

THE WOOD STRUCTURE OF DICRANOSTYLES (CONVOLVULACEAE)*

ALBERTA M. W. MENNEGA

Botanisch Museum en Herbarium, Utrecht

SUMMARY

The anatomy of the mature wood of three species of the South American genus of woody climbers *Dicranostyles* Bth. is described and compared with that of the secondary wood of other genera of the *Convolvulaceae*. The stems are characterized by the occurrence of concentric rings of included phloem tissue. In most characters the three species are quite similar, except for the absence of rays over two cells wide in *D. guianensis*. Instead of these, aggregate rays occur at intervals between consecutive rings of included phloem. *D. mildbraediana* possesses fibre tracheids with next to the normal large bordered pits numerous very large irregular slits giving the impression of a helical sculpturing of the walls. From a comparison with other Convolvulaceous genera like *Bonamia*, *Ipomoea*, *Maripa*, *Neuropeltis*, and *Prevostea*¹ it appears that nearest to *Dicranostyles* in general appearance as well as in anatomical structure is the genus *Maripa*. The resemblance to *Ipomoea* seems only superficial. The relation between anatomical conformities of genera and their position in the various systems of subdivision of the family is discussed.

1. INTRODUCTION

In the course of a study of a collection of woody climbers gathered in Suriname by Dr. J. van Donselaar some difficulties arose over two stems with concentric bands of included phloem. Though the wood structure as seen with a hand lens was reminiscent of *Moutabea* and *Securidaca*, the sterile or, respectively, fruiting herbarium vouchers excluded Polygalaceous relationship. As described elsewhere (MENNEGA 1968) these herbarium specimens were eventually identified as species of *Dicranostyles*, a genus of *Convolvulaceae* hitherto unknown from Suriname. It turned out that the wood structure is in agreement with some other genera of this family.

2. LITERATURE

In his treatment of lianas with abnormal secondary growth PFEIFFER (1926) mentions 12 genera of *Convolvulaceae* with the concentric type of included phloem, in his terminology "corpus lignosum circumvallatum". *Dicranostyles* is not among these. Earlier SCHENK (1893) studied mature wood of lianas, chiefly from South Brazil. *Argyreia*, *Convolvulus*, *Ipomoea* and *Porana*, an

* Dedicated to Professor Dr. C. E. B. Bremekamp.

¹ Though *Prevostea* is a synonym of *Calycobolus* (HEINE 1963) the name *Prevostea* will still be used in the present paper to follow the current anatomical literature.

Asiatic taxon, are cited by him as genera in which successive bundles of interxylary phloem occur. On the basis of his own investigations he described and illustrated more fully *Ipomoea violacea* and *I. umbellata* (a synonym for *Merremia umbellata* (Mey) Hall.f.) and a sample of *Porana*. In both species of *Ipomoea* the 3 cm thick stems are deeply tri-sulcate. In the same year H. HALLIER (1893) published his extensive and very thorough studies of the *Convolvulaceae*, in which are included their anatomy, morphology, and pollen structure. His division of the family is based on the results of these ample investigations. Not having material at hand of larger-sized stems his remarks on the anatomy of *Dicranostyles*, and the closely related genus *Lysiostyles*, were bound to be rather scanty. He reported the occurrence of intraxylary phloem, a general feature of the subfamily *Convolvuleae*, the large size and the simple perforations of the vessels, and the presence of fibre-tracheids with large bordered pits. SOLEREDER (1899) based his account of this family chiefly on Hallier's paper, and in METCALFE & CHALK's *Anatomy of the Dicotyledons* (1950) it is stated that not much additional information on wood anatomy is available. Particularly for *Dicranostyles* the data are very scarce. Earlier CHALK & CHATTAWAY (1937) did not include the *Convolvulaceae* in their paper on woods with included phloem. More recently Miss OBATON (1960) published a study on the wood of lianas from West Africa with abnormal secondary growth. Three genera of *C.* are treated: *Bonamia*, *Neuropeltis* and *Prevostea*. In none of them the circummedullary type of included phloem occurs.

3. MATERIAL

The specimens of *Dicranostyles* and of some other species investigated for this study are listed below.

