

A TAXONOMIC REVISION OF DICTYONEURA (SAPINDACEAE)

J. VAN DIJK

Rijksherbarium, Leiden, The Netherlands

SUMMARY

Dictyoneura Blume (Sapindaceae) is a small Malesian genus. In this revision three species are described, one of which has not been named. Under one species a new subspecies is described.

INTRODUCTION

Dictyoneura is a small genus in the Sapindaceae. Within its tribe, the Cupanieae, it is easily recognized by its comparatively small leaflets with the characteristic finely reticulate nervation and its flowers without petals and mostly 5 stamens.

In his monograph of the Sapindaceae, Radlkofer (Engl. Pflanzenr. 98, 1931–34) distinguished nine species under *Dictyoneura*. As in most of his work, he primarily used fruit characters to separate them. However, most of these characters, viz. size, shape and colour of the fruit, are dependent of the state of maturation, thus being not very valuable for delimitation purposes. Moreover, the material he had at his disposal was quite inadequate: of the 18 specimens cited, only 10 bear fruits in various states of maturation. Of one species, *D. bamleri*, he did not even see any fruit at all.

In the present work, for which about 90 collections could be examined, only two species are accepted, one of which is divided into two subspecies. Another, possibly new species, based on one sterile collection only, is also described, but has not been named.

For this study I used material from the following herbaria: BO, K, L, and M.

I wish to express my thanks to Dr. P.W. Leenhouts, Leiden, for his valuable suggestions and his continuous support of my work.

DICTYONEURA

Dictyoneura Blume, Rumphia 3 (1847) 163; Radlk., Engl. Pflanzenr. 98 (1933) 1219–1224. –
Lectotype (chosen by present author): *D. acuminata* Blume.

Shrubs to medium-sized trees. *Indumentum* consisting of simple, solitary hairs: fulvous to yellowish white, c. 0.3–1 mm long hairs, very sparsely to densely on all axes, very densely on the younger parts; in the inflorescences (stamens, disk, sepals)

also flat, ligular, often contorted, whitish hairs; inside the fruits c. 1.5 mm long, orange hairs; further consisting of small, round (glandular?) scales on leaflets, pistils, and fruits. Twigs terete, more or less grooved. *Leaves* spirally arranged, without stipules, paripinnate, with 2–12 leaflets per side; petiole terete to sometimes slightly marginate, slightly to strongly broadened at the base; rachis terete to narrowly winged, broadest below each leaflet, above often ridged, beneath rounded; petiolules absent or short, beneath at the base often swollen; all axes glabrous or hairy, above more densely so than beneath. *Leaflets* alternate to opposite, \pm oblique, especially near the base, smooth, variably hairy, sparsely to sometimes densely scaly, with or without domatia; base (cuneately) attenuate to adaxially rounded, abaxially acute and attenuate; margin subentire to sparsely, sometimes coarsely, (serrate-)crenate, sometimes only near the apex; midrib above slightly and beneath more strongly raised; nerves not or inconspicuously joined, above flat to slightly raised, beneath slightly to strongly raised; veins on both sides finely reticulate; slightly raised. *Inflorescences* axillary, often placed near the end of the twigs (pseudoterminal), simple and raceme-like or \pm strongly branched, sometimes only at the base, the axes bearing 1–few-flowered cymules; bracts and bracteoles densely hairy, mostly caducous; all axes sparsely to densely short-haired, often grooved. *Flowers* unisexual, female and male in the same inflorescence, actinomorphic. *Sepals* 5(–6), imbricate, slightly connate at the base, suborbicular to subelliptic, about equal or the inner- and/or outermost sepal sometimes distinctly smaller, (thin-)membranaceous, the base often thicker, outside glabrous or hairy, inside mostly glabrous, without glands, ciliolate, entire. *Petals* none. *Disk* regular, subannular, swollen, without appendages, tomentose. *Stamens* (4–)5(–6), inserted inside of the disk around the pistil(lode), exerted in male flowers; filament long patently hairy or sometimes sparsely short-haired, mainly in the basal half; anther (basally to) halfway dorsally attached, glabrous or sometimes sparsely hairy, dehiscence introrse. *Pistil* 2-, rarely 3-merous, sessile to short-stalked; ovary 2(–3)-celled, \pm hairy, sparsely to densely scaly; style apical, shorter to a little longer than the ovary, 2-grooved, with 2 stigmatic grooves at the apex, the sterile part about terete, glabrous to sparsely hairy, the stigmatic part obtuse-triangular, glabrous, making up 40–95% of the total length of the style. *Ovules* 1 per locule, axillary, erect, campylotropous, apotropous. *Infructescences* with thickened axes, especially the pedicels; sepals, disk, and sometimes stamens persistent under the fruit. *Fruits* capsular, (sub)sessile, obovoid to globular to transversely ellipsoid, 1- or 2- (rarely 3-)seeded, loculicidally dehiscent; fruit wall granular, outside very sparsely to densely hairy, sparsely to densely scaly, inside \pm carnosous, with a thicker carnosous layer in a narrow to broad strip along the dissepiment, covering the inside of the valves for 30–100%, this layer being either (sub)glabrous, or densely coated with orange hairs, the rest being glabrous to sparsely hairy; dissepiment smooth or granular, glabrous or very sparsely hairy. *Seeds* ovoid to ellipsoid; testa pergamentaceous or a \pm hard shell; aril on the ventral side cupular and covering 25–100% of the seed, dorsally interrupted by a very narrow to very broad cuneate cleft; embryo straight, cotyledons superposed, the upper one slightly to very much larger than the lower one, rootlet dorsal, basal.

