

PLAGIOGYRIACEAE

(X.C. Zhang, Beijing, China & H.P. Nootboom, Leiden, The Netherlands)

Plagiogyriaceae Bower, Ann. Bot. 40 (1926) 484.

Terrestrial ferns, small to medium sized, 10–150 cm, rarely up to 2 m high, devoid of scales. *Rhizome* stout, thickened, with persistent stipe bases, erect or suberect, or short decumbent, dictyostelic, sometimes bifurcate or stoloniferous; roots blackish, sparsely branched, wiry, regularly arranged on the stem, one beside each stipe base. *Fronds* dimorphous, bearing minute, uniseriate, multicellular, gland-headed, mucilage-secreting trichomes, of which most are lost when dry, or becoming amorphous flaky ‘scales’ at the secretion. *Stipes* round, oval, triangulate, or tetragonal, bearing aerophores or not; base of stipe swollen, flat on ventral face and with a strong median ridge on the dorsal face and dividing this into two surfaces, each of which bears a row of warts looking like aerophores; the stipe with a single vascular bundle which expands or divides into three meristemes in the enlarged base; rachis winged or not, ventral face sulcate, dorsal face terete, flat, or carinate, aerophores absent, or present near the base of the pinnae. Laminae of *sterile fronds* herbaceous to subcoriaceous, glaucous below or not, once pinnate or deeply pinnatifid; pinnae falcate to linear-lanceolate, glabrous or sparsely glandular hairy underneath, margin entire, minutely serrulate to dentate at the apex; veins simple or paired at base, mostly once to twice forked, reaching the margin of a pinna. Laminae of *fertile fronds* similar in shape as the sterile ones, in the middle of a plant, erect, with a proportionally longer stipe and a shorter lamina, once pinnate or deeply pinnatifid, pinnae short stalked or sessile, glabrous or with few short glandular hairs at the edge, the tissue above the veinlets hygroscopic and reversible, functioning as indusium (‘false indusium’), at young stage the scarious margins covering the sori, recurved at mature stage, but when wet covering the sori again; veins free, once to twice forked, solitary or paired at the base, not entering into the scarious marginal part, margin of fertile pinnae entire or irregular, apical pinna usually pinnatifid or conform to the lateral ones, having a few lobes at base or not. *Sori* borne on the swollen end of veins, extended a little, confluent, ascrostichoid, nearly fully covering the lower surface of pinnae when ripe; paraphyses many, a little longer than sporangia, uniseriate, multicellular, orange to dark brown, gland-like, apically slightly capitate, deep in colour intermingled with sporangia. *Sporangia* with a complete oblique annulus, not interrupted by the stalk, lateral in dehiscence, 64 spores per sporangium. *Spores* tetrahedral-globose, trilete, the laesurae about 3/4 the radius, surface ornamentation irregular coarse tubercles, with coalescent papillae and rodlets.

Plagiogyriaceae is a monotypic family in the leptosporangiate Pteridophyta.

DISTRIBUTION AND ECOLOGY

Plagiogyria has an interesting amphi-Pacific disjunct distribution. In Asia it occurs north from Japan, South Korea (Cheju Island), to South China, westwards to East Himalayas ending on the south slope of Central Himalayas, in India only common at the far

eastern corner, not extending southwards on the subcontinent, and eastwards extending southwards via Indochina to Malesia, the Bismarck Archipelago, and the Solomon Islands. In tropical America it is found from Mexico to the Caribbean and the Andes of Venezuela, extending south to Bolivia and southeastern Brazil. The present distribution centre of *Plagiogyria* is in South and Southwest China. Eight species are found in China, most very common and abundant. *Plagiogyria assurgens* is the only species endemic to China. Second to China, six species and one variety are found throughout the Philippines and, except the one variety shared with Borneo, all six species are shared with Taiwan and South to Southwest China. This distribution is not often found in other groups of ferns. Those six species reached the Philippines perhaps by way of mainland China via Taiwan. Iwatsuki & Price (1977) commented that the Himalaya-Taiwanese floral component of northern Luzon is not a relict but recent. It is noted that *P. falcata*, *P. euphlebia*, and *P. stenoptera* in the Philippines are restricted in distribution and their populations are small. Japanese islands are also very rich in species; five occur there and all are rather common, except *P. stenoptera* which is found only in Yakushima Island. This species has a disjunct distribution between SW China, Taiwan and northern Luzon, and this case falls within many other examples of ferns that have a disjunctive distribution from SW China or East Himalayas to Taiwan and Japan. *Plagiogyria matsumureana*, an interesting endemic Japanese species, is the only summer-green species of *Plagiogyria*. It is the only extant relative of the tropical American species, *P. pectinata*. These two species are so similar that they are nearly unseparable morphologically and it seems that the only possible explanation of the origin of the American species is that it is derived from a common ancestor in Asia. Unlike the Sino-Himalaya, or Sino-Japan distribution groups, *Plagiogyria* is not well developed in the Indian subcontinent. The fact that none of them occurs in Africa, Australia and the lower part of India may shed light on the explanation of the historical biogeography of *Plagiogyria*. A few species in the north and northeastern corner of India are probably recently dispersed from the east. *Plagiogyria* has a wide extension in the islands of SE Asia, but most species are restricted to higher mountain forests. The four distinct local varieties of *P. egenolfioides* are morphologically and ecologically different. *Plagiogyria egenolfioides* var. *sumatrana* is distributed from Sumatra to Peninsular Malaysia, not uncommon at 1300-1800 m high ridges. The plants are usually large, the leaves have an elongate pinna-like apex and resemble *P. euphlebia*. *Plagiogyria egenolfioides* var. *decrescens* is the commonest high altitude fern in New Guinea and ranges from 1800 to about 4000 m. In the summit grasslands, this variety forms large dense populations often associated with *Blechnum vestitum* and it reaches eastwards into the Solomon Islands, and to the north into the Moluccas (Seram). Two other varieties occur in Borneo, the Philippines, Sulawesi, and east to Seram. In the Pacific *P. egenolfioides* var. *decrescens* and *P. glauca* were once collected on the summit of Mt Popomanatsen in Guadalcanal (Solomon Islands). The geographic distribution may be explained by the fact that all *Plagiogyria* species are mountain plants, abundant on cold, moist, forested high ridges. Most, if not all, are growing in acid peaty soil (Holltum 1966). Most of the plants can form large dense populations, and are dominant herbs in the undergrowth. Some species have a forked rhizome, or form runners to propagate vegetatively.

References: Holttum, R.E., A revised Flora of Malaya II. Ferns of Malaya. Ed. 2 (1966). Government Printing Office, Singapore. — Iwatsuki, K. & M.G. Price, The Pteridophytes of Mt. Burnay and vicinity, northern Luzon. South East Asian Studies 14 (1977) 540–572.

MORPHOLOGY

Rhizome — The morphology and anatomy of the rhizome and stipe were studied in detail in some species by Bower (1910), Nayar & Kazmi (1962), and Ogura (1972).

The rhizome is erect, suberect, or decumbent, a few to c. 15 cm long. Long rhizomes in *P. egenolfioides* var. *latipinna* and var. *decrescens* are up to 50 cm and still upright, only the stipe bases are relatively sparsely arranged. Short decumbent rhizomes are occasionally found in *P. euphlebia*, *P. falcata*, and *P. adnata*; there are no essential differences in anatomy from the erect ones. The shape of the rhizome is subject to change with the environmental condition. The long rhizome specimens are plants growing in soil covered by a thick moss layer.

Occasional stolons (runners) occur in *P. glauca* and *P. pycnophylla*. The stolon is interesting in anatomy. Its basal part shows a protostele, enlarges into a solenostele and then a dictyostele, showing all stages of ontogenetic development (Ogura 1972).

Stipe — There is no difference between the stipes of sterile fronds and those of the fertile ones in one species. Usually, the fertile frond has a longer stipe, but shorter stipes occur in some populations of *P. euphlebia* and in *P. egenolfioides*.

Cross sections of stipes, especially from the middle part of the swollen bases, are valuable in taxonomic studies of this genus. All the species except *P. matsumureana* and *P. pectinata* (not in Malesia) have one *Loxsona*-type stele in the stipe, V- or U-shaped, surrounded by a sclerenchyma sheath. In the two above mentioned species the stele is V-shaped at the very base but a few millimetres higher it divides into three meristele.

Plagiogyria egenolfioides var. *decrescens*, var. *latipinna*, var. *sumatrana*, *P. glauca*, and *P. pycnophylla* form a group characterised by a thick sclerenchyma sheath surrounding the vascular bundle. The latter is U-shaped in cross section when cut off at the middle part of a stipe base. In *P. egenolfioides* var. *egenolfioides* the plants are very small and the vascular bundle is V-shaped in cross section. *Plagiogyria assurgens* has one U-shaped vascular bundle surrounded by a thin layer of sclerenchyma. In large plants of *P. euphlebia* the vascular bundle is U-shaped, in smaller plants it is V-shaped. *Plagiogyria adnata*, *P. falcata*, and *P. stenoptera* (and *P. japonica* outside Malesia) are species with a thin sclerenchyma sheath around the V-shaped vascular bundle. *Plagiogyria matsumureana* and *P. pectinata* (not in Malesia) are two very exceptional species with three vascular bundles each surrounded by a thin sclerenchyma sheath.