Name	Wood No.	Locality	Collector	Diam.
<i>Bonamia maripoides</i> Hall. f.	Uw 11753	Venezuela	Breteler 3747	1, 3, 3 × 5.5 cm
<i>Bonamia maripoides</i> Hall. f.	Uw 11761	Venezuela	Breteler 3761	3 cm
<i>Bonamia maripoides</i> Hall. f.	Uw 12126	Suriname	v. Donselaar 3510	1.8 cm
<i>Calycolobus</i> (<i>Prevostea</i>) spec.	Uw 9342	Cameroun	Breteler 1568	2.5 cm
<i>Calycolobus</i> spec.	Uw 9455	Cameroun	Breteler 2088	4 cm
<i>Calycolobus mortehanii</i> (de Wild.) Heine	Uw 9422	Cameroun	Breteler 1829	3.5 cm
<i>Dicranostyles guianensis</i> A. Mennega	Uw 11866	Suriname	v. Donselaar 2457	4 cm
<i>Dicranostyles mildbraediana</i> Pilger	Uw 14508	Peru	Tessmann 4069 (type, BFA 2744, Reinbek)	—
<i>Dicranostyles villosa</i> Ducke var. <i>lasiocalyx</i> A. Mennega	Uw 1874	Suriname	Lanjouw & Lindeman 2667	2 cm
<i>Ipomoea murucoides</i> R. et S.	Uw 14726	Mexico	Iltis, Koeppen, Iltis 816	15 cm
<i>Maripa</i> cf. <i>glabra</i> Choisy	Uw 12014	Suriname	v. Donselaar 3122	4.5 × 5 cm

WOOD STRUCTURE OF DICRANOSTYLES

Name	Wood No.	Locality	Collector	Diam.
<i>Maripa reticulata</i> Ducke	Uw 11880	Suriname	v. Donselaar 2792	4 × 6 cm
<i>Maripa scandens</i> Aubl.	Uw 2687	Brazil	Ducke 273 (Yale 32649)	—
<i>Maripa scandens</i> Aubl.	Uw 11882	Suriname	v. Donselaar 2806	3.5 cm
<i>Maripa violacea</i> (Aubl.) v. Ooststr.	Uw 2199	Suriname	BBS 15	3.5 cm
<i>Neuropeltis acuminata</i> Bth.	Uw 9336	Cameroon	Breteler 1547	3, 6.5 cm
<i>Neuropeltis acuminata</i> Bth.	Uw 9386	Cameroon	Breteler 1700	3.5 cm
<i>Neuropeltis velutina</i> Hall. f.	Uw 9344	Cameroon	Breteler 1577	3.5 cm

4. ANATOMY

4.1. The wood structure of *Dicranostyles*

In the following generic description the first-formed secondary xylem is left out of consideration, as in a ring of about 1–1.5 mm around the pith the structure of the wood is completely different from the parts formed afterwards.

Stems on cross section with a round outline, the pith often more or less ex-centric, clearly visible. The bark rather thin, patchy, yellowish brown, longitudinally superficially fissured. The wood yellowish brown, hard, characterized on cross section by large, mostly solitary vessels and by narrow concentric bands of included phloem, the bands slightly darker than or of the same colour as the wood.

Microscopic structure:

Vessels: Mostly solitary, few in tangential or radial pairs, scattered, on the average 3.5–5 (1–10) per sq. mm; round in cross section; diameter highly variable, from 50–360 μ , with a preponderance of 240–300 μ ; length of vessel elements between 300–650 μ ; perforations simple, horizontal in the wide vessels, slightly oblique in the narrow ones; wall 3–4 μ thick; intervascular pits alternate, rounded, the apertures extending to the borders 12–20 μ wide; thin-walled tyloses frequent (*figs. 1, 6*).

Tracheids: Usually present, not numerous, often with one-sided perforations; of the same length as the vessel members.

Fibre tissue: Composed of fibre tracheids with numerous large bordered pits with crossed apertures on radial and tangential walls; diameter from 20–36 μ , the walls 4–6 μ thick; on the average 1000 (650–1200) μ long in *D. mildbraediana* and *D. villosa*, 700 (500–1000) μ in *D. guianensis*; the ends of rather variable shape; the pits 8–9 μ wide in *D. guianensis*, and *D. villosa*, 16 μ in *D. mildbraediana*; in all species round apertures 6–12 μ wide may be present in variable numbers on the radial walls (*figs. 4, 6*). A peculiarity of *D. mildbraediana* are the numerous irregular slits in the walls giving the impression of helical sculpturing (*figs. 3, 4*).

