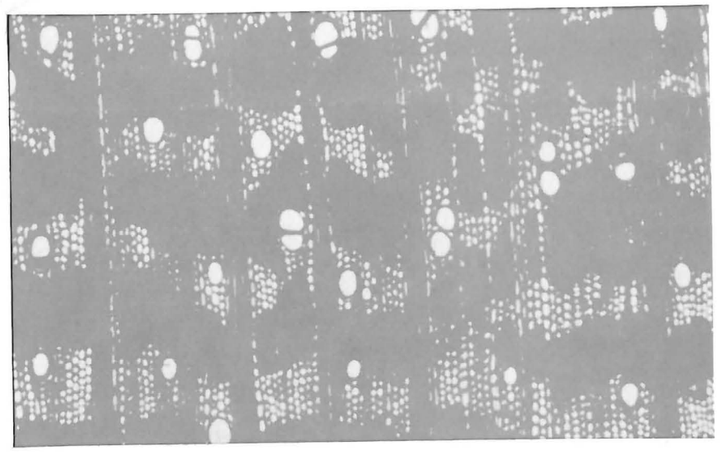
IAWA BULLETIN

1971/1



IAWA BULLETIN

1971/1

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

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

We have been pleased to receive a few letters from members with suggestions for the future of the Bulletin and the Association. Ideas are always welcome since our function is simply to implement such ideas once the Council has approved them. We urge you to keep the letters coming!

In 1971 we plan to publish four issues if enough material is received to justify this action. Because the newsletter role of the Bulletin is important for communications within our organization, two issues per year would seem inadequate. We will try for four issues realizing that three may prove to be more realistic. So send your news items, requests, notices, technical notes and short papers keeping in mind that readers of the Bulletin are wood anatomists having broad interests in many related fields.

This issue carries the financial report for 1970. While the operating balance is adequate considering the size and the activities of the Association, about half of the members have not paid their dues for 1970 and previous years. Fortunately, 25 members have already paid for 1971 and payments have been received quite steadily since notices were sent.

Our last word for this time concerns a point made in the first sentence of this message. Do you feel that IAWA and its objectives as described in the current Constitution represent the orientation desired by the average member? If we are to remain a vital organization, occasional self-analysis may be helpful. Read the report in this issue of the recent meeting held near Hamburg and let us have your reactions to these ideas, and some of your own thoughts on our future.

W. A. Côté
C. de Zeeuw

SCANNING REFLECTION ELECTRON MICROSCOPY IN STUDIES OF WOOD STRUCTURE AND ITS DEGRADATION

by

S. M. Jutte* and J. F. Levy
(Department of Botany, Imperial College, London)

The basic principle of scanning reflection electron microscopy was propounded in Germany in 1935, but it was not until thirty years later that a commercial production model was readily available. During the last five years it has found a very wide range of applications, including considerable use in the biological field. Echlin (1968) reviewed this use with examples from a variety of botanical subjects. The application of scanning electron microscopy to the study of wood has received comparatively little attention. Wellwood, Ifju and Wilson (1965) used scanning electron microscope pictures in a study of wood strength properties, but made no comment on this use. Wagenfuhr and Zimmer (1968) and Resch and Blaschke (1968) demonstrated some of the advantages of scanning microscopy in studies of wood cell wall and cross-field pit structure. Findlay and Levy (1969) pointed out the potential breadth of application of the scanning electron microscope to the study, not only of wood anatomy at a gross and at cellular level, but also of wood decay. Findlay and Levy (1970) extended this work to the more detailed anatomy of a particular species, Fitzroya cupressoides, and showed various pictures of pit structures and wall layers. Perrins (1970) did further preliminary studies with wood including the suggestion of the use of a silver stain

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* On leave of absence from The Organization for Industrial Research, T. N. O., The Hague, Holland.

rather than metal coating for preparing the specimens and concluded that for wood anatomy the scanning electron microscope was most useful between the magnification ranges of 200X and 5000X. Findlay (1970) devotes a part of his Ph.D. thesis to an examination of decayed wood. He shows that the instrument, when used in conjunction with the more traditional optical and transmission electron microscopy, can be an extremely useful tool in determining the micromorphological characteristics of the patterns of decay at cellular level, as well as for indicating certain chemical and physical aspects of the nature of the woody cell wall. Jutte and Wardrop (1970) also used the scanning electron microscope in studying soft-rot cavities in Pinus sylvestris.

