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THE GENUS PIPER (PIPERACEAE) IN NEW GUINEA, SOLOMON ISLANDS, AND AUSTRALIA, 1

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THIS PAPER, the first of a number to be published seriatim, is the outcome of an attempt to determine the collections made by the Royal Society Expedition to the Solomon Islands in 1965. It soon became clear in the investigation that reference had to be made to the New Guinean species of which more than one hundred have been described or recorded. Thus I was led to examine the very rich collections housed in the herbaria at Bogor (where types and authentic materials of earlier binomials are kept), Brisbane, Canberra, Lae, Singapore, and Sydney. In all, about 560 collections representing thirty-seven species have been studied. This resulted in twenty-two species being found conspecific with the fifteen dealt with in this paper. Also some of these have their ranges of distribution extended, while two Australian species have been found to be similar to New Guinean ones.

The presentation of the species in this series is very concise. Synonymy and literature references are kept at the minimum and descriptions are reduced to a diagnostic type. Detailed presentation is being reserved for the final comprehensive revision.

1. **Piper abbreviatum** Opiz in Presl, Rel. Haenk. 1: 157. 1828; Quisumbing, Philip. Jour. Sci. 43(1): 58. 1930.

P. bivalvantherum C.DC. Nova Guinea Bot. 8(2): 417. 1910, *syn. nov.*
P. internibaccum C.DC. *l.c.* 420. 1910, *syn. nov.*
P. fragrans Trelease, Jour. Arnold Arb. 9: 147. 1928, *syn. nov.*

TYPE. Philippine Islands. Luzon: *Haenke s.n.* (PR).

ICON.: Quisumbing, *l.c. fig. 24 & 25.* 1930.

Dioecious glabrous climbers. *Lamina* shortly petiolate, elliptic, ovate to broad ovate, ca. 10 cm. long, 5 cm. broad, length:breadth ratio ca. 2:1, glabrous on both sides; apex acute to acuminate; base cuneate to rounded, symmetrical; lateral veins 4 pairs, the lowermost pair very short, arising from the base, the 2nd and 3rd usually long, arising from the midrib

a little above the base, the distal 4th pair very short, often absent, arising from the midrib near the apex. *Stipules* to 1.5 cm. long, often shorter, usually as long as petioles. *Inflorescences* shorter than leaves, peduncular stalks ca. 1.5 cm. long, usually as long as petioles, males thin, to 6 cm. long, females shorter and thicker, ca. 2 cm. long, 0.8 cm. broad. *Male flowers* 2-staminate; stamens ca. 1 mm. long; anthers reniform to subglobose, 2-valved, slightly shorter than filaments; bracts peltate, subsessile, orbicular, the very short pedicel stout, hirsute. *Female flowers* sessile; stigmas 3- or 4-fid, sessile; bracts orbicular, peltate, sessile. *Fruits* sessile, entirely concrescent at maturity.

DISTRIBUTION. Philippines, Java, Celebes, Moluccas, New Guinea, Bismarck Archipelago, and Solomon Islands.

West New Guinea. SOUTHERN. Noord-rivier. Bivakeiland: *Versteeg 1058*, May (type of *P. bivalvantherum*, BO); *Versteeg 1021*, May (type of *P. internibaccum*, BO). VOGELKOP. Aifat River Valley: *van Royen & Sleumer 7052*, Oct. (LAE); Djitmau: *Versteegh BW. 7367*, May (CANB, LAE).

N.E. New Guinea. MOROBE DIST. Lae: *Millar GH 99*, March (BRI) & *NGF 9930* (BRI, LAE); Oomsis: *Brass 29201*, Apr. (CANB, LAE); *White NGF. 10474*, March (BRI, LAE); Wau-Salamaua Rd.; *Womersley & Millar NGF 8485*, Jan. (LAE).

Papua. CENTRAL DIV. Iawarere: *Brass 701*, Nov. (type of P. *fragrans*, BRI); near Sogeri: *Schodde 2927*, Sept. (BRI, LAE). MILNE BAY DIST. Dulubi village: *Henty NGF 16960*, June (BRI, CANB, LAE, NSW); Modewa: *Brass 28864*, Dec. (LAE). NORTHERN DIV. Pitoki village: *Hoogland 3973*, Sept. (BRI, CANB, LAE).

Bismarck Archipelago. NEW BRITAIN. Trans Vudal: *Streimann NGF 44396*, Aug. (LAE).

Solomon Islands. BOUGAINVILLE. Buin: *Kajewski 2047 & 2175*, Aug. (BRI, NSW); Lake Loloru: *Craven & Schodde 145*, July (BRI, CANB, LAE); *Lavarack & Ridsdale NGF 31475*, Feb. (LAE); *Schodde & Craven 3771*, Aug. (BRI, CANB, LAE).

Two types of leaf forms have been observed to occur in the individual plant. Leaves borne on the climbing stems are usually broad to very broad ovate with somewhat cordate bases. Those borne on free side branches tend to be narrow ovate to elliptic and often larger (e.g. *Schodde & Craven 3771* and *Kajewski 2047*). It is on such a variation that De Candolle's *P. bivalvantherum* and *P. internibaccum* as well as Trelease's *P. fragrans* are based.

The New Guinean and Solomon Islands' populations differ slightly from those in the Philippines. In the former, the lower part of the lamina is usually furnished with three pairs of lateral veins, the lowermost pair of which is often very short and faint. In the Philippine populations, however, the lowermost pair is altogether absent.

I am certain Rumphius' *Pharmacum magnum parvifolium* from Ternate, which Merrill (1917) failed to interpret, is referable to this species. The characteristic abbreviated infructescence and the venation of the small ovate leaves as clearly illustrated by Rumphius, leaves its identity in no doubt whatsoever.

Piper abbreviatum is not to be confused with *P. fragile* with which it has many characteristics in common (see note under that species).

2. **Piper aduncum** L. Sp. Pl. 29. 1753; C.DC. in DC. Prodr. 16(1): 285. 1869.

Stephensia aduncа (L.) Kunth, Linnaea 13: 633. 1839.
Artanthe aduncа (L.) Miq. Comm. Phyt. 49. *tab. 4.* 1840; Syst. Piperac. 449. 1844.

Icon.: Miq. *l.c. tab. 4.* 1840; Koord. Exk. Fl. Java 4: 451. fig. *728.* 1924.

Monoecious shrubby trees. *Lamina* ovate, ca. 16 cm. long, 5 cm. broad, length:breadth ratio ca. 3:1, hispidulous; apex long acuminate; base lightly asymmetrically cordate; lateral veins 6–7 pairs arising alternately from the midrib, 1 or 2 short ones directly from the base. *Petiole* slightly longer than the sinus of the lamina base, shorter than the peduncular stalk. Inflorescences often bisexual, usually curved, as long as leaves, with flowers borne in dense spirals; peduncular stalk ca. 2 cm. long. *Male flowers* 2- or 3-staminate; bracts peltate, somewhat triangular. *Female flowers* sessile; stigmas 3-fid, sessile. *Fruits* sessile, obpyramidal, somewhat truncate.

Distribution. Mexico, Central America, northern South America, and West Indies. Naturalized in many places in Malesia.

West New Guinea. Northern. Hollandia. Polimac: *v.d. Sijde BW 4155*, Jan. (LAE). Waigeo Island. Majalibit Bay: *van Royen 5278*, Jan. (LAE).
N.E. New Guinea. Morobe Dist. Lae Botanic Gardens: *Native coll. NGF 4719*, Dec. (BO, BRI, LAE, NSW, SING); Huon Peninsula. Pindiu: *Hoogland 8847*, Apr. (BRI, CANB, LAE).

Being a native of the New World Tropics, this species bears no relationship whatsoever to any Malesian and Australasian native. Its closest American ally is *Piper hispidum* which has also been introduced into Java. From the few collections available for my study, *P. hispidum* seems to be only a less hispid version of *P. aduncum*.

I have made no comments on the type of *Piper aduncum*. Being a Linnaean species, based on pre-Linnaean ones, its typification is very involved, and can only be sorted out in the older herbaria of Western Europe where much pre-Linnaean literature and many collections are still extant. For the present work, I adopt the interpretation of Miquel and De Candolle.

3. **Piper amboinense** (Miq.) C.DC. in DC. Prodr. 16(1): 347. 1869; Merrill Interpret. Herb. Amb. 182. 1917; Holth. & Lam, Blumea 5: 173. 1942.

Chavica amboinensis Miq. Ann. Mus. Bot. Lugd. Bat. 1: 134. 1863, incl. var. *latifolia* Miq. *l.c.* 140. 1863.

TYPE: Moluccas. Amboina: *Forsten*, May (L). FIGURE 1.

Dioecious climber, entirely glabrous. *Lamina* very shortly petiolate; ovate to oblong, somewhat rugose, 30 cm. long, 14 cm. broad, length: breadth ratio ca. 2:1; apex bluntly acuminate; base unilaterally cordate; lateral veins 4–5 pairs, the broader side often with 2 or 3 veins more, the two distal pairs arising from the midrib, the rest directly from the base. *Petioles* ca. 1 cm. long. Inflorescences shorter than leaves; peduncular stalks longer than petioles. *Male flowers* 2-staminate; anthers reniform,

