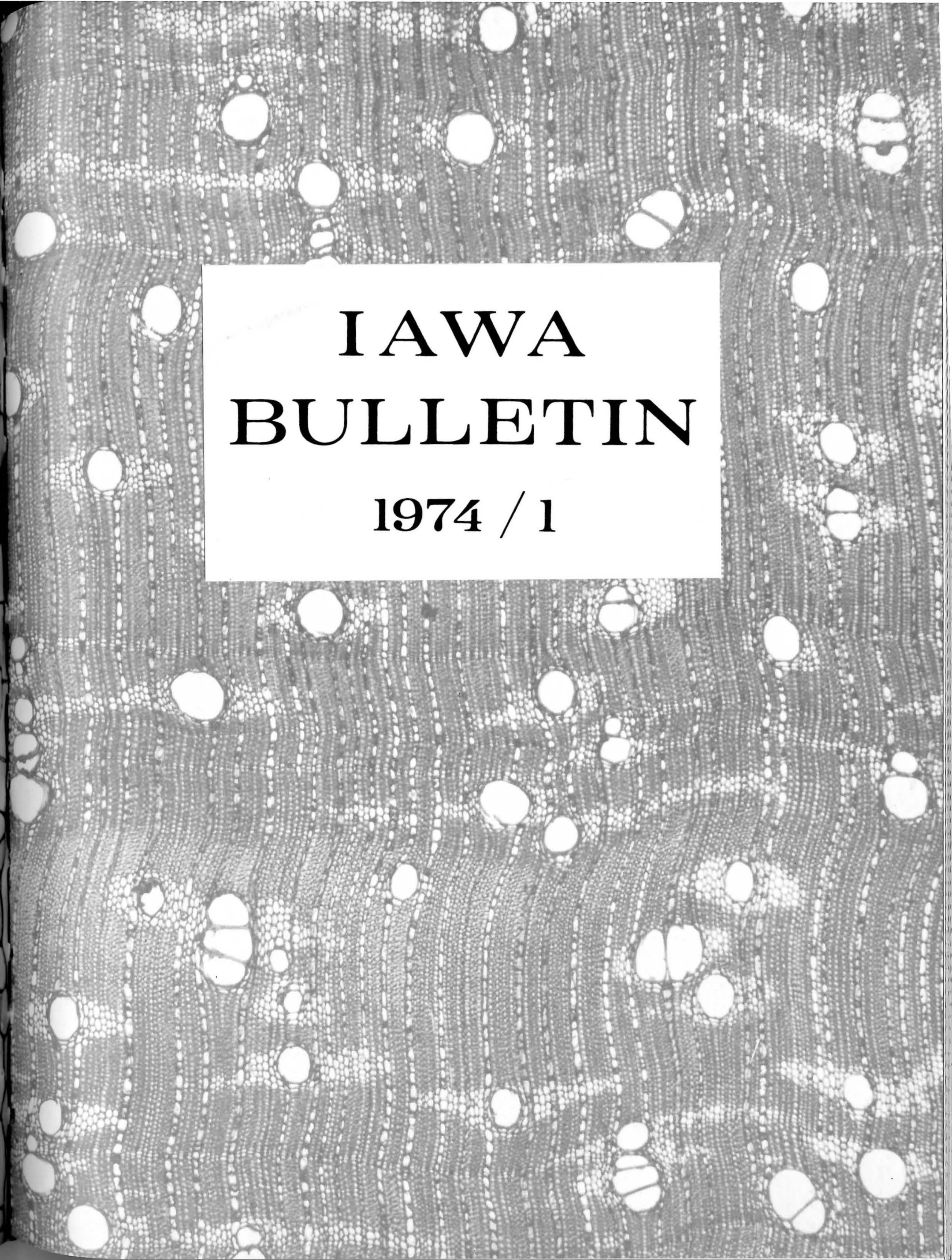
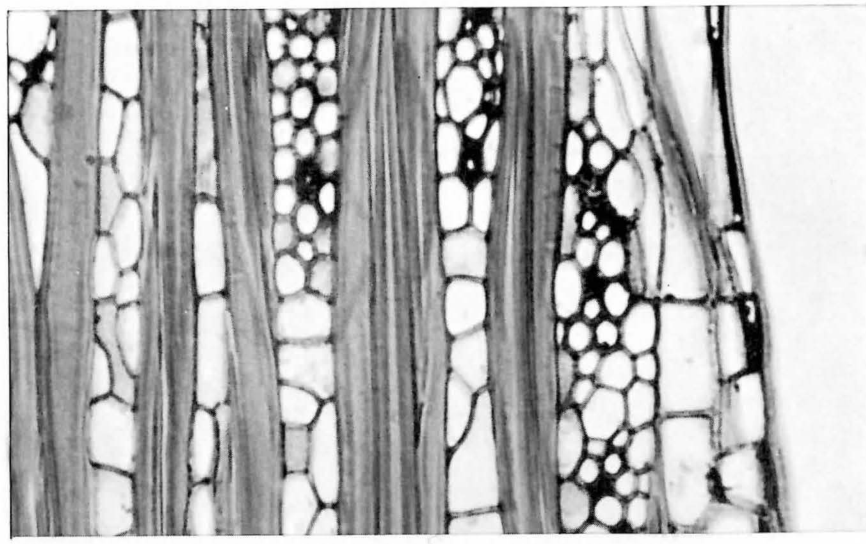
IAWA BULLETIN

1974 / 1





IAWA BULLETIN

1974 / 1

INTERNATIONAL ASSOCIATION OF WOOD ANATOMISTS

STATE UNIVERSITY OF NEW YORK / COLLEGE OF FORESTRY / AT SYRACUSE UNIVERSITY

SYRACUSE, N.Y. 13210 / U.S.A.

OUR COVER

The photographs are of *Eschweilera reversa* Pittier (Lecythidaceae) taken from Pittiers' type collection No. 4394 (US 679549-50). This Panamanian example of the large genus *Eschweilera* is unusual both within the genus and the family in that the wood exhibits aliform parenchyma whereas the family otherwise is characterized by the presence of paratracheal parenchyma in bands which vary from uniseriate to 6-8+ seriate.

. . . .

The International Association of Wood Anatomists was organized in 1931 to advance the knowledge of wood anatomy in all its aspects. It does this in part by attempting to promote and facilitate cooperation among the relatively small number of specialists in wood anatomy.

Prospective members are invited to write to the Office of the Executive Secretary for a copy of the Constitution, an application form, and information about IAWA. Membership dues, which includes a subscription to the IAWA Bulletin, are currently $5.00 (U. S.) per year.

EDITORIAL

We are pleased to report that 1974 has started on a more optimistic note than some recent years have. Our readers need to go back only a year or two to find appeals for more papers. We were not trying to create a backlog; it was just an effort to meet each issue with one or two papers. Having a few good papers well in advance of our publishing deadlines is of great help. Please keep them coming.

Association finances have been a cause for worry. During the past year it was necessary to transfer funds from the meager balance in the savings account just to meet current expenses. There was some concern about our ability to pay for Bulletin costs for this and later issues in 1974. Fortunately, the response from members who paid their 1974 dues right on schedule has helped us through this critical period. More than one-third of our members have already paid! Some paid for 1975 and 1976, and a few paid for 1970, 1971, 1972 and 1973, all of which should keep us operating through this year without requesting an increase in dues from the current $5.00.

There has also been gratifying response to the questionnaire which appeared on the reverse side of the dues statement. Many have indicated their intention of attending the XII International Botanical Congress and quite a large number have offered papers for the technical sessions our committee is trying to organize. We trust that each member will consider seriously the possibility of attending and contributing to the success of the meetings. We have few occasions for social and professional exchange. Once in five or six years we must assemble at least a nucleus of the Association so we urge you to consider 1975 as <u>the</u> year for your participation.

