

# WOOD ANATOMY OF LYTHRACEAE—ADDITIONAL GENERA (*CAPURONIA*, *GALPINIA*, *HAITIA*, *ORIAS*, AND *PLEUROPHORA*)<sup>1,2</sup>

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## ABSTRACT

The wood anatomy of the lythraceous genera *Capuronia* (Madagascar), *Galpinia* (South Africa), *Haitia* (Hispaniola, Dominican Republic), *Orias* (= *Lagerstroemia excelsa* from China), and *Pleurophora* (South America) is described as an addendum to earlier studies on the wood anatomy of the family. *Capuronia* and *Galpinia* resemble each other and the genera *Pehria* and *Ginoria* very closely in their wood structure. The resemblance to the last two genera is contrasted by major differences in morphological features and may be due to parallel development. *Haitia* resembles *Lafoensia* and *Tetrataxis* in its wood anatomy, but also shows similarities with *Ginoria* p.p. The wood anatomy of *Orias* supports its modern treatment as *Lagerstroemia excelsa*, and shows much resemblance to that of *Lagerstroemia subcostata*. *Pleurophora* shows a striking wood anatomical similarity with *Heimia*, but taking into account characters from reproductive morphology, this similarity seems to be due to parallel evolution, despite the very different ecologies of the two taxa. *Pleurophora* may be more closely allied to *Woodfordia*, with which it also shares a number of wood anatomical characters. The likelihood of parallel development of chambered crystalliferous fibers and vascular tracheids in the evolution of the Lythraceae is discussed, and an earlier phylogenetic classification of the family based on wood anatomy is modified to a purely phenetic scheme, not necessarily indicating mutual affinities.

In an earlier study a broad survey of the wood anatomy of the Lythraceae was presented (Baas & Zweypfenning, 1979). Together with studies on the genera *Alzatea* (Baas, 1979), *Punica* (Bridgwater & Baas, 1978), and *Koehneria* (Graham et al., 1986), this left only the woody genera *Capuronia*, *Galpinia*, *Haitia*, *Orias* (now *Lagerstroemia*), and *Pleurophora* as taxa whose wood anatomy was unknown. Thanks to the help of Peter Raven (Missouri Botanical Garden) and several other botanists, vouchered wood samples have recently become available for study. This paper thus completes the wood anatomical survey of the family at the generic level. There is still scope for substantial extension of wood anatomical studies below the genus level, because many genera show an interesting wood anatomical range that can aid in arriving at more natural classifications. Four genera without truly woody representatives, viz. *Didiplis*, *Hionanthera*, *Pepilis*, and *Rotala* are of course beyond the scope of this study.

Methods employed are similar to those of the earlier studies and the descriptive style more or

less follows the same format, with the exception that for material from thin stems full quantitative characters are presented here. It should be stressed that these values can be taken only as a very rough indication of what the values in thicker stems might be. As is generally known, vessel diameter, vessel member length, fiber length, and ray width increase from the pith outward in juvenile wood, while vessel frequency decreases. Moreover, the rays in juvenile wood usually have a much higher proportion of strongly upright cells than mature wood.

All wood samples and slides studied are kept at the Rijksherbarium (L<sub>w</sub>). When known, the location of the herbarium vouchers is indicated under material studied using the abbreviations from Index Herbariorum.

## WOOD ANATOMICAL DESCRIPTIONS AND TAXONOMIC NOTES

### *CAPURONIA* LOURTEIG (FIGS. 1–3)

Material studied: *C. madagascariensis* Lourteig: Madagascar, *Dorr et al.* 4136 (twig of 6 mm

<sup>1</sup> The other genera were described in Baas and Zweypfenning (1979), Bridgwater and Baas (1978), and Graham et al. (1986).

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diam. with many indistinct growth increments, MO), *Léandri* 2669 (twig of 2.5 mm diam. with 7 growth increments, L), *Bernardi* 11425 (twig of 3.5 mm diam. with 5 growth increments, L).

Shrub in dry tropical forests, West Madagascar.

*Growth rings* faint to distinct. *Vessels* diffuse or wood weakly semi-ring-porous. Vessels ca. 200–300 per square mm, ca. 30% solitary, the remainder in radial (rarely oblique to tangential) multiples of 2–4(–6), sometimes including very narrow vessel elements, round to weakly angular, tangential diam. (20–)30–35(–45)  $\mu\text{m}$ , radial diam. up to 50  $\mu\text{m}$ , walls 2–6  $\mu\text{m}$  thick. Perforations simple in oblique end walls. Vessel member length (130–)210–240(–380)  $\mu\text{m}$ . Intervessel pits alternate, vestured, round to weakly polygonal, 4–6  $\mu\text{m}$ . Vessel-ray pits similar but half-bordered. Vessels occasionally with gummy contents. Spiral thickenings absent. *Fibers* thin- to medium thick-walled, or thick-walled and gelatinous, (220–)340–390(–560)  $\mu\text{m}$  long, with simple to minutely bordered pits mainly confined to the radial walls, septate, partly chambered crystalliferous, mostly with cytoplasmic contents. *Parenchyma* extremely scanty paratracheal, in 3–4-celled strands. *Rays* ca. 16 per mm, exclusively uniseriate, (1–)3–6(–20) cells high, composed of upright to weakly procumbent cells (juvenilistic to Kribs' heterogeneous type I). *Crystals* solitary prismatic, large and one per chamber in crystalliferous fibers, sometimes associated with a number of minute, irregularly shaped crystals. Silica bodies absent.