The distinction of so-called U-shaped or V-shaped vascular bundles in some species is not very clear. For example, most cross sections made at the middle of stipe bases in *P. stenoptera* show an arch with two divergent arms. The bottom has a roundish angle, which is called V-shaped; in some bigger specimens the stipe base is more dorsiventral and the vascular arch's bottom is horizontal, referred to as U-shaped. There is a gradual transition of the vascular bundle from U-shaped to V-shaped. The apomorphic state is a divided stele. It is clearly shown this is a V-shaped stele at the beginning, that divides

into three strands. Ontogenetically and phylogenetically the evolution of the stele is interesting in all the groups of *Plagiogyria*.

Aerophores — Aerophores (pneumatophores) are prominent on the dorsal side of swollen stipe bases. They form a common character of all *Plagiogyria* species. Hook-shaped aerophores up to 2 mm or more develop on stipes and on dorsal sides of rachises at the base of the insertion of pinnae in *P. egenolfioides* var. *decrescens*, var. *latipinna*, and var. *sumatrana*. Horn-like ones, usually c. 0.5 mm long, occur on the stipes and pinnae bases of *P. glauca* and *P. pycnophylla*. Nakai called them the *Polypneumatophorata* Group. They are also representatives of the most primitive members in *Plagiogyria* with a thick sclerenchyma shell around the vascular bundle in the stipes. In *P. egenolfioides* var. *egenolfioides*, and the dwarf plants of other taxa, the aerophores are not fully developed on the stipe and rachis, sometimes they even appear to be absent. Round, wart-like aerophores appear at the base of stipes of all other species (Nakai's *Paripneumatophorata* Group) and sometimes develop on the stipe and rachis of large specimens of *P. euphlebia*. In smaller specimens of *P. falcata* and *P. stenoptera* (also *P. matsumureana* and *P. pectinata*, not in Malesia) only very few small aerophores, usually 1 to 3 pairs, occur at the not much dilated bases. The development of aerophores correlates with that of the mechanical tissues (sclerenchymatic tissues) in the stipe and may function as an aeration pathway for the living parenchymatic tissues inside. Large stomata occur on the apex of aerophores.

References: Bower, F. O., Studies in the phylogeny of the Filicales, I. *Plagiogyria*. Ann. Bot. (1910) 24. — Nayar, B. K. & F. Kazmi, Ferns of India No. IV, *Plagiogyria*. Bull. Nat. Bot. Gard. Lucknow 64 (1962) 1–37. — Ogura, Y., Comparative anatomy of the vegetative organs of the Pteridophytes. In: Handbuch der Pflanzenanatomie, Ed. 2, VII, 3 (1972). Gebr. Borntraeger, Berlin.

PLAGIOGYRIA

Plagiogyria (Kunze) Mett., Abh. Senckenb. Naturf. Ges. 2 (1858) 265; Bedd., Ferns Brit. India 1 (1866) 51; J. Sm., Hist. Fil. (1875) 162; Diels in Engl. & Prantl, Nat. Pflanzenfam. 1, 4 (1899) 281; C. Chr., Index Filic. (1906) 43; Alderw., Malayan Ferns (1908) 340; Malayan Ferns Suppl. 1 (1916) 243; Nakai, Bot. Mag. (Tokyo) 42 (1928) 204; Copel., Philipp. J. Sc. 38 (1929) 377; Backer & Posth., Varenfl. Java (1939) 30; Copel., Fern Fl. Philipp. 2 (1960) 193; Holttum, Revis. Fl. Malaya, ed. 2 (1966) 109. — *Lomaria* Blume, Enum. Pl. Javæ (1828) 205, p.p.; Hook., Sp. Fil. 3 (1860) 2, p.p.; Racib., Pteridoph. Buitenzorg 1 (1898) 159, p.p. — *Lomaria* sect. *Plagiogyria* Kunze, Farrnkräuter 2 (1850) 61, 63. — *Lomaria* § *Plagiogyria* Hook., Sp. Fil. 3 (1860) 19. — *Plagiogyria* sect. *Plagiogyria*, Ching, Fl. Reip. Popul. Sin. 2 (1959) 86. — Type: *Plagiogyria euphlebia* (Kunze) Mett. [*Lomaria euphlebia* Kunze].

Lomaridium C. Presl, Epim. Bot. (1851) 154, p.p.

Polygramma C. Presl, Epim. Bot. (1851) 156, nom. inval. — Type: *Lomaridium ? semicordatum* C. Presl.

Stenochlaena C. Presl, Epim. Bot. (1851) 162, p.p.

Plagiogyria subsect. *Adnatae* Ching ex Lellinger, Amer. Fern J. 61 (1971) 111. — Type: *Plagiogyria adnata* (Blume) Bedd.

Plagiogyria sect. *Carinatae* Ching ex Lellinger, Amer. Fern J. 61 (1971) 111. — Type: *Plagiogyria argutissima* H. Christ.

Plagiogyria subsect. *Pycnophyllae* Ching ex Lellinger, Amer. Fern J. 61 (1971) 111. — Type: *Plagiogyria pycnophylla* (Kunze) Mett.

KEY TO THE SPECIES

- 1a. Most pinnae of sterile lamina (except the uppermost) auriculate, margin of pinnae of sterile lamina crenate **2. *P. egenolfioides***
- b. Most pinnae of sterile lamina (except the uppermost) adnate to rachis or not, but not auriculate, margin of pinnae of sterile lamina (or except the apex) serrulate (sometimes towards base becoming entire or nearly so) 2
- 2a. Most pinnae of sterile lamina (except the uppermost) adnate to rachis or only the acroscopic side adnate 3
- b. Most pinnae of sterile lamina (except the uppermost) cuneate, rounded, truncate, or attenuate 6
- 3a. Aerophores present on stipe and rachis, cross section of stipe one U-shaped vascular bundle, fronds covered with an amorphous gelatinous mucilage layer when dry **2. *P. egenolfioides* (var. *latipinna*)**
- b. Aerophores only present on base of stipe, cross section of stipe one V-shaped vascular bundle, fronds not covered with an amorphous gelatinous mucilage layer when dry 4
- 4a. Most pinnae of sterile lamina (except the uppermost) with acroscopic side adnate into a wide wing along rachis, dorsal side of rachis semiterete or trigonous, fertile lamina pinnate except the apex, lower pinnae shortly stalked **1. *P. adnata***
- b. Most pinnae of sterile lamina (except the uppermost) adnate to rachis but not into a wing, dorsal side of rachis flattened or carinate, fertile lamina pinnate throughout, pinnae nearly sessile, or deeply pinnatifid and rachis slightly winged throughout 5
- 5a. Some pairs of lowermost pinnae of fertile lamina become aerophore-like vestiges on stipe together with aerophores, upper part of stipe tetragonal, dorsal side of the rachis of fertile lamina flattened or grooved, apex of fertile lamina terminated by a pinna conform to the lateral ones and often beaded at the base, base of middle pinnae of fertile lamina shortly stalked **7. *P. stenoptera***
- b. Lowermost pinnae of fertile lamina not or gradually shortened, upper part of stipe triangular, dorsal side of rachis of fertile lamina carinate, apex of fertile lamina pinnatifid, acuminate or caudate, base of middle pinnae of fertile lamina broadly adnate **4. *P. falcata***
- 6a. Aerophores cushion-like, rhizome short **3. *P. euphlebia***
- b. Aerophores slender, hook-shaped with pointed apex, or elongate, horn-like with blunt apex, rhizome short to c. 15 cm long, or occasionally up to 50 cm long . 7
- 7a. Aerophores elongate, horn-like, with blunt apex, fronds not covered with an amorphous gelatinous mucilage layer when dry, paraphyses few, mostly lost, spores yellow to brown, not obviously tuberculate 8
- b. Aerophores slender, hook-shaped with pointed apex, fronds covered with an amorphous gelatinous mucilage layer when dry, paraphyses many, spores yellow or brown, with reddish tubercles **2. *P. egenolfioides***
- 8a. Sterile lamina not glaucous, herbaceous, lowermost pinnae slightly shorter or gradually shortened **6. *P. pycnophylla***
- b. Sterile lamina glaucous beneath, firm herbaceous or subcoriaceous, not or abruptly shortened **5. *P. glauca***

1. *Plagiogyria adnata* (Blume) Bedd.

Plagiogyria adnata (Blume) Bedd., Ferns Brit. India 1 (1865) pl. 51; Kuhn, Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 291; Luer., Bot. Jahrb. Syst. 4 (1883) 365; Copel., Polypod. Philipp. Is. (1905) 97; Alderw., Malayan Ferns (1908) 342; Copel., Philipp. J. Sc., Bot. 3 (1908) 280; C. Chr., Acta Horti Gothob. 1 (1924) 92; Copel., Philipp. J. Sc. 38 (1929) 396; C. Chr. & Holttum, Gard. Bull. Str. Settle. 7 (1934) 225; Holttum, Gard. Bull. Str. Settle. 9 (1937) 133; Backer & Posth., Varenfl. Java (1939) 31; Copel., Fern Fl. Philipp. 2 (1960) 195; Holttum, Revis. Fl. Malaya, ed. 2 (1966) 111; Parris et al., Pl. Mount Kinabalu 1 (1991) 97. — *Lomaria adnata* Blume, Enum. Pl. Javae (1828) 205; Hook., Sp. Fil. 3 (1860) 19, t. 147, excl. syn. *Lomaria scandens*; Racib., Pteridoph. Buitenzorg 1 (1898) 162. — Type: *Blume s.n.* (L. sh. 908.315-140), Java.

Lomaria brooksii Alderw., Bull. Jard. Bot. Buitenzorg II, 28 (1918) 32. — *Struthiopteris brooksii* Ching, Sunyatsenia 5 (1940) 243. — Type: *Brooks 333s* (holo BM), Sumatra, Benkoelen, Lebong Simpang, alt. 1400 m, VIII-1917.