Distribution. Two, maybe three species, occurring in E. Borneo, the Philippines (northernmost Polillo, c. 15°N), Central & S. Celebes, the Moluccas (Buru, Ceram, Halmahera, Obi), and New Guinea (including also New Britain and New Ireland). Fig. 2.

Ecology. Mostly understorey trees in primary and secondary forest, often found on riverbanks or otherwise at the edge of the forest; altitude 0–800 (–1900) m.

Uses. Economically the genus is probably not important. The wood of *D. obtusa* is once reported as being used for house posts. Further it is used as an ornamental tree.

Notes. 1. *Taxonomy.* In the present work, three taxa are distinguished under *Dictyoneura*, viz. *D. acuminata* subsp. *acuminata*, *D. acuminata* subsp. *microcarpa*, and *D. obtusa*. (The fourth, unnamed taxon, described under *Dictyoneura* sp., is left out of consideration here.) Of these three taxa, *D. acuminata* subsp. *acuminata* and *D. obtusa* are well delimited and can sharply be separated by two strong characters, viz. the length of the petiole and, above all, the hairiness inside the fruit. Taxonomically as well as geographically, *D. acuminata* subsp. *microcarpa* stands between these two taxa. In fact, several characters of it are more *obtusa*-like than *acuminata*-like: the hairiness, the simple inflorescences, the small, usually 2-seeded fruits, and the small seeds, for more than 60% covered by the aril. Still, on phylogenetic grounds it is clear that it should be placed under *D. acuminata*. *Dictyoneura obtusa* and *D. acuminata* subsp. *microcarpa* share the primitive character states 2-seeded fruits and nearly equal cotyledons, whereas *D. acuminata* subsp. *acuminata* has the derived character states 1-seeded fruits and very unequal cotyledons. In addition there is another difference between the latter taxon and one of the two more primitive ones, *D. obtusa*, viz. inside densely hairy fruits versus inside glabrous ones. Accordingly, the former character state may also be derived, and a more direct derivation of *D. acuminata* subsp. *acuminata* from *D. acuminata* subsp. *microcarpa*, which has the fruits also inside hairy, seems obvious. *Dictyoneura obtusa* must then be regarded as most primitive, and has to be separated first in the phylogenetic tree. A secondary split has to be made between *D. acuminata* subsp. *acuminata* and *D. acuminata* subsp. *microcarpa*. The taxonomic level on which this separation should take place may best be the level of subspecies. Geographically the two taxa are clearly separated. Morphologically the three collections of *D. acuminata* subsp. *microcarpa* are very similar, especially in their fruit characters. The suggestion of hybridization is improbable, because all three specimens bear well developed seeds. Summarizing, the conclusion must be that these three collections represent a good taxon that rightly deserves the rank of subspecies under *D. acuminata*.

2. *Domatia.* The domatia found in *Dictyoneura* are of the pocket-type, in the sense of Jacobs (On domatia – The viewpoints and some facts. Proc. Kon. Ak. Wet. A'dam C 69, 1966, 277, 278, fig. 1). The pockets are mostly rather shallow and nearly always covered by hair-tufts on the midrib and the nerve. The surface of the leaf in the pockets is often dark coloured. The occurrence of domatia seems to be geographically correlated, rather than taxonomically. In New Guinea all collections examined have domatia, though sometimes not on all leaflets. Going to the West domatia be-

come more rare, and finally they disappear completely. This implies that all collections of *D. obtusa* and *D. acuminata* subsp. *microcarpa* have domatia, whereas *D. acuminata* subsp. *acuminata* shows the whole range from well developed domatia in New Guinea (*Ledermann 10047*) to complete absence in Borneo and Celebes. In the Philippines they occur rarely in some specimens in a rather weakly developed form, as also in *Eyma 1847* from Ceram. The other Moluccan collections, *Binnendijk 14346* from Buru and *de Vogel 3207* from Halmaheira, have well developed domatia. Finally, *Atasrip 50* from Obi I., the only collection of *Dictyoneura* sp., has weakly developed domatia.

3. *Flowers*. The principal number of sepals and stamens is 5, but not rarely there is a deviation of this rule. Some specimens possess flowers with 6 sepals, the outermost or innermost one (or both) often being smaller than the rest. The sixth stamen, if present, often has a shorter filament. Radlkofer (1933) mentioned the occurrence of 1 or 2 cup-shaped petals in well developed flowers. However, in none of the (many) flowers I examined did I see any petal-like organ. He may have mistaken the reduced innermost sepal for a petal.

4. *Fruits*. On the inside of the valves the fruit wall is more or less carnosous. Between the dissepiment and the margin of the valves there is an extra, paler, carnosous layer, which covers the valves for 30–100%. In cross section, this layer is thickest in the middle and thinning out towards the dissepiment and the margin of the valves. The layer is either densely coated with orange hairs (*D. acuminata*, fig. 1b) or (sub-)glabrous (*D. obtusa*, fig. 1f).

