favorable to decay.

Macroscopic Characteristices:

Growth rings distinct, delineated by a pronounced band of darker late wood, narrow to moderately wide (approx. 12—25 per in), and variable in width. Early wood zone narrow; transition from early-to late-wood abrupt; late wood zone generally wide, occupying one half or more of the ring, conspicuous to the naked eye, darker and denser than the early wood. Longitudinal parenchyma not visible. Rays fine (x), visible to the naked eye, forming a fine, close, relatively conspicuous fleck on the radial surface. Resin canals present, moderately large and moderately numerous (x), appearing as white flecks in both early-and late-wood to the naked eye, solitary or occasionally 2-several contiguous in the tangential direction, forming conspicuous brownish streaks along the grain (t).

Microscopic Characteristics:

Resin canals present, longitudinal and transverse; longitudinal canals evenly distributed in both early-and late-wood, 100—140μ in diameter; tylosoids present; epithelium thick-walled; transverse resin canals much smaller, 35—45μ in diameter. Resin cells normally absent. Radial diameter of early wood tracheids 35—80μ, tangential diameter 25—45μ; radial diameter of late wood tracheids 10—30μ, tangential diameter 15—45μ; length 2200-7000μ; wall of tracheids in early wood 3—4μ, in late wood 4.5—7.5μ thick. Tangential bordered pits of late wood tracheids small, with round aperture; radial bordered pits of early wood tracheids in 1—2 rows, in late wood always in one row. Rays of two types, uniseriate and fusiform; (1) uniseriate rays numerous, 1—22, mostly 2—9 cells high; (2) fusiform rays scattered, with a transverse resin canal, 2-3-seriate through the central portion, tapering above and below to uniseriate margins similar to the a rays,

12—20 cells in height; marginal ray tracheids small, thin-walled, non-dentate, with small bordered pits on the radial wall; ray parenchyma cells in early wood with one or two large simple pits in each cross-field, with one in late wood.

16. Taxus chinensis Rehd.

Plate. XVI. Figs. 91,92,93,94,95,96.

General Characteristics and properties:

Heart-wood sharply distinguished from sap-wood, sap-wood usually narrow, yellowish white to yellowish brown, heart-wood reddish brown; grain crossed; texture very fine, dense and even; heavy (Sp. gr. 0,58, based on ovendry weight and green volume), very hard, very strong in bending and endwise compression, very high in shock resistance; somewhat difficult to work with tools; takes glue readily; takes and holds paint very well; shrinks considerably; stays in place well when seasoned; very durable when exposed to conditions favorable to decay.

Macroscopic Characteristics:

Growth rings scarcely distinct, delineated by a dark line or band of denser late wood, usually undulating, narrow to very narrow (approx. 25—40 per in) and variable in width; false growth rings present (often doubled or trebled). Early wood zone occupying most of the ring; transition from early-to late-wood very gradual; late wood zone distinct to the naked eye, somewhat darker than the early wood, generally narrow. Longitudinal parenchyma not visible. Rays very fine (x), visible with a hand lens, forming a fine, close, inconspicuous fleck on the radial surface. Resin canals absent.

Microscopic Characteristics:

Resin canals and resin cells (longitudinal parenchyma) absent. Radial diameter of early wood tracheids 25—40μ, tangential diameter 30—45μ; radial diameter of late wood tracheids 15—20μ, tangential diameter 25—35μ; length 2200—4000μ; wall of tracheids in early wood 3.5—4μ; in late wood 4—4.5μ thick; the inner wall of early-and late-wood tracheids with spiral thickenings. Tangential bordered pits of tracheids small and sparse; radial bordered pits of early wood tracheids in one row sometimes in pairs, one row in late wood, with elliptic and slanting aperture. Rays uniseriate, rarely biseriate, 1-38, mostly 2—18 cells high; ray parenchyma cells in early wood with 2 or 3 round semi-bordered pits in each cross-field, aperture elliptic, with 1 or 2 semi-bordered pits in late wood, aperture linear.

17. Pinus luchuensis Mayer

Plate. XVII. Figs. 97,98,99,100,101,102.