Rhizome short, erect to suberect or curved, thick with many stipe bases. Stipes stramineous or brownish, of sterile fronds (4.5–)15–25(–35) cm long, of fertile fronds (17–)40–50(–65) cm long, base slightly to moderately enlarged, 2–7 mm wide in the middle, in cross section one V-shaped vascular bundle, upper part of stipe tetragonal or rarely triangular, aerophores only present on base of stipe; rachises glabrous. Fronds not covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis semiterete to trigonous, not winged, rachis (0.5–)1–1.5(–3) mm wide in the middle part. *Sterile lamina* herbaceous, not glaucous, pinnatifid, rarely except a few free basal pinnae, widest basally to medially, (8–)15–25(–36) by (3–)5–15(–26) cm, index (1.3–)2(–3.5); pinnae (8–)13–20(–35) pairs, widest below or about the middle, veins of pinnae paired at base, forked above base, or rarely simple, distinct on both surfaces, stomata scattered on the lower epidermis, margin minutely serrulate but towards the base becoming entire or nearly so or nearly entire except the apex, most pinnae except the uppermost with inequilateral base, acroscopic side adnate into a wide wing along the rachis; lowermost pinnae adnate, not or slightly deflexed, not or slightly shortened; middle pinnae (1.5–)5–7(–11) cm long, (0.4–)0.7–1.2(–1.7) cm wide in the middle, acroscopic side of base adnate to the rachis into a wide wing, basicopic side rounded, partly free from rachis; uppermost pinnae adnate, base about equal-sided, basicopically decurrent into rachis wing; apex of lamina pinnatifid, terminated by a pinnatilobed, short- or long-triangular segment. *Fertile fronds* usually longer than the sterile ones, dorsal side of rachis flattened or slightly grooved, not winged, rachis (0.5–)1(–2) mm wide in the middle part; lamina pinnate except the apex, lower pinnae shortly stalked, (8–)16–26(–45) by (2–)4–10(–16) cm; pinnae glabrous or sparsely bearing short glandular hairs, (9–)13–17(–24) pairs, margin entire or subentire; lowermost pinnae not shortened, 1–4 cm apart; middle pinnae (1–)4–8(–11) cm long, 2–3(–4) mm wide, base sessile or shortly stalked; apex terminated by a pinna conform to the lateral one and often beaded at the base or pinnatifid, acuminate, or caudate. Paraphyses many or few, rarely mostly lost, yellow to brown. *Spores* yellow, with reddish tubercles. — **Fig. 1.**

Distribution — Japan, China (Anhui, Zhejiang, Fujian, Jiangxi, Hunan, Guangdong, Guangxi, Hainan, Taiwan, Sichuan, Guizhou, Yunnan), Burma, E India (Assam, Khasia, Shillong), Thailand, Vietnam; *Malesia*: Peninsular Malaya, Sumatra, Java, Borneo (Mt Kinabalu), Philippines (Luzon).

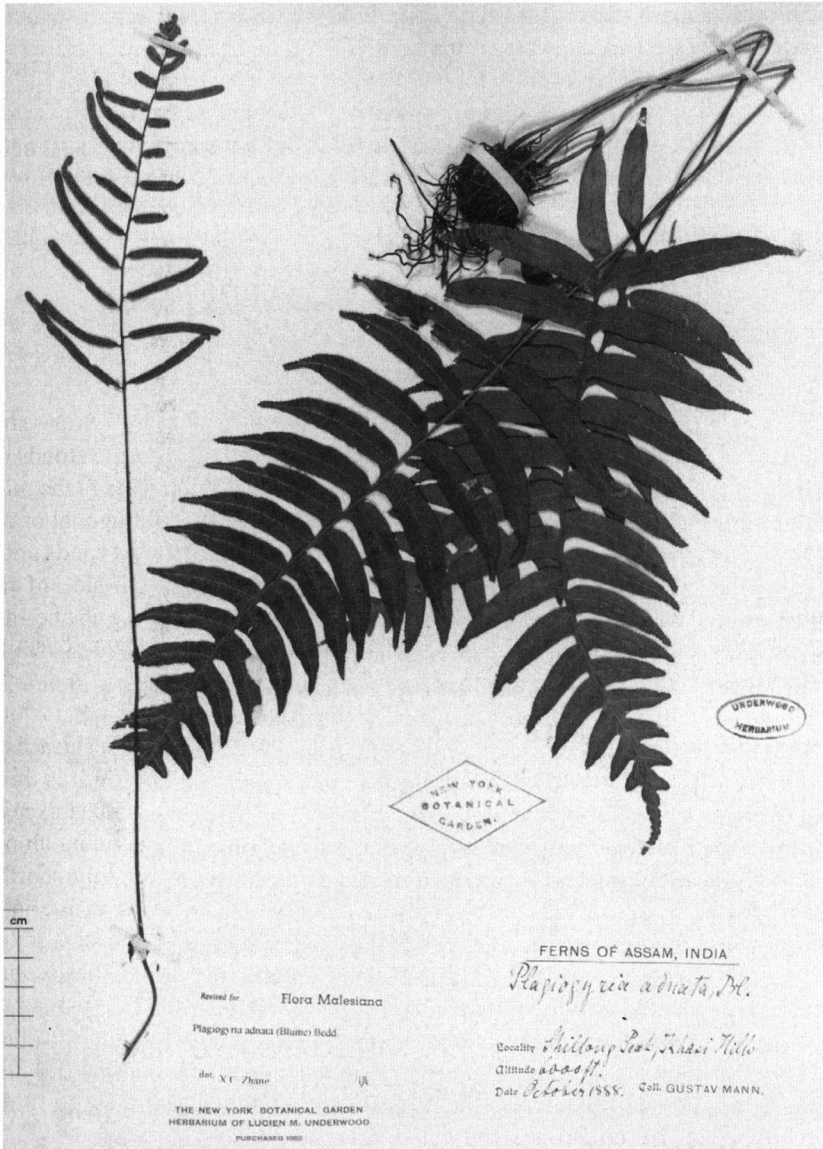


Fig. 1. Herbarium sheet of *Plagiogyria adnata* (Blume) Bedd. in NY.

Habitat — On rather wet forest mountain slopes; altitude 60–2000 m, common above 500 m; on Mt Kinabalu from 1400–1600 m.

Chromosome number — Nakato [J. Jap. Bot. 63 (1988) 214] reported $2n = 260$, under the name *Plagiogyria rankanensis* Hayata; Weng [Acta Phytotax. Sin. (1990) 27] reported $n = 60$, under the name *Plagiogyria distinctissima* Ching.

Notes — 1. Kuhn (1869) ascribed *P. adnata* to T. Moore, Ind. Fil., a manuscript name. Apparently he was unaware of the combination made by Beddome four years before.

2. A few sheets of *Hancock 216bis* in BM and K are all *P. stenoptera* (*Lomaria concinna*). Ching's original type of *P. yunnanensis* could not be traced in the above herbaria.

2. *Plagiogyria egenolfooides* (Baker) Copel.

Plagiogyria egenolfooides (Baker) Copel., J. Str. Br. Roy. Asiat. Soc. 63 (1912) 72; Alderw., Malayan Ferns Suppl. 1 (1916) 244; Copel., Sarawak Mus. J. 2 (1917) 387; Philipp. J. Sc. 38 (1929) 394; X.C. Zhang & Noot., Blumea 42 (1997) 483. — *Lomaria egenolfooides* Baker, Kew Bull. (1894) 7. — *Blechnum egenolfooides* C. Chr., Index Filic. (1906) 153. — Type: *Hose 309* (holo K; iso P, fragm. BM, photogr. PE), Sarawak, Mt Dulit, alt. 5000 ft, 1891.
For further synonymy see under the varieties.

Rhizome short to c. 15 cm long or occasionally up to 50 cm long, erect, suberect, or decumbent, narrow, sometimes very woody. *Stipes* reddish brown, of sterile fronds (0.5–)3–35(–72) cm long, of fertile fronds (2.5–)6–55(–88) cm long, base slightly, strongly, or moderately enlarged, 0.5–20 mm wide in the middle, cross section one U-shaped or one V-shaped vascular bundle, upper part of stipe tetragonal, terete, or oval, aerophores present on stipe and rachis, only on base of stipe, or seemingly absent when dry, slender, hook-shaped, with pointed apex (usually); stipes and rachises glabrous. Fronds usually in var. *latipinna* covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis semiterete, trigonous, flattened or grooved, not winged, rachis (0.2–)0.5–4(–5) mm wide in the middle part. *Sterile lamina* subcoriaceous, not glaucous, rather thick to rather thin but firm, pinnate except the pinnatifid or pinnatilobed apex or lower part pinnate, upper 1/3 to 1/2 pinnatifid, except a few free basal pinnae, or rarely pinnatifid throughout, widest medially to subbasally, (4–)12–74(–100) by (1–)2.5–22(–27) cm, index (1.68–)2–8(–11); pinnae (6–)17–60(–80) pairs, widest near base to about the middle, veins of pinnae simple, paired at base, forked above base, or simple as many as forked, distinct, obscure, or invisible on both surfaces, stomata scattered on the lower epidermis, margin (sometimes except the apex) entire, crenate or serrulate, most pinnae except the uppermost with equilateral or inequilateral base, acroscopic side adnate, cuneate, rounded, auriculate or attenuate; lowermost pinnae sessile, shortly stalked or rarely adnate but slightly constricted, deflexed or not, slightly, gradually, or abruptly shortened, not reduced or rarely some pinnae vestigial on stipe sided by aerophores; middle pinnae (0.5–)1–14(–20) cm long, (0.15–)0.4–1.4(–1.9) cm wide in the middle, sessile to shortly stalked, base rounded, cuneate, or auriculate; apex of lamina pinnatifid, terminated by a pinnatilobed segment or rarely by a pinna conform to lateral ones. *Fertile fronds* usually longer than the sterile ones, rarely shorter or about the same length, dorsal side of rachis semiterete, flattened or grooved, not winged, rachis 0.5–4(–5) mm wide in the middle part; lamina pinnate throughout, pinnae nearly sessile or shortly stalked, or pinnate except the apex and lower pinnae shortly stalked, or pinnate with stalked pinnae, uppermost pinnatifid, pinnae base decurrent, (6–)11–60(–100) by (0.7–)1.5–20(–30) cm; pinnae sparsely bear-

