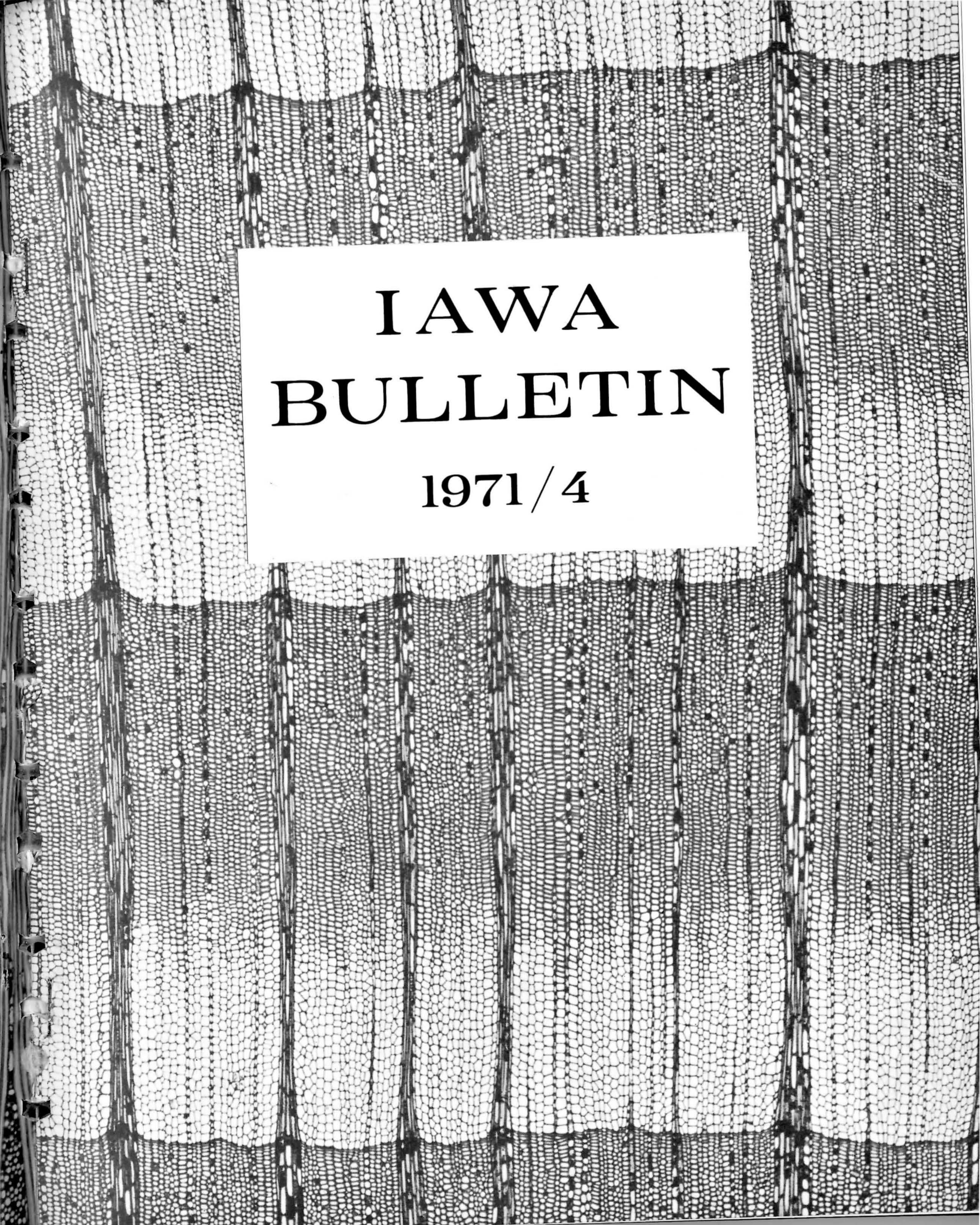

IAWA BULLETIN

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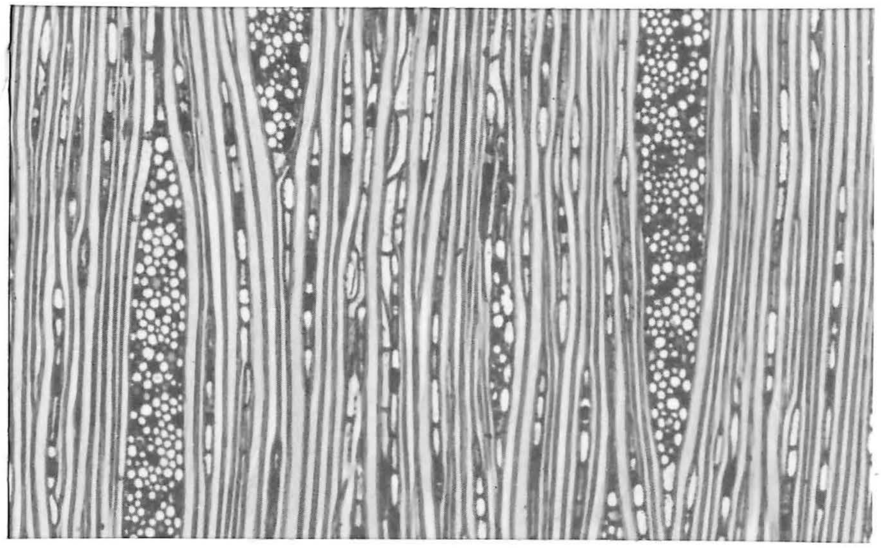

IAWA BULLETIN

1971/4

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

For 1971, the IAWA Bulletin cover consists of photomicrographs (cross- and tangential sections) of a particularly interesting wood, *Trochodendron aralioides* S. et Z., Family Trochodendraceae. The absence of vessels, and the nature of the growth increment boundaries, are significant features.

The slide and specimen (BWC_W) 5941 were borrowed from the Harry Philip Brown Memorial Wood Collection at State University of New York College of Forestry. The sample was received from M. Fujioka, Komaba, Tokyo, Japan, on October 20, 1933. Its source was given as Yamaguruma, Formosa.

Editorial

It is with some feeling of accomplishment that we send you this issue of the I.A.W.A. Bulletin, 1971/4. Completing the first year of quarterly publication is one reason, of course, but also we have been fortunate in obtaining worthwhile contributions from members in sufficient quantity to justify four issues in one year. We believe that there have been some innovations brought to your attention through this forum and that more frequent contact with your Association probably left you with the impression that IAWA is still a vital organization.

In this issue there is a blend of the traditional and the "new look" in wood anatomy studies. Some may argue that certain points are far afield from anatomical research. Yet, the impact that these might make on future work could be substantial, in our estimation.

Again we ask for your opinions and your further contributions to your Bulletin. With your help there can be four issues in 1972. It is our intention to issue a new Membership Directory to be mailed with the 1972/1 Bulletin. If you have address changes to bring to our attention, please send them immediately.

W. A. Côté

C. H. de Zeeuw

ANOMALOUS TANGENTIAL PITTING IN *Picea abies* Karst. (EUROPEAN SPRUCE)

By

Peter B. Laming and Berend J. H. ter Welle[1]