Scanning electron reflection microscopy differs fundamentally from transmission electron microscopy in that an even-focused electron beam probe is scanned over a small area of specimen in a square raster. This electron beam has several effects, the main importance of which are (a) to directly reflect high energy electrons off the surface of the specimen (reflective mode), and (b) to cause the specimen itself to emit low energy secondary electrons (emissive mode). Electrons given off by either of these methods are collected and processed to produce a visual image of the surface of the specimen. The advantages of using this instrument are many-fold. Amongst others, a good depth of focus which gives a three-dimensional image and a relatively easy preparation technique are probably the most noteworthy. If wood is to be studied it must be completely dry and the surfaces coated with a suitable material so that an electron conducting surface is produced which will allow the charges to be conducted

away and prevented localized beam damage or a blurred image.

The specimens were prepared by splitting splinters of even thickness (20-100μm) from longitudinal faces of a small block of wood orientated in the radial or tangential directions. The differences between cut and split longitudinal faces have been discussed by Findlay and Levy (1970). Any loose residual fragments can be removed by lightly pressing a piece of adhesive tape to the surface and quickly peeling off. Radial faces can be split more easily than tangential faces. The splinters to be examined were then stuck to a microscope stub with double sided adhesive tape and the stub with specimens was then coated under vacuum with gold/palladium alloy to produce an electron-conducting surface. The stub was then mounted in the microscope and the specimens examined without any further preparation.

The figures shown in this paper are all of longitudinal surfaces prepared in this manner. Figures 1-4 are radial faces of spruce (Picea sp.): figures 5 & 6 are radial faces of Pinus radiata; figures 7 & 8 are radial faces of Pinus sylvestris; figure 9 shows a radial face of birch (Betula sp.); figure 10 is a tangential view of ash (Fraxinus excelsior); figures 11 & 12 are fragments cut from a weathered oak (Quercus sp.) bridge to show natural degrade on an exposed weathered surface.

This paper is intended to give some idea of the range of use to which the instrument can be put, from magnifications of 500X to 5,000X. The former are well within the range of the light microscope but show a very much greater depth of focus. At the higher magnifications the fine structure of the wall becomes visible by a much simpler and quicker

preparation technique than in transmission electron microscopy. Details of anatomy are clearly visible and even fungal hyphae are not drastically distorted. The detail of the scalariform perforation plate in a vessel of birch (Figure 9) could hardly be better seen in any other form of microscopy.

Figures 1, 6, 7, 8, 9 & 10 show normal sound wood. Figures 2, 3, 4 & 5 all show partially degraded wood, after 48 hours soaking in a cellulose preparation. Figures 11 & 12 show natural degrade in wood surfaces under normal exposure to weathering for a number of years.

The details are as follows:

Figure 1. Unaspirated bordered pit in radial wall of early wood tracheid of Spruce (Picea sp.). The pit diameter is about equal to the radial dimension of the tracheid. The microfibrils of the margo are incrusted and part of the margo has been broken down, possibly due to the preparation technique in high vacuum. The torus is also incrusted; no microfibrils can be observed here. As the wood has been split along the middle lamella, the upper part of the bordered pit pair has gone. Parts of the compound middle lamella and the S_1 layer can be observed. (2,500X)

Figure 2. Part of a ray with several cross-fields and their semi-bordered pits as seen from the adjacent tracheid in Spruce (Picea sp.). On the right the S_2 layer shows up, in which the bordered part of the semi-bordered pit is revealed with slit-like pores, but in the central and left part the S_1 layer is visible and the S_2 layer is split off taking away the upper border, so that only a part of the border (originating from S_1) can be seen plus, somewhat deeper, the pit membrane. The white vertical ragged strips are parts of the tangential tracheids (2 days cellulase

treatment). (1,000X)