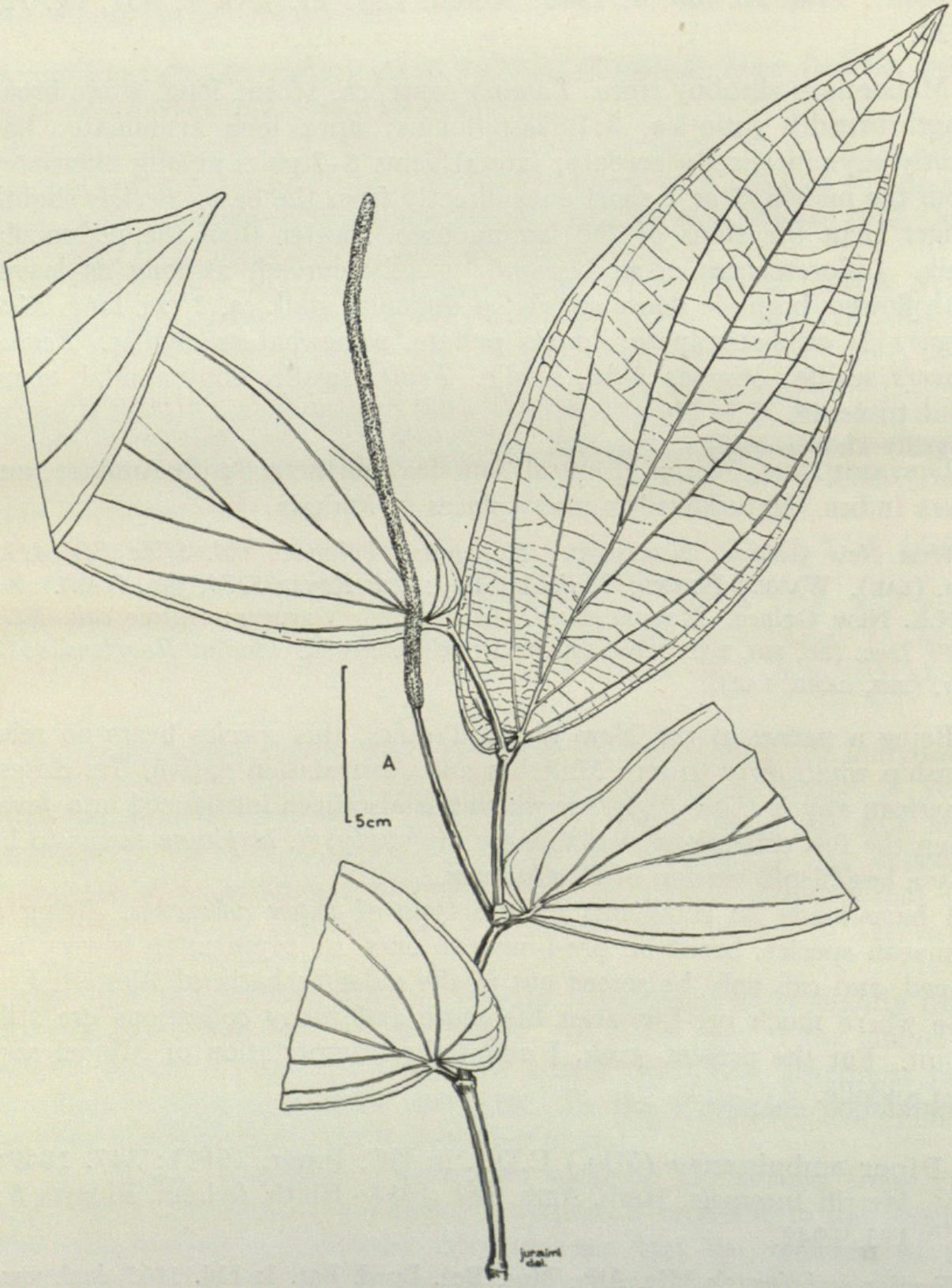

FIGURE 1. **Piper amboinense.** ♀ twig, from type.

bracts peltate, rounded. *Female flowers* sessile; stigmas 3-fid, sessile. *Infructescences* often slightly longer than the leaves. *Fruits* sessile, somewhat cylindrical, free.

DISTRIBUTION. Celebes, Moluccas, and New Guinea.

Celebes. MAKASSAR PENIN. Pangkadjene: *Teysmann 11717* (BO).
Moluccas. AMBOINA. Batoe Gadjah: *Robinson Pl. Rumph. Amb. 58* (NSW); Ema: *Teysmann s.n.* (BO).
West New Guinea. Sine loc.: *Boorsma 2* (BO).

This species is very close to *Piper majusculum* from which it differs principally in the shorter female inflorescences, the less cordate lamina base, the very short petioles, and the fewer, differently patterned lateral veins.

The species has been erroneously recorded for Borneo by Holthuis and Lam (1942) who based their claim on one of Elmer's collections distributed as *Piper amboinense*. I have seen this collection and agree with Merrill (in Pl. Elm. Born. 40. 1929) that this is a misidentification. Elmer's specimen belongs to *P. majusculum*.

The New Guinean collection cited above seems to be not only the first record but also the only one for that island. I have included in the citation materials from Celebes and Moluccas as these collections had actually been authenticated by De Candolle and, as far as Teysmann's materials are concerned, actually by Miquel himself.

4. **Piper caninum** Bl. Verh. Bat. Genoot. **11**: 214. 1826; C.DC. in DC. Prodr. **16**(1): 341. 1869; Warb. Bot. Jahrb. **13**: 283. 1891; K. Sch. & Laut. Fl. Schutzgeb. 257. 1900.

Cubeba canina (Bl.) Miq. Syst. Piperac. 293. 1843.
P. banksii Miq. Versl. Med. Akad. ser. 9. **2**: 61. 1868; C.DC. Bot. Jahrb. **55**: 207. 1918; Benth. Fl. Austral. **6**: 205. 1873, *syn. nov.*
P. lauterbachii C.DC. in K. Sch. & Laut. Fl. Schutzgeb. 255. 1900, *syn. nov.*
P. macrocarpum C.DC. Nova Guinea Bot. **8**(2): 421. 1910, *syn. nov.*
P. pubipes C.DC. *l.c.* 421. 1910, *syn. nov.*
P. kietanum C.DC. Denkschr. K. Akad. Wiss. M.-N. Kl. Wien **89**: 527. 1914, *syn. nov.*
P. flavifructum Trelease, Jour. Arnold Arb. **9**: 147. 1928, *syn. nov.*

TYPE. Java: *Blume* (L).

ICON.: Bl. Verh. Bat. Genoot. **11**: *fig. 26.* 1826; Quisumbing, Philip. Jour. Sci. **43**(1): 121. *fig. 62.* 1930.

Dioecious climber. *Twigs* and petioles pilose. *Lamina* shortly petiolate, ovate, ca. 14 cm. long, 7 cm. broad, length:breadth ratio ca 2:1, glabrous on the upper side, subglabrous to pubescent on the lower side; apex long acute to acuminate; base slightly asymmetrically rounded to shallowly cordate; lateral veins 3–4 pairs, the distal pair arising from the midrib at ca. 2–3 cm. from the base, the rest directly from the base. *Petioles* ca.

2 cm. long. *Female inflorescences* up to as long as leaves, not densely flowered; peduncular stalk pilose, slightly longer than petioles. *Female flowers* sessile when young; stigma 4-fid, reflexed, sessile; bracts peltate, sessile. *Infructescences* often longer than leaves. *Fruits* ca. 4 × 3 mm. pedicellate, ovoid to globose.

DISTRIBUTION. Widely distributed in Malesia through New Guinea to the Solomon Islands and Australia.

West New Guinea. CENTRAL. Sabang: *Branderhorst 330* (isotype of *P. macrocarpum*, BO). Sine loc.: *Atasrip 64*, Exped. Wichmann (isotype of *P. pubipes*, BO); *Boorsma 4* (BO); *Branderhorst 425*, June (BO).

N.E. New Guinea. MADANG DIST. Aiome: *Frodin NGF 26954*, June (LAE). MOROBE DIST. Finschhafen: *Lauterbach 1337* (isotypes of *P. lauterbachii*, BO, BRI, SING); Oomsis: *Brass 29175*, April (LAE). SEPIK DIST. Ambunti: *Hoogland & Craven 10114*, May (BRI, LAE).

Papua. CENTRAL DIV. Dieni: *Brass 3926 & 3966*, May (BRI); Domara River: *Brass 1644*, June (isotype of *P. flavifructum*, BRI). MILNE BAY DIV. Normanby Island. Waikaiuna: *Brass 25390*, April (LAE).

Bismarck Archipelago. NEW BRITAIN. Gasmata: *Sayers NGF 24171*, March (LAE, NSW).

Solomon Islands. BOUGAINVILLE. Buin: *Kajewski 1782*, May (BRI). GUADALCANAL. Mt. Tutuve: *Kajewski 2646*, May (BRI). NEW GEORGIA. Vaimbu River: *Cowmeadow BSIP 4762*, Sept. (LAE). SAN CRISTOBAL. Maru Bay: *Gafui BSIP 12829*, Nov. (LAE).

Australia. QUEENSLAND. Cape Tribulation: *Mason s.n.*, July (NSW); Rockingham Bay: *Dallachy s.n.* (BO, NSW).

This widespread and consequently very well known species needs no introduction. Though quite variable in lamina form and infructescence size, it is easily recognized throughout its entire range of distribution. I have examined the types and authenticated materials of the synonyms cited above and have found that they come within the circumscription of this species as established by Blume and adopted by De Candolle and subsequent authors.

5. **Piper decumanum** [Rumph.] Linnaeus in Stickman, Herb. Amb. 19. 1754; Amoen. Akad. 4: 128. 1759; Merrill, Interpret. Herb. Amb. 181. 1917.

Sirium decumanum Rumph. Herb. Amb. **5**: 45. *tab. 27*. 1747.
Chavica majuscula (Bl.) Miq. Syst. Piperac. 271. 1843, *partim*.
Ch. imperialis Miq. Ann. Mus. Bot. Lugd. Bat. **1**: 134, 140. 1863.
Ch. rumphii Miq. *l.c.* 141. 1863.
P. forstenii C.DC. in DC. Prodr. **16**(1): 348. 1869; Nova Guinea Bot. **8**(6): 1007. 1914; Gibbs, Phyt. Fl. N. Guinea 207. 1917.
P. rumphii (Miq.) C.DC. in DC. Prodr. **16**(1): 354. 1869.
P. majusculum auct. *non* Bl., C.DC. *ibid.* 350. 1869, *partim*.

TYPE. Moluccas: *Rumph. Herb. Amb. 5: tab. 27*. 1747.

ICON.: Rumph. *l.c.*; Quisumbing, Philip. Jour. Sci. 43(1): 43. *fig. 14.* 1930.

Dioecious climber, completely glabrous. *Lamina* very shortly petiolate, ovate, often rugose, ca. 40 cm. long, 18 cm. broad, length:breadth ratio ca. 2:1; apex acute to bluntly acuminate; base asymmetrically cordate to auriculate; lateral veins 4–6 pairs, the distal pair arising alternately from the midrib, the rest from the base, the larger side usually with 2–3 veins more. Petioles often shorter than the auriculate base, sheathing at the lower half. *Male inflorescences* about as long as the leaves. *Female inflorescences* much longer; peduncular stalks as long as petioles. *Female flowers* sessile; stigmas 2-lipped to 3-fid, borne on tapering styles. *Infructescences* to 60 cm. long. *Fruits* ca. 3 × 1.5 mm., oblong, sessile, congested.

DISTRIBUTION. Philippine Islands, Celebes, Moluccas, and New Guinea.

West New Guinea. NORTHERN. Sawaii: *Gjellerup 599*, Aug. (BO). VOGELKOP PENINSULA. Manokwari: *Schram BW 12924*, March (LAE). WAIGEO ISLAND. Radjah Ampat: *van Royen 5215*, Jan. (CANB, LAE).

N.E. New Guinea. MADANG DIST. near Aiome: *Womersley NGF 24752*, June (LAE). SEPIK DIST. Ossima: *Streimann & Kairo NGF 39196*, Jan. (LAE).

Linnaeus based *Piper decumanum* entirely on Rumphius' *Sirium decumanum* from the Moluccas. Unfortunately, he later (1762) extended the concept to include an entirely different species described by Plumier from the American Tropics: unfortunately, because this led to some confusion on the use of the name *P. decumanum*.

The error was noticed by Miquel (1843) and De Candolle (1869) who quite rightly separated Plumier's species from the Moluccan one; but both erred in other respects. They incorrectly retained the epithet for the American species and placed our Moluccan one under *Piper majusculum*, an entirely different species (see notes there). It was not until 1917 that the matter was corrected by Merrill.

The basal leaves of this species differ greatly from the upper ones in being almost symmetrically ovate with deeply symmetrically cordate bases. Both *Sirium decumanum* of Rumphius and *Chavica rumphii* of Miquel are based on plants with such leaves.

I have seen authenticated materials of *Piper forstenii*, under which name De Candolle recorded our species from New Guinea, and I am satisfied that *P. forstenii* was correctly referred to *P. decumanum* by previous authors.

6. **Piper fragile** Benth. Lond. Jour. Bot. 2: 234. 1843; C.DC. in DC. Prodr. 16(1): 358. 1869; Nova Guinea Bot. 8(2): 417. 1910.

