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EDITORIAL

Our publication has undergone some design changes, as you can see. For five years we have held to the same form, chiefly because of budgetary limitations. It was the least expensive method we could find to produce a publication of reasonable quality.

These changes do not reflect an increase in production costs, fortunately. Our host, the State University of New York College of Environmental Science and Forestry, has added new equipment which has been made available to us for preparation of the Bulletin. This method of photocomposition produces a page of text that is more attractive, more readable and less space consuming. We can fit our usual 24 pages of text on 10 or 12 pages with the new type.

What impact will this have on our quarterly journal? First, we can accommodate somewhat longer articles than we have in the past. Second, we could publish three articles per issue instead of two as we have until now. There will be a saving in postal charges as well because the weight of this redesigned Bulletin is considerably less than that of the 1970-74 issues.

However, such advantages do not come without certain drawbacks. In this case it will mean that our members must submit more articles than in the past. Articles on wood anatomy, ultrastructure and related topics are needed *now*. We have no backlog of material for the 1975/2 issue. Please send your papers and other relevant items as soon as possible.

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INTERSTITIAL SPACES
A Review and Observations on Some Araucariaceae

By

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INTRODUCTION

The existence of intercellular spaces in the xylem of members of the Coniferae has long been recognised. Such interstitial spaces (I.A.W.A., 1964) are most commonly observed running radially through the rays. For example, Greguss (1955), in discussing the xylotomy of the genus *Picea*, mentions spaces running radially in association with ray parenchyma in the description of almost every species. In discussing the Araucariaceae, this author mentions such "canals" for only *Araucaria cunninghamii* var. *glauca* and *A. montana*, but drawings of the T.L.S. through rays of other species in the family reveal that some form of interstitial spaces are present. Others publishing reports or micrographs of radial space systems in a variety of coniferous species include Back (1969), Cote' and Day (1969), Esau (1953), Harada and Wardrop (1960), Koch (1972), Laming (1974), Nyren and Back (1960), Panshin and de Zeeuw (1970), Reinders and Reinders-Gouwentak (1961), Russow (1883) and Ziegler (1956-57). In hardwoods, reports of radial interstitial spaces are less common, including those of Fengel (1966a, 1966b), Hook and Brown (1972), Preusser *et al.* (1961) and Russow (1883).

According to Russow (1883) radial interstitial spaces are regularly connected with ray parenchyma cells via pits in members of the genera *Fagus, Larix, Populus, Quercus, Salix* and *Ulmus*. Laming (1974) reports these pits to be blind in *Picea abies*, as do Preusser *et al.* (1961) and Fengel (1966a, 1966b) for *Fagus sylvatica*, while Back (1969) reports slit-like pits in *Pinus sylvestris*. There appears to be no reported work on the ontogeny of these pits.

There has long been debate as to whether or not such radial interstitial spaces continue through the cambium and join up with similar spaces in the phloem, or perhaps even with lenticels in the bark. (See, for example, Hook and Brown (1972), Russow (1883) and Von Höhnel (1879). The issue is an important one if, as most authors *assume*, the interstitial space system in xylem serves as a gas canal system for respiring tissues. This is, in general, borne out by MacDougal (1936) who found that air could be drawn across the cambium of normal trees of both coniferous and broadleaved species with pressure differentials as low as 5 to 30 mm. Hg. However, intercellular spaces in the cambium were too small to be observed microscopically.

The findings of Preusser *et al.* (1961) and Fengel (1966a), based on studies of electron micrographs of the interstitial spaces in the rays of *Fagus sylvatica* must thus be regarded as a minority view. These authors found interstitial spaces containing a phenolic substance and concluded that their function was one of storage. Preusser *et al.* supposed that these might also serve as the major pathway for lignin precursors and heartwood encrusting substances entering the middle lamella. Such substances were thought to enter the interstitial spaces by diffusing across blind pit membranes.

The occurrence of longitudinal interstitial spaces has received much less attention in the literature; these do not, for example, appear to be a commonly reported feature of normal wood of members of the Pinaceae. Essau (1953) suggests that their main occurrence may be in association with longitudinal parenchyma. Russow (1883) observed vertical intercellular spaces between parts of longitudinal tracheids when adjacent to ray parenchyma cells. These short spaces were not found between all pairs of axial tracheids, but in groups of three to six separated by tissue apparently lacking such structures. Preusser *et al.* (1961) demonstrate the presence of longitudinal channels in *Fagus sylvatica*. These also appear to be visible in micrographs of *Populus* spp. presented by Isebrands and Parham (1974), but are not commented on in the text. Hook *et al.* (1972) consider that in most hardwoods such canals are so infrequent that living cells within the xylem must depend on the transpiration stream for gaseous interchange.

Perhaps one reason why such longitudinal spaces are so rarely reported in normal gymnosperm wood is that these have been regarded as a diagnostic feature of compression wood; their presence may, therefore, be taken as an indication that the material studied is not normal. However, according to Westing (1965) species of *Agathis, Araucaria* and *Juniperus* show normal wood with particularly large intercellular spaces and rounded cells, (another feature usually indicative of the presence of compression wood). McGinnes and Phelps (1972) have published micrographs of

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interstitial spaces in wood of *Juniperus virginiana*; while this has the appearance of compression wood, it is reputedly comparable to normal wood in lignin content, cell wall thickness and specific gravity. Further, Greguss (1955) notes the presence of longitudinal interstitial spaces in normal wood of *Agathis beccarii*, *A. celebica*, *A. lanceolata*, *Araucaria angustifolia* and *A. beccarii* only, and yet implies that there is some difficulty in distinguishing normal wood from compression wood in the other species of the Araucariaceae. However, there may be little value in making such a distinction between normal and compression wood in this respect, since there is little indication that the interstitial spaces in these tissues differ in origin and structure. (Casperson and Zinsser [1965], Wardrop and Davies [1964]).

