IAWA BULLETIN

Contents

Front cover: Transverse section of *Lagerstroemia indica* L. (Lythraceae). The banded pattern in this and some other *Lagerstroemia* species is due to fibre dimorphism and not to parenchyma differentiation (cf. P. Baas & R.C.V.J. Zweypfenning: Wood anatomy of the Lythraceae. Acta Botanica Neerlandica 28 (2), in the press).

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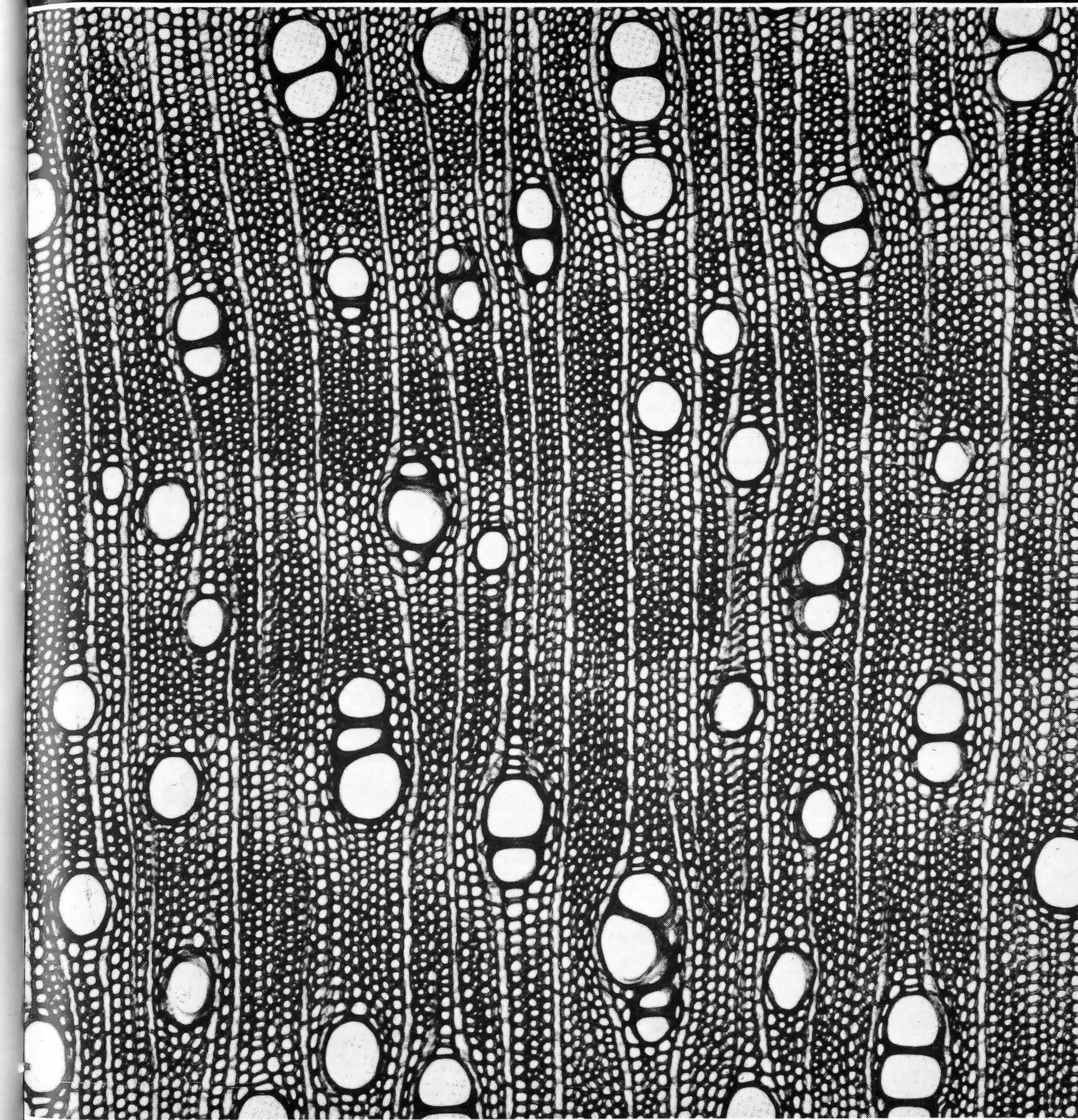

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THE WOOD ANATOMY OF THREE PROTEACEOUS TIMBERS PLACOSPERMUM CORIACEUM, DILOBEIA THOUARSII AND GARNIERIA SPATHULAEFOLIA

by

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Abstract
A study has been made of the wood anatomy of three unusual members of the Proteaceae, namely, *Placospermum coriaceum, Dilobeia thouarsii* and *Garnieria spathulaefolia*. The anatomy of each is described and their relationship with other members of the family is discussed.

Introduction

Placospermum C.T. White & Francis, *Dilobeia* Thou. and *Garnieria* Brongn. & Gris. are three monotypic genera belonging to the family Proteaceae. *Placospermum* consists of the species *P. coriaceum* C.T. White & Francis which occurs in the rain forests of Queensland, *Dilobeia* consists of the species *D. thouarsii* Roem. & Schult. which occurs in Malagasy and *Garnieria* consists of the species *G. spathulaefolia* Brongn. & Gris. which occurs in New Caledonia. This study of the wood anatomy of these three species was undertaken firstly because none of them were included by Chattaway in her study of the family (Chattaway, 1948) nor by Metcalfe and Chalk in their 'Anatomy of the Dicotyledons', 1950, and the description of the wood anatomy of *Placospermum coriaceum* by Briggs, Hyland and Johnson (1975) is brief and is not illustrated. A comprehensive study of the anatomy of these three genera is therefore necessary for a fuller understanding of the wood anatomy of the family as a whole. Also, they are of special interest because they lack the typical wide rays found in most members of the family. The two features by which most members of the family are recognised are the wide rays and the wide to narrow bands of axial parenchyma which curve inwards between the large rays, sometimes enclosing the vessels but more characteristically with the vessels grouped on the pith or convex side. Both these features are lacking in *Placospermum coriaceum, Dilobeia thouarsii* and *Garnieria spathulaefolia*.

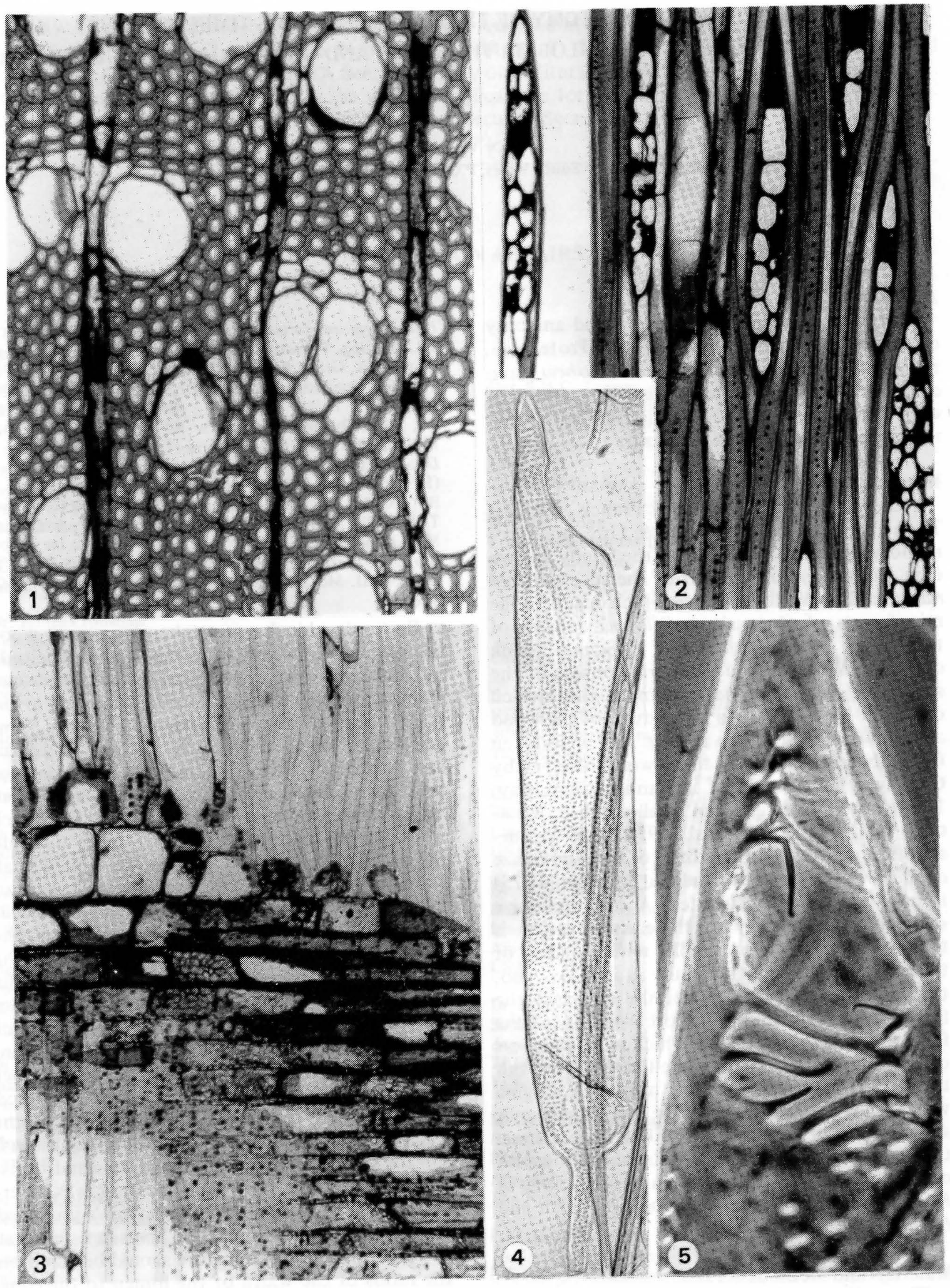
Materials and Methods

The wood specimens listed below were available for study. Wood collection reference numbers are given between brackets, followed by numbers of herbarium collections if available. Abbreviations are according to Stern (1978).

Placospermum coriaceum: Atherton District, (SFCw R1116), leg. Forestry Dept. Atherton per Dr. B. Briggs, Royal Bot. Grdns Sydney; ibid., (SFCw R1117) = AFO/156, leg. Queensland Forestry Dept.; ibid., (SFCw R1132-1) = QFS 75/15, ibid.; ibid., (SFCw R1132-2) = AFS 16, ibid.; Queensland, (SFCw R1166-4), ibid. per Div. Building Res. CSIRO, Melbourne.
Dilobeia thouarsii: Malagasy, Ankazobe Forest Reserve, (SFCw R1136) = D. Weins 4731, leg. Dr. B. Briggs, Royal Bot. Grdns Sydney; Malagasy, (SFCw R933-54), leg. TEFw; ibid., (SFCw R1166-3), leg. TEFw per CSIRO, Melbourne.
Garnieria spathulaefolia: New Caledonia, (SFCw R1113), leg. Dr. H. McKee per Dr. B. Briggs, Royal Bot. Grdns Sydney.

Sectioning blocks were taken from each wood sample and from these transverse, radial longitudinal and tangential longitudinal sections were cut, stained and made into permanent mounts in the usual manner for wood anatomical studies. Some additional radial longitudinal sections were cut and prepared in the usual way to determine the presence or absence of silica (Bamber & Lanyon, 1960). Macerations were also prepared from each wood sample (Anonymus, 1956). Since the sample of *Dilobeia thouarsii*, R1136, was only a small stem approximately 2 cm in diameter, it was not used for measuring the sizes of the various cells and tissues. The pore size and frequency and the ray width and frequency were measured from the sections with the use of a projection screen; the size of the inter-vessel pitting was measured from the tangential longitudinal sections by means of an ocular micrometer; vessel and fibre length were estimated from the macerations, 10 vessels per sample and 50 fibres per sample being measured on a projection screen. The maximum ray height was measured from the tangential longitudinal surface of the wood using a hand lens and transparent gauge. The fibre wall thickness was determined in accordance with Chattaway's proposed standards (Chattaway, 1932). She suggested that the description of this feature should be based on the ratios of the width of the lumen to the combined thickness of the walls between it and the lumen of the next cell. The following categories were used:

Very thin - Lumen much greater than thickness of walls.



Thin - Lumen greater than thickness of walls.
Thick - Lumen less than thickness of walls.
Very thick - Lumen almost completely closed.

Results

Placospermum coriaceum (Figs. 1–5)

Macroscopic description. – Timber light to moderately light, pale pinkish brown in colour, lacking any distinctive figure except for a slight pattern on the quarter sawn surface produced by the darker coloured rays. Rays not conspicuous on the end grain.

Microscopic description. – Growth rings* not defined. Pores solitary and in multiples of 2 to 3. In one sample the pores showed a definite tendency for arrangement in concentric tangential bands. Pores angular to rounded in shape, numbering 10 per sq. mm with a mean tangential diameter of 115 μm; mean vessel member length 1.25 mm. Perforation plates simple, oblique, with occasional scalariform to reticulate perforation plates present (Fig. 5). Inter-vessel pitting alternate, round to oval, approximately 8 μm in diameter. Pits to contiguous ray and axial parenchyma cells similar to the inter-vessel pits, see Figs. 1 and 4.

Axial parenchyma paratracheal, mostly confined to the abaxial side of the pores forming a 'cap' 1 to 3 cells wide radially, occasionally vasicentric, see Fig. 1.

Rays numbering 2–3 per mm and consisting of uniseriate rays and multiseriate rays ranging from 2 to 4 cells wide. The uniseriate rays mostly only 1 to 4 cells high and composed of square and upright cells; the multiseriate rays composed of a central portion of procumbent cells with several marginal rows of square and/or upright cells, see Figs. 2 and 3. Maximum height of rays approximately 2 mm; all gradations of sizes present. Sheath cells occasionally present.

Ground tissue composed of thin walled fibres with distinctly bordered pits on both tangential and radial walls. Average length of fibres 2.16 mm.

Silica not observed.

* All terms used in this paper are in accordance with the definitions given in: 'Multilingual Glossary of Terms used in Wood Anatomy', International Association of Wood Anatomists, 1964.

Dilobeia thouarsii (Figs. 6–9)

Macroscopic description. – Timber heavy to moderately heavy, medium brown to red brown in colour with no distinctive figure. Rays not conspicuous on the end grain.

Microscopic description. – Growth rings not defined. Pores mostly solitary, round to oval in shape, numbering 2.5–3 per sq. mm, mean tangential diameter 195 μm, mean vessel member length 0.82 mm. Perforation plates simple, slightly oblique. Inter-vessel pitting sparse because of the predominantly solitary arrangement of the vessels, alternate, round, 3–4 μm in diameter. Pits to contiguous ray and axial parenchyma similar to the inter-vessel pits, see Figs. 6 and 9.

Axial parenchyma predominantly paratracheal, mainly confined to the abaxial side of the pores forming a 'cap' with tangential wing-like extensions. These wing-like extensions from adjacent pores often coalesce thus linking several pores tangentially. Occasional diffuse cells also present, see Fig. 6.

Rays numbering 4 per mm, one to three (occasionally four) cells wide, composed of procumbent cells, the cells constituting the marginal row having a slightly greater axial dimension than the remaining cells of the ray, see Figs. 7 and 8. Maximum height of rays approximately 1 mm.

Ground tissue composed of very thick walled fibres with some thin to thick walled fibres in the vicinity of the vessels. Pits with small borders present on both the radial and tangential walls. Mean fibre length 1.95 mm.

Silica not observed.

Garnieria spathulaefolia (Figs. 10–14)

Macroscopic description. – Timber very heavy, brown to reddish brown in colour, no distinctive figure. Rays not conspicuous on the end grain.

Microscopic description. – Growth rings not defined. Pores diffuse, numbering 16 per sq. mm, solitary and in multiples of 2 to 3, the majority arranged in concentric tangential bands 1–2 pores wide radially; round to oval in transverse section, mean tangential diameter 74 μm, mean vessel member length 0.49 mm, see Fig. 7. Perforation plates simple, oblique. Inter-vessel pitting alternate, round, measuring 6–7 μm in diameter, *vestured.* Pits to contiguous ray cells similar to the inter-vessel pitting. Vessels in the heartwood

Fig. 1–5. *Placospermum coriaceum.* –– Fig. 1. Transverse section showing general arrangement of the cells. x 90. Note axial parenchyma mainly confined to the abaxial side of the pores. –– Fig. 2. Tangential longitudinal section. x 90. Note the heterogeneous rays. –– Fig. 3. Radial longitudinal section. x 90. Note the heterogeneous rays. –– Fig. 4. Macerated material showing a typical vessel element. x 100. –– Fig. 5. Portion of a vessel element showing a scalariform to reticulate perforation plate. x 620. Phase contrast.

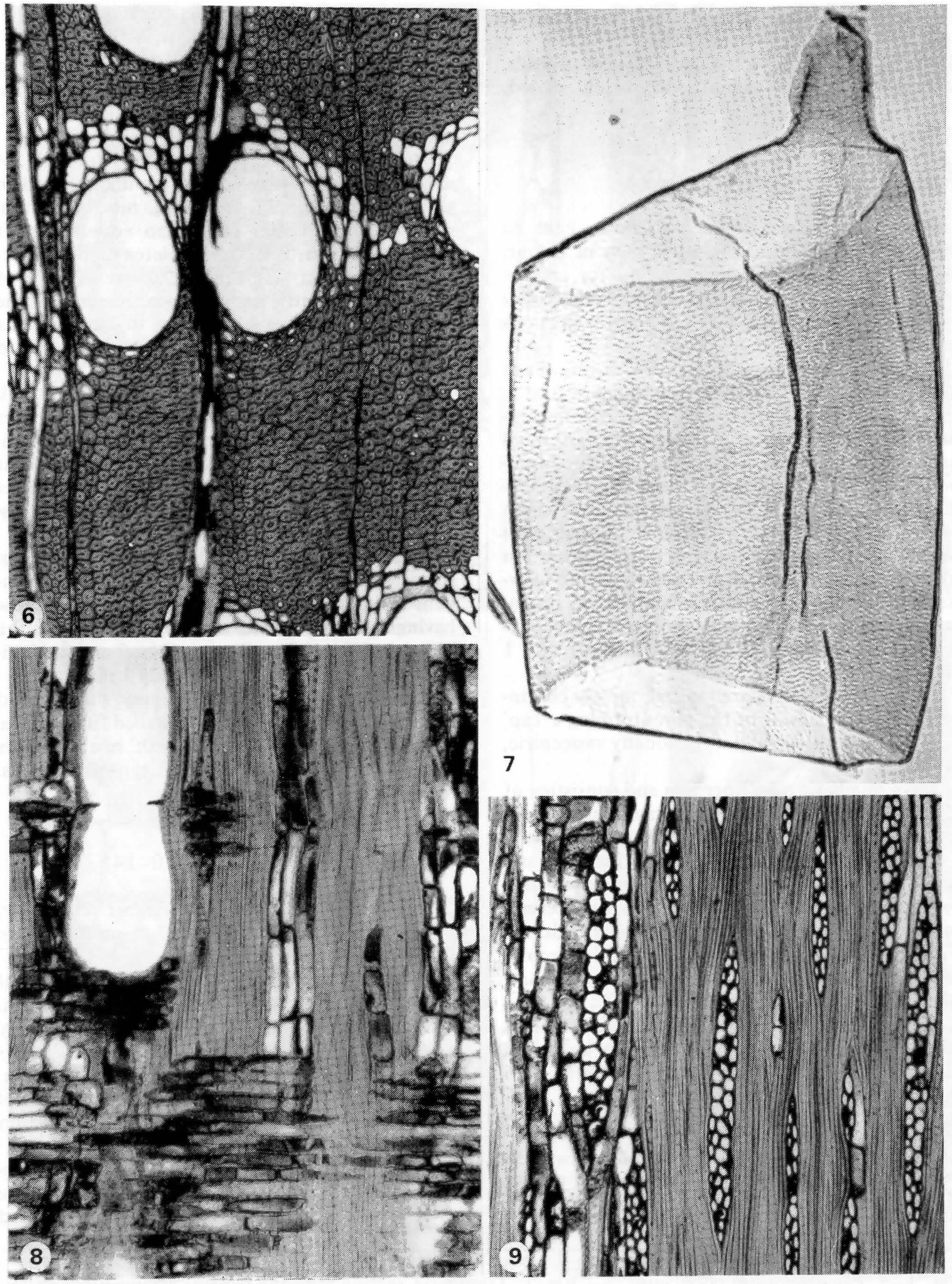


Fig. 6–9. *Dilobeia thouarsii.* — Fig. 6. Transverse section showing general arrangement of the cells. x 90. — Fig. 7. Tangential longitudinal section. x 90. — Fig. 8. Radial longitudinal section. x 90. — Fig. 9. Macerated material showing a typical vessel element. x 155.

blocked with amorphous deposits. In the macerated material an unusual type of vessel element was observed. Whilst most of the vessel elements were of normal shape, see Fig. 13, some vessel elements had the two perforation plates situated close together and towards one end of the element, the other end being extended to form a very long tail, see Fig. 14.