*Taxonomic note.* When Lourteig (1960) described the genus *Capuronia* she considered it close to the genus *Nesaea* of Koehne's subtribe Nesaeinae (1892). Other genera in this subtribe with woody species are *Adenaria*, *Crenea*, *Decodon*, *Ginoria*, *Heimia*, *Pehria*, and *Tetrataxis*. *Haitia* would also belong there (see below). In its wood anatomy *Capuronia* resembles *Galpinia*, *Ginoria*, and *Pehria* rather than *Nesaea*. The former genera as well as *Punica* (a putative Lythraceae or Punicaceae, cf. Bridgwater & Baas, 1978) share chambered crystalliferous fibers, a character that was considered to be strongly indicative of mutual affinity (Baas & Zweypfening, 1979). *Capuronia* and *Galpinia* share the presence of foliar nectaries but differ substantially in floral and pollen morphology (Graham, pers. comm.). Both Graham and Tobe (pers. comm.) consider *Ginoria*, *Pehria*, and *Punica* at

most distantly related to *Capuronia*. This might indicate that chambered crystalliferous fibers have evolved independently in at least two different groups of genera of the Lythraceae.

A wood anatomical comparison of *Capuronia* and *Galpinia* yields as the only relevant difference the exclusively uniseriate rays of the former and the uni- and biseriate rays in the latter. This is a very minor difference, especially because biseriate rays are quite rare in *Galpinia* and because the possibility cannot be excluded that *Capuronia* is capable of forming some biseriate rays in more mature wood.

#### GALPINIA N.E. BR. (FIGS. 4–6)

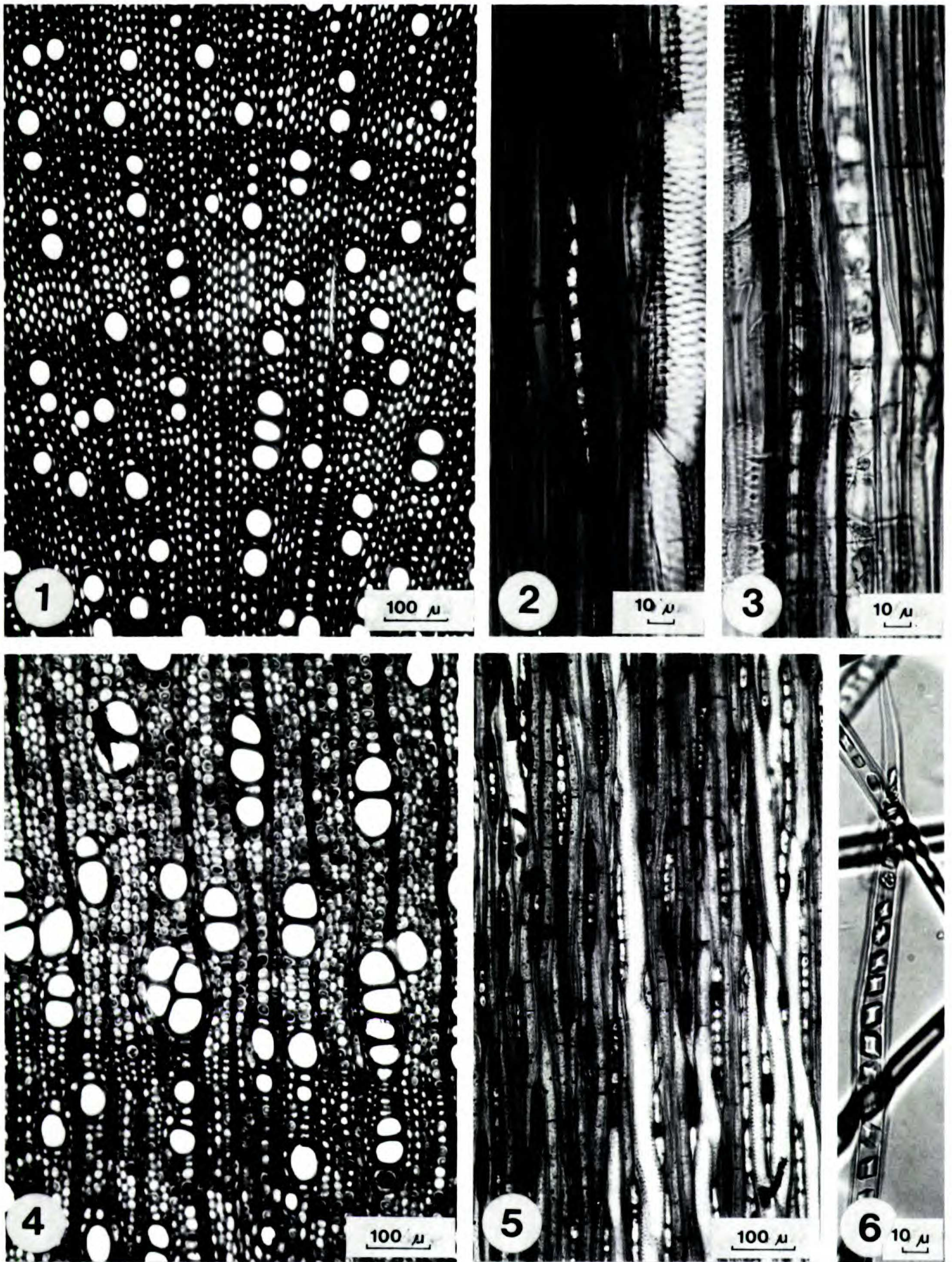
Material studied: *G. transvaalica* N. E. Br., South Africa, *Balsinhas* 3636 (stem of 3 cm diam., PRE).