General Characteristics and properties:

Colour demarcation between sap-and heart-wood sometimes distinct, sometimes not; sap-wood light yellowish brown, heart-wood reddish yellow brown; grain straight; texture moderately coarse and uneven; very heavy (Sp. gr. 0.61, based on ovendey weight and green volume), very hard, very strong in bending and endwise compression, high in shock

resistance; somewhat difficult to work with tools; glues well; takes and and holds paints well, but the resin in heart-wood tends to discolor paint; shrinks considerably, apt to check if not well seasoned; durable when exposed to conditions favorable to decay.

Macroscopic Characteristics:

Growth rings distinct, delineated by a pronounced band of darker late wood, moderately wide to wide (approx. 8—15 per in), and variable in width. Early wood zone narrow; transition from early-to late-wood abrupt; late wood zone generally wide, occupying one-half or more of the ring, conspicuous to the naked eye, decidedly darker and denser than the early wood. Longitudinal parenchyma not visible. Rays fine (x), visible to the naked eye, forming a fine, close, relatively conspicuous fleck on the radial surface. Resin canals present (x), moderately large, appearing as white flecks in the dark late wood to the naked eye, moderately numerous, solitary or 2 contiguous in the tangential direction, forming conspicuous brownish streaks along the grain (t).

Microscopic Characteristics:

Longitudinal and transverse resin canals present; longitudinal canals distributed mostly in late wood, 90—110μ in diameter; tylosoids present; epithelium thin-walled; transverse resin canals much smaller, 30—45μ in diameter. Resin cells normally absent. Radial diameter of early wood tracheids 25—45μ, tangential diameter 20—40μ; radial diameter of late wood tracheids 8—15μ, tangential diameter 15—30μ; length 2500—5100μ; wall of tracheids in early wood 1.5—2μ, in late wood 3—8μ thick. Bordered pits on the tangential walls small and scarce, with round aperture; radial bordered pits of tracheids mostly in one row occasionally in pairs in early wood, one row in late wood. Rays of two types, uniseriate and fusiform; (1) uniseriate rays numerous, 1—30, mosty 2—15 cells high; (2) fusiform rays scattered, with a transverse resin canal, 2-3-seriate through the central portion, tapering above and below to uniseriate margins similar to the a rays, 13—28 cells in height; marginal ray tracheids small, thin-walled, non-dentate, with small bordered pits on the radial wall; ray parenchyma cells in early wood with one large simple pit in each cross-field, with one slit-like simple pit in late wood.

18. Podocarpus macrophyllus (Thunb.) Lamb.

Plate. XVIII. Figs. 103,104,105,106,107,108.

General Characteristics and properties:

Without clear colour demarcation between sap-and heart-wood; wood yellowish brown; grain straight; texture fine, dense and even; moderately heavy (Sp. gr. 0.46, based on ovendry weight and green volume), moderately hard, strong in bending and endwise compression, moderately high in shock resistance; works easily under tools, glues and holds paint well; shrinks little, stays in place well after seasoning; immune from the attack of termites, very durable when exposed to conditions favorable to decay.

Macroscopic Characterstics:

Growth rings barely distinct, delineated by a dark line or band of denser late wood, narrow to moderately wide (approx. 10—20 per in), and variable in width. false growth

rings present (often doubled or trebled). Early wood zone generally occupying most of the ring; transition from early-to late-wood very gradual; late wood zone scarcely distinct to the naked eye, somewhat darker than the early wood, generally narrow. Longitudinal parenchyma not visible. Rays very fine (x), visible with a hand lens, forming a fine, close, inconspicuous fleck on the radial surface.

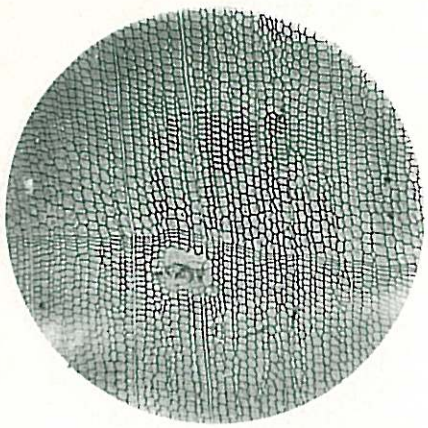
Microscopic Characteristics:

Longitudinal parenchyma cells (resin cells) scarce, scattered amony the tracheids as single cells, with dark resinous contents, Radial diameter of early wood tracheids 15-30μ, tangential diameter 15—30μ; radial diameter of late wood tracheids 6—15μ, tangential diameter 10—30μ; length 1000-4000μ; wall of tracheids in early wood 2.5—3μ, in late wood 4—5μ thick; Tangential bordered pits of late wood tracheids small and sparse; radial bordered pits of tracheids in one row in both early-and late-wood, with lenticular aperture in cross-appearance. Rays uniseriate, 1—21, mostly 2—10 cells high; ray parenchyma cells in early wood with 1-3 lenticular and slanting semi-bordered pits in each cross-field, with 1 narrowly lenticular and slanting pit in late wood.

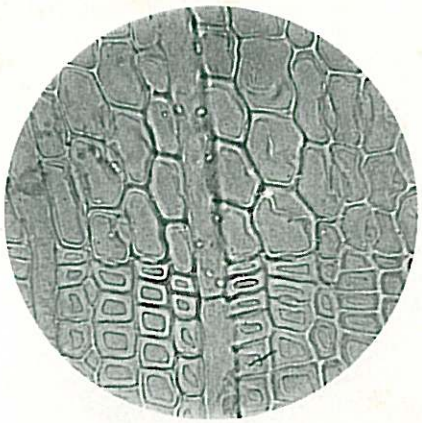
Ⅲ 圖 版

附 圖 版

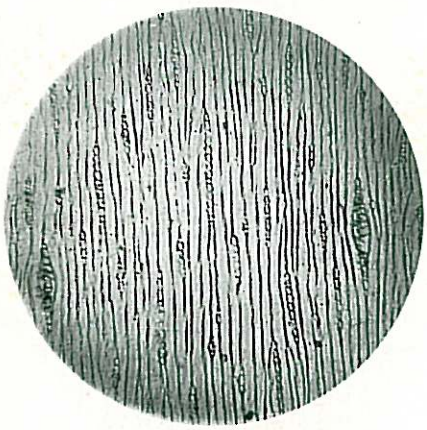
圖版第十三 (Plate XIII)



圖七十三 (Fig 73)
(X −95X)



圖七十六 (Fig 76)
(X −540X)



圖七十四 (Fig 74)
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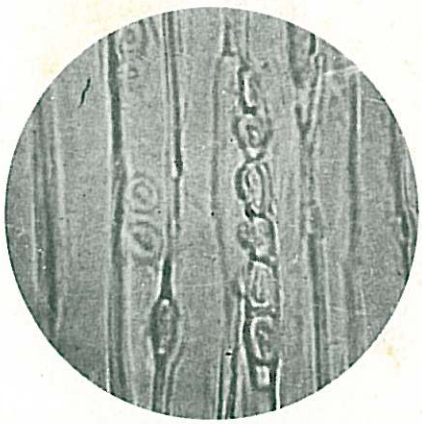

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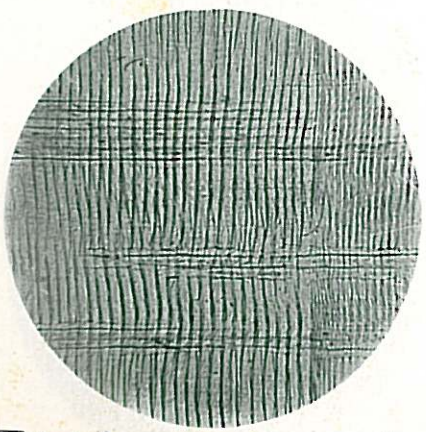
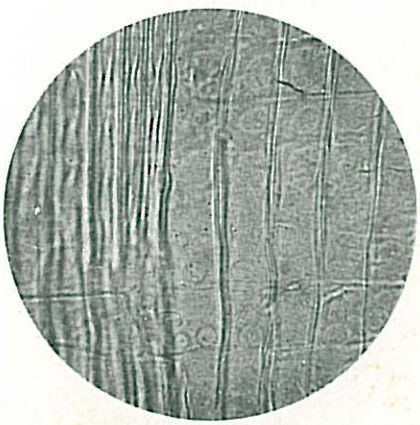
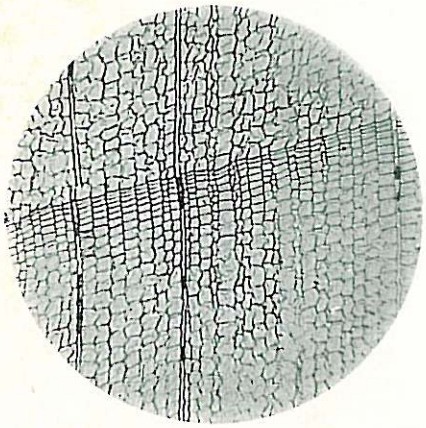