5. *Aril*. Radlkofer (1933: 1219) referred to the aril as being 'brevis adnatus', shortly adnate, thus suggesting that it is an arilloid. However, in my opinion the aril is a sarcotesta. It is difficult to separate from the (rest of the) testa, even when the seed is boiled. When it is removed, it leaves a shallow scar on the surface of the seed coat. Moreover, even very young seeds show the complete aril, whereas an arilloid usually grows out rather late in the development of the seed.

6. *Embryo*. Two quite distinct embryo types can be found in *Dictyoneura*. The first type, exclusively found in *D. acuminata* subsp. *acuminata*, has two cotyledons with an extreme difference in size, the upper being large, the lower very small (fig. 1e). This goes along with a testa that is pergamentaceous and easily removable. The second type, mainly found in *D. obtusa*, has two nearly equal and rather small cotyledons, the upper being only slightly larger than the lower. The testa of these seeds is often a hard shell, and difficult to separate from the embryo. It is hard to say whether the two embryo types represent different germination strategies, as seedlings have not been examined. The first, probably more derived type, has undoubtedly food-storing cotyledons that stay under the ground during germination. But the same may very well hold true for the second type. Moreover, there appears to be no ecological significance; there seem to be no (clear) differences in habitat between *D. acuminata* and *D. obtusa*.

7. *Measurements*. All numbers and sizes of the vegetative parts in keys and descriptions are taken from flowering or fruiting branches, so care must be taken with sterile specimens. For example, a sterile collection of *D. obtusa*, *Teijsmann 17473 HB*,

counts up to 40 leaflets per leaf. The length-proportion of a leaf can be found by dividing the length of the largest leaflet by the length of the smallest leaflet of the first jugum.

KEY TO THE SPECIES

- 1a. Leaflets more than 5 cm wide, at least the larger ones 3. *Dictyoneura* sp.
- b. Leaflets up to 5 cm wide, mostly much narrower 2
- 2a. Fruits inside hairy. Petioles, at least those of the larger leaves, nearly always longer than 2 cm 1. *D. acuminata*
- b. Fruits inside (sub)glabrous. Petioles up to 2 cm long, very rarely up to 2.5 cm long 2. *D. obtusa*

1. *Dictyoneura acuminata* Blume

- D. acuminata* Blume, Rumphia 3 (1847) 163; Radlk., Engl. Pflanzenr. 98 (1933) 1221. — *Cupania acuminata* Miq., Fl. Ind. Bat. 1, 2 (1859) 567. — Lectotype (chosen by present author): *Muller s.n.*, Borneo, fr. (L sheet nr. 908.269-857).
- D. sphaerocarpa* Radlk. in Elmer, Leaf. Philip. Bot. 1 (1907) 209; non Nova Guinea 8 (1909) 172 (= *D. obtusa*); Bot. Jahrb. 56 (1920) 292 (*Branderhorst 260* = *D. obtusa*); Merr., Enum. Philip. Fl. Pl. 2 (1923) 510; Radlk., Engl. Pflanzenr. 98 (1933) 1221 (*Branderhorst 260* = *D. obtusa*). — Type: *Elmer 7157*, Philippines, Leyte, Palo, I-1906 (M; iso BO, K, L).
- D. rhomboidea* Radlk., Philip. J. Sc. 6 (1911) Bot. 182; Merr., Enum. Philip. Fl. Pl. 2 (1923) 510; Radlk., Engl. Pflanzenr. 98 (1933) 1221. — Type: *BS 10359*, Philippines, Polillo, X/XI-1909, fr. (M; iso K).
- D. philippinensis* Radlk. in Elmer, Leaf. Philip. Bot. 5 (1913) 1613; Merr., Enum. Philip. Fl. Pl. 2 (1923) 510; Radlk., Engl. Pflanzenr. 98 (1933) 1220. — Syntypes: *Clemens 'W'*, Philippines, Mindanao, Lake Lanao, Camp Keithley, III-1907, fl. (M); *Clemens 532*, same loc., V-1906, fr. (M; iso BO); *Clemens 567*, same loc., V-1906, fr. (M); *Elmer 10965*, Philippines, Davao, Todaya, Mt Apo, VI-1909, fr. (M; iso BO, K, L).
- D. subhirsuta* Radlk., Bot. Jahrb. 56 (1920) 292; Engl. Pflanzenr. 98 (1933) 1222. — Type: *Ledermann 10047*, New Guinea, Sepik, Lordberg, XII-1912, fr. (B, lost; iso K, L).
- D. bamleri* auct. non K. Schum. & Lauterb.: Ridley, Trans. Linn. Soc. Bot. 9 (1916) 32; Radlk., Engl. Pflanzenr. 98 (1933) 1223 as for *Kloss s.n.*