In normal wood the formation of interstitial spaces is thought to occur by schizogamy - yet the removal of some previously laid down material is implied. The parental meristematic cell about to divide has a wall composed of middle lamella and primary wall layers. When the cell divides, the new middle lamella forms in the cell plate dividing the two cells, and a layer of primary wall forms on either side of this. But between the new middle lamella and the parental middle lamella lies the primary wall of the parental cell. It is in such a corner that the interstitial space is formed - yet when mature it is apparently totally surrounded by middle lamella substance. According to Jungers (1937), Martens (1937 and 1938), and Priestley and Scott (1939) the free ends of the new middle lamella thicken to form a triangular mass. A space develops within this and enlarges. As it does so, the cellulose wall between the middle lamellae of parental and daughter cells breaks down or is dissolved. More occasionally, a cavity may develop in the parental middle lamella simultaneous with that arising in the daughter middle lamella. In this case, the two spaces merge with the complete disappearance of the parental primary wall.

While the chemical nature of the lining of interstitial spaces has received some attention, different workers are not unanimous in their conclusions (see review articles by Sifton [1945 and 1957]). This disparity of opinion may be partly attributed to the diversity of the tissues studied. An early view (reported by Sifton [1945] but otherwise largely ignored) that these spaces are lined with protoplasmic remnants has been partly substantiated by Wardrop and Dadswell (1964). The more popular hypothesis, recently supported by Laming (1974) in a study of radial interstitial spaces, is that these are lined with, or sometimes blocked with, pectinaceous substances. Russow (1883) and Fengel (1966a) report that interstitial spaces in older tissues are particularly susceptible to blocking. Casperson and Zinsser (1965) report the blocking of longitudinal interstitial spaces

observed in serial sections of compression wood.

Laming (1974), reporting the work of Reinders and Reinders-Gouwentak (1961), indicates that small pectinaceous projections may be seen in cross sections of interstitial spaces.

Fengel (1966b) observed a membrane crossing a radial interstitial space. These features may be of similar origin to the thin, feebly birefringent membranes crossing longitudinal interstitial spaces observed under polarising and normal light microscopes by Wardrop (1952) and Wardrop and Dadswell (1952, 1953) in *Pinus pinaster* compression wood. Similar structures were visible in normal wood in interstitial spaces formed by careful delignification. Casperson and Zinsser (1965) reported these membranes to be rare in interstitial spaces between the xylem cambial initials in *Pinus sylvestris* compression wood, but recognised that this did not preclude their formation or exposure as the result of post cambial cell divisions. Mahmood (1968) observed similar membranous structures, thought to be the remnants of parental cell walls, in the cambial tissue of *Pinus radiata*. Newman (1956) also provides evidence of the continuing integrity of the parental cell walls in this species. Since such membranes have never been reported for mature normal wood, it may be presumed that they are obscured in the subsequent development of the xylem. Others reporting observations of such parental cell walls in meristematic tissue of a variety of plants include Giltay (1882), Priestley and Scott (1939) and Elliot (1951).

Jayme and Fengel (1961) show tenuous membranes linking lignin skeletons of *Picea abies* viewed under the transmission electron microscope. Dunning (1968) provides transmission electron micrographs of delignified pulp fibres of *Pinus palustris* latewood showing intercellular bridging membranes but no gaps between adjacent axial tracheids. While in one case membranes could be found traversing eleven consecutive tracheid junctions (radially), it was thought unlikely that these all originated from the same parental cell wall. Evidence that these membranes were the result of consolidation of a number of separate parental membranes was noted.

Parham (1973) showed similar structures in holocellulose of earlywood and latewood of *Picea glauca*, *Pinus strobus*, *Pinus banksiana* and *Abies balsamea* observed under transmission and scanning electron microscopes. What is significant is that in many cases these membranous connections pass over or through interstitial spaces - which were presumably formed in the preparation of the holocellulose. These spaces receive no mention in the text.

Wardrop and Dadswell (1947) were of the opinion that the intercellular adhesion in a variety of delignified hardwood and softwood species involved elements of the cell wall composed not of a

polyuronide substance but rather of one at least as chemically resistant as Cross and Bevan cellulose or Cross and Bevan alpha-cellulose. However, Kibblewhite *et al.* (1971) provide evidence that the bonding forces holding together holocellulose preparations of resin and epithelial cells of *Pinus elliottii* are due to the bridging of intercellulose spaces by fibrils and lamellae both of cellulosic and non-cellulosic nature. The results of Kerr and Bailey (1954) indicate that a polyuronide substance plays a role in intercellular adhesion.

In summary, while radially running interstitial spaces are relatively well documented, this is not the case for those running longitudinally. If interstitial spaces do serve as gas canals (this is logical but not proven) the need for longitudinal canals in mature wood in the absence of axial parenchyma is not clear. Neither has it been made clear how longitudinal canals might connect with the atmosphere. Further, little is known of their ultrastructure.

Possible answers to some of these questions arose from an investigation of ultrastructural changes induced in Parana pine (*Araucaria angustifolia*) swollen under restraint. Numerous interstitial spaces were observed in untreated wood of this species and also in authenticated specimens of Australian kauri (*Agathis robusta*), Fijian kauri (*Agathis vitiensis*), New Zealand kauri (*Agathis australis*), and Hoop pine (*Araucaria cunninghamii*) taken from a timber collection in the Department of Forestry and Wood Science, University College of North Wales. In every case, split radial surfaces were viewed under the scanning electron microscope. Because of the very limited amount of material of each species available, the aim of this exploratory study was to demonstrate what range of ultrastructural detail could be observed within the family. The identification of between and within species differences will require a much more intensive study.

A study of the *Araucaria angustifolia* material under the light microscope (paper in preparation) has revealed that this material at least, is not likely to be compression wood: an S3 layer is visible under polarised light; the cell wall in earlywood is very thin; there is no evidence of helical checking in the cell wall.

OBSERVATIONS

In all species examined, longitudinal interstitial spaces were present between the corners of most axial tracheids. These could be followed over considerable distances — e.g. from one ray to the next. It was also apparent in all five species that these channels were linked just above and below the rays (Figs. 1, 2, 10, 11, 15.)

