

## I. PROTIUM Burman f.

by

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(Rijksherbarium, Leiden)

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### Introduction.

A revision of the species, comprised in the section *Eu-Protium* of the genus *Protium* from the region from Asia to Australia incl., might, in view of the elaborate publications by H. J. Lam (The Burseraceae of the Malay Archipelago and Peninsula etc., Bull. Jard. bot. Buitenzorg, S. 3, 12, 1932, p. 318—324) and J. J. Swart (A Monograph of the genus *Protium* and some allied genera, Rec. Trav. bot. néerl., 39, 1942, p. 211—446), seem superfluous. However, an examination of the Clemens material from New-Guinea of 1939 and of the type material of the thusfar mysterious *Bursera tonkinensis* Guill. justified the publication of some notes thereon. To these some remarks concerning observations on other species have been added.

I am much indebted to the directors of the following herbaria for the loan of material: the herbarium of the Botanisches Museum, Berlin; the herbarium of the Arnold Arboretum, Jamaica Plain, Mass. (A); the herbarium of the Royal Botanic Gardens, Kew; the herbarium of the Muséum d'Histoire Naturelle, Paris; the herbarium of the Botanical Institute, Wroclaw (BRSL); the "Rijksherbarium", Leiden (L).

## Key to the species.

Although in most cases the distinction of the few species seems, at first sight, fairly easy, the composition of a key showed, that several characters are quite variable, not rarely overlapping each other in different species as they are understood in the present paper.

- 1.a. Flowers 4-merous, rarely some 5-merous flowers in the same specimen. Apex of the leaflets acuminate, acumen 1.1—1.5 cm long and 0.4 cm wide at base. Inflorescences 2.5—6 cm long,  $\frac{1}{4}$ — $\frac{1}{3}$  the length of the leaves. Pedicels 0.95—0.1 cm long,  $\pm \frac{1}{3}$  the length of the flowers. (*Palawan*)
  - 3. *P. connarifolium* (Perk.) Merr.
- b. Flowers 5-merous, rarely some 4-merous flowers in the same specimen. . . 2
- 2.a. Petiolules usually very short, 0.1—0.7 cm long. Ovary and fruit glabrous. Acumen of the leaflets  $\pm 1$ — $1\frac{1}{2}$  times as long as wide. (*Java to Sumbawa*)
  - 1. *P. javanicum* Burm. f.
- b. Petiolules rather long, (0.5—)0.75—3.5 cm long. Ovary and fruit more or less pilose
  - 3
- 3.a. All parts, especially the inflorescence, densely pilose. Leaves ( $1\frac{1}{2}$ —) $2\frac{1}{2}$ — $4\frac{1}{2}$  (— $5\frac{1}{2}$ )-jugate. Margin of the leaflets suberrate — especially near the apex — to subentire. Lenticels of the petiolules not conspicuous. (*India, Siam, Indo-China*)
  - 2. *P. serratum* (Wall. ex Colebr.) Engl.
- b. Sparsely pilose. Leaves ( $1\frac{1}{2}$ —) $2\frac{1}{2}$  (— $3\frac{1}{2}$ )-jugate. Margin of the leaflets entire. Lenticels on the petiolules conspicuous, in most cases transversely elongated, particularly on the rims of the groove. (*N.E. New-Guinea*)
  - 4. *P. schlechteri* (Lauterb.) Leenhouts

1. *Protium javanicum* Burm. f.; Lam, l. c. 322; Swart, l. c. 248; E. Meijer Drees, in Comm. For. Res. Inst. Indonesia, 33, 1951, 43.  
 LESSER SUNDA ISLANDS — Lombok, Mt. Rindjani, Bajan, alt. 125—225 m, park-land: *Elbert 721* (L) fr. IV; *ibid.*, Sadjang, forest, alt. 500—700 m: *Elbert 812* (L) fr. IV; *ibid.*, Swela, alt. 350—500 m: *Elbert 2036* (L) ster. VI.

Remarks: Meiomery of the ovary was stated in two cases: there were only 3 cells, without any trace of a 4th or 5th (*fig. 5*).

Distribution: Java, Madura, Bawean, Kangean, Bali, Lombok, Sumbawa.