Tree, sometimes treelet or shrub, up to 12(–15) m high and 20(–30) cm d.b.h. Twigs 2–5 mm thick. *Leaves* with (2–)3–7(–11) leaflets per side; length proportion 1.4–1.8(–2.3); petiole 1.5–7.5 cm long, terete to very slightly marginate; rachis 4–18 cm long, terete to marginate; petiolules 0–4 mm long. *Leaflets* (2.5–)3.5–10.5(–18) by (1–)2–4(–5) cm, (1.7–)2–4(–5) times as long as wide, widest beneath or sometimes about the middle, (slightly) oblique, pergamentaceous, sometimes coriaceous, above glabrous or rarely very sparsely hairy, except for the sparsely to densely short-haired, or sometimes densely long-haired midrib and the sometimes sparsely hairy nerves, the axils of midrib and nerves, and the margin at the base, beneath short- or long-haired, (very) sparsely to sometimes densely so on the midrib and sometimes in the axils of midrib and nerves and along the margin at the base, (very) sparsely so for the rest, domatia mostly absent (but see note 2 under the

genus); apex acute to tapering short to long acuminate, the very apex obtuse, sometimes slightly emarginate; nerves 5–16(–22) mm apart. *Inflorescences* sometimes simple, mostly branched; bracts and bracteoles up to 3 mm long; pedicels up to 2 mm long. *Flowers* c. 5 mm diam. *Sepals* 1.5–2.5 by 1–2 mm, outside glabrous or sparsely to sometimes densely hairy, inside subglabrous. *Disk* (1.2–)1.5–1.8 mm diam. *Stamens* 5(–6); filament long patently hairy, in male flowers (2.5–)3.2–3.5 mm long, in female flowers (0.5–)1.5–2 mm long; anther narrowly cordate to ovate, 0.6–0.8 by 0.4–0.7 mm, glabrous or sometimes sparsely hairy. *Pistil* 2-merous, 2.5–3.2(–3.5) mm long; pistillode 0.5–1.2 mm long; ovary ellipsoid, (1.5–)1.8–2 by (1–)1.3–1.5 mm, sparsely hairy but often densely hairy along the sutures, mostly densely scaly; style 1–1.2(–1.5) mm long. *Fruits* obovoid to globular, rarely transversely ellipsoid, outside mostly (very) sparsely hairy, but often more densely so along the sutures, rarely densely hairy all over, mostly \pm densely scaly, inside densely hairy. *Seeds*: testa pergamentaceous.

Distribution. E. Borneo, the Philippines, Central & S. Celebes, the Moluccas (Buru, Ceram, Halmaheira), W. & NE. New Guinea.

KEY TO THE SUBSPECIES

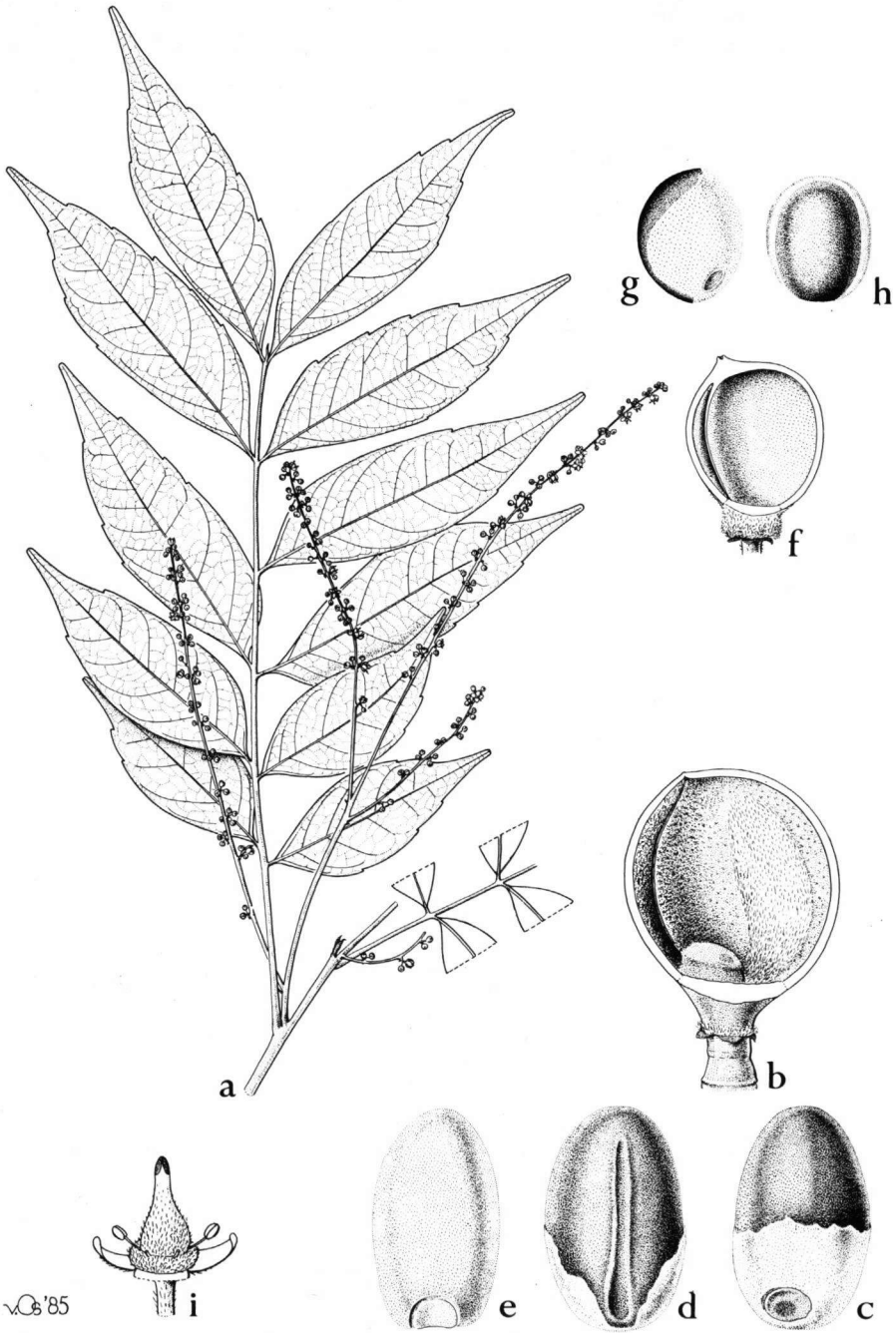
- 1a. Fruits usually 1-seeded, 9–20 mm long. Aril covering up to 60% of the seed, dorsally interrupted by a (very) broad cuneate cleft. Inflorescences often more or less strongly branched a. subsp. *acuminata*
- b. Fruits usually 2-seeded, 6–8 mm long. Aril covering more than 60% of the seed, dorsally interrupted by a narrow cuneate cleft. Inflorescence simple b. subsp. *microcarpa*