Axial parenchyma mostly paratracheal, occurring as a 'cap' on the abaxial side of the solitary pores and as tangential bands 1–2 (occasionally 3) cells wide radially on the abaxial side of the tangential rows of pores, see Fig. 10.

Rays numbering 4–5 per mm, uniseriate or biseriate, occasionally triseriate; composed of procumbent cells with the marginal row consisting of cells which are of slightly greater axial dimension than the remaining cells, see Figs. 11 and 12. Maximum height of rays 0.8 mm. Occasional broad rays (10–12 cells wide) were found and these contained stone cells.

Ground tissue composed of fibres which are profusely pitted with bordered pits on both the radial and tangential walls. Walls of fibres very thick and average length of fibres 1.24 mm.

Silica not observed.

Discussion

Placospermum, Dilobeia and *Garnieria* are of interest to the wood anatomist because their endgrain pattern is so unlike that of the majority of Proteaceous woods. However, of the three, *Placospermum* is perhaps the most interesting because it shows a number of features which are more primitive than the corresponding features in other members of the family. This is in agreement with the position it has been given by Johnson and Briggs in their reconstruction of the phylogeny of the family (Johnson & Briggs, 1975). In their arrangement of the families, sub-families, tribes, sub-tribes and genera, *Placospermum* is placed in the sub-family Persoonioideae very close to the *Proto-Proteacea*, that is, the hypothetical most advanced common ancestor of the living members of the family.

The following features indicate that *Placospermum* is more primitive from the wood anatomical point of view than other members of the family:

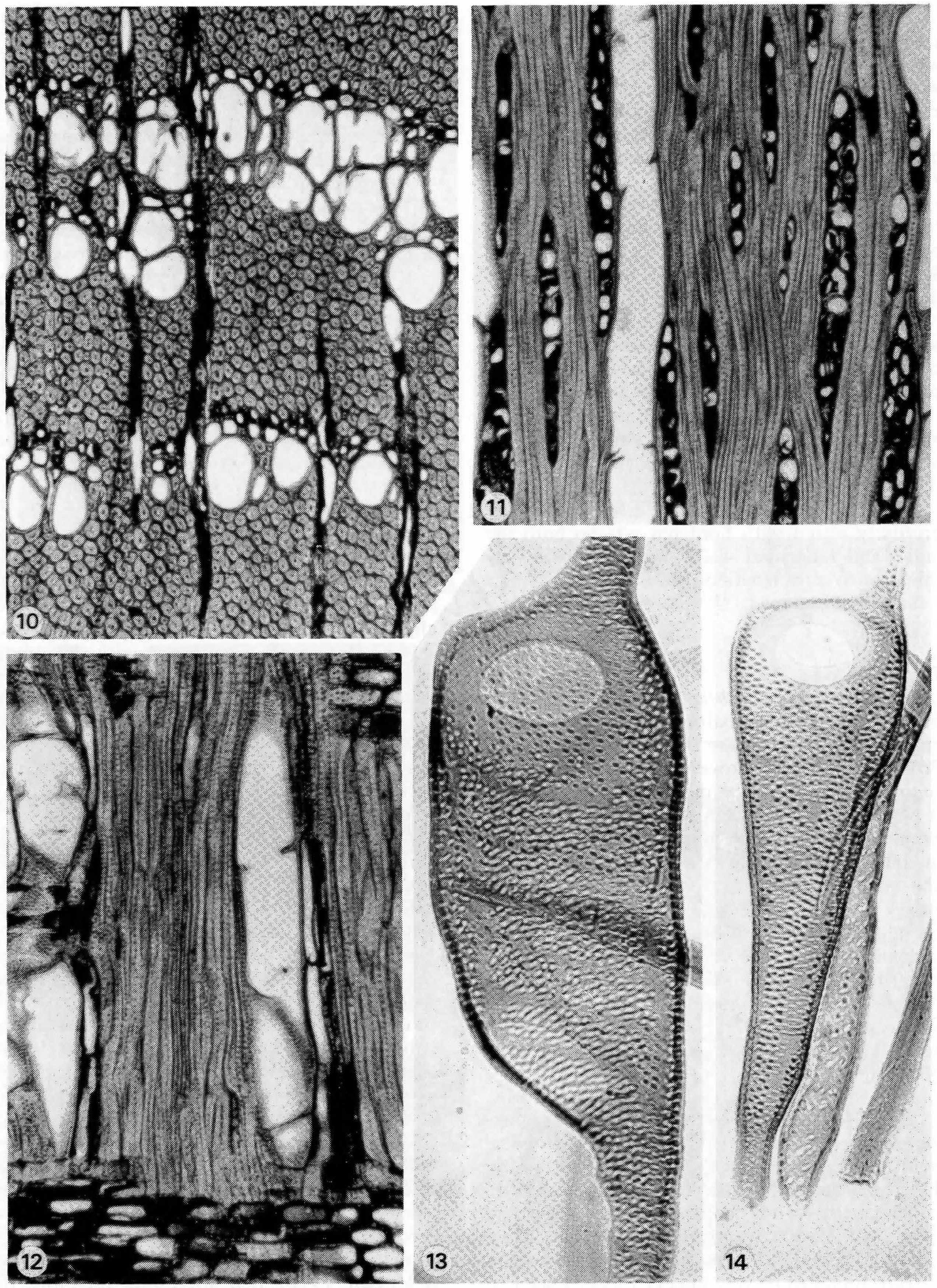
1. Vessel member length. The usual vessel member length for the family is medium (Metcalfe & Chalk, 1950; Anonymus, 1937), that is 0.35 mm–0.8 mm, whereas those in *Placospermum* were found to be very long (1.25 mm), see Fig. 4.
2. Type of perforation plate. Simple perforation plates are typical of the family and, although most of the vessel elements in *Placospermum* were also found to have simple perforation plates, an occasional reticulate to scalariform perforation plate was observed, see Fig. 5.
3. The arrangement of the vessels and parenchyma. Many members of the family have continuous narrow to wide tangential bands of vessels which is a more advanced type of arrangement than the scattered vessels and vessel groups found in *Placospermum*.
4. Type of ray. The family usually shows homogeneous rays except for a few sheath cells (Metcalfe & Chalk, 1950) whereas in *Placospermum* the rays are decidedly heterogeneous, see Fig. 2.
5. Type of fibre. Although Chattaway found that in a few genera the ground mass of the wood is formed of fibre tracheids with conspicuously bordered pits, she states that 'in most genera the ground mass of the wood is formed of libriform fibres with simple or indistinctly bordered pits.' (Chattaway, 1948). The ground mass of the wood of *Placospermum* is composed of fibres with distinctly bordered pits.

Although all three genera lack the typical bands of axial parenchyma which curve inwards between adjacent rays, it is interesting to note that they all possess predominantly paratracheal axial parenchyma which is mainly confined to the abaxial side of the vessels. This agrees with the arrangement in many other genera of this family which have banded axial parenchyma with the vessels lying mostly on the adaxial or pith side of the parenchyma bands. It would appear therefore that the tendency for the axial parenchyma to occur on the abaxial side of the vessels is a strong family characteristic.

Garnieria, whilst lacking wide rays, does have a definite tangential, banded arrangement of the vessels and axial parenchyma. These tangential bands of parenchyma, however, do not curve inwards between the rays as is the case in most Proteaceous timbers but, instead, more or less follow the contour of the stem. In this respect the wood structure of *Garnieria* closely resembles that of those species of *Persoonia* which have narrow rays (Chattaway, 1948). Johnson and Briggs (1975) in their classification of the family, have placed *Garnieria* in the sub-tribe Persooniinae together with *Persoonia, Pycnonia, Acidonia* and *Toronia* and the wood anatomy supports this classification.

The presence of vestured pits in *Garnieria* is of interest. The Proteaceae is not one of the families listed by Bailey (Bailey, 1933) as possessing vestured pits. However, vestured pits have been found to be present in *Persoonia toru* (Butterfield & Meylan, 1974). It is interesting, therefore, that in this respect also *Garnieria* is similar to *Persoonia*.

The wood anatomy of *Dilobeia* is different from that of any other member of the Proteaceae so far examined. Wood samples of three other genera of the tribe *Conospermeae* (sensu Johnson



and Briggs) were available for study, namely, *Petrophila* (2 species), *Isopogon* (2 species) and *Conospermum* (1 species). All these showed a similar type of parenchyma arrangement to *Dilobeia* and, in *Petrophila*, the pore arrangement was predominantly solitary. However, in all three genera there was a tendency for wide rays. Johnson and Briggs (1975) have placed *Dilobeia* in a subtribe of its own within the tribe *Conospermeae* and from the aspect of the wood anatomy there is no disagreement with this.

Acknowledgements

I wish to thank Dr. R.K. Bamber, Dr. H. Gottwald, Mr. D. Edwards and Dr. R. Curtin for helpful suggestions and comments during the preparation of this paper. I am also indebted to Mr. R. Colley for help in the preparative and measurement work. Curators of wood collections and other institutions who supplied wood samples are gratefully acknowledged.

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Fig. 10–14. *Garnieria spathulaefolia*. — Fig. 10. Transverse section showing general arrangement of the cells. x 90. — Fig. 11. Tangential longitudinal section. x 90. — Fig. 12. Radial longitudinal section. x 90. — Fig. 13. Macerated material showing a typical vessel element. x 245. — Fig. 14. Macerated material showing an unusual type of vessel element in which the two perforation plates are both situated at one end of the element. x 200.

ABSTRACTS OF PAPERS TO BE PRESENTED AT THE WOOD ANATOMY CONGRESS OF THE AFRO-EUROPEAN REGIONAL GROUP OF THE INTERNATIONAL ASSOCIATION OF WOOD ANATOMISTS, THE WOOD QUALITY SUBJECT GROUP OF IUFRO DIVISION V, AND OF THE PLANT MORPHOLOGY AND ANATOMY SECTION OF THE ROYAL BOTANICAL SOCIETY OF THE NETHERLANDS

Royal Tropical Institute, Mauritskade 63, Amsterdam-5, The Netherlands. August 27–30, 1979

The papers are presented in alphabetical order of the author's name. When no abstract was received before April 1, only the title is given. Of many papers full accounts will be published in future issues of the IAWA Bulletin

PIETER BAAS, Rijksherbarium , Schelpenkade 6, Leiden, The Netherlands. – **Comparative wood anatomy: possibilities and limitations.**

Comparative wood anatomy, here defined as any study of wood structure that attempts to view descriptive and experimental research against the broadest possible background of what is known of wood structural diversity in higher plants, is perhaps the oldest, and at present possibly somewhat neglected branch of wood science. However, its potentialities to help solve problems in all fields of pure and applied wood anatomy are considerable. This applies to those fields which have traditionally profited most from comparative wood anatomy (systematics, identification, phylogeny and more recently ecological anatomy) as well as to plant physiological and morphogenetic problems. The possibilities and limitations of comparative wood anatomy in some of these fields will be explored using examples from recent studies.

In the author's opinion the limitations of comparative wood anatomy are greatest in the rigid application of insufficiently tested 'characters' as static parameters in systematic wood anatomy. If, however, due attention is given to the dynamics of phylogenetic and ontogenetic development, comparative anatomy is a powerful tool for formulating the correct questions and providing the answers to them in all fields of wood structural research.

TINE BARETTA-KUIPERS, Institute of Systematic Botany, Transitorium II, Utrecht, The Netherlands. – **The wood structure of Leguminous tribes: their characterization by ray and parenchyma features.**

In the course of a comprehensive world-wide survey of woods of the Leguminosae, it became apparent that ray features are of paramount importance. Characters such as ray type (homocellular or heterocellular), storied versus non-storied alignment, and uniseriate versus multiseriate condition all may give important clues.

Examples from all three subfamilies will be given, as for instance the tribe Ingeae (Mimosoideae), the tribes Amherstieae and Detarieae (Caesalpinioideae) and the tribes Dalbergieae and Tephrosieae (Papilionoideae).

The parenchyma distribution is a distinguishing feature on a lower level, viz. mostly on the genus and species level as will be demonstrated by examples.

M. BARISKA and L.J. KUČERA, Institut für Mikrotechnologische Holzforschung, ETH, Zürich, Switzerland. – **Fracture surfaces of wood after different types of mechanical testing: an SEM-study.**

The strength properties of wood are tested in practice in different ways. Although the strength and consistency of a material are defined by its intermolecular forces, the strength values and breakage surfaces typically resulting from differently applied stresses are decisively influenced by the anatomical structure of (the) wood. In the present work, the fracture surfaces of wood after the application of tensile, compressive, bending, shearing and torsion stresses are presented in SEM electron micrographs and discussed.

J. BARNETT, Plant Science Laboratories, University of Reading, Whiteknights, Reading, U.K. – **Ultrastructural investigations into xylem differentiation.**

The stages in differentiation of xylem elements have been extensively examined using both *in vivo* and *in vitro* techniques. Despite this work, no single step in the process is fully understood. The current status of research into the way the various structural and conducting elements of xylem are formed from the cambium in secondary tissues will be reviewed, with particular emphasis on the results of ultrastructural investigations.

TH. BARTHOLIN, Department of Quaternary Geology, Tornavägen 13, S-223 63 Lund, Sweden. – **Environment and dating - Wood anatomy applied to a Neolithic settlement.**

The value of wood-anatomical integration in archaeological investigations is demonstrated through results from the current excavations of the Alvastra pile dwelling in the central part of southern Sweden. It is possible to give relative datings of periods of activity in the construction: the relative years 1, 2, 8, 11, 12, 14, 15, 16 and 40–42. For all the periods piles were taken from the same forest, which started to grow about 40 years earlier in an open landscape, probably situated on the moraine slope down to the bog with the dwelling.

It is possible to reconstruct in detail the vegetation cover 50 years before the settlement took place and during the years of activity and to see that the piles were collected within a larger area than the twigs and branches in the horizontal layers. The analyses give information about the season of the activities, the kinds of activities, and details of the tree working technique.

J. BAUCH, A. SHIGO and M. STARCK, Institute of Wood Biology, University of Hamburg, B.R.D., and Northeastern Forest Experiment Station, Durham, New Hampshire, U.S.A. – **Wound effects in xylem of Acer and Betula.**

Artificial wounding was done with a drill bit - 2 cm diameter, 3 cm deep - in September 1977 on *Acer rubrum, A. saccharum, Betula papyrifera* and *B. alleghaniensis*, in New Hampshire, U.S.A., 10 trees of each species. After cutting of the trees one year later, it was striking that the extent of discolorations in longitudinal direction was for *Acer* species moderate (av. ~ 30 cm) whilst in *Betula* species this effect was much more pronounced (av. ~ 100 cm), with distinct variations within a species. Morphological, histometrical, and permeability studies on the wood showed that the vessel diameter and the pits of the vessels apparently influenced the development of the discoloration in longitudinal direction. In *Acer* species the vessels were plugged with accessory compounds from the neighboring parenchyma cells which hinders an extended discoloration reaction upwards and downwards in the tree. In *Betula* species the vessels remained almost completely empty which may explain the faster penetration of air into the wood stimulating stronger discoloration.

P.D. BURGGRAAF, Botany Department, Nonnensteeg 3, Leiden, The Netherlands. – **On the formation of vessels in the wood of Fraxinus excelsior L.**

Results of research on the three-dimensional course of the vessels in the wood of ash indicate that plant hormones may not have a specific regulatory role in the determination of fusiform elements in the cambial zone into vessel-elements, as is currently assumed. An alternative model will be presented, which is based on the following arguments.

The position of developing vessel-elements seems to be negatively related to that of the rays: i.e. these elements do occur, not exclusively, but more frequently, in radial files of fusiform elements which have no contact with ray cells.

Diameter growth of developing vessel-elements is related to differences in cell-division frequencies in adjacent radial files. Such differences in cell-division frequencies are also consistently found between radial files with and without contact with rays. These may produce local differences in pressure within the tissue.

From the literature it is known that pressure differences can have strong effects on cell-division, -production and -differentiation in the cambial zone of trees.

It would seem possible then, that local pressure differences in the cambial tissue, caused by unequal cell-division frequencies in the radial files, particularly in relation to the position of the rays, are determinative agents for the production of vessel-elements. Vertical alignment of the vessel-elements into vessels is then due to the longitudinal structure of the tissue and to the tendency to propagate such pressure differences in the longitudinal direction.

Implications of this model for production of different tissue patterns in wood will be discussed briefly.

J. BURLEY, Commonwealth Forestry Institute, South Parks Road, Oxford, U.K. – **Variation of wood properties in Pinus cubensis and P. tropicalis from natural forests in Cuba.**

J. BURLEY and A.E. AKACHUKU, Ibid. – **Variation of wood anatomy of Gmelina arborea Roxb. in Nigerian plantations.**

B.G. BUTTERFIELD and B.A. MEYLAN, Botany Department, University of Canterbury, Christchurch, and Physics and Engineering Laboratory, DSIR, Lower Hutt, New Zealand. – **Aspects of angiosperm vessel structure.**

Scanning electron micrographs are used to illustrate vessel perforation plate development and evolution, unusual perforation plate types, vessel wall structure and pitting, pit membranes, vestured pits, helical thickenings, tyloses and trabeculae.