The anatomical characteristics and the location of bordered pit pairs in *Picea abies* Karst. have been recorded by many investigators. It is well known that bordered pit pairs occur normally on the radial walls of the longitudinal tracheids. In earlywood their number is greater than in the latewood. In general the diameter of the torus and the pit cavity decreases progressively from early to latewood. A difference in dimension of the radial pits is particularly obvious between the first few rows and the last few rows in the latewood zone. Tangential pitting is generally restricted to the last 4 or 5 rows of longitudinal tracheids of a growth layer; within this zone the number of bordered pit pairs increases noticeably towards the boundary between late- and earlywood.

Greguss (2) has systematically examined the wood anatomy of most of the *Picea* species. In descriptions of all species he has noted tangential pitting in the last few rows of latewood. In a smaller number of species he found tangential pitting throughout the latewood zone, and in a few species he also noted that it occurs in the transition zone between early-wood and latewood. In three species (*Picea bicolor*, *Picea glauca* and *Picea mariana*) he has stated that tangential pitting is present in all longitudinal

[1]Forest Products Research Institute TNO, Delft, Holland

tracheids throughout the growth layer. Greguss also noticed in *Picea sitchensis* (Sitka spruce) that sparse tangential pitting occurs in the tracheid cell walls in the first-formed fiber rows in the earlywood, as well as in the corresponding rows of the previously formed latewood.

In other sources of literature on the subject of wood anatomical descriptions of the genus of *Picea* no reference had been made of bordered pit pairs on the tangential wall in earlywood. In case of *Picea sitchensis*, Panshin *et al.* (6) only mentioned tangential pitting in the last few rows of latewood. The same authors and Jane (5), however, made reference to the occasional presence of tangential pitting in the first few rows of tracheids in the growth layer as a feature for conifers in general. In the conifer investigations of Jacquiot (4) tangential pitting in earlywood tracheids in species of the genus of *Picea* was not mentioned.

As a result of our recent investigations into the problem of aspiration of the pit membrane in bordered pit pairs in *Picea abies* we encountered earlywood tangential pitting similar to that described by Greguss in *Picea sitchensis*.