ing short glandular hairs or glabrous, 15–72 pairs, margin erose, entire, or subentire; lowermost pinnae the longest or gradually shortened, 0.5–4(–8) cm apart; middle pinnae (0.4–)0.8–14(–22) cm long, 1.5–6 mm wide, base slightly cordate, shortly stalked, or sessile (rarely auriculate or with one basiscopic lobe); apex pinnatifid, acuminate or caudate, rarely terminated by a pinna-like segment. Paraphyses many or few, mostly lost or absent, yellow, brown, or dark brown. *Spores* brown or yellow, with reddish tubercles.

KEY TO THE VARIETIES

- 1a. Plants small (dwarfed), aerophores obscure, only present on base of stipe **a. var. egenolfooides**

 b. Plants not dwarfed, aerophores distinct, present from base of stipe to the rachis 2
 2a. Pinnae stalked, apex of sterile lamina usually terminated by a pinna conform to lateral ones **d. var. sumatrana**
 b. Pinnae subsessile or base adnate; apex of sterile lamina usually pinnatifid 3
 3a. Lowermost pinnae gradually abbreviated **b. var. decrescens**
 b. Lowermost pinnae not abbreviated, or only 1 to 2 pairs shorter . **c. var. latipinna**

a. var. egenolfooides

Plagiogyria egenolfooides (Baker) Copel., J. Str. Br. Roy. Asiat. Soc. 63 (1912) 72; Alderw., Malayan Ferns Suppl. 1 (1916) 244; Copel., Sarawak Mus. J. 2 (1917) 387; Philipp. J. Sc. 38 (1929) 394; X.C. Zhang & Noot., Blumea 42 (1997) 483. — *Lomaria egenolfooides* Baker, Kew Bull. (1894) 7. — *Blechnum egenolfooides* C. Chr., Index Filic. (1906) 153. — Type: *Hose 309* (holo K; iso P, fragm. BM, photogr. PE), Sarawak, Mt Dulit, alt. 5000 ft, 1891.

Plagiogyria minuta Copel., Philipp. J. Sc., Bot. 10 (1915) 148; Alderw., Malayan Ferns Suppl. 1 (1916) 243; Copel., Sarawak Mus. J. 2 (1917) 387; Philipp. J. Sc. 38 (1929) 394, pl. 3. — Type: *Native collector 939* (not '393' by Copeland 1915) (holo MICH; fragm. BM, photogr. GH, PE), Sarawak, without exact locality.

Rhizome short, erect or decumbent, narrow. *Stipes* of sterile fronds (0.5–)3–13 cm long. *Fertile fronds* (2.5–)6–23 cm long, base slightly enlarged, 0.5–2 mm wide in the middle, cross section one U-shaped vascular bundle or one V-shaped vascular bundle (likely), upper part of stipe tetragonal to terete or oval, aerophores only present on base of stipe or seemingly absent when dry. Fronds covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis semiterete, grooved or flattened, rachis (0.2–)0.5–1(–1.5) mm wide in the middle part. *Sterile lamina* rather thick, pinnate except the pinnatifid or pinnatilobed apex, widest medially, (4–)14–36 by (1–)2.5–5.5 cm, index (4–)5–7.8; pinnae (13–)20–38 pairs, widest basally, veins of pinnae simple (or forked), invisible on both surfaces, margin crenate, most pinnae except the uppermost with equilateral or inequilateral base, auriculate; lowermost pinnae sessile, deflexed, gradually shortened; middle pinnae (0.5–)1–2.5 cm long, (0.15–)0.4–0.6 cm wide in the middle, sessile, base auriculate (auricle up to 0.8 cm long, and pinnatilobed); apex of lamina pinnatifid, terminated by a pinnatilobed segment. *Fertile fronds* usually longer than the sterile ones, dorsal side of rachis semiterete or grooved or flattened, rachis 0.5–1 mm wide in the middle part; lamina pinnate throughout, pinnae shortly

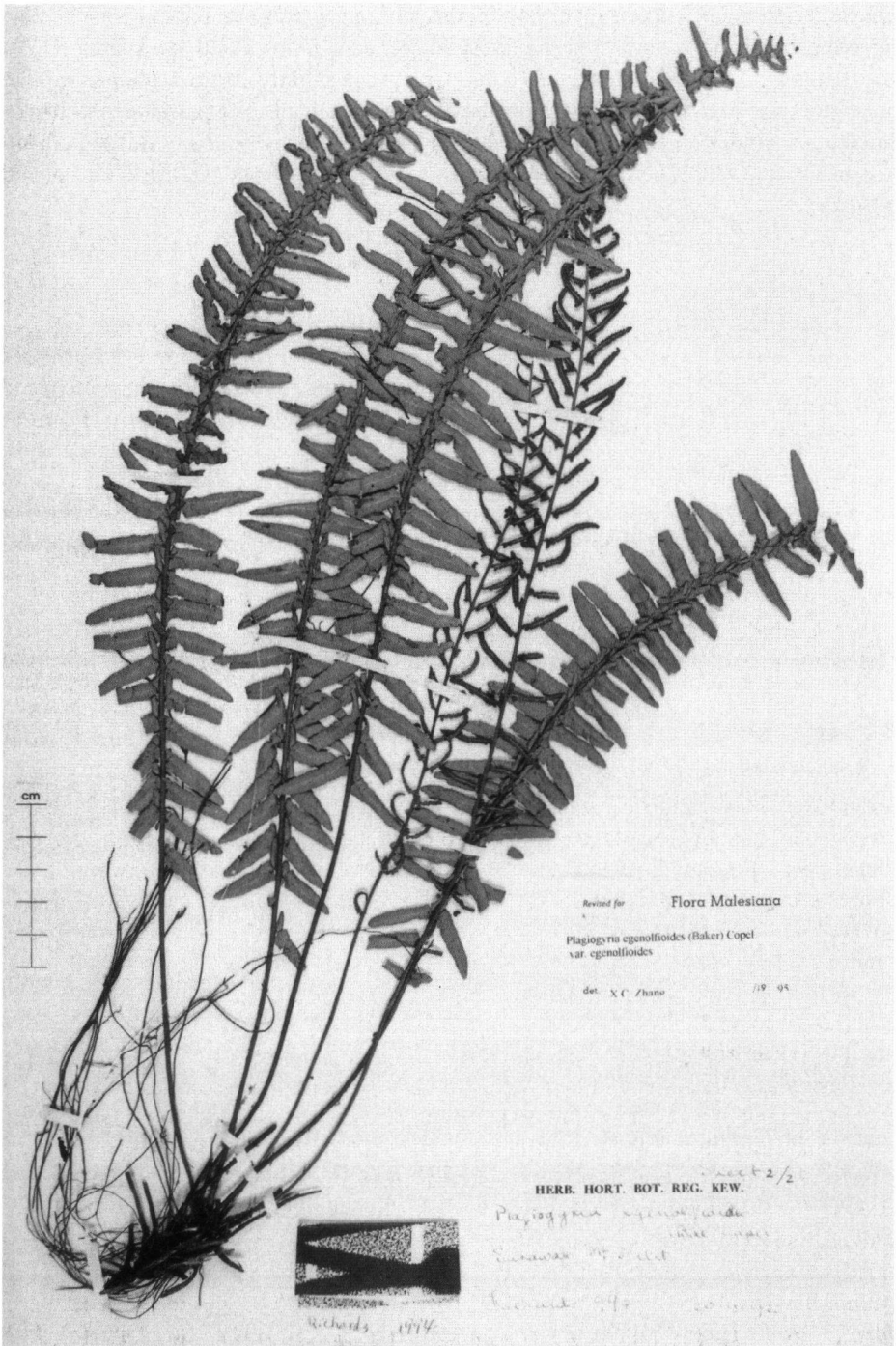


Fig. 2. Herbarium sheet of *Plagiogyria egenolfioides* (Baker) Copel. var. *egenolfioides* in K.

stalked or nearly sessile, (6–)11–25 by (0.7–)1.5–3.5 cm; pinnae glabrous, 22–28 pairs, margin erose; lowermost pinnae gradually shortened, 0.5–0.8 cm apart; middle pinnae (0.4–) 0.8–1.5 cm long, 1.5–2 mm wide, base shortly stalked or slightly cordate (or auriculate, sometimes with one basispicopic lobe); apex pinnatifid, acuminate or caudate. Paraphyses few, mostly lost or absent, dark brown. *Spores* brown, with reddish tubercles. — **Fig. 2.**

Distribution — *Malesia*: Borneo, endemic in Sarawak (3 collections from Mt Dulit).

Habitat — On shaded sandstone cliff, growing with *Dipteris conjugata*; altitude 1230–1500 m.

b. var. *decreescens* (C. Chr.) X.C. Zhang & Noot.