Figure 3. Bordered pits on radial walls in Spruce (Picea sp.) The S_2 layer appears in some areas showing up on the lumen side of the tracheids. In the tracheid at extreme left the S_2 layer was lifted in splitting; the lower portion of it is missing, but in the upper part the attached layers can be observed, split along the direction of the microfibrils. In the other tracheids only the S_2 layer has partly disappeared whereas the S_1 layer remained behind (2 days cellulase treatment). (500X)

Figure 4. Radially split surface of Spruce (Picea sp.) in which many cell wall layers can still be observed. The construction of the pit dome is particularly striking. On the upper right side the S_2 layer can be seen with the S_1 layer below. The compound middle lamella and the S_1 layer of the lower tracheid are also visible. From the lower pit pair the top dome has been lifted, leaving the lower dome and the aspirated, heavily incrusted torus. Evidence of the pore and also parts of the margo can be seen. However, there are no microfibrils visible where the margo should be (2 days cellulase treatment). (2,000X)

Figure 5. Part of a tracheid in radially split radiata pine (Pinus radiata) showing two pits which are partly degraded. Both the S_1 and S_2 layers are visible. Both pores are closed with an apparently structureless membrane at the central part of the torus. The latter and the margo cannot be observed. The lower pit half is for the greater part intact, the upper pit dome however, is degraded and peeling off in a spiral manner (2 days cellulase treatment). (2,000X)

Figure 6. Bordered pits in the cell walls of three tracheids of radiata pine (Pinus radiata). The S_1 layer can easily be observed especially in the lefthand cell. In the two pits in the left tracheid the tori have holes which are as large as the porus. As no microfibrils from the margo show up, it may well be that the inside of the dome has a thickening adjacent to the porus. In the central tracheid only a part of the upper pit dome is raised; it is clear that the part formed by the S_1 layer is more resistant. Inside the pit the torus with a central hole and a part of the margo is visible. In the righthand tracheid the same residue of the pit is left as in the central one, but its membrane and torus are missing. (1,300X)

Figure 7. Bordered pit of Scots pine (Pinus sylvestris) in aspirated condition. The torus, margo and warts can easily be detected. The margo microfibrils can be followed up to the edge of the porus. The portion of the torus covering the porus does not show microfibrils and is "lifted" in a peculiar way. Up to now this phenomenon has been observed on the lumen side of tracheids in electron micrographs of Pinus replicas (Dahlitz and Spit, Pers. Comm.). (5,200X)

Figure 8. Radially split surface of Scots pine (Pinus sylvestris) showing part of a ray with window pits in its parenchyma cells and bordered pits in its tracheids. Most of the membranes have disappeared from the window pits leaving a view of the inside of the reduced dome on the adjacent tracheid wall. Two rows of ray tracheids can be identified. They have small bordered pits the details of which are not well resolved. (500X)

Figure 9. Radially split surface of birch (Betula sp.) with scalariform perforations and pitting of vessel elements. Through the perforation more pitting on the back wall can be observed. (1,040X)

Figure 10. Group of pits on the tangential wall of a vessel of Ash (Fraxinus excelsior) showing an interesting effect of central slit-like openings. Originally the pits were covered by a fairly thick membrane with openings which are smaller than the above, giving the pits a smooth surface view (tangential section). (2,500X)

Figure 11. Decayed fragment of Oak (Quercus sp.), from a weathered bridge, showing fungal hyphae growing across the exposed surface. Note the partial removal of some of the wall layers with a hypha growing between the parts that remain. Note also the wartiness of the fungal hyphae and associated fungal spores. (1,700X)

Figure 12. The same sample as Figure 11 showing a fungal hypha with a pronounced warty surface growing across an area of pits from which part of the wall layers are missing, including the pit borders and the membrane. Note the penetration through the pit opening. (4,700X)