In the earlywood tracheids of European spruce bordered pit pairs have been observed on the tangential wall (Fig. 1), both in heartwood and in sapwood. The material used for examination was from several origins of growth; both very young stems (5 years) and older stems (33 years) have been examined.

The presence of earlywood tangential pitting extended as far as the eighth tracheid row after the growth layer boundary. In their appearance there seems to exist a natural preference for a location in the cell wall of the second and third tracheid (Fig. 2 A, B). Their frequency in other cell

walls is considerably lower. The occurrence of the pits on the tangential wall in earlywood seems not to be influenced by the width of the growth layers. Earlywood tangential pitting has been located in both very narrow rings (width of 9 tracheid rows and a single row of latewood tracheids) as well as in very broad rings (up to 150 tracheid rows wide).

The occurrence is most irregular. In the longitudinal direction the pits may be grouped up to 30, but as a rule as a single example or gathered in small groups. The diameter of the pit cavities in earlywood tangential pit pairs comes to 6.7, 9.6, 13.3 μm, with a tendency for a decreasing radius depending on the location within the growth layer boundary. In latewood of the previous year's growth the cavity diameters of the bordered pit pairs on the tangential wall of the last four rows are 5.7, 8.4, 10.5 μm. Within the earlywood zone the cavity diameters of the tangential bordered pit pairs exhibit an increasing radius of the cavity the further their location is from the boundary. In addition, torus diameter differences have been noticed: 3.9, 4.4, 4.8 μm in earlywood and 2.3, 3.3, 4.2 μm in latewood. Contrary to the statement of Howard and Manwiller (3) concerning tangential pits in earlywood of 10 species of Southern pine (*Pinus* species), the tangential pits in European spruce earlywood are considerably smaller than the adjacent radial pits.

The origin of the tangential pitting in the first few rows of earlywood might possibly be ascribed to a delayed full-growth after a dormant stage of the last-formed latewood tracheids (1, 7). In this view such a tracheid might function as a xylem mother cell. As can be noticed in Figure 4 it can hardly be said to be a full-grown latewood tracheid (X). This tracheid with a bordered pit pair on the tangential wall has in comparison with preceding latewood cells similar tangential dimensions but different dimensions in radial direction compared with adjacent cells in the last row. As contrasted with the cell wall thickness in the latewood, the thickness of the wall of this type of tracheid corresponds much more to the tissue in the adjoining earlywood. It has been suggested that it might be an earlywood tracheid not fully grown, as a result of cambial activity at the end of the previous growing-season and partially full-grown in the next season.

This phenomenon, the presence of tangential bordered pit pairs in a number of earlywood cell walls from the growth layer boundary, suggests the possibility of more than one division of the xylem mother cell. In Figure 1 the tangential pits in the cell wall of the last latewood tracheid and the first-formed earlywood tracheid are radially at nearly the level of the pits in the wall of the third and fourth earlywood tracheid. The material examined suggests that only in the radial direction in one of the jointed tracheid walls formed by a xylem mother cell can tangential pitting be observed. However, not frequently, this type of pit was found in two or even three cell walls in the earlywood zone. The pits, usually, have been observed in the middle part of the tracheid length and rarely in the direct neighborhood of ray parenchyma or ray tracheids.

It is a matter for discussion whether importance for impregnation purposes can be ascribed to this type of pitting. So far as impregnation by liquids is concerned it can be remarked that there is no aspiration of pit membranes in the earlywood tangential bordered pit pairs after drying of the wood (Fig. 5). This may be an explanation of the fact that in *Picea abies* after impregnation (e.g. by immersing) with a moderate fluid-absorption, whereby only some latewood zones become filled, locally some adjacent earlywood fiber rows of the next growth layer have absorbed the fluid. Because of non-aspiration of the tangential pits it seems plausible that in seasoned wood a more or less open system can exist on both sides of the boundary resulting in a fluid-transport from latewood fibers to adjacent earlywood fibers. Figure 6 shows a R. L. S. of treated European spruce. The preservative consisted of tributyltin oxide dissolved in white spirit, stained by Rhodamine B. Note the filling of the pit cavities in the tangential wall of the earlywood tracheid which is much like the bordered pits in the latewood tracheids and ray tracheids.

These observations suggest a high resemblance in structure of tangential bordered pit pairs in the latewood and in the first-formed rows of earlywood; there may even be structural similarity with the bordered pit pairs in the ray tracheids.

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EXPLANATION OF FIGURES

Figure 1. On the right series of bordered pit pairs in the tangential cell wall of the third and fourth earlywood tracheid; on the left tangential pitting in latewood. R. L. S. of *Picea abies*.

