IAWA BULLETIN

Contents

Front cover: Scanning electron micrograph of vestured intervessel pits (pit floors removed) in *Anogeissus acuminata* (Roxb. ex DC.) Wall. (Combretaceae). Courtesy G.J.C.M. van Vliet, Leiden.

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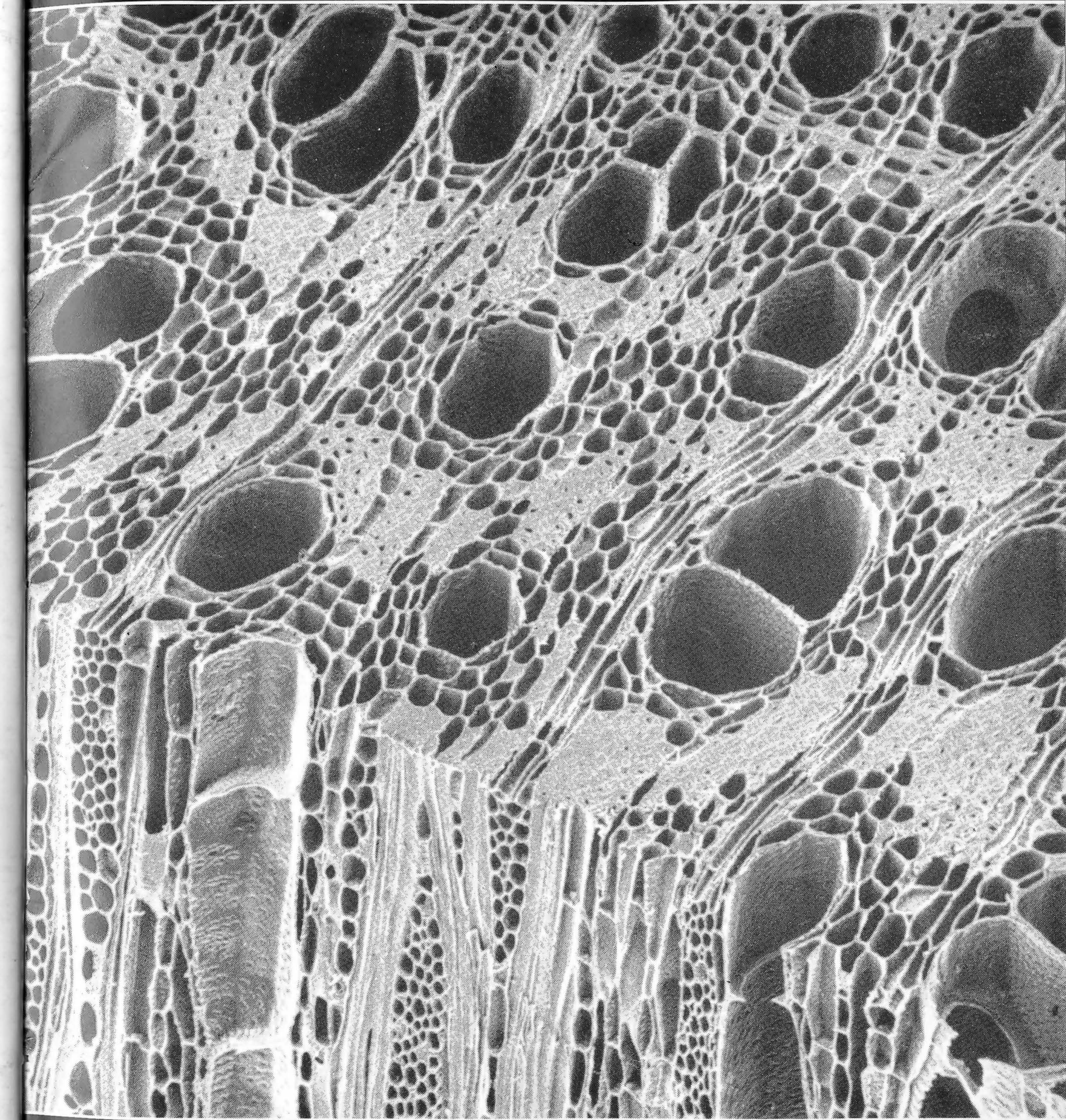

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Contributions and books for review, as well as applications for membership, and IAWA Bulletin subscriptions should be addressed to the Office of the Executive Secretary.

EDITORIAL

This rather belated first issue of the IAWA Bulletin in 1978 marks a bad start for this Association year. Part of the delay in appearance is due to a serious lack of manuscripts. The positive tone of our latest editorial (IAWA Bulletin 1977/4: 66) has thus to be reversed and once more we have to urge our membership to participate more actively in Association affairs, also by contributing scientific papers, notes and requests to keep our Bulletin a representative and lively periodical.

One may wonder about the causes of the lack of copy as now experienced by the IAWA Bulletin. For a relatively small and highly specialized research area like wood anatomy as represented by our Association much can be due to chance fluctuation, but other causes may be involved as well. Rumour has it that, in spite of the general increase in scientific staff of most institutes in the fifties and sixties, scientific output has gone down in recent years. The IAWA Bulletin is not the only periodical suffering from a lack of suitable manuscripts for publication. Perhaps part of the decrease in scientific output is due to an increasing involvement of many scientists in administrative affairs ensuing from more democratic structures at research centres and universities. In many respects these democratic structures are a blessing, but often they can lead to many needless, time-consuming meetings and paper-wasting reports by many individuals, where one person could have done the job much better and more efficiently. In spite of the fame of Parkinson's laws and of the Peter Principle these caricatural warnings seem to be more applicable now than ever. Let us hope that this does not hold true for the wood anatomists assembled in IAWA!

Together with this Bulletin we enclose two copies of application forms for IAWA membership. Please use these to stimulate colleagues with an active interest in wood structure to join the International Association of Wood Anatomists. Perhaps it helps to tell IAWA members-to-be that they will experience little delay in getting a paper published in this Bulletin. In order to take away further thresholds for publication in the Bulletin we are considering a reduction of the price of reprints. The latter measure can, of course, only be applied as long as our finances allow such a generous attitude (see the financial report in this Bulletin issue).

Finally, although belated, we wish all readers of the Bulletin a happy and productive 1978!

Pieter Baas
Peter B. Laming

WOOD ANATOMY OF THE PUNICACEAE

by

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Summary
The wood anatomy of the monogeneric family Punicaceae is described in detail. Close affinities of *Punica* with other families of the Myrtales, notably with Lythraceae, are confirmed.

Introduction
This short note forms part of a series of papers on the wood anatomy of true or putative members of the order Myrtales, mainly by Van Vliet (1975, 1976, 1978, and in preparation) and partly by Zweypfenning & Baas (in preparation). The monogeneric family of the Punicaceae consists of two species only: *Punica granatum* L. (the pomegranate tree) which grows wild and cultivated all around the Mediterranean and in the Orient to NW India and the use of which stretches back into pre-history (Goor, 1967); and *P. protopunica*, first described by Balfour (1882) as a distinct species endemic to the island of Socotra in the Gulf of Aden. The wood of *P. granatum* is fairly well-known from descriptions by Greguss (1959), Jacquiot, Trenard & Dirol (1973), and Metcalfe & Chalk (1950). We owe a description in Russian of the wood of *P. protopunica* to Shilkana (1973). The present work, including a scanning electron microscope study of the vestured pits, was carried out to make our knowledge of *Punica* wood anatomy comparable with that of other families of the Myrtales, and thus to introduce wood anatomy into the discussion of the taxonomic position of the family.

Materials and techniques
Wood samples were obtained from the wood collections of several institutes and in the field. Institutional wood collections are referred to using Stern's (1967) abbreviations. Herbarium vouchers are listed where known; collection numbers referring only to wood samples are given between brackets; mature samples are listed without special indication but immature samples (less than 5 cm ø) have the diameter given. Light microscope sections were stained according to a modified method by Maácz & Vágás (1961) with safranin and astrablue. Macerations were obtained using Franklin's method (hydrogen peroxide and glacial acetic acid) and mounted in glycerine jelly.

For each sample 25 measurements were made of the vessel member length (tails included), vessel diameter, and fibre length. Data on vessel frequencies are based on at least 5 counts in each specimen in areas of 1 mm². Ray frequencies are based on 5 counts over a tangential distance of 1 mm each. Some wood samples (marked with *) were examined with a Cambridge scanning electron microscope. Tangential, transverse and oblique surfaces, and radially split surfaces were cleaned in diluted household bleach and coated with carbon and gold.

Description of the wood of Punica (Fig. 1–8)
Material studied. *P. granatum* L.: Greece, Mennega & Driehuis 40, Orphanides 4468 (*ex* Firenze); Yugoslavia, Mennega & Baretta *s.n.* (= Uw 13825) ø 2 cm; Netherlands, Cult. hort. Baarn Cp 1506* ø 1.5 cm, Cult. hort. Leiden *s.n.*; Locality unknown, (FHOw 11666) sections only. *P. protopunica* Balf.: Socotra, Schweinfurth *s.n.** (*ex* KJw), Smith & Lavranos 287 (*ex* KJw).