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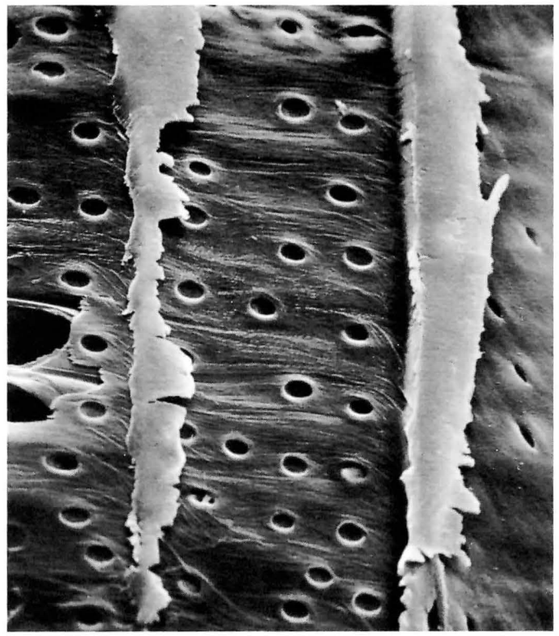

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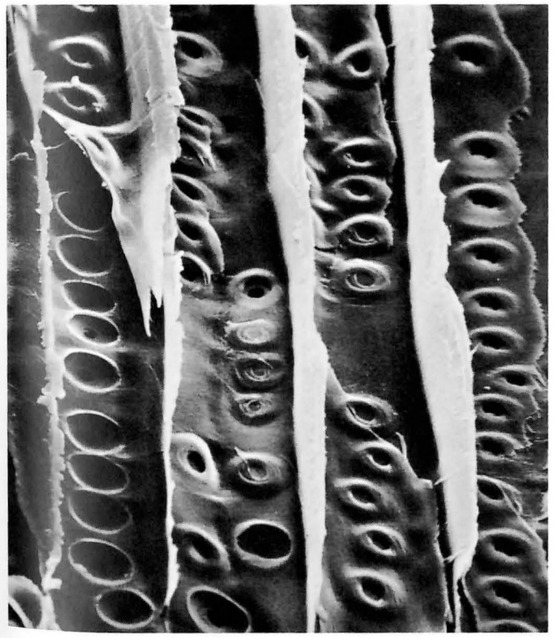

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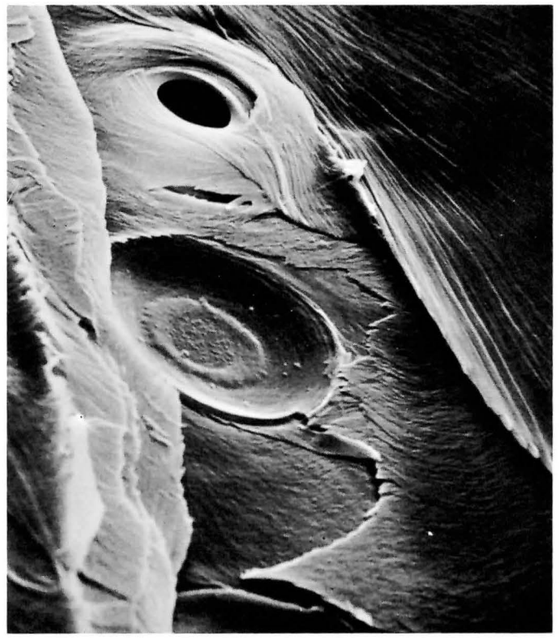

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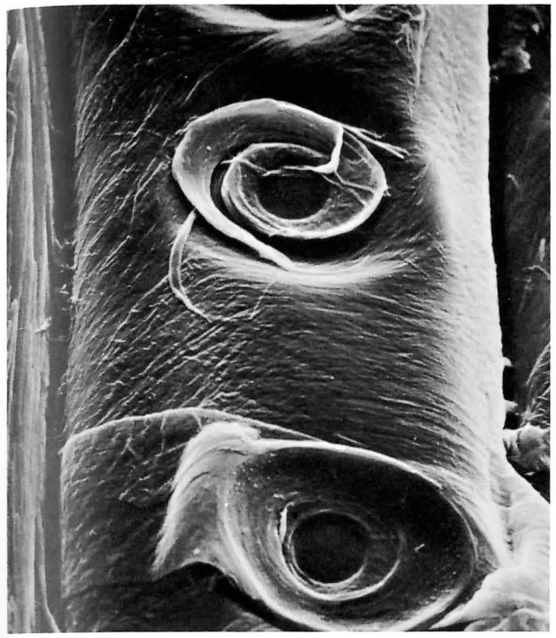