Figure 2. A. Small tangential bordered pit pairs in the walls of the second and third earlywood tracheids. T. S.

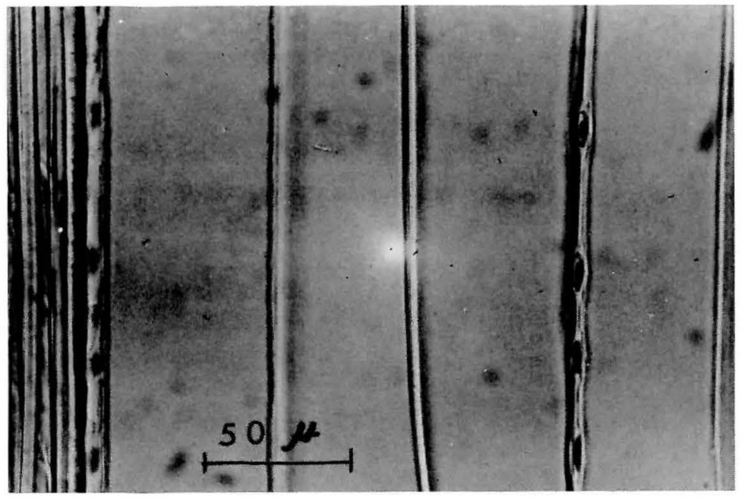
B. Detailed microphotograph of A.

Figure 3. Series of tangential pitting in the cell wall of the first and second tracheid. R. L. S.

Figure 4. A deviating structure of a latewood tracheid (X) with a tangential bordered pit pair. Contrary to adjacent latewood cells this one has larger radial dimensions and a less thick cell wall. T. S.

Figure 5. A. and B. Non-aspirated tangential bordered pit pairs in earlywood tracheids. R. L. S. of air-dried European spruce.

Figure 6. R. L. S. of treated European spruce. Note the filled pit cavities (see arrow) of the earlywood tangential bordered pit pair.



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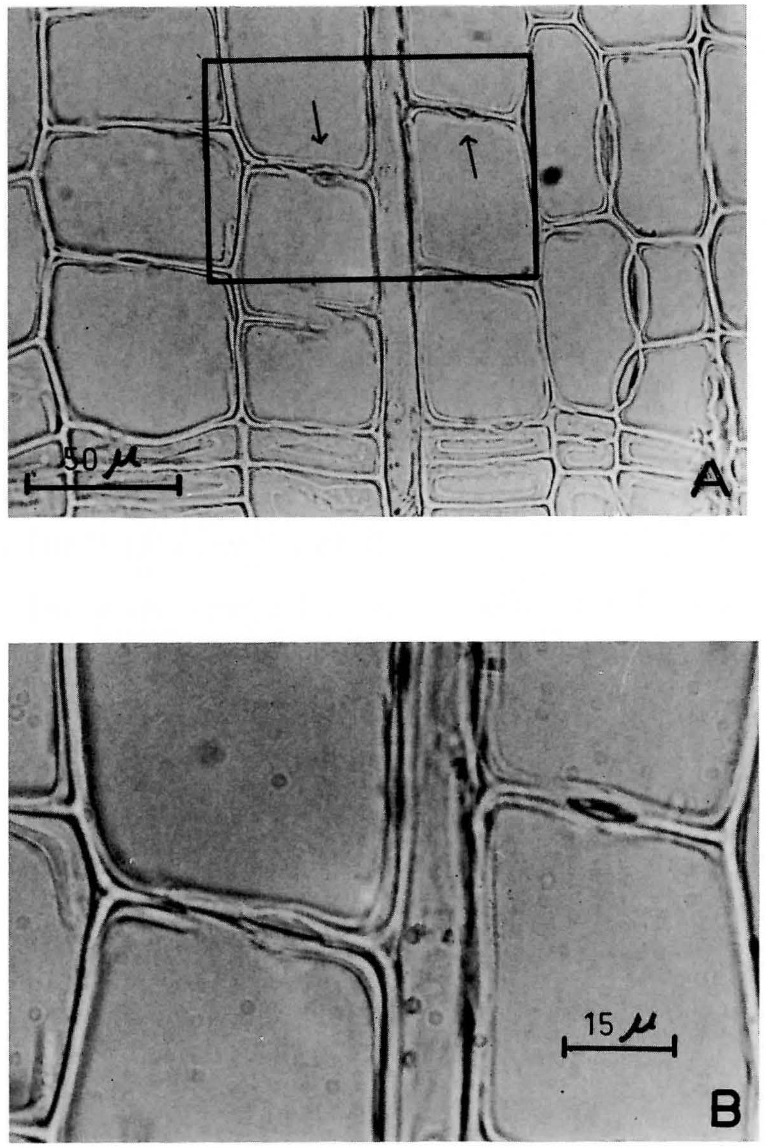