圖七十五 (Fig 75)
(r −95X)

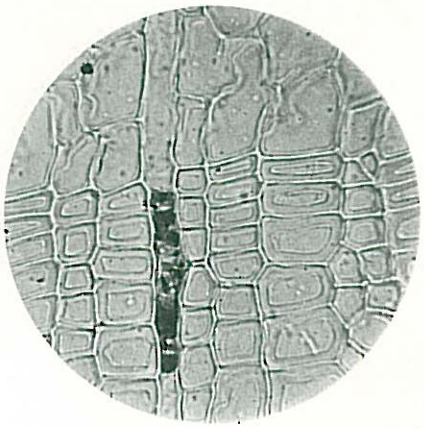


圖七十八 (Fig 78)
(r −540X)

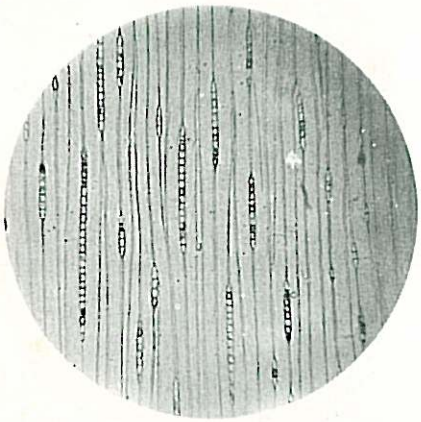
圖版第十四 (Plate XIV)



圖七十九 (Fig 79)
(X－95X)



圖八十二 (Fig 82)
(X－540X)



圖八十 (Fig 80)
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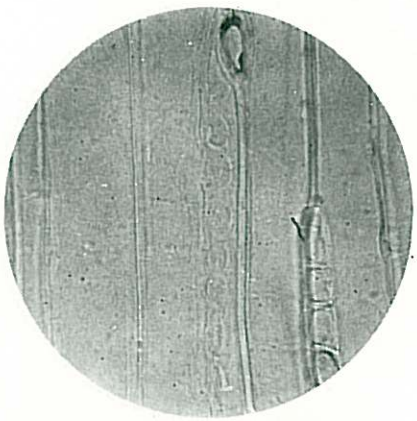

圖八十三 (Fig 83)
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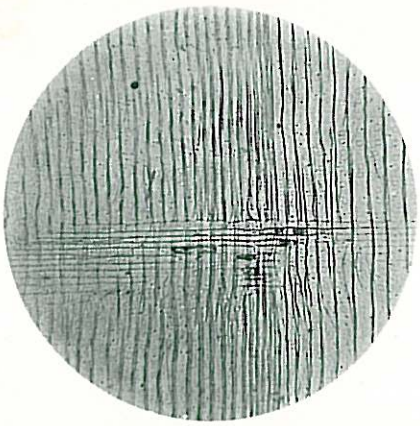