B.G. BUTTERFIELD and B.A. MEYLAN, Ibid. – **The structure of coconut wood.**

Although palms do not produce 'wood' in the usual sense of the word, their stems are often physically quite hard and may reach 60 cm or more in diameter. This paper describes the wood of coconut (*Cocos nucifera* L.) and illustrates various features of the vascular and non-vascular bundles, and the ground parenchyma tissue with scanning electron micrographs. Variations in the basic density of the wood are due to differences in the distribution of the bundles, the proportion of fibres to other cell types present in the vascular bundles, and the thickness of the fibre and ground parenchyma cell walls. An interesting feature of the intercellular spaces in the ground tissue is the presence of pectic strands.

A.M. CATESSON and Y. CZANINSKI, Laboratoire de Botanique, 24 rue Lhomond, Paris Cedex 05, France. – **Dynamical cytochemistry of wall development during vessel differentiation.**

Polysaccharide deposition was followed by PATAg (periodic acid-thiocarbohydrazide - silver proteinate) technique according to Thiéry (1) which chiefly contrasts vic-glycol groups. Lignin was visualized by Coppick and Fowler's procedure (2): chlorine water - ethanolamine - silver nitrate.

After glutaraldehyde - osmium tetroxide fixation PATAg gives strong contrast to primary walls whether they are lignified or not but not to mature secondary walls (3). In differentiating secondary thickenings the newly deposited polysaccharides strongly react with PATAg and show fibrillar structure. Their contrast is progressively lost as free vic-glycol groups become fewer and fewer. However, following treatment with chlorine water, PATAg produces in secondary walls a good contrast the significance of which will be discussed. During differentiation of secondary walls, the loss of free vic-glycol groups seems correlated with lignin deposition although it may be due to a greater compactness of cellulose microfibrils.

Swollen transverse walls intensely react with PATAg; they are easily destroyed after chlorine water treatment even at the beginning of vessel differentiation while partial hydrolysis of pit primary walls is one of the last events of vessel maturation.

(1) Thiéry, J.P. 1967. J. Microscopie 6: 987–1017.

(2) Coppick, S. & W.F. Fowler. 1939. Paper Trade J. 109: 81–86.

(3) Czaninski, Y. 1979. Biol. Cell. 34, no 3 (in print).

D.M. CATLING, The Metropolitan Police Forensic Science Laboratory, 109 Lambeth Road, London SE1 7LP, U.K. – **The identification of vegetable fibres.**

Although man-made fibres have, to a large extent, replaced natural fibres, it is often necessary to identify the species from which plant fibres have been extracted. Some manufactured goods such as sacking and cordage are still made from vegetable fibres and archaeologists and historians need to study articles of interest to them. There are few text books or papers which contain comprehensive accounts of the bast fibres and, in those which are available, some of the information is incorrect. The microscopical characteristics of the fibres from eight species have been studied. Some old myths are exploded and some features which will be useful for fibre identification are suggested.

D.J. DICKINSON and J.F. LEVY, Department of Botany, Imperial College of Science & Technology, London, U.K. – **The action of wood preservatives in relation to wood anatomy.**

The effects of wood inhabiting fungi on the structure of wood cell walls are now well established. The effectiveness of wood preservatives depends on their penetration in the wood structure and particular into the layers of the cell walls. Their ultimate distribution governs the type of decay organism which finally destroys the wood.

R. DODD and M.P. DENNE, Department of Forestry and Wood Science, University College of North Wales, Bangor, Gwynedd, Wales, U.K. – **Cambial reactivation and wood production vary within trees of Acer pseudoplatanus and Fraxinus excelsior.**

The beginning of wood production and its subsequent development during the season are examined at different heights within the main stem and branches of *Acer pseudoplatanus* and *Fraxinus excelsior*. These trends are considered in relation to within tree variations of wood quality.

D. ECKSTEIN and E. FRISSE, Ordinariat für Holzbiologie der Universität Hamburg, Leuschnerstrasse 92, Hamburg, B.R.D. – **Environmental influences on the vessel size of beech and oak.**

Severe changes in the environmental conditions of a tree are well documented in the annual increments of the wood. Until now the analysis of tree-rings has mostly been based on the width of the increment. The research program under consideration additionally takes into account the anatomical structure within the annual rings; in a preliminary study the vessel system turned out to be the most promising parameter. The investigation deals with two oak trees and eight beech trees from four different sites in Germany and Austria. Ring widths were measured in the usual manner. For the vessel size also time series were established, each value for one year being the mean of 40 single vessels.

The year-to-year variation of the vessel size is more climatically influenced than the ring width

variation, whereby the factor precipitation plays a dominant role. On the basis of these results a reconstruction of the climatic conditions until 1885 was possible for a specific site.

D. ECKSTEIN and W. LIESE, Ibid. – **Structural alterations in the wood due to anthropogenous influences on trees.**

The conditions of trees near industrial regions and in cities are becoming increasingly unfavourable. Trees damaged by such anthropogenous influences often exhibit external symptoms only shortly before death. However, through reactions of the xylem an ecological stress can exactly be determined and traced back to its very beginning. Thus it is possible to reconstruct the process of damage and to give information about subacute influences accumulating in the course of time.

The wood-anatomical changes might be regarded as an adaptation of the tree to cope with its unfavourable life conditions. The most sensitive tissue has proven to be the hydrosystem. Often, the xylem produced under pollution influences resembles that grown under drought conditions. There is also some evidence that various specific wood structures enable some trees to be more resistant against environmental stress than others. Such structural types may be used as a parameter for selecting suitable trees for breeding.

KAZUMI FUKAZAWA and HITOSHI IMAGAWA, Department of Forest Products, Faculty of Agriculture, Hokkaido University, Sapporo, Japan. – **Quantitative analysis of lignin using UV microscopic image analyser.**

The microscopic image analyser which consists of XY scanning stage, stage control unit, amplyfier unit, planimeter unit and iso-density plotter was attached to the UV microscope (Carl Zeiss; Type MPM 01). Densitic signals are taken out directly from the scanning spots on wood cross section under the UV microscope. Iso-density areas of UV absorbance are graphed and counted by setting the limits of density. The arbitrary unit of lignin content is calculated by integrating UV absorbance. This direct method from wood sections is to be preferred to the indirect method which is performed by analysing densitometrically the negative of UV microscopic images, because of poor reproducibility of densitic measurements.

In the report, we discuss the fundamental techniques of the method and the results of examining variation of lignin content within a growth increment of some coniferous woods. Lignin content attains a maximum value near the beginning of the early wood and a minimum near the end of the late wood. Early wood has much area of higher absorbance, but in late wood, there is much of the lowest absorbance. The differences of area of middle lamella and lignin content of S_2 between early and late wood will effect coincidentally the variation within a growth increment.

H. GOTTWALD, Institut für Holzbiologie und Holzschutz der Bundesforschungsanstalt für Forst- und Holzwirtschaft, Leuschnerstrasse 92, Hamburg, B.R.D. – **The secondary xylem of Magnoliaceae, its taxonomy and possible relation to other families.**

The family of the Magnoliaceae is a prominent group because of its pronounced primitiveness, which characterizes the order of Magnoliales, frequently considered the starting point of all living higher plants. In order to find out whether the anatomy of the secondary xylem is in accordance with this archaic position, wood samples from about 200 trees of all magnoliaceous genera were investigated and compared with the structure of other so-called primitive families.

The results confirm that the Magnoliaceae in its current delimitation represent a well defined natural group distinct from other taxa of the same order. As is common in very homogenous families the diagnostic value of the anatomical features at generic-level is low and often only groups of genera are distinguishable. The most constant and widest structural distance is evident between the genera *Liriodendron* and *Elmerrillia* also corresponding with their contrasting north–south positions; in combination with the structural middle-position of *Magnolia*, this scheme fits in the conspectus of the tribes and genera of the family. As a very rare feature in woody plants further species were detected which develop tyloses in the fibrous tissue. In terms of wood anatomical relationship only some families of the order Magnoliales may be considered close to Magnoliaceae.

The primitiveness of the structural concept and of individual features is less pronounced in Magnoliaceae than in various other vessel-bearing families within and outside the Magnoliales.

H.R. HÖSTER, Institut für Landschaftspflege und Naturschutz, Herrenhäuserstrasse 2, Hannover, B.R.D. – **Xylem structure of roadside trees in urban environment.**

In consequence of stresses, that bear on roadside trees, like subnormal supply of water, soil compression, soil cover with asphalt or concrete, root injuries by digging or stem injuries by traffic, salt load after strong winter and air pollutions of different kind, in Germany more than 40.000 trees die year by year. The environmental stresses mainly influence leaves or roots, in consequence cambial activity of stem and xylem production is reduced, cell size, arrangement of cells and the proportion of different tissue types are altered. Growth rings therefore are excellent indicators for recognizing environmental influences.

Especially endangered are species of *Tilia, Acer* and *Aesculus*, the most common roadside trees, whereas others like *Platanus, Quercus, Robinia* and *Sophora* can do comparatively well in the urban environment. In the strategy of survival of trees great importance should be assigned to the structure of root system, bark and leaves, but also to the structure and development of xylem. Using the example of tree damage by de-icing salts, differences in the pattern of cambial activation, xylem structure and water transport are discussed in relation to relative resistance against sodium chloride.

If we cannot change environmental conditions to a great extent, we have to look for trees which are better suited to cities, and in this connection xylem structure plays an important role.

I.S. IZUGBOKWE, Ministry of Agriculture, Engineering Division, Imo State, Nigeria. – **Grading of structural timbers in Imo State of Nigeria.**

L.J. KUČERA, H.H. BOSSHARD and E. KATZ, Institute für Mikrotechnologische Holzforschung, ETH, Zürich, Switzerland. – **Growth ring depressions and phloem ray development in beech (Fagus sylvatica L.).**

Growth ring depression in the area of a broad ray is a characteristic feature of the secondary xylem of beech, but occasionally also occurs in the secondary xylem of some other European woody species, such as plane (*Platanus sp.*) and lime (*Tilia sp.*).

The present work deals with the quantitative and qualitative morphology of the phloem ray development in beech. The observations and measurements were made with light and scanning electron microscopes. The connection of growth ring depressions with the ontogeny of the rays in their phloem parts is demonstrated, and secondary changes of the ray structure, such as dilatation and sclerification, are described. The functional significance of the observations is discussed.

ZBIGNIEW LAUROW, S.G.G.W.–AR, Warsaw, Poland. – **Technical quality of Scots Pine from selected sites of the Piska Forest.**

Investigations were carried out on nine experimental plots in the North-East part of Poland (the best pine wood quality provenance in Poland). Structure and properties of wood were examined according to the Polish standards.

Studies reveal, that Pisz pine has tracheids distinguishing themselves with a higher than average tracheid length (arithmetic mean often above 4 mm), coefficient of slenderness (to 205) and rigidity (to 0,6), and a higher cellulose content than the pine of other origin. Tracheid slenderness and rigidity coefficient are slightly higher in the wood from poorer sites (excluding boggy ones) and from heartwood.

The largest resistance, late wood proportion and density of wood were found under site conditions of medium fertility and moisture. Arithmetic means of resistance, calculated for particular areas, were usually large, and differed to above 40%. The intensity of properties increases with increase of the ring width, late wood content and density of wood are lower in wood from the worst and best sites, than from medium ones. Wood from the sites having more moisture had lower resistance and lower increase of properties than from drier ones. Higher vulnerability to deformation under loading was noted in the wood from the best sites and the worst from swampy areas and the lower vulnerability for wood from medium site conditions (differentiation up to 50%).

Scanning microscopy and X-ray investigations led to the conclusion that the substructure of wood has in many cases a high influence on the properties and vulnerability to the deformation of wood.

A. LECLERQ, Station de Technologie Forestière, C.R.A. 6, Avenue Maréchal Juin, 5800 Gembloux, France. – **Relationships between Beechwood anatomy and its physical and mechanical properties.**

Within the framework of a comprehensive experimental study of the effects of site quality and of sylvicultural treatment on Beechwood quality, it was necessary to search for wood parameters which explain its properties. In this connection, specific gravity and annual growth rate have proved to be estimators lacking in precision. Therefore a detailed analysis of wood anatomical structure has been considered necessary to explain wood properties in the best way.

The anatomical analysis concerns a large number of samples cut off from test pieces used for physical and mechanical tests so that connections can be directly established between physico-mechanical data and anatomical data. The anatomical data consist of qualitative and quantitative measures of fibrous and vascular tissue only, viz. total void volume, length, diameter, and thickness of fibre walls and lumina.

All results have been analysed statistically following the multiple regression method which has allowed the derivation of equations that explain, sometimes with great precision, each wood property.

ELDAR D. LOBJANIDZE, Paliashvili 49, ap. 16, 380030 Tbilisi, U.S.S.R. – **Peculiarities of cambial activity in mountain forests of Transcaucasus.**

A. MARIAUX, Centre Technique Forestier Tropical, Nogent-sur-Marne, France. – **Formation of silica grains in wood as a function of growth rate.**

Several authors have described the occurrence of silica grains very near the cambium in various woody species. Because this occurrence seems to some biologists a little surprising in living and active cells, we have examined whether silica deposition is linked to the age of the cells or the distance from the cambium.

On 3 trees of *Aucoumea klaineana* a transverse disk was finely polished to obtain a good view of the growth rings, one with rapid growth rate, one with slow growth rate, one with very irregular width of the same ring on various radii. All the 3 trees were felled in the same season. In large rings, silica appears in ray cells of the year, 3 to 6 months old. In narrow rings, silica occurs nearer the cambium, but in cells being about 1 year or more old.

This means that neither only age nor distance from the cambium but a combination of both these factors affect silica deposition.

A. MARIAUX and A. VITALIS-BRUN, Centre Technique Forestier Tropical, Nogent-sur-Marne, France. – **A tentative statistical method for wood identification in 20 genera of Sapotaceae.**

Sapotaceae are a wood anatomically very homogeneous family and the identification of red heavy woods is sometimes very difficult, especially if the provenance is unknown.

It was thought that a statistical method could be more efficient for this purpose than a dichotomous key. A detailed analysis of 80 samples from 20 genera resulted in 26 varying characters. Two methods were tested: principal component analysis and factorial discriminant analysis. The first one gives the 2 or 3 better linear combinations of initial variables, the 26 characters explaining a maximum of the total variation of the population, without consideration of the identity of the samples. The second one tries to compute the data in linear combinations of variables in such a way that a better clustering of each genus and a greater distance between them is obtained. The second method appears more efficient to identify a sample (that is to put it in a group) but the first method gives a natural clustering which may be of interest for taxonomic considerations. A point to be discussed is the use of secondary characters (as silica grains) sometimes very discriminant, together with structural and more basic characters.

ANTON MATOVIČ, Faculty of Forestry, University of Agriculture, Zemědělská 3, Brno, Czechoslovakia. – **Cambial activity and xylem differentiation in Fraxinus angustifolia Vahl ssp. pannonica Soó et Simon.**

The aim of the study was to determine the probable time of cambium origin, its activity during the growing period in relation to the temperature and precipitation, the course of differentiation of xylem elements at the beginning of the growing period as well as the course of differentiation of wood fibres during the vegetation period.

The study was carried out during the period of 1969–1974 on one to six-year-old seedlings of the same origin and on the same trial plots. Measuring of the diameter increment (macro-measuring) was performed using a micrometer with an accuracy of ca. 0.1 mm on six plots with 50 seedlings per plot. The origin of cambium, its activity during the growing period and the course of xylem differentiation were observed on microscopic sections. Sampling was carried out from six trial plots with 150 individuals per plot taking one seedling from each trial plot. These plots were parallel to the plots for macro-measuring. The choice of the seedling from a plot represented the average seedling determined by the macro-measuring. Wood fibre differentiation was observed according to Wodzicki (1971).

A continuous cambial ring appears ca. 1 month after the establishment of seedlings. Approximately at the same time the phellogen originates. Cambium starts its activity before bud flushing after long-lasting mean temperatures of 7–9°C. It terminates its activity approximately at the same temperatures. The differentiation of xylem and phloem begins at about the same time. Spring vessels are differentiated first, probably from the overwintering cells of the cambial zone. The mean width of cells of the cambial zone during the period of the onset of cambial activity is about 6 μm. The mean number of cells of the cambial zone during the growing period amounts to 4–6. The lignification of the cell wall of the spring vessels begins first, then of wood parenchyma and in the end of wood fibres. The course of the differentiation of wood fibres during the growing period has a similar tendency as tracheid differentiation in Scots pine (Wodzicki, 1971). A sigmoid curve is characteristic of the diameter growth. The modification of growth curves is affected by climatic factors, especially by interactions between temperature and precipitation. A long-lasting dry period in the second half of the growing period could cause the inhibition of cambial activity.

Reference:

Wodzicki, T.J. 1971. Mechanism of xylem differentiation in Pinus silvestris L. J. Exp. Bot. 22, no. 72: 670–687.

REGIS B. MILLER, Center for Wood Anatomy Research, U.S. Forest Products Laboratory, P.O. Box 5130, Madison, Wisconsin 53705, U.S.A. – **Computerized wood identification.**

Wood identification is a practical aspect of wood anatomy, but the lack of comprehensive keys for many geographical areas makes it time consuming and difficult. To obtain a more efficient method of identification for woods on a worldwide basis, a system of computer programs developed by Larry Morse for the identification of biological specimens has been adopted by our Laboratory. The data structure is presented to interactive programs as anatomical data matrices in coded form for 67 characters. The three types of characters used in the system are dichotomous (two character states), multistate (a maximum of six character states), and quantitative (numerical ranges). To conserve data storage space, all taxa are placed in only one of the following six data banks: ring-porous, scalariform perforation plates, banded parenchyma, reticulate parenchyma, septate fibres, and 'main', a miscellaneous catch-all file. When identifying unknowns, coded character states are entered in any order until the 'correct taxon' is attained. Some user options include 'suggest useful characters', which aids in separating the taxa not eliminated, and 'list possibilities remaining'. A powerful option is the variability limit. When the variability limit is zero (monothetic mode), one difference between specimen and description eliminates the taxon. When the variability limit is one, two, etc. (polythetic mode), one, two, etc., differences between specimen and description will be tolerated before any taxon is eliminated. After a suggested identification is attained, unusual characters for the taxon and characters used in the identification are listed.

VLADIMIR NEČESANÝ, State Forest Products Research Institute, Bratislava, Yugoslavia. – **Effects of some lignin precursors on xylem differentiation in poplar.**

It has been known for longer time that many lignin precursors affect the growth of plants as inhibitors. Notwithstanding, some of them can act like growth stimulators under special conditions. The aim of this paper is to verify this opinion with respect to the xylem formation in poplar effected by graded concentrations of shikimi, p-coumaric, caffeic and sinapic acids.

It was assessed that all precursors used caused a decrease of the average number of vessels inside a unite area of the spring wood transverse sections; in the late wood it was mainly the sinapic acid that stimulated an increase of vessel number. The average radial diameter of spring wood vessels was higher than in the control with a single exception; in the late wood it was also higher, but the p-coumaric acid and to a certain extent also the caffeic acid inhibited the diameter growth of vessels. The ratio of total vessel area compared with the libriform area was (with some exceptions) superior to the control in the spring wood, but in the late wood libriform predominated, especially when shikimi and p-coumaric acids were administered.

In no case any decline in cell wall lignification was recorded. An examination of the effect of precursors on the length of vessel members and of libriform fibres did not reveal any significant differences.