Rays: Of two sizes and heterocellular. The uniseriats generally composed of square and upright cells, 1–15 cells high (up to 700 μ), 15–20 μ wide. The multi-

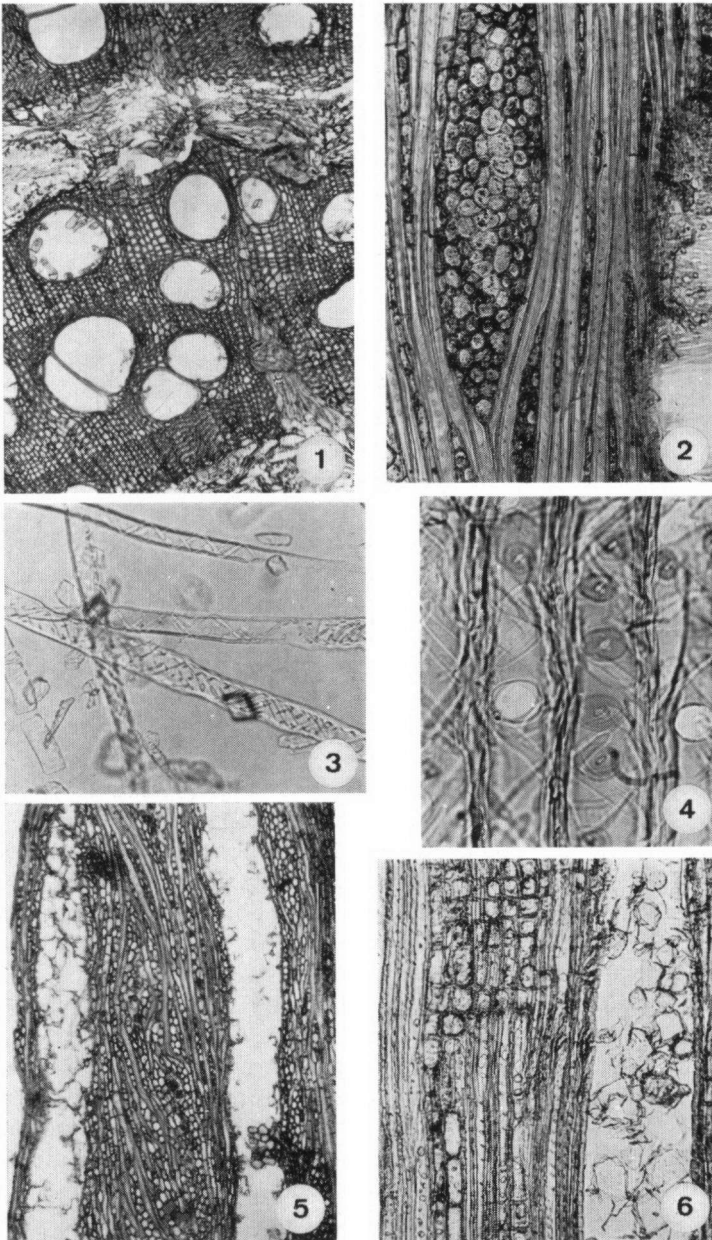


Fig. 1, 2. *Dicranostyles villosa* var. *lasiocalyx* (Uw 1874) transv. sect. 33 \times ; tang. sect. 80 \times .
 Fig. 3, 4. *D. mildbraediana* (Uw 14508) macerated fibres, 80 \times ; fibres, rad. sect. 325 \times .
 Fig. 5, 6. *D. guianensis* (Uw 11866) aggregate ray, tang. sect. 33 \times ; rad. sect. 80 \times .

seriates 2 cells wide in *D. guianensis*, 4–8 cells in *D. villosa*, and *D. mildbraediana* (figs. 2, 5), the uniseriate margins few to several cells high, most of the cells of the multiseriate parts square, height of the multiseriate part up to 55 cells (1750 μ). Pits to vessels large, roundish or ovate. Rhombic crystals present in the wide rays, particularly where those are in contact with the bands of included phloem, in these places ray cells often transformed into stone cells (fig. 1).

In *D. guianensis* instead of wide rays aggregate rays composed of rays and fibres, in the other species the wide rays often obliquely dissected by some fibres. Number 7–10 per mm, of which 0–2 wide or aggregate rays.