圖八十一 (Fig 81)
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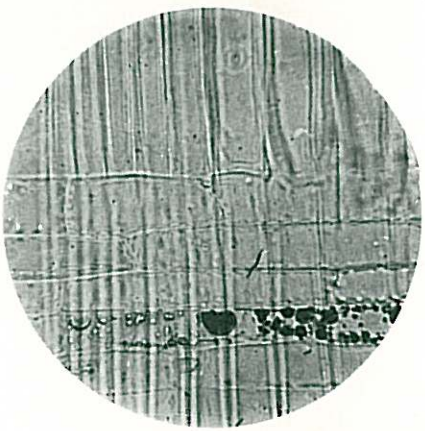
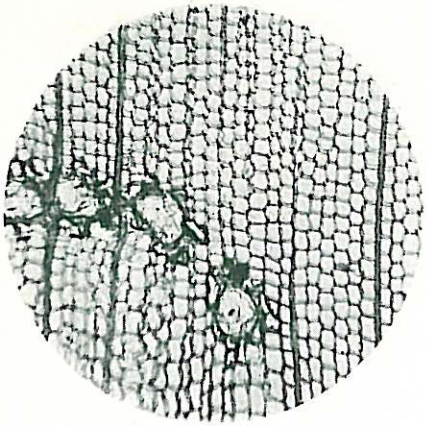
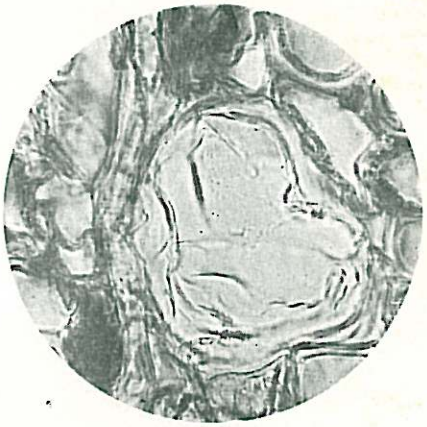


圖八十四 (Fig 84)
(r－540X)

圖版第十五 (Plate XV)

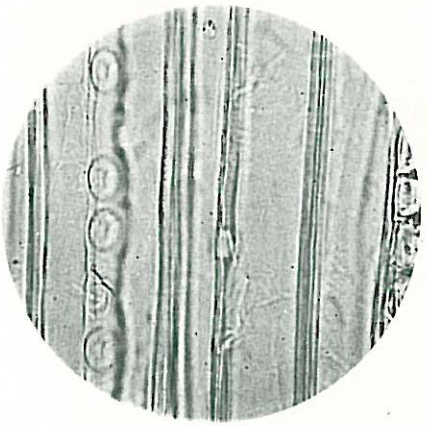


圖八十五 (Fig 85)
(X－95X)



圖八十八 (Fig 88)
(X－540X)

圖八十六 (Fig 86)
(t－95X)



圖八十九 (Fig 89)
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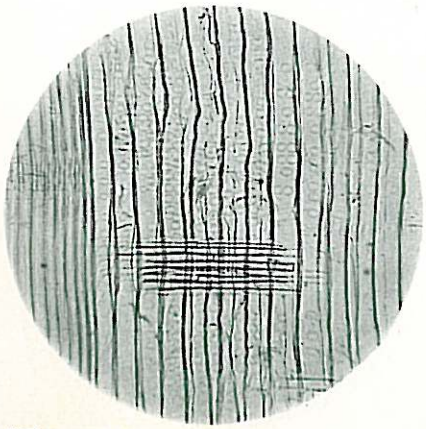

圖八十七 (Fig 87)
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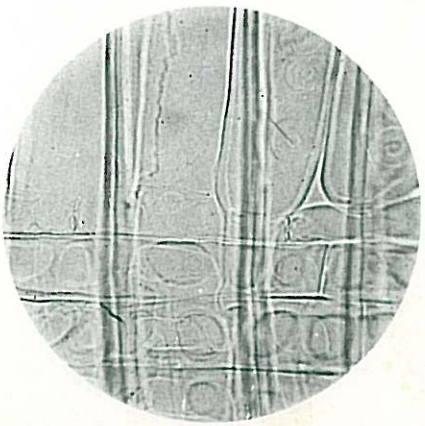
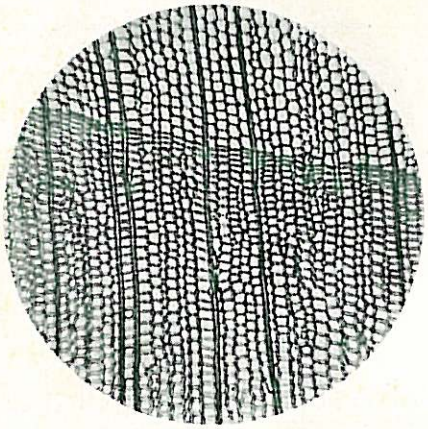