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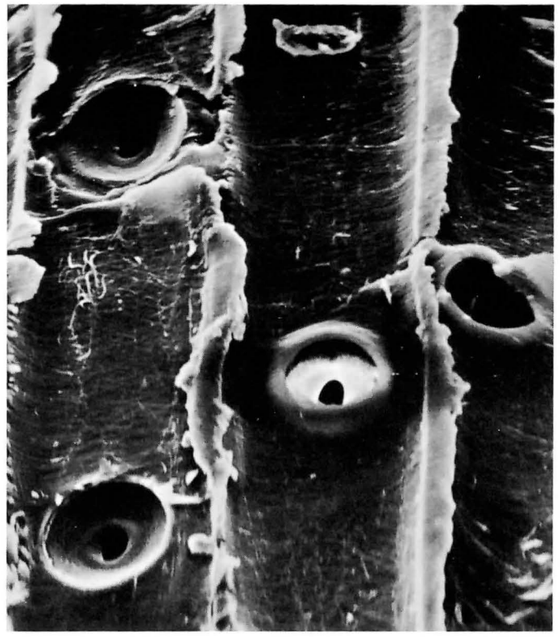

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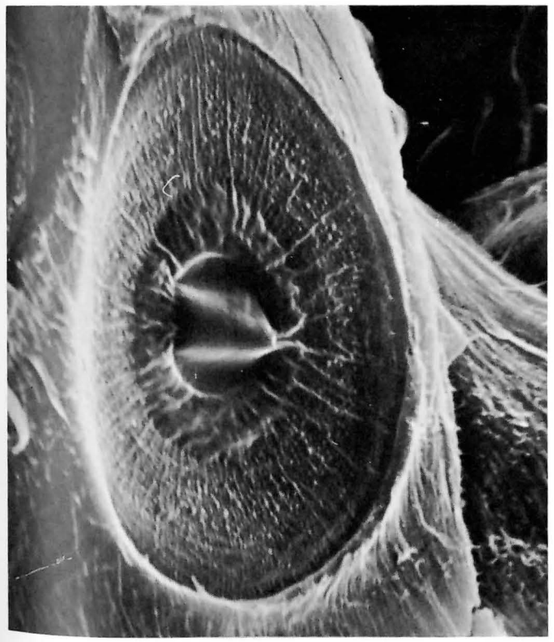

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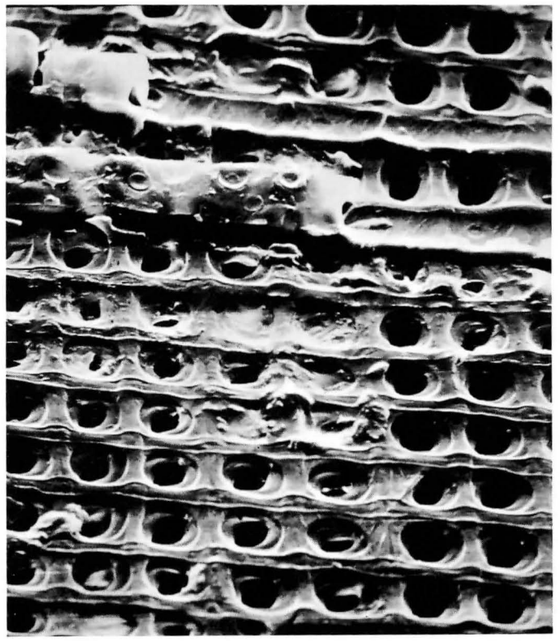