Growth rings faint to distinct. *Vessels* diffuse, 45–84/mm², solitary or in radial multiples of 2–4(–9), percentage of solitary vessels 26–82, round to oval, tangential diameter (26–)37–66(–87) µm, radial diameter up to 110 µm, vessel wall thickness 2.5–4.0 µm. Vessel member length (160–)250–330(–530) µm. Perforations simple in oblique end walls. Tails present, short to long. Intervessel pits crowded, alternate, 3–5 µm, round to polygonal with round to slit-like, sometimes coalescent apertures. Vessel-ray and vessel-parenchyma pits similar but less crowded and half-bordered. Intervessel pits vestured with fairly thick *vestures* inserted around the pit aperture and branching profusely into the pit chamber (type B, *sensu* Van Vliet, 1978; see also fig. 7 & 8). Vessel-ray pits with small, slightly branched vestures. Vessel walls finely to heavily warted, warts continuous into pit apertures in heavily warted *P. granatum* specimen studied. Solid amorphous *contents* frequently present. Thin-walled *tyloses* occasionally present in some *P. granatum* samples.

Fibres (300–)460–540(–820) µm long with rather thin to thick walls and simple pits with slit-like apertures mainly confined to the radial walls, septate and/or chambered crystalliferous (septae disappear on maceration), partly gelatinous. Tendency towards fibre dimorphism noted in *P. granatum* (Orphanides 4468) in which crystalliferous fibres are shorter (460 μm on average) than non-crystalliferous fibres (650 μm), and in Cult. hort. Leiden *s.n.* in which fibres around vessels are wider and shorter than other fibres and have rounded ends. Ratio of fibre to vessel member length 1:7–1.9 : 1.

Parenchyma very scanty paratracheal to almost absent. Strands of 2–4 cells.

Rays 12–21/mm, heterogeneous, mostly uniseriate and completely composed of square to erect cells or including portions of weakly procumbent cells, partly bi- more rarely triseriate with central portions of procumbent cells. Uniseriates 1 to 8 cells high, bi- or triseriates up to 26 cells high.

Rhomboidal *crystals* confined to chambered fibres, often one per chamber, sometimes several crystals per chamber (fig. 4), very frequent or scarce (in two *P. granatum* samples).

N o t e. Quantitative values of the immature *P. granatum* specimens have been left out of the description, but are not very different from those for the mature samples. The rays of the juvenile specimens tend to be exclusively uniseriate and composed of erect to square cells only. The wood structure of *P. protopunica* is within the range of variation of *P. granatum*. This range is very considerable for characters such as vessel grouping (percentage of solitary vessels), vessel diameter, ray frequency and the proportion of chambered crystalliferous fibres.

The above description agrees well with reports from the literature, although absence of parenchyma or exclusively uniseriate rays have been erroneously reported by some authors, presumably due to the study of immature specimens. The occasional tracheids reported by Greguss (1959) possibly represent incomplete vessel members associated with vessel multiples.

Discussion

There has been unanimous taxonomic agreement about the myrtalean nature of the Punicaceae. Bentham & Hooker's system included *Punica* in the Lythraceae and although treated as a separate family by most other authors the affinities with Lythraceae have not been disputed. Thorne (1976) recently re-incorporated *Punica* as a separate subfamily of the Lythraceae and also included Crypteroniaceae and Sonneratiaceae in that family. The wood anatomy of *Punica* very closely resembles that of several Lythraceae (Zweypfenning & Baas, in preparation): vessel morphology and distribution, narrow heterogeneous rays, crystalliferous chambered fibres, scanty to absent parenchyma occur in the genera *Ginoria* and *Grislea*, while other Lythraceae share three of these four important characters. The type of vesturing in the vessel wall pits as well as the occurrence of warts is also shared by numerous members of the Lythraceae. Other Myrtales with a wood anatomy reminiscent of that of *Punica* are Oliniaceae, and the problematic, probably Lythraceous genera *Alzatea* and *Rhynchocalyx* (*cf.* Van Vliet, 1975). The strongest resemblance remains, however, with the Lythraceae referred to above. Wood anatomy thus confirms the close affinities with, or even inclusion in Lythraceae of the genus *Punica*. This does not only agree with macromorphological, but also with phytochemical evidence (Hegnauer, 1969).

Acknowledgements

The authors are indebted to Ger van Vliet and Ruud Zweypfenning for valuable discussions and advice. Curators of wood collections who provided wood samples are gratefully acknowledged. Special thanks are due to Mr. Mennega and Mr. Driehuis (Utrecht) for collecting additional material in the field. Mrs. Judith Kramer-Wiltink kindly prepared the slides, and Mr. F.P. van Sandijk operated the SEM at the Geology Department of Leiden State University.

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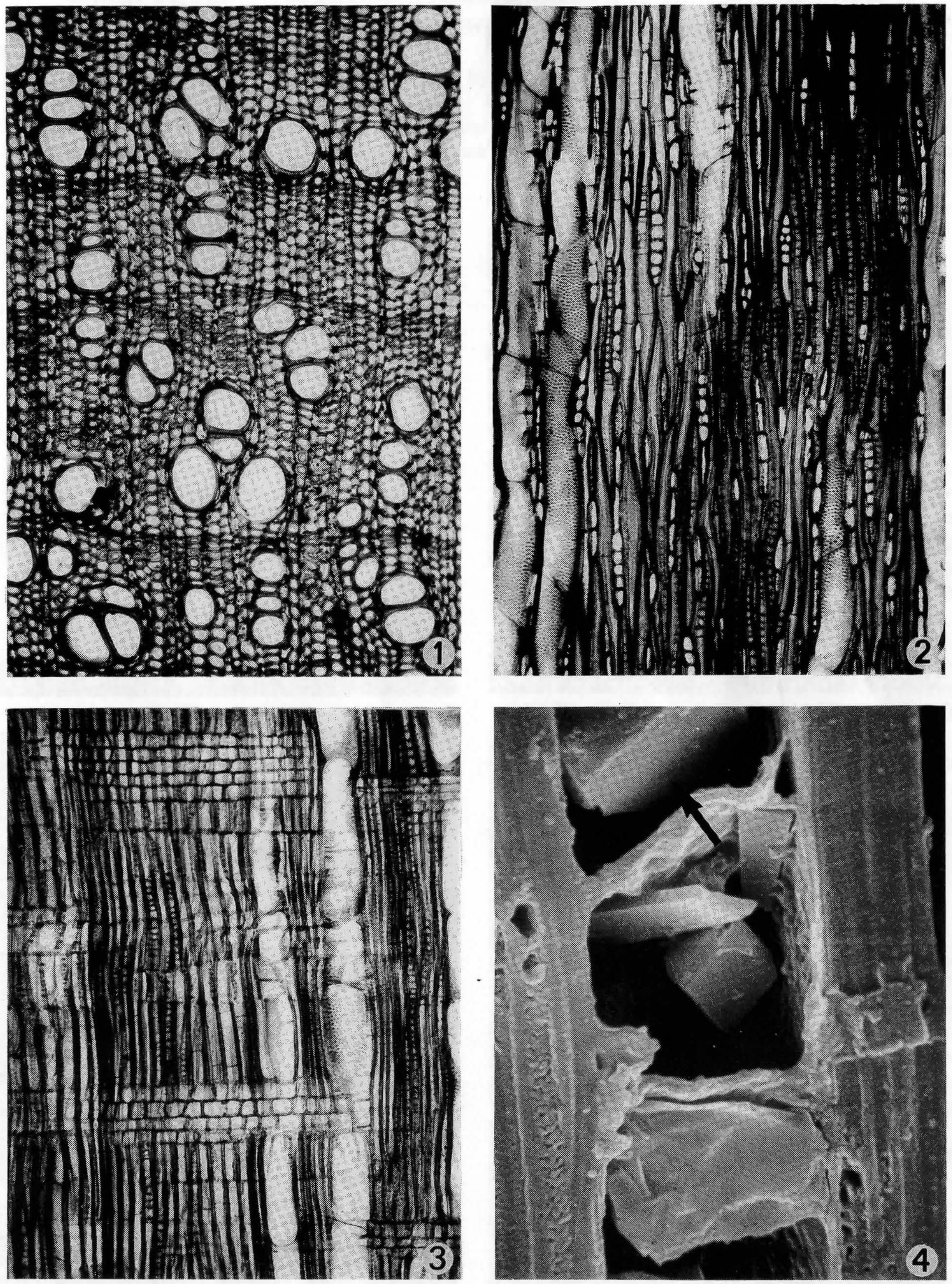

Fig. 1–4. *Punica protopunica* Balf. (Schweinfurth *s.n.*) —— 1: Transverse section, x 100. —— 2: Tangential section, showing predominantly uniseriate rays and crystalliferous fibres, x 100. —— 3: Radial section, x 100. —— 4: Detail of crystalliferous fibre, showing one chamber with several crystals and one (arrow) with a single crystal, SEM x 5900.