2. *Protium serratum* (Wall. ex Colebr.) Engl.; Lam, l. c. 321; Swart, l. c. 254; Guillaumin in Suppl. Fl. Gén. Indo-Chine, 1, 1946, 682.

Remarks: The specimen *Kerr 20300* (L) showed in one case a small additional leaflet inserted on the node of one of the basal leaflets, such as is frequently found in *Garuga*, but was never before reported in *Protium* (*fig. 1*).

I examined 3 or 4 ovaries; all of these showed 4 well-developed cells. In one case only there was not a trace of a 5th one, in the others the place of the 5th cell was shown by two resiniferous ducts, instead of one, in the mesocarpium between two of the cells; the mesocarpium showed also a stronger development at that spot.

Distribution: India, Burma, Siam, Indo-China.

3. *Protium connarifolium* (Perk.) Merr.; Lam, l. c. 320; Swart, l. c. 258.

Remarks: This species is undoubtedly a quite distinct one. It is easily distinguished from *P. schlechteri* by the long tapering apex of the leaflets, and by the medulla of the branchlets, which is gradually disappearing with a scalariform transitional stage. In *P. schlechteri* the medulla is solid and permanent.

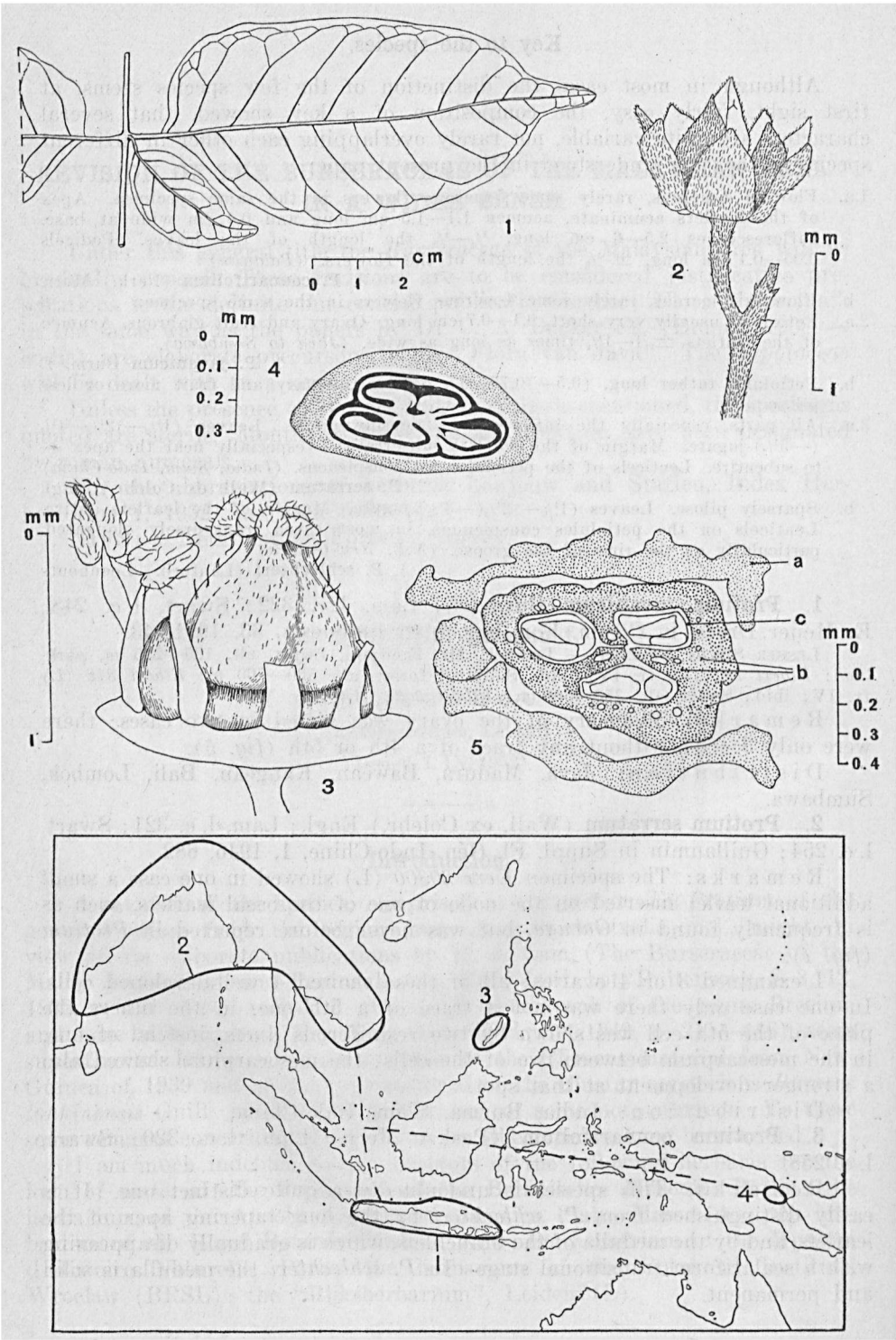


Fig. 1.

Only in one of the 6 flowering specimens examined I found some 5-merous flowers, but most flowers of this specimen were 4-merous.

Distribution: Palawan (Philippines).

4. *Protium schlechteri* (Lauterb.) Leenhouts nov. comb. — *Santiria schlechteri* Lauterb. in Engl. Bot. Jahrb. 46, 1921, 333; Engl. in Engl. Pr., Nat. Pfl. fam. ed. 2, 19a, 1931, 454 — *Protium connarifolium* auct. non Merr., Lam, l. c. 320—321; Swart, l. c. 260.

As Lauterbach's description was based upon one single specimen and therefore is a very incomplete one, a new diagnosis may follow here:

Large or moderate-sized trees. *Branchlets* 4—5 mm thick, greyish brown to ferruginous, scabrous, youngest parts somewhat pubescent, striate when young; lenticels many, round to ovate, in older parts strongly transversely elongated, fulvous; pith solid and rather hard. *Leaves* ( $1\frac{1}{2}$ —) $2\frac{1}{2}$ — $3\frac{1}{2}$ -jugate, 15—23 cm long; *petioles* striate, terete, incrassate at base, brown to purplish-brown when dry, minutely