W. A. Côté
C. H. de Zeeuw

On the Nature of the First-formed Tracheids in Compression Wood

By

H. R. Höster[1]

In a recent study Timell (1972) discussed the structure of the last-formed tracheids in compression wood. He showed that these tracheids, while lacking intercellular spaces and being flattened in the radial direction, in all other respects were typical compression wood cells with thick S_1 and S_2 layers, helical cavities, and a distribution of lignin typical of compression wood tracheids. In contrast, the first rows of tracheids at the beginning of the growth season look like normal tracheids (Fig. 1). They possess a rectangular form and helical cavities; intercellular spaces do not occur. Ultrastructural characteristics and chemical composition of the cell wall are similar to those of the later formed typical compression wood (Côté, Day, Kutscha and Timell 1967). The authors suppose that "obviously there is some factor lacking when these cells are formed, which prevents them from assuming their usual form. What this factor is cannot be decided at present". Until now the nature of these first-formed tracheids has not been studied again.

During an investigation of cambial activity and production of xylem and phloem cells special emphasis was given to the formation of "compression wood" at the beginning of the growth season. Observations were made from

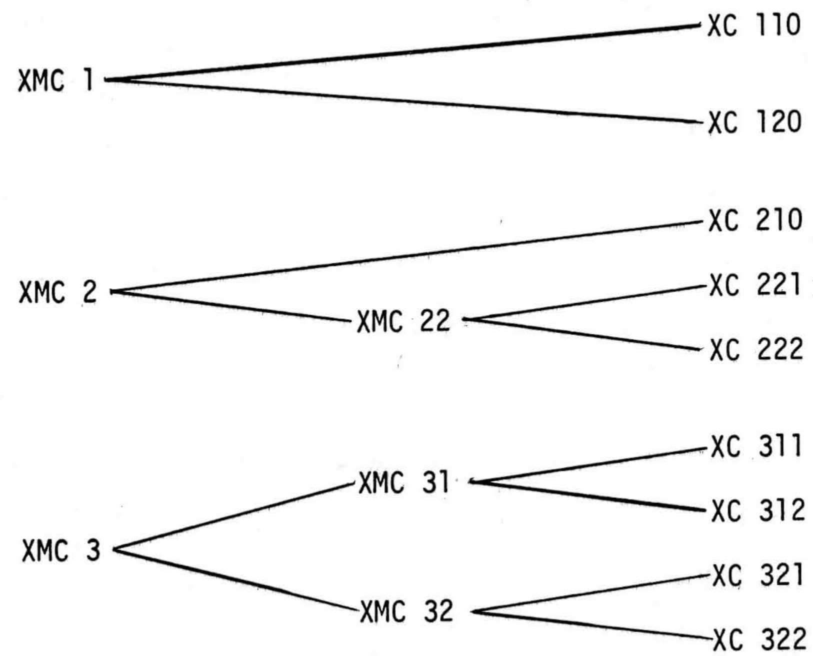
[1]Research Scientist, Institut für Holzbiologie und Holzschutz, Bundesforschungsanstalt für Forst- und Holzwirtschaft Reinbek, D-205 Hamburg 80, Germany, Leuschnerstrasse 91d (BRD).

April to October 1972 on 30-year-old stems of *Picea abies* (L.) Karst., grown in the Saxon Forests near Hamburg. The terminology proposed by Wilson, Wodzicki and Zahner (1966) for cambium and its derivatives has been used in the present paper.

In the dormant stage the cambial zone consists mostly of 5-6 cells which cannot be distinguished from each other cytologically; they are radially flattened and thin-walled. After a study of the development it could be concluded that the cambial zone consists of one overwintering phloem mother cell, one cambial initial and 3-4 overwintering xylem mother cells (= XMC). Shortly before the initiation of mitotic activity in the cambial initial, the phloem mother cell is enlarging radially and differentiates into one sieve cell or by division into two. The first sign of periclinal division in the cambial initial to produce phloem cells was observed on April 14; a few days later the xylem mother cells began to enlarge and divide. The rate of division was greatest in the upper region of the crown and lowest in samples at breast height. Three weeks later groups of 2-4 cells could be recognized on the basis of their arrangement and differences in thickness of the tangential wall (Fig. 2). Cell-grouping, mostly of two cells, was recognized first by Sanio (1873) in the differentiating xylem of *Pinus silvestris* L., but his observations relate to late seasonal activity in early July or in August. On the contrary Mischke (1890) showed cell-groups of 2-4 cells in the first-formed xylem of *Pinus silvestris* L., produced by overwintering cells of the cambial zone. Light- and electron microscopic investigations on the cambium of *Pinus radiata* (Mahmood 1968) and *Pinus strobus* L. (Murmanis 1970) always showed

groups of four cells. Theoretical considerations on cambial activity were contributed by Bannan (1962), Mahmood (1968) and Brown (1970).

Our observations on the sequence of divisions in the cambial zone of compression wood at the beginning of the season do not always confirm the results in the literature cited above, especially with regard to the grouping of cells. If XMC 1, XMC 2 and XMC 3 are three overwintering xylem mother cells (XMC 1 at the boundary of growth ring) the sequence of xylem cells (XC) at the beginning of the growth season will be as follows:



If there is one more xylem mother cell, four cells will arise after subsequent divisions. The behaviour of xylem mother cells varies in different radial files, but generally the sequence of cell divisions resembles the scheme mentioned above. In this way, the first 9-13 xylem cells are to be derived from overwintering XMC and all further tracheids originate from the cambial initial itself. On the other hand the same number of first-formed tracheids in a growth ring with compression wood look like normal tracheids. This leads to the hypothesis that these tracheids are derived from xylem mother cells in late summer of the previous year.

Considering the results of Nečesaný (1958) and others, according to which formation of compression wood is correlated with the presence of large amounts of IAA in the cambium, one can expect that at times of low IAA-availability (late July/August) no more compression tracheids are produced. During this time, after formation of the last latewood tracheids, the cambial initial produces 3-4 xylem mother cells. Consequently these cells are not destined to differentiate into compression tracheids in the following spring. After the initiation of the first-formed tracheids these cells show a rectangular outline and thin walls without helical cavities, thus resembling normal tracheids. In most cases there exists a transition zone between the first-formed "normal" tracheids and typical compression wood tracheids.

In normal wood of straight-grown trees there is no visible difference between the tracheids which are derived from xylem mother cells of the previous year and those from the cambial initial or xylem mother cells from the current year; reaction wood on the contrary, shows this striking difference.