圖九十 (Fig 90)
(r－540X)

圖版第十六 (Plate XVI)



圖九十一 (Fig 91)
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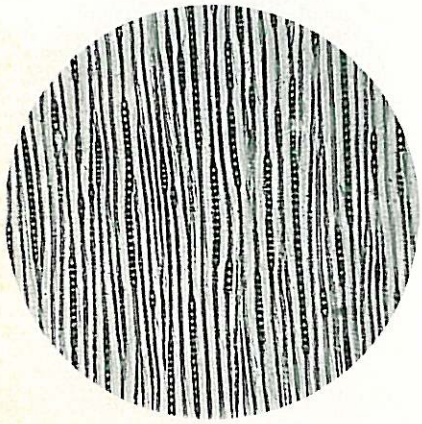

圖九十二 (Fig 92)
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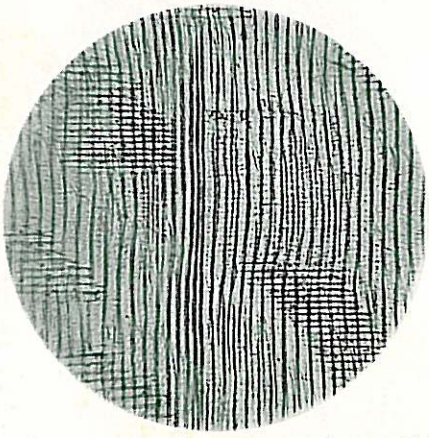

圖九十三 (Fig 93)
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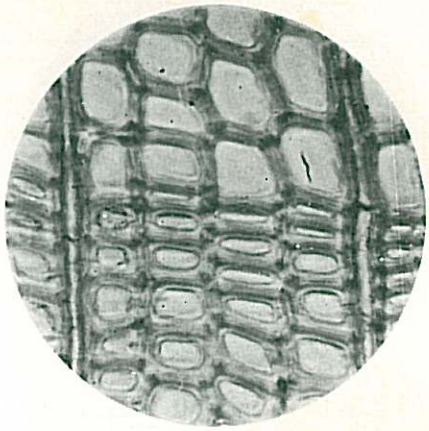
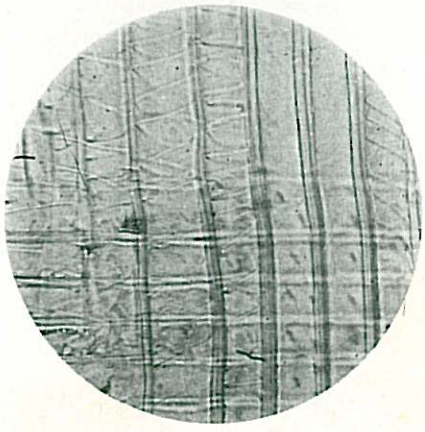


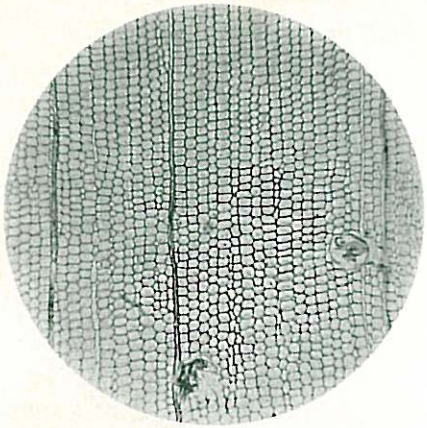
圖九十四 (Fig 94)
(X－540X)

圖九十五 (Fig 95)
((t－540X)



圖九十六 (Fig 96)
(r－540X)

圖版第十七 (Plate XVII)



圖九十七 (Fig 97)
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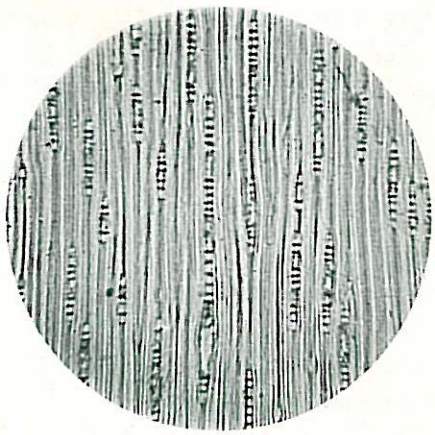