greyish to fuscously puberulous, to glabrous, (2.4—)3.0—3.2(—4.4) cm; lenticels conspicuous, or, in older parts and especially at base, transversely elongated; *interjugae* (1.6—)2.5—2.8 (—3.2) cm; *petiolules* with conspicuous to almost inconspicuous articulation at either end, strongly canaliculate, i. s. yellowish- to purplish-brown, thinly greyish to fuscously puberulous, especially in groove, glabrescent in older parts, lenticels large, ovate, soon becoming transversely elongated, at first at basal and apical articulation only, in older leaves the whole petiolule becoming strongly rimose; lateral ones 0.5—1.8 cm, terminal ones (1.5—)2.4(—3.5) cm. *Leaflets* ovate to elliptic-ovate, herbaceous to subcoriaceous, glabrous, dull to nitidulous above, dull beneath, 5.0—11.6 cm long and (2.2—)3.5—4.0(—5.4) cm wide, apex gradually narrowed into a short and broad acumen; acumen rounded to cordate, mucronate, 0.8 cm long and 0.5 cm wide; base cuneate — especially in terminal leaflets — to rounded, somewhat decurrent, more or less unequal in lateral ones; margins entire; midrib grooved above on each side, distinctly more prominent than in *P. connarifolium*, prominent beneath, glabrous or nearly so; secondary nerves 8—10 pairs, prominulous above, prominent beneath; tertiary nerves conspicuous above, prominulous beneath; nerflets inconspicuous above, conspicuous beneath. *Inflorescences* axillary, main ramifications racemose, endings dichasial; ♂ inflorescences much branched, 5—15 cm long, peduncle very short, primary branchlets long (half the length of inflorescence), secondary branchlets 0.5—0.8 cm long, main axes terete and striate, smaller ones angular when dry, sparsely to very sparsely, greyish to ferruginously, minutely puberulous, bracts triangular, ferruginously puberulous; pedicels 0.1—0.3 cm, as long as flower or longer; ♀ inflorescence less branched, 4—8 cm long, peduncle  $\frac{1}{3}$ — $\frac{1}{2}$  the length of inflorescence, secondary branchlets 0.3—0.8 cm long. ♂ flower a typical 5-merous *Protium*-flower, cream-coloured (*Clemens* 10508); *calyx* cupuliform, sparsely puberulous, imbricate, lobes triangular, subacuminate, somewhat longer than tube; *petals*