At higher magnifications, (Figs. 3-9), considerable ultrastructural detail could be seen within those longitudinal channels — some of which bears a remarkable similarity to that shown in micrographs of channels in holocellulose published by Parham (1973). The simplest type of fine structure took the form of encrusted corrugations (Fig. 4). A second feature was fibrils appearing to bridge the interstitial space (Fig. 5). These were not always intact, but this may not be an artefact of specimen preparation, since the broken ends appear rounded and encrusted. Most interesting of all were areas where the fibrillar bridges appeared to be the result of the perforation of a membrane. (Figs. 3 and 6-9; Fig. 9 was taken at a point further along the channel of Fig. 6 — lower down in the Figure.) Such areas were not very frequent, and were generally found quite close to a ray. It is noticeable (e.g. Fig. 8) that these perforations become larger and larger until single fibrils bridge the space. (The smallest fibrils have a diameter of the same order of size as the fibrils constituting the pit margo of many coniferous species). These perforated membranes might be the end of the dividing wall between two adjacent longitudinal spaces, where these gradually coalesce. If this is true, then Fig. 6 may represent an area where three spaces coalesce.

From the literature review, it seems fairly certain that the thin bridging membranes or fibrils must be the remnants of the wall of the parental cell. While it is possible that structures such as those shown in Figures 3 and 6-9 could be simply the result of a partial breakdown of a number of parental primary walls consolidated together (see Dunning, 1968), this seems unlikely; if this was the case, two such areas could be expected to occur occasionally on the stretch of a single interstitial space between two rays. Yet in the limited material studied, two such areas were never observed on the same space.

The texture of the lining of these interstitial walls is considerably smoother than that of the wall layers surrounding it (which probably vary from middle lamella, through primary wall to S1). Figures 4 to 6 and 9 would seem to support the view of Laming (1974) that the interstitial space is encrusted.

Further study of the longitudinal spaces revealed that these passed beneath (i.e. presumably on both sides of) the ray cells (Figs. 10, 11, 15). But, at the point where the longitudinal space first disappears beneath a parenchyma cell, the space is crossed by a membrane. In some cases this appears to have a fine structure not unlike that of a pit margo, (Figs. 15, 16, 18). In others, it appears impervious, (Fig. 11), or possibly encrusted. It is difficult to understand either the function or ontogeny of this membrane.

Where the longitudinal space comes in contact with the ray it appears to interconnect with radial

interstitial spaces, (Figs. 10 to 14). Between the two space systems there is normally a very open fibrillar membrane, rather variable in nature, which often appears to have been damaged during specimen preparation, (Figs. 12 to 14). Presumably these features originate from the parental walls of the cells involved.

Finally, a structure which might be an interconnection between a ray parenchyma cell and an interstitial space was occasionally observed (Fig. 17). These structures seem to have a texture of randomly orientated fibrils, somewhat encrusted. If their function has been correctly described, these membranes might be the equivalent of the blind pits previously reported.

Having demonstrated the presence of longitudinal interstitial spaces and their interconnection with radial spaces, the question of function arises. If this system plays a role in gaseous interchange, which respiring cells benefit from the presence of a longitudinal canal system? Axial parenchyma cells are absent in members of the *Araucariaceae*. The implication is that this system is of use mainly when all the xylem cells are still respiring — i.e. before secondary wall thickening is complete. If this is true, it might also apply to members of the *Pinaceae* at an early stage of cell differentation (see Parham, 1973) — but in this case encrustation (Russow, 1883, Fengel, 1966a and Laming, 1974) may block the system in mature wood. Research presently being carried out in this Department may reveal whether this is so. The nature of intercellular spaces in compression wood of both families must clearly also be further examined in this light.

FIGURES:

1. *Araucaria angustifolia* × 770. Axial direction vertical: the edge of ray cells can be seen at the bottom of the picture. Arrows indicate interconnections between longitudinal spaces.

2. *Agathis vitiensis* × 380. Arrows indicate interconnections between longitudinal spaces.

3. *Agathis australis* × 1500.

4. *Araucaria angustifolia* × 3800.

5. *Araucaria cunninghamii* × 3800.

6. *Araucaria angustifolia* × 7800.

7. *Agathis vitiensis* × 3900. Detail from Fig. 2.

8. *Agathis australis* × 3900.

9. *Araucaria angustifolia* × 7800. From same interstitial space as Fig. 6.

10. *Agathis australis* × 780.

11. *Agathis robusta* × 780. The interconnection between longitudinal spaces can be seen beneath the ray.

12. *Araucaria angustifolia* × 3700. The axial direction is vertical. The arrow indicates the direction of the radial interstitial space system.

13. *Agathis australis* × 1400.

14. *Agathis robusta* × 3900. Detail from Fig. 11. Arrows indicate the direction of the radial interstitial space system.

15. *Araucaria cunninghamii* × 770. The axial direction is horizontal. Arrows indicate membranes crossing longitudinal space systems before the latter disappear beneath the ray cells.

16. *Araucaria cunninghamii* × 3900. Detail from Fig. 15.

17. *Araucaria cunninghamii* × 3900. Detail from Fig. 15. Arrow indicates possible interconnection (? blind pit) between ray cells and interstitial space system.