Shrubs or small trees in rather open mountain vegetation.

*Growth rings* faint to distinct. Wood diffuse- to weakly semi-ring-porous. *Vessels* ca. 140 per square mm, ca. 20% solitary, remainder in radial multiples of 2–5(–10), occasionally in clusters including very narrow vessels, weakly angular, tangential diam. (20–)40(–60)  $\mu\text{m}$ , radial diam. up to 65  $\mu\text{m}$ , walls 2–4  $\mu\text{m}$  thick. Perforations simple in oblique to nearly horizontal end walls. Vessel member length (300–)390(–500)  $\mu\text{m}$ . Intervessel pits alternate, vestured, round to polygonal, 5–7  $\mu\text{m}$ . Vessel-ray pits similar but half-bordered. Some vessels with gummy contents. Spiral thickenings absent. *Fibers* thin- to medium thick-walled or thick-walled and gelatinous, (390–)580(–720)  $\mu\text{m}$  long, with simple pits mainly confined to the radial walls, septate, partly chambered crystalliferous; non-crystalliferous fibers rich in starch grains. *Parenchyma* extremely scanty paratracheal, in 2-celled strands, intergrading with wide, septate paratracheal fibers. *Rays* ca. 17 per mm, mainly uniseriate, partly with a low biseriate central part, (1–)2–8(–20) cells high, heterocellular, composed of upright and square to procumbent cells (Kribs' heterogeneous types I–II). *Crystals* solitary prismatic or irregularly shaped, one to several per chamber in crystalliferous fibers. Silica bodies absent.

*Taxonomic notes.* *Galpinia* was doubtfully placed in an alliance with *Diplusodon* and *Pemphis* (Diplusodontinae in Koehne's classification, 1892) by Brown (1894) when he described this monotypic genus from South Africa. Koehne





FIGURES 1-6.—1-3. *Capuronia madagascariensis*.—1. TS.—2. TLS, note septate fibers.—3. RLS, note chambered crystalliferous fibers.—4-6. *Galpinia transvaalica*.—4. TS.—5. TLS, note septate fibers.—6. Maceration, chambered crystalliferous fiber.



(1903) followed this suggestion but also commented on the resemblance in habit to *Lawsonia* and *Lagerstroemia*.

The main wood anatomical difference between *Galpinia* and *Diplusodon* lies in the nonseptate, noncrystalliferous fibers of *Diplusodon*. *Pemphis* is wood anatomically quite isolated within the family on account of its well developed vasicentric parenchyma (Baas & Zweypfenning, 1979) and differs in many other wood anatomical characters from *Galpinia*. In contrast, there are very close wood anatomical similarities between *Galpinia* and *Capuronia*, *Ginoria*, *Pehria*, and *Punica*. On the basis of morphological characters (Graham, pers. comm.) only a close affinity with *Capuronia* seems to be supported.

#### HAITIA URBAN (FIGS. 7, 8)

Material studied: *H. pulchra* Urban & Ekman, Haiti, *Zanoni et al.* 28433 (stems of 2, 3, and 4 mm diam., MO).

Shrubs of dry limestone terraces.

*Growth rings* faint to absent. *Vessels* diffuse, ca. 100 per square mm, 15% solitary, remainder in radial (to oblique) multiples of 2–4(–5), rounded to angular, tangential diam. (20–)40(–50)  $\mu\text{m}$ , radial diam. up to 60  $\mu\text{m}$ , walls 1.5–3  $\mu\text{m}$  thick. Perforations simple in oblique end walls. Vessel member length (300–)390(–500)  $\mu\text{m}$ . Intervessel pits alternate, vested, round to polygonal, 4–7  $\mu\text{m}$ . Vessel-ray pits similar but half-bordered. Spiral thickenings and vessel contents absent. *Fibers* thin- to medium thick-walled or thick-walled and gelatinous, (390–)580(–720)  $\mu\text{m}$  long, with simple pits mainly confined to the radial walls, septate. *Parenchyma* very scanty paratracheal, in 2–3-celled strands. *Rays* ca. 13 per mm, 1–2(–3)-seriate, (1–)2–12(–24) cells high, heterocellular with strongly upright marginal cells and (in case of taller rays only) square to procumbent central cells (Kribs' heterogeneous type I). *Crystals* and silica bodies absent.

*Taxonomic note.* *Haitia* was described by Urban (1919) as a relative of the genus *Ginoria*. Graham (pers. comm.) supports this affinity, but wood anatomically *Haitia* is closer to *Tetrataxis* and *Lafoensia* (cf. Baas & Zweypfenning, 1979). There is a perfect wood anatomical match especially with *Tetrataxis* from Mauritius. Interestingly enough, Koehne (1886) assumed phylogenetic links between *Tetrataxis* and *Ginoria* so that in an indirect way wood anatomy is not

entirely in conflict with a presumed affinity of *Haitia* with *Ginoria*. Graham and Lorence (1978) concluded, however, that the relationships of *Tetrataxis* to other members of the Lythraceae remains unknown, thus invalidating this argument.