Plagiogyria egenolfooides (Baker) Copel. var. *decreescens* (C. Chr.) X.C. Zhang & Noot., *Blumea* 42 (1997) 483. — *Plagiogyria tuberculata* var. *decreescens* C. Chr., *Brittonia* 2 (1937) 284. — Type: *Brass* 4746 (holo BM; fotogr. PE), Papua New Guinea, Central Prov., Wharton Range, Murray Pass, alt. 2840 m, 8-VIII-1933.

Blechnum pendulum Brause, *Bot. Jahrb. Syst.* (1920) 157. — *Struthiopteris pendula* Ching, *Sunyatsenia* 5 (1940) 243. — *Plagiogyria pendula* Chambers ex Nakaike, *Bull. Nat. Sc. Mus. Tokyo* 17 (1991) 92, f. 13. — Type: *Ledermann* 11927 (holo B; fotogr. BM, PE), Papua New Guinea, Sepik, 'Baumkronen', alt. 2070 m, 2-VI-1913.

Plagiogyria novoguineensis Alderw., *Nova Guinea* 14 (1923) 36. — Type: *Lam* 1860 (holo BO, n.v.; fragm. L, fotogr. BM, K, PE), New Guinea, Doorman Summit, alt. 2950 m, 30-X-1920.

Plagiogyria papuana C. Chr., *Brittonia* 2 (1937) 285; Nakaike, *Bull. Nat. Sc. Mus. Tokyo* 17 (1991) 92. — Syntypes: *Brass* 4317 (BM, fotogr. PE), Papua New Guinea, Central Prov., Mt Albert Edward, alt. 3680 m, 23-VI-1933; *Brass* 4483 (BM, NY, fotogr. PE), alt. 3680 m, 10-VII-1933.

Plagiogyria tuberculata auct. non Copel.: C. Chr., *Brittonia* 2 (1937) 284.

Rhizome short to c. 15 cm long or occasionally up to 50 cm long, erect, suberect, or decumbent. *Stipes* reddish brown, of sterile fronds 6–35(–72) cm long, of fertile fronds 16–50(–88) cm long, base strongly or moderately enlarged, 5–15 mm wide in the middle, cross section one U-shaped vascular bundle, upper part of stipe tetragonal, aerophores present on stipe and rachis, slender, hook-shaped, with pointed apex. Fronds covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis semiterete to trigonous or grooved, rachis (1–)2–4(–5) mm wide in the middle part. *Sterile lamina* rather thick, lower part pinnate, upper 1/3 to 1/2 pinnatifid, widest medially, 12–74 by (1.5–)3–13(–26) cm, index (2.5–)5–8(–11); pinnae (strongly ascending) (18–)30–60(–80) pairs, widest below or about the middle, veins of pinnae simple to as many as forked, distinct to obscure on both surfaces, margin entire, most pinnae except the uppermost with inequilateral to equilateral base, rounded to cuneate; lowermost pinnae sessile to shortly stalked, not deflexed, usually gradually shortened, some pinnae vestigial on stipe sided by aerophores (sometimes a few pairs); middle pinnae (1.3–)3.5–7(–18) cm long, (0.3–)0.5–1 cm wide in the middle, sessile to rarely shortly stalked, base rounded or cuneate (when dry); uppermost pinnae adnate, base unequal-sided, basispicopically decurrent into rachis wing to perpendicular to the rachis; apex of lamina pinnatifid, sometimes terminated by a pinnatilobed or a pinna-like segment. *Fertile fronds* usually longer than the sterile ones, sometimes shorter (or about the same length, sometimes from the high grasslands), dorsal side of rachis semiterete, trigonous or grooved, rachis (1–)2–4(–5) mm wide in the middle part; lamina pinnate

except the apex, lower pinnae shortly stalked, 18–54(–90) by 3–12(–25) cm; pinnae sparsely short glandular hairy, 25–70 pairs, margin erose; lowermost pinnae gradually shortened, (0.8–)1–3(–6) cm apart; middle pinnae 3–14 cm long, 3–5 mm wide, base sessile, slightly cordate or shortly stalked; apex pinnatifid, acuminate or caudate. Paraphyses many, yellow to (glossy) brown. Spores brown, with reddish tubercles.

Distribution — *Malesia*: Sulawesi, Moluccas (Seram), New Guinea, S New Ireland, Solomon Islands (Guadalcanal); very common at high elevations in New Guinea.

Habitat — Forming large spots in fire-induced, treefern-dominated grasslands, and subalpine shrubbery, in primary cloud forest, rarely as epiphyte, altitude 1250–4000 m.

Chromosome number — Walker [J. Linn Soc. Bot. (London) 67, Suppl. 1 (1973) 91] reported $n = 66$ under the name of *Plagiogyria tuberculata* Copel.

Note — Hennipman [Blumea 16 (1968) 97] made a detailed study of the mucilage-producing glandular hairs on the base of stipes of this variety and *P. pycnophylla*. He found that the hairs of the two species show certain differences in orientation and in shape and size of stalk and capitate glandular cell. Our observations confirmed his report, but this character is not very useful in practice to distinguish species.

c. var. latipinna (Copel.) X.C. Zhang & Noot.

Plagiogyria egenolffoides (Baker) Copel. var. *latipinna* (Copel.) X.C. Zhang & Noot., Blumea 42 (1997) 484. — *Plagiogyria tuberculata* var. *latipinna* Copel., Philipp. J. Sc., Bot. 2 (1907) 133; Alderw., Malayan Ferns (1908) 826. — Type: Merrill 5962 (iso GH, US, photogr. PE), Philippines, Mt Halcon, alt. 2400 m, XI-1906.

Plagiogyria tuberculata Copel., Philipp. J. Sc. 1, Suppl. (1906) 153; Alderw., Malayan Ferns (1908) 343; C. Chr., Mitt. Inst. Allg. Bot. Hamburg 7 (1927) 154; Copel., Philipp. J. Sc. 38 (1929) 391, p.p., excl. pl. Borneo, Sumatra; Fern Fl. Philipp. 2 (1960) 194, p.p., excl. pl. New Guinea, Borneo, Sumatra; K. Iwats. & M.G. Price, South East Asia Studies 14 (1977) 550; Parris, Stud. Fl. Gunung Mulu Nat. Park, Sarawak (1984) 177; M. Kato, Acta Phytotax. Geobot. 40 (1989) 91. — Type: Copeland 1924 (holo MICH-Herb. E.B. Copeland No. 33), Luzon, Lepanto, Bagnen, alt. 6500 ft, 4-XI-1905.

Plagiogyria tuberculata var. *gracilis* Copel., Leafl. Philipp. Bot. 2 (1908) 405; Alderw., Malayan Ferns Suppl. 1 (1916) 244. — Type: Elmer 9740 (BM, F, GH, K, L, NY, P, U, US), Philippines, Negros, Mt Cuernos, alt. 1800 m, IV-1908.

Plagiogyria pycnophylla var. *integra* Copel., Philipp. J. Sc., Bot. 5 (1910) 285; Alderw., Malayan Ferns Suppl. 1 (1916) 244; Copel., Sarawak Mus. J. 2 (1917) 388. — Type: Brooks s.n. (BM), Sarawak, Mt Bengkarum, Sambas River, alt. 3500 ft, IX-1908.

Plagiogyria pycnophylla var. *integra* subvar. *stenophylla* Bonap., Notes Pterid. 14 (1923) 484. — Type: Mjöberg 9 (holo P; iso US), Sarawak, Mt Murud, alt. 5000–6000 ft, 1922–1923.

Plagiogyria rotundipinnata Bonap., Notes Pterid. 14 (1923) 484; Copel., Philipp. J. Sc. 38 (1929) 395. — Type: Mjöberg 7 (holo P; iso K, photogr. BM, PE), Sarawak, Mt Murud, summit, alt. 8000 ft, 1922–1923.

Plagiogyria clemensiae Copel., Philipp. J. Sc. 38 (1929) 395, pl. 4; C. Chr. & Holttum, Gard. Bull. Str. Settle. 7 (1934) 225; Tagawa, Acta Phytotax. Geobot. 26 (1974) 113; Parris et al., Pl. Mount Kinabalu 1 (1992) 97. — Type: Clemens 10589 (holo MICH-Herb. E.B. Copeland No. 26, fragm. BM-Herb. C. Christensen; photogr. GH, NY, PE), Borneo, Mt Kinabalu, Paka Cave, alt. 3000 m, 12/14-XI-1915.