18. *Araucaria cunninghamii* × 3900. Detail from Fig. 15.
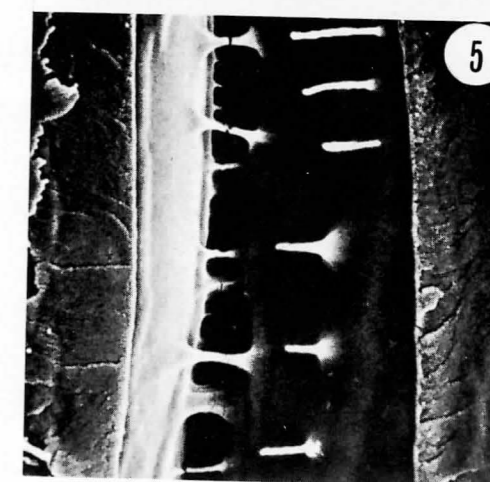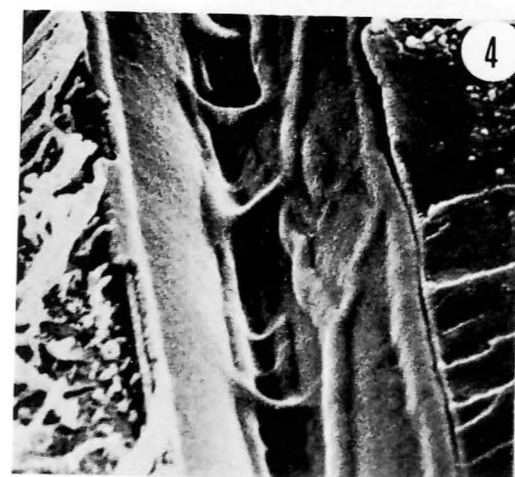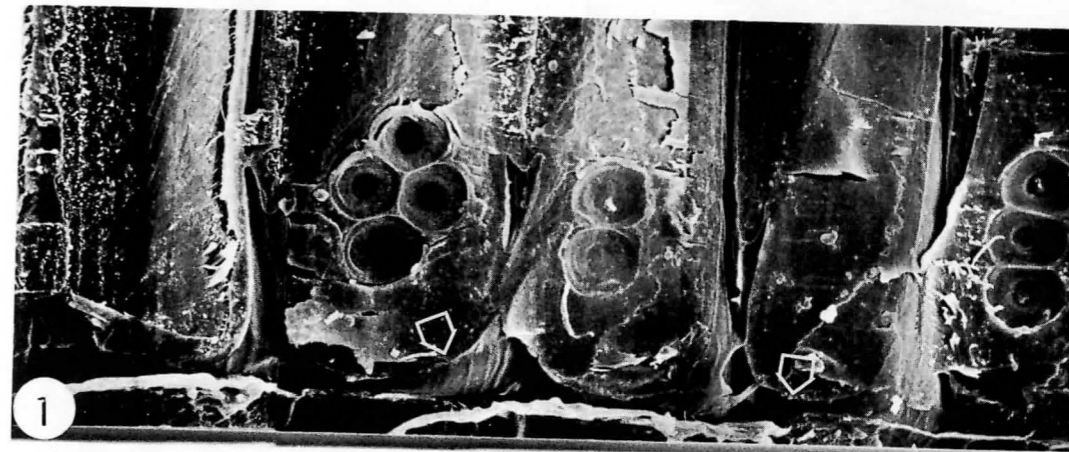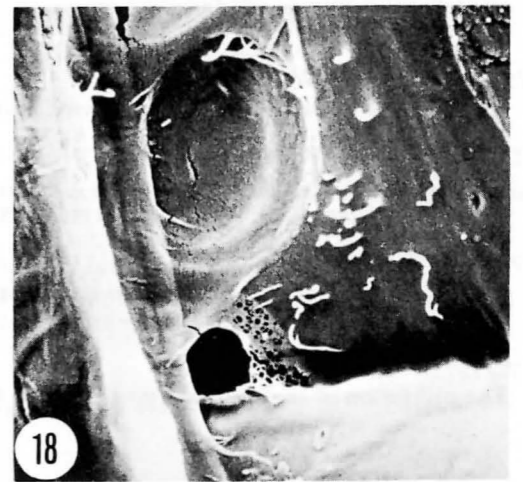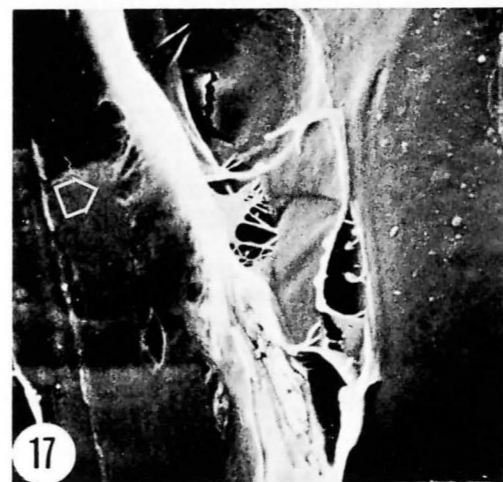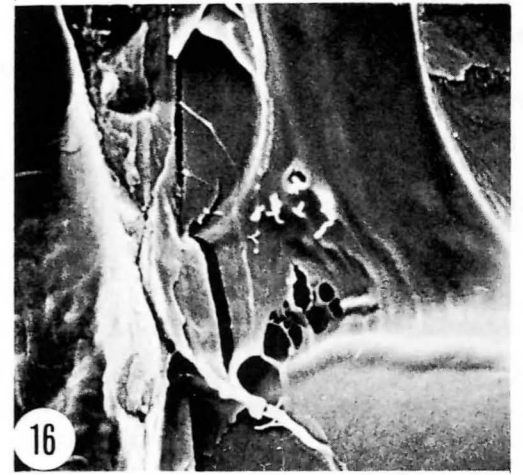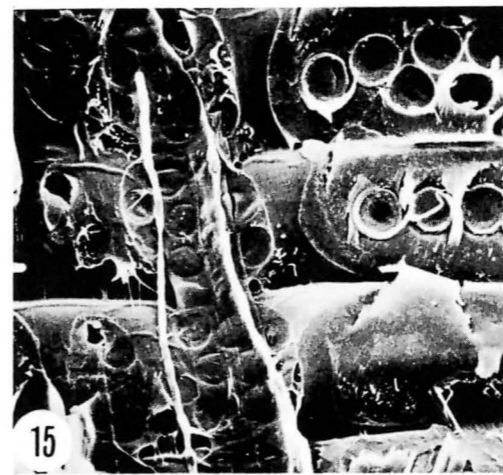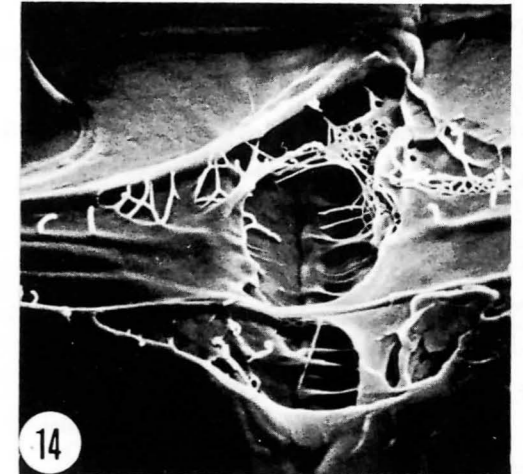