The main difference between *Ginoria* and *Haitia* concerns the chambered crystalliferous fibers in the former, which are absent from *Haitia*. However, in the restricted material of *Ginoria*, we also encountered one specimen (of *G. americana*) that was devoid of crystalliferous fibers (Baas & Zweypfenning, 1979). Studies of more materials of *Ginoria* and *Haitia* might thus reveal a wood anatomical overlap between the two genera, since they are similar in most other wood anatomical features.

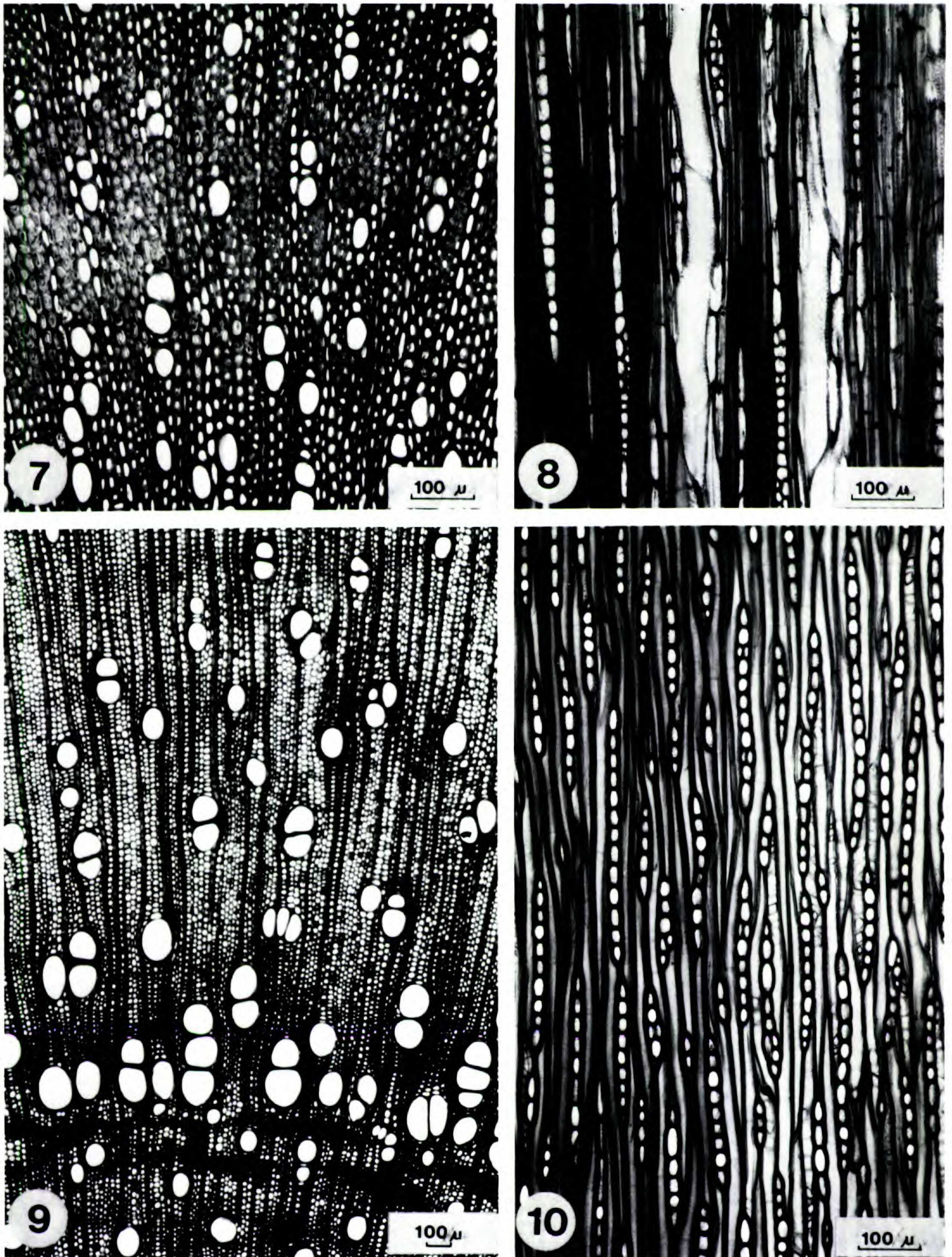
#### ORIAS DODE (FIGS. 9, 10)

Material studied: *Lagerstroemia excelsa* (Dode) Chun ex S. Lee & L. Lau (= *Orias excelsa* Dode), China, Sichuan, *Liu et al.* 5220 (stem of ca. 2 cm diam., MO).

Trees, in rainforests between 1,200 and 2,000 m.

*Growth rings* distinct. Wood semi-ring-porous. *Vessels* ca. 28 per square mm, 35% solitary, remainder in radial multiples of 2–3 or in small clusters, round to oval, tangential diameter (30–)75(–120)  $\mu\text{m}$ , radial diam. up to 160  $\mu\text{m}$ , walls 2–5  $\mu\text{m}$  thick. Perforations simple in horizontal to oblique end walls. Vessel member length (200–)300(–360)  $\mu\text{m}$ . Intervessel pits alternate, vested, round to polygonal, 6–8  $\mu\text{m}$ . Vessel-ray pits and vessel-parenchyma pits alternate to reticulate, with reduced borders to simple, infrequently unilaterally compound or elongate. Thick-walled tyloses present in some of the vessels. Vessel contents or spiral thickenings absent. *Fibers* of two types: 'normal' fibers with simple pits mainly confined to the radial walls, thin- to medium thick-walled, (280–)520(–740)  $\mu\text{m}$  long; and 'parenchyma-like' fibers, all thin-walled, 200–400  $\mu\text{m}$  long, and also with simple pits mainly in the radial walls, in poorly defined broad tangential, discontinuous bands, including some true parenchyma strands. Both types of fibers septate and partly chambered crystalliferous. *Parenchyma* scanty paratracheal and scattered between the 'parenchyma-like' fibers, in 2–5-celled strands. *Rays* ca. 16 per mm, almost exclusively uniseriate, rarely with a low biseriate portion, (1–)2–8(–20) cells high, weakly