Chavica benthamiana Miq. Syst. Piperac. 233. 1843.

TYPE. New Guinea: *Hinds s.n.* (K).

ICON.: Quisumbing, Philip. Jour. Sci. 43(1): 100. *fig. 50.* 1930.

Dioecious climber, entirely glabrous. *Lamina* shortly petiolate, ovate, ca. 8 cm. long, 6 cm. broad, length:breadth ratio ca. 4:3; apex acute; base rounded, often subpeltate, rather coriaceous; lateral veins 2 pairs, often with one more very short and faint pair at the very base, all arising from the base. *Petioles* ca. 1/4 the length of lamina. *Inflorescences* shorter than leaves; the females very short; densely flowered in both; peduncular stalks as long as petioles; bracts peltate, sessile. *Male flowers* with 2 stamens; filaments very short, oblong; anthers ovoid, as long as filaments, 2-valved. *Female flowers* sessile; stigmas 4-fid, reflexed, sessile. *Infructescences* shorter than leaves, often congested and curved. *Fruits* ca. 3 mm. diam., almost globose, concrescent at the lower half.

DISTRIBUTION. Philippines, Moluccas, New Guinea, and Solomon Islands.

West New Guinea. Sine loc.: *Boorsma 9* (BO).

N.E. New Guinea. MADANG DIST. Bagabag Island: *Vandenberg & Mann NGF 42263*, June (LAE); Serang: *Millar NGF 37693*, July (LAE). WEST SEPIK DIST. Selio Island: *Millar & Vandenberg NGF 40900*, June (LAE).

Papua. MILNE BAY DIV. Wagalasa Island: *Mann & Osborn NGF 43037*, March (LAE).

Solomon Islands. BOUGAINVILLE: *Kajewski 1595*, March (BRI). GUADALCANAL. Rove West: *Nakisi BSIP 7919*, June (LAE); *Corner RSS 193*, Nov. (SING).

This species can easily be confused with *Piper abbreviatum* with which it has a few characteristics in common. In both, the lamina are small and ovate with few veins, the female inflorescences rather short and "abbreviated," and the fruits concrescent. A detailed examination of these characters, however, reveals important differences between the two species. In *P. fragile*, all the lateral veins arise from the very base which is often subpeltate; whereas in the other species this is not so. In the female flowers and fruits, the sigmas are 3-fid and the fruits entirely concrescent in *P. abbreviatum*; but they are 4- or 5-fid and the fruits only partially concrescent in *P. fragile*.

Piper varibracteum C.DC. (1910) of the Philippines probably is a synonym of *Piper fragile*, but the type material of it must be examined before its relationship to *P. fragile* can be assessed with certainty.

7. **Piper gibbilimbum** C.DC. Nova Guinea Bot. 8(2): 416. 1910; Bot. Jahrb. **55**: 211. 1918.

P. squamuliferum C.DC. Nova Guinea Bot. 8(6): 1009. 1914, *syn. nov.*

TYPE. West New Guinea. Noord-rivier, near Alkmaar: *Versteeg 5115*, July (BO). FIGURE 2.

Dioecious trees. *Lamina* very shortly petiolate, asymmetrically ovate, ca. 15 cm. long, 9 cm. broad, length:breadth ratio ca. 3:2 to 5:3, generally glabrous, sometimes lightly hirsute on the veins on the under side, brown puncticulate on both surfaces; apex acuminate; base unilaterally

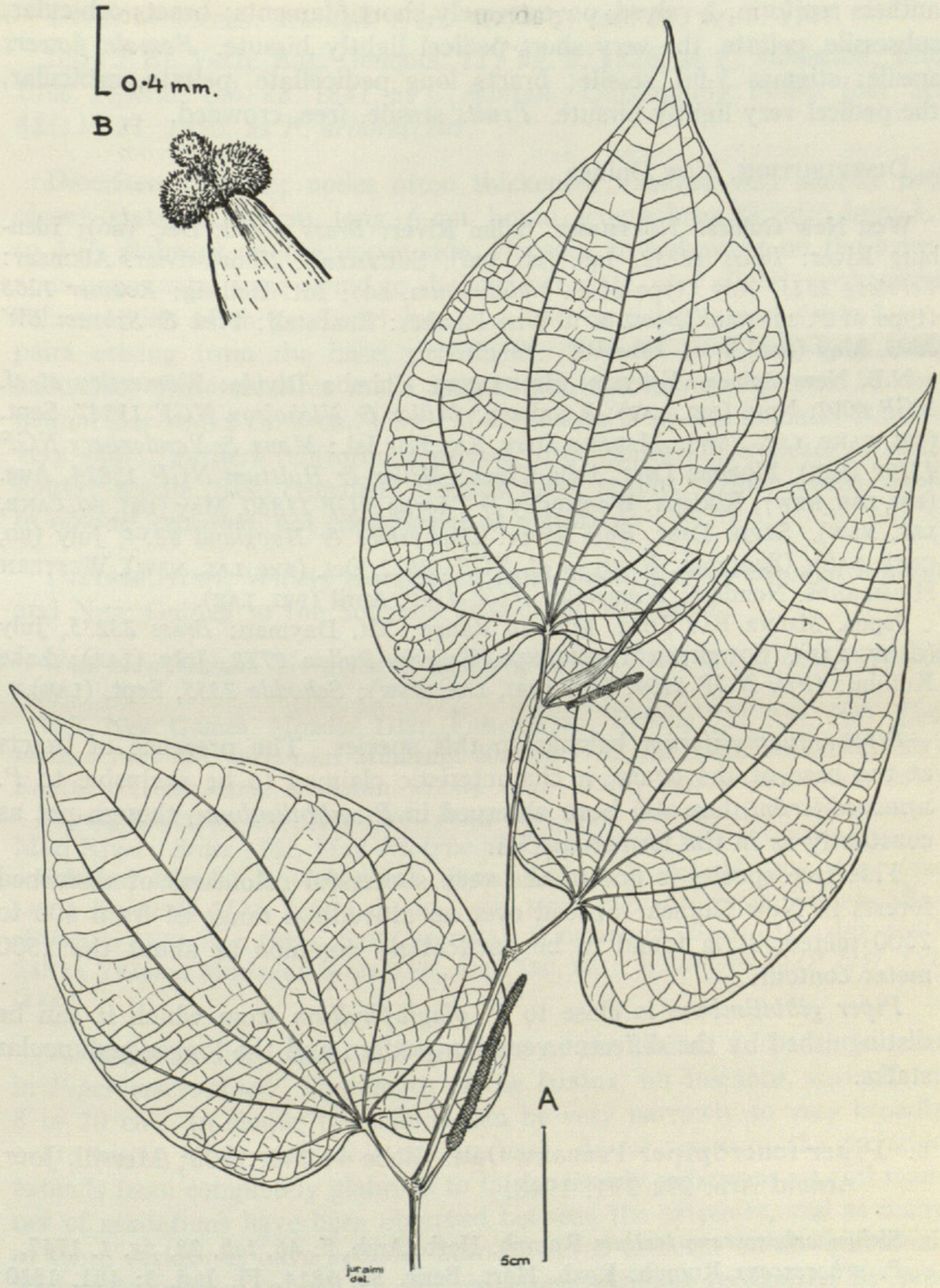

FIGURE 2. **Piper gibbilimbum.** A, ♀ twig; B, stigma, from *Brass 12252*.

to asymmetrically cordate, those of the basal leaves usually deeply symmetrically cordate; lateral veins 3 or 4 pairs, all arising from the base, the broader side often with one more faint vein. *Stipules* thin, ca. 2 cm. long, usually as long as petioles. *Inflorescences* usually shorter than adult leaves; peduncular stalks usually as long as petioles, male and female equal in length. *Male flowers* 2-staminate; stamens ca. 0.4 mm. long;

anthers reniform, 2-valved, on extremely short filaments; bracts orbicular, subsessile, peltate, the very short pedicel lightly hirsute. *Female flowers* sessile; stigmas 3-fid, sessile; bracts long pedicellate, peltate, orbicular, the pedicel very lightly hirsute. *Fruits* sessile, free, crowded.

DISTRIBUTION. New Guinea.

West New Guinea. NORTHERN. Balim River: *Brass 11671*, Dec. (BO); Idenburg River: *Brass 12252*, Jan. (BO, BRI). SOUTHERN. Noord-rivier. Alkmaar: *Versteeg 1515*, July (type of *P. gibbilimbum*, BO); Mt. Hellwig: *Roemer 1268* (type of *P. squamuliferum*, BO); Wissel Lakes: Enarotali: *Vink & Schram BW 8593*, May (LAE).

N.E. New Guinea. EASTERN HIGHLANDS. Chimbu Divide: *Womersley et al. NGF 6097*, Nov. (BRI, LAE); Kundiava: *Millar & Nicholson NGF 13847*, Sept. (BRI, CANB, LAE, NSW). MADANG DIST. Kar Kar Isl.: *Mann & Vandenberg NGF 43192* (LAE). MOROBE DIST. Edie Creek: *Millar & Holttum NGF 15824*, Aug. (BRI, LAE, NSW); Kikiepa: *Womersley & Thorne NGF 11860*, May (BRI, BO, CANB, LAE, NSW). SEPIK DIST. Bliri River: *Darbyshire & Hoogland 8254*, July (BO, CANB, LAE); Oksapmin: *Henty et al. NGF 38972*, Oct. (BRI, LAE, NSW). WESTERN HIGHLANDS. Nondugl: *Womersley NGF 4349*, April (BRI, LAE).

Papua. MILNE BAY DIST. Maneau Range: Mt. Dayman: *Brass 23235*, July (CANB, LAE). SOUTHERN HIGHLANDS. Kuave: *Pullen 2778*, July (LAE); Lake Kutubu: *Gray NGF 8109*, May (BRI, LAE, NSW); *Schodde 2355*, Sept. (LAE).

Piper squamuliferum belongs to this species. The presence of bracts at the base of the ovary, a characteristic claimed to be exclusive to *P. squamuliferum*, has also been observed in *P. gibbilimbum*, though not as constantly as in the former species.

This tree species is one of the very successful colonizers of disturbed forests in New Guinea. Spread over an altitudinal range of from 800 to 2600 meters, it is found to be particularly common at about the 1500 meter contour.

Piper gibbilimbum is close to *P. plagiophyllum* from which it can be distinguished by the different venation pattern and the longer peduncular stalks.

8. **Piper macropiper** Pennant, Outl. Globe **4**: 242. 1800; Merrill, Jour. Arnold Arb. **29**: 191. 1948.

Sirium arborescens tertium Rumph. Herb. Amb. **5**: 46. *tab. 28, fig. 1*. 1747.
P. arborescens Rumph. Roxb. Hort. Beng. 80. 1814, Fl. Ind. **1**: 161. 1820; Miq. Syst. Piperac. 320. 1844; C.DC. in DC. Prodr. **16**(1): 358. 1869; Merrill, Interpret. Herb. Amb. 180. 1917.
P. miniatum Bl. Verh. Bat. Genoots. **11**: 166. 1826; K. Sch. & Laut. Fl. Schutzgeb. 261. 1900; C.DC. Nova Guinea Bot. **8**(2): 415. 1910.
Chavica miniata (Bl.) Miq. Syst. Piperac. 234. 1843.
P. pendulum Warb. Bot. Jahrb. **13**: 283. 1891, *syn ?*
P. quinquenervium Warb. *l.c.* 284. 1891, *syn.?*
P. brassii Trelease, Jour. Arnold Arb. **9**: 147. 1928, *syn. nov.*
P. morianum Trelease, *l.c.* 148. 1928, *syn. nov.*

TYPE. Moluccas: *Rumph. Herb. Amb. 5: tab. 28, fig. 1.* 1747.