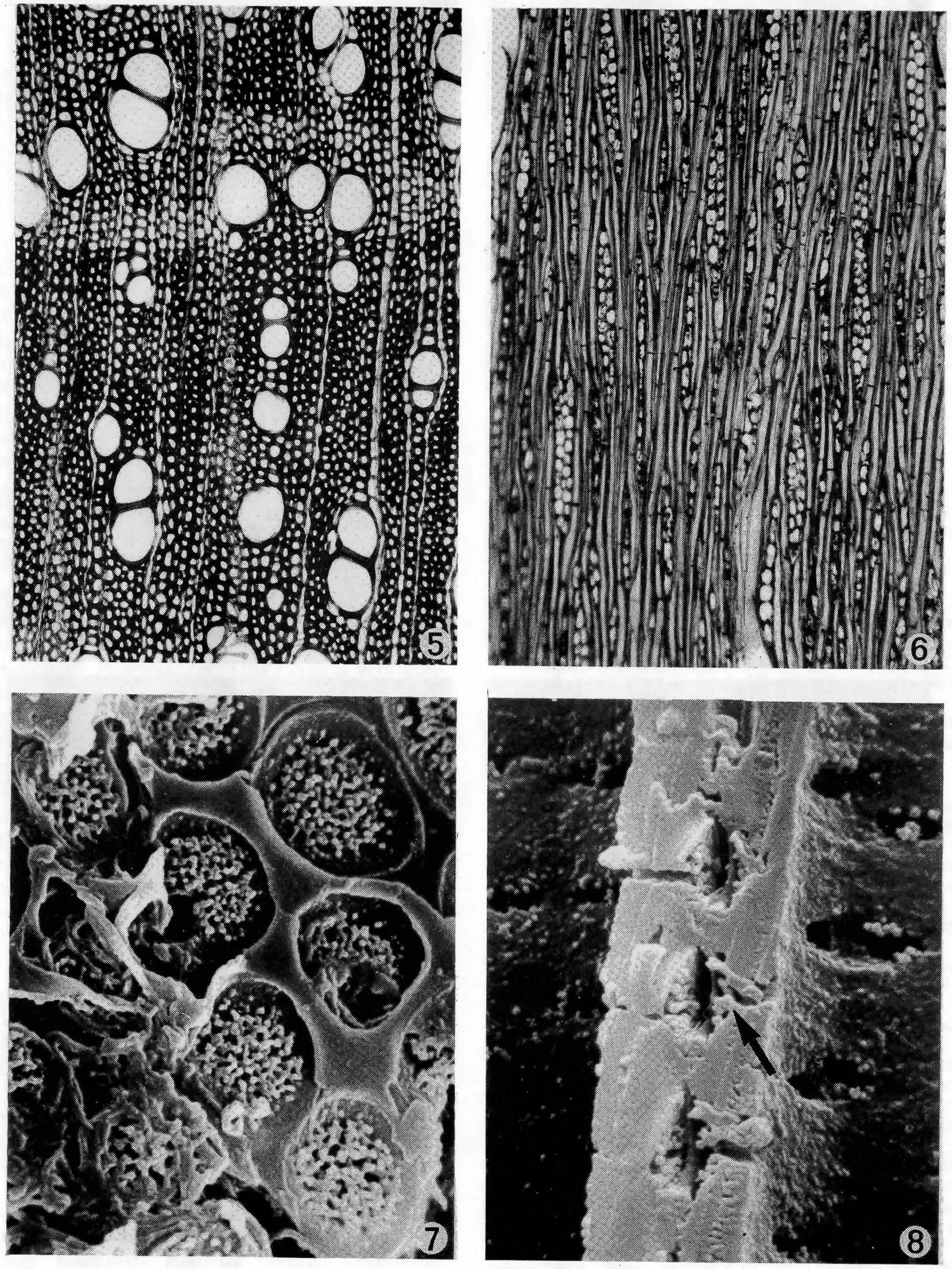

Fig. 5–8. *Punica granatum* L. —— 5: Transverse section; thin-walled fibres mark faint growth ring boundary, as well as tendency towards fibre dimorphism, Orphanides 4468, x 100. —— 6: Tangential section showing numerous biseriate and some triseriate rays, Orphanides 4468, x 100. —— 7: Vestured intervessel pits viewed from the pit-chamber showing mat of terminal branches of vestures, Cp 1506, SEM x 6200. —— 8: Longitudinal surface of intervessel walls showing warts and type of vestures in section (arrow), Cp 1506, SEM x 6100.

EARLY DIFFERENCES BETWEEN RADIAL WALLS AND TANGENTIAL WALLS OF ACTIVELY GROWING CAMBIAL ZONE

by

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Summary
Cytochemistry and shadowing techniques used in conjunction with mild extractions show a significant difference in the arrangement of the polysaccharides within the walls which is related to expansion properties. During radial growth, large portions of cell wall appear devoid of cellulose.

Introduction

During growth of primary tissues, produced by apical meristems, recent biochemical, cytochemical and ultrastructural data lead to the concept that the wall, by means of its specialized and 3-dimensionally associated subunits, may serve as a mechanical transducer for factors and information coming from the cytoplasm. Loosening of the molecular architecture of the wall associated with turgor pressure allows the cell to grow in a defined direction and in so doing controls the final shape of primary tissues and organs.

The secondary tissues result from a specific and rather complicated program of cell growth. The early step is characterized by a great radial expansion associated with periclinal divisions of the cambial initials and their immediate derivatives. Then, intercellular re-adjustments intervene: differential enlargement (especially dramatic in porous wood) and often local slidings (tip growth) of certain cells (see Wardrop 1964). The different sequences of expansion determine the histogenetic characters of wood and obviously imply a precise control for wall growth, the mechanism of which is still unknown. Ontogeny and physiological properties of the cell wall in the early stage are quite different. The tangential walls (T-walls) are built *de novo* at each periclinal division and their extension is limited. Conversely, the radial walls (R-walls) appear as a sort of plastic and actively extensible continuum.

The aim of the present work was to examine cytochemically at the ultrastructural level if precocious differences were detectable between the different parts of the wall which could be related with their different expanding properties.

Techniques

1–2 years old stems were taken in April and May from poplar (*Populus canescens*), elm (*Sambucus nigra*) and oak (*Quercus macrocarpa*) grown in the Museum Botanical Garden, Paris. Slabs of cambial zones and adjacent tissues were fixed in glutaraldehyde, embedded in resins and sectionned. Before embedding, some specimens were chemically (ethylene diamine tetracetique - EDTA - or dimethylsulfoxide - DMSO) or enzymatically (pectinases, hemicellulases) extracted for 1 to 6 hours. Sections were either: 1) stained for polysaccharides with the PAS-derived test (periodic acid - thiocarbohydrazide - silver proteinate = PATAg staining of Thiery, 1967) or 2) shadowed under vacuum with platinum. Details of the procedures have been fully described previously (Roland, 1977; Reis & Roland, 1974). The present observations were performed on fusiform initials in actively expanding cambial zone (fig. 1). All figures correspond to transverse sections.

Results and Discussion

After PATAg staining all the unextracted walls of the cambial zone exhibit a high contrast. The reactivity is uniform (insert of fig. 3). The R-walls are 2–3 fold thicker than the T-walls. Pits are visible in the R-walls and in the T-walls only dispersed plasmodesmata can be observed. After shadowing, all walls exhibit a massive aspect if no extraction has been carried out.

When cytochemistry is used in conjunction with a mild extraction of polysaccharides a differential loss of reactivity of the R-walls is noticeable. Pectin solvents such as EDTA (fig. 2–5) decrease the density of the median regions. Such portions then exhibit an aspect usual for a young wall: middle lamella with adjacent primary walls (fig. 2). Other portions of the R-walls show a distinct organization. In those regions no differentiation between lamella and primary wall is visible. The extraction produces local swelling and loosening of the walls (arrows, fig. 2–4). Such areas are distinct from pit-fields and exist on both sides of the cambial zone in cells obviously expanding radially. They correspond to regions of local weakness. A more complete treatment produces a total extraction and the rupture of the R-walls (fig. 5). Disorganization of the polysaccharide subunits involves the total removal of the fibrillar elements. Therefore, these zones appear completely devoid of cellulose.

Extractions associated with shadowing confirm the occurrence, in the R-walls of entirely extractable areas. A progressive action of pectinase is shown on figures 7 to 9. Here again, a local disorganization of R-walls occurs and finally no insoluble fibril is left in the extracted zone. Conversely, if the same experiment is performed in older cells, for example during vascular differentiation, insoluble fibrils remain all around the cell in the primary wall (fig. 10).

A striking and unexpected result concerns the T-walls. They are very homogeneous in section and despite their thinness are much more resistant to extraction than the R-walls. Figures 4 and 6 show for example respectively the absence of action of EDTA and of DMSO on the T-walls whereas the removal is pronounced in the R-walls. No stratification is visible within the T-wall. The T-wall is joined with the primary R-wall by its enlarged margins but during several successive cell cycles one can notice that the T-wall remains unconnected with the middle lamella of the R-wall (fig. 3, 4 and 6).