If the values assessed with control seedlings are thought normal, then the effect of applied precursors can be considered stimulating in spring wood similarly like β-indole acetic acid, but rather inhibiting in the late wood, without any negative effect on lignification. However, their concentration may particularly affect the regulating characteristics.

VLADIMIR NEČESANÝ, Ibid. – **Electron microscopic characteristics of laser cut wood surface.**

The fine structure of laser cut surfaces of wood has been analysed with a scanning electron microscope and the results compared with the quantity of the used energy. This quantity marked as Q has been expressed by a ratio of the used output power of the laser source and the speed of wood movement against the laser beam.

The following was ascertained on the transverse sections of beech and spruce woods: At the lowest values of Q = 1 to 2, i.e. at a low output power and a relatively high cutting speed, the edges of transversally cut cell walls are rounded, covered with a smooth, glass-like slag, lumina are open or by part filled with the same substance, while middle lamellae are mostly free of it. When the Q-values are a little higher, up to 2, the slag surface becomes covered with numerous fine bubble-like structures. Over Q = 2, all middle lamellae are free of amorphous substance, the cell wall edges are glass-like and smooth again, and irregularly oriented fibres of the same glass-like substance can be observed on the section surface.

According to the general submicroscopic view of sections within the above mentioned range of Q-values, it is considered that because of a high temperature developed by an interaction of laser beam and wood, the lignin of middle lamellae and cell walls is melted and gradually evaporated. Participation of some hemicelluloses in the composition of the glass-like thermoplastic substance can not be excluded.

Within the Q-values ranging between 5 and 6 no more glass-like slag on the wood surface can be observed and the cell wall skeleton is irregularly crushed. At values of Q = 7 to 10 all sharp edges of the skeleton fragments get rounded, they seem to melt again, but the surface fine structure does not obtain the glass-like smooth appearance. These features are supposed to be derived from the changes of the cellulosic cell wall skeleton.

A.R.A. NOEL, Department of Botany, University of Natal, Pietermaritzburg, Republic of South Africa. – **Aspects of wall formation in non-vascular tracheidal elements.**

The deposition and elaboration of the secondary wall in xylem elements is now very well documented. Nevertheless, there are still different views on the mechanism of the deposition and orientation of wall material. Similarly, studies of tracheid differentiation *in vitro* have been inconclusive. On the basis that a general theory of wall thickening should be applicable to less specialised, non-conducting tracheary cells, examples of a variety of discontinuously thickened walls have been studied, in particular in the *velamen radicum* of orchids, in the testa hairs of *Impatiens* and in the endothecium of *Bulbine*. In each of these situations there were many similarities to the type of development reported in xylem vessels, especially in the oriented and localised apposition of cellulose microfibrils to build up the helical thickening bars. However, microtubules have been shown to have a much more ubiquitous distribution than was previously described, and yet a highly developed Golgi system did not seem to be a pre-requisite for extensive wall thickening. Moreover it appeared that the paramural region was the site of a complex three-dimensional interaction of plasmalemma extensions (often vesicular), sections of microtubules, and wall microfibrils. No helical pre-patterning was ever verified. A further result of these studies was to confirm the unreliability of potassium permanganate as an indicator of lignification (at the E.M. level) and the non-specificity for cellulose in cell walls of the PAS reaction.

A.R.A. NOEL and C. PUFF, Ibid. – **The wood anatomy of Galium tomentosum Thb.**

Wood structure in most of the tribes of the Rubiaceae has been described in considerable detail, but in the Rubieae woodiness is rare and relatively few specimens have been examined.

Galium tomentosum from very arid situations in Namaqualand and S.W. Africa, until recently known only from its herbaceous shoots, may form a woody stem 1.5 m tall and up to at least 17.5 mm in diameter. The wood is hard and brittle, with a characteristic *Asperula* smell. Vessels are diffuse to semi-ring porous, mostly solitary, narrow (72 x 53 μm), very short (182 μm), with simple transverse end plates. The inner walls are thinly warty. Pitting is multiseriate, alternate, oval to circular, with very narrowly elliptic apertures. At moderate magnifications they appear vestured. Vascular tracheids are much narrower (21 μm), with a greater range of length, and biseriate pits. There are no typical elongate libriform fibres, septate fibres or fibre tracheids. Growth increments are marked by terminal to metatracheal parenchyma, which is conspicuously storied. Rays are absent. This wood, therefore quite unrepresentative of the Rubiaceae, has peculiarities which may well reflect secondary specialisation in a predominantly herbaceous tribe, particularly if this is associated with a semi-desert habitat.

E.R. PALMER, Tropical Products Institute, 56–62 Grays Inn Road, London, U.K. – **The use of anatomical characteristics of wood in predicting pulp properties.**

N. PARAMESWARAN, Ordinariat für Holzbiologie der Universität Hamburg, Leuschnerstrasse 92, Hamburg, B.R.D. – **Bark and wood anatomy of some problematic taxa in the Dipterocarpaceae.**

The commercially important family Dipterocarpaceae contains some problematic taxa with regard to their position within the genus and family. Wood and bark anatomy of some species of *Balanocarpus, Doona, Parashorea, Pentacme, Shorea, Upuna* and *Vatica* reveals the necessity for a renewed revision of some taxa, while the position of some others becomes confirmed. The large genus *Shorea* constitutes a taxon of more or less well-established characters with little variation, absorbing partially other, until now stable, genera like *Parashorea*.

N. PARAMESWARAN and W. LIESE, Ibid. – **Fine structural studies in bamboo.**

The fine structural studies in bamboo concern the wall structure of the various cell types like fibres, vessels and parenchyma cells. The construction of the fibre wall is related to certain elastic properties. The topochemical localization of polysaccharides and lignin in the cell walls has been investigated. Preliminary results about cytoplasmic organization and lignification of fibres are discussed. The development of septate fibres show modifications in comparison with hardwood fibres.

HUBERT POLGE, Centre National de Recherches Forestières, Champenoux, Seichamps, France. – **Utilization of an image analyser for quantitative anatomy in relation with wood quality.**

Every difference in wood physical, mechanical or technological characteristics has its origin in anatomical features at the microscopic or submicroscopic level.

Specialists in wood quality studies perfectly know the tremendous within-tree and between-trees variation of all the quality parameters and therefore they generally use very large samplings to get representative values when they estimate the quality of a species on a given site, compare different genotypes or study the effects of different silvicultural treatments on wood quality. As variable of course is the wood pattern (relative proportion and arrangement of the different types of cell, cell wall thickness, lumen diameters, ...) and, for the same reasons, large numbers of trees also are to be sampled for studying wood anatomy in order to explain wood quality. This was difficult up to recently owing to the time required for measuring the different anatomical features on microscopic sections. That time is especially long because the examination of many cells is necessary on each sample to take in account the additional within-ring and between-rings variation of cell characteristics.

By chance a new electronic equipment initially designed for metallographic studies has now become available for automatically or semi-automatically quantifying the wood anatomy: the image analyser. This apparatus has proved suitable for several anatomical applications:

– Wood pattern comparison of early and late flushing oaks.
– Explanation of beech mechanical strength by the area and the number per cm^2 of the large xylem rays.
– Differentiation of individuals in beech by the elliptical form of the vessels.
– Variability of beech vascular characteristics in several stem levels and orientations.
– Specific and infraspecific variability study of diameter, bark thickness and fibre percentage in 4 years old oak seedlings.
– Shrinkage explanation of Silver fir by tracheid characteristics and of beech by vessel characteristics.
– Relationship between the sap or sugar yield and the number or the sizes of sugar maple xylem rays or vessels.
– Influence of long day exposures on the cell wall thickness and the lumen diameter of the tracheids of Douglas fir, Grand fir, Norway spruce and *Abies nordmanniana.*

At the present time an image analyser is used at the wood quality research station in Nancy for 2 important studies: The first one concerns the effect of different parameters (water availability, photoperiod, quantity of light, auxin applications) on the wood structure of beech and oak. The second one deals with the selection of oak plus trees having large and/or numerous vessels in the early-wood and a low relative area of fibres in the late-wood in spite of a quick growth.

ANA MARIA RAGONESE, Instituto de Botánico Darwinion, Lavardén 200, 1640 San Isidro, Argentina. – **Intermediate forms between fibres and parenchyma in certain Leguminosae.**

The woods of several genera of the Leguminosae such as *Pithecellobium* and *Samanea* possess certain elements which are difficult to classify, being intermediate between parenchyma and fibres. The typical paratracheal parenchyma of the family is represented in *Pithecellobium scalare* by parenchyma strands (usually 2-celled) and fusiform parenchyma cells, with a prevalence of the latter. In contact with the vessels there are cells with numerous and conspicuous pits that can easily be recognized as parenchyma and the same occurs with part of the fibres, viz. those with thick walls. The ground mass of tissue is constituted in this species by short fibres, with wide lumina and thin walls, and between these and the fusiform parenchyma cells, a sort of intermediate forms possessing transitional features occur. It is possible to recognize these elements in sections as well as in macerated material. As the wide lumen fibres compose the ground tissue of the wood, it is rather difficult to detect, in transverse sections at low magnifications, the precise distribution pattern of the parenchyma.

P.J. ROBBERTSE, Department of Botany, University of Pretoria, Republic of South Africa. – **Wood anatomy of the South African Acacias.**

Wood specimens of 35 different *Acacia* species were used for this study. Specimens were taken at breast height from trees with stems not less than 8 cm in diameter and immediately fixed in FAA. Of all the wood characters investigated only nine were found to be useful to use in a principal component analysis to differentiate between the different species. Of these the width and to a lesser extent, the height of the rays gave the best results. The rays in the wood of the subgenus *Acacia* are 1–3-seriate, while those of the subgenus *Aculeiferum* are multiseriate. The variation of the wood of *Acacia karroo* from different localities and different ecological habitats is also discussed.

JEAN-CLAUDE ROLAND and BRIGITTE VIAN, Laboratoire de Biologie Végétale, Cytologie Expérimentale, ENS, 24 rue Lhomond, Paris Cedex 05, France. – **Cytochemical observations on growing and non-growing walls of cambium in Dicotyledons.**

WERNER SCHOCH, Eidgenössische Anstalt für das forstliche Versuchswesen, 8903 Birmensdorf, Switzerland. – **Holzstruktur von anaerob abgebauten Hölzern nach der Konservierung mit verschiedenen Methoden** (Wood structure of anaerobically degraded woods following preservation by different methods).

In schweizerischen prähistorischen Seeufersiedlungen wurden viele hölzerne Gegenstände gefunden. Da die Hölzer infolge langer Lagerungszeit in wassergetränkten Sedimenten durch anaerobe Organismen abgebaut wurden und infolgedessen in ihrer Struktur sowie den mechanischen und physikalischen Eigenschaften verändert sind,

wurde abgeklärt, welche Methoden sich zur Konservierung der kulturhistorisch wertvollen Funde eignen.

In dem Versuch wurden sieben verschiedene Konservierungsmethoden geprüft. Als Probenmaterial dienten stark abgebaute, weiche, neolithische, wenig bis stark abgebaute, bronzezeitliche und wenig abgebaute mittelalterliche Hölzer aus schweizerischen Mittellandseen.

Bei allen Methoden blieben die Dimensionen im trockenen, konservierten Zustand weitgehend erhalten, denn die äusseren Zellformen entsprechen annähernd denen der nicht abgebauten. Wesentliche Unterschiede ergeben sich jedoch in Gewicht, Druckfestigkeit und Biegsamkeit, da die Sekundärwände grösstenteils zerstört sind. Durch die Einlagerung von Konservierungsmitteln kann die Stabilität aber erhöht werden. Die durch die verschiedenen Methoden bedingten grossen Farbunterschiede sind unwesentlich, da sie durch geeignete Oberflächenbehandlung ausgeglichen werden können.

RUDI WAGENFUHR, Forschungsinstitut für Holztechnologie, Zellescher Weg 24, Dresden, D.D.R. – **Influence of the anatomical structure on the technological properties of wood.**

BEN J.H. TER WELLE, Institute of Systematic Botany, Transitorium II, Utrecht, The Netherlands. – **Melastomataceae: Are they really uniform?** (based on research by J. Koek-Noorman, G.J.C.M. van Vliet, and B.J.H. ter Welle).

This very natural family comprises over 240 genera and about 4000 species. Melastomataceae are mainly tropical, being especially well represented in the New World, and include herbs, shrubs, trees, lianas and epiphytes. Based on morphological characters, a classification of 3 subfamilies is accepted by most plant taxonomists. These subfamilies are: Melastomatoideae (11), Astronioideae (2) and Memecyloideae (2). The number of tribes is given between brackets. Even without flowers or fruits the taxa are easy to recognize as representatives of the Melastomataceae by their peculiar leaf venation, the Memecyloideae excepted.

The wood anatomy of the Melastomatoideae and of some genera of the Astronioideae, representing over 95% of the number of genera of the family, is rather uniform. Characteristic are the narrow heterogeneous rays, commonly without procumbent cells, and the parenchyma or parenchyma-like structures, often as short wavy tangential bands and with conspicuous intercellular spaces. However, certain types of intervascular pits, ray-composition, parenchyma distribution and crystals are sometimes restricted to systematic units like genera or tribes.

A small group of genera, viz. *Memecylon*, *Mouriri*, and *Kibessia* (including *Pternandra*), differs in so many xylem characters (fibres with bordered pits instead of simple pits, a F/V ratio of 2 to 3 instead of 1.2–1.6, presence of included phloem) from the other Melastomataceae examined, that a separation of this part of the family and a reinstalment of the Memecylaceae is proposed. The anatomical evidence will be discussed and finally a possible phylogenetic scheme will be presented.

M.T.M. WILLEMSE, Botanical Laboratory, Arboretumlaan 4, Wageningen, The Netherlands. – **Primary fluorescence of secondary xylem.**

WOOD ANATOMY NEWS

Request for information on Moraceae wood samples

Mr. S.M.C. Topper from Utrecht has this year embarked on a comprehensive study of wood and leaf anatomy of the Moraceae. This project will be carried out in close cooperation and under the supervision of Dr. J. Koek-Noorman and Dr. P. Baas. To complete his research materials all curators of wood collections are kindly requested to send lists of species and collecting data of wood specimens of Moraceae housed in their collections to Mr. Topper, Department of Systematic Wood Anatomy, Institute of Systematic Botany, Transitorium II, De Uithof, Utrecht, The Netherlands. From such lists (or xerox copies of catalogue cards) Mr. Topper could make a highly selective choice for specific requests of species or genera, at present underrepresented in his considerable research materials. Since the success of this project will largely depend on international collaboration of this type, the help of curators of wood collections will be much appreciated. Any costs in xerox copying can be refunded if so desired.

Request for wood samples

Miss D.M. Catling of the Metropolitan Police Forensic Science Laboratory, 109 Lambeth Road, London SE1 7LP, U.K., requests wood samples for sectioning of any species of *Aesculus* (especially *A. octandra* Marsh), *Betula, Liquidambar, Magnolia, Nyssa* and *Liriodendron tulipifera* L. The samples will be of great value in expanding the reference collection of slides for forensic work on woods used in chipboard and paper making. Duplicate slides will be sent in due course to those who provide Miss Catling with (some of) the above items.

Report from the IUFRO conference on Tropical Woods in the Philippines

This first IUFRO conference on Wood Quality and Utilization of tropical species was organized by Dr. Philip R. Larson of S5.01 (Wood Quality); Dr. W.E. Hillis, Dr. L. Youngs and Dr. Francisco N. Tamolang, Leaders and Deputy Leaders respectively of Project Group P5.01-00 under Division V. This four-day conference was held October 30–November 2, 1978 at the Forest Products Research and Industries Development Commission (FORPRIDECOM) and was hosted by the University of the Philippines, College of Forestry at Los Baños, College, Laguna.

About 70 delegates from 19 different countries representing all parts of the world listened to the keynote address by Dr. Segundo V. Roxas from the Ministry of Science on behalf of the National Science Development Board. This had been preceded by a colourful and musical opening ceremony.

One of the main objectives of the meeting was to bring together experts on tropical woods for discussions on wood quality, effective utilization, and conservation of forest resources. Participants had been provided the opportunity to promote the exchange of ideas, experience and technical information and to collate pertinent data and conclusions that could be useful for future research on wood and other forest products.

To project the need for efficient utilization and conservation of the world's forestry resources, the organizing committee had adopted as theme of the conference: 'Wood Quality and the Utilization of tropical species'. Based on this theme the meeting covered five related topics during the technical sessions, viz. (1) Anatomical characteristics and wood properties, (2) Wood quality problems associated with utilization, (3) Identifying wood properties required for processing and marketing, (4) Evaluating tropical species to meet wood quality requirements for processing and marketing, and (5) Improving wood quality and final recovery of tropical species by silviculture, forest operations and utilization practices.

More than 60 contributed papers were presented, of which the tenor varied from pure wood anatomy to wood technology, larded with views on requirements for end-use and realistic marketing aspects. The three days' discussions were lightened by a number of social hours and a day excursion in the beautiful surroundings of the conference locality.

As a result of papers presented and discussions held, the following recommendations were made:

1. Every effort should be made to increase research capability of organizations working in the area of wood quality as related to utilization of tropical species in areas of research that are most significant to advancing needs in the field.

2. There is a major need for a system of property assessment and end-use classification that can be used and integrated internationally. To assist in developing such a system and standards based upon it, there is an urgent need for classification of timber species into a small number of simply defined end-use groups, identification of those uses for which major demands exist or are likely to develop, and the most important properties required. IUFRO, working with FAO and national forest products research organizations could play a major coordinating role in this development.

3. In view of the increasing interest in the use of tropical woods for structural purposes, there is a need for increased international coordination in developing an approach to structural grading that can be used uniformly in various parts of the world. While IUFRO is not in a position to implement such a system, it could serve as a coordinator for various national and international grading organizations.

4. As a means of fascilitating the utilization of the hundreds of timber species that are not currently being used most effectively, there is an increasing need for interchange of information from: (a) research, (b) developments in conversion, and (c) quality control techniques. To this end, it is recommended that IUFRO provide coordination for regional cooperation for the dissemination of such information on timbers common to the region.

5. In view of the shortage of information on under-utilized timber species and the difficulties of species identification at point of processing and use, increased attention should be given in particular cases to determine uses, end-use requirements, and means of assessing individual pieces of wood against such requirements that are not strongly dependent on individual species characteristics. Systems of classification should be developed that are only minimally dependent on individual species.

6. It is recognized that for many uses, detailed knowledge of wood anatomy, wood quality and species characteristics is necessary and should be reported in ways that can be broadly and uniformly interpreted. To this end, strengthened efforts in wood anatomy and wood quality research and development of means to exchange such information amongst those involved in such research are encouraged.

7. Information is needed on the characteristics of tropical species that result in rejection, degrade or limitation of the usefulness of species. Such information could enable the discovery of ways to utilize certain of these for specific purposes, or the reduction and/or elimination of the causes of degrade.

The attending participants (including 8 IAWA members) are much indebted to Commissioner Dr. Tamolang for providing this means of contact and they will long remember their splendid stay characterized by a colourful and cheerful atmosphere on the shore of Laguna de Bay.