Fig. 1 — *Protium serratum* (Wall. ex Colebr.). Engl., additional leaflet (*Kerr* 20300) — 2. *Bursera tonkinensis* Guill., flower; 3. flower, calyx and corolla removed; 4. ovary, cross-section; (2—4: *Balansa* 4034) — 5. *Protium javanicum* Burm. f., ovary, cross-section (*Herb. Kew.* 23/6/50-237); a: exocarpium; b: mesocarpium; c: endocarpium.

ovate, valvate near base, induplicate in upper part, apex acute, with in-crassate-inflexed apiculum, carnose, thinly ferruginously puberulous; *stamens* 10,  $\pm 1\frac{3}{4}$  mm long, anthers more or less basifix, oblong; *disc* annular, glabrous, 0.25—0.5 mm high; *ovary* at base surrounded by the disc, minutely puberulous,  $\pm 1$  mm high, distinctly 5-lobed; stigma sessile, 5-lobed. ♀ *flower* not seen. *Fruit* a drupe, obliquely ellipsoid, monopyrenous, 0.7 cm long and 0.5 cm wide, or 2—4-lobed and 2—4-pyrenous, 0.8 cm long and wide, in the latter case sometimes with remainders of a 5th cell, smooth, very sparsely ferruginously puberulous, glabrescent, green when young growing pale brown (*Clemens 10524 bis*, 10689), i. s. pale brown.

N.E. NEW GUINEA — Madang, Kani Mts, alt. 800 m: *Schlechter 16755* (BRSL), fr. XI, type spec. of *Santiria Schlechteri* Lauterb.; Morobe, Kajabit, Markham vall., alt. 250—300 m: *Clemens 10508* (A), ♂ VII; *ibid.*, *Clemens 10524bis* (A), fr. VIII; *ibid.*, Kajabit Mission vicinity, near village, planted for shade, alt. 300—350 m: *Clemens 10689* (A), fr. IX; *ibid.*, village: *Clemens 10847* (A), ♂ XI; *ibid.*, grassland, alt. 300 m: *Clemens 10855bis* (A), fr. XI; *ibid.*, *Clemens 10629 K* (A), ♂ IX.

**Remarks:** Lauterbach described his *Santiria schlechteri* on account of very incomplete material, which made him think that the flower should be 3-merous. The resemblance of the leaves with those of *Santiria apiculata* Benn., a species widely spread from Malaya to Polynesia, seemed to confirm his supposition that the specimen should represent *Santiria*.

On examination of the Berlin material, however, Lam (l. c. 321) found indications that the flower is rather 4-merous. Finding some similarity with *Protium connarifolium* (Perk.) Merr. from the Philippines, he combined the two species under the name of the latter. Later on, Swart (l. c. 260) shared this opinion, concluding that the two are at least closely related.

However, on re-examining the type material, kindly put at our disposal by the Director of the Botanical Institute at Wrocław (Breslau), showed that the flowers might well be 5-merous. On closer examination yet other differences from *P. connarifolium* (Perk.) Merr. were found, though also our present material is not fully complete. The main differences may be found in the key.

Curiously enough, *P. schlechteri* (Lauterb.) Leenhouts seems to be more closely related to the *serratum-javanicum* group than to *P. connarifolium* (Perk.) Merr., which seems to be rather isolated systematically.

**Uses:** Fruit eaten by the natives (*Clemens 10689*). Planted for shade (*Clemens 10689*).

**Distribution:** N.E. New Guinea.

#### Excluded species.

*Protium tonkinense* (Guill.) Engl. in Engl. Pr., Nat. Pfl. fam. ed. 2, 19a, 1931, 413; Lam, l. c. 321; Swart, l. c. 391 — *Bursera tonkinensis* Guill. in Rev. gén. bot. 19, 1907, 161; id. in Suppl. Fl. Gén. Indo-Chine, 1, 1946, 682.