It is generally agreed that a new primary wall is deposited around each cambial daughter protoplast at each cell division (Mahmood, 1968). Srivastava (1966) and Freundlich & Robards (1974) have emphasized the fibrillar structure of the cambial wall. Srivastava (1966) noted that whether the fibrils consist of cellulose or of other polysaccharides is not clear. Analyses made by Thornber & Northcote (1961, 1962) have shown that cellulose represents less than half of the bulk of polysaccharides of the cambial walls. Various hemicelluloses and polyuronides are always represented in great amount but the quantitative determinations do not give information about their *in situ* distribution.

Cytochemistry and mild extractions indicate a specific segregation of the wall compounds related to expansion properties. Particularly large portions of the actively expanding walls appear completely devoid of cellulose and it is not even necessary to have recourse to alkaline solutions to extract large portions of cell wall entirely.

Generally speaking, in expanding walls the fibrillar texture has a major role in the control of direction of growth (see Roland *et al.*, 1975 and 1977). Apparently any high molecular weight polysaccharides, especially polyuronides and hemicelluloses, with a fibrillar appearance can be found in the electron microscope (Leppard & Colvin, 1972; Franke *et al.*, 1974; Rees & Welsh, 1977; Reis, 1977). Further observations will be necessary to qualify the origin and the behaviour of these components during growth more precisely.

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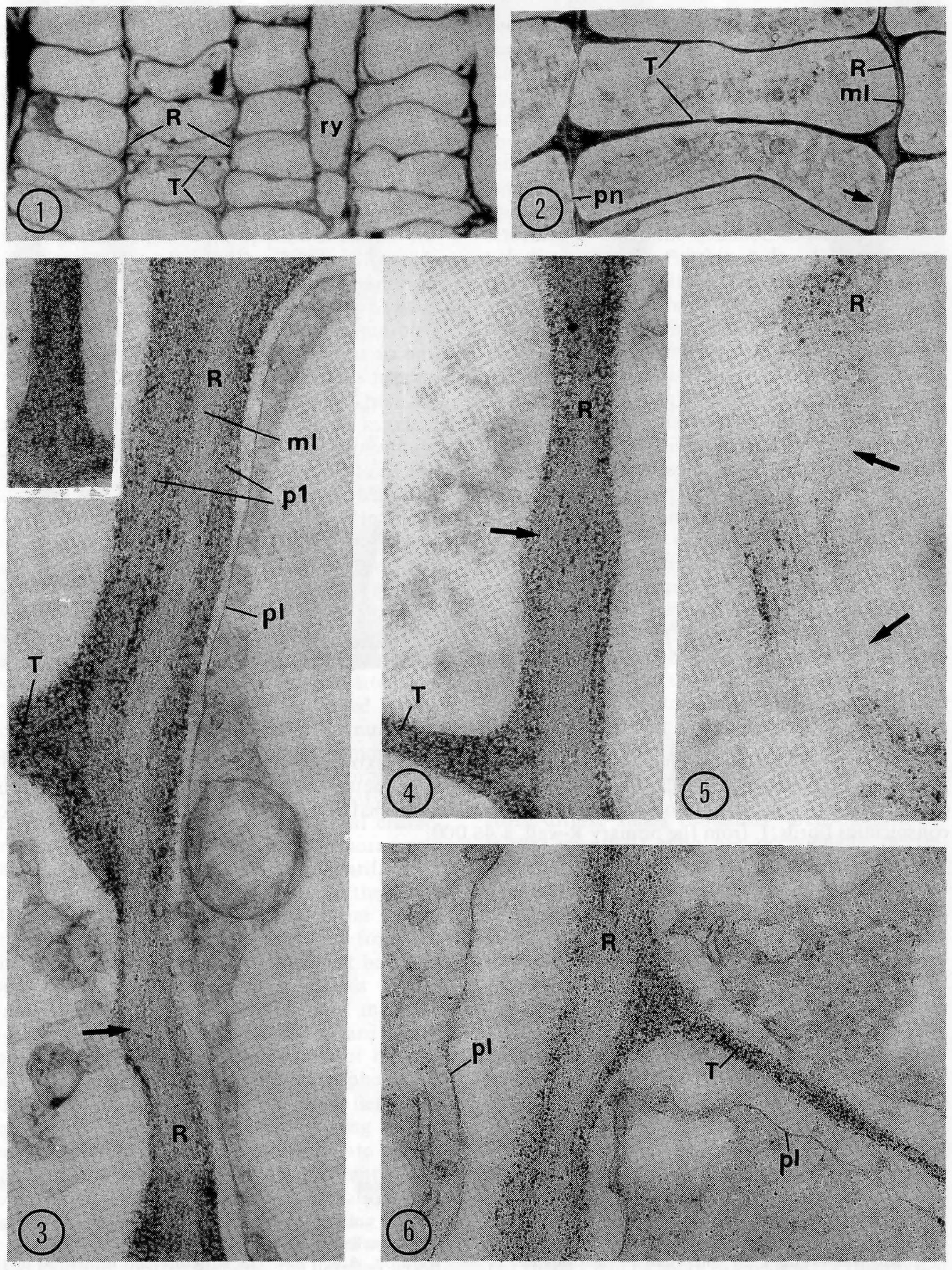

Fig. 1–6. *Populus canescens*. 1: thick section of the cambial zone; control (unextracted specimen), x 1,100. — 2–5: extraction with EDTA; contrast with PATAg staining for polysaccharides (insert of 3 shows the uniform contrast of an unextracted wall, x 27,000). The radial walls appear locally swollen or even completely removed (arrows), x 35,000 and x 60,000. — 6: extraction with DMSO; same staining. The radial wall is more extracted than the tangential wall, x 60,000. — ml: middle lamella; p1 : primary wall; pl: plasmalemma; pn: pit field; R: radial wall; ry: ray; T: tangential wall.

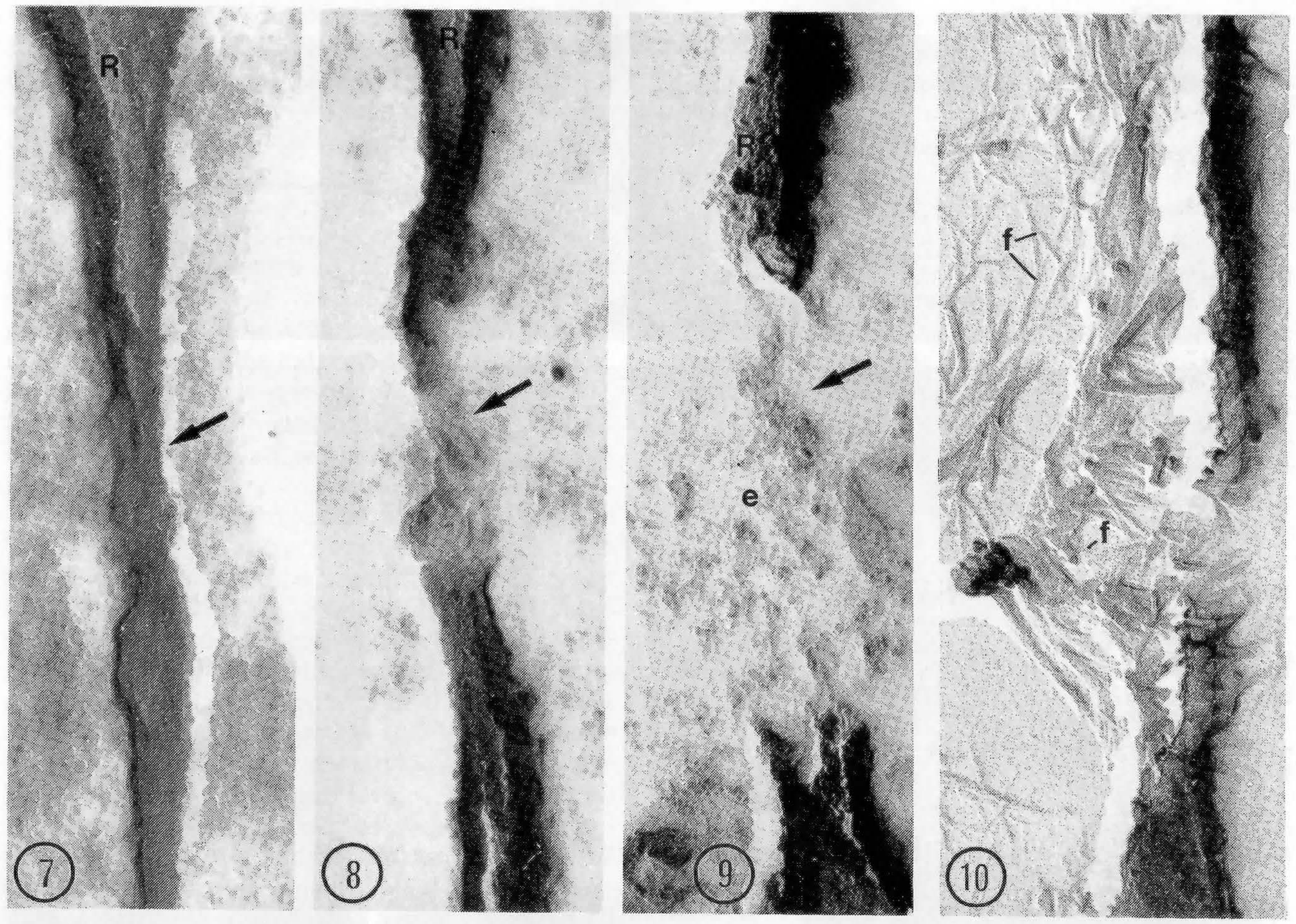

Fig. 7–9. *Sambucus nigra*. Shadowed sections. Progressive extraction with pectinase in radial wall, R, in the cambial zone. No fibrillar elements remain in the extracted area, x 42,000. –– e: extracted zone of the wall. –– Fig. 10. Action of pectinase in an older cambial derived cell. Same specimen. Release of conspicuous fibrils, f, from the primary R-wall, x 46,000.