The post-conference field tour from November 3–6 was attended by 26 participants from 12 countries in Asia, America and Europe, and lead to Mindanao. In Davao City a number of sawmills and integrated industries were visited. The large number of questions raised by participants during and after each visit gave proof of keen and professional interest. The final trip to Mindanao in this tour was a visit to the biggest paper industry and integrated plant of the Philippines, at Bislig, including visits to the nursery, reafforestation projects and logging operations on this firm's concessions. Participants can look back upon a successful tour.

P.B. Laming

Proposals on wood terminology

A brief note 'Proposals on wood terminology' in IAWA Bulletin 1978/4: 80 proposed that this journal be the site of amended or new definitions of wood anatomical terms for a new edition of the 'Multilingual Glossary of Terms Used in Wood Anatomy', the current edition being of 1964 vintage. I wholeheartedly agree with this suggestion. However, since the note just cited presented as samples four terms which I amended in previous issues of IAWA Bulletin (Schmid, 1976, 1977), I would like to take this opportunity to correct the definitions of 'protoxylem' and 'metaxylem' as presented in the aforecited note to bring them in conformity with my original proposal (Schmid, 1977), namely:

Protoxylem – First-formed primary xylem; *in stems* usually with tracheary elements characterized by annular or helical (spiral) wall thickenings (patterns).

Metaxylem – Later-formed primary xylem; *in stems* usually with tracheary elements characterized by scalariform, scalariform-reticulate, or pitted wall thickenings (patterns).

The corrections are twofold. First, I believe that definitions of word pairs such as the above should have a parallel format. Secondly, and much more inportantly, the point I wished to make in my 1977 article is that 'in stems' must be added as a qualifier in mentioning the type of wall patterns since vascular bundles of reproductive structures typically have *only* annular or helical wall thickenings, whereas vascular cylinders of roots often have only scalariform-reticulate or pitted wall thickenings.

In my 1977 article I proposed several other redefinitions of commonly used terms, which I would formally like to list here:

Xylem lacuna – A space involving part or all of the xylem of a vascular bundle and resulting from the destruction of the tracheary elements during extension of the axis. 'Protoxylem lacuna' or 'protoxylary lacuna' are inaccurate designations unless developmental evidence is available. See also xylic-phloic lacuna.

Xylic-phloic lacuna – A space involving part or all of the vascular bundle and resulting from the destruction of the tracheary *and* phloic elements during extension of the axis. Also called vascular lacuna. See also xylem lacuna.

Vascular lacuna – See xylic-phloic lacuna.

Protoxylem lacuna – An often improper designation for xylem lacuna, which see. Also called protoxylary lacuna.

The format for cross references in the above definitions is based on the glossary in Esau's well-known textbook (Esau, 1977, and the 1960 first edition). This well thought out glossary could (should!) serve as the basis for revising terms for a new 'Multilingual Glossary of Terms Used in Wood Anatomy' since the terms in Esau's glossary are frequently based on developmental criteria. Although many wood anatomists are little concerned with developmental aspects, it is generally preferable, as elaborated earlier (Schmid, 1976, 1977), to involve whenever possible developmental criteria in defining terms. Otherwise, terms based mainly or exclusively on structural (so-called morphological) criteria may be ambiguous or even inaccurate (see especially the discussion in Schmid, 1977).

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Esau, K. 1977. Anatomy of seed plants. 2nd ed. New York, John Wiley & Sons. (First edition 1960).

Schmid, R. 1976. The elusive cambium – another terminological contribution. IAWA Bull. 1976/4: 51–59.

— 1977. Tracheary element secondary wall patterns and the definition of protoxylem and metaxylem. IAWA Bull. 1977/1: 7–9.

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Rudolf Schmid

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Financial Report 1978

Debit		Credit	
Balance 1977	Dfl. 8530.46	IAWA Bulletin	Dfl. 6785.76
Glossary and Directory sales	Dfl. 106.00	Index Xylariorum	Dfl. 905.30
Reprint sales	Dfl. 1374.00	Postage	Dfl. 31.00
Old Bulletin sales	Dfl. 95.00	Banking costs (extra)	Dfl. 46.35
Registration fees congress 1979	Dfl. 155.00	Balance	Dfl. 12290.66
Dues and subscriptions	Dfl. 9372.66		
Interest	Dfl. 425.95		
	Dfl. 20059.07		Dfl. 20059.07

Statement of account:
December 31, 1978. 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. 2335.66.
High interest savings account (No. 45.14.36.067): Dfl. 9955.00.

The financial report over 1978 shows a further increase of our funds, albeit a much smaller one than in 1977. In 1979 production costs of the IAWA Bulletin will rise substantially and ultimately expenditure will be higher than our income. Our savings of the present years will then be a welcome buffer to avoid a direct increase of Membership dues.

WOOD ANATOMY OF ARCHIDENDRON F. v. MUELLER, MIMOSOIDEAE, LEGUMINOSAE

by

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Abstract

A description is given of the wood structure of six *Archidendron* species. The wood structure is of an obviously advanced nature and by this does not support the theory of primitiveness of this pluricarpellate genus in an otherwise almost exclusively unicarpellate family.

Archidendron (Mimosoideae) is a genus that has aroused interest time and again, because it is rather exceptional in the Leguminosae in view of its pluricarpellate flowers. *Archidendron* occurs in New Guinea, the Moluccas, the Solomon Islands, the Philippine Islands and Queensland/Australia. The genus was described by F. von Mueller in 1865, revised by De Wit in 1942 and 1952; by Mohlenbrock in 1966 and in part by Verdcourt in 1977.

The etymological derivation of its name has been given both as 'chief of trees' and as 'primitive tree'. The first alternative could be correct, because the first described species is a beautiful tree (*Archidendron vaillantii* F.v.Muell.), but most of the later species are small inconspicuous trees. The second alternative seems more appropriate because of the supposed primitive nature of the flower within the family Leguminosae.

The number of ovaries was decisive in the separation of the genus from its closest ally, the genus *Pithecellobium*. The latter always has a single ovary, although Mohlenbrock (1963) refers to a *Pithecellobium* species as having one or two ovaries and specimens of *Archidendron* as having a single ovary. This caused Mohlenbrock (1966) to incorporate *Archidendron* as a section in *Pithecellobium*, as in his opinion the main discrepancy between the two allied genera was removed.

Verdcourt (1977), however, does not agree with Mohlenbrock and according to De Wit (1952) the pluricarpellate condition is occasionally found in all three subfamilies of the Leguminosae. It is to be hoped that the group of scientists (including a wood anatomist) now working on the *Pithecellobium* complex, will be able to clarify some of the many taxonomic problems concerning these genera.

As the structure of the wood of *Archidendron* has, to my knowledge, never been described before and because the structure of its wood may be especially of interest in a phylogenetic sense, a description is given here.

Material studied

Archidendron aruense (Warb.) De Wit: W. New Guinea, Van Royen 5074; *A. brevipes* (K.Schum.) De Wit: W. New Guinea, BW 2613 and BW 7620; *A. glabrum* (K.Schum.) Laut. & K.Schum.: New Guinea, NGF 11930; *A. lucyi* F.v.Muell.: W. New Guinea, BW 9258; *A. muricarpum* (Kosterm.) Verdc.: New Guinea, Normanby Isl., Womersley & Gray in NGF 8612 (Type); *A. ptenopum* Verdc.: Papua New Guinea, Gillison in NGF 25011 (Type). The material was obtained by courtesy of CSIRO, Melbourne and the Rijksherbarium at Leiden, The Netherlands.

Because the wood structure of all species is essentially the same, one general description suffices.

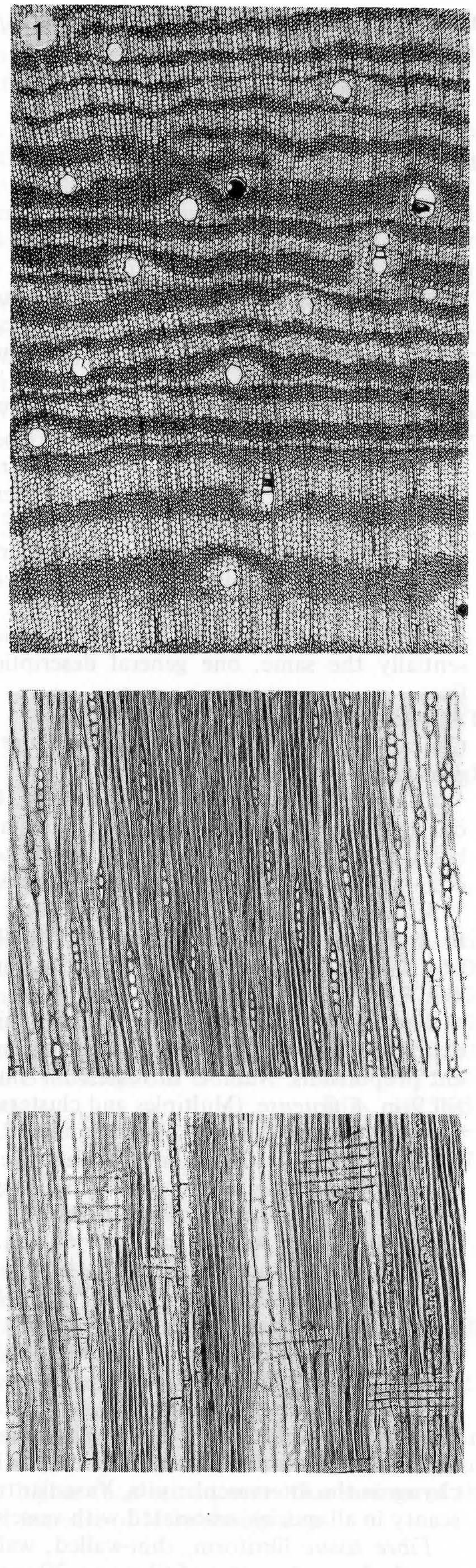
General description of the wood structure of the genus Archidendron

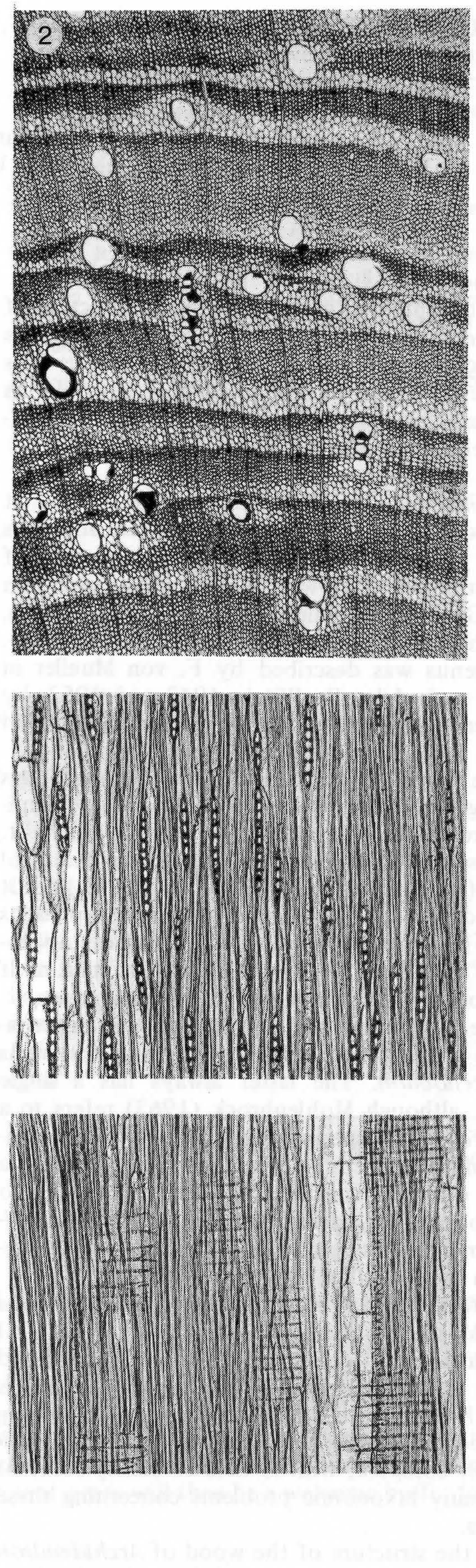
Colour. In all species, except *A. lucyi*, the colour is a pale yellow without a clear demarcation between sapwood and heartwood. In *A. lucyi* the colour is pinkish brown, more or less streaked.

Microscopical characters. Growth rings faintly to well demarcated by flattened crystalliferous fibres, in *A. ptenopum* also by banded parenchyma.

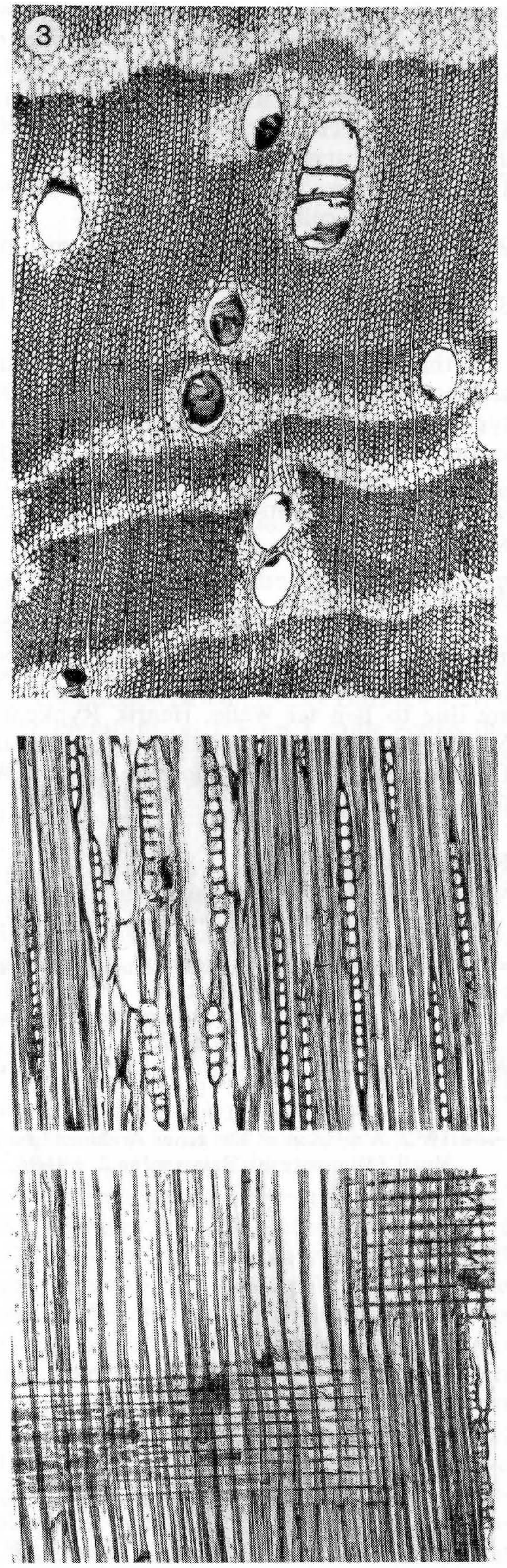
Vessels diffuse, solitary as well as in short radial multiples and in occasional clusters in different proportions. Number of vessels 1–7/mm^2, up till 9 in *A. aruense*. (Multiples and clusters always counted as one vessel.) Pores round, diameter ranging from 50–200 μm, with average values from 100–150 μm; an exception is *A. glabrum* which has considerably smaller vessels, ranging from 30–70 μm with a mean of 60 μm. Vessel member length ranges from 200–550 μm with average values from 340 till 450 μm; *A. lucyi* being above average with vessel members 450–750 μm with a mean of 575 μm. Perforations are always simple, mostly transverse or nearly so, but rather oblique perforations are also seen. Intervascular pits vestured, mostly about 6 μm, sometimes confluent. Pits to axial and radial parenchyma as the intervascular pits. Vascular tracheids scanty in all species, associated with vessels.

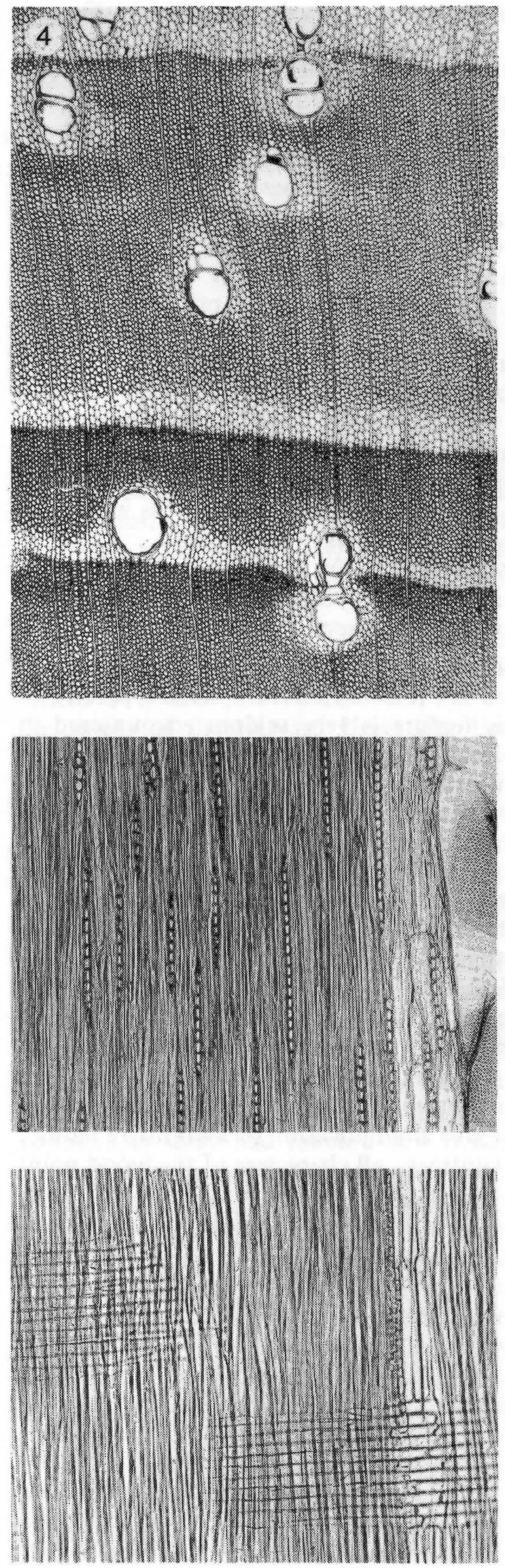
Fibre tissue libriform, thin-walled, wall thickness 2–3 μm, diameter of fibres ca. 20 μm. Small, simple, round to oval pits on radial walls mainly. *A. lucyi* is an exception in having slit-like pits with a vestigial border. Fibre length 750–1450





Figures from top to bottom: transv. x 40, tang. x 100, rad. x 100. — Fig. 1. *Archidendron glabrum* (K. Schum.) Laut. & K. Schum., NGF 11930. — Fig. 2. *Archidendron muricarpum* (Kosterm.) Verdc., NGF 8612, Holotype.





Figures from top to bottom: transv. x 40, tang. x 100, rad. x 100. — Fig. 3. *Archidendron lucyi* F. von Muell., BW 9258. — Fig. 4. *Archidendron ptenopum* Verdc., NGF 25011, Holotype.