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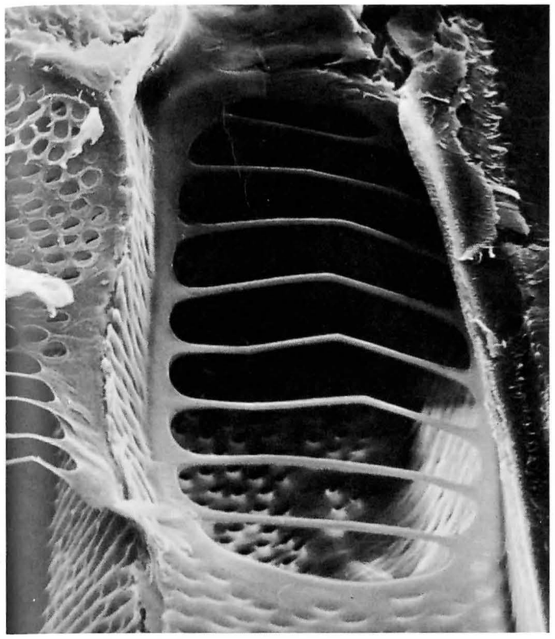

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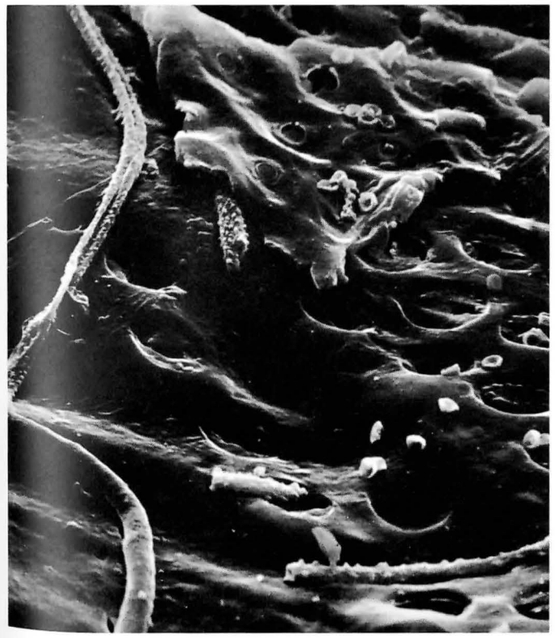

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ASSOCIATION AFFAIRS

Financial Report - 1970

Income

Transfers from Zurich office: (Feb. 4, 1970)	$ U. S.	150.00
(April 13, 1970)		1246.00
		1396.00
Receipts (Syracuse office): Dues payments, subscriptions, and sales of Glossaries		777.98
Interest (Savings Account)		14.88
Total:		$2188.86

Expenditures

Costs of publishing IAWA Bulletin	304.09
Postage	89.45
Office expenses (stationery, office supplies, etc.)	271.75
Freight Charges (transfer of office records to Syracuse)	77.23
Total:	$742.52

Operating Balance $1446.34

Statement of Account

December 31, 1970

Unibank Account No. 102-042-603

Lincoln National Bank and Trust Company
of Central New York
Syracuse, New York, U. S. A.

Savings Account:	$514.88
Checking Account:	931.46
Total:	$1446.34

MEMBERSHIP DIRECTORY

Corrections

Dr. Judson C. Isebrands should read: Dr. Judson G. Isebrands

Dr. I. Poliquin should read: Dr. J. Poliquin

Geographical Index:

Under DDR, list Dr. habil. Gerhard Casperson and Dr. R. Wagenführ. Both were incorrectly listed under Germany in the new Directory.

Deletions:

Dr. A. J. Mia	Resigned 9/30/70
Dr. Irma E. Webber	Resigned 12/31/70

CURRENT COUNCIL ACTIVITIES

Members of the Council are currently giving consideration to the preparation of By-Laws to implement the provisions of the revised Constitution. Included must be the procedures to be followed in the nomination and admission of new members, especially Associate Members, a new category of membership. In the past nominations have been made by members in letter form and supported by one or more additional members in a similar way. Nominations, supported by letters and credentials, have been circulated among all members of the Council for approval. It is hoped that a simpler and faster method of application and of processing nominations can be developed for both classes of membership.