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Die Hölzer Mitteleuropas – Ein mikrophotographischer Lehratlas. D. Grosser, 208 pp., 87 plates, many textfigs., 3 separate tables. Springer Verlag, Berlin, Heidelberg, New York, 1977. Price: DM. 98.

This book succeeds the much smaller-sized 'Mikrophotographischer Atlas der mitteleuropäischen Hölzer' by E. Schmidt published in 1941. Schmidt's atlas is an excellent tool for the identification of the common European woods, and the much extended version by Dr. Dietger Grosser is even better. The book starts with a comprehensive introduction to the structure of wood giving full attention to both macro- and micromorphological aspects. The text of this section is accompanied by line-drawings and micrographs making it most suitable for teaching purposes. There are also useful sections on general problems in wood identification and on microtechnical procedures. The bulk of the book consists of descriptions and plates of 9 coniferous and 63 dicotyledonous woods. The descriptions contain general information on the tree or shrub, on macroscopic features, and on the anatomy of the wood. The wood anatomical descriptions highlight qualitative rather than quantitative features and have deliberately been kept concise. If appropriate there are also notes on the possibilities or impossibilities of distinguishing between closely related species or genera. Identification is facilitated by the inclusion of separate tables: one for the nine softwoods; one for the most important (commercial) hardwoods (23 species) using macromorphological characters only; and one for all dicotyledonous woods using 44 selected anatomical characters. In the introductory text there is moreover a table facilitating the microscopical identification of the most important hardwoods with the aid of 20 selected anatomical characters. From several remarks in the introductory text and from the notes accompanying the descriptions it becomes apparent that the author has based his careful conclusions on the study of abundant material, and it is refreshing to read straightforward admissions that several woods simply cannot be told apart on anatomical and macromorphological characters. The true glory of this book lies in the marvellous collection of plates showing micrographs at various, but always appropriate magnifications of transverse, radial and tangential sections. Mostly two different magnifications are used for the transverse section, one giving a good impression of pore distribution and growth ring behaviour and another showing the detailed wood histology.

If a review has to contain critical remarks, it is difficult to find them for this book. Three minor comments are perhaps appropriate; on page 27 vascular tracheids and vasicentric tracheids are said to represent intermediate stages in the development from tracheids to specialized water conducting elements. This is at least open to debate, considering the advanced woods in which they often occur and their relative shortness. On page 36 vasicentric tracheids are again, in my opinion erroneously, recorded for *Fraxinus* (it would be interesting to trace the common source of this belief, because both Panshin & De Zeeuw's 'Textbook' and Core, Côté & Day's 'Wood Structure and Identification' have it that *Fraxinus* possesses vasicentric tracheids). Finally one would wish plate 2, fig. 9, illustrating vestured pits to be of a much higher magnification.

For the European woody flora there are now a number of wood anatomical, illustrated manuals. The present book surpasses all of these because of the very good introductory chapters, the constantly maintained high quality of illustrations and descriptions, and the critical comments on the distinction of closely related woods. This should not be taken as a criticism to such important books as Greguss' 'Holzanatomie der europäischen Laubhölzer und Sträucher' or the more recent 'Atlas d'Anatomie des Bois' by Jacquiot, Trenard & Dirol published by the Centre Technique du Bois at Paris. These and other major contributions to the European wood anatomical literature are different in scope from Grosser's new book, and have a different coverage of species. The present book will be an indispensable aid, not only for teaching, but also for wood anatomists from diverse fields (botanists, archeologists, forensic scientists) who are occasionally or frequently engaged in the identification of woods. The book deserves the widest possible circulation, and it is therefore a pity that an expensive (though excellent) lay-out was chosen. A much cheaper paperback edition (if possible translated into English) would be most welcome.

Pieter Baas

Herkennen van Loofhout. (Recognition of Hardwoods). 3rd Edition. P.B. Laming & S.M. Jutte, 119 pp., 66 plates. In Dutch. Houtinstituut TNO, Delft, 1977. Price: Dfl. 20.00.

The Dutch introduction is aimed at enabling the interested layman to identify wood using a hand lens. For the international public the inclusion of end-grain incident light photographs (x 12) of 393 species of more or less important timber species will be more interesting. In this revised edition some extra illustrations have been included of species recently introduced on the timber market. The quality of most plates is good. For an inevitable future edition it is hoped that for those few species of which the photos are from unsatisfactory end-grain surfaces, new illustrations can be included.

Pieter Baas

The Variation of the Basic Density Level and Tracheid Width within the juvenile and mature Wood of Norway Spruce. P.O. Olesen, 21 pp., Forest Tree Improvement 12. Akademisk Forlag (St. Kannikestraede 6–8) Copenhagen, Denmark, 1977. Price: DKr. 18.00.

This booklet contains an essay on the withintree variation of latewood percentage, ringwidth and tracheid diameter and their effects on basic density level variation in sexually and vegetatively propagated Norway Spruce. The regularly recurring variation pattern in density found in numerous individuals are lucidly explained on the basis of these wood anatomical parameters. Differences between vegetatively and sexually reproduced individuals are hypothesized to be due to different ages of the apical meristem affecting the developmental pattern of the juvenile wood, rather than resulting in different starting points for secondary xylem formation. This attractive hypothesis, as the author admits based on too limited observations, will be the subject of future research.

Pieter Baas

40 Belangrijke Houtsoorten uit Indonesisch Nieuw Guinea (Irian Jaya) met de anatomische en technische kenmerken. (40 Important Timberspecies from Indonesian New Guinea (Irian Jaya) with their anatomical and technical characteristics). J.M. Fundter & J.H. Wisse, 223 pp., 40 plates, 40 drawings. In Dutch with English Preface. Mededelingen Landbouwhogeschool Wageningen - The Netherlands 77-9, 1977. Price: Dfl. 52.50.

The Dutch can boast of a long tradition of high quality descriptive anatomical publications on Indonesian woods. Most monumental of all is Janssonius' 6–volume work on Javanese woods ('Mikrographie des Holzes der auf Java vorkommenden Baumarten' - the first volumes of which were co-authored by J.W. Moll - published from 1906–1936 by Brill, Leiden). Most of the volumes as well as the dichotomous key to the Javanese woods in English of 1952 are still available from the publisher. Other outstanding anatomical contributions are those by Den Berger, mainly on commercial timber species. The former author has no doubt left us the largest collection of unrivalled, detailed wood anatomical descriptions, but the tremendous amount of detail together with the language chosen for publication (German) are probably the reason for the general neglect of this standard work by French and English speaking wood anatomists (Metcalfe and Chalk's 'Anatomy of the Dicotyledons' being a very fortunate exception to this rule). Den Berger published in Dutch, making his valuable publications, including a unique lens key to the Malesian woods down to the family, and for some families down to the genus, largely inaccessible to the international wood anatomical world. In the colonial days publishing in Dutch had its advantages, or at least an excuse, but it is astonishing to see another, handsomely printed manual on Indonesian woods published in Dutch so many years after decolonization. Much of the useful information on distribution, nomenclature, macromorphological tree features, technological properties, uses, lens characters as well as on the detailed wood anatomy will consequently remain limited to a handful of Dutch speaking specialists in Indonesia and the Netherlands.

The plates, accessible to all of us, show satisfactory micrographs of transverse, tangential and radial sections. In addition there are drawings of flowering or fruiting branches, largely copied from Kraemer's 'Trees of the Western Pacific Region'. The inclusion of such illustrations is suggestive of the authors' aim to make their book of particular use to local foresters. The latter – if in command of the Dutch language – might indeed find the notes on macromorphological tree features and on the appearance of the timber useful assets, but they can hardly be expected to have an involved interest for the detailed anatomical descriptions and illustrations, constituting the main sections for each timber species. The anatomical descriptions are fairly detailed and accurate. There are, however, some peculiar inconsistencies. In the preface it is stated that fibres are deliberately left unclassified and will be described instead (a wise decision, considering the numerous transitions between fibre-tracheids and libriform fibres). It is therefore remarkable to see that the true tracheids of Araucariaceae are described as 'fibre-tracheids'. Moreover, the description of fibre pits as 'lens-shaped' for numerous hardwoods leaves the question unanswered whether the lens-shaped pit-*apertures* are associated with bordered or non-bordered pits (e.g. for *Alstonia scholaris* which has bordered pits, but is recorded to have lens-shaped pits). It is also a pity that the detailed quantitative values in the descriptions only concern maximum and minimum values, not the average or most frequent range. This renders most of the figures almost meaningless.