a. subsp. *acuminata* – Fig. 1a–e.

All synonyms, except *D. bamleri* auct.

Inflorescences sometimes simple, mostly \pm strongly branched. Fruits 9–14(–20) mm by 8–14(–20) mm, 1- (rarely 2-)seeded. Seeds subellipsoid, 8–12 by 5.5–8 mm, the aril covering (25–)45–60% of the seed, dorsally interrupted by a (very) broad cuneate cleft; embryo: the upper cotyledon mostly very much larger than the lower one.

Fig. 1. *Dictyoneura acuminata* Blume subsp. *acuminata*. a. Tip of flowering branch (NBFD SAN 90800; $\times \frac{1}{2}$); b. valve from inside showing the densely hairy part; c. seed, ventral; d. seed, dorsal; e. embryo, showing the extreme difference in size between the upper and lower cotyledon (all *Kostermans* 6892; $\times 2\frac{1}{2}$). — *D. obtusa* Blume. f. Valve from inside, glabrous; g. seed, latero-ventral, showing the aril covering the seed ventrally for 100%; h. seed, dorsal (all NGF 29418; $\times 2\frac{1}{2}$). — *Dictyoneura*. i. Female flower (schematically) with two stamens and three sepals removed ($\times 3$).



Field notes. Bark greenish or greyish, smooth; inner bark (pale) brown; wood white. Young leaves light green. Flowers greenish, whitish, yellowish, or yellowish-brown; buds greenish. Fruits from green over yellow and orange to red and finally brownish.

Distribution. E. Borneo, the Philippines, Central & S. Celebes, the Moluccas (Buru, Ceram, Halmaheira), NE. New Guinea.

BORNEO. Southeast Kalimantan: Korthals s.n., Mt Pamatton (L sh. nrs. 908.269-877 & 978). – East Kalimantan: 6 collections. – Sabah: Nbfd SAN 90800, Kunak, Pulau Silumpat (L).

PHILIPPINES. Luzon: BS 33717, Camarines Prov., Paracale (K). – Polillo: BS 10359 (K, M). – Samar: BS 24423, Catubig R. (K); M Sablaya 49, same loc. (K). – Leyte: BS 41484, Cabalian (BO, K, L); 41503, same loc. (K); Elmer 7157, Leyte Prov., Palo (BO, K, L, M). – Sulu Islands: Vidal 2502, Jalo (K). – Mindanao: 16 collections.

CELEBES. Central: Kjellberg 2867, Kawata (near Lake Matana) (BO); Rachmat 850, Balandae (BO). – Southwest Peninsula: Teijsmann 12677, Baleh-angien (BO). – Southeast Peninsula: Kjellberg 878, Wawotobi, Palaiahi (BO), 2197, Lake Towoeti, P. Loeika (BO), 2223, Lake Towoeti, Beao (BO).

MOLUCCAS. Halmaheira: De Vogel 3207, Ekor, Bukit Talikimangairi, 0°49'N 127°52'E. – Buru: Binnendijk 14346 (BO). – Ceram: Eyma 1847, Pileana, Biv. Pileana (K, L).

NEW GUINEA. Northeast: Ledermann 10047, Sepik, Lordberg (K, L).

Ecology. In primary and secondary forest, often at the edge, along rivers, on the border of a lake, on ridges, or in open understorey, mostly on dry, sometimes on swampy soil; soil sandy to loamy, on limestone-rock; altitude 0–1000 (–1700) m. Fl. mainly in Feb.–Aug., fr. the year round.

Vernacular names. Kajoe imber (E. Borneo); lotjoh-lotjoh (SW. Celebes).

Notes. 1. *Variability and taxonomy.* The characters Radlkofer used to separate the species now combined under *D. acuminata* subsp. *acuminata*, were quite unfortunately chosen. The fruit characters primarily used, viz. shape, size and colour, are all dependent of the state of maturation of the fruit. With the inadequate material he had at his disposal, with ripe and unripe fruits, these characters were useless for delimitation purposes. The other characters he used, the branching of the inflorescences and the shape of the leaflets, may vary throughout the present subspecies, and even within one collection. In fact, the subspecies is as a whole even not very variable. Most fruit and seed characters, with few exceptions stated below, show a remarkable constancy when compared with the same characters in *D. obtusa*. The inflorescences may be simple to strongly branched, but both may occur in one and the same collection. Yet, most variation can be found in the vegetative parts, especially in the general shape of the leaflets and in the measure of incision of the margin. The variation in leaflet-shape is largely due to the degree of obliqueness, which shows a fluent line from only slightly to quite strongly so. The margin of the leaflets may be either entire, or \pm coarsely incised, but there seems to be no correlation with other characters.