ICON.: Bl. Verh. Bat. Genoots. 11: *fig. 6.* 1826, as *P. miniatum*; Miq. Illus. Piperac. *tab. 28.* 1847, as *C. miniata*; Quisumbing, Philip. Jour. Sci. 43(1): 21. 1930, as *P. arborescens.*

Dioecious climber; nodes often thickened. *Lamina* very shortly petiolate; ovate, ca. 16 cm. long, 6 cm. broad, length:breadth ratio from 2:1 to 5:2, glabrous on the upper side, glabrous to pubescent on the lower; apex acuminate; base round to shallowly cordate, very slightly asymmetrical, one side often produced into a minute auricle; lateral veins 2 or 3 pairs arising from the base, prominent. *Stipules* to 2 cm. long, early caducous. *Inflorescences* much longer than the leaves, often to 20 cm.; peduncular stalks ca. 3 cm. long. *Male flowers* 2- or 3-staminate; stamens very short; anthers reniform, 2-valved, often appearing truncate. *Female flowers* sessile, free, crowded; stigmas 3-fid, sessile. *Fruits* sessile, ovoid to oblong, crowded, not concrescent at maturity.

DISTRIBUTION. Widely distributed from India, Ceylon through Malesia and New Guinea to the Solomon Islands in Melanesia.

West New Guinea. NORTHERN. Idenburg River: *Brass 13710 & 13976*, Jan. (BRI).

N.E. New Guinea. MOROBE DIST. Finschhafen: *Hellwig 624*, Apr. (BO); *Lauterbach 1489* (BO, BRI); near Mumeng: *Hartley 9765*, Jan. (BRI, CANB, LAE, NSW). EASTERN HIGHLANDS. Kainantu: *Henty NGF 29361*, March (BRI, CANB, NSW).

Papua. CENTRAL DIV. Iawarere: *Brass 683*, Nov. (isotype of *P. brassii*, BRI); Mori River: *Brass 1562*, May (isotype of *P. morianum*, BRI).

Solomon Islands. BOUGAINVILLE. Buin: *Craven & Schodde 201*, Aug. (BRI, LAE); *Kajewski 2133*, Aug. (BO, BRI, NSW, SING). GUADALCANAL. Tutuve Mts.: *Kajewski 2579*, Apr. (BRI). SAN CRISTOBAL. Waimamura: *Brass 2581, Aug.* (BRI). SANTA YSABEL. Meringe: *Brass 3347*, Dec. (BO, BRI); *Whitmore BSIP 2257*, Oct. (LAE).

Variation in size, shape and vestiture of the lamina and twig is great in *Piper macropiper.* The length of the lamina, for instance, varies from 8 to 20 cm. In shape, the lamina can be very narrowly to very broadly ovate with a fairly noticeable cordate base. As for vestiture, the variation extends from completely glabrous to fairly densely pubescent. As all manner of gradations have been observed between the extremes, and as many of these variations have actually been observed to occur on an individual, Trelease's species as well as the numerous varieties recognized by previous authors are not maintained here. Nevertheless, this species remains one of the most distinctive in the genus.

In the Herbarium at Bogor, Indonesia, there is a collection of Lauterbach *no. 1489* and one of Hellwig *624* named by De Candolle as *Piper pendulum* and *P. quinquenervium* respectively. These collections have been found by me to belong to *Piper macropiper*, and the names they bear are placed in the synonymy above, each with a query because their types have not been examined.

This species has suffered two name changes, the latest of which is most unfortunate because it was caused by the discovery of an overlooked publication (*vide* Merrill 1948).

9. **Piper majusculum** Bl. Verh. Bat. Genoots. 11: 210. 1826; C.DC. in DC. Prodr. 16(1): 350. 1869, partim; Quisumbing, Philip. Jour. Sci. 43(1): 45. 1930.

Chavica majuscula (Bl.) Miq. Syst. Piperac. 271. 1843, *partim*.
P. insignilimbum C.DC. Candollea 2: 219. 1925, *syn. nov.*

TYPE. Java. Mt. Salak: *Blume* (L).

ICON.: Bl. Verh. Bat. Genoots. 11: *fig. 25*. 1826; Quisumbing, Philip. Jour. Sci. 43(1): 46. *fig. 16*. 1930.

Dioecious climber. *Lamina* shortly to very shortly petiolate, ovate to pentagonal, ca. 30 cm. long, 15 cm. broad, length-breadth ratio ca. 2:1, sparsely hirsute on the midrib below; apex shortly acuminate; base asymmetrically cordate, one or both sides auriculate; lateral veins ca. 6 pairs, all arising from the midrib, the auricles usually with 2–3 more short and rather faint veins arising from the base. *Petioles* ca. 2 cm. long, usually shorter than the sinus of the lamina base. *Inflorescences* very much longer than leaves, very densely flowered; peduncular stalks longer than petioles. *Female flowers* sessile; stigmas 3-fid, sessile; bracts peltate, sessile, glabrous. *Infructescences* ca. 35 cm. long, 2 cm. diam., pendulous. *Fruits* concrescent.

DISTRIBUTION. Widely distributed in Malesia, through New Guinea to the Solomon Islands.

West New Guinea. BIAK. Oregontrail: *Vink BW 12052*, July (CANB, LAE). VOGELKOP PENINSULA. Manokwari: *Versteegh BW 7572*, April (LAE); Nabire: *Kanehira & Hatusima 11531 & 12643* (BO). Sine loc.: *Boorsma 3 & 13* (syntypes of *P. insignilimbum*, BO).

Papua. GULF DIV. Kikori. Biara: *Gray & Floyd NGF 8050*, July (BRI, LAE).

Solomon Islands. GUADALCANAL. Mt. Mambulu: *Nakisi BSIP 7914*, June (LAE). SANTA YSABEL. Maloku: *Beer BSIP 7259*, May (LAE).

I have examined the holotype of *Piper insignilimbum* and having compared it with authentic materials of Blume's species, I am quite satisfied that it is conspecific with *Piper majusculum*. The only difference I can find between the two is in the petiole which seems to be slightly shorter in the New Guinea and Solomon Island plants.

It is not surprising that Miquel and De Candolle confused Rumphius' *Sirium decumanum* (= *Piper decumanum*) with *Piper majusculum*. In the first place, the lamina of the latter are rather similar to the basal leaves of *P. decumanum* in that both are cordate and often auriculate at the base. Rumphius' illustration clearly depicts a plant with such basal leaves. Secondly, both species are notable by their greatly elongated female inflorescences which, being densely covered with flowers, become

pendulous at maturity. The two species, however, differ clearly in the following characters: (a) the stigmas in *P. majusculum* are 3-fid, small and sessile, in *P. decumanum* they are 2-lipped or 3-fid and borne on tapering styles, (b) the fruits are concrescent in *P. majusculum* but free in *P. decumanum*.

10. **Piper mestonii** Bailey, Rep. Exped. Bellenden-Ker 54. 1889; Lam, Vegetationsbilder **15**(5/6): 5. 1924.

P. rueckeri K. Sch. & Hollrung, Fl. Kais. Wilh. Land. 36. 1889; C.DC. Bot. Jahrb. **55**: 204. 1918, *syn. nov.*
P. bilobulatum C.DC. Nova Guinea Bot. 8(2): 418. 1910, type only, *syn. nov.*
P. rhodocarpum Trelease, Jour. Arnold Arb. **9**: 149. 1928, *syn. nov.*

TYPE. Australia. Queensland. Harvey's Creek. Russell River: *Meston & Bailey s.n.* (isotype of *P. mestonii*, NSW).

ICON.: Bailey, Compr. Cat. Queensl. Pl. *tab. 12, fig. 402*. 1913.

Dioecious climber. *Twigs* glabrous, nodes fairly prominent. *Lamina* moderately petiolate, ovate, ca. 20 cm. long, 14 cm. broad, length:breadth ratio ca. 3:2, glabrous; apex acute to bluntly acuminate; base rounded to cordate at maturity; lateral veins ca. 4 pairs, the distal pair arising alternately ca. 1/3 up the midrib, the 2nd pair slightly above the base, the rest directly from the base. *Stipules* much shorter than petioles. *Inflorescences* shorter than leaves, peduncular stalks glabrous, as long as petioles; males thinner and shorter; bracts orbicular, sessile. *Female flowers* sessile; stigmas 2-lipped, on long attenuate styles. *Infructescences* ca. 12 cm. long, 1.5 cm. diam., brick red at maturity. *Fruits* sessile, completely concrescent at maturity.

DISTRIBUTION. New Guinea and Australia.

West New Guinea. NORTHERN. Begowri: *Gjellerup 219*, June (BO); Hollandia: *Kalkmann BW 3420*, March (CANB, LAE); *Koster BW 1175*, Jan. (CANB, LAE). SOUTHERN. Noord-rivier. Alkmaar: *Versteeg 1533*, Aug. (isotype of *P. bilobulatum*, BO).

N.E. New Guinea. MOROBE DIST. Umi River. Kalapit: *Millar & van Royen NGF 15658*, Jan. (BRI, CANB, LAE, NSW). MADANG DIST. Bili Bili River: *Hoogland 4847*, June (BRI, CANB, LAE). SEPIK DIST. Augustafluss: *Hollrung 260* (isotype of *P. rueckeri*, BO); Leitre: *Millar & Vandenberg NGF 40944*, June (LAE).

Papua. CENTRAL DIV. U-uma River: *Brass 1427*, May (isotype of *P. rhodocarpum*, BRI). WESTERN DIV. Fly River: *Brass 8276*, Nov. (BRI, CANB); Palmer River: *Brass 7258*, July (BRI).

Australia. QUEENSLAND. Cairns Dist. Harvey Creek: *Flecker 12449*, Aug. (NSW); *Meston & Bailey s.n.* (isotype of *P. mestonii*, NSW).

I am confident that this New Guinean species, *Piper mestonii*, is none other than the Queensland Long Pepper of Australia which Lam (1924) recorded as being very common along rivers in New Guinea. I have examined all the type materials of the names listed above in synonymy and have found that they differ from each other only in lamina form.

The type of *Piper rueckeri* has ovate leaves, that of *P. bilobulatum* narrowly ovate to small elliptic leaves with very cuneate bases, while *P. rhodocarpum* has lamina more cordate than *P. mestonii*. As numerous recent collections have been found to contain all these lamina forms on one plant (e.g. *Schiefenhovel 107*; *Hoogland & Craven 10575, & Pullen 2818*), it is here concluded that these leaf forms are but manifestations of the various developmental stages in the life history of one species.

There is a superficial resemblance between *Piper mestonii* and *P. versteegii*, particularly in lamina shape, size, and venation. Because of this, De Candolle misidentified Gjellerup's collection no. 219 as *P. versteegii* (*vide*: C.DC. Nova Guinea Bot. 8(6): 1007. 1914). The two species are however quite distinct (see notes under *P. versteegii*) and are easily told apart by many other characters as was done by De Candolle subsequently in 1923 in his monographic key.