Parenchyma: Apotracheal and paratracheal; predominantly in very irregular short to rather long apotracheal bands of variable width, often on the adaxial side in contact with the vessels and sometimes in a narrow vasicentric ring; strands of 2–4 cells in *D. guianensis* and *D. villosa*, up to 8 cells in *D. mildbraediana*; the cells 20 μ wide tangentially, 60–80 (100) μ high.

Interxylary phloem: In concentric bands, the bands slightly undulating, and each band of variable width, on the average 500 μ wide (200–1000 μ); sometimes anastomosing or with dead ends, in places radially connected by strands composed of fibres, and multiseriate rays (fig. 1).

Sclerotic cells or groups of these cells often present in the connecting strands and on the abaxial sides of the phloem bands, here also rhombic crystals and in *D. mildbraediana* druses.

4.2. General remarks on the structure of the wood

As the species proved to be rather similar in their microscopic structure a generic description seemed adequate.

The most remarkable feature which distinguishes *D. mildbraediana* from the other species is the peculiar structure of the fibre walls (figs. 3, 4). Perhaps this is what HALLIER (p. 503) observed and described for the wood fibres of *Erycibe micrantha* and *Prevostea spectabilis* (a synonym of *Bonamia maripoides*) as holes and cavities in the fibre wall. (In material of the latter species studied by me such fibres were not observed). These fibre-tracheids resemble more or less the spiral cells of the parenchyma of *Ancistrocladus* as figured in GOTTWALD & PARAMESWARAN's paper (1968).

D. guianensis differs by the absence of wide rays.

Other peculiarities like the wide round pores in the radial walls of the fibre tracheids and the very large intervascular pits are as far as can be judged from a sketchy examination of material of other genera (see the next paragraph), of more general occurrence and rather characteristic for the *Convolvulaceae*.

4.3. Other genera

The woody genera represented in South America beside *Dicranostyles* are *Bonamia*, *Convolvulus*, *Exogonium*, *Ipomoea*, *Maripa*, *Merremia* and *Calycobolus* (syn. *Prevostea*). Material was available of *Bonamia maripoides*, *Ipomoea muruoides*, *Maripa* (four species). Of those species the material of *Maripa* showed the closest resemblance to the woods of *Dicranostyles* in general appearance as

well as in microscopic characters. The chief differences are the occurrence of thick instead of thin tyloses, and the lack of wide rays in *Maripa*.

Concentric rings of included phloem also occur in *Ipomoea*, as stated before, and this could be confirmed by a study of the wood of *I. murucoides*, a small tree. Here, however, the resemblance is more superficial. The widest vessels (160 μ) are arranged in a ring on the adaxial sides of the phloem bands, the intervascular pits are at most 15 μ wide; the fibre tissue is composed of extremely thin-walled short fibres with few bordered pits and more numerous simple pits on their radial walls; the ray tissue consists of 1-seriate and numerous 2-7-seriate rays; parenchyma is restricted to a few paratracheal cells; connective strands are absent. To what degree the arborescent habit of this species is of influence on the structure of the elements is difficult to assess. It would be interesting to investigate wood of climbing species for comparison. From the pertinent literature no detailed references on the microscopic structure are available.

In *Bonamia maripoides*, *Neuropeltis* (from Africa) and *Prevostea* spec. (Africa) the abnormality of the wood is different. In young stems of *Bonamia* and in *Neuropeltis* the phloem forms wedges in the woody cylinder, Pfeiffer's "corpus lignosum interruptum". In older, thick stems of *B. maripoides* the pattern of the wood and the included phloem becomes far more complicated and different from woods of *Neuropeltis*. Species of *Prevostea*, as described by Obaton and confirmed by material seen by myself, are characterized by stems with dispersed woody cylinders, Pfeiffer's "corpus lignosum diffractum". Here, too, the elements show the same characteristic features, like wide vessels, large intervascular pits, fibre-tracheids with large bordered pits and circular pores on their radial walls as seen in *Dicranostyles* and *Maripa*.