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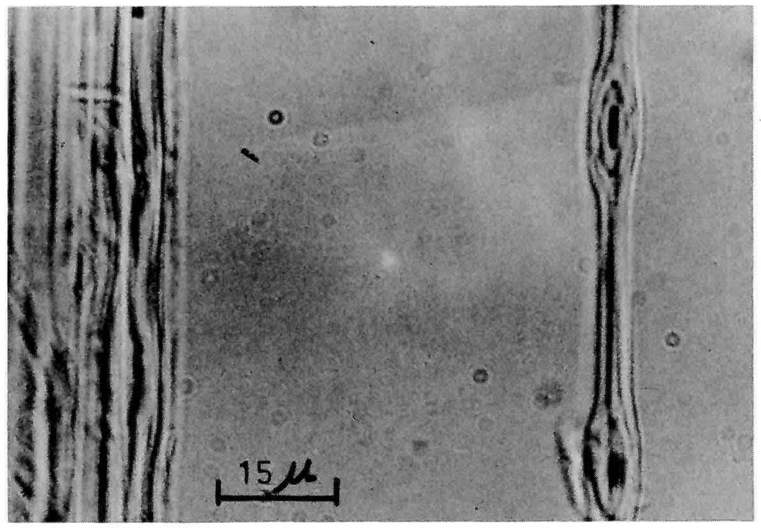

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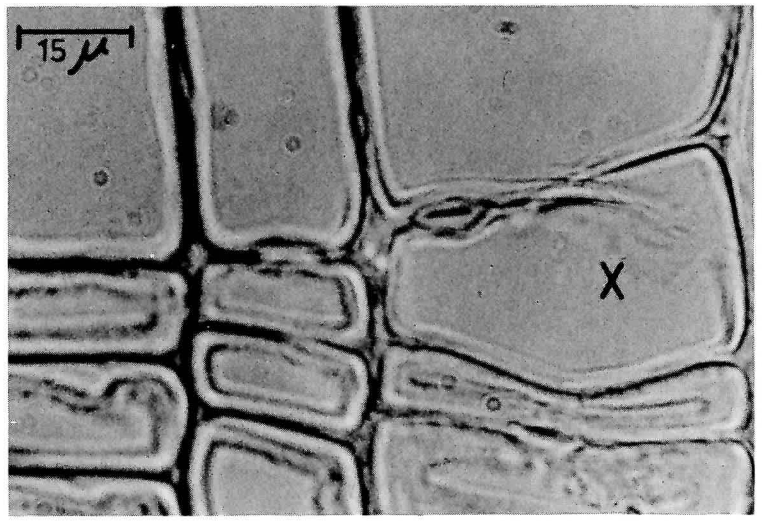

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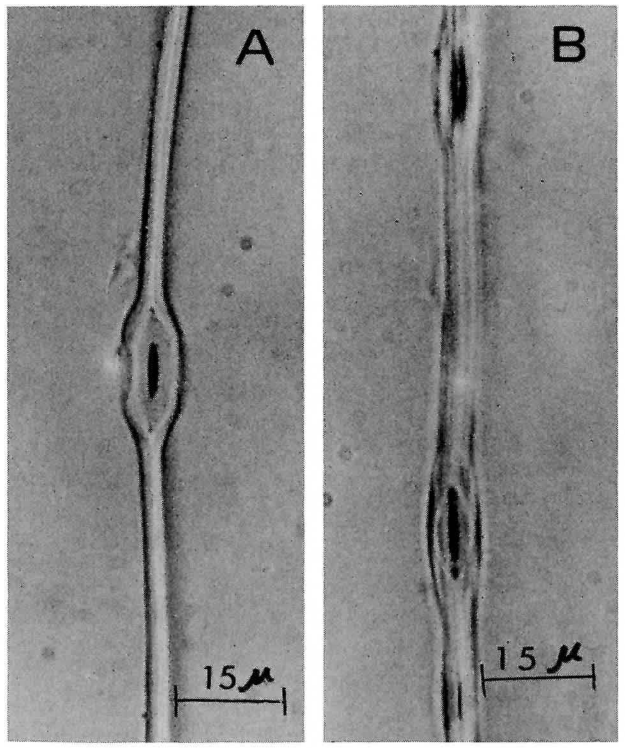