The work on this book, started by the late Ir. J.H. Wisse and completed by his colleague Mr. J.M. Fundter, should not be the subject of criticism alone. It is hoped that the useful information accumulated over the years will not be ignored on account of lack of knowledge of the Dutch language by the potential users of this manual.

Pieter Baas

A HYPOTHESIS ON THE FUNCTION OF VESTURED PITS

by

R.C.V.J. Zweypfenning

Rijksherbarium, Leiden, The Netherlands

Summary

In case of high pressure drops between adjoining vessel elements caused by air-embolism, pit membrane aspiration in angiosperms is hypothesized to be safer in vestured pit-pairs than in non-vestured ones because the membrane deflection necessary for complete aspiration is minimized by the vestures largely filling the pit chambers. This is considered to decrease risks of membrane rupturing.

The hypothesis

The possible functions of the bordered pits and of pit-aspiration in conifers are well documented (*cf.* Bolton, 1976; Bolton & Petty, 1975; Petty, 1972 and Zimmermann & Brown, 1971). Pit aspiration in angiosperms has to my knowledge only been reported and functionally interpreted by Thomas (1972). The latter author stressed the functional significance of pit borders because they support the displaced membrane, and yet allow the utilisation of a large membrane for liquid flow in the non-aspirated condition. The pit borders, in restricting the amount of displacement would moreover prevent membrane rupture and thus prohibit the spreading of air embolism. These assumptions can be convincingly supported by considering the forces acting on the pit membrane in different stages of deflection and at full aspiration in an idealized bordered pit pair with a circular pit chamber with radius r_1 and a circular inner pit aperture with a radius r_2 (Fig. 1A). In case of a strong pressure drop (ΔP) caused by an air embolism in a vessel the displaced pit membrane will assume the shape of a spherical segment (Fig. 1B), the surface area of which is given by the formula $2.\Pi.R.h$, in which R is the variable radius of the sphere and h is the maximum displacement from the median plane of the pit membrane. R can be equalled to

$$\frac{r_1^2 + h^2}{2h}$$

by simple goniometric derivation. The total force (F) on the membrane in any situation is than given by the product of pressure drop ΔP and the total surface area of the pit membrane:

$$F = \Delta P\,(r_1^2 + h^2)\,\Pi$$

With increasing pressure drop and deflection of the pit membrane F will increase as illustrated in Fig. 2, until the membrane reaches the pit borders which will counteract the force acting on the greater part of its surface area. The total force is than given by the equation

$$F = \Delta P\,(r_2^2 + h^2)\,\Pi$$

and will be at a much lower level due to the fact that the radius of the pit aperture is much smaller than the radius of the pit chamber. In non-vestured pits the maximum force acting on the attachment of the pit membrane to the cell wall is thus primarily governed by the radii of the pit chamber prior to aspiration; r_1 being considerably greater than the height (h_{max}) of the pit chamber.

In vestured pits the pit chambers are usually filled with a dense network of vestures terminating in a more or less flat mat of rounded ends, very close, and parallel to the pit membrane (*cf.* Fig. 1C and illustrations in Van Vliet, 1975). Minimal deflection, presumably resulting from a moderate pressure drop, will bring the pit membrane in contact with the terminal branches of the vestures and F will thus be counteracted, until (hypothetically) the pit membrane will be in touch with vestures along its complete surface and F is reduced to zero (see broken line in Fig. 2). Although initially governed by the same equation, pit aspiration in vestured pits is thus achieved at a much lower pressure drop than in non-vestured pits, and the maximum force acting on the attachment of the pit membrane is much lower. This implies that any risks of rupturing the pit membrane at high pressure drops are considerably reduced in vestured pits, and that consequently the spreading of an air embolism through bordered pits is reduced.

Biological implications

Functional hypotheses like the one offered above gain in value if they can be supported by factual evidence. Weak points in this hypothesis are due to our lack of knowledge on the strength properties of pit membranes in angiosperms and on the pressure drops needed to obtain aspiration and/or rupturing of the pit membrane in bordered pits. Perhaps the strength properties are such that realistic pressure drops can never result in the rupture of a pit membrane.

Aspiration of vestured pits is probably a fairly common phenomenon, judging from SEM images of pit membranes seemingly cemented to the ves-

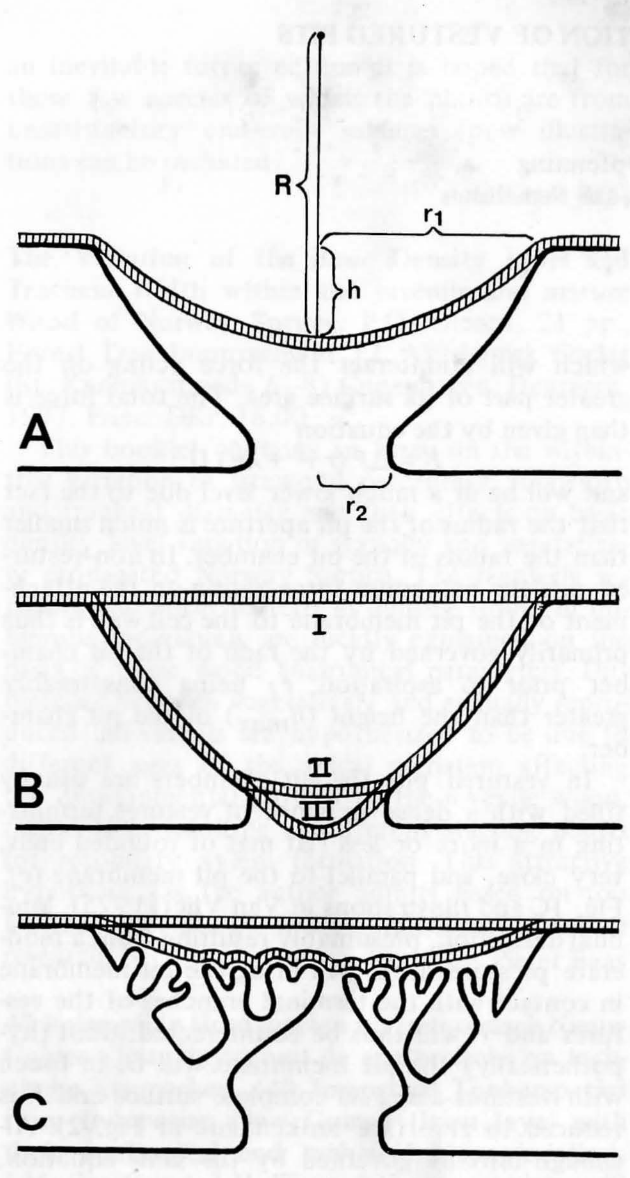

Fig. 1. Diagrams of non-vestured and vestured bordered pits. For explanation see text.

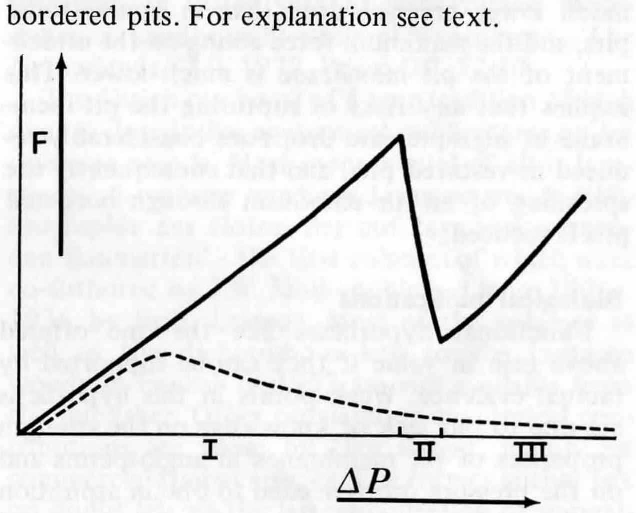

Fig. 2. Graph showing relationship between force (F) acting on attachment of pit membrane and pressure drop (ΔP) in non-vestured (solid line) and vestured pits (broken line). I, II, and III represent stages in pit aspiration illustrated in Fig. 1B.

tures in one of the pit chambers observed in several members of the Myrtales (Van Vliet, personal communication).