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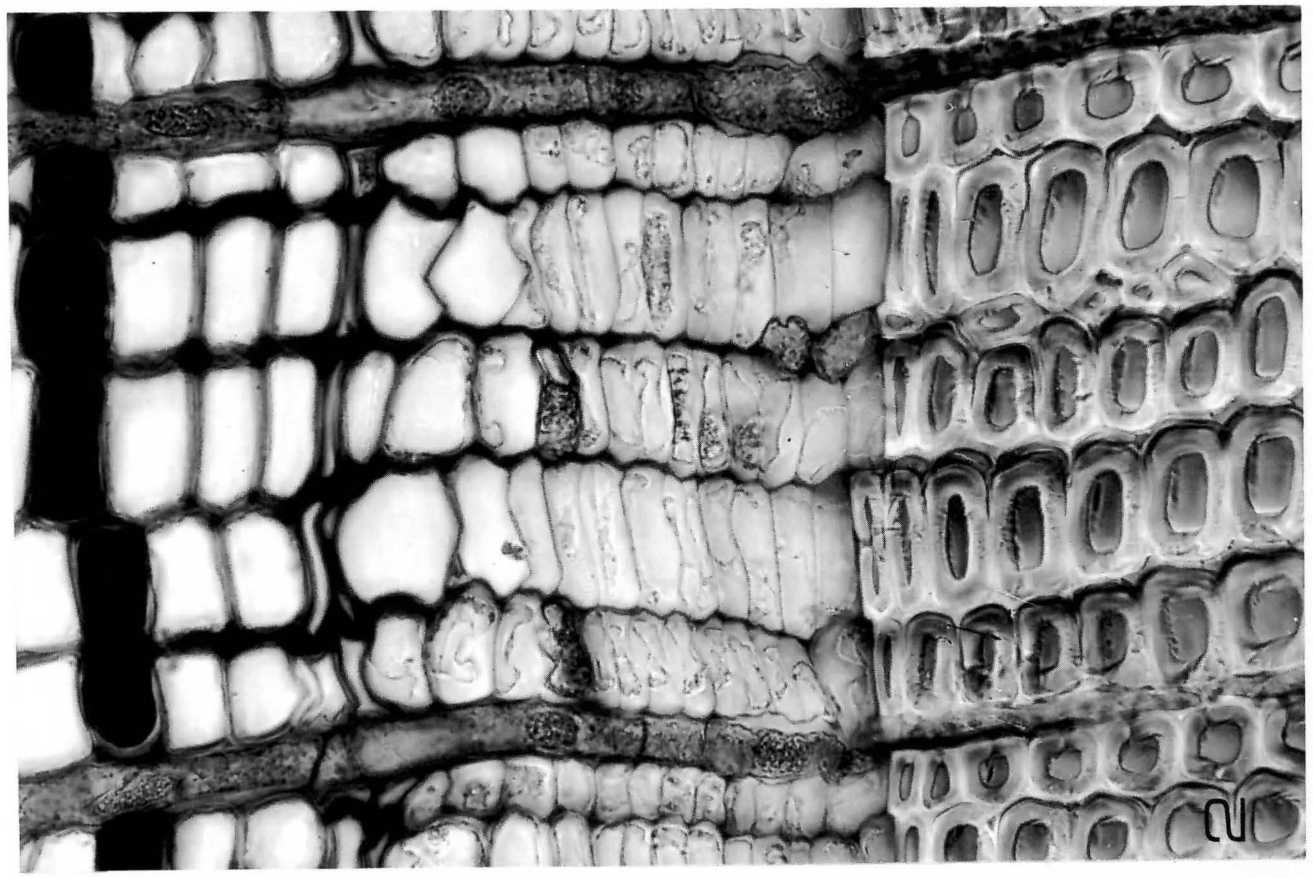
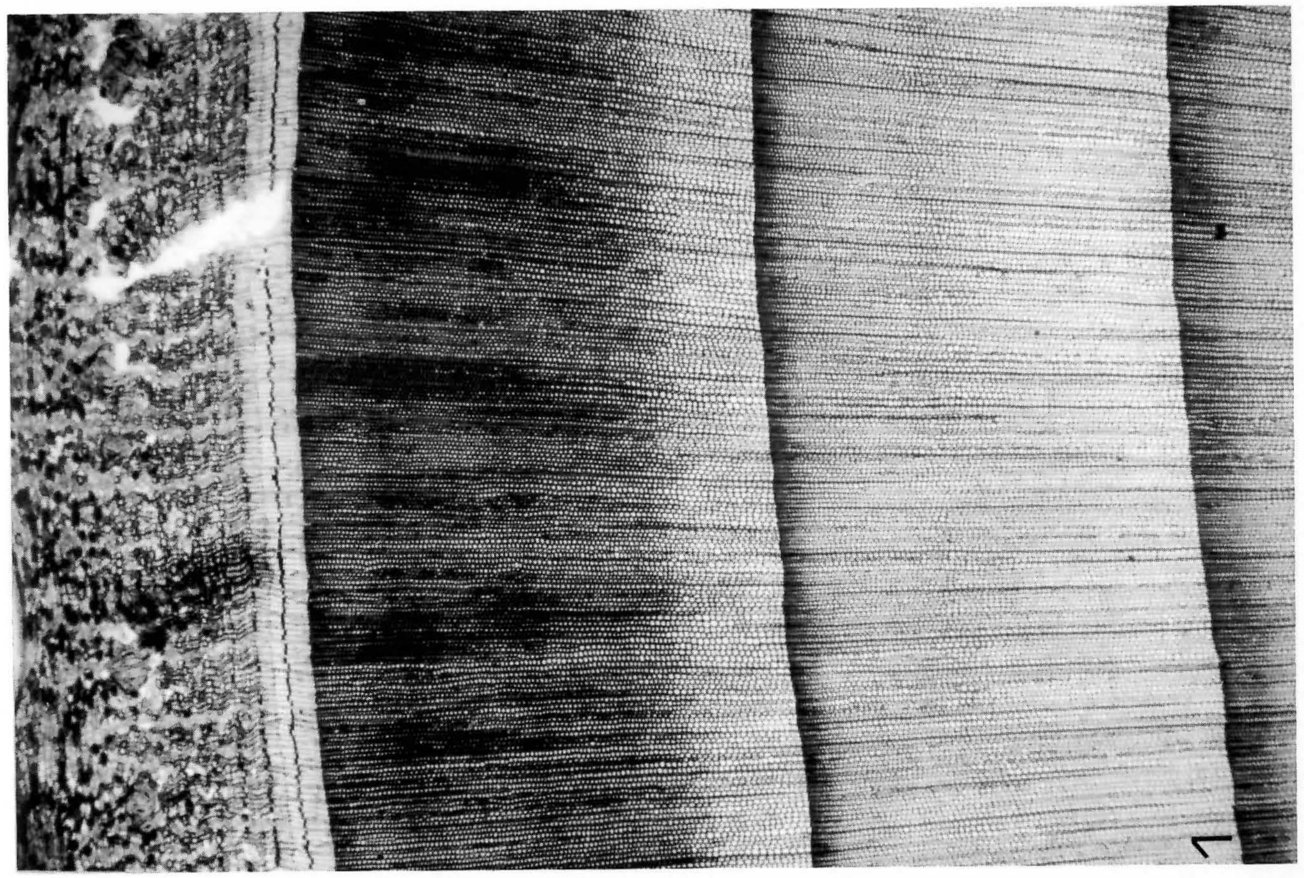
FIGURES

Figure 1. Transverse section of normal and compression wood in *Picea abies* (October 1972); note the normal tracheids at the beginning of the growth ring 1972 (20X).

Figure 2. Transverse section of the cambial zone in *Picea abies* (19.5.1972), showing typical grouping of 2-4 cells (480X).





Vestured Vessel and Fibre Pits in *Persoonia toru* A. Cunn. (Proteaceae)

By

B. G. Butterfield[1] and B. A. Meylan[2]

Vestures are outgrowths or deposits in the bordered pit cavities of the vessel members and fibres of certain dicotyledonous woods. They are known to occur in almost all the members of the Leguminosae (Schmid, 1965) and in some members of a number of other families (Record, 1936; Bailey, 1933; Metcalfe and Chalk, 1950). These published lists do not make reference to an occurrence in the Proteaceae.

During a survey of the structure of New Zealand woods currently being undertaken by the present authors, prominent vestures were observed in both the vessel and the fibre pits of *Persoonia toru* A. Cunn., a member of the Proteaceae endemic to New Zealand.

Samples of sapwood and heartwood were collected from a number of mature trees of *Persoonia toru* growing naturally in forests of North Auckland, New Zealand. Cubes of wood were prepared for examination in the scanning electron microscope by our usual technique (Exley, Butterfield and Meylan, 1973) and examined using a Cambridge Series IIA scanning electron microscope.

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[1]Lecturer, Department of Botany, University of Canterbury, Christchurch, New Zealand.

[2]Research Scientist, Physics and Engineering Laboratory, Department of Scientific and Industrial Research, Lower Hutt, New Zealand.