FIGURES 7-10.—7, 8. *Haitia pulchra*.—7. TS.—8. TLS, note septate fibers and heterocellular rays.—9, 10. *Lagerstroemia excelsa*.—9. TS, note faintly expressed fiber dimorphism.—10. TLS, 'normal' fibers on the left and thin-walled 'parenchyma-like' fibers on the right (including some chambered crystalliferous fibers).



heterocellular with one row of square to weakly upright marginal cells or completely composed of procumbent cells (Kribs' heterogeneous type III to homogeneous). *Crystals* solitary prismatic, large and one per chamber or accompanied by smaller crystals of irregular shape, in crystalliferous fibers. Silica bodies absent.

*Taxonomic note.* *Lagerstroemia excelsa* was originally described as *Orias excelsa* by Dode (1909), who noted that it was close to *Lagerstroemia* and *Lawsonia* (subtribe Lagerstroemiinae). In the flora of China, *Orias* was reduced to *Lagerstroemia* by Lee and Lau (1983) and *L. yangii* was recognised as a synonym. Dode (1909) and Furtado and Srisuko (1969) stressed affinities of this species with *L. subcostata*.

Wood anatomically *L. excelsa* fits very well into the group of *Lagerstroemia* species with fiber dimorphism. This group also includes *L. subcostata*. The wood anatomical differences between *L. excelsa* and *L. subcostata* are very slight: in the limited material of the latter species studied only its diffuse-porosity and more prominently half-bordered vessel-ray pits contrast with the situation in *L. excelsa* (cf. Baas & Zweypfening, 1979). Other *Lagerstroemia* species with fiber dimorphism are *L. calyculata*, *L. floribunda*, *L. indica*, *L. loudonii*, and *L. tomentosa* and probably a number of other species that have hitherto never been described wood anatomically.

#### PLEUROPHORA DON

Material studied: *P. patagonica* Spegazzini, Argentina, *Grondona 23859* (stem of ca. 8 mm diam. with 14 annual rings, MO); *P. saccocarpa* Koehne, Argentina, *Schinini & M. Martinez Crovetto 22640* (stems of 3 and 5 mm diam., swollen stem base of 8 mm diam., root of 1.5 mm diam., MO).

Fruticose or herbaceous perennials or annuals of dry places.

In view of the substantial wood anatomical differences between the two species studied, separate descriptions are given for each.

#### *P. patagonica* (Figs. 11–13)

*Growth rings* distinct. Wood semi-ring-porous. *Vessels* ca. 250–500 per square mm, mainly in multiples (radial, oblique or tangential; the extent of the multiples is difficult to estimate due to intergradation of narrow vessels and vascular