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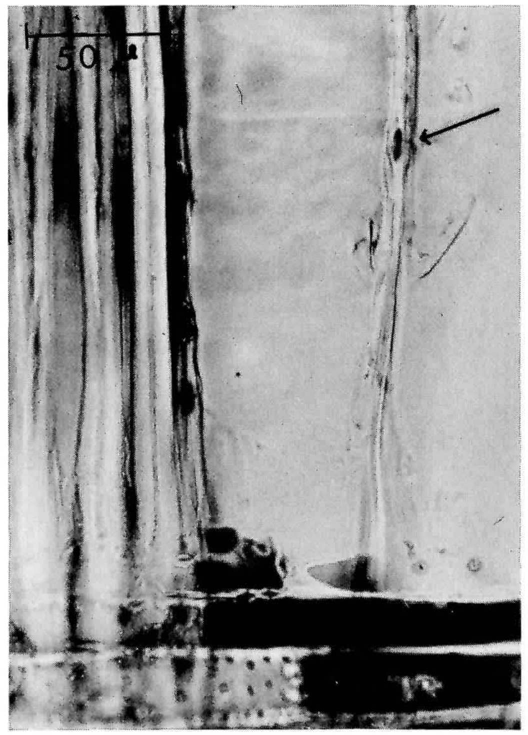

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STUDIES OF WOOD TREATED BY HIGH DOSES OF γ-RADIATION

By

R. C. Antoine, T. Avella and J. C. Van Eyseren[1]

The anatomical study of wood even with Scanning Electron Microscopy (SEM) remains difficult because of the limitations of specimen preparation techniques. Indeed, clear pictures of the transverse section of wood are difficult to obtain, and of the radial and tangential pictures, the former are generally preferred because "radial faces can be split more easily than tangential faces" (Jutte and Levy, 1971).

On the other hand the influence of low doses of gamma-rays (γ) (less than 10 Mrad) on the physical and chemical properties of wood has been studied by several authors and Seifert (1964) has shown that the chemical composition of γ-radiated wood varies under the influence of doses, which however did not exceed 178 Mrad. With the same doses, according to Burmester (1966), the morphological characteristics of γ-radiated wood apparently did not change.

This is why Antoine and Van Eyseren (1971) proposed a novel and easy technique of SEM wood sample preparation using γ-radiation at doses higher than 400 Mrad; this technique was shown to enable a new approach to the observation of the structure of wood.

Spruce [*Picea abies* (L.) Karst] samples of 1 x 1 x 15 cm and spruce cellulose were γ-radiated in air with doses up to 655 Mrad. From 400 Mrad

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[1]Laboratoire Forestier, Université Catholique de Louvain, Kardinaal Mercierlaan, 92, B-3030 Heverlee, Belgium.

on, the friability of wood becomes so as to permit clear breaks in the longitudinal as well as in the transverse, and even in the oblique direction (Fig. 1). Moreover the cleanness of the break permits a view in depth of the cell wall sculpturing (Fig. 2) as far as into the pit chamber (Fig. 3). (Specimens were gold and carbon coated and the JSM-U3 scanning electron microscope was operated at from 5 to 25 kV.)

However, even if the morphological structure is not affected by γ-radiation as high as 655 Mrad, it must be admitted that the results obtained by this technique are nevertheless due to the fundamental modifications of the chemical properties of γ-radiated wood in comparison with the untreated one (Table 1). Cellulose is most importantly affected after a 655 Mrad γ-radiation: the apparent cellulose content as obtained by the Klauditz method is zero.

With a 170 Mrad γ-radiation, Seifert (1964) still observes 7.47% of cellulose. The change in cellulose content is due to the rupture of the cellulose chains; this is evident from the intrinsic viscosity (η) of the γ-radiated cellulose in cupri-ethylene-diamine hydroxide (CUEN) solutions. The (η) value of untreated cellulose equals 7.34, while it falls to 0.068 after a 655 Mrad treatment. The corresponding calculated DP values (Browning, 1967) are of 1400 and of about 13. The amount of lignin as measured by the Halse method decreases from 29.95 to 27.34% which means that about 9% of the lignin present in the untreated wood becomes undetectable after γ-radiation (Table 1). This decrease is smaller than the one found by Seifert (1964) which amounted to 23.71% at 178 Mrad; this discrepancy could eventually be imputed to the method of measurement. After γ-radiation, the yield of water and ethanol-benzene extractives increases strongly (Table 1).

The solubility of γ-radiated wood in dilute alkali is almost total. This fact points to a degradation of lignin which is not detectable by the Halse method determination.

Some changes may be observed in the I. R. spectrum of irradiated spruce in comparison with the spectrum of untreated spruce: a new band at 3.41 microns (2933 cm^{-1}) appears. This band is attributed to the CH_2 groups of the lignin and of the decay products of cellulose. The most important change in the spectrum of wood after irradiation concerns the C=O stretching region: the band at 5.80 microns (1736 cm^{-1}) is strongly enhanced. The increase in carboxyl groups modifies the pH value of γ-radiated wood which decrease from 5.33 to 2.93.