The wood of *Persoonia toru* conforms with the general description given in Metcalfe and Chalk (1950) for this genus. The vessels and axial parenchyma are arranged in more or less concentric bands, alternating within the growth ring with bands of thick walled fibres (Fig. 1). The vessel members are of medium length with oblique, exclusively simple perforation plates. Slight helical thickenings occur on some vessel walls. Both uniseriate and multiseriate rays are common.

Almost all of the vessel pits are prominently vestured (Figs. 2-4). This includes vessel to vessel, vessel to fibre and vessel to ray pitting. The vestures line the pit canals (Fig. 4) and completely occlude most of the pit apertures, forming prominent mounds often extending over the vessel walls well beyond the limits of the pit apertures. Occasional isolated vestures occur on the vessel walls between the pits where they can usually be distinguished from the particles of the warty layer by their larger size (Figs. 2 and 3). All the vessel pits are bordered but the shape of the apertures is almost impossible to ascertain because of the vesturing. The distribution of the vestures suggests that the apertures of the intervessel pits are oval to slit shaped, the long axis of the opening being almost at right angles to the long axis of the cell (Fig. 2). The vessel to fibre and vessel to ray pits are more circular in outline.

The fibre pits are only slightly bordered, their slit-shaped apertures being aligned along the long axis of the cell. Most of the fibre pits are also vestured (Figs. 5-7). In most cases, however, the vestures do not form prominent outgrowths from the cell wall as in the vessels. When present, they occur in the pit canal, especially at the inner aperture and

spread by varying amounts onto the inner wall of the fibre. In extreme cases they cover an extensive area of the inner wall adjacent to the pit apertures (Fig. 8).

Ray and axial parenchyma cell pits are completely free from any trace of vesturing.

The similarity in appearance of the vestures and the particles of the warty layer has led to speculation that the two structures could be of common origin (Côté and Day, 1962). The observation that the vestures in *Persoonia toru* can spread onto the cell walls well beyond the pit apertures lends further weight to this belief.

ACKNOWLEDGMENT

The authors are indebted to Mr. R. C. Lloyd, New Zealand Forest Service, and to Mr. A. P. Druce, Botany Division, D. S. I. R., for separately collecting and identifying material of *Persoonia toru*, and to Mr. R. Exley for preparing the specimens for the scanning electron microscope.

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FIGURE LEGENDS

Figure 1. Transverse and tangential faces of a cube of *Persoonia toru* wood. 140X.

Figure 2. Surface view of a vessel wall showing the prominent vesturing of the intervessel pits. 1750X.

Figure 3. Detail of a vessel wall surface. 8000X.

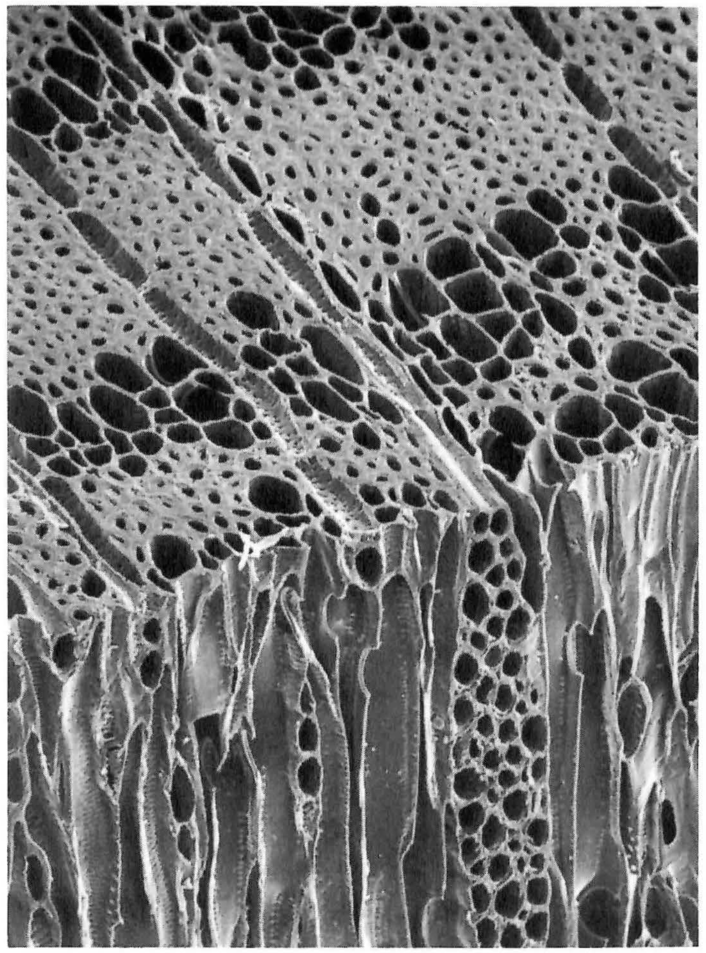
Figure 4. Longitudinal section of the walls of two adjacent vessel members showing the position of the vesturing with respect to the pit chamber and membrane. 7750X.

Figure 5. Fibres in longitudinal view showing vestured fibre pits with the vestures spreading over the cell wall. 3200X.

Figure 6. Detail of the lower pit shown in Figure 5. 14,250X.

Figure 7. Another less prominently vestured fibre pit. 10,750X.

Figure 8. A fibre where the vesturing has spread over an extensive area of the fibre wall. 4500X.



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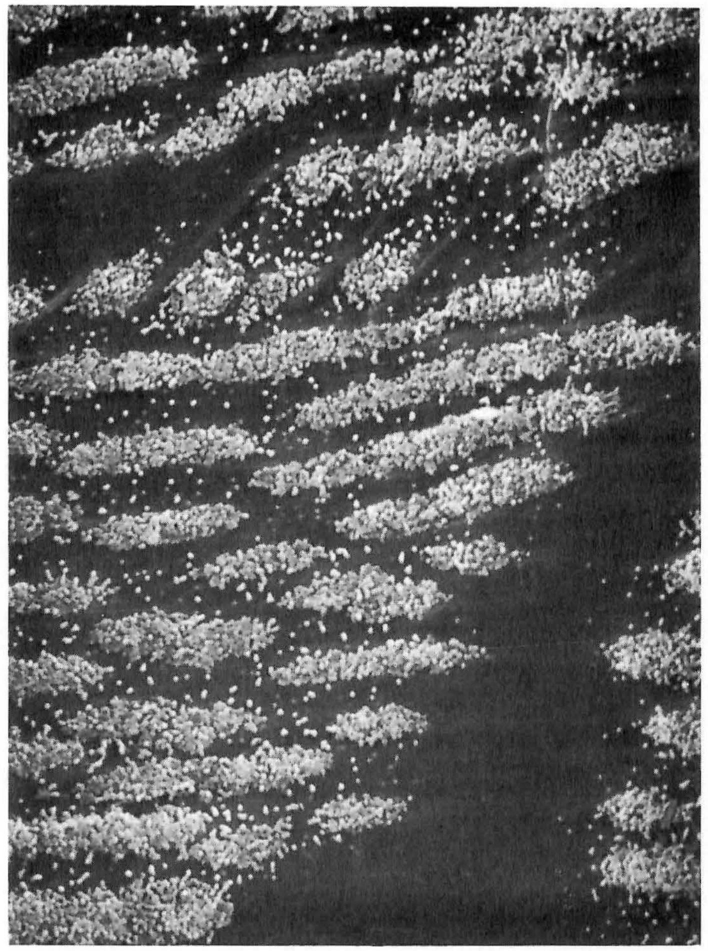