Piper mestonii seems close to *P. reinwardtianum* of the Moluccas from which it differs only in the stigmas being 2-lipped instead of 3- or 4-fid.

The Papuans call this species "O–O–O"!

11. **Piper plagiophyllum** K. Sch. & Laut. Fl. Schutzgeb. 260. 1900; C.DC. Bot. Jahrb. **55**: 206. 1918; Ridl. Trans. Linn. Soc. Bot. ser. 2. **9**: 143. 1916.

TYPE. N.E. New Guinea. Oertzen Gebirge: alt. 300 meters, *Lauterbach 2143*, May (B). FIGURE 3.

Dioecious trees ca. 5 meters high, entirely glabrous. *Lamina* very shortly petiolate, asymmetrically ovate, ca. 17 cm. long, 10 cm. broad, length:breadth ratio ca. 3:2; apex short acuminate; base asymmetrically rounded to unilaterally cordate, the lower ones properly cordate; lateral veins 4 pairs, the distal pair arising alternately from the midrib, the rest from the base, the lowermost pair usually very short and faint. *Stipules* 4–5 cm. long, much longer than petioles. *Inflorescences* of equal length in both sexes, much shorter than adult leaves, but longer than petioles; peduncular stalks very short, less than 1 cm. *Male flowers* 2-staminate; stamens ca. 1 mm. long; anthers reniform, large, longer than filaments; bracts orbicular, peltate, sessile, hirsute at the base. *Female flowers* sessile; stigmas 3-fid, sessile; bracts as in the males. *Fruits* sessile, free, crowded.

DISTRIBUTION: New Guinea.

West New Guinea. VOGELKOP PENINSULA. Arfak Mts.: *Versteegh BW 12665*, May (LAE).

N.E. New Guinea. MOROBE DIST. Busu River: *Hartley 12187*, Sept. (BRI, CANB, LAE); Busu Road: *Henty NGF 11912*, Feb. (BO, CANB, LAE, NSW); Butibum River: *Hartley 9620*, Dec. (BRI, CANB, LAE); Kaindi: *Brass 29542*, May (CANB); Rebel: *Schlechter 16791* (BO); Mt. Torricelli: *Schlechter 14604* (BO); Wobbe: *Schlechter 16252* (BO).

Papua. MILNE BAY DIV. between Agamoia & Ailuluai Mts.: *Brass 27128*,

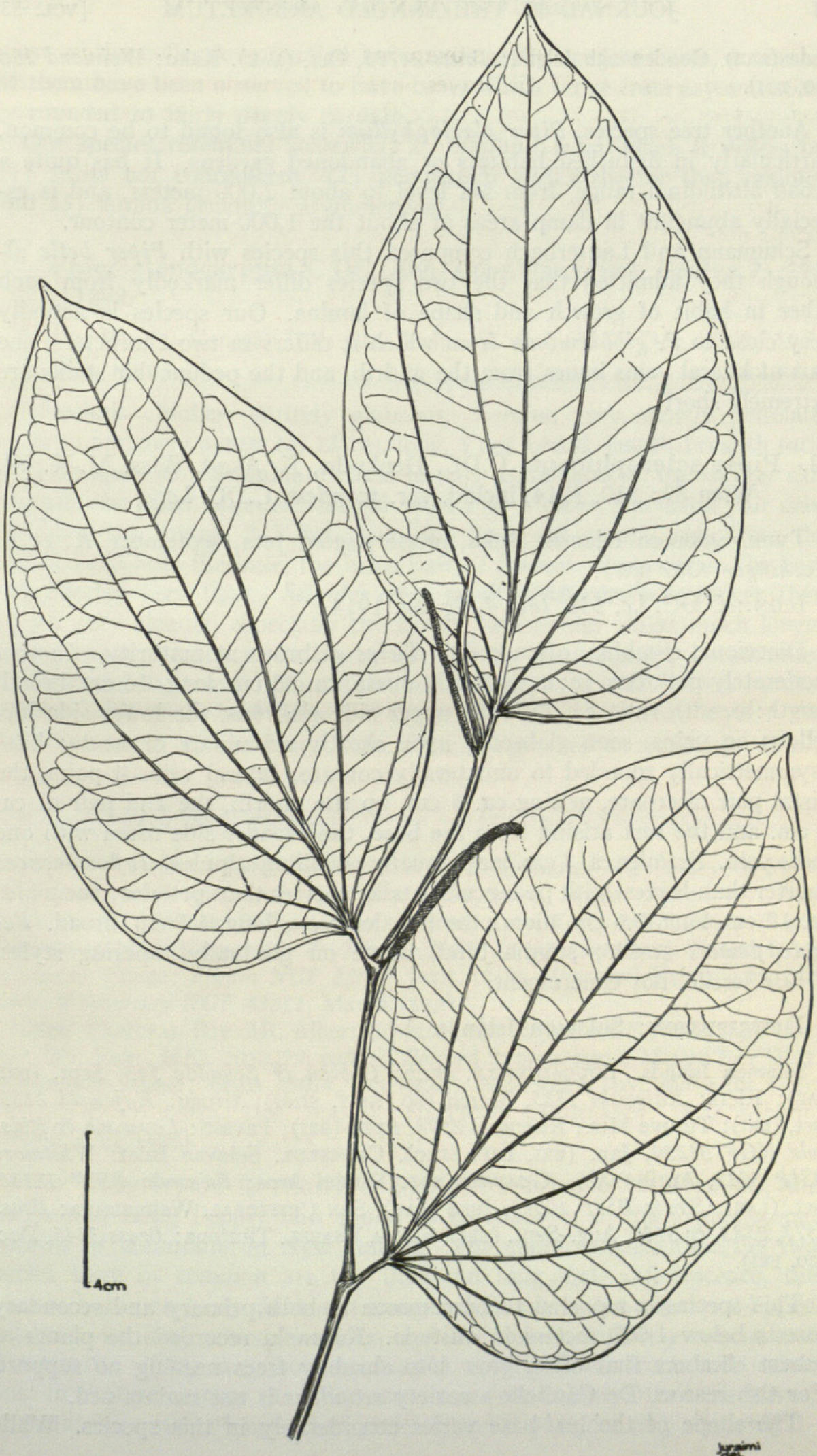

FIGURE 3. **Piper plagiophyllum.** ♀ twig, from *Henty NGF 11912.*

June (LAE). Goodenough Island: *Brass 24735*, Oct. (LAE). Kako: *Weinland 256* (BO, BRI).

Another tree species, *Piper plagiophyllum* is also found to be common, particularly in disturbed habitats or abandoned gardens. It has quite a broad altitudinal range, from sea level to about 2,000 meters, and is especially abundant in damp areas at about the 1,000-meter contour.

Schumann and Lauterbach compared this species with *Piper betle* although they admitted that the two species differ markedly from each other in habit of growth and shape of lamina. Our species is actually very close to *P. gibbilimbum* from which it differs in two characters, one pair of lateral veins issues from the midrib, and the peduncular stalks are extremely short.

12. **Piper sclerophloeum** C.DC. Denkschr. K. Akad. Wiss. M.-N. Kl. Wien 89: 530. 1914, includ. var. *scandens* C.DC. *l.c.*

TYPE. Solomon Islands. Buka, prope pagum Jeta, septembri, *K. et L. Rechinger 4387* (W).

ICON.: C.DC. *l.c.* 530. *tab. 4, fig. 6a.* 1914.

Dioecious, climbing, often erect. *Twigs* glabrous at maturity. *Lamina* moderately petiolate, asymmetrically ovate, ca. 23 cm. long, 16 cm. broad, length:breadth ratio ca. 4:3, the upper side glabrous, the lower side hirtellous on veins, soon glabrous; apex shortly acuminate or acute; base asymmetrically rounded to unilaterally cordate; lateral veins 4 pairs, the distal pair alternate, arising ca. 3 cm. up the midrib, the 2nd pair at ca. 1 cm. and the rest arising from the base, the broader side often with one more vein. *Petioles* ca. 3 cm. long, usually equalling stipules. *Inflorescences* shorter than leaves, with peduncular stalks shorter than petioles; the males ca. 10 cm. long, 0.6 cm. diam., the females 7 cm. long, 1.5 cm. broad. *Female flowers* sessile; stigma bifid, borne on gradually tapering styles. *Fruits* sessile, not concrescent.

DISTRIBUTION: Solomon Islands.

Solomon Islands. BOUGAINVILLE. Buin: *Craven & Schodde 513*, Sept. (BRI, LAE); Kieta: *Kajewski 1585*, March (BO, NSW, SING); Urugu: *Kajewski 2185*, Oct. (BRI); Tutuve Mts.: *Kajewski 2598*, April (BRI); Pavairi: *Lavarack & Ridsdale NGF 31239*, Jan. (BRI, LAE, SING). CHOISEUL. Solovae Inlet: *Whitmore BSIP 3917*, April (LAE). GUADALCANAL. Duidui Area: *Fa'arodo BSIP 12116*, Oct. (LAE); *Sirute BSIP 10091*, June (LAE). SAN CRISTOBAL. Waimamura: *Brass 2577, 2583, & 3139*, Aug.–Sept. (BRI). SANTA YSABEL. Tiratona: *Brass 3345*, Dec. (BO, BRI).

This species is reported to be common in both primary and secondary forests below 1,000 meters in altitude. Kajewski recorded the plants as robust climbers that often grow into shrubby trees needing no support. For this reason, De Candolle's variety *scandens* is not maintained.

The shape of the leaf-base varies considerably in this species. While

most of the collections studied have unilaterally cordate bases, a number of them have been observed to have bases which range from asymmetrically rounded to fairly deeply cordate.

Our species resembles somewhat *P. mestonii* from which it differs in: (1) fruits not concrescent, (2) peduncular stalks shorter than petioles, and (3) lamina generally asymmetrical.

13. **Piper stenocarpum** C.DC. Ann. Cons. Jard. Bot. Genève 2: 270. 1898.

TYPE. Papua. Central Div. Mt. Yule: *G. Belford ?*, Dec. 1890, *MEL 1010379* (MEL). FIGURE 4.

Dioecious climber, entirely glabrous. *Lamina* very shortly petiolate, ovate to narrowly ovate, ca. 13 cm. long, 5 cm. broad, length:breadth ratio ca. 5:2; apex long acuminate; base usually asymmetrical, the shorter side cuneate, the other rounded; lateral veins 2 or 3 pairs, the distal pair arising from the midrib 2–3 cm. from the base, the second also from the midrib very near the base, the basal pair, if present, always from the base and usually very faint. *Stipules* very small. *Inflorescences* longer than leaves, very slender, especially the males; peduncular stalks much longer than petioles; bracts sessile, somewhat oblong. *Male flowers* 2-staminate; filaments much longer than anthers at maturity. *Female flowers* sessile; stigmas very short and bluntly 2-lipped, on long attenuate styles. *Infructescences* to 20 cm. long, 1 cm. diam., bright red at maturity. *Fruits* sessile, completely concrescent at maturity.

DISTRIBUTION. New Guinea.