The high dose γ-radiation of wood increases considerably the friability of that material and allow its breakage in any direction; this is probably due, at least partly, to the important modifications that we observe in the chemical composition of the treated samples. We believe that this technique permits an interesting approach to the morphological study of woody plants.

We acknowledge the help offered by the C. E. N. (Mol - Belgium) for the wood sample irradiation, and the technical assistance of Miss C. Degive.

FIGURES

Figure 1. General view of earlywood tracheids of γ-radiated spruce. This stereoscopic view is obtained after simple mechanical breakage.

Figure 2. Sharp break of γ-radiated spruce tracheids displays cell wall organization and sculpturing.

Table 1. COMPARISON BETWEEN THE CHEMICAL PROPERTIES OF γ-RADIATED AND UNTREATED SPRUCE

Constituents	Untreated Spruce	655 Mrad γ-radiated Spruce
	Calculated on basis of oven-dry wood (%)	
Ethanol-benzene extractives	3.60	25.50
	Determined after ethanol-benzene extraction, and calculated on basis of unextracted oven-dry wood (%)	
Water extractives	0.19	44.22
Cellulose	47.94	0.00
Lignin	29.95	27.34
Pentosans	6.94	2.31
Mannans	1.74	0.58
Ash	0.39	0.30

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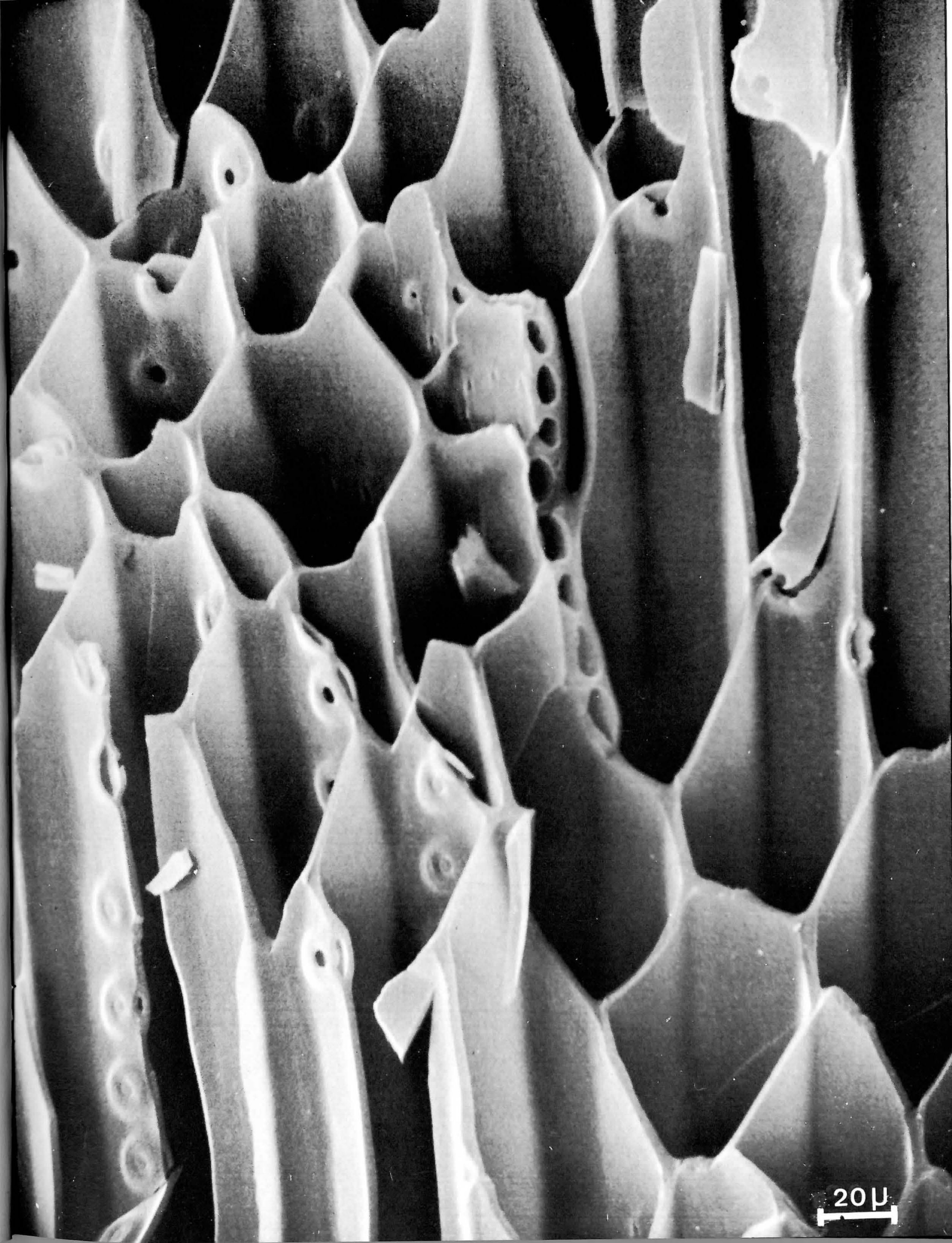