2. *Distribution.* The distribution of *D. acuminata* subsp. *acuminata* shows a gap between the Moluccas and the Sepik area in New Guinea (fig. 2). The Sepik collection, *Ledermann 10047*, deviates from almost all other collections in its densely puberulous axes and its well developed domatia. This suggests that there must be, or must have been, a morphocline ranging from the Moluccas to the Sepik. The absence

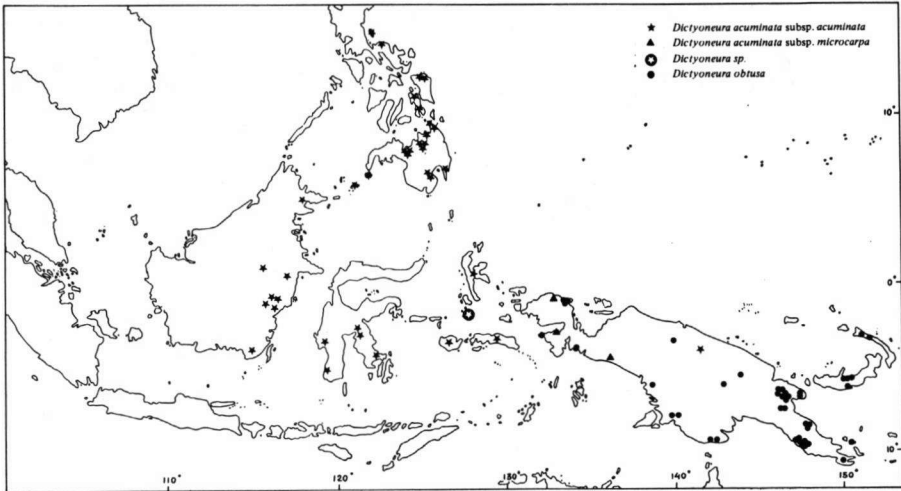


Fig. 2. The distribution of *Dictyoneura*.

of collections in this area may then be explained in two ways: either the subspecies does no longer occur in the area, or it does occur, but has not been collected. The latter explanation may be supported by the fact that most collecting in West New Guinea has been done by foresters who were usually not interested in small trees like *Dictyoneura*.

3. *Fruits and seeds.* Although the fruits and seeds show very little variability in most of their characters, there are a few deviating specimens. *BS 33717* bears exceptionally large fruits up to 20 mm diam. *Binnendijk 14346* and *de Vogel 3207* have fruits with a very thick wall, up to 3 mm thick, whereas usually the walls are 1–1.5 mm thick. The fruits of *de Vogel 3207* are not scaly outside but densely yellow-haired. *Kjellberg 2867* has a very short aril, which covers the seed for less than 30%.

b. subsp. *microcarpa* J. van Dijk, subsp. nov.

D. bamleri auct.

Descriptio typi: Inflorescentiae eramosae. Fructus 6–7 × 6–7 mm. Semina (1 vel) 2, semi-ovoidea, ca. 5 × 3 mm; arillus seminis pro 60–70% obvestiens, dorso fissura anguste cuneiforme interruptus; embryo: cotyledon superior quam inferior paulo major. – **Typus:** *Aet 673* (L; iso K), New Guinea, Div. West, McCluer, Babo, 14-VIII-1941, fr.

Inflorescences simple. Fruits 6–8 by 6–8 mm, sometimes 1-, mostly 2-seeded. Seeds semi-ovoid, 5–7 by 3–4.5 mm, the aril covering 60–85% of the seed, dorsally interrupted by a narrow cuneate cleft; embryo: the upper cotyledon only slightly larger than the lower one.

Field notes. Tree, 15 m high and 30 cm d.b.h. Bark greyish green, not fissured, not peeling; inner bark light brown, sapwood white, no heartwood. Slash ferruginous. Fruits orange or red.

Distribution. West New Guinea. Fig. 2.

NEW GUINEA. Vogelkop Peninsula: Aet 673, McCluer, Babo (K, L); BW 7236, Kebar Valley (L). – Southwest: Boden Kloss s.n., Utakwa R. to Mt Carstensz, Canoe Camp (K).

Ecology. Primary forest on level clayey soil; altitude up to 450 m. Fr. Aug., Nov.

2. *Dictyoneura obtusa* Blume – Fig. 1 f–h.