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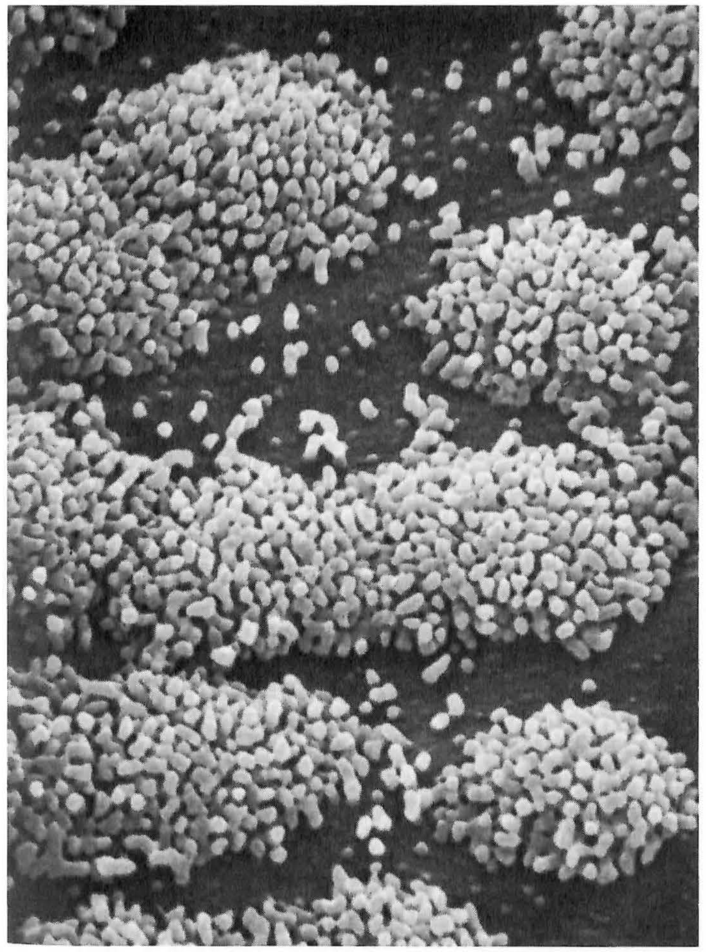

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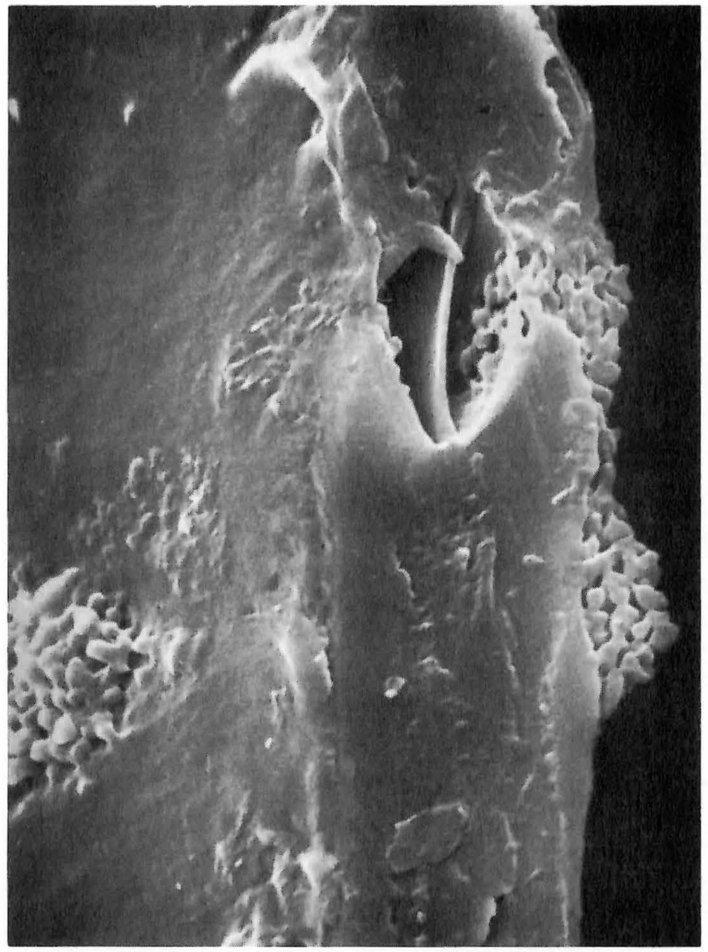

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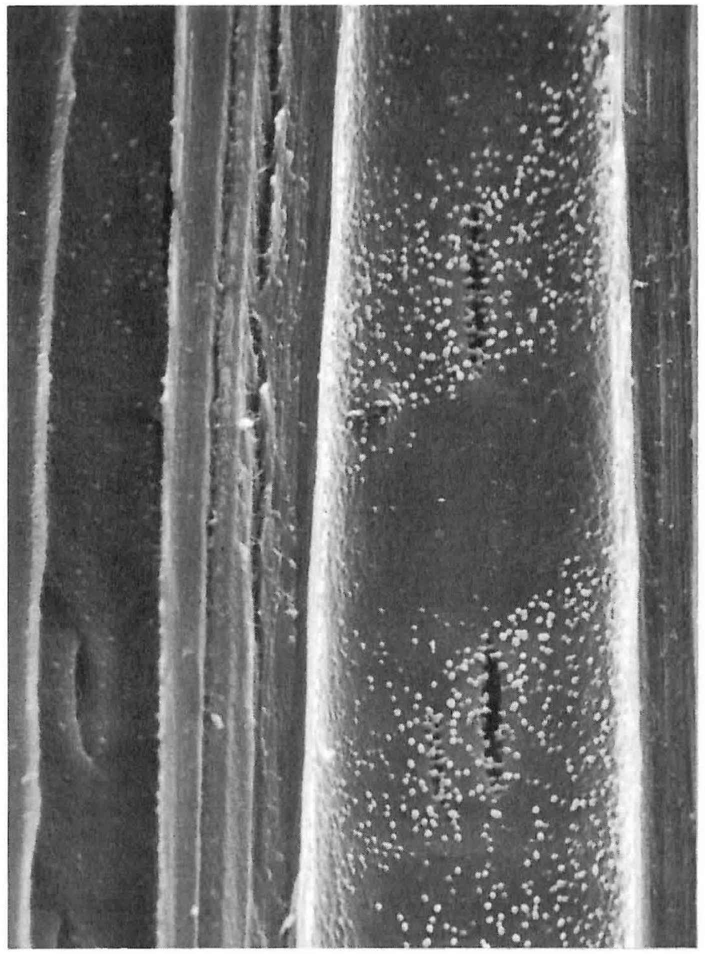

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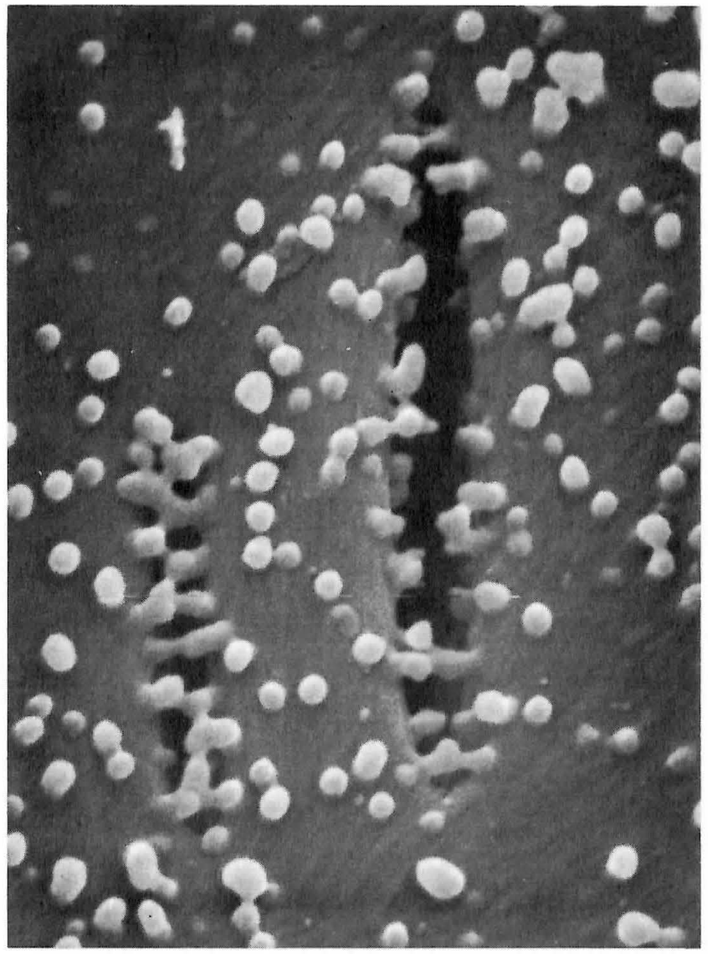