μm, with average values of 1000–1100 μm, again *A. lucyi* being an exception with fibres up to 1600 μm and an average of 1300 μm. The fibre-vessel member length ratio is 2.2 in *A. lucyi* and *A. pternopum*; 2.3 in *A. muricarpum* ; 2.9 in *A. brevipes*; 3.0 in *A. glabrum*; 3.3 in *A. aruense*.

Rays uniseriate only, occasionally a few cells are doubled. Very low, from 2–18 cells high (40–300 μm), except in *A. lucyi*, where they are up to 550 μm. 6–10/mm, in *A. aruense* up till 12/mm. The rays consist of procumbent cells only.

Parenchyma abundantly present in all species investigated, in bands of 2–7 cells wide. Locally aliform and aliform to confluent. The banded parenchyma, however, is predominant. Parenchyma strands 2–4-celled; fusiform parenchyma present as well. The parenchyma cells are rather coarse, with a diameter of ca. 30 μm.

Crystals rhombic, in chambered fibres (up till 30 'chambers'), always present, mostly found on the boundaries between parenchyma and fibres.

The most striking feature of the structure of the wood is the conspicuously banded parenchyma. This feature is very seldom encountered in Mimosoideae, *Calliandra* and some *Acacia* species being the only other genera where it is found. For a mimosaceous genus, the parenchyma is very abundantly present. In most other genera it is vasicentric, aliform or aliform to confluent.

The rays are another striking feature in *Archidendron*: they are uniseriate, very low and rather widely spaced. This feature is shared with many *Pithecellobium s.l.* species. In my opinion this is an indication of the close relationship of *Archidendron* and *Pithecellobium*, as indeed is always stressed by taxonomists.

The structure of the wood of *Archidendron* does not give any indication of a primitive nature. On the contrary: all characters of the wood point to a high specialisation level. (No mention will be made of features of the wood of *Archidendron* that are common to all leguminous woods and that also indicate a high level of specialisation.) These high-specialisation characters of *Archidendron* are for instance:

1) the very low, uniseriate rays that consist of procumbent cells only;
2) the abundance of the axial parenchyma in wide bands;
3) the length of vessel members and fibres (short to of medium length).

Within the subfamily Mimosoideae, which in itself has a wood structure of a rather specialised type, *Archidendron* to my idea certainly is not among its least specialised members, but on the contrary among the most advanced ones according to the Baileyan concepts of evolution in xylem.

Acknowledgements

I am grateful for the provision with excellent and rare material by Mr. Ingle, CSIRO, Melbourne and by Dr. Baas, Rijksherbarium, Leiden. Thanks are due to Ben ter Welle, Henrik Rypkema and Mr. Kuiper for their technical assistance and to Dr. Mennega, Dr. Koek-Noorman and Dr. Westra for their discussions on the subject.

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Wit, H.C.D. de. 1942. Conspectus of the genus Archidendron F. von Mueller (Legum.). Bull. Bot. Gard. Buitenzorg ser. III, 17: 256–272.

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THE DISCOVERY OF TYLOSE FORMATION BY A VIENNESE LADY IN 1845

by

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Introduction

This fascinating detective story began a few years ago when I was working on a chapter entitled 'Dysfunction in the flow of food' for a five-volume treatise on plant pathology (Zimmermann & McDonough, 1978). Tyloses, occasionally regarded as causing interruption of water flow in the xylem, are more likely the result of cessation of water conduction (Klein, 1923). During a search for older literature on tyloses I came across the paper of Wieler (1888), and found in the same volume an article by Praël (1888). The latter contained a very peculiar paragraph. Freely translated, it reads as follows:

'Tyloses formation has been explained by an anonymous paper in 1845. His (correctly her) observations indicated that tyloses were outgrowths, through the pits, of neighboring wood parenchyma cells. This was generally accepted until it was questioned by Böhm who maintained that 'those peculiar structures are the result of accumulation of cytoplasm between the lamellae of the vessel wall, whose innermost layer grows into a tylosis.' However, Reess (1868) and Unger (1867) defended the earlier view successfully.'

The German grammar (here translated by 'his' and 'her') implies that the author was a lady. I immediately went to the library of the Harvard University Herbaria to look up Volume 3 of the 'Botanische Zeitung' where, indeed, I found an anonymous paper, published in two parts in two successive issues. Interestingly, the wording 'von einem Ungenannten' (by an anonymous author) implies a male author. My fascination increased as I read the text: here was such a comprehensive description of tyloses, based on such careful observations that many later papers seemed redundant. Who was the author of this? After a long search I finally came across the answer in the 'Physiological Plant Anatomy' of Haberlandt (1914) who begins his section on tyloses, 'These intrusive vesicles, the development of which was first studied and explained by Hermine von Reichenbach, are known as tyloses.' In the bibliography Haberlandt cites the paper under the name Reichenbach, followed by the words 'published anonymously'. So, the name was found, but two questions remained, (1) who was Hermine von Reichenbach, and (2) why did she publish anonymously?

Anyone interested in the history of botany will consult Julius Sachs (1875, 1890). But Sachs, it turned out, does not mention her. So, I went to the stacks of the Harvard University Herbarium Library, settled down in the history section and went through all likely books. There was a Heinrich Gottlieb Ludwig Reichenbach (1793–1879), Professor in Dresden, who published a 'Conspectus regni vegetabilis' in 1828 (Möbius, 1937). There was also a father and son, Gustav Reichenbach who published on phanerogams in 1820 (Jessen, 1864). I originally suspected that Hermine might be the daughter of one of these botanists. But then, finally, I discovered her real identity in Winckler (1854) who mentions 'Hermine, Baroness von Reichenbach of Vienna' who had published, also anonymously, on laticifers (Reichenbach, 1846). The story had taken a new twist: maybe her papers were published anonymously not because, as a woman, the author was not permitted to publish, but because as a baroness she might not have wanted to use her name. At this point, the sources of the Harvard University Herbarium Library were obviously exhausted and to make further progress, the search had to be continued in Vienna. Fortunately, the author has a good friend in Vienna whose help was successfully solicited.* Before we go further into this, let us have a look at Reichenbach's (1845) paper on tyloses, which has some surprises to offer.

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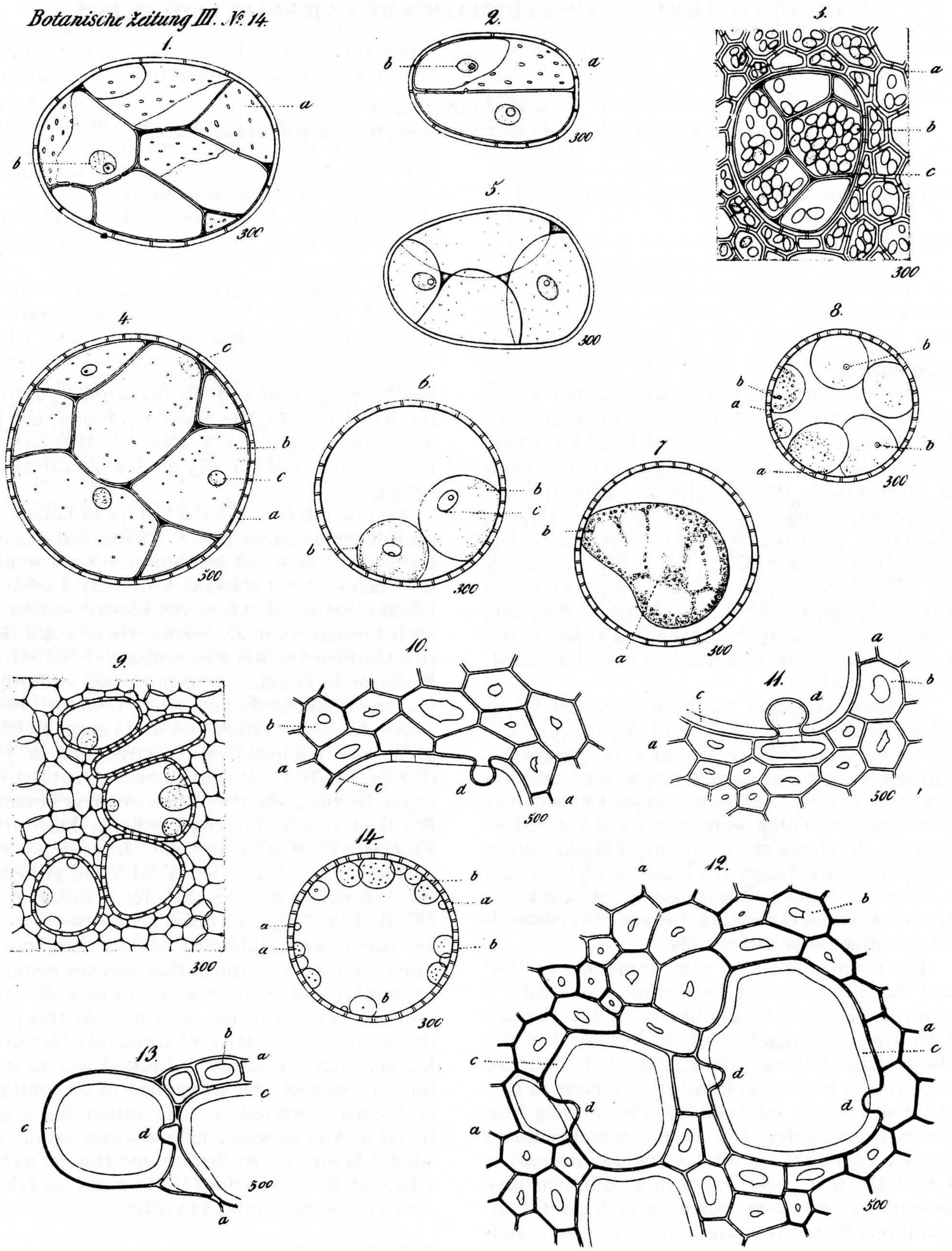
* Dr. Peter Ruckenbauer of the Institut für Pflanzenbau und Pflanzenzüchtung, Universität für Bodenkultur. The biographical material, given at the end of this paper, has been found by Drs. Birgit and Robert Kartusch of the Botany Department of the same university. In spite of considerable efforts on their part, no picture of Hermine von Reichenbach could be found. Their help is greatly appreciated.



Summary of Reichenbach's paper, *'Investigations on the cell-like structures that fill some vessels.'* (The original illustrations, reproduced here, are re-arranged to fit the IAWA Bulletin page size).

In many plants cell-like structures fill the lumen of vessels more or less as soon as these have reached a certain age. This phenomenon had been described earlier by Malpighi, Leeuwenhoek, Sprengel, Kieser and Mirbel. Meyen gave a historical survey of earlier reports and added his own observations. Many authors considered these vesicles to be separate entities, without contact with each other and with neighboring cells. Schleiden, Endlicher and Unger made little progress, the origin of these little 'bubbles' remained unknown. There follows a long list of plants, including several tropical and subtropical species, the vessels of which show the phenomenon. However, it has never been observed in the tracheids of conifers.

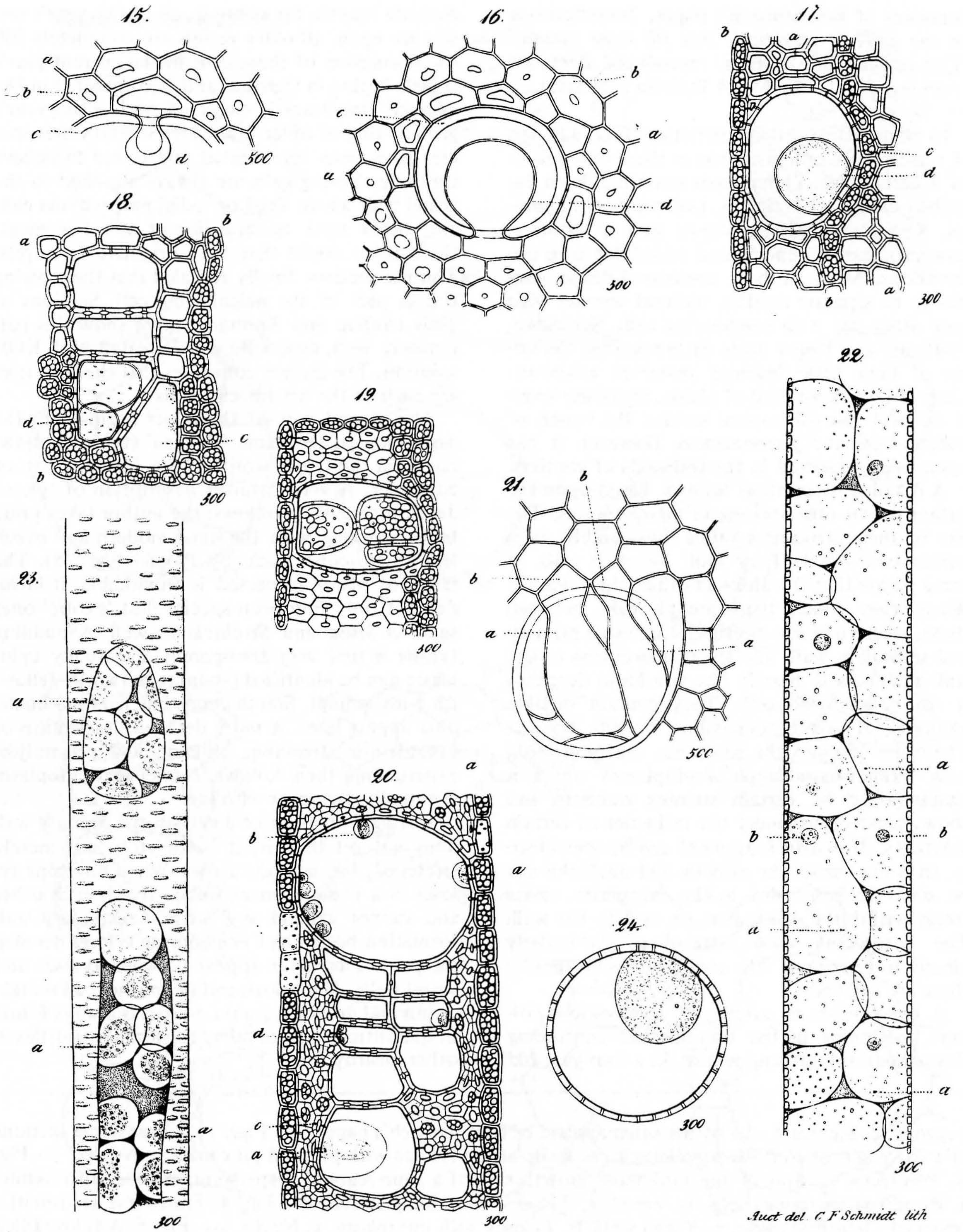
A detailed description follows, based upon the author's own observations in many species. The size of these structures varies considerably, even within one vessel. They look like real cells, in some plants they are thin-, in others thick-walled. Where they touch there are pit pairs between them, where one can clearly distinguish a primary and secondary wall. The slight unevenness of the wall thickness is exactly like von Mohl describes it for parenchyma cells. They contain variable amounts of starch, depending on the species. They also contain the substance that von Mohl calls 'Primordialschlauch' (cytoplasm) which is characterized by certain staining reactions and shows plasmolysis under the influence of certain solutions. Brownian movement can be seen clearly. In many plants the nucleus and nucleolus can be observed suspended in the cytoplasm, either freely within the cell lumen, or next to the wall. The cytoplasm shows streaming, particularly clearly in *Cucurbita*. The conclusion is inevitable: these are real cells.

A description of a series of observations follows, beginning in the summer and continuing throughout autumn and winter. In a four-year-old *Robinia* branch, for example, all of this year's vessels are open, all older vessels are completely filled. Formation of these cells in the current year's vessels begins in October and is completed in December. One-year-old twigs behave like this year's growth ring of older branches. Several other species have been investigated and found to behave similarly. Young cells are always attached to the vessel wall where axial or radial parenchyma cells are, never next to an adjacent vessel element; there is no doubt that they originate from pits. Thinner sections finally revealed that the growing cell is part of the neighboring cell. Sections of *Vitis vinifera* and *Sambucus nigra* show this particularly well, especially when treated with KOH solution. The author concludes that these vesicles are parts of the neighboring cells.

The second part of the paper begins with the suggestion of the name 'Thyllen' (tyloses), deriving from the Greek word ϑυλλις, meaning bag, or container. A very detailed description of tyloses development then follows; the author takes pride to be working with the most modern and excellent microscope made by Plössl (Fig. 25). The range of plants inspected is remarkable, it includes not only European species, but 'exotic' ones such as *Musa* and *Strelitzia* as well. A budding tylosis is first very transparent, eventually cytoplasm can be identified (staining brownish-yellowish with iodine). Starch grains, nucleus and nucleolus appear later. A more detailed description of cytoplasmic streaming, staining and plasmolysis experiments then follows. Nuclei and cytoplasm eventually disappear with age.

During formation of a tylosis, the primary wall does not get thinner, it is therefore not merely stretched, but actually grows. When different tyloses in a vessel element finally touch each other and cannot expand any further, secondary wall formation begins and neighboring tyloses develop pit pairs. Pits never appear between tyloses and vessel walls. The tylosis and its mother cell remain a unit and do not separate. Starch is always found in quantities corresponding to starch quantities in other, nearby tissue.

Legends to Figures 1–14 of the original plate of Reichenbach's paper. — Figs. 1, 2. Transverse sections of two vessels of *Robinia pseudacacia*. a. Walls of the tyloses with pits and pit canals. b. Nuclei. — Fig. 3. Transverse section of the innermost growth ring of a four-year-old grape stem, stained with iodine. a. Wood (parenchyma) cells. b. Vessel. c. Tyloses, containing starch. — Fig. 4. Transverse section of a vessel of *Cucurbita pepo*. a. Vessel wall. b. Tyloses with cytoplasm. c. Nuclei. — Fig. 5. A tylose-filled vessel of *Strelitzia reginae*. — Figs. 6, 7. Two vessels of *Cucurbita pepo*. b. Tyloses with cytoplasmic streaming. c. Nuclei. — Fig. 8. A vessel from the same plant with young tyloses. a. Cytoplasm (plasmolized). b. Nucleoli. — Fig. 9. Transverse section from *Cucumis sativus*. — Figs. 10, 11. Transverse sections of one-year-old shoots of *Vitis vinifera*. a. Primary cell walls. b. Secondary cell walls of wood parenchyma. c. Secondary vessel wall. d. Young tyloses with their respective mother cells. — Figs. 12, 13. Transverse sections of one-year-old shoots of *Sambucus nigra*, treated with KOH. Legend as in Fig. 10. — Fig. 14. Vessel of *Cucurbita pepo*. a. Very young, translucent tyloses. b. Somewhat older tyloses with granular content (cytoplasm).



The author concludes that tyloses develop when the vessels are air filled, they appear in the fall after cessation of water conduction. They remain in contact with their mother cells because they cannot get any water or nutrients from the vessels. A similar phenomenon, but unrelated, is that in some plants non-functional vessels are filled with gum ('körniger Schleim'), which oozes through the pits into vessels. When a gum deposit is followed along the vessel in serial sections, its origin can almost invariably be traced to a wound. Tyloses are produced by thin-walled parenchyma cells that have only primary and, at most, very little secondary wall. The mother cells are axial or radial parenchyma. Tyloses are usually found in pitted vessel members, rarely in elements with ring- or spiral-shaped secondary wall.