- D. obtusa* Blume, Rumphia 3 (1847) 164; Radlk., Bot. Jahrb. 56 (1920) 293; Engl. Pflanzenr. 98 (1933) 1223; P. van Royen, Man. For. Trees Papua New Guinea 2 (1964) 4, 16, f. 7; Peekel, Fl. Bismarck-Arch. p. 1098^{xx}, 1098^{xxx}. – *Cupania obtusa* Miq., Fl. Ind. Bat. 1, 2 (1859) 567. – Type: Zippelius s.n., New Guinea, Lobo, VI/VII-1828 (L sh. nr. 908.269-767; iso sh. nrs. 777 & 780, also in K).
- D. bamleri* K. Schum. & Lauterb., Fl. Schutzgeb. Südsee (1900) 421; non Ridley, Trans. Linn. Soc. Bot. 9 (1916) 32 (= *D. acuminata* subsp. *microcarpa*); Radlk., Bot. Jahrb. 56 (1920) 293; Lauterb., Bot. Jahrb. 62 (1929) 564; Radlk., Engl. Pflanzenr. 98 (1933) 1223 (*Kloss s.n.* = *D. acuminata* subsp. *microcarpa*). Type: Bamler 29, New Guinea, Kaiser-Wilhelmsland, Sattelberg, 5-I-1899, fl. (B, lost; iso M).
- D. microcarpa* Radlk., Bot. Jahrb. 56 (1920) 293; Engl. Pflanzenr. 98 (1933) 1222. – Type: Branderhorst 282 (erroneously cited 202), New Guinea, Kabatiel, 22-XII-1907, fr. (M; iso BO, K, L).
- D. sphaerocarpa* auct. non Radlk.: Radlk., Nova Guinea 8 (1909) 172; Bot. Jahrb. 56 (1920) 292; Engl. Pflanzenr. 98 (1933) 1221, as for *Branderhorst* 260.
- Dictyoneura* sp. Streimann, Plants Upper Watut Watershed Papua New Guinea (1983) 169.

Tree, sometimes shrub, up to 15(–25) m high and 20(–30) cm d.b.h. Twigs 1.5–4 mm thick. Leaves with 3–9(–12) leaflets per side; length-proportion 1.5–4(–6); petiole up to 1.5(–2.5) cm long, terete to slightly marginate; rachis 1.5–16 cm long, marginate to narrowly winged; petiolules 0–2 mm long. Leaflets (0.6–)2–9(–12.5) by (0.4–)1–2.5(–3.5) cm, (1.7–)2–3.5(–4.5) times as long as wide, widest about or below the middle, oblique, (thin-)pergamentaceous, variably hairy, above mostly short-haired, sparsely to densely so on the midrib and sometimes on the nerves, and sometimes sparsely so on the veins, along the margin, at the incisions in the margin, and in the axils of midrib and nerves, beneath short- or long-haired, sparsely to densely so on the midrib and sometimes on the nerves and veins and in the axils of midrib and nerves, glabrous or sparsely hairy for the rest, domatia usually present and well developed; apex obtuse to acute, rarely very shortly acuminate, the very apex obtuse to slightly emarginate; nerves (2.5–)5–13(–19) mm apart. Inflorescences simple or sometimes sparingly branched, often only at the base; bracts and bracteoles up to 1.5 mm long; pedicels up to 1.5 mm long. Flowers 3–4(–5) mm diam. Sepals 1.2–2 by 0.8–1.6 mm, the inner- or outermost sepal (or both) sometimes smaller, outside sparsely to densely hairy, inside glabrous or sparsely hairy. Disk 1–1.5 mm diam. Stamens (4–)5(–6); filament long patently hairy, sometimes sparsely short-haired, in male flowers (1.4–)1.8–2.6 mm long, in female flowers 0.6–1

mm long; anther cordate to broadly ovate, 0.4–0.8 by 0.5–0.8 mm, glabrous. *Pistil* 2- (rarely 3-)merous, 1.5–2.5 mm long; pistillode 0.3–0.6(–1) mm long; ovary ovoid to ellipsoid, 1.1–1.8 by 0.7–1.4 mm, densely hairy, (very) sparsely scaly; style 0.6–1.2 mm long. *Fruits* subglobular to transversely ellipsoid, 6–8(–12) by 6–8(–11) mm, outside sparsely or sometimes densely hairy, (very) sparsely scaly, 1- or 2- (rarely 3-)seeded, inside glabrous or with few hairs near the placenta. *Seeds* (semi-) ovoid to (semi-)ellipsoid, 4–9 by 4–7 mm; aril covering (45–)60–100% of the seed, dorsally interrupted by a very narrow to very broad cuneate cleft; testa a more or less hard shell; the upper cotyledon slightly larger than the lower one.

Field notes. Slender, much branched tree, bushy, with a narrow or spreading crown, rarely spurred. Bark smooth, close, finely marked vertically, or faintly fissured, or with few inconspicuous pustular lenticels, grey to brown, fairly dark, sometimes grey brown blotched, rarely under red and green with finely anastomosing streaks; inner bark fibrous, streaked with straw, green-cream, salmon, pink, red, (light) brown, or redbrown with greenish streaks on the back, paler redbrown with indistinct paler streaks within; sapwood pinkish or pale straw, sometimes white; heartwood pinkish straw, pale red, or pinkish, or ginger. Slash light pink brown, hard. Leaves deciduous or semi-deciduous, softly textured, semigloss or very shiny, light to dark green, sometimes pale or jade green, below often paler than above; young leaves reddish or purplish green; new shoots yellow brown to pale green. Flowers white to yellow, when young greenish. Fruits somewhat fleshy, from brown green over orange(-yellow) to orange-red, finally orange-brown. Seeds black, shining; aril (light) orange or yellow.

Distribution. New Guinea (including also New Britain and New Ireland). Fig. 2.