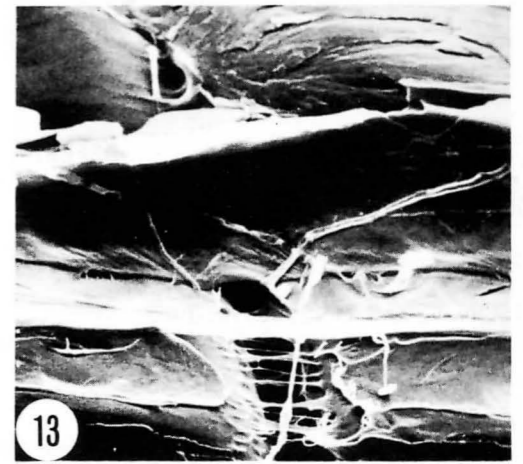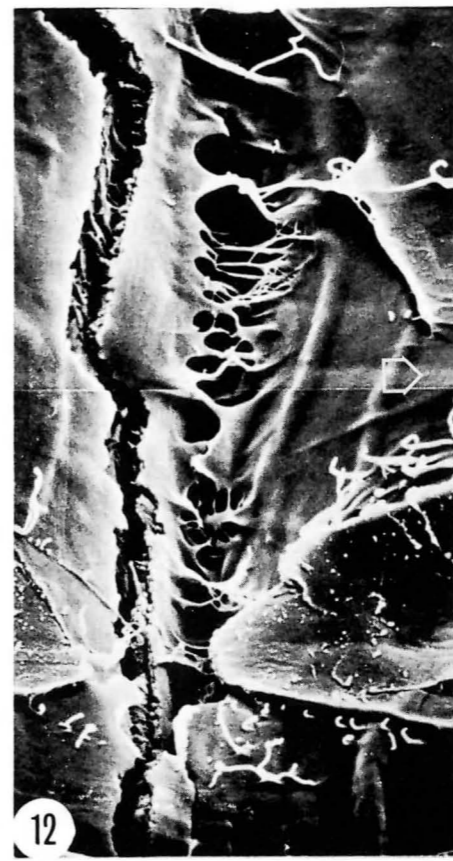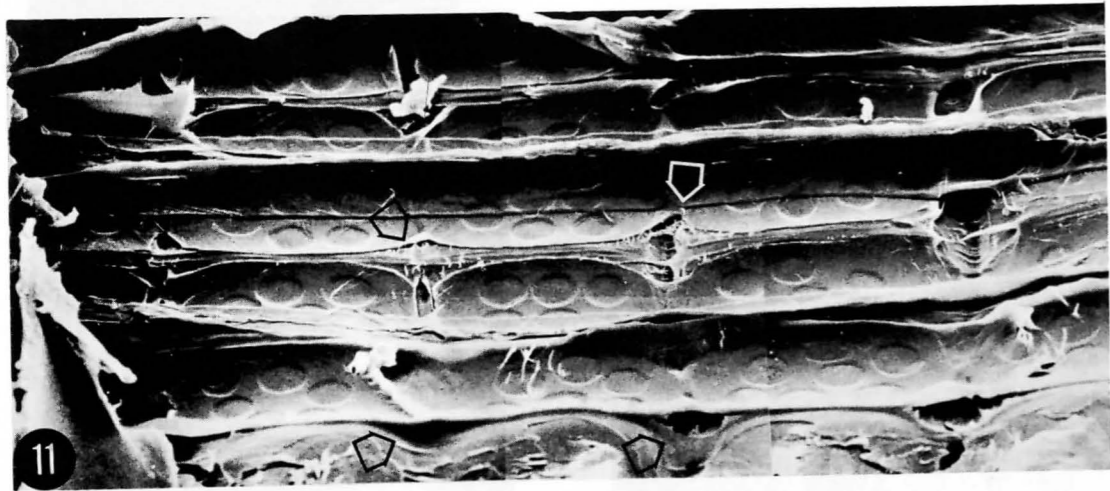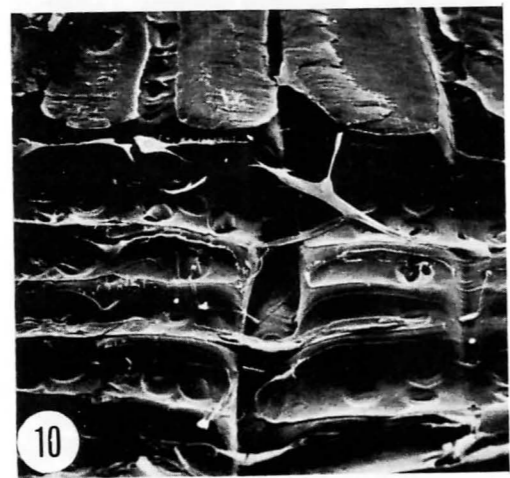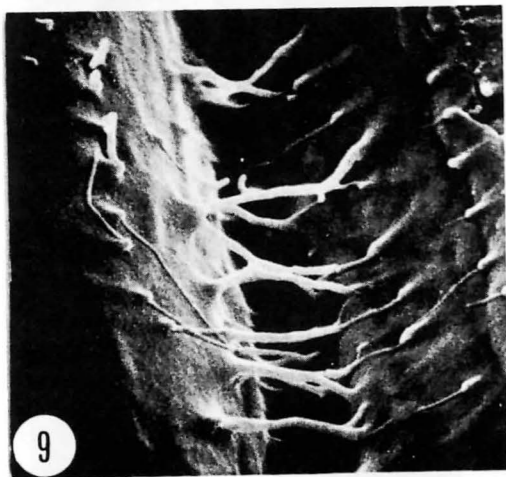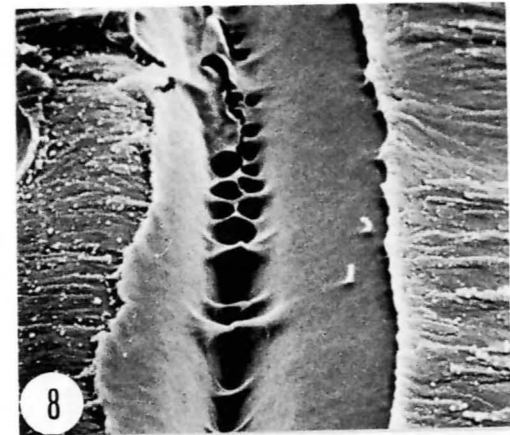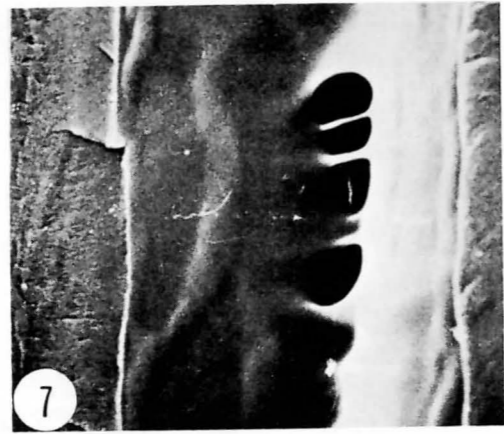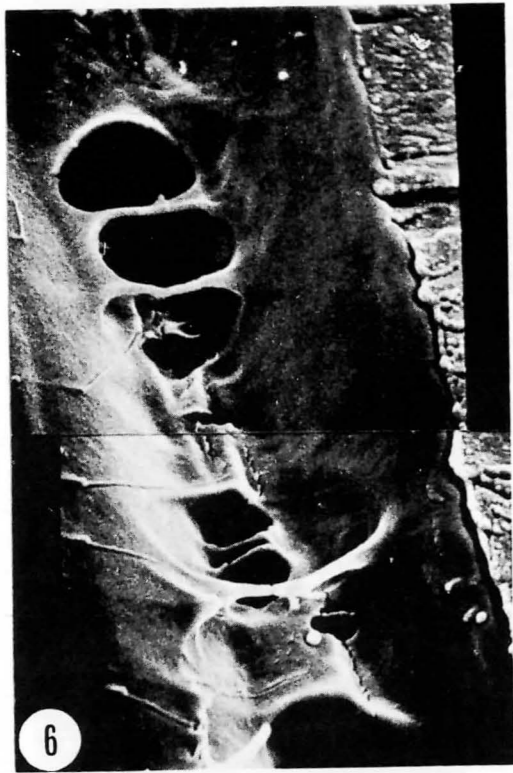
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TERMINOLOGY USED FOR DESCRIBING THE CAMBIUM