Circumstantial evidence in favour of the hypothesis would be provided if the occurrence of vestured pits in woody plants were centred in plant groups developing high negative pressures in their xylem (very high trees, and woody plants from xeric habitats; *cf.* Zimmermann & Brown, 1971, and Carlquist, 1975). In such plants high pressure drops result from local air embolisms, and according to the hypothesis vestured pits could be of adaptive significance in these woods. From Bailey's work (1933) and many subsequent studies we know, however, that vestured pits are a taxonomic character of several large natural assemblages – irrespective of the ecology or stature of their representatives. The distribution of vestured pits over families or orders of widely different affinity is suggestive that vestured pits arose several times in the evolutionary history of the dicotyledons, and that they became very firmly established in such important and diverse groups as for instance Dipterocarpaceae, Leguminosae, Myrtales and Rubiaceae. One might use the evolutionary success of these groups in adapting themselves to numerous ecological niches and/or in producing numerous emergent species in the tropical rain forest as an argument in favour of a positive selective value of vestured pits. However, at the same time one should realize that equally successful plant groups may lack vestures in their bordered pits. An alternative device for protecting the pit membranes against the risk of rupturing would be to decrease the radius of the pit chamber (see first equation above). Minute intervessel pits are a common feature of families such as Meliaceae and Rutaceae. It remains quite easy, however, to list numerous taxa of either high trees or extremely xeric shrubs without either vestured pits and/or minute vessel pitting. Much room is thus left for putting a different emphasis on the adaptive or non-adaptive significance of the occurrence of vestured pits (*cf.* the differences in approach by Carlquist, 1975, and Baas, 1976, on the adaptive significance of other aspects of wood anatomical diversity).

The present hypothesis is therefore offered here as a very tentative one. It is hoped that it will stimulate the accumulation of data – experimental and descriptive - necessary to test its validity.

Acknowledgements

I wish to thank Drs. G.J.C.M. van Vliet and Dr. P. Baas for stimulating discussions. To the latter I am particularly indebted for framing the English manuscript. Dr. A.J. Bolton (Bangor) is acknowledged for sharing his vast knowledge of tree physiology.

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WOOD ANATOMY NEWS

A collection of wood samples of Dutch provenance

On the initiative of the Dutch 'Wood and Bark Club', comprising the greater part of the IAWA membership in the Netherlands, a collection of wood samples of woody plants growing in the Low Countries has been assembled. The collection consists of 91 specimens belonging to 89 species, 67 genera and 37 families of both softwoods and hardwoods. Apart from trees, also a number of shrubs and climbers native to, introduced into, or sub-spontaneous in the Netherlands are represented. From most of the species about 200 specimens have been prepared. The dimensions of the samples vary according to the habit of the plant. Of at least 52 species, boards measuring 15 x 10 x 2 cm have been sawn; of the other species the specimens are 10 to 12 cm long and vary in width according to the diameter of the stems.

A complete list with local and Latin names, and with information on habit, habitat and provenance, and on diameter of the stem from which the samples were derived accompanies the collection. Staff members of the Institute for Systematic Botany and of the Botanical Gardens of the State University of Utrecht have seen to the correct naming of the species.

The collections have been composed with various objectives in mind. They can be used for practical training courses in wood anatomy, for research purposes and for exchange with institutional wood collections or others interested outside the Netherlands. In order to avoid confusion and duplication of work the main centres for wood anatomical research in the Netherlands propose the following scheme for distribution and exchange of this comprehensive wood collection. This reflects the main field of activities of the Dutch institutes. From the specialization of your own institute and from the availability of wood collections for exchange from specific geographical areas it will be clear to whom to address your request. It is hoped that many curators of wood collections will consider an exchange of wood samples with one of the institutes listed below.

1. Wood Technological Institutes – All over the world, contact: P.B. Laming, Forest Products Research Institute, Schoenmakersstraat 97, Delft, The Netherlands.
2. University departments of wood structural research, of systematic botany and the like, situated in or specializing on woods from the following regions:
   a. Africa, contact: Dr. R. Den Outer, Botanisch Laboratorium, Arboretumlaan 4, Wageningen, The Netherlands.
   b. Asia, Australia, New Zealand, Oceania, contact: Dr. P. Baas, Rijksherbarium, Schelpenkade 6, Leiden, The Netherlands.
   c. Europe, North and South America, contact: B.J.H. ter Welle, Institute of Systematic Botany, Transitorium II, De Uithof, Utrecht, The Netherlands.

The following species are included in the collection:

Hardwoods – *Acer negundo, A. palmatum, A. pseudoplatanus, Aesculus hippocastanum, Alnus glutinosa, Amelanchier lamarckii, Aralia elata, Berberis vulgaris, Betula pendula, Bilderdykia aubertii, Buxus sempervirens, Carpinus betulus, Castanea sativa, Catalpa bignonioides, Cercidi-*

phyllum japonicum, Clematis vitalba, Corylus avellana, Cotoneaster spec., Crataegus laevigata, C. lavallei, C. monogyna, Diospyros lotus, Dipteronia sinensis, Erica arborea, Euonymus europaeus, Fagus sylvatica, Frangula alnus, Fraxinus excelsior, F. ornus, Gleditsia triacanthos, Hedera helix, Hydrangea petiolaris, Ilex aquifolium, Juglans nigra, Koelreuteria paniculata, Laburnum anagyroides, Liriodendron tulipifera, Lonicera periclymenum, Malus sylvestris, Myrica gale, Phellodendron amurense, Populus canadensis, P. nigra, P. tremula, Prunus avium, P. padus, P. persica, P. serotina, P. spinosa, Pyracantha coccinea, Pyrus communis, Quercus petraea, Q. rubra, Rhododendron spec., Robinia pseudoacacia, Salix alba, Sambucus nigra, S. racemosa, Sarothamnus scoparius, Sorbus aucuparia, Syringa vulgaris, Tilia cordata, T. euchlora, Ulex europaeus, Ulmus minor, Viburnum opulus, Vitis vinifera, Wisteria sinensis.

Softwoods – *Abies grandis, A. koreana, Calocedrus decurrens, Cedrus atlantica, Cephalotaxus harringtonia, Chamaecyparis lawsoniana, C. pisifera, Cryptomeria japonica, Juniperus communis, J. virginiana, Larix decidua, L. kaempferi, Picea abies, Pinus nigra (2 ssp.), P. strobus, P. sylvestris, Pseudotsuga menziesii, Sequoiadendron giganteum, Taxus baccata, Tsuga heterophylla.*

Meeting on aspects of xylem differentiation

On March 30, 1978 at the University of Reading, England, a one-day meeting will be organized on 'Aspects of Xylem Differentiation'. The meeting which is organized by Reading University in collaboration with the Royal Microscopical Society will be chaired by Professor R.D. Preston FRS. The program includes the following papers:

Professor P.B. Gahan: Differentiating xylem as a model for the study of cell death.

Dr. P. Denne: Have we any hope of controlling wood structure in the tree?

Dr. R. Johnson: Some methods for freeze-etching xylem.

Dr. R. Philips: The cell cycle in relation to tracheary element differentiation in cultured explants of Artichoke tuber.

Dr. J.R. Barnett: The structure of cambium and xylem in differentiated nodules of Pine callus.

Further details and registration forms from: Dr. J.R. Barnett, Plant Science Laboratories, University of Reading, Whiteknights, Reading RG6 2AS, Berks., England. It is hoped that this notice comes in time in this rather belated IAWA Bulletin issue, because the program has much to offer of special interest to members of IAWA.

Thirteenth International Botanical Congress, Preliminary Announcement

Sydney, Australia, 21–28 August, 1981. The programme will consist of 12 sections – molecular, metabolic, cellular and structural, developmental, environmental, community, genetic, systematic and evolutionary, fungal, aquatic, historical, and applied botany. There will be plenary sessions, symposia, and sessions for submitted contributions (papers and posters). Chairman of the Programme Committee: Dr. L.T. Evans.

Field trips will include visits to arid and semi-arid regions, eucalypt forest, rain forest, heath, coastal vegetation (e.g. Great Barrier Reef, mangroves) etc., and specialist trips. Chairman of the Field Trips Committee: Prof. L.D. Pryor.

First Circular, containing details, will be mailed in August, 1979. Send your name and full address, preferably on a postcard, to ensure your inclusion on the mailing list.

Enquiries should be sent to the Executive Secretary, Dr. W.J. Cram.

Congress address: 13th I.B.C., University of Sydney, N.S.W. 2006, Australia.

The 13th International Botanical Congress will be sponsored by the Australian Academy of Science.

Pan American Regional Group Meeting

When preparing this Bulletin for the Press the editors had not received further news on the program of the forthcoming joint meeting of the Botanical Society of America and the Pan American Regional Group of IAWA, to be held at Virginia Polytechnical Institute and State University (VPI) in Blacksberg, Virginia from June 25–30, 1978. Hopefully, the next IAWA Bulletin will contain the abstracts of papers to be read on that memorable occasion in the history of IAWA. Members are urged to contact the meeting organizers Dr. W.C. Dickison (Dept. of Botany, University of North Carolina, Chapel Hill) or Dr. J.G. Isebrands (Institute of Forest Genetics, Rhinelander, Wisconsin) for further information.