N.E. New Guinea. CENTRAL HIGHLANDS. Korofunota: *Womersley & Floyd NGF 6934*, Nov. (BRI, LAE). EASTERN HIGHLANDS. Daulo: *Pullen 407*, Aug. (CANB, LAE). MOROBE DIST. Aiewa: *Streimann & Kairo NGF 39034* (LAE); Finnesterre Mt.: *Womersley & Thorne NGF 11891* (BRI, LAE). SEPIK DIST. Nerenanip village: *Frodin NGF 28509*, Sept. (LAE). WESTERN HIGHLANDS. Mt. Kum: *Womersley NGF 43611*, March (LAE).

Papua. CENTRAL DIV. Mt. Albert Edward: *van Royen NGF 30092*, Jan. (BRI, LAE); Mt. Yule: *MEL 1010379, coll. G. Belford ?* (type, MEL). MILNE BAY DIST. Goodenough Island: *Brass 25014*, Oct. (LAE). NORTHERN DIV. above the Gap: *Carr 13793 & 13815*, Dec. (CANB). SOUTHERN HIGHLANDS. Near Kiburu: *Schodde 1397* (LAE).

Piper stenocarpum is clearly a highland relative of *P. mestonii*, the Queensland Long Pepper now found to be common in the lowlands and foothills of mountains in New Guinea. The characteristics that the two species have in common are the thin and long male inflorescence, the stamens borne on fairly thick and elongated filaments, the stigmas 2-lipped and borne on long attenuate styles, and the fruits completely concrescent at maturity. They are, however, easily distinguished from each other thus: in *P. stenocarpum* the inflorescences are much longer than the leaves, the peduncular stalks longer than petioles, and the stigma very shallowly 2-

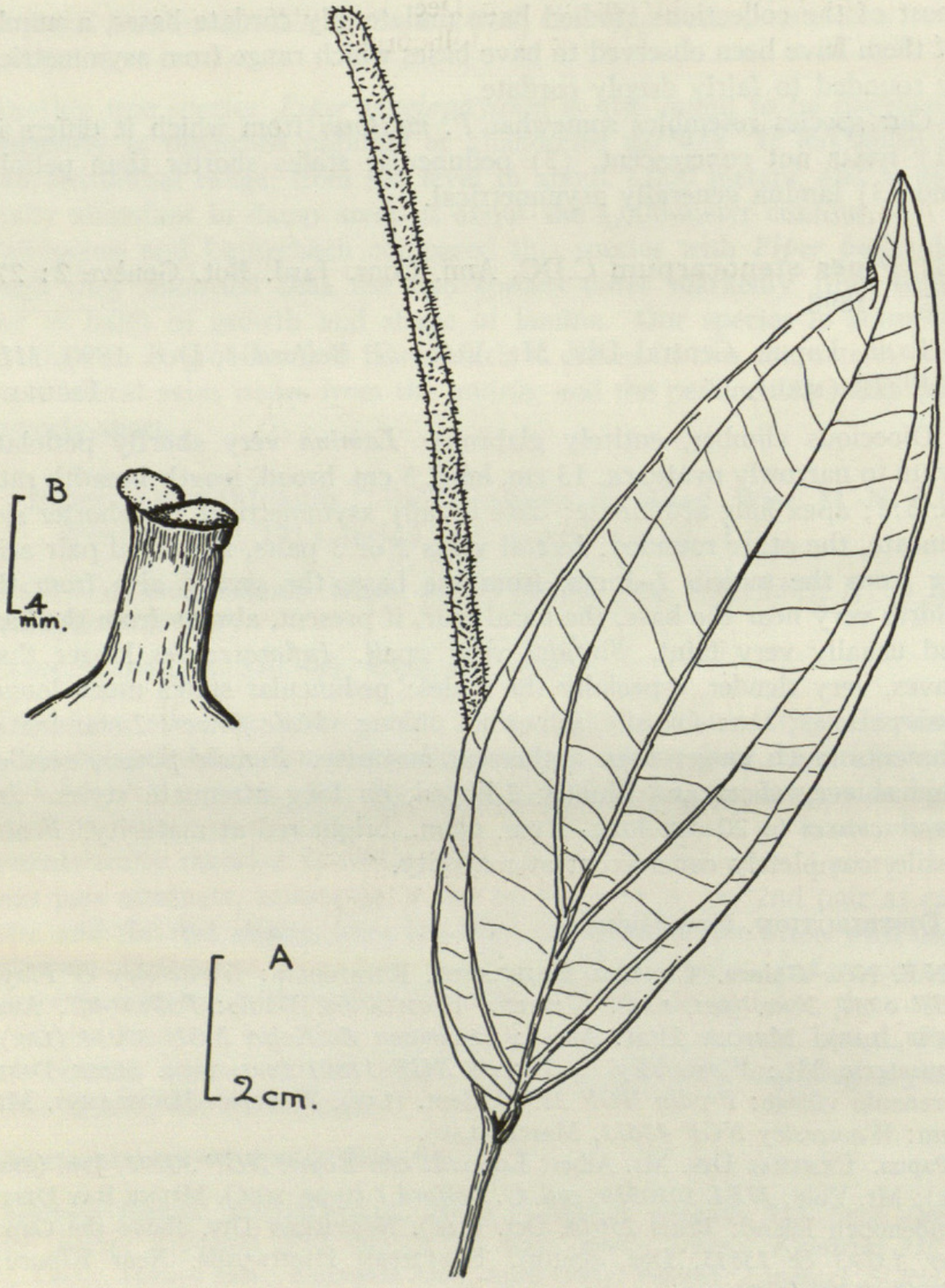

FIGURE 4. **Piper stenocarpum.** A, ♀ twig; B, stigma, from *Pullen 407*.

lipped, whereas in *P. mestonii* the inflorescences are shorter than the leaves, the peduncular stalks invariably of the same length as the petioles, and the stigmas very deeply 2-lipped.

The altitudinal range of our species extends from about 1500 to 3500 meters and overlaps that of *Piper mestonii* by about 500 meters at its lower limit. It has been reported to be commonest in fagaceous forests at about the 2200-meter contour.

The type collection was possibly gathered by George Belford who went

on an expedition to Mount Yule in Dec. 1890 and subsequently sent his material to Baron von Mueller in Melbourne.

14. **Piper versteegii** C.DC. Nova Guinea Bot. **8**(2): 415. 1910; Candollea **1**: 179. 1923.

P. rhizocaule Trelease, Jour. Arnold Arb. **9**: 149. 1928, *syn. nov.*

TYPE. West New Guinea. Noord-rivier; near Bivak-eiland: *Versteeg 1136*, March (lectotype in BO, L). FIGURE 5.

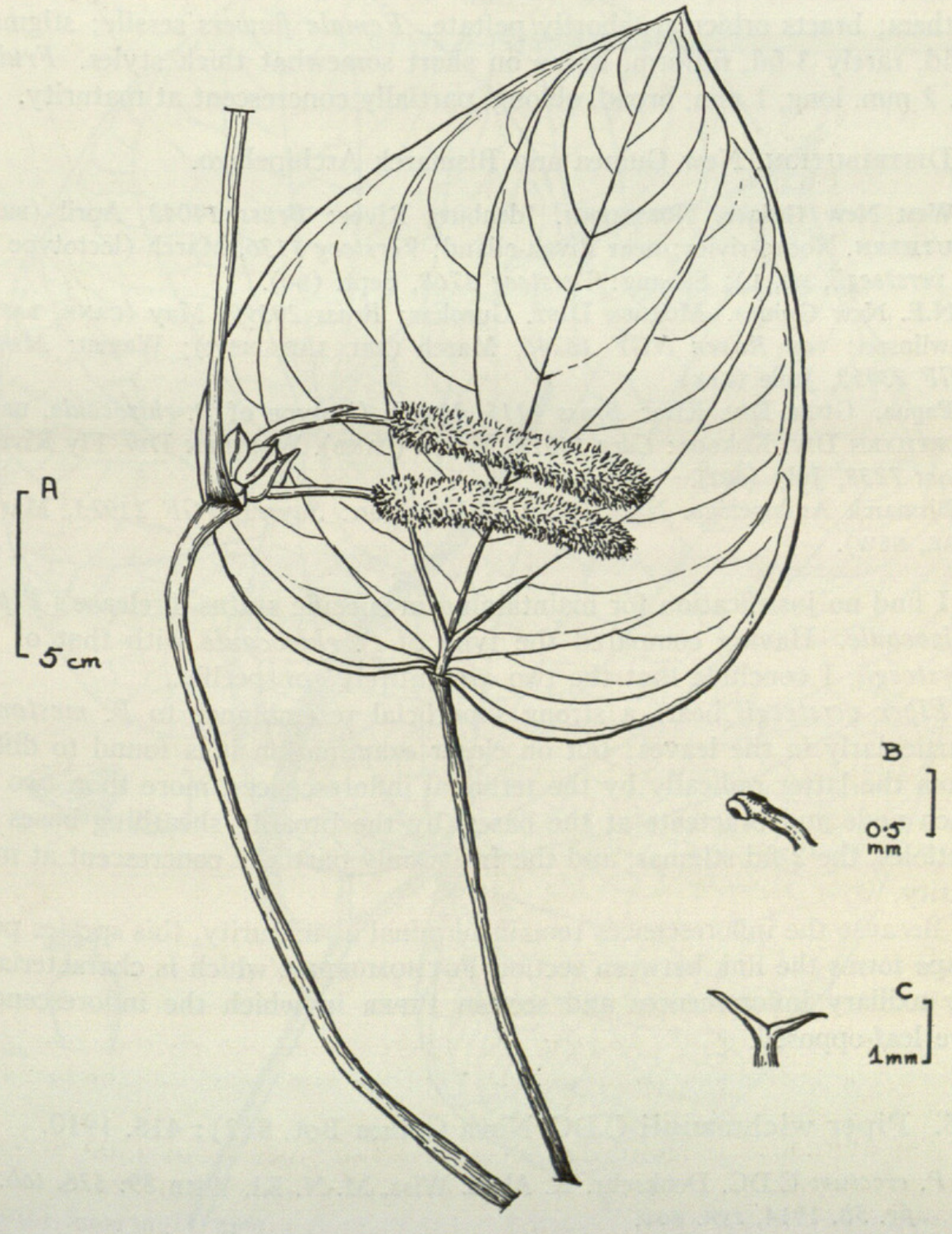

FIGURE 5. **Piper versteegii.** A, leaf and ♀ twig, from *Brass 14042*; B, stamen, from *van Royen NGF 16246*; C, stigma, from *Brass 14042*.

Dioecious climber, entirely glabrous. *Lamina* fairly long petiolate, ovate to very broadly ovate, ca. 25 cm. long, 18 cm. broad, length:breadth ratio 2:1 to 1:1; apex acuminate; base symmetrical, rounded to broadly cordate, often very slightly subpeltate; lateral veins 4–5 pairs, one pair arising ca. 1/5 up the midrib, the rest from the base, often another very short pair from the midrib near the apex. *Petioles* 12–15 cm. long, sheathing at the lower third. *Inflorescences* terminal, usually more than two at the end of side branches, the bases enclosed by bracts ca. 1.5 cm. long. *Male inflorescences* slender, to 14 cm. long; peduncles to 3 cm. long. *Female inflorescences* thicker, to 10 cm. long; peduncles ca. 2 cm. long. *Male flowers* 2-staminate; anthers oblong, 2-valved; filaments longer than anthers; bracts orbicular, shortly peltate. *Female flowers* sessile; stigmas 2-fid, rarely 3-fid, filiform, borne on short somewhat thick styles. *Fruits* ca. 2 mm. long, 1 mm. broad, oblong, partially concrescent at maturity.