By

B. G. Butterfield[1]

A number of conflicting views are held on the nature of the cambium. The cambial zone normally consists of an unbroken cylinder of undifferentiated meristematic cells (fusiform and ray) arranged in radial files. These files extend into the mature secondary xylem and secondary phloem where they may become obscured by changes that occur with differentiation. Dividing cells close to the mature phloem form the phloem mother cells while those adjacent to the xylem are the xylem mother cells. The transitions in cell type and activity through the cambial zone are gradual especially in the active cambia of dicotyledons, and in practice it is difficult to define the radial extent of the true cambium. Catesson (1964) made a careful attempt to define the limits of the cambium. She concluded that the term was best reserved for a truly meristematic region where mitoses are abundant and where the cells are narrow with thin walls. Such a cambium is separated from mature xylem and phloem tissue by bands of cells in which size changes and other differentiation processes are proceeding.

The concept of a multiseriate cambium may or may not include reference to a single initial within each radial file of cells. One school of thought postulates a multiseriate zone in which all the cells are equivalent. This interpretation proposed by Raatz (1892), has been given support by Catesson (1964). From a meticulous study of active cambium of *Acer pseudoplatinus* L., she found it impossible to distinguish a layer in which divisions were more or less frequent than in adjacent cells. Nor could an initial be distinguished by any other criterion such as histochemical, anatomical or cytological differences. She therefore concluded that the active cambium was formed of several layers of similar cells, each endowed with equal powers of multiplication.

The most widely held interpretation of the cambium, however, postulates the existence of a single initial cell in each radial file of cambial cells from which all the derivatives of the cambium are ultimately derived. Such an initial lies somewhere between the xylem and phloem mother cells. Evidence in favour of this concept has been provided by Bannan (1955, 1968) and Newman (1956), both of whom were able to distinguish single initials between the xylem

and phloem in gymnosperms. The continuity of the radial files of cells on either side of the cambium is the most convincing argument in favour of the single initial theory. In conifers, virtually all the anticlinal divisions within the cambium result in doubled files of cells in the tissues to both sides of the meristem. Other features also correspond in the xylem and phloem, including the loss of radial files of axial cells and the replacement of such files by rays. If the initiating layer were more than one cell wide, an exact duplication of all anticlinal divisions, loss or conversion to ray initials would be required in the several initials of the radial file, in order to produce corresponding patterns in the xylem and phloem.

Further evidence in support of the existence of a single initial in each radial file of cells in the cambium has been provided by Murmanis (1970). Working on *Pinus strobus* L., this author detected differences in the thickness of the tangential walls thereby enabling him to group the cells according to the sequence of the previous divisions. This enabled him to deduce the position of the initial. The location of the initial in most species remains, however, difficult if not impossible to determine in light microscope sections.

The small amount of published information on anticlinal divisions in the cambia of dicotyledons shows that they could be restricted to a single layer (Cumbie, 1967) or be distributed over several layers (Catesson, 1964). This is perhaps not surprising in view of the complexity and variety of activity of the cambia of these plants. The single initial concept, however, is still an attractive one for the same reasons as have been applied to the cambia of conifers. Even where a wide multiseriate zone of periclinally dividing cells occurs, there could still be only one initial in each radial file. Such initials need not be tangentially aligned; that is, the initials may not form a cylinder within the cambium, but they may be radially offset according to their immediate state of mitotic activity. While periclinal divisions may continue in the xylem and phloem mother cells, anticlinal (sometimes termed multiplicative) divisions are virtually restricted to the initials (Bannan, 1955).