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ASSOCIATION AFFAIRS

New Members

We are pleased to announce the election of the following new members. Their addresses are listed as "Additions" under "Membership Directory Changes". Associate Members are graduate students whose major interest or activity lies in the area of wood anatomy. It is anticipated that most would become Full Members upon completion of their advanced studies.

Full Members

Professor Raymond ANTOINE
Dr. Aldos C. BAREFOOT, Jr.
Dr. Dwight W. BENSEND
Dr. Pieter D. BURGGRAAF
Mr. Brian G. BUTTERFIELD
Miss Dorothy M. CATLING
Dr. Samuel C. CHAFE
Dr. Paul GREGUSS
Dr. Lalita KAKAR
Dr. Edgar A. McGINNES, Jr.

Associate Members

Mr. Christopher DAVIDSON
Mr. Richard L. GRAY
Mr. Paul T. MANN
Mr. John E. PHELPS
Mr. John E. WEBBER

Membership Directory Changes

Address Changes

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Nr. Bishops Stortford
Herts., England

Mr. Frank W. Hankins
307 East Avenue C
Alpine, Texas 79830
(Winter Address)

Dr. Laurence E. Lassen
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Gaithersburg, Maryland 20760

Dr. Roswitha Schmid
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Aylesbury (Bucks.), England

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Dr. Pieter D. Burggraaf
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Mr. Brian G. Butterfield
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Miss Dorothy M. Catling
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Mr. John E. Phelps
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Columbia, Missouri 65201

Mr. John E. Webber
School of Forestry
Oregon State University
Corvallis, Oregon 97331

Honorary Membership

It is a pleasure to announce the recent Council action in which Dr. E. W. J. Phillips was elected to Honorary Membership of I. A. W. A. Dr. Phillips retired in 1968 from his position at the Forest Products Research Laboratory in Princes Risborough, England, where he was Head of the Wood Structure Section. He has been affiliated with IAWA for forty years, including long service on the Council.

LETTERS TO THE EDITOR

Greece

Dr. George Tsoumis, Professor at Aristotelian University in Thessaloniki, writes (6/29): .... "I wonder if you could publish in the Bulletin names of colleagues, or laboratories, willing to exchange wood samples".

. . . .

The Editors would be pleased to list the names of individuals or organizations willing to cooperate in such an exchange. Specific requests could also be made.

Netherlands

.... "May I take this opportunity to let you know how much I appreciate the Bulletin in its new shape. It was most encouraging to get several positive and useful reactions to my short note on wood anatomy facilities in Leiden in the issue of last spring. I hope that the plans of including lists of available reprints from IAWA members, briefly discussed in Hamburg last year, will also materialize in the near future. Please let me know if I can help in any way in getting information about other wood anatomical activities in the Netherlands."

(6/28) (Signed) Pieter Baas

Iceland

Member Haraldur Ágústsson writes (Aug. 10) that he will be pleased to supply copies of his publications at the following prices which include postage:

1. Viðareinkenni = Wood features $1.75
2. Heiti úr viðarfraeði = Terms from wood technology $1.75
   (In Icelandic, Danish, English, German)
3. Heiti úr viðarlíffraeði = Multilingual Glossary of Terms Used in Wood Anatomy (Icelandic version) $2.50

Write to him at: Brávallagata 20, Reykjavik, Iceland

Belgium

Member Roger Dechamps of the Musée Royal de L'Afrique Centrale at Tervuren, Belgium, wrote us recently (Sept. 6) about the availability of two publications. The first is a 104-page book, "Comprendre L'Anatomie du Bois"--Étude descriptive du xylème des végétaux angiospermes dicotylédonés. The second is "Clé Dichotomique de Triage Préliminaire sur Critères Anatomiques des Espèces Ligneuses au Sud du Sahara". This 98-page publication should be a useful key for members working with African woods.

Both books by Mr. Dechamps may be obtained from the author who has reserved some copies for fellow members of our Association. His address is: Service d'Anatomie des Bois Tropicaux, Musée Royal de l'Afrique Centrale, B-1980 Tervuren, Belgium.