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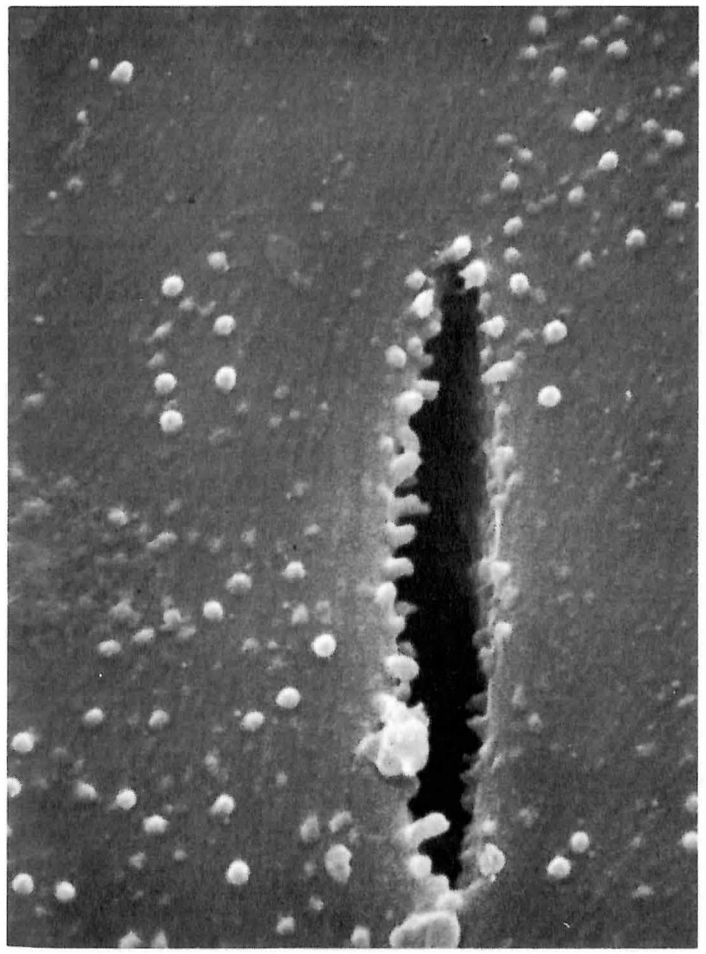

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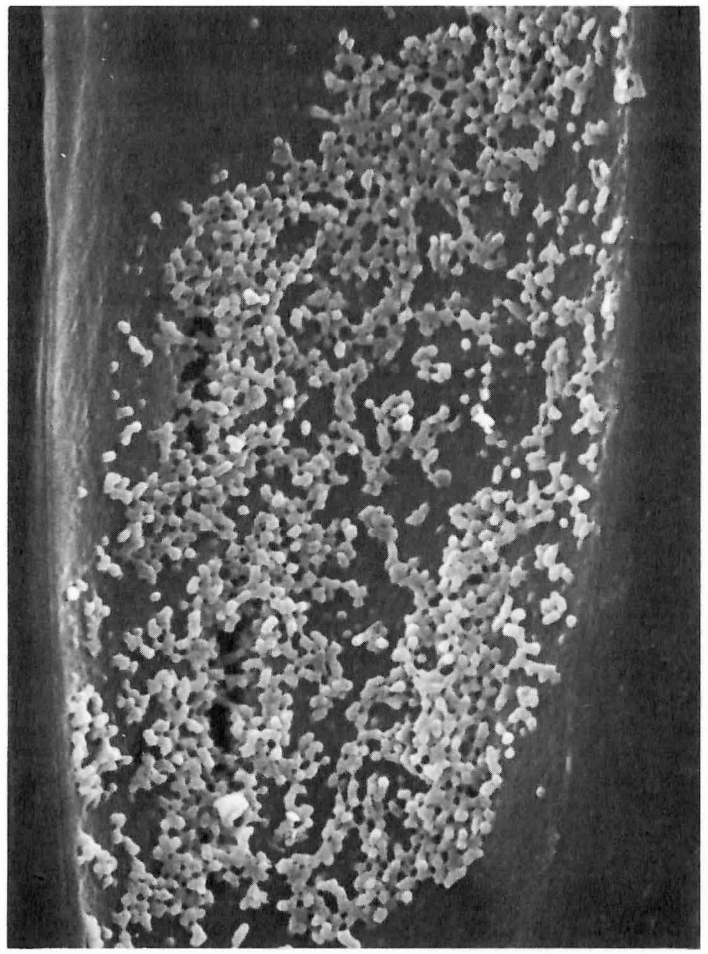

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Slip Planes and Minute Compression Failures in Kraft Pulp from *Populus* Tension Wood

By

J. G. Isebrands and R. A. Parham[1]

Tension wood and its properties are important in appraising the wood quality of hardwoods to be used for pulp (Perem and Clermont, 1961). In *Populus*, tension wood is characterized by the presence of gelatinous fibers (Fig. 1) having a gelatinous (G) layer as the innermost layer of the cell wall (Wardrop and Dadswell, 1948; 1955). The gelatinous layers are cellulosic, highly crystalline, and are loosely attached to the S_2 wall lamellae (Fig. 2).

Pulps made from tension wood are usually deficient in bonding properties. Thus, the resulting papers are inferior in strength properties such as fold, burst, and tensile (Jayme and Harders-Steinhäuser, 1953). The reduced strength of these papers appears to be associated with (1) bulkiness contributed by the G-layer (Fig. 2), which hinders fiber collapse, (2) the lower hemicellulose content which limits interfiber bonding, and (3) the presence of discontinuities called slip planes and minute compression failures which lower the strength of individual fibers.

Slip planes and minute compression failures have been studied extensively in wood cell walls (Dinwoodie, 1968; Keith and Côté, 1968; Keith, 1971; 1972). They have described slip planes as single folds in the

[1]Wood Anatomist, North Central Forest Experiment Station, Rhinelander, Wisconsin and Research Fellow, Institute of Paper Chemistry, Appleton, Wisconsin, respectively.

cell wall resulting from linear displacement of wall lamellae, usually associated with longitudinal compressive stress. Minute compression failures, on the other hand, result from a similar distortion of the wall lamellae leading to V-shaped double folds in the cell wall.

Slip planes and minute compression failures have been identified as characteristics of tension wood by numerous investigators including Wardrop and Dadswell (1948; 1955), Robards (1967) and Isebrands and Bensend (1972), although their appearance may be different from those commonly found in conifer tracheids. The objective of this work is to describe the slip planes and minute compression failures on the fiber surfaces of tension wood in juvenile *Populus* after kraft pulping.

Matchstick-sized chips of tension wood and normal wood were taken from various positions within the stems of several *Populus tristis* trees. The trees were grown at 1 ft. x 1 ft. spacings in maximum yield plots in northern Wisconsin (Dawson and Hutchinson, 1972). The chips were then pulped by the kraft process in the laboratory at the Institute of Paper Chemistry (Thode, Peckham, and Daleski, 1961). After pulping the chips were washed, air dried, and mounted on SEM specimen pedestals for coating with carbon and gold-palladium (Isebrands and Parham, in press).