NEW GUINEA. Vogelkop Peninsula: 5 collections. – Northwest: BW 2853, Div. Hollandia, Jafi Dist., Singgi (L). – Southwest: Branderhorst 260, probably Kabatiel (K, L); 282, Kabatiel (BO, K, L, M); Rachmat 171, Swalor (BO, M). – Southeast: 14 collections, mainly from the Central and Northern Districts. – Northeast: 18 collections, mainly from the Morobe Dist. – D'Entrecasteaux Islands: LAE 68759, Ferguson I., track between Tutubea and Lake Lavu, 9°33' S 150°37' E (K, L, M). – New Britain: 5 collections. – New Ireland: NGF 29709, inland from Lossuk, on track to Bagaterra, 2°45' S 151°06' E (K, L); Peekel 133, Uguna Dist. (BO).

Ecology. Primary and secondary forest, sometimes (lower) montane forest or old gardens, more rarely plantings or open places, often on riverbanks or otherwise at the edge of the forest, mostly in the understorey, sometimes in the subcanopy layer, on flat to steep terrain or on ridges, sometimes swampy, also on old well drained volcanic soil; soil rocky, clayey, or sandy, over limestone; altitude 0–500(–1900) m. Fl. in June–Nov.(–Feb.), fr. almost the year round, but mostly in Nov.–March. The fruits are eaten by birds.

Uses. Often used as an ornamental tree because of its orange fruits and reddish young leaves (P. van Royen, 1964, p. 4). The wood is used for house posts.

Vernacular names. Wahi (Papoeaseh lang.; Onin Peninsula), sigoga (Orokaiva lang., Mumuni; Northern Dist.), sil insiling (Morobe Dist.), bomba (Buangs-Patep dial., Morobe Dist.), la tai segi (W. Nakanai, New Britain).

Note. *Variability and taxonomy.* *Dictyoneura obtusa* is much more variable than

D. acuminata. Several geographic and ecologic races can be distinguished by their habit, but all these races are linked by intermediates, thus making no sharp division possible. The three species now combined under *D. obtusa* are in fact representatives of three such races. In West New Guinea and on higher altitudes in the East the plants bear leaves with comparatively small leaflets. The western form, *D. obtusa* in the sense of Radlkofer (1933), has many leaflets per leaf and often conspicuously yellow-haired domatia. The lower montane form, *D. bamleri*, shows a tendency towards more glabrescent leaves with a wingless rachis and thicker glossy leaflets. Towards the East and on lower altitudes the leaflets become larger, the largest ones are found on New Britain and New Ireland. The plants on these two islands are generally more coarse in all their parts. Medium-sized leaflets are found in the South and the East. The southern form, *D. microcarpa*, has leaves with few leaflets, only incised near the apex. In the Morobe District the leaflets are often rather strongly oblique, whereas in the Northern and Milne Bay Districts the plants are densely puberulous all over.

As stated before, none of these races can be delimited, although it is often possible to 'identify' specimens and place them in the right area.

Other characters, like the branching of the inflorescences and most of the fruit characters, may vary throughout the range of the species, showing no (clear) correlation with each other or with geographic or ecologic factors.

3. *Dictyoneura* sp.

Leaves: petiole 3–6.5 cm long, terete, rachis terete; petiolules 2–4 mm long. Leaflets (6.5–)9–21 by (3–)5–8 cm, 1.7–3.2 times as long as wide, widest below, about, or sometimes slightly above the middle, (slightly) oblique, thin-coriaceous, above glabrous except for the (very) sparsely short-haired midrib and nerves, beneath glabrous to sparsely hairy except for the densely hairy midrib and the sparsely to densely hairy nerves, domatia weakly developed; apex (abruptly) acuminate, the very apex acute to obtuse to sometimes emarginate; nerves (5–)10–20(–28) mm apart.

Distribution. Moluccas (Obi). Fig. 2.

MOLUCCAS. Obi Islands: Atasrip 50, Obi (BO).

Note. The cited collection consists only of loose leaf-fragments mounted on several herbarium sheets. These fragments resemble *D. acuminata*-leaves as for the indumentum, the finely reticulate nervation, and the acuminate leaflets with a slightly oblique base, but differ clearly in the size of the leaflets. No information is given on the herbarium label about the plant or about particular ecological circumstances.

The inadequate material, together with the complete absence of additional information, makes it impossible to say whether the collection belongs to *D. acuminata* or represents a new taxon. Therefore, for the time being, it seems wise to separate it from the rest of *Dictyoneura* without naming it, until more material becomes available.

EXCLUDED

Dictyoneura integerrima Radlk., Feddes Repert. 18 (1922) 343 = *Ganophyllum* cf. *falcatum* Blume, Mus. Bot. 1 (1850) 230; Radlk., Engl. Pflanzenr. 98 (1933) 1424.

Note. The type specimen (*Koorders 10558*) consists only of a small number of leaves. At first glance these leaves resemble those of *D. acuminata*, but a more thorough examination brings about some major differences: the marginate rachis is rounded above, not ridged; the petiolules are fluted; the leaflets are studded with peculiar scales, probably resin-glands; and, less important, the number of leaflets per side goes up to 11. All these features point in the direction of *Ganophyllum*. In addition, some circumstantial evidence is provided. The distribution of *Ganophyllum* ranges from Australia to the Andaman Islands, S. of Burma. *Koorders 10558*, collected at P. We (an islet NE. of Sumatra), fits very well in that distribution, but does not fit at all in the distribution of *D. acuminata*. Moreover, Radlkofer (1933, p. 1426) cites under *Ganophyllum falcatum* the collection *Koorders 10557*, originating from the same region as *10558*.

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