The paper concludes with a description of the course of vascular bundles in the *Cucurbita* stem. General comments about the origin of plant cells then follow, the logic of which is somewhat difficult for us to follow today. It is obviously not easy for us 20th century biologists to judge these general remarks fairly, without studying the knowledge and philosophies of the time. Taking the paper for what it is, namely a description of the most careful and detailed original observations, the reader is left with the greatest admiration. Most impressive perhaps is the clear recognition that tyloses formation and gum production are the result (not the cause) of the cessation of water conduction (or of injury), an observation that only much later found firmer experimental support (e.g. Klein, 1923).

A brief biography of Hermine von Reichenbach

Hermine's father, Karl Ludwig (1788–1869), came from a middle-class family of surgeons, civil servants, etc. He was a very colorful personality. Right at the outset of writing about Hermine, one runs into the danger of having her overshadowed by her father, as it probably happened during her lifetime. Karl Ludwig studied the natural sciences and married Frederike Luise Erhard, the daughter of a wealthy Stuttgart book dealer. He traveled widely during his studies and did extensive work on charcoal manufacture whereby he isolated and described wood distillates, such as paraffin and creosote. His interests ranged very widely; he worked on steel production (e.g. the manufacture of railroad tracks), collected and studied meteorites and even tried to cultivate silk worms. The King of Württemberg made him a Baron in 1839. Later in his life he became quite interested in spiritualism and made considerable efforts to investigate and describe some of the obscure phenomena scientifically, thereby causing endless controversies.

Hermine was born on September 5, 1819, as the fourth child and second daughter of a family to which, three years later, a fifth child was added. Her mother died on May 11, 1835 when Hermine was fifteen. We have not been able to find out where she studied, but it is safe to assume that she was stimulated by her father's love for natural history. She was twenty years old when her father became a Baron, thus becoming a Baroness herself. She published her tylosis papers at the age of twenty-six, and her papers on laticifers at twenty-seven. On November 11, 1849, she married Karl Schuh. She seems to have discontinued her studies at this point, at least no further publications are known to us. Her husband died fourteen years later and she spent the rest of her life as a widow.

Two more entries in botanical journals have come to our attention. The first is a note in Bot. Z. 7: 104 (1849), where she is listed as one of eleven corresponding members admitted to the Royal Botanical Society of Regensburg during the years 1847 and 1848. In addition, seven regular members are listed. The second entry was found in Flora 61(4): 64 (1878), in 'Kurze Mittheilungen' (brief notes) prepared by M. Göppert of Breslau (now Wroclaw, Poland). The paragraph is entitled 'Honor to whom honor is due' and reveals the identity of the author of the articles on tylosis and laticifers. But Göppert knows neither if any further publications exist and if she continued her botanical studies at all. He appeals to his Viennese colleagues for further information. He praises her for having assembled a very rich herbarium collection and being very knowledgeable in systematic botany.

Legends to Figures 15–24 of the original plate of Reichenbach's paper. — Figs. 15, 16. Transverse sections from *Vitis vinifera*, treated with KOH. a. Primary cell walls. b. Secondary cell walls of wood parenchyma. c. Secondary vessel wall. d. Young tyloses with their respective mother cells. — Figs. 17, 18. Transverse sections of *Juglans regia*. a. Wood (parenchyma) cells. b. Ray parenchyma. c. Vessels. d. Tyloses. — Fig. 19. Transverse section from *Quercus robur*; tyloses containing starch. — Fig. 20. Transverse section of a one-year-old shoot of *Robinia pseudacacia* with young tyloses and (a) plasmolyzed cytoplasm. — Fig. 21. Transverse section of the stem of *Strelitzia reginae*. Vessel with spiral thickening, filled with tyloses. a. Tyloses, with their mother cells (b). — Figs. 22, 23. Two vessels of *Cucurbita pepo* in longitudinal section. a. Cytoplasm of the tyloses. b. Nuclei. Both are from a stem which had been fixed in alcohol (brandy!) for a longer period of time. — Fig. 24. Transverse section of a vessel of *Cucurbita pepo* with a tylosis and appearing nucleus.

The elusive question why she published her papers anonymously remained unanswered. The earlier suspicion that, as a baroness, she might not have wanted to use her name is almost certainly wrong, because her father published so many papers and books. A possible clue may be the one I found in a recent article about the history of the 'Allgemeine Forst- und Jagdzeitung' (published

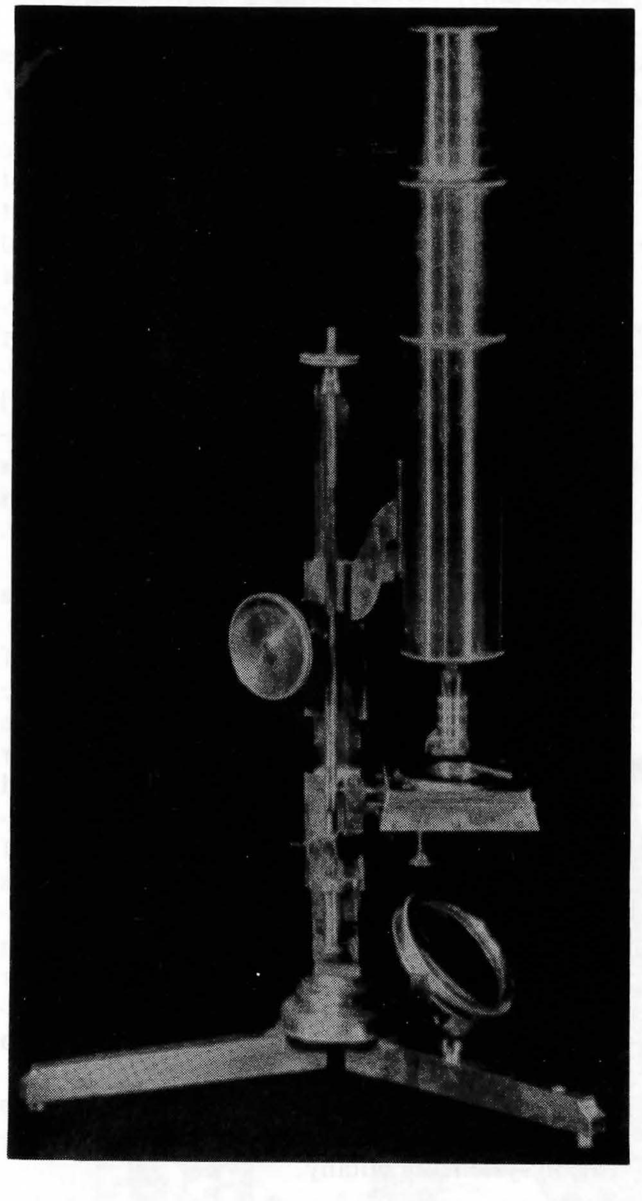


Fig. 25. A microscope by the Austrian maker Simon Plössl (1794–1868) in the collection of the Department of Plant Physiology, University of Vienna. An article describing the historical importance of Plössl has been published by Patzelt (1947).

by Sauerländer, Frankfurt am Main, Germany) which now celebrates its 150th year of existence (Hasel, 1979). It is a forestry journal, but botanists may remember that much of Theodor Hartig's work on forest botany was published there during the mid-19th century. Th. Hartig is, of course, best known for the discovery of the sieve tubes. Hasel (1979, page 2) makes the following statement about the early days (before 1850). 'As was customary at the time, authors remained often anonymous. Anonymousness was not even lifted in the case of controversy so that a quarrel had to be carried out against an unknown or suspected opponent. Only well-known authorities signed their articles.' (Free translation by this writer). This may be the very simple answer to our seemingly elusive question.

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A NOTE ON THE WOOD ANATOMY OF DILLENIA (DILLENIACEAE)

by

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Abstract

The wood anatomy of 31 species of *Dillenia* is described and discussed with reference to environmental factors. The number of bars on scalariform perforation plates appears to be lowest in species of seasonally dry habitats.

Introduction

Dillenia L. is a genus of approximately 65 species that ranges from Madagascar through SE. Asia and Malesia to N. Australia and Fiji (Hoogland, 1972). Although a few species are shrubby, these plants are mostly trees which bear large leaves and large flowers in few-flowered inflorescences. Most species occur in everwet forests, with several showing a pronounced preference to temporarily flooded situations. Some species, however, are more or less confined to savannahs whereas others typically grow in regions with a distinct dry period (Hoogland, 1952). Plants vary from evergreen to deciduous although this feature is not always correlated with habitat since some deciduous species are found in, or even confined to, everwet areas and some evergreen species extend into periodically dry regions. The genus occurs from sea level to an elevation of about 2000 meters.

Since my earlier detailed description of the secondary xylem of *Dillenia* (Dickison, 1967) a large number of additional collections and species have become available for study. The objectives of this study were to ascertain the extent of wood anatomical diversity within *Dillenia* and analyze the observed variability in relation to various environmental factors.

Materials and methods

Wood samples were obtained from xylaria throughout the world. A total of 71 samples representing 31 species were examined. Sections were cut on a sliding microtome and subsequently stained with safranin. Quantitative data were obtained from macerations prepared with Jeffrey's macerating fluid. For each sample 25 measurements or counts were made of vessel element length (tails included), fiber length, and scalariform perforation plate bar number. Cell diameters were measured from transverse sections. All specimens studied appeared to represent older wood.

Material studied (abbreviations of xylaria follow Stern, 1978): *D. aurea* Sm., Indonesia: Kools 32 (FHOw 18865); Malaya: For. Dept. 1619 (FHOw 9282), (KEPw 1619); Java: (SJRw 30030). *D. auriculata* Martelli, New Guinea: van Royen 5490 (Lw). *D. beccariana* Martelli, Borneo: Fuchs 21349 (Lw). *D. biflora* (A. Gray) Martelli ex Dur. & Jacks, Fiji: Smith 3471 (SJRw 28327), (SJRw 25674, SJRw 25835). *D. castaneifolia* (Miq.) Martelli ex Dur. & Jacks, New Guinea: BW 803 (Lw), BW 1583 (Lw), BW 9201 (Lw), BW 8138 (Lw), BW 600 (Lw), Hoogland 3273 (Lw). *D. cyclopensis* Hoogl., New Guinea: BW 5465 (Lw). *D. diantha* Hoogl., New Guinea: Jacobs 8008 (Lw). *D. excelsa* (Jack) Gilg, Sarawak: Carver 20 (FHOw 6655); Java: (SJRw 30025, SJRw 30026, SJRw 30027); Borneo: Fuchs 21265 (Lw); Sumatra: Krukoff 271 (USw 7127). *D. eximia* Miq., Malaya: (KEPw 7302, KEPw 6661). *D. grandifolia* Wall., Malaya: (KEPw 2311, KEPw 2558, KEPw 377). *D. indica* L., Java: (SJRw 30028); Malaya: (KEPw 5968). *D. ingens* Burtt, Bougainville: Waterhouse 25 (SJRw 21156), Schodde & Craven 4060 (Lw), Walker 146 (FHOw 17958). *D. megalantha* Merr., Philippines: For. Prod. Res. Inst. 901 (Lw). *D. montana* Diels, New Guinea: Hoogland & Pullen 6265 (Lw). *D. nalagi* Hoogl., New Guinea: Hoogland 3411 (Lw), Hoogland & Taylor 3438 (Lw). *D. ovata* Wall. ex Hook. f. & Thoms., Malaya: (KEPw 2706); Thailand: s.n. *D. papuana* Martelli, New Guinea: BW 11574 (Lw), BW 4414 (Lw), BW 6605 (Lw), BW 6921 (Lw), BW 10954 (Lw). *D. parviflora* Martelli, Burma: Groedel (USw 22928), For. Dept. 957 (FHOw 2027). *D. pentagyna* Roxb., Java: (SJRw 30032); Indonesia: Kools 33 (FHOw 18866). *D. philippinensis* Rolfe, Philippines: (USw 5213). *D. pulchella* (Jack) Gilg, Sarawak: Murthy S14508 (FHOw 19957); Malaya: (KEPw 3675, KEPw 6544), For. Dept. 181 (FHOw 7401). *D. quercifolia* (White & Francis ex Lane-Poole) Hoogl., New Britain: (USw 22228); New Guinea: Hoogland 3273 (Lw), Hoogland 3842 (Lw). *D. reticulata* King, Malaya: SING 21801 (FHOw 5564), For. Dept. 422 (FHOw 7602), (KEPw 7261, KEPw 5779). *D. retusa* Thunb., Ceylon: (SJRw 9781). *D. salomonensis* (White) Hoogl., Solomons: Walker 145 (FHOw 17957). *D. scabrella* (D. Don) Roxb. ex Wall., Burma: For. Dept. 607 (FHOw 1676). *D. schlechteri* Diels, New Guinea: Hoogland 4011 (Lw). *D. suffruticosa* (Griff.) Martelli, Singapore: Keng s.n. *D. sumatrana* Miq., Malaya: (KEPw 403, KEPw 382). *D. triquetra* (Rottb.) Gilg, Madagascar: (USw 27395); Ceylon: (SJRw 9807). *D. turbinata* Fin. & Gagnep., Hainan: (SJRw 29564), (USw 8597).

Observations and discussion (Figs. 1–4)

Habitat data and selected quantitative characteristics of the xylem of species studied are summarized in Table 1. All specimens examined fall within the range of variability described for the

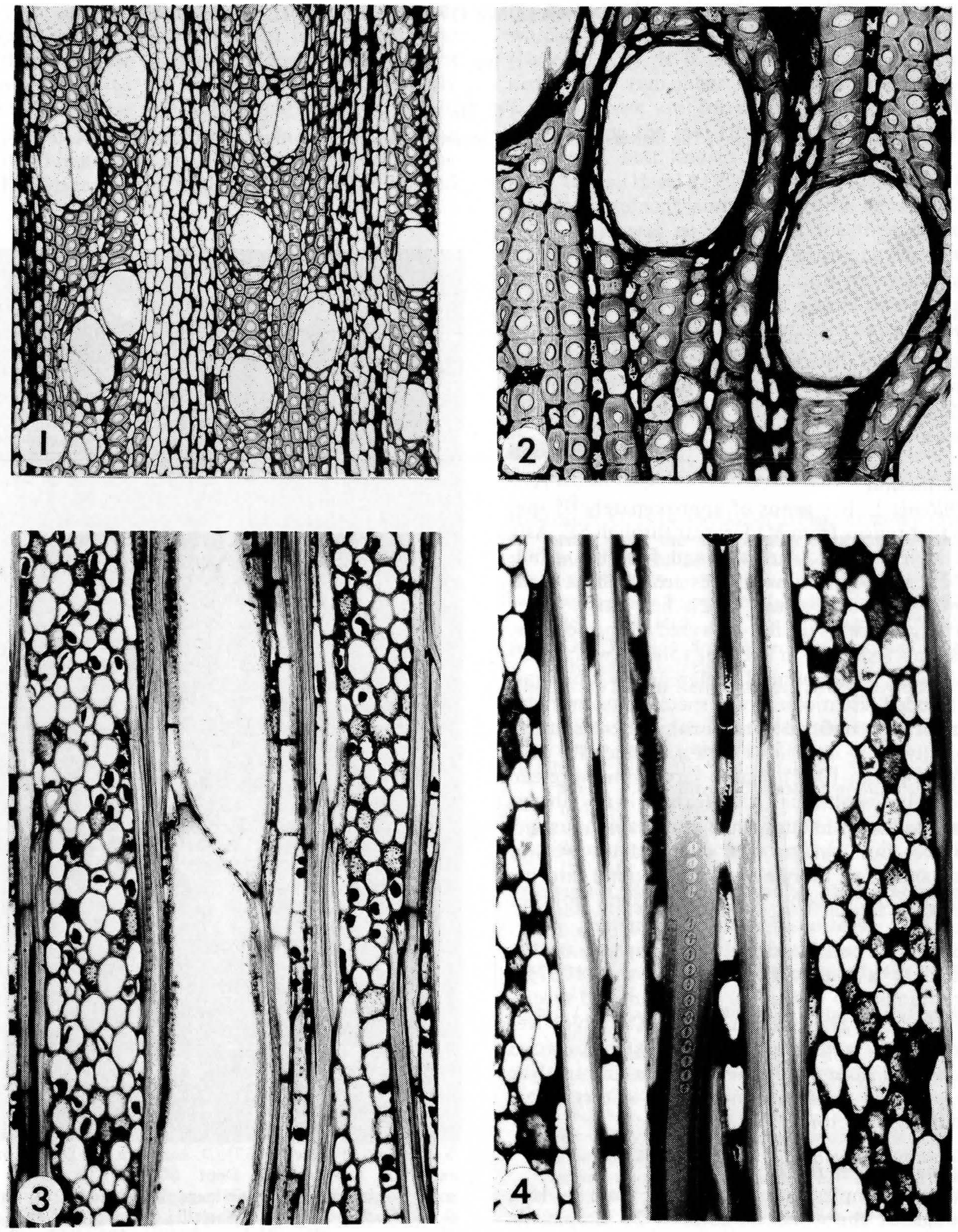

Fig. 1. *Dillenia ingens* Burtt (SJRw 21156), transverse section, showing solitary, overlapping vessel elements, x 55. — Fig. 2. *Dillenia papuana* Martelli (BW 11574), transverse section, showing distribution of axial parenchyma, x 130. — Fig. 3. *Dillenia pentagyna* Roxb. (SJRw 30032), tangential section, showing both multiseriate and uniseriate heterogeneous rays and a few-barred scalariform perforation plate, x 130. — Fig. 4. *Dillenia ingens* Burtt (SJRw 21156), tangential section, showing ray histology and fiber-tracheids, x 130.

Table 1. Habitat and wood characteristics of *Dillenia*

The number corresponding to character states are: 1. Plants evergreen (E) or deciduous (D). 2. Mean vessel diameter, μm. 3. Mean vessel element length, μm. 4. Bars per perforation, average. 5. Mean fiber length, μm.