The surfaces of pulped chips of normal wood (Figure 3) and tension wood (Figure 4) differ at low magnification. Tension wood has a large number of slip planes and minute compression failures on the G-fiber surfaces as opposed to the smooth surface of normal wood. These structures are seen in greater detail in Figs. 5 and 6. It is suggested that the slip planes and minute compression failures shown in these micrographs (Fig. 6)

may result from differential shrinkage in the cell wall layers upon drying (Isebrands and Parham, in press). This phenomenon may be related to the lack of lignification and large fibril angle to the cell axis in the S_2 of tension wood, which both contribute to excessive longitudinal shrinkage.

To facilitate fiber separation, the pulped chips were beaten mildly in a Waring blender and dried down on a glass slide for SEM observations. Figures 7 and 8 illustrate the slip planes and compression failures present after fiber separation and beating. Note that the folds lie at an angle of approximately 70° to the long axis of the fiber.

In summary, kraft pulps made from tension wood of juvenile *Populus* stems develop numerous slip planes and minute compression failures upon drying. Such discontinuities, together with fiber bulkiness, and lower hemicellulose content no doubt detract from the quality of paper products made from tension wood.

LIST OF FIGURES

Figure 1. Scanning electron micrograph (SEM) of a cut, transverse surface of tension wood. Note the presence of thick, loosely attached gelatinous layers in nearly every fiber (360X).

Figure 2. Several gelatinous fibers showing the loose attachment of the G-layer to the S_2. The thick G-layer contributes to the bulk of the fiber (3000X). SEM.

Figure 3. Normal wood chip after kraft pulping showing the smooth fiber surfaces (400X). SEM.

Figure 4. Tension wood chip after kraft pulping. Note the numerous slip planes and minute compression failures on the G-fiber surfaces (400X). SEM.

Figure 5. Normal wood after kraft pulping. Note fiber separation at the middle lamella, the smooth fiber surfaces, and absence of slip planes and minute compression failures (1500X). SEM.

Figure 6. Tension wood after kraft pulping. Fiber separation is at the middle lamella, and the fiber surfaces appear rough due to slip planes and minute compression failures (1500X). SEM.

Figure 7. Gelatinous fiber dried onto glass after mild beating. Note slip planes and minute compression failures which may detract from the quality of paper products made from tension wood (1200X). SEM.

Figure 8. Higher magnification of Figure 7. Note that the slip plane folds appear to be at approximately 70° from the long axis of the fiber (2500X). SEM.

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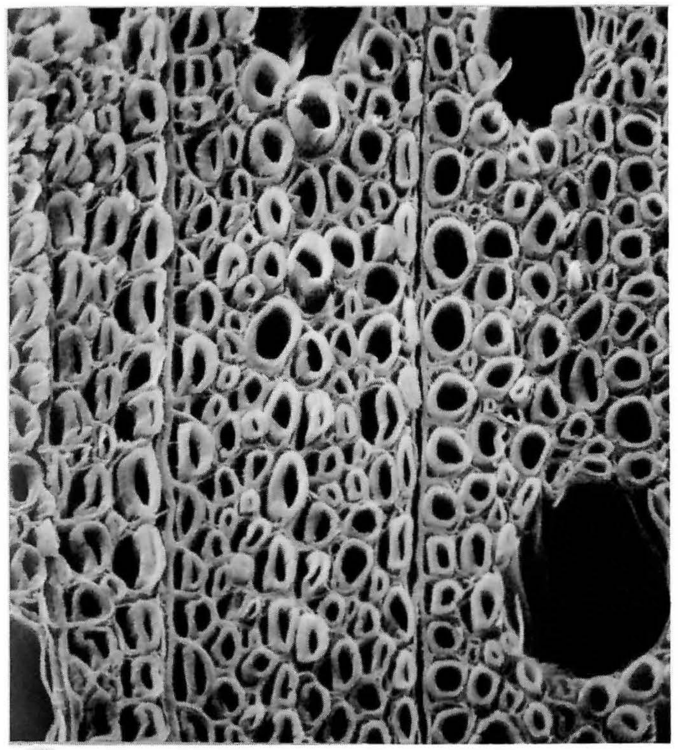

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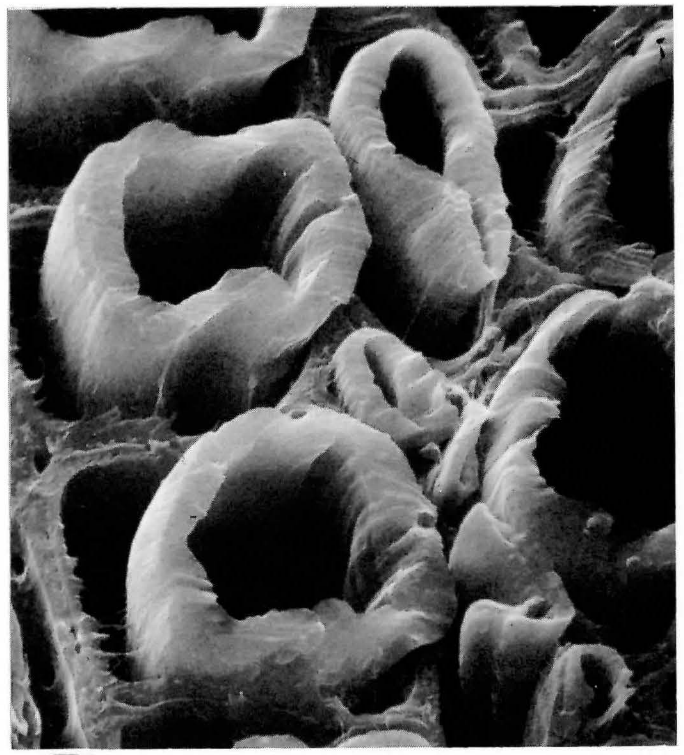