Rhizome short to c. 15 cm long, erect to decumbent, narrow and very woody. *Stipes* of sterile fronds (6–)10–35(–45) cm long, of fertile fronds 22–55(–66) cm long, the

base strongly or moderately enlarged, 4–20 mm wide in the middle, cross section one U-shaped vascular bundle (but in smaller plants more like a V-shaped form), upper part of stipe tetragonal, aerophores present on stipe and rachis, slender, hook-shaped, with pointed apex (usually short). Fronds usually covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis usually semiterete, trigonous, grooved, or sometimes flattened, rachis 1–2(–4) mm wide in the middle part. *Sterile lamina* rather thin to rather thick, lower part pinnate, upper 1/3 to 1/2 pinnatifid to pinnatifid except a few free basal pinnae (or pinnatifid, the Kinabalu high elevation population), widest medially to subbasally, (10–)20–50(–66) by 5–18(–22) cm, index 2–4; pinnae 20–40(–60) pairs, widest medially (usually, rarely widest at the base in the pinnatifid form), veins of pinnae simple or paired at base or forked above base (few veins), distinct on both surfaces, margin entire (usually completely) or except the apex, most pinnae except the uppermost with equilateral base, cuneate, rounded, attenuate, or acroscopic side adnate; lowermost pinnae sessile to shortly stalked or rarely adnate but slightly constricted, usually slightly deflexed, abruptly or slightly shortened; middle pinnae (3–)4–10(–20) cm long, (0.4–)0.6–0.9(–1.4) cm wide in the middle, sessile to rarely shortly stalked, basiscopic side rounded, partly free from rachis, perpendicular to rachis, or round, base cuneate or rounded (sometimes attenuate); uppermost pinnae adnate, base unequal- to about equal-sided, basiscopically decurrent into rachis wing or rarely rounded; apex of lamina pinnatifid, terminated by a pinnatilobed, short-triangular to pinnatilobed, long-triangular or pinna-like segment (very rare, up to 10 cm long, base connected with upper shorter lateral pinnae). *Fertile fronds* usually longer than the sterile ones, dorsal side of rachis semiterete, flattened, or grooved, rachis 1–2(–5) mm wide in the middle part; lamina pinnate except the apex, lower pinnae shortly stalked, (8–)20–45(–65) by (3–)7–20(–26) cm; pinnae usually sparsely bearing short glandular hairs or glabrous, 15–50(–72) pairs, margin entire or subentire; 1–2(–4) cm apart; middle pinnae 4–11(–16) cm long, 2–3 mm wide, base sessile to shortly stalked; apex pinnatifid, acuminate or caudate, or terminated by a pinna-like segment, or rarely by a pinna conform to the lateral ones and often beaded at the base. Paraphyses many, yellow to dark brown. *Spores* yellow, with reddish tubercles.

Distribution — *Malesia*: Borneo, Philippines, Sulawesi, Moluccas (Seram).

Habitat — A common constituent in mossy forest, in deep shade, rarely epiphytic on moss-covered tree trunks; altitude 1200–4000 m.

d. var. *sumatrana* (Rosenst.) X.C. Zhang & Noot.

Plagiogyria egenolfooides (Baker) Copel. var. *sumatrana* (Rosenst.) X.C. Zhang & Noot., *Blumea* 42 (1997) 484. — *Plagiogyria sumatrana* Rosenst., *Feddes Repert. Spec. Nov. Regni Veg.* 13 (1914) 214; *Alderw., Malayan Ferns Suppl.* 1 (1916) 244; *Bull. Jard. Bot. Buitenzorg III*, 2 (1920) 164; *Copel., Philipp. J. Sc.* 38 (1929) 392. — Type: *Winkler in Rosenstock, Filic. Sumatra Ex. 127* (BM, K, L, P), Sumatra, Batakland, 1911.

Plagiogyria subrigida Alderw., *Bull. Jard. Bot. Buitenzorg III*, 2 (1920) 163. — Syntypes: *Bünnemeijer 4122* (K, L, U), Sumatra, Mt Malintang, alt. 2000 m, 29-VII-1910; *Lörzing 6006* (L), Sumatra, Mt Sibajak, alt. 2000 m, 28-VIII-1910.

Plagiogyria integripinnata Bonap., *Notes Pterid.* 14 (1923) 60. — Type: *Haniff & Nur 8144* (holo P), Malaya, Gunung Tahan, alt. 5500 ft, 11-VI-1922.

Plagiogyria malayensis R.D. Dixit & A. Das, Fern Gaz. 12 (1981) 182, photogr. 1. — Type: *Wray 317* (holo CAL; iso BM), Malaya, Peninsula, Perak, summit of Gunung Batu Puteh, 6700 ft. Paratype: *Scortechini 397* (CAL), Malaya, Peninsula, without exact locality.

Plagiogyria tahanensis Miyamoto & H. Ohba, Acta Phytotax. Geobot. 43 (1992) 31, f. 1: A–H. — Type: *Miyamoto 89-373* (holo TI), Malaya, Pahang, summit of Gunung Tahan, alt. 1600 m.

Plagiogyria tuberculata auct. non Copel.: Holttum, Revis. Fl. Malaya, ed. 2 (1966) 111; A.G. Piggott, Ferns of Malaysia in Colour (1988) 88, photogr. 252–255; Miyamoto & H. Ohba, Acta Phytotax. Geobot. 43 (1992) 32, f. 1: I.

Rhizome short to c. 15 cm long, erect to decumbent, narrow and very woody. *Stipes* of sterile fronds (2–)12–30(–40) cm long, of fertile fronds (4–)24–45 cm long, base strongly enlarged, 3–15 mm wide in the middle, cross section one U-shaped vascular bundle, upper part of stipe tetragonal, aerophores present on stipe and rachis (sometimes absent on stipe, and not prominent), slender, hook-shaped, with pointed apex (usually). Fronds covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis grooved (usually), flattened, semiterete, or trigonous, rachis (0.5–)2–3(–5) mm wide in the middle part. *Sterile lamina* rather thick, pinnate except the pinnatifid or pinnatilobed apex or lower part, upper 1/3 to 1/2 pinnatifid, widest medially to subbasally, (5–)30–60(–100) by (2.5–)13–22(–27) cm, index (1.68–)2–3.85(–6.13); pinnae (6–)17–39 pairs, widest below or about the middle, veins of pinnae simple to, rarely, as many as forked, distinct to obscure on both surfaces, margin entire or rarely serrulate, most pinnae except the uppermost with equilateral to inequilateral base, cuneate to rounded; lowermost pinnae shortly stalked (sometimes stalk up to 1 cm long), not deflexed, gradually to abruptly shortened (2 or 3 pairs); middle pinnae (1.5–)6–14 cm long, (0.4–)0.7–1.4(–1.9) cm wide in the middle, sessile to shortly stalked, base rounded or cuneate; uppermost pinnae adnate, base unequal-sided, basiscopically decurrent into rachis wing or rounded; apex of lamina pinnatifid or terminated by a pinna-like (2–7 cm long) or pinnatilobed, long-triangular segment, rarely terminated by a pinna conform to lateral ones with free base, shortly stalked, 11 cm long. *Fertile fronds* usually longer than sterile ones, dorsal side of rachis grooved, flattened, or semiterete, rachis 1–4(–5) mm wide in the middle part; lamina pinnate, pinnae stalked, uppermost pinnatifid, pinnae base decurrent, (12–)35–60(–100) by (2–)9–15(–30) cm; pinnae sparsely bearing short glandular hairs or glabrous, 16–30 pairs, margin erose; lowermost pinnae not shortened (short to long stalked, rarely one or two pairs shorter), (2–)4(–8) cm apart; middle pinnae (2.5–)7–13(–22) cm long, (3–)4–5(–6) mm wide, base shortly stalked; apex pinnatifid, terminated by a pinna-like segment (usually 2–4 cm long). Paraphyses many, dark brown or yellow. *Spores* brown, with reddish tubercles.

Distribution — *Malesia*: Sumatra, Peninsular Malaya.

Habitat — Common in open forest and low scrub, on rather dry soil, in light shade, also on rocks in fairly open places; altitude 1000–2500 m.

3. *Plagiogyria euphlebia* (Kunze) Mett.

Plagiogyria euphlebia (Kunze) Mett., Farngett. II (1858) 274; Bedd., Handb. Ferns Brit. India (1892) 129; Ridl., J. Malayan Branch Roy. Asiat. Soc. 4 (1926) 35; Copel., Philipp. J. Sc. 38 (1929) 387. — *Lomaria euphlebia* Kunze, Bot. Zeitung (Berlin) (1848) 521. — Syntypes: *Görling 128* (Herb. Römer); *Zollinger* in Herb. Zollinger & Moritzi No. 1 (L), Japan.