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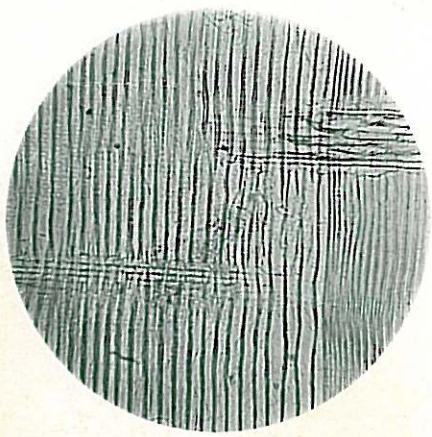

圖九十九 (Fig 99)
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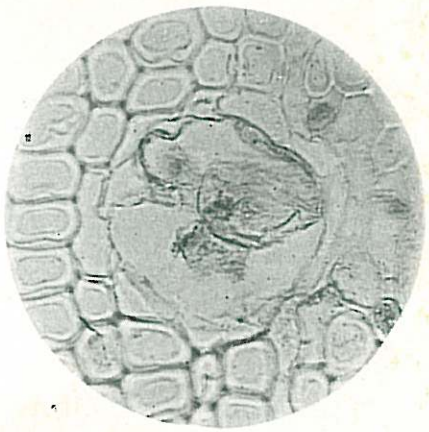

圖一〇〇 (Fig 100)
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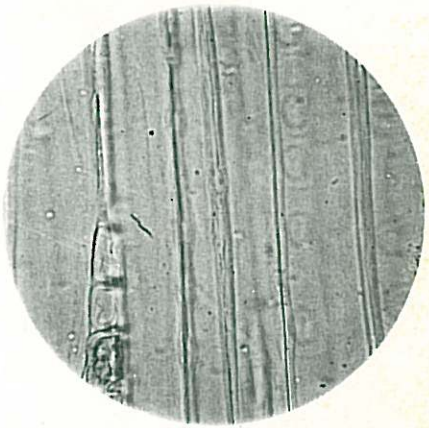

圖一〇一 (Fig 101)
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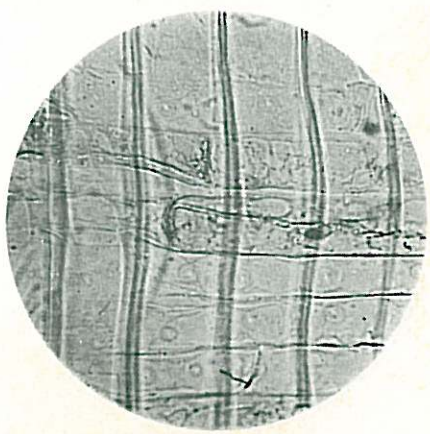

圖一〇二 (Fig 102)
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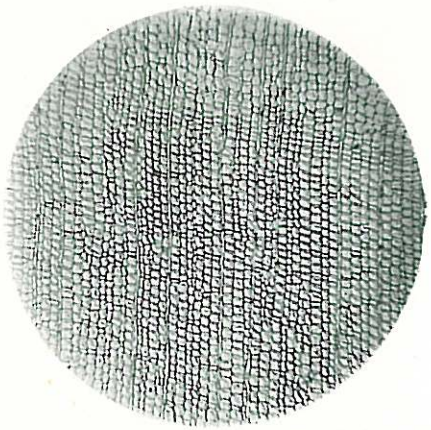
圖版第十八　(Plate XVIII)



圖一〇三　(Fig 103)
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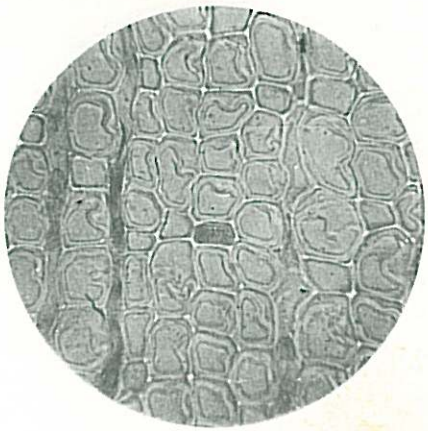