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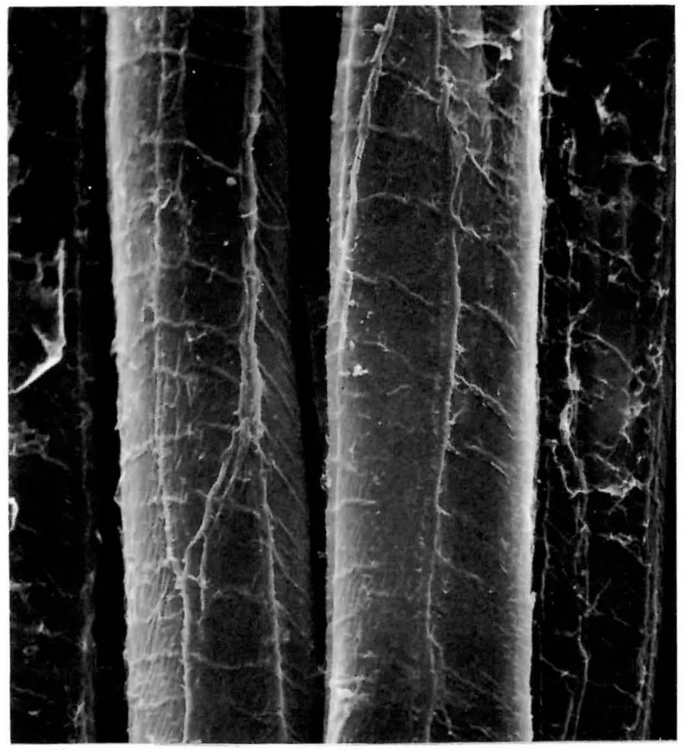
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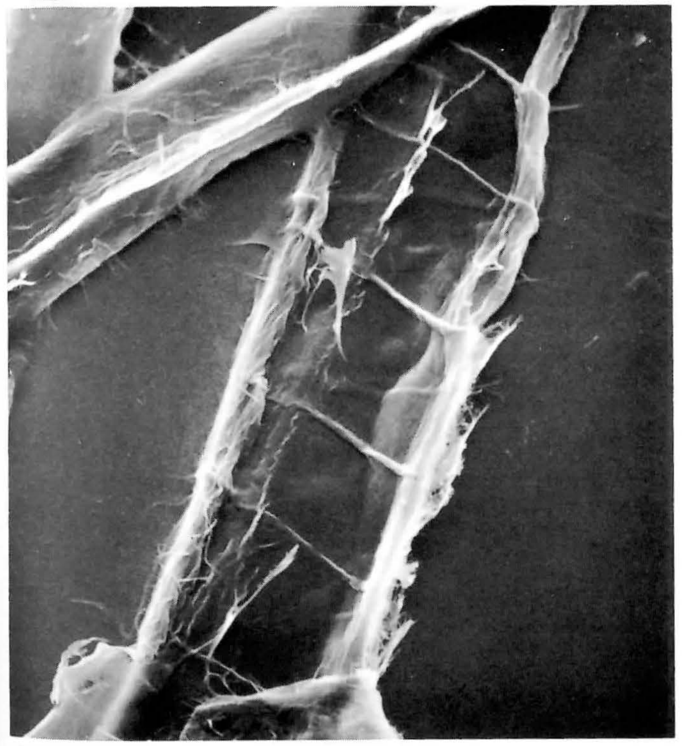
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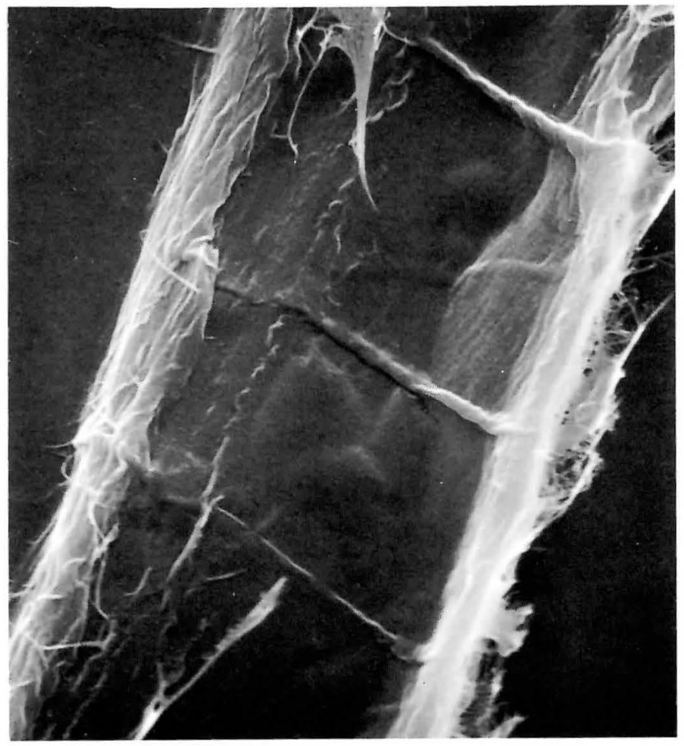
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ASSOCIATION AFFAIRS

Financial Report - 1973

Balance 1972 (Savings & Checking Accounts)		$ 842.45
Income		
Membership Dues		1036.73
Glossary and Reprint Sales		344.72
Interest on Savings Account		14.22
	Total Income:	$1395.67
	1972 Balance + 1973 Income:	$2238.12
Expenditures		
IAWA Bulletin (Paper, printing, etc.)		1002.61
Postage		384.00
Refund		5.00
	Total Expenditures:	$1391.61
Operating Balance:		$ 846.51

Statement of Account

December 31, 1973

Unibank Account No. 102-042-603
Lincoln First Bank-Central
Syracuse, New York 13201, U. S. A.

Savings Account:	$288.58
Checking Account:	557.93
	$846.51

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Havana, Cuba

Change of Address

Dr. Paul T. Mann
3316 S. Illinois Avenue
Caldwell, Idaho 83605

Member Deceased

We have received notification of the death of one of our members, Professor Erik Björkman of the Royal College of Forestry at Stockholm, Sweden. According to the letter received from a member of his staff, Professor Björkman died on November 8, 1973. We were saddened by this news as we know many members who knew Professor Björkman will be upon hearing of his passing.

WOOD ANATOMY ACTIVITIES AROUND THE WORLD

U.S.S.R. -- XII International Botanical Congress (1975)

We have finally received notification, via the First Circular, of the scheduled dates of the XII International Botanical Congress. This meeting which will be held in Leningrad is scheduled for July 3-10, 1975.

A number of members have inquired about this since it was rather difficult to apply for travel funds until such information became available.

Other botanical societies have been moving ahead with their plans for technical sessions. Thus far, we have asked Professor A. A. Yatsenko-Khmelevsky, a member of the Organizing Committee of the Congress, as well as a member of IAWA, to serve as a member of our Planning Committee. Dr. Walter Liese of the University of Hamburg has agreed to serve and from the United States Dr. William C. Dickison of the University of North Carolina indicated his willingness to participate in IAWA planning.

The Office of the Executive Secretary has attempted by various means to collect information about participation of IAWA members in the Congress. The most effective device was the questionnaire included with the 1974 membership dues statements which are being returned in gratifying numbers. As soon as a majority of replies are available, they will be delivered to the Planning Committee so that a program can be organized.

Members desiring information about the technical program are asked to contact the Office of the Executive Secretary or the individual committee members mentioned above.

General information about the Congress can be obtained by writing to the following address:

XII International Botanical Congress
2, Prof. Popov Str.
Leningrad, 197022, USSR

U.S.A. -- News from the University of Maine

Over 1,000 indexed wood samples from all over the world were recently donated to the School of Forest Resources, University of Maine, Orono, Maine, by Mrs. Theron Loose of Cumberland Center, Maine. The samples had been collected over the past 17 years by the late Mr. Loose who was an avid wood collector and member of the International Wood Collectors Society. The Society is devoted to the furtherance of a knowledge and understanding of wood and wood products, the collection of samples for scientific study and the use of wood in creative craftsmanship.

Mr. Loose not only collected and exchanged woods, but also gave talks which described wood as a biological material which is both useful and decorative. In addition he designed and sold fine jewelry which he fashioned from some of his more exotic and rarer woods.

The collection will become part of the recently dedicated Gregory Baker Wood Collection at the School and will be used for teaching and scientific investigation purposes. The Loose Collection will remain intact. The Baker Collection is currently being maintained by Dr. Norman P. Kutscha of the Wood Technology Group at the School and a member of IAWA.

INDIA -- Book Review

Rao, K. R. and S. K. Purkayastha, Indian Woods, Their Identification, Properties and Uses, Vol. III, Leguminosae to Combretaceae. Forest Research Institute and Colleges, Dehra Dun, India, 1972. 262 pages, indices to scientific and common names, 93 plates.

Continuation of the series started in 1958 by K. A. Chowdhury *et al.* Vol. I covers Dilleniaceae to Elaeocarpaceae (280 species of woods). Volume II covers 263 species in the families Linaceae to Moringaceae. The present volume discusses 169 species in the families Leguminosae to Combretaceae. The general format of the first two volumes is continued with information on the genera, and the particular species covered. The available information

on gross structure, uses and strength properties are given for each species. There is a citation of the specific samples in the DD_W which were used and low power photomicrographs of the cross sections of each of the woods described. In addition there are fairly extensive bibliographies for each of the families and in several cases short keys or critical separation features for the genera within families. The work has been carefully performed and will be quite useful for those who do not require detailed microscopic descriptions.

Carl de Zeeuw