Despite the difficulty in isolating the actual initials in the actively dividing cambial zone, there is a significant group of anatomists who restrict the use of the word "cambium" to the initials only. By their definition the cambium is a functionally uniseriate layer between actively dividing xylem and phloem. This interpretation is often used in the American

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TABLE 1. *Proposed terminology for describing the tissues associated with the vascular cambium.*

SECONDARY PHLOEM		Mature tissue
DIFFERENTIATING PHLOEM		Secondary walls deposited (a) Cells enlarging Limited cell division (b, c)
CAMBIUM	PHLOEM MOTHER CELLS	Periclinal division
	CAMBIAL INITIAL	Periclinal and Anticlinal division
	XYLEM MOTHER CELLS	Periclinal division
DIFFERENTIATING XYLEM		Limited cell division (c) Cells enlarging Secondary walls deposited
SECONDARY XYLEM		Mature tissue

Notes:

(a) Fibres and sclereids only,

(b) Some transverse and longitudinal divisions associated with sieve tube and companion cell development.

(c) Some transverse divisions associated with the development of axial parenchyma strands.

literature (Wilson, *et al.* 1966; Zimmermann and Brown, 1971).

The present author suggests that the cambium should be defined as a "multiseriate zone of periclinally dividing cells lying between the differentiating secondary xylem and phloem, with a distinct initial capable of both periclinal and anticlinal divisions lying somewhere within each radial file of cells". A diagrammatic presentation of the proposed terminology relating to the cambium is presented in Fig. 1.

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3. Catesson, A.M. 1964. Origine, fonctionnment et variations cytologiques saisonnieres du cambium de l'*Acer pseudoplatanus* L. (Aceracees). Annales des Sciences naturelles (Botany), 12e series 5, 229-498.

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5. Murmanis, L. 1970. Locating the initial in the vascular cambium of *Pinus strobus* L. by electron microscopy. Wood Science and Technology, 4: 1-14.

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ASSOCIATION AFFAIRS

Financial Report — 1974

Balance 1973 (Savings & Checking Accounts)	$846.51
Income	
Membership Dues	787.69
Glossary and Reprint Sales	206.25
Interest on Savings Account	14.76
Total Income:	$1008.70
1973 Balance + 1974 Income:	$1855.21
Expenditures	
IAWA Bulletin (Paper, printing, etc.)	$1264.53
Postage	155.10
Total Expenditures:	$1419.63
Operating Balance - 1974	$435.58
Income for 1975	
Membership Dues	$755.00
Bulletin Subscriptions	160.00
Total Income:	$915.00

Statement of Account

December 31, 1974

Unibank Account No. 102-042-603

Lincoln First Bank-Central

Syracuse, New York 13201, U. S. A.

Savings Account:	$303.34
Checking Account:	1047.24
	$1350.58

New Members

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Changes of Address

With the receipt of dues payments have come many changes of address which will not be listed in this issue of the Bulletin because of the large number. However, a new Membership Directory will be prepared and distributed with one of the future issues of the Bulletin.

Retired Member

We are pleased to announce the transfer of Mr. J. S. Reid to "Retired Status" in our Association. We are sure that members will want to join us in wishing Mr. Reid a satisfying period of retirement.

Member Deceased

It is with deep regret that we announce the passing of Mr. William N. Watkins who had been a long-time member of our Association. Mrs. Watkins wrote to the Office indicating that Mr. Watkins had passed away on March 27, 1974.

WOOD ANATOMY ACTIVITIES AROUND THE WORLD

IUFRO Xylem Physiology Group

The Growth Processes Working Party of the International Union of Forest Research Organizations is forming a new group for people concerned with the various aspects of xylem physiology. The main function of this group is to promote research into wood production, structure and function, in relation to tree physiology; it aims to be complementary to existing wood anatomy societies such as IAWA. The Xylem Physiology Group is producing an informal newsletter for the exchange of news about projects in progress, and for suggestions for future projects. For further information please write to Dr. P. Denne, Department of Forestry and Wood Science, University College of North Wales, Bangor, Gwynedd, United Kingdom.

IAWA-Linnean Society Symposium 26-27 June 1975

Dr. D. F. Cutler has submitted a report on the progress for the IAWA-Linnean Society Symposium to be held in London on June 26-27, 1975. While this program is subject to minor changes, it is essentially complete.

Dr. C. R. Metcalfe, Dr. A. W. Mennega, and Professor I. Manton will chair the sessions.

An introductory paper will be given by Dr. C. R. Metcalfe.

30-minute papers

D. M. Catling	Forensic application of plant anatomy.
Dr. G. Blunden	Pharmacognosy of *Salix* leaves.
Mr. G. Creber	Gymnosperm growth rings and palaeodendrochronology.
Dr. J. D. Boyd	A reinterpretation of compression wood.
Dr. J. F. Levy	Latest development in research on timber decay.
Mr. F. Hughes	Anatomical criteria in the selection of breeding trees.
Dr. M. Y. Stant	Seed coat studies in *Gibasis* (Commelinaceae).
Dr. P. Baas	Altitude as a moderator of taxonomic data in the wood of *Ilex*.
Mrs. J. Koek	Rubiaceae - numerical studies on plant anatomy.
Dr. D. Dilcher	Palaeobotany.
Dr. M. Zimmermann	Safety and efficiency in translocation.
Unnamed Speaker	Paper technology. (Speaker from Tropical Products Institute)

10-minute note

Dr. N. P. Kutscha	Morphological and anatomical effects of salt on *Thuja occidentalis* L. and *Picea glauca* (Moench.) Voss.

BOOK REVIEW

The Physical Biology of Plant Cell Walls, R. D. Preston, FRS, 491 pages, 203 figures. Chapman & Hall, London, and Halsted Press Division of John Wiley & Sons, New York. Price: 12.00 Pounds (U.K.) and $35.00 (U.S.A.). Publication Date 10/15/74.

The appearance of this new book by Professor Preston was evidently timed to coincide with his retirement from the Astbury Department of Biophysics at Leeds University where he served as Head of the Department from 1962. One has the immediate impression upon scanning through this volume for the first time that it reflects Dr. Preston's professional interests and activities during his tenure as teacher and researcher at Leeds, a period spanning some four decades. The topics, the micrographs and drawings, and the development of some of the concepts provide a history of this facet of science as well as a compilation of ideas that the author calls "physical biology of plant cell walls."