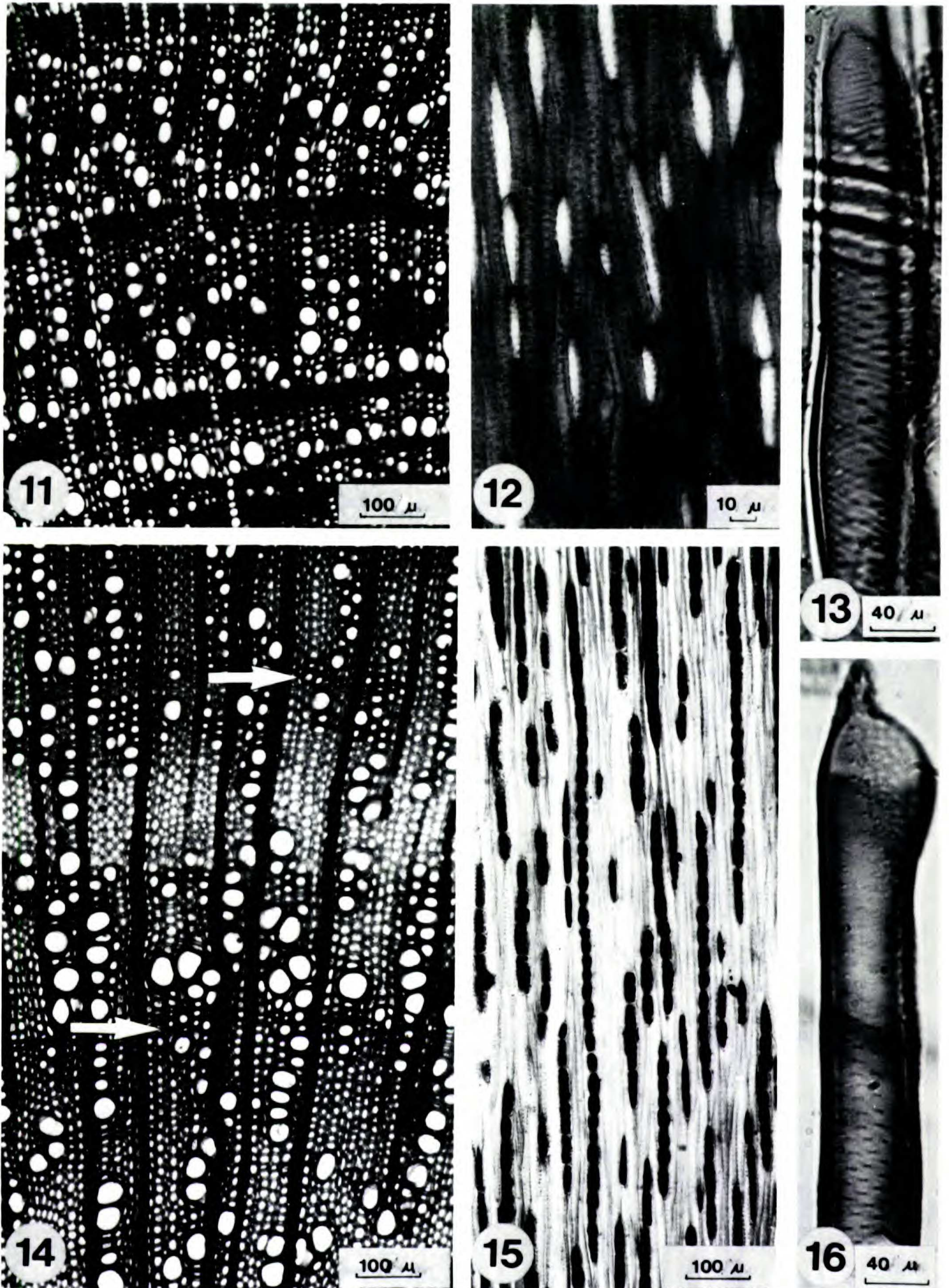
tracheids in the latewood), vessels rarely solitary, rounded to slightly angular, tangential diam. (10–)20(–30)  $\mu\text{m}$ , radial diam. up to 40  $\mu\text{m}$ , walls 2–3  $\mu\text{m}$  thick. Perforations simple in oblique end walls. Vessels of two types: 'normal' ones, and very narrow ones intergrading with vascular tracheids in the latewood. Length of 'normal' vessel members (150–)200(–250)  $\mu\text{m}$ ; of the very narrow vessel members and vascular tracheids (170–)215(–300)  $\mu\text{m}$ . Intervessel pits alternate, vestured, polygonal to rounded, 3–7  $\mu\text{m}$ . Vessel-ray pits similar but half-bordered. All vessels and vascular tracheids with closely spaced spiral thickenings. Some vessels with dark-staining gummy contents. *Vascular tracheids* (see above) forming the ground tissue in the latewood, thick-walled. *Fibers* thin- to medium thick-walled, forming ground tissue in the early and intermediate wood only, (210–)285(–360)  $\mu\text{m}$  long, with simple to minutely bordered pits mainly confined to the radial walls, nonseptate, mostly with cytoplasmic contents. *Parenchyma* virtually absent; only one 2-celled paratracheal strand noted. *Rays* ca. 12 per mm, exclusively uniseriate and very low, 1–8 (mostly only 1–2) cells high, entirely composed of upright cells. *Crystals* and silica bodies not observed.

#### *P. saccocarpa* (Figs. 14–16)

The various parts of stems and root do not differ substantially from each other; the description is based on the stem of 5 mm diameter.

*Growth rings* faint to distinct. Wood diffuse- to semi-ring-porous. *Vessels* ca. 400 per square mm, mainly in radial multiples of 2–6(–10), rarely solitary or in short oblique to tangential multiples, rounded to slightly angular, tangential diam. (10–)20(–40)  $\mu\text{m}$ , radial diam. up to 45  $\mu\text{m}$ , walls 1–4  $\mu\text{m}$  thick. Perforations simple in oblique to nearly horizontal end walls. Vessels of two types: 'normal' ones, and very narrow ones intergrading with vascular tracheids associated with vessel multiples and in zonate bands coinciding with growth ring boundaries. Length of 'normal' vessel members (150–)235(–350)  $\mu\text{m}$ , of the very narrow vessel members and vascular tracheids (180–)260(–360)  $\mu\text{m}$ . Intervessel pits alternate, vestured, round to polygonal, ca. 6  $\mu\text{m}$ . Vessel-ray pits similar but half-bordered. Spiral thickenings absent. Some vessels with dark-staining contents. *Vascular tracheids* (see above) forming ground tissue of narrow tangential bands associated with growth ring boundaries (but not





FIGURES 11-16. *Pleurophora*.—11-13. *P. patagonica*.—11. TS, note latewood zones of thick-walled tracheids.—12. TLS through latewood. Note low rays and tracheids with spiral wall thickenings.—13. Maceration, part of vessel element with spiral thickenings.—14-16. *P. saccocarpa*.—14. TS. Arrows indicate indistinct zones with tracheids.—15. TLS, note relatively tall rays.—16. Maceration, vessel element with smooth wall.



always identifiable as latewood), thick-walled. *Fibers* thin-walled or thick-walled and gelatinous, (240–)350(–480)  $\mu\text{m}$  long, with simple to minutely bordered pits mainly confined to the radial walls, mostly nonseptate, very rarely septate, often with cytoplasmic contents and starch grains. *Parenchyma* absent. *Rays* ca. 24 per mm, exclusively uniseriate, (1–)2–10(–25) cells high, largely composed of upright cells, but some with square to procumbent cells in part of the rays. *Crystals* and silica bodies not observed.