5. DISCUSSION

From the foregoing we may conclude that the wood of *Dicranostyles* is more similar to *Maripa* than to any of the other genera investigated. This is not in agreement with the taxonomic position of *Dicranostyles* according to Hallier's system. Here we find in the tribe *Dicranostyleae* the genera *Prevostea*, *Bonamia*, *Neuropeltis*, *Dicranostyles*, *Lysiostyles*, and 6 other genera, mostly herbs or small shrubs; but *Maripa* in the tribe *Erycibeae*. Both tribes belong to his subdivision *Psiloconiae*, characterized by smooth pollen whereas *Ipomoea* belongs to the *Echinoconiae* with spinulose pollen. Nearly the same subdivision of the family is accepted by VAN OOSTSTROOM (1953) in his revision of the Malesian taxa, except that *Dicranostylinae* are treated as a subtribe of *Convolvuleae* of the subfam. *Convolvuloideae*. PETER (1897) treated the family in 1891 for Engler & Prantl, but it did not appear in Vol. IV, 3a of that work until 1897. Here, too, *Dicranostyles* is placed in a tribe *Dicranostyleae* with the same genera as enumerated above, whereas *Maripa* is placed in the subtribe *Argyreinae* of the *Convolvuleae*, and *Ipomoea* in the subtribe *Convolvulinae*. In the 1964 edition of Engler's Syllabus the genus *Dicranostyles* is to be found under the tribe *Argyreieae*; *Prevostea* under the tribe *Poraneae*; *Bonamia* and *Ipomoea* in the *Con-*

volvuleae. (*Maripa* and *Neuropeltis* are not mentioned.) ROBERTY (1952) in his *Genera Convolvulacearum* recognizes a new subfamily *Argyreioideae* with 3 tribes. One of these is the tribe *Lysiostyleae* including the genera *Lysiostyles*, *Dicranostyles*, *Maripa* and *Mouroucoa*. The last-named genus consists of a number of species formerly included in *Maripa*. With regard to this last rearrangement no conclusion can be drawn from wood anatomy, but the grouping of *Dicranostyles* with *Maripa* in one tribe is supported by the results of this study.

From the brief investigations of woods of *Bonamia*, *Neuropeltis* and *Prevostea* (see also Obaton's paper) I would suggest that each of them is of a different structure. In Roberty's system *Bonamia* belongs in the subfamily *Convolvuloideae*, tribe *Cresseae*, but *Neuropeltis* and *Prevostea* in separate tribes of the *Poranoideae*.

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REFERENCES

- CHALK, L. & M. M. CHATTAWAY (1937): Identification of woods with included phloem. *Trop. Woods* no. 50: 1-31.
- GOTTWALD, H. & N. PARAMESWARAN (1968): Das sekundäre Xylem und die systematische Stellung der Ancistrocladaceae und Dioncophyllaceae. *Bot. Jb.* 88: 49-69.
- HALLIER, H. (1893): Versuch einer natürlichen Gliederung der Convolvulaceae auf morphologischer und anatomischer Grundlage. *Engler's Bot. Jhb.* 16: 453-591.
- HEINE, H. (1963): The genus *Calycobolus* Willd. ex Roem. & Schultes (Convolvulaceae) in Africa. *Kew Bull.* 16: 387-391.
- MENNEGA, A. M. W. (1968): On two new species and one new variety of *Dicranostyles* (Convolvulaceae) collected in the Guianas and Amazonia. *Proc. Kon. Ned. Akad. Wet. (Amsterdam) Ser. C*, 71: 550-557.
- METCALFE, C. R. & L. CHALK (1950): *Anatomy of the Dicotyledons*. Oxford.
- OBATON, M. (1960): *Les lianes ligneuses à structure anormale des forêts denses d'Afrique occidentale*. Thèse, Paris.
- OOSTSTROOM, S. J. VAN (1953): Convolvulaceae In *Flora Malesiana* Ser. 1, vol. 4: 388-513.
- PETER, A. (1897): Convolvulaceae. In ENGLER & PRANTL, *Die natürlichen Pflanzenfamilien*, IV, 3a: 1-40. Leipzig.
- PFEIFFER, H. (1926): Das abnorme Dickenwachstum. In K. LINSBAUER's *Handbuch der Pflanzenanatomie* 9. Berlin.
- ROBERTY, G. (1952): Genera Convolvulacearum. *Candollea* 14: 11-61.
- SCHENK, H. (1893): Beiträge zur Biologie und Anatomie der Lianen, Teil II. In A. F. W. SCHIMPER, *Botanische Mitteilungen aus den Tropen* Heft 5, II. Jena.
- SCHLEPEGRELL, G. VON (1892): Beiträge zur vergleichende Anatomie der Tubifloren. *Bot. Centr. bl.* 49: 259, sqq.
- SOLEREDER, H. (1899): *Systematische Anatomie der Dicotyledonen*. Stuttgart.