WOOD ANATOMY ACTIVITIES AROUND THE WORLD

New Wood Anatomy Research Facility in the Netherlands

The wood collection at the Rijksherbarium, Schelpenkade 6, Leiden, Netherlands, was organized in 1969 following the appointment of a comparative anatomist at the herbarium. The present collection contains about 8,000 specimens, representing approximately 400 genera from 94 families, mainly from the Malaysian region. The larger part of the collection is formed by an almost complete set from the Forestry Service of West Guinea (BW series). Other fairly small, but botanically very interesting, collections are those made by Kalkman, Kostermans, Van Royen and Vink (New Guinea), Fuchs and Jacobs (Borneo), Meijer (Sumatra), Mitzura Hotta (Sabah), Van Beuzekom (Thailand) and Jacobs (The Philippines). Of about 300 collection numbers from New Guinea (BW, Vink and Kalkman) duplicates are still available. Current research of the anatomist concerns the taxonomic affinities of some enigmatic genera and/or monotypic families. In connection with these studies, wood, bark and leaf material from the following taxa would be highly welcome:

Afrostyrax, Hua, Lophopyxis, Medusagyna, Oceanopapaver, Oncotheca, Paracryphia, Phelline and Sphenostemon.

We feel that a study of anatomical structures in all the above material is necessary in order to get clues from as many anatomical characters as possible.

The department of anatomy at the Rijksherbarium is still in an embryological stage of development. The slide-collection is therefore

very small with slides of leaf, twig and wood of only about 60 genera. Exchange of wood specimens and, if possible, also of slides would be highly appreciated in order to build up a more comprehensive reference collection on a worldwide base.

P. Baas

Professor Liese Hosts Meeting of IAWA Members

An impromptu meeting of members of IAWA was held on the 27 November 1970 at the new facilities of the Bundesforschungsanstalt für Forst- und Holzwirtschaft, Reinbek-Lohbrügge on the occasion of the IUFRO conference on Properties and Utilization of Tropical Woods. There were 14 members present including 4 of the Council. In the course of the short meeting the matter of processing regular and student membership applications was discussed. It was recommended by the group that the Council establish application forms and appoint a small committee to act on the applications which will be submitted under the new system.

A second matter brought under discussion was the News Bulletin. The discussion covered the number of issues per year and the nature of material to be included. The consensus of the group was that we could not hope to compete with established journals publication of technical articles because of funding and limited circulation. We could better expand the basis of service to members by serving as a clearing house for news on projects and areas being investigated by members. This could well include general announcements of samples and slides available for exchange, requests for

special material needed in investigations and lists of members' publications available as reprints, etc. A service such as discussed could have a very real purpose and does not now exist. An example of this sort of service has been included by Mr. P. Baas in this issue. For a system such as this to be most effective there should be more than two issues of the Bulletin per year, as Dr. A. Mennega pointed out. Dr. Liese also pointed out that in addition to the usual business items of the society, the Bulletin could also publish an annual list of publications of the society.

The meeting was concluded with a recommendation from the group that in light of the present attendance that IAWA meetings should be convened at future sessions of the IUFRO.

Members in attendance were:

W. Liese	J. Brazier
C. de Zeeuw	N. Parameswaran
J. Bauch	A. Mariaux
P. Baas	P. Laming
G. Scaramuzzi	H. Gottwald
B. F. Kukachka	J. Collardet
J. Poliquin	A. Mennega

U. S. A.

Council Member William L. Stern has written that the following publication is available free-of-charge:

"Genera and families of plants represented by wood specimens in the Division of Plant Anatomy, Department of Botany, Smithsonian Institution" (1967). Names are listed by genera and family, alphabetically.

To obtain a copy, send your request to:

Dr. William L. Stern, Professor
Department of Botany
University of Maryland
College Park, Maryland 20742
U. S. A.

Requests will be honored until April 15, 1971, unless the supply is exhausted earlier.