*Taxonomic note.* *Pleurophora saccocarpa* differs from *P. patagonica* in its lack of spiral vessel- and tracheid wall thickenings and its much greater ray height. *Pleurophora patagonica* is really very unusual in exhibiting such very low rays, so far found nowhere else in the Lythraceae. In other wood anatomical features the two species are quite similar. Their most striking feature is in the occurrence of bands of (vascular) tracheids.

Koehne (1892) incorporated *Pleurophora* in the Lythrinae, a subtribe in which some genera include woody species: *Ammannia*, *Cuphea*, *Lythrum*, and *Woodfordia*. Tobe (pers. comm.) considers *Pleurophora* close to *Cuphea* but the latter genus lacks tracheids in its wood. Wood anatomically *Pleurophora patagonica* is strikingly similar to *Heimia*, through the shared vascular tracheids in the latewood and the prominent spiral thickenings in both vascular tracheids and vessel members and similarities in all other wood features (cf. Baas & Zweypfenning, 1979; a mature wood sample of *Heimia myrtifolia* was also studied for the present comparison). *Pleurophora saccocarpa* is also quite similar to *Heimia*, but lacks spiral thickenings and has lower rays.

The only other genus in Lythraceae with numerous narrow vessels intergrading with vascular tracheids at growth ring boundaries is *Woodfordia*, a genus that in other wood anatomical characters is also similar to *Pleurophora*. Thus an affinity of *Pleurophora* to one of the members of the subtribe Lythrinae can be supported.

The similarities between the wood of *Heimia* and *Pleurophora* can be contrasted by numerous significant differences in floral and pollen morphology (Graham, pers. comm.; Koehne, 1903). Because of these differences a close mutual affinity seems unlikely and this makes it probable that the wood anatomical similarities are due to parallel evolution. This parallelism cannot be accounted for by similar selective pressure induced

by environmental factors on the hydrosystem: *Heimia* is a genus of shrubs occurring along river margins and in wet ditches; *Pleurophora* is a genus of herbaceous and fruticose annuals and perennials of dry places.

#### DISCUSSION

In an earlier paper a tentative phylogenetic classification of the Lythraceae was proposed based exclusively on wood anatomical diversity patterns (Baas & Zweypfenning, 1979). It would be quite easy to fit the genera described in this paper into this classification. However, assumptions on the monophyletic nature of chambered crystalliferous fibers and fiber-dimorphism, as well as classical transformation series for types of ray tissue according to Kribs (1935), played important roles in constructing this phylogenetic scheme. In the taxonomic notes for *Galpinia* and *Capuronia* it had to be concluded that on the totality of evidence from reproductive and vegetative morphology and wood anatomy, close affinities of these genera with *Pehria* and *Ginoria* are unlikely, which implies that their shared chambered crystalliferous fibers must have originated independently. The same conclusion probably applies to vascular tracheids in *Pleurophora*, which apparently arose independently from those in *Heimia*. Ray specialisation as already emphasised in the earlier paper (Baas & Zweypfenning, 1979) and later advocated in a more general context (Baas, 1982), is probably highly subject to parallelism and reversibility and cannot be used as an unambiguous criterion for determining advancement levels or mutual affinity. This is especially the case in the Lythraceae in which the wide range of habit categories (from annual herbs, via fruticose perennials to large trees) makes the developmental phase of the outer wood of a plant of small stature incomparable to that of a large tree. The distribution of septate and nonseptate fibers in *Cuphea* and *Pleurophora* (which both may or may not have septate fibers) also suggests parallel development or reversibility of these character states.

For the reasons outlined above, I refrain from using the data on *Capuronia*, *Galpinia*, *Haitia*, and *Pleurophora* for the elaboration of a phylogenetic classification of the Lythraceae. Instead the most important data on these genera are summarised together with those on other Lythraceae in a phenetic scheme (Fig. 17). Even as a phenetic scheme, Figure 17 cannot give an ideal picture