The earlier book by Prof. Preston (1952), *The Molecular Architecture of Plant Cell Walls*, still remains a useful reference after more than twenty years. In his Preface to the present book, the author points out that mathematical statements could be used to a greater extent this time than in the previous work because botanists are better able to handle this approach now than in the past. Still, this need not deter botanists who prefer to avoid mathematics. Much of this volume is useful and informative whether or not one is at ease with the calculus.

I found the overall plan of this book to be logical and practical. The introductory chapter sets the background and provides the justification for the book, including a historical review of knowledge of the plant cell and cell walls. Chapters 2 and 3 then deal with bonding and molecular models and the chemical components of the plant cell wall. The author devotes three chapters to the theory and use of physical tools with optical microscopy (the light microscope) and x-ray diffraction making up the bulk of these discussions. The transmission electron microscope for structure determination is considered in only fourteen pages while the other two tools take up some eighty pages of text. It is regrettable that no mention is made of scanning electron microscopy.

Before exploring detailed cell wall structure, the author discusses general principles of wall architecture, including cellulose microfibrils and elementary fibrils. It is an important chapter dealing as it does with the structure of the cellulose chain. In two subsequent chapters, cellulosic and non-cellulosic algae, probably Prof. Preston's favorite subjects, are treated in great detail, covering more than eighty pages.

"The secondary walls of flowering plants" is a chapter that is actually devoted almost exclusively to wood cell walls. Some of the controversial topics that have appeared in other publications, or surfaced at various conferences, happily do get a review in this major chapter. Spot checks indicate that the author has done a rather thorough literature review of the areas I am particularly familiar with.

The remaining chapters, no less important to some wood anatomists, include "Viscoelastic properties of secondary cell walls," "Wall extension and cell growth," and "Wall biosynthesis."

All of the references are listed at the end of the book and a supplementary author index provides easy access to those subjects for which many of us know the author best. Although the subject index is not extensive, most of the items I was interested in checking were listed.

This book is attractively designed. The type style is very readable and clean. Paper quality, layout, drawings and photographic reproductions are excellent. One distracting shortcoming is the large number of typographical and other proofreading errors. On a single page I found four glaring mistakes. Fortunately, this does not occur on every page.

In my view, many of you will find Professor Preston's new book to be a desirable addition to your personal or laboratory library. It should become a standard for the specialists who are concerned with cellular ultrastructure and the physical tools with which to characterize it.

Wilfred A. Côté

PROGRAM
for
TECHNICAL SESSIONS OF INTERNATIONAL ASSOCIATION
OF WOOD ANATOMISTS
at the
XII INTERNATIONAL BOTANICAL CONGRESS

Leningrad, July 3-10, 1975

SESSION I — Cambium   Friday, July 4, 0930-1300

Chairman: V. Necesaný

Taylor, F. W.	Variation in the Angiosperm, Cambium and Xylem Derivatives
Bosshard, H. H.	Cambial Activity and Differentiation Evaluated on the Basis of Three-Dimensional Anatomical Studies
Datta, P. C.	Effects of Compression and Aeration on Wood Formation in *Lennea grandis* Eng. (with Basantika Mitra)
Ayensu, E.	Structural Analysis of Anomalous Stems in Vines; with Special Reference to *Passiflora multiflora*.
Hoster, H. R.	Cambial Activity and Differentiation of Reaction Wood
Keith, C. T.	Fixation of Conifer Cambium for Ultrastructural Study
Catesson, A. (Invited non-member)	

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(Invited non-member)

SESSION II — Wood Differentiation   Friday, July 4, 1500 - 1800

Chairman: E. Ayensu

Necesaný, V.	Mechanism of the Primary Wall Growth
Kutscha, N. P.	Studies of Lignification in Balsam Fir
Wardrop, A. B.	Recent Evidence Relating to the Mechanism of Lignification in Plants
Isebrands, J. G.	Vascular Organization in the Node of Eastern Cottonwood
Ifju, G.	Quantitative Changes in Cell Walls and Cell Wall Constituents of Differentiating Secondary Xylem of *Tsuga canadensis* (L.) Carr. (with George A. Grozdits)

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(Invited non-member)

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(Invited non-member)

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(Invited non-member)

SESSION III — Taxonomic and Evolutionary Value of Wood Anatomy   Saturday, July 5, 0930-1300

Chairman: W. C. Dickison

Necesaný, V.	Structure and Function of Living Wood Rays
Braun, H. J.	Wood Ray Types — Their Principles
Mennega, A. M. W.	Wood Anatomy and the Classification of the Euphorbiaceae
Gottwald, H.	The Anatomy of Magnoliaceae with Reference to Systematic Classification
Grosser, D.	On the Anatomy of Bamboos, with Special Reference to the Classification
Czaninski, Y. (Invited non-member)	Wood Cells Associated with Vessels and Its Physiological Role

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(Invited non-member)

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(Invited non-member)

SESSION IV — Wood Anatomy and the Environment   Wednesday, July 9, 0930-1300

Chairman: W. Liese

Baas, P.	Wood Anatomical Variation in Widely Distributed Taxa in Relation to Ecological Factors and Phylogeny
Liese, W.	Environmental Effects on Wood Structure
Mariaux, A.	Studies of Dendrochronology in the Sahelian Climate (Essais de dendroclimatologie en climat Sahelien)

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(Invited non-member)

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(Invited non-member)

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(Invited non-member)

Standby Paper: (Wardrop, A. B.)	The Influence of Environmental Factors on Cell Wall Structure

Chairman: W. Côté

Thomas, R. J.	Composition of Pit Membranes as Determined by Chemical & Enzyme Treatments
Wagenfuhr, R.	Importance of the Wood Anatomy for Identification of the Wood Species and Wood Properties
Parameswaran, N.	Fine Structure and Lignin Character of Sclereids in Tree Bark
Ifju, G.	Application of the Principles of Stereology to the Quantitative Microscopy of Wood (with J. A. Johnson and J. H. Steele, Jr.)
Côté, W.	Ultrastructural and Diagnostic Studies of Wood Using SEM and EDXA
Boyd, J.	Microfibrils in primary and secondary wall growth develop trellis configuration (with R. C. Foster)

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(Invited non-member)

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(Invited non-member)

BUSINESS MEETING OF IAWA