DISTRIBUTION. New Guinea and Bismarck Archipelago.

West New Guinea. NORTHERN. Idenburg River: *Brass 14042*, April (BRI). SOUTHERN. Noord-rivier; near Bivak-eiland: *Versteeg 1136*, March (lectotype of *P. versteegii*, BO, L); Sabang: *Versteeg 1768*, Sept. (BO).

N.E. New Guinea. MOROBE DIST. Gurokar: *Brass 29399*, May (CANB, LAE); Rawlinson: *van Royen NGF 16246*, March (BRI, LAE, NSW); Wagau: *Millar NGF 23453*, June (LAE).

Papua. GULF DIV. Kira: *Brass 1115*, March (isotype of *P. rhizocaule*, BRI). NORTHERN DIV. Kokoda: *Carr 16313*, March (CANB). WESTERN DIV. Fly River: *Brass 7238*, July (BRI).

Bismarck Archipelago. NEW BRITAIN. Kandrian: *Sayers NGF 21973*, March (LAE, NSW).

I find no justification for maintaining in specific status Trelease's *Piper rhizocaule*. Having compared the type of *P. rhizocaule* with that of *P. versteegii*, I conclude that the two are entirely conspecific.

Piper versteegii bears a strong superficial resemblance to *P. mestonii*, particularly in the leaves; but on closer examination it is found to differ from the latter radically by the terminal inflorescences, more than two at each node and bracteate at the bases, by the broadly sheathing bases of petioles, the 2-fid stigmas, and the fruits only partially concrescent at maturity.

Because the inflorescences remain terminal at maturity, this species perhaps forms the link between section POTHOMORPHE which is characterized by axillary inflorescences and section PIPER in which the inflorescences are leaf-opposed.

15. **Piper wichmannii** C.DC. Nova Guinea Bot. 8(2): 418. 1910.

P. erectum C.DC. Denkschr. K. Akad. Wiss. M.-N. Kl. Wien **89**: 528. *tab. 4, fig. 5b.* 1914, *syn. nov.*

P. schlechteri C.DC. Bot. Jahrb. **55**: 204. 1918, *syn. nov.*

P. arbuscula Trelease, Jour. Arnold Arb. **9**: 146. 1928, *syn. nov.*

TYPE. West New Guinea. Côte du Nord: *Atasrip 39*, Exped. Wichmann (BO, L). FIGURE 6.

Dioecious shrubs. *Lamina* moderately petiolate; asymmetrically broad ovate; ca. 26 cm. long, 18 cm. broad, length:breadth ratio ca. 3:2; the upper side glabrous, the lower minutely hirtellous on the veins only; apex shortly acuminate; base asymmetrically deeply cordate; lateral veins 4 or 5 pairs, the distal pair arising from the midrib at ca. 1.5 cm. from the

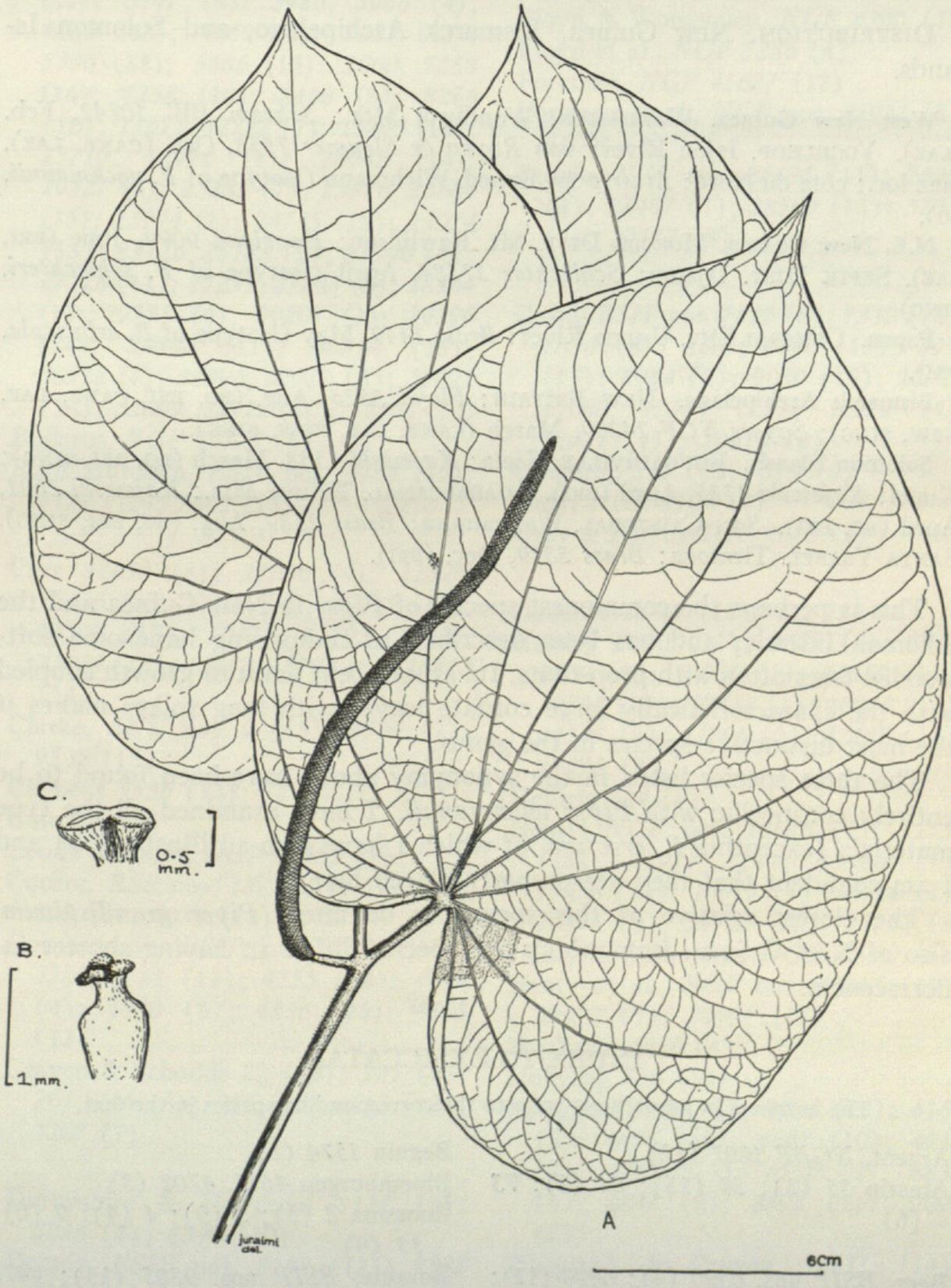

FIGURE 6. **Piper wichmannii.** A, ♀ twig; B, ovary; C, stamen. All from type.

base, the rest directly from the base, the broader side often with 1 or 2 more veins; margin ciliate. *Petiole* as long as the sinus of the base of the lamina is deep. *Stipules* ca. 5 cm. long, longer than petioles. *Inflorescences* up to as long as leaves, the females invariably shorter; peduncular stalks shorter than petioles. *Male flowers* 2-staminate; stamens 0.5 mm. long; anthers reniform, dehiscing apically; filaments short, broad, and stout. *Female flowers* sessile; stigmas 3-fid, subsessile; bracts round, peltate, long pedicellate. *Fruits* sessile, somewhat obconical, free at maturity.

DISTRIBUTION. New Guinea, Bismarck Archipelago, and Solomon Islands.

West New Guinea. WANDAMEN. Wondiwoi Mts.: *Schram BW 10742*, Feb. (LAE). VOGELKOP. Isjon River: *van Royen & Sleumer 7558*, Oct. (CANB, LAE). Sine loc.: côte du Nord: *Atasrip 39*, Exped. Wichmann (isotype of *P. wichmannii*, BO).

N.E. New Guinea. MOROBE DIST. Mt. Rawlinson: *Hoogland 9099*, June (BRI, LAE). SEPIK DIST. Djamu: *Schlechter 17584*, April (isotype of *P. schlechteri*, SING).

Papua. CENTRAL DIV. U-uma River: *Brass 1449*, May (isotype of *P. arbuscula*, BRI).

Bismarck Archipelago. NEW BRITAIN: *Floyd 3525*, Aug. (BO, BRI, CANB, LAE, NSW, SING); *Sayers NGF 24209*, March (CANB, LAE, NSW, SING).

Solomon Islands. BOUGAINVILLE. Kieta: *Kajewski 1538*, March (BO, BRI, SING); Kupei: *Kajewski 1725*, April (BRI). GUADALCANAL. Tutuve Mts.: *Kajewski 2601*, April (BO, BRI). SAN CRISTOBAL. Waimamura: *Brass 2589*, Aug. (BO, BRI, SING). SANTA YSABEL. Tiratona: *Brass 3319*, Dec. (BRI).

This is perhaps the commonest species of *Piper* in New Guinea and the Solomon Islands; and has been described as comprising handsome soft-wooded trees often with prop-roots. Its arborescent habit of growth coupled with the characteristically large cordate leaves with long spikes makes it the most distinctive species in the genus.

The three species listed in the synonymy above have been found to be entirely conspecific with *Piper wichmannii*. I have examined all the type materials (excepting *P. erectum*, of which I have seen an illustration) and I am confident that they are properly placed here.

The closest relative of this species is definitely *Piper grandispicum*, also of New Guinea, from which our species differs in having shorter inflorescences.

INDEX TO EXSICCATAE

The numbers in parentheses refer to the corresponding species in the text.