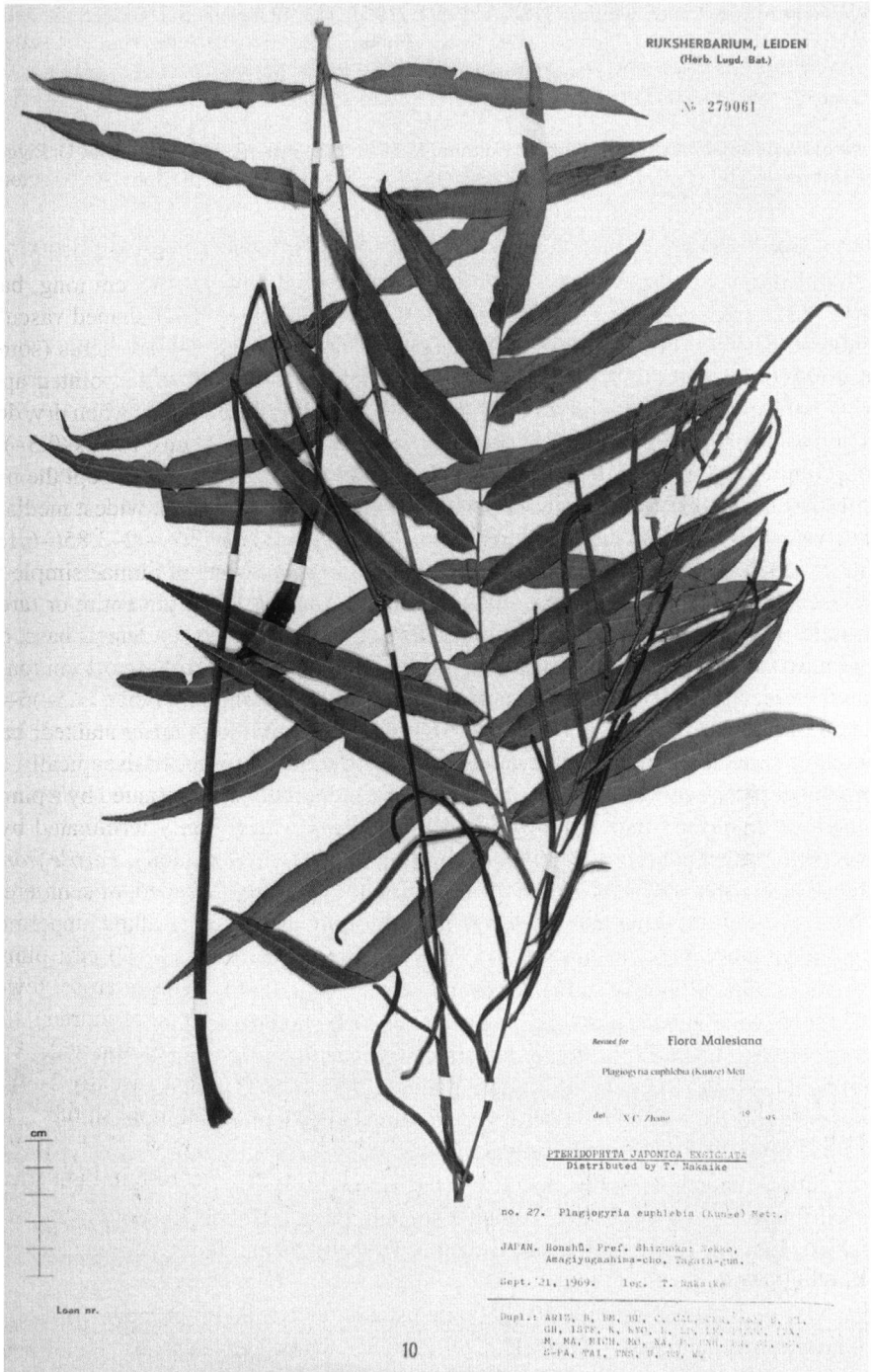


Fig. 3. Herbarium sheet of *Plagiogyria euphlebia* (Kunze) Mett. in L.

Plagiogyria christii Copel., Philipp. J. Sc. 1, Suppl. (1906) 153; Philipp. J. Sc., Bot. 2 (1907) 133; Alderw., Malayan Ferns (1908) 342, 826; Copel., Philipp. J. Sc. 38 (1929) 388; Fern Fl. Philipp. 2 (1960) 194; R.D. Dixit & A. Das, Proc. Indian Acad. Sci. (Plant Sci.) 90 (1981) 375, photogr. 2. — Type: *Copeland 1509* (MICH, n.v.), Philippines, Mt Apo, 1500–1800 m.

Rhizome short, erect to decumbent, narrow, sometimes very woody. *Stipes* stramineous to brownish, of sterile fronds (7–)25–35(–70) cm long, of fertile fronds (9–)40–77 cm long, base slightly to strongly enlarged, 5–10(–20) mm wide in the middle, in cross section one V-shaped to one U-shaped vascular bundle, upper part of stipe terete or oval (usually) or tetragonal, aerophores only present on base of stipe or seemingly absent at dry stage, present on base of stipe and lower part of rachis, or present on stipe and rachis, cushion-like; rachises glabrous to hairy to sometimes densely hairy. Fronds not covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis semiterete (usually), flattened or grooved, not winged, rachis 1–2(–5) mm wide in the middle part. *Sterile lamina* herbaceous to firm herbaceous to subcoriaceous (very rare, found near the sea), not glaucous, pinnate, apical pinna base free, or sometimes connected with upper lateral ones, or rarely pinnate except the pinnatifid or pinnatilobed apex, widest basally to medially, (11–)20–60(–136) by (7–)12–30(–40) cm, index 1.36–2.5(–3.8); pinnae 7–25 pairs, widest medially, veins of pinnae simple to as many as forked, distinct on both surfaces, stomata scattered on the lower epidermis, margin serrulate or towards the base becoming entire or nearly so, most pinnae except the uppermost with equilateral, cuneate, rounded, or attenuate base; lowermost pinnae shortly stalked or rarely sessile, not deflexed, not or slightly shortened (the basal pair); middle pinnae (5–)11–17(–30) cm long, 0.9–2(–2.6) cm wide in the middle, shortly stalked or sessile, base cuneate or rounded; apex of lamina terminated by a pinna conform to lateral ones or rarely pinnatifid, base with 1–3 irregular auricles or free, shortly stalked, or connected with 1 or 2 shorter lateral pinnae (sometimes connected with more than 2 pairs), (4–)7–10(–30) cm long, terminated by a pinnatilobed, short-triangular or pinna-like segment. *Fertile fronds* usually longer than the sterile ones, rarely shorter or about the same length, dorsal side of rachis semiterete (usually), flattened, or grooved, not winged, rachis 1–2(–5) mm wide in the middle part; lamina pinnate throughout, pinnae shortly stalked or nearly sessile, (9–)20–50(–80) cm long, (3–)10–20(–33) cm wide; pinnae glabrous or sparsely bearing short glandular hairs, 7–25 pairs, margin entire, subentire, or erose; lowermost pinnae not shortened (or the basal pair shorter), (1–)4–6(–8) cm apart; middle pinnae (2–)7–20(–33) cm long, 2–4(–5) mm wide, base shortly stalked to sessile; apex terminated by a pinna conform to the lateral ones and often beaded at the base. Paraphyses many, brown. *Spores* yellow or brown, with reddish tubercles. — **Fig. 3.**

Distribution — Japan, China (Anhui, Zhejiang, Fujian, Hubei, Hunan, Guangdong, Guangxi, Jiangxi, Taiwan, Sichuan, Guizhou, Yunnan), Nepal, India, Burma, Vietnam; *Malesia*: Philippines.

Habitat — In forest; altitude 50–2500 m, usually 600–1500 m; in Japan 50–650 m.

Chromosome number — Kurita [J. Coll. Arts Sci. Chiba Univ. Nat. Sci. Sér. 4 (1963) 43 and Tsai [J. Sc. Engin. 10 (1973) 261] reported $n = c. 125$, and $n = 125$; Nakato and Mitui [J. Jap. Bot. 58 (1983) 105] reported $2n = 260$.

4. *Plagiogyria falcata* Copel.

Plagiogyria falcata Copel., Philipp. J. Sc., Bot. 2 (1907) 133, pl. 1, f. B; Alderw., Malayan Ferns (1908) 826; Hayata, Icon. Pl. Formos. 4 (1914) 239; Copel., Philipp. J. Sc. 38 (1929) 400; Fern Fl. Philipp. 2 (1960) 196; K. Iwats. & M.G. Price, South East Asia Studies 14 (1977) 549. — Type: *Merrill 5960* (MICH, P), Philippines, Mindoro, Mt Halcon, alt. 2100 m, XI-1906.

Rhizome short to c. 15 cm long, suberect, narrow or thick with many stipe bases. *Stipes* stramineous, of sterile fronds (6–)12–20(–30) cm long, of fertile fronds 20–45 cm long, base slightly or moderately enlarged, 4–6(–8) mm wide in the middle, in cross section one V-shaped vascular bundle, upper part of stipe (sharply) triangular, aerophores only present on base of stipe; rachises glabrous. Fronds not covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis carinate, not winged (or winged on the sharp ridge), rachis 1–2 mm wide in the middle part. *Sterile lamina* herbaceous, not glaucous, pinnatifid, widest medially, (10–)20–40(–55) by (3–)5–13(–17) cm, index (2.5–)3–4(–5.4); pinnae (12–)35–53 pairs, widest near base, veins of pinnae paired at base, forked above base to paired at base, or branched at base, both branches forked above or rarely simple, distinct on both surfaces, stomata scattered on lower epidermis, margin serrulate, sometimes towards base becoming entire or nearly so, or entire except apex (rarely biserrulate to the apex), most pinnae except the uppermost with (nearly) inequilateral base, adnate to rachis; lowermost pinnae adnate, deflexed (usually), not shortened to abruptly shortened; middle pinnae (1.5–)5–8.5 cm long, 0.4–1 cm wide in the middle, acroscopic side of base adnate to the rachis but not into a wide wing, basiscopic side perpendicular to rachis or rounded, partly free from rachis or round; uppermost pinnae adnate, base about equal-sided, basiscopically perpendicular to the rachis; apex of lamina pinnatifid, terminated by a pinnatilobed, long-triangular segment. *Fertile fronds* usually longer than the sterile ones, dorsal side of rachis carinate, rachis 1.5–2.5 mm wide in the middle part; lamina deeply pinnatifid, rachis slightly winged throughout, 20–50 by 3–6 (–10) cm; pinnae glabrous, (15–)35–50 pairs, margin subentire; lowermost pinnae not or gradually shortened (sometimes not well developed), 2–3 cm apart; middle pinnae (1–)2.5–5 cm long, 2–4 mm wide, base broadly adnate; apex pinnatifid, acuminate, or caudate. Paraphyses few, mostly lost or absent, yellow. *Spores* yellow, with reddish tubercles. — **Fig. 4.**

Distribution — China (Anhui, Zhejiang, Fujian, Jiangxi, Hunan, Guangdong, Guangxi, Hongkong, Hainan, Taiwan, Guizhou); *Malesia*: Philippines.

Habitat — In dense ravine forest, or under shade rocks, altitude 40–2150 m, usually 500–1500 m.

5. *Plagiogyria glauca* (Blume) Mett.