Mutations at Utrecht

Dr. Jifke Koek-Noorman acts as head of the division of Systematic Wood Anatomy at the University of Utrecht, following the retirement of Dr. Alberta M. W. Mennega in August last year. All correspondence concerning loans and exchange of wood samples should be addressed to Mr. B.J.H. ter Welle, Institute for Systematic Botany, Transitorium II, De Uithof, Utrecht, The Netherlands.

Good response for Amsterdam meeting

The preliminary questionnaire for the first meeting of the Afro-European Regional Group meeting to be held in August, 1979 in Amsterdam has had a good response. This meeting which will be organized in collaboration with IUFRO Division 5, Wood Quality Subject Group and the plant anatomy and morphology section of the Royal Dutch Botanical Society will probably be attended by over 50 wood scientists and the program will include well over 30 papers on a diversity of subjects from fundamental and applied wood structural research. A further notice will be sent in autumn this year. Members outside Europe or Africa who are considering attending the meeting should contact the Executive Secretary.

ASSOCIATION AFFAIRS

Financial Report 1977

Debit		Credit	
Balance 1976	Dfl. 1877.90	Stationary	Dfl. 278.50
Final transfer from Syracuse account	Dfl. 92.44	IAWA Bulletin	Dfl. 4285.84
Glossary and directory sales	Dfl. 46.00	Banking costs (extra)	Dfl. 63.45
Reprint sales	Dfl. 1118.00		
Dues and subscriptions	Dfl. 9994.84		
Interest	Dfl. 29.07	Balance	Dfl. 8530.46
	Dfl. 13158.25		Dfl. 13158.25

Statements of account:
December 31, 1977. AMRO Bank, Account No. 45.13.20.352 of IAWA (address of bank: Rapenburg, Leiden, The Netherlands; postal giro of bank: 9200).
Checking account: Dfl. 5530.46.
High Interest Savings account (No. 45.14.36.067): Dfl. 3000.00.

The financial report over 1977 shows a considerable increase of our funds. This is partly due to a genuine improvement of our financial status, enabled by favourable conditions mentioned in the editorial of IAWA Bulletin 1977/4. Partly the high balance is caused by the early receipt of 1978, and even some 1979 dues. In order to minimize the effects of inflation and to be prepared for unexpected financial drawbacks a part of our capital has been transferred to a high interest (7%) account.

Transferring dues – A frustrating affair?

Several of our members have complained about the trouble involved in transferring membership dues to the office of the Executive Secretary. Frustrating experiences with post offices or banks which are not accustomed to handling international money orders or time-consuming efforts to learn the rate of exchange of the Dutch Guilder must indeed be a pain in the neck. In order to avoid this inconvenience as much as possible we would like to alter our previous recommendations and suggest the following procedures:

Members in the U.S.A., Canada, Australia and New Zealand are recommended to use personal cheques and transfer the equivalent of 35 Dutch Guilders in dollars directly to our office. With fluctuating rates of exchange we have to ask our members to keep an eye on the proper conversion rates because all IAWA expenditure has to be paid in Dutch Guilders. At present 1 U.S. dollar equals about 2.20 Dutch Guilders. For other countries outside Europe dues can either be paid in Dutch or in U.S. currency. Most members in Europe can order their bank directly to pay into account No. 45.13.20.352 of AMRO-Bank, Leiden, c.o. IAWA, Schelpenkade 6, Leiden. Alternatively they can transfer money into the giro-account 9200 of the AMRO-Bank, stating the account number of IAWA and address of our office. These two methods of payment do not involve extra banking costs on our behalf, and the sum of 30.00 Dutch Guilders will suffice. Yet another alternative is to use personal cheques in local currency to the equivalent of 35.00 Guilders. It is regretted that we cannot give any suggestions to make the transfer of money from countries with currency restrictions easier. All we can do is to recommend payment of two consecutive years at one time.

Suggestions by some of our members to have regional officials to collect dues in their own countries cannot be followed because of the complications and delays that will arise from splitting our administration.

We hope that these new recommendations will take away some of the inconvenience in the future. May we in turn ask you to make our book keeping an easy affair by clearly indicating your name and address on bank cheques or other means of payment?

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Deceased Member

Dr. C.A. Reinder-Gouwentak, Professor Emeritus, Ede, The Netherlands, passed away last year. She had been a member of IAWA from 1954 onwards. Our sympathy goes to her husband and colleague Professor E. Reinders.

Information requested

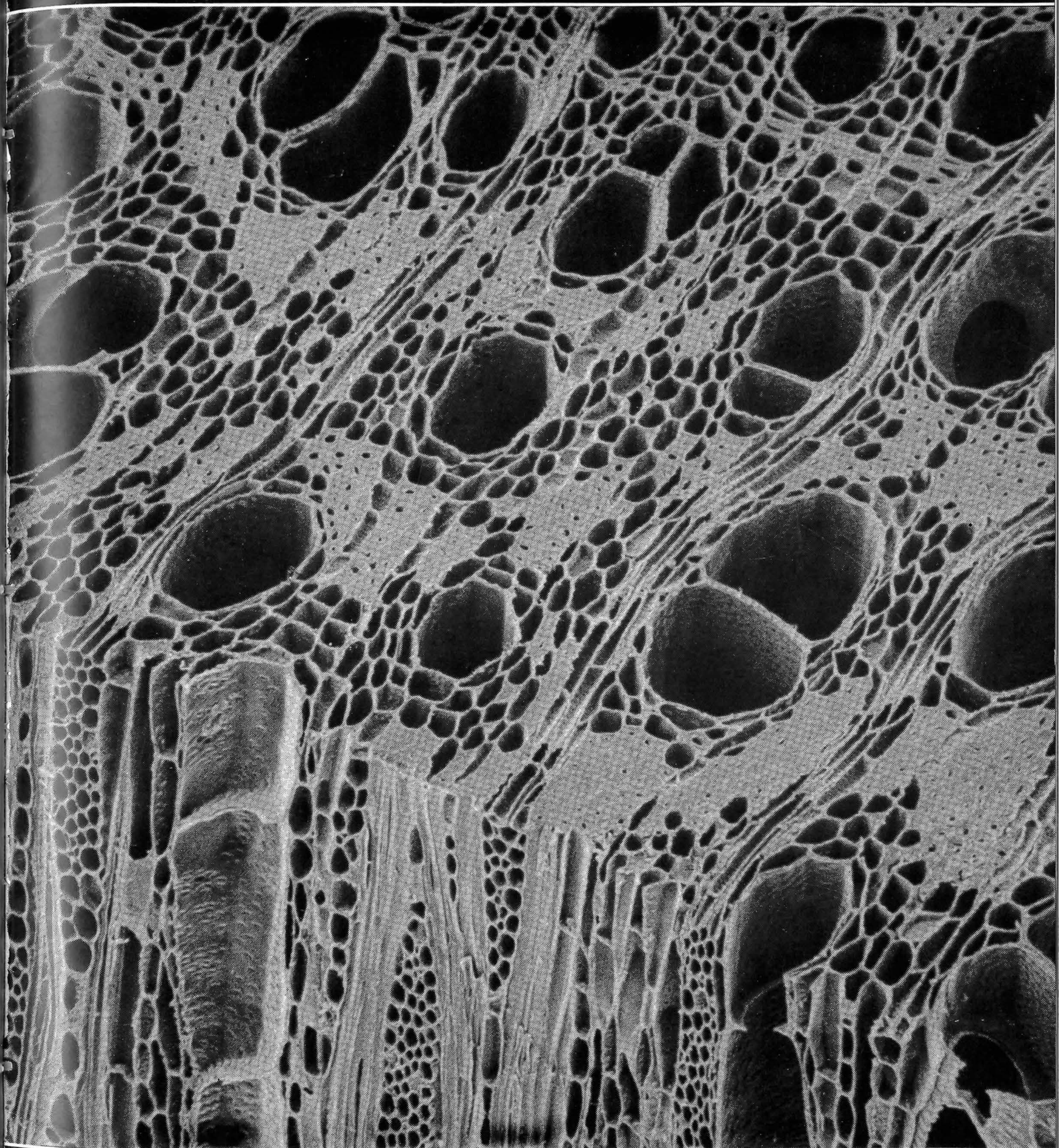
Recently mail has been returned from our Member Dr. Geoffrey W.D. Findlay, previously resident at Farnham, Herts., England. Members who know the present address of Dr. Findlay are urged to inform the Executive Secretary.

IAWA BULLETIN

Contents

Front cover: Scanning electron micrograph of the wood of *Eugenia maire* A. Cunn. (Myrtaceae), one of the numerous New Zealand Woods pictured and described by B.A. Meylan and B.G. Butterfield in their 'Structure of New Zealand Wood', N.Z. Government Printer, Wellington, 1978. Courtesy B.A. Meyland and B.G. Butterfield, Lower Hutt and Christchurch.

IAWA BULLETIN 1978/2&3



International Association of Wood Anatomists

Published at the Rijksherbarium

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