Borgman *259* (7); *383* (13)
Bowers *51*, *53* (7); *86* (8); *254*, *402*, *403*, *426* (7); *809* (8)
Branderhorst *330*, *425* (4)
Brass *683* (8); *701* (1); *1115* (14); *1427* (10); *1449* (15); *1562* (8); *1644* (4); *2577* (12); *2581* (8); *2583* (12); *2589* (15); *2603* (4); *3139* (12); *3141* (4); *3319* (15); *3345* (12); *3347* (8); *3926*, *3966* (4); *4680* (13); *4969* (8); *5113* (13); *5396* (15); *5486* (13); *7000*, *7238* (14); *7258* (10); *8128* (8); *8276* (10); *11671*, *12252* (7); *13243* (15); *13710*, *13976* (8); *14042* (14); *19327* (4); *23235* (7); *23576*, *23684* (*15*); *23944* (1); *24735* (11); *25014* (13); *25126*, *25133* (8); *25390* (4); *27128* (11); *27255*, *27285* (8); *28864* (1); *29175* (4); *29201* (1); *29399* (14); *29542* (11); *30814* (13); *30918* (7); *31596*, *32089* (8); *32091* (14); *32099*, *32112* (15); *32591* (10)
Buderus, *NGF 20775* (8)
Burn-Murdoch, *BSIP* nos. *6964* (15); *7122* (12); *7462* (15)

Carr *11454* (8); *11636* (4); *11896*, *12436* (8); *12725* (4); *13011* (13); *13199* (15); *13321*, *13793*, *13815*, *13924* (13); *15447*, *15793* (8); *16313* (14)
Clarke, *ANU* nos. *9* (15); *9509* (7); *9538* (15)
Clemens *5536* (13)
Cole *51* (12)
Coode & Katik, *NGF 40353* (7)
Corner, *RSS* nos. *187* (12); *193* (6); *197* (8); *3038* (12)
Cowmeadow, *BSIP* nos. *3281* (15); *3283*, *3782* (12); *4755* (15); *4762* (4); *4830* (8); *4836* (15); *4838* (12)
Craven & Schodde *22* (12); *145* (1); *201*, *246* (8); *512* (15); *513* (12); *1207* (7)

Darbyshire & Hoogland *8124* (5); *8254* (7); *8344* (10)
Dennis, *BSIP* nos. *8148* (12); *8532* (15)
Docters van Leeuwen *9745* (15)

Fa'arodo, *BSIP* nos. *12116*, *12170* (12)
Flecker *12449* (10)
Flenley, *ANU* nos. *2040* (7); *2314* (8)
Floyd, *NGF* nos. *3525* (15); *5510* (10); *6601* (15)
Floyd & Womersley, *NGF 6300* (13)
Floyd et al., *NGF 5286* (4)
Foreman, *NGF 45627* (12)
Foreman et al., *NGF* nos. *45931* (8); *48004* (4)
Frodin, *NGF* nos. *26434* (11); *26954* (4); *28407* (7); *28509* (13); *32052* (7); *32172* (8)

Gafui, *BSIP* nos. *7511* (6); *7512* (15); *7636* (8); *8665*, *8890* (12); *8958* (15); *8964* (8); *9039* (15); *10229*, *11080*, *12503* (12); *12829* (4); *12971* (15); *12978* (8)
Gjellerup *219* (10); *599* (5)
Gray, *NGF 8109* (7)
Gray & Floyd, *NGF 8050* (9)

Hainsworth *49* (15); *61*, *158* (8)
Hartley *9620* (11); *9639* (2); *9765*, *9839* (8); *10036* (4); *10189* (11); *10355* (15); *10438* (1); *10938* (15); *11345* (8); *11796* (7); *12187* (11); *12376* (8)
Hellwig *624* (8)
Henty, *NGF* nos. *10626* (7); *11554* (15); *11912* (11); *11986* (4); *13676* (11); *16925* (4); *16960* (1); *20898* (8); *20922* (15); *29361* (8)
Henty & Streimann, *NGF 38900* (8)
Henty et al., *NGF* nos. *33063* (15); *38972* (7); *38991* (15)
Heyligers *1420* (4)
Hollrung *260* (10)
Hoogland *3973* (1); *3976* (15); *4165* (8); *4445* (15); *4847* (10); *4915* (4); *5202* (15); *6506* (2); *8832* (4); *8847* (2); *8895* (11); *9099* (15)
Hoogland & Craven *10111* (14); *10114* (4); *10299* (8); *10368* (5);

10409, *10410* (8); *10507* (4); *10575* (10)
Hoogland & MacDonald *3513* (14)
Hoogland & Pullen *5253* (7); *5254* (8); *5301* (7); *6163*, *6165* (8)
Hoogland & Schodde *6817* (7); *6914*, *7283* (8)
Hooley *27* (15)
Hornibrook *93* (7); *118* (15)
Hunt, *RSS* nos. *2124*, *2392* (12); *2393* (15); *2408* (12); *2557* (4)

Jackson *68*, *69* (15); *125* (8)
Jones *3024* (4)

Kairo & Streimann, *NGF* nos. *26030* (8); *26031* (4); *35722* (8)
Kajewski *1538* (15); *1585* (12); *1595* (6); *1725* (15); *1782* (4); *2047* (1); *2133* (8); *2175* (1); *2185* (12); *2579* (8); *2598* (12); *2601* (15); *2646* (4)
Kalkman, *BW* nos. *3420*, *3644* (10); *3782* (4); *4044* (7); *5200*, *5252* (8)
Kanehira & Hatusima *11531* (9); *12643* (9)
Koster, *BW* nos. *1175* (10); *4269* (9); *4409*, *10775* (4)
Kotali, *BSIP* nos. *11336* (15); *11341* (12)
Kuswata & Soepadmo *188* (3)

Lam *2460*, *3630* (3)
Lauterbach *1337* (4); *1489* (8)
Lavarack & Ridsdale, *NGF* nos. *31239*, *31366* (12); *31475* (1)
Lipaqeto, *BSIP* nos. *3352* (4); *3369* (15)

Maenu'u, *BSIP* nos. *5175* (4); *5186* (12); *6070* (15); *6149* (12)
Mann, *NGF 43170* (4)
Mann & Osborn, *NGF 43037* (6)
Mann & Vandenberg, *NGF* nos. *43192* (7); *43442* (8)
Mauriasi, *BSIP* nos. *7602* (15); *8106* (4); *8479* (12); *8754*, *8836* (15); *9596* (12); *9771* (15); *9794* (8); *11389* (12); *11455* (15); *11456* (4); *11526* (8); *11635* (12); *11636*, *11759* (15); *11771* (8); *13223* (4); *13285*, *13456* (12); *13457* (8); *13559* (15); *13585* (8); *13641* (12); *13656* (8); *13668*, *13878*, *13943* (12); *13983* (8); *14116*, *14242* (12); *14269*, *14364* (15)
McKee & Floyd, *NGF 6389* (13)
Millar, *GH 99* (1); *NGF* nos. *9930*, *12228* (1); *14575* (8); *22662* (4); *22764* (7); *23240* (8); *23391* (15); *23453*, *35393* (14); *37647* (15); *37693* (6); *37695* (8); *37730* (15)
Millar & Holttum, *NGF 15824* (7)
Millar & Nicholson, *NGF 13847* (7)
Millar & van Royen, *NGF 15629A*, *15658* (10)
Millar & Sayers, *NGF*, *23747* (8)
Millar & Vandenberg, *NGF* nos. *35212* (8); *37555* (10); *40900* (6); *40944* (10)
Morrison, *BSIP* nos. *177* (15); *281* (4)

Nakisi, *BSIP* nos. *7914* (9); *7919* (6); *7920* (4)
Native coll., *NGF* nos. *4719* (2); *5512* (8)

Panoff *105* (8); *115* (15)
Pulle *172*, *517* (7)
Pullen *407* (13); *411* (8); *454* (7); *637* (13); *961* (4); *1085* (14); *1462* (8); *1829* (4); *2778* (7); *2818* (10); *5168*, *5224* (8); *5961* (15)
Pulsford & Floyd, *NGF 5422* (10)

Ramo & Ben, *BSIP 8132* (4)
Ridsdale & Lavarack, *NGF 30627* (8)
Robbins *122* (15); *468* (8); *1655* (4)
Robinson Pl. Rumph. Amb. *58* (3)
Roemer *1268* (7)
Royen *4180* (14); *5215* (5); *5278* (2); *NGF* nos. *16246* (14); *18260* (7); *20253* (4); *30092* (13)
Royen & Millar, *NGF 15689* (13); *17527* (8)
Royen & Sleumer *6159*, *6191* (8); *7026* (4); *7052* (1); *7551* (8); *7558* (15)
Runikera, *BSIP* nos. *10341* (15); *10369*, *10464* (12); *10786* (8);

10901 (12); *12705* (8); *12731* (12); *12939* (8)

Saanan *26* (3)
Sayers, *NGF 13205* (4); *19603* (1); *19746* (15); *21695* (8); *21973* (14); *24171* (4); *24209* (15); *24224* (8)
Schiefenhovel *107* (10)
Schlechter *14604*, *16252*, *16791* (11); *17010* (8); *17584* (15)
Schodde *1393* (8); *1397* (13); *2242* (15); *2355* (7); *2433* (10); *2435* (8); *2927* (1)
Schodde & Craven *3605* (4); *3771* (1); *3984* (12); *4084* (8); *4331* (9); *5032* (8); *5067* (14)
Schram, *BW* nos. *9339*, *10704* (8); *10742* (15); *12924* (5)
Sijde, *BW 4155* (2)
Simonett *3*, *61* (7)
Sirute, *BSIP* nos. *9668* (8); *9683*, *9970*, *10091* (12)
Sleumer & Vink *4432* (8)
Stauffer & Sayers *5577* (8)
Straatman, *BMF 207* (4)
Street *62* (8)
Street & Manner *269*, *396* (15)
Streimann, *NGF* nos. *35849*, *44296* (8); *44396* (1); *44489* (8)
Streimann & Kairo, *NGF* nos. *47552* (8); *27750* (7); *27794* (15); *35822* (14); *39034* (13); *39188*, *39195* (10); *39196* (5)
Susui, *BSIP 8322* (12)

Teona, *BSIP* nos. *4865* (12); *6301* (8)
Teysmann *1975*, *5633*, *11717* (3)

Vandenberg & Galore, *NGF 42063* (4); *42071* (7)
Vandenberg & Mann, *NGF* nos. *42195* (8); *42204A* (15); *42263* (6); *42265* (4)
Vandenberg et al., *NGF* nos. *39706* (8); *42047* (14); *42049* (15)
Versteeg *1021*, *1058* (1); *1086* (8); *1136* (14); *1515* (7); *1533* (10); *1768* (14)
Versteegh, *BW* nos. *3120* (8); *3935* (4); *7367* (1); *7572* (9); *12665* (11)
Vink *16341*, *16419*, *16564A* (7); *16802* (8); *16839* (15)
Vink, *BW* nos. *11426* (4) *12052* (9); *12155*, *15227* (8)
Vink & Schram, *BW* nos. *8593* (7); *8678* (8); *8924* (7)
Vorderman *30* (3)

Walker, *ANU* nos. *32*, *419* (7)
Weinland *256* (11)
White, C. T. *255*, *354* (8); *454*, *518* (15)
White, C. T. et al., *NGF* nos. *1554* (4); *1567* (10)
White, K. J., *NGF* nos. *9521* (14); *10453* (15); *10457* (8); *10474* (1)
Whitmore, *BSIP* nos. *905* (8); *1861* (15); *2032* (12); *2130* (15); *2230* (4); *2257* (8); *2316* (15); *2917*, *3110* (12); *3827* (8); *3867*, *3917* (12); *3970* (4); *4190* (8); *4269*, *5785* (4); *5838* (12)
Whitmore, *RSS* nos. *6109* (8); *6144*, *6222* (12)
Whitmore & Womersley, *BSIP 829* (12)
Womersley, *NGF* nos. *4321* (8); *4322* (15); *4349* (7); *4404* (13); *4482*, *4892* (8); *9023* (10); *11224* (8); *17848* (14); *19153* (8); *24752* (5); *43611* (13); *43632* (15)
Womersley & Floyd, *NGF 6934* (13)
Womersley & Ingle, *NGF 5378* (11)
Womersley & Millar, *NGF* nos. *8483* (13); *8485* (1)
Womersley & Simmonds, *NGF 7134* (8)
Womersley & Thorne, *NGF* nos. *11860* (7); *11891* (13); *12711* (14); *12766* (8)
Womersley & Woolliams, *NGF* nos. *37083*, *37085* (8)
Womersley et al., *NGF* nos. *6082*, *6097* (7); *37258* (4)

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