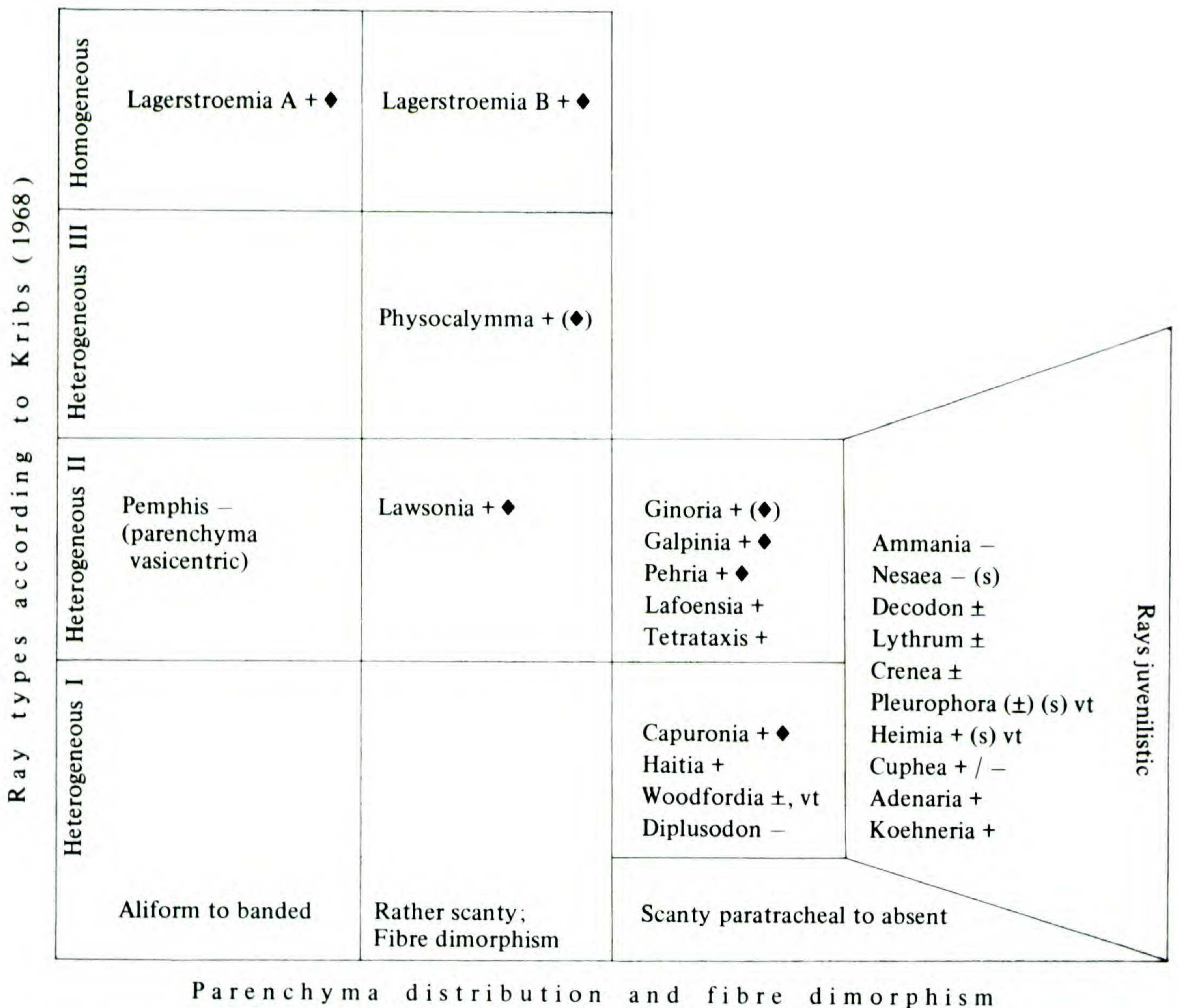


FIGURE 17. Grouping of Lythraceae genera on wood anatomical characters. Ray tissue characters (according to Kribs, 1935, 1968) on the vertical axis\*; parenchyma characters on the horizontal axis. The column of genera on the right has juvenilistic rays composed mainly or exclusively of upright cells. Other wood anatomical characters indicated in the diagram: ♦: chambered crystalliferous fibers; +, ± and (±): septate fibers abundant, infrequent and present in only part of the specimens respectively; –: all fibers nonseptate; s: spiral thickenings present on the vessel walls; vt: vascular tracheids common; ( ): feature only present in part of the species or specimens.

\* Within individual genera or even species or specimens two sequential ray tissue types may intergrade. In this diagram only the most frequently occurring type has been taken into account.

of the wood anatomical similarities and differences of some groups of genera. This is partly because of the limitations imposed by any two-dimensional diagram and because in the present scheme ray characters are given too much significance. Differences between two sequential ray types may be taxonomically very insignificant (cf. Baas & Zweypfenning, 1979) and yet they cause *Capuronia* to be in a different cluster of genera in Figure 17 from that of *Galpinia*, *Ginoria*, and *Pehria*, with which it has more in common than with *Haitia*, *Woodfordia*, and *Diplusodon*. Similarly, *Woodfordia*, although sim-

ilar to *Heimia* and *Pleurophora*, figures in a different column because of relatively minor differences in ray composition. Therefore Figure 17 should be interpreted with caution and be seen as only one possible way to present the wood anatomical variation in the Lythraceae in an orderly manner.

There is no reason to abandon our earlier views that within Lythraceae the combination of heterogeneous type I (sensu Kribs) rays, septate fibers, and scanty paratracheal parenchyma presents the plesiomorphic condition for the family. Specialisation in rays towards homogeneity in



the tree genera on the one hand and towards juvenility in small shrubs and fruticose perennials on the other hand, acquisition of vascular tracheids, spiral vessel wall thickenings, crystaliferous fibers, fiber dimorphism, and banded or vasicentric parenchyma, as well as loss of fiber septation in some taxa, all probably represent apomorphic character states. The likelihood that these apomorphic states evolved independently in some only remotely related Lythraceae became apparent in discussions with specialists of the family who are engaged in taxonomic and morphological studies of the family (S. A. Graham and Hiroshi Tobe). The problem at this stage is that we have no ways to identify in which combination of taxa the apomorphic state is monophyletic and in which it is not. It seems to me that further progress in interpreting the wood anatomical diversity in terms of character polarity and phylogenetic significance can be achieved only by extending our wood anatomical data base with many more species, and by active cooperation with taxonomists.

The extended generic survey of wood anatomy of the Lythraceae does not alter the wood anatomist's view of the position of the family within the order Myrtales (Van Vliet & Baas, 1984).

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