We were fortunate enough to study the type and, as far as is known, single specimen of *Bursera tonkinensis* Guill., kindly put at our disposal by the Director of the Muséum d'Histoire Naturelle, Paris. There are two

sheets, both from *Balansa* (4034), and the material is incomplete. The general impression is that of a *Bursera*. Thusfar, however, that genus is only known from tropical America and it seems improbable that it should be represented by a single species in East Asia.

The flowers make the impression to be bisexual: the anthers are well developed in flowers with a fertile ovary. The latter is 3-celled and the cells are biovulate (fig. 2—4). Generally speaking, the difference between the development of the androecium and the gynaeceum is distinctly less than is found in the Asiatic *Protia*. The perianth is 5-merous and there are 10 stamens.

In addition, a cross-section through the ovary shows a picture very much different from that in *Protium*. The mesocarpium is less strongly developed and there are no traces of resiniferous ducts. The cross-section rather recalled that of the fruit of *Boswellia papyrifera* Hochst. (N.E. Africa; some other species of this genus are found in India), which shows, however, a very different habit. Cross-sections through ovaries of some *Bursera*-species seemed to resemble that of our *Protia* more closely than *Bursera tonkinensis* Guill. does. The above considerations made me exclude the species from *Protium*. Yet, the material does not allow to put it definitely in any other genus. It seems beyond doubt that it is a member of the tribe *Bursereae* and it seems probable that it is related to the American *Bursera* and possibly to the African-Asiatic *Boswellia*. Only full material, and particularly fruits, can lead to a definite conclusion.

*Icica? timoriensis* DC., Prodr., 2, 1825, 78; Don, Gen. Hist. Diehl. Pl., 2, 1832, 83; Decaisne, Herb. Timorensis, 1835, 149, Swart, l.c. 395 — *Spondias acida* Soland. in Herb. Banks, not of Blume, *nomen nudum* — *Spondias solandri* Benth. in Benth. et Mueller, Fl. Austr., 1, 1863, 492 — *Spondias pleiogyna* Mueller, Fragm. Phytogr. Austr., 4, 1863—'4, 78 — *Pleogynium solandri* (Benth.) Engl. in DC., Mon. Phan., 4, 1883, 255; F. Manson Bailey, Queensl. Fl., 1, 1899, 324; id., Compr. Cat. Queensl. Pl., 1909, 124; W. D. Francis, Austr. Rain-Forest Trees, 1929, 214; and in most recent literature.

= *Pleogynium timoriense* (DC) Leenhouts nov. comb.

As is already mentioned by Swart, l.c., this is no *Protium* and not even a *Burseraceae*. On examination of the specimen in the Herbarium at Geneva, which we were so fortunate as to have got on loan, being either the type or a duplicate of the type, it showed to be an *Anacardiaceae*, hitherto known as *Pleogynium solandri* (Benth.) Engl. As De Candolle's epitheton specificum *timoriensis* is the older one, the name *solandri* had to be rejected.

*Protium australasicum* (Bailey) Sprague in Kew Bull. 1912, p. 370; *Santiria ? spec.* Swart, l.c. 393.

= *Canarium australasicum* (Bailey) Leenhouts nov. comb.

This species will be discussed in a following paper.

#### List of collectors' numbers.

Only those numbers are inserted, which have been seen by the present author and are not mentioned by J. J. Swart (1942). The number in parentheses refers to the number of the species in the present paper.

Beccari 2192 (1; cult. Amboina.)  
Clemens 10508 (4); 10524bis (4); 10629 K (4); 10689 (4); 10847 (4); 10855bis (4).  
Demandt/van Dillewijn 618 (1).  
Dorgelo 929 (1); 1793 (1).  
Eballo 428 (3); 601 (3); 630 (3).  
Edaño 505 (3); 563 (3); 861 (3).  
Elbert 721 (1); 812 (1); 2036 (1); 3560 (1); 3680 (1); 3866 (1); 3932 (1);  
3986 (1); 4002 (1).  
Herb. Hookerianum s. n. (1).  
Hort. Bog. VII D. 69 (2).  
Jenkins s. n. (2).  
Mochtarno 2 (1).  
Neth. Ind. For. Serv. Ja 4315 (1); Ja 4911 (1).  
Simons s. n. (2).  
Sulit 3726 (3); 3767 (3).  
de Voogd 664 (1); 666 (1).  
White 8631 (2).  
Zollinger 3768 (1).