圖一〇六　(Fig 106)
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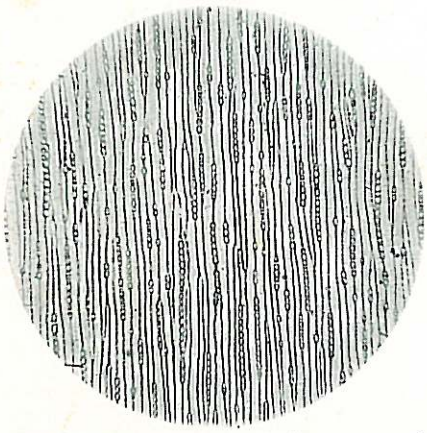

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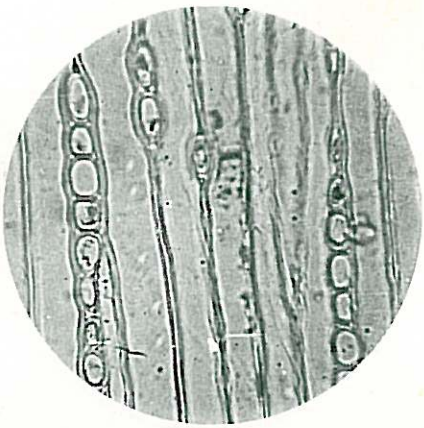

圖一〇七　(Fig 107)
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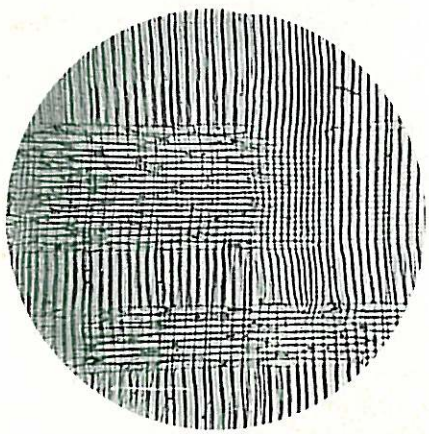

圖一〇五　(Fig 105)
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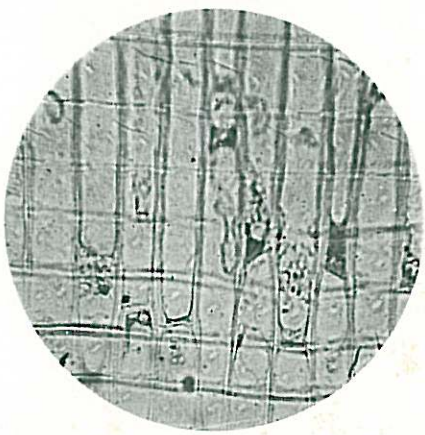

圖一〇八　(Fig 108)
(r－540X)

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蔣福慶：臺灣產主要針葉樹材之構造與材性之研究，臺灣省林業試驗所報告第 154 號，民國五十六年十二月。

研究樹種：

1. 紅　　檜 (Chamaecyparis formosensis Mats.)
2. 櫸 大 杉 (Cunninghamia konishii Hay.)
3. 臺灣雲杉 (Picea morrisonicola Hay.)
4. 臺灣五葉松 (Pinus formosana Hay.)
5. 臺灣扁柏 (Chamaecyparis taiwanensis Mas. et Suzuk.)
6. 臺 灣 杉 (Taiwania cryptomerioides Hay.)
7. 威氏粗榧 (Cephalotaxus wilsoniana Hay.)
8. 鐵　　杉 (Tsuga chinensis Pritz.)
9. 臺灣肖楠 (Libocedrus formosana Florin.)
10. 馬 尾 松 (Pinus massoniana Lamb.)
11. 柳　　杉 (Cryptomeria japonica D. Doon.)
12. 廣 葉 杉 (Cunninghamia lanceolata (Lamb.) Hook.)