Species	Habitat and Altitude*	1	2	3	4	5
aurea	seasonally dry forests	D	126	944	15	2151
auriculata	dense forests, riverbanks or ridges, low elevation	E	53	1263	77	2520
beccariana	low elevation forests	E	144	1842	47	2770
biflora	wet situations, up to 300 m	E	113	1530	30	2262
castaneifolia	dense forests, riversides, swamps, up to 200 m	E	177	1767	24	2387
cyclopensis	low elevation forests	E	132	1575	21	2232
diantha	forests, up to 400 m	E	113	1143	31	1596
excelsa	forests on dry to swampy soil, low elevation	E	158	1470	19	2524
eximia	primary and secondary forests, up to 300 m	D	176	1777	27	2312
grandifolia	lowland rainforest, up to 300 m	D	170	1741	28	2580
indica	moist forests	E	228	1504	32	2220
ingens	lowland rainforests, up to 150 m	E	115	1897	42	2865
megalantha	often on riverbanks, up to 1000 m	E	180	1722	31	2518
montana	forests between 1350–2000 m	E	141	1513	35	2489
nalagi	lowland rainforest	E	153	1479	29	2550
ovata	open forests, savannahs, up to 1500 m	E	192	1242	22	2226
papuana	primary forests, temporary flooded lands, also permanently dry situations, mostly at low elevations	E	259	2006	23	2797
parviflora	dry, open forests	D	180	1080	9	2272
pentagyna	open forests of savannahs	D	188	1017	9	2148
philippinensis	forests at low and medium elevations	E	154	1501	20	2665
pulchella	primary and secondary forests, wet, often peaty soil, low elevation	E	186	1486	20	2574
quercifolia	low elevation rainforests	E	158	1499	22	2667
reticulata	usually in swampy localities, up to 200 m	D	176	1696	21	2504
retusa	moist low country	E	142	1140	25	1737
salomonensis	lowland rainforest	E	143	1867	26	2708
scabrella	forests up to 1300 m	D	151	1363	8	2252
schlechteri	forests between 1300–1700 m	E	167	1963	21	3289
suffruticosa	wet lowlands	E	101	1566	28	2264
sumatrana	forests up to 500 m	E	128	1877	30	2659
triquetra	forests at low altitude	E	135	2105	43	3225
turbinata	forests between 500–1200 m	E	124	1529	25	2402

* from Hoogland (1952, 1959, 1972).

genus by Dickison (1967). Briefly, *Dillenia* woods are distinguished by almost exclusively solitary vessel elements that have scalariform perforation plates and small, sparse, predominantly opposite intervascular pitting. Pore number ranges between mostly 3–17 per mm^2. Imperforate tracheary elements are tracheids and fiber-tracheids with large bordered pits and thin to thick, mostly medium, walls. According to the criteria established by Metcalfe and Chalk (1950), pores have a medium diameter whereas both vessel elements and fibers are of long length. Rays are heterogeneous and of two sizes. Multiseriate rays are wide (up to 12 cells) and very long (up to and exceeding 8 mm) with prominent uniseriate wing extensions. The smallest multiseriate rays are present in *D. scabrella* (average 4 cells wide and 1 mm tall). Wood parenchyma is diffuse, diffuse-in-aggregates, and scanty. Raphides are numerous in the ray parenchyma.

Despite their apparent homogeneity, however, some interesting species specific variation is present. The one variable structural feature that is most conspicuous is the number of bars on scalariform perforation plates. Whereas the majority of species possess vessel elements with an average of 20 or more bars per perforation plate, *Dillenia parviflora, D. pentagyna,* and *D. scabrella* average less than 10 bars per plate with as few as 5 bars occasionally present. Although it may appear somewhat subtle, there is clearly a correlation between perforation plate bar number and habitat, since all species with reduced numbers of perforation plate bars occur in seasonally dry habitats.

Dillenia aurea, also from seasonally dry areas, shows a similar condition but to a lesser degree. A similar trend toward reduction in bar number in response to drier habitats is also present in the dilleniaceous genus *Hibbertia* (Dickison *et al.*, 1978). Although vessel elements from *Dillenia* species growing in drier regions tend on an average to be slightly shorter than other taxa, there is not a corresponding decrease in pore diameter or increase in pore number per unit area. The significance, if any, of the observed variation in pore diameter is unclear. Fiber length is relatively uniform in all species.

In his discussion of functional and adaptive aspects of vessel element morphology, Baas (1976) used *Dillenia* as an example of a genus in conflict with the adaptive hypothesis of Carlquist (1975), i.e., species from drier habitats possess vessel elements with predominantly simple perforation plates in response to adaptive selective pressures. Baas (loc. cit.) discussed several woody genera which both follow and deviate from this pattern with regard to perforation plate type. Although it is true that no species of *Dillenia* possesses simple perforation plates, the reduction in bar number within scalariform perforation plates in the drier habitat species is very apparent. The only species which is seemingly in contradiction to this trend is *D. ovata*, which grows in mixed evergreen, deciduous, or dry dipterocarp forests, or savannahs, but retains a higher bar number. It should be noted, however, that this is an evergreen species. Although all of the species with reduced bar numbers are deciduous, deciduous species (e.g., *D. grandifolia*) growing in wet conditions exhibit the same features as other dillenias from everwet habitats. The shrubby species *D. suffruticosa* did not deviate significantly anatomically from other plants.

No altitudinal differences of the type described for *Ilex* (Baas, 1974) have been observed. Hoogland (1952) found no satisfactory way of recognizing subgeneric groups within the genus and wood anatomy provides no clues in this regard.

Acknowledgement

I wish to thank Mr. Phillip M. Rury for his assistance in slide preparation.

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FIBRE CHARACTERISTICS OF SOME CUBAN HARDWOODS

by

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Abstract

Fibre length and fibre wall thickness of 7 Cuban hardwood species has been studied and is compared with that of 2 species grown in Hungary.

Seven species of Cuban woods from a wood collection donated to our institute by Miguel Vales from the Botanical Institute of the Cuban Academy of Sciences were studied for fibre characteristics considered of importance for industrial applicability.

The species studied are: *Bombacopsis cubensis* A. Robyns (Bombacaceae); *Garrya fadyenii* Hook. (Garryaceae or Cornaceae); *Ceratopyxis verbenacea* Hook. ex Hook. (Rubiaceae); *Magnolia cubensis* Urb. ssp. *cubensis* (Magnoliaceae); *Tabebuia lepidota* (Bignoniaceae); *Catalpa punctata* Griseb. ssp. *punctata* (Bignoniaceae); *Pera bumeliaefolia* Griseb. (Euphorbiaceae). For details on stature and habitat of these species see Babos & Vales (1977) and Knapp (1965). For comparison the same fibre characters were studied in two species grown in Hungary, viz. Austrian oak (*Quercus cerris* var. *cerris* Loud., Fagaceae) and giant poplar (*Populus* x *euramericana* (Dode) Guinier cv. *'robusta'*, Salicaceae); see also Babos, 1970 and 1974.

All measurements were carried out on toluidin blue stained macerated material. Mean values are based on 100 measurements each. The characteristics of fibre ends were also recorded.

Table 1. Fibre characteristics of 7 Cuban hardwoods and 2 woods grown in Hungary.

Species	Fibre length				Wall thickness	Lumen diameter	Fibre end
	Mean	S.D.	$S_{\bar{x}}$	C.V.			
Bombacopsis cubensis (Bombacaceae)	1779	210	25.9	1.5	4.5– 6.3– 8.1	6.3–19.8–33.3	Ending in a smooth peak
Garrya fadyenii (Garryaceae or Cornaceae)	1280	190	76.6	6.0	4.6	11.5–17.2–20.7	Ending in a smooth peak or with toothed margin, rarely bifurcating
Ceratopyxis verbenacea (Rubiaceae)	1091	160	67.9	6.2	3.6– 5.8– 8.1	10.8–17.6–24.3	Ending in a smooth peak, rarely bifurcating
Magnolia cubensis ssp. cubensis (Magnoliaceae)	1669	259	86.7	5.29	5.4–13.5–18.0	1.8– 3.7– 7.2	Ending in a smooth peak or with toothed margin, rarely bifurcating
Tabebuia lepidota (Bignoniaceae)	925	119	54.1	5.9	4.6– 7.1–11.5	2.3– 5.3–13.8	Ending in a smooth peak or with toothed margin
Catalpa punctata ssp. punctata (Bignoniaceae)	1047	167	76.6	7.3	4.6– 8.2–11.5	6.9–11.0–16.1	Ending in a smooth peak or with toothed margin
Pera bumeliaefolia (Euphorbiaceae)	1952	248	79.3	4.0	2.3– 5.7–13.8	4.6– 6.4– 9.2	Ending in a smooth peak or with toothed margin
Populus x euramericana cv. 'robusta' (Salicaceae)	1300	327	172.3	13.2	2.3– 4.0– 6.9	16.1–19.6–25.3	Ending in a smooth peak
Quercus cerris var. cerris (Fagaceae)	1318	151	89.3	6.7	9.2–11.3–13.8	2.3– 3.4– 6.9	Ending in a smooth peak, rarely bifurcating

Measurements in μm. S.D. = Standard Deviation; $S_{\bar{x}}$ = Standard Error of the mean; C.V. = Coefficient of variation.

The results are summarized in Table 1. It appears that the tropical species do not differ significantly from the two temperate species. It should be noted that all species studied only reach a maximum of 70 % with an average of 50 % of the values for tracheid length measured in pines. Felting is an important factor in the application of defiberized wood products, and it is strongly influenced by fibre length, wall thickness and fibre end morphology of the species. In this respect pine tracheids have the most advantageous properties. It is hoped that the fibre data recorded here may contribute to the understanding of the possible applications of the Cuban species involved.

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BOOK REVIEWS

Essences forestières du Zaïre. A. Pieters, 249 pp., 9 plates, 105 photographs. Onderzoekcentrum voor Bosbouw, Bosbedrijfsvoering en Bospolitiek, Faculty of Agriculture, State University Gent, Belgium, 1977.

The author, Prof. Pieters, has lived in Zaïre for several years and has thus felt the urgent need for a work on the forest tree species of the tropical rainforest zone of this country. He has now produced a book containing numerous field observations complemented with data from herbarium material and from literature. Although data on some of the species can also be found in the Flore d'Afrique Centrale and similar works, many species belong to families not yet treated in these floras. The book by Pieters is thus much more than a compilation.

In the introduction guidelines for botanical identification are given. The main part consists of accounts of 112 species, comprising commercial names (no vernacular names are given), data on habitat and habit of the tree (bole, bark, heartwood etc.), a detailed botanical description, macroscopic features of the wood and notes on its utilization, and the distribution in Zaïre (no wood anatomy).

In my opinion it would have been interesting to include data on distribution of the species outside Zaïre. The distribution data for Zaïre itself are sometimes incomplete. The book would also have gained in value if additional species had been included. For instance for *Entandophragma*, the rare species *E. palustre* is described but not the locally common *E. congoense* which is often confused with *E. cylindricum*.

The book is produced in offset which sometimes has resulted in greyish photoplates lacking in detail. The photographs are of the trunks of the trees and of leaves and fruits. The necessity of publishing at low cost with a decrease of printing quality is a common phenomenon. However, for a work of this kind it is a better solution than not to publish at all.

The author still has some copies which are available to IAWA members on request. If the reception of the book is good, the University of Gent would be prepared to produce a second printing to be sold at a very low price. This should be welcomed, I think. Let us hope that this volume will be complemented with another including species not yet treated.

R. Dechamps

Wood – Structure and Identification. H.A. Core, W.A. Côté & A.C. Day, 2nd edition, xii, 182 pp., numerous illus. Syracuse Wood Science Series 6 (ed. W.A. Côté), Syracuse University Press, 1979. Price: $11.95 (paper).

Clad in an even nicer cover than the first, successful edition, this new version of Wood – Structure and Identification contains a number of significant improvements and additions. It is gratifying that all desiderata mentioned in a review of the first edition (IAWA Bull. 1977/3: 60–61) have been met with. Apart from some corrections there are two major additions, viz. the collection of excellent low power incident light micrographs of all 76 woods dealt with in the keys, and an indexed glossary of terms. This will certainly help students to interpret the micrographs of individual features and to use the keys.

The definition of wood anatomical terms is notoriously difficult, but the authors have usually succeeded in doing so adequately. Just to show that perfection is hard to achieve, the definition of a tracheid as 'a *specialized* fiber having conspicuous bordered pitting and with a definite secondary wall' may be cited as sounding rather unfortunate to the phylogenetically inclined wood anatomist.

It is a good omen for wood anatomy that books of this kind sell out at such a fast rate. The low price cannot be prohibitive to use it for courses at various levels.

Pieter Baas

Tropical Trees as Living Systems. P.B. Tomlinson & M.H. Zimmermann (eds.), xviii, 675 pp., many illus. Cambridge University Press, Cambridge, London, New York, Melbourne, 1978. Price: £27.50.

This volume contains the full proceedings of a symposium held at Harvard Forest in 1976. Twenty-seven papers on a wide diversity of topics related to tropical trees and forests (sometimes also with a glimpse of their temperate counterparts) are arranged under six main themes: 1. Origins and Variation; 2. Reproduction and Demography; 3. Architecture and Construction; 4. Roots, Leaves and Abscission; 5. Organizational Control; 6. Community Interactions. Each paper is followed by a verbatim report of the discussions held during the symposium, which adds to the scientific value of this extremely well edited volume. It would be impossible for any single reviewer to give a critical commentary of each individual paper and this would also be rather out of place in our specialized Bulletin.

Students of angiosperm evolution may be interested in Doyle's paper, which reckons that the early angiosperms were pioneer shrubs of disturbed or semiarid environments and later radiated into aquatic and other herbaceous niches in one direction and through early successional tree stages into the canopy of climax forests in the other. This, perhaps somewhat controversial, hypothesis may have interesting implications for the views on ecological strategies in xylem evolution as advocated by Carlquist in his 1975 book and in many other publications. The paper by Zimmermann on structural requirements for optimal water conduction in tree stems also contains a wealth of information and ideas to be assimilated by all wood anatomists who indulge in functional considerations from time to time. Especially his idea that scalariform perforations may be functional in cool temperate to arctic woods for trapping air bubbles which arise after the frozen xylem sap melts, is attractive because it is in agreement with the common occurrence of this primitive vessel character in high montane tropical areas and cool temperate to arctic floras.

Singling out these two papers for review does not imply that the others are less relevant. Libraries of botanical institutions and forestry and forest products establishments are well-advised to include this book in their collection.

Pieter Baas

Photomicrographs of World Woods. Anne Miles, 233 pp. including 1353 photomicrographs. Department of the Environment, Building Research Establishment, London: Her Majesty's Stationary Office, 1978. Price: £20.00.

This impressive collection of high-quality micrographs is a welcome companion to the widely used FPR Bulletins nos. 22 and 46 on the identification of softwoods and hardwoods by Philips (1948) and Brazier and Franklin (1961). Transverse, tangential and radial sections mostly at x 60, of 451 taxa are pictured. This will certainly facilitate identification for wood anatomists who lack the luxury of a well-stocked reference slide collection although the dangers of basing an identification on comparisons with photomicrographs alone are also recognized by the author of this atlas.

There are pros and cons for each editorial choice one has to make for a work of this kind: for instance the consistently maintained magnification of x 60 for the radial and tangential sections of hardwoods has the advantage of showing ray histology quite satisfactorily but leaves much to be desired about the distinctness of such important diagnostic features as vessel wall pitting and even type of vessel perforations. Fortunately the softwoods are provided with x 250 radial photomicrographs showing the cross-field pitting quite clearly.

Although it is quite legitimate to state that certain woods cannot be distinguished from each other, I object to the practice adopted here that for a given set of illustrations the legend gives a number of species names or simply genus name with the epitheton *spp.* without stating the actual species used for the illustrations. Similarly there seems little sense in giving a number of well labelled illustrations of several species of a genus together with an unnamed set (e.g. for the genus *Ulmus*).

The botanical nomenclature follows the British Standard of 1974 - and the author is therefore not to be blamed for not having assimilated all taxonomic changes of the last decades (e.g. by still recognizing *Pygeum* in the Rosaceae, which should be *Prunus* according to a widely accepted monograph of 1965).

These critical remarks should certainly not result in the impression that this atlas merits a negative review. As for the positive side, what else can one say than: well executed, extremely valuable because many of the woods treated were never pictured so well before, and a must for all institutes and individual wood anatomists engaged in identification or comparative wood anatomy.

Pieter Baas

IAWA BULLETIN

Contents

Front cover: Transverse section of *Lagerstroemia indica* L. (Lythraceae). The banded pattern in this and some other *Lagerstroemia* species is due to fibre dimorphism and not to parenchyma differentiation (cf. P. Baas & R.C.V.J. Zweypfenning: Wood anatomy of the Lythraceae: Acta Botanica Neerlandica 28 (2/3): 117–155. 1979).

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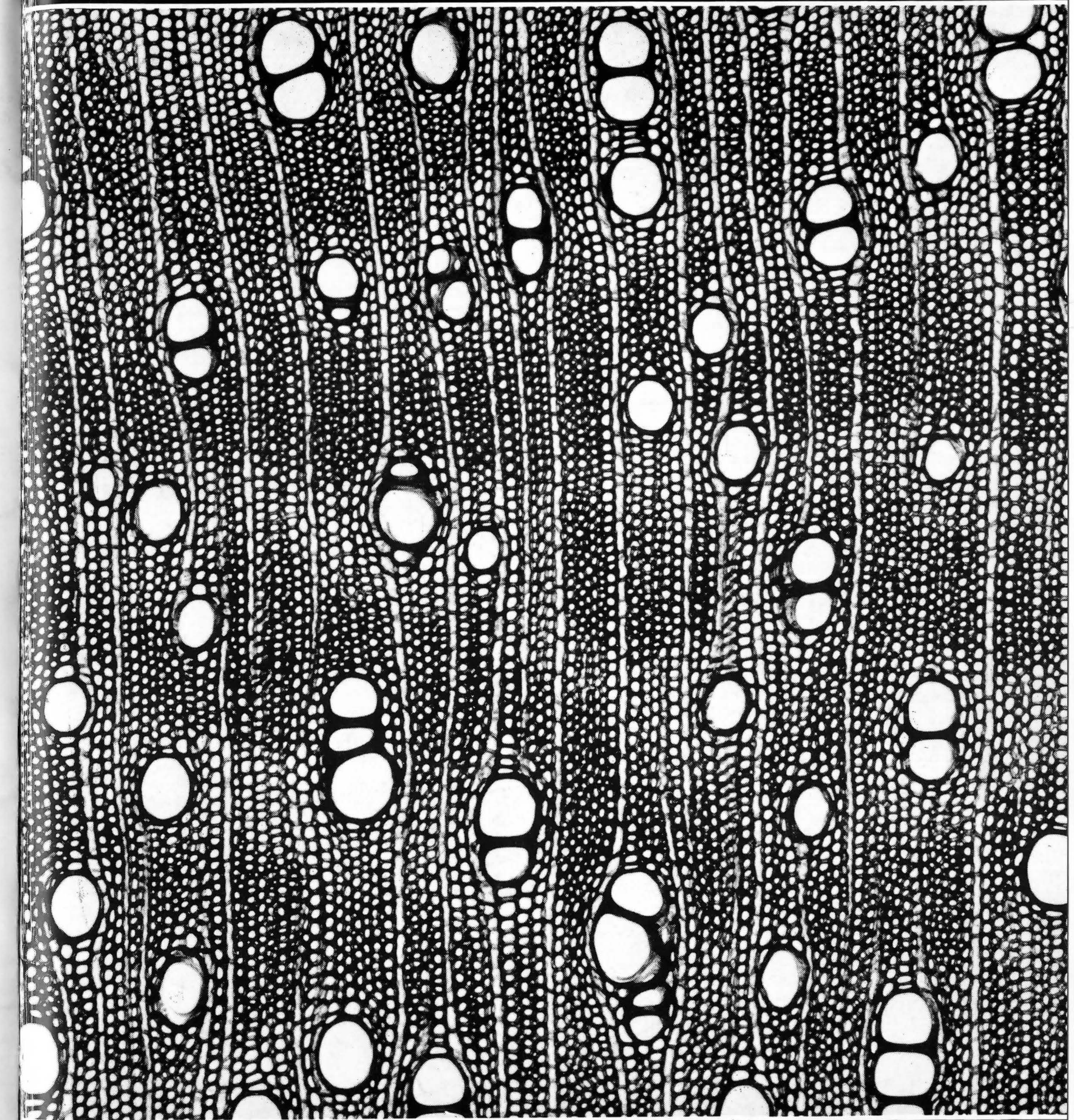

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