Plagiogyria glauca (Blume) Mett., Farngett. II (1858) 273; Bedd., Ferns Brit. India 1 (1866) pl. 90; Kuhn, Ann. Mus. Bot. Lugd-Bat. 4 (1869) 291; Alderw., Malayan Ferns (1908) 342; Copel., Sarawak Mus. J. 2 (1917) 388; C. Chr. & Holttum, Gard. Bull. Str. Settlement. 7 (1934) 225; Backer & Posth., Varenfl. Java (1939) 31; Copel., Fern Fl. Philipp. 2 (1960) 195; Holttum, Revis. Fl. Malaya ed. 2 (1966) 112; Parris et al., Pl. Mount Kinabalu 1 (1992) 97. — *Plagiogyria glauca* subsp. *glauca* Nakaike, Bull. Nat. Sc. Mus. Tokyo 14 (1971) 264. — *Lomaria glauca* Blume, Enum. Pl. Javae (1828) 204; Moritz, Syst. Verz. (1844) 112. — Lectotype: *Blume s.n.* (L sh. 908.316-285), Java, Salak.

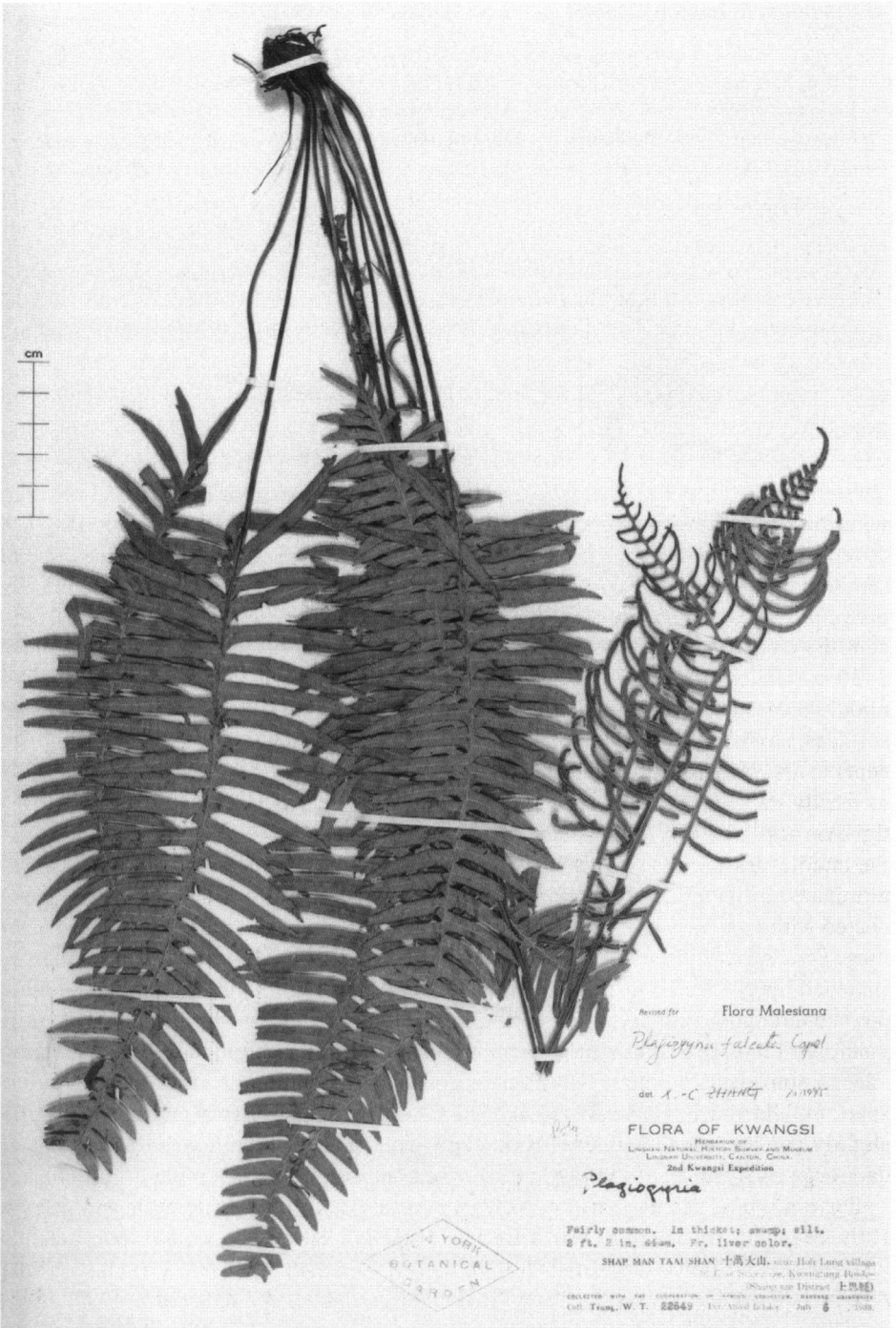


Fig. 4. Herbarium sheet of *Plagiogyria falcata* Copel. in NY.

- Lomaria glauca* var. *B* Blume, Enum. Pl. Javae (1828) 204. — Lectotype: *Blume s.n.* (L sh. 908.316-284).
- Plagiogyria glauca* var. *philippinensis* H. Christ, Bull. Herb. Boiss. 6 (1898) 150; Copel., Polypod. Philipp. Is. (1905) 98; Alderw., Malayan Ferns (1908) 342. — Type: *Loher s.n.* (P), Philippines, Mt Data, XI-1893.
- Plagiogyria nana* Copel., Philipp. J. Sc., Bot. 4 (1909) 114, non Fée ex Salomon (1883); Alderw., Malayan Ferns Suppl. 1 (1916) 244; Copel., Philipp. J. Sc. 38 (1929) 393; Fern Fl. Philipp. 2 (1960) 195. — *Plagiogyria glauca* var. *nana* C. Chr., Brittonia 2 (1937) 284. — Syntypes: *FB 16306* (MICH), *PPE-113* (BM, K, L, PE, P, NY, US), Luzon, Benguet, Mt Pulog, alt. 2850 m, V-1909.
- Blechnum papuanum* Brause, Bot. Jahrb. Syst. (1920) 158. — *Plagiogyria papuana* Alston, J. Bot. (1939) 290, non C. Chr. (1937). — *Struthiopteris papuana* Ching, Sunyatsenia 5 (1940) 243. — *Plagiogyria brausei* Nakaike, Bull. Nat. Sc. Mus. Tokyo 17 (1991) 90. — Type: *Ledermann 11978* (holo B; fragm. BM, photogr. BM, PE), Papua New Guinea, Sepik, alt. 2070 m, 3-VI-1913.

Rhizome short to c. 15 cm long, erect, suberect to curved, or decumbent, narrow and very woody or thick with many stipe bases. *Stipes* stramineous or brownish, of sterile fronds 3–55 cm long, of fertile fronds 5–75 cm long, base strongly enlarged, 5–15 mm wide in the middle, in cross section one U-shaped vascular bundle, upper part of stipe tetragonal, terete, or oval, aerophores present on stipe and rachis, elongate, horn-like with blunt apex; rachises glabrous to hairy or sometimes densely hairy. Fronds not covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis semiterete to flattened or grooved, not winged, rachis 0.5–4 mm wide in the middle part. *Sterile lamina* firm herbaceous or subcoriaceous, glaucous beneath, pinnate except the pinnatifid or pinnatilobed apex, widest medially or a little higher, 7–110 by 2–30 cm, index (1.8–)2.8–3.8(–4.6); pinnae 13–43 pairs, widest below or about the middle to near the base, veins of pinnae as many simple as forked, distinct on both surfaces, stomata scattered on the lower epidermis, margin serrulate, most pinnae except the uppermost with equilateral base, truncate or rounded; lowermost pinnae sessile to shortly stalked, not or slightly deflexed, abruptly shortened or not, some pinnae vestigial on stipe sided by aerophores; middle pinnae 1–15.5 cm long, 0.6–1.8 cm wide in the middle, sessile, base truncate or rounded (at dry stage); apex of lamina pinnatifid, terminated by a pinnatilobed segment or by a pinna conform to lateral ones, base connected with 1 or 2 shorter lateral pinnae or rarely with 1–3 irregular auricles, 1–10 cm long. *Fertile fronds* usually longer than the sterile ones, dorsal side of rachis semiterete, flattened, or grooved, not winged, rachis 0.5–4 mm wide in the middle part; lamina pinnate throughout, pinnae shortly stalked or nearly sessile, 11–77 by 4–24 cm; pinnae glabrous, 13–43 pairs, margin subentire to erose; lowermost pinnae gradually shortened or some pairs aerophore-like vestiges on stipe together with aerophores, 2–4 cm apart; middle pinnae 2–14 cm long, by 2–4.5 mm wide, base shortly stalked, sessile, or slightly cordate; apex pinnatifid, acuminate or caudate. Paraphyses few, mostly lost, dark brown or yellow. *Spores* yellow to brown, not obviously tuberculate.

Distribution — China (Taiwan, Xizang, Yunnan), India (Assam, Khasia and Jaintea Hills, Manipur, Naga Hills), North Burma; *Malesia*: Sumatra, Java, Lesser Sunda Islands (Flores), Borneo (Mt Kinabalu), Philippines (Luzon, Mindanao), Sulawesi, Moluccas (Seram), New Guinea, S New Ireland, Solomon Islands (Guadalcanal).

Habitat — In light shade or open places, grasslands; altitude 1200–3800 m.

Chromosome number — Walker [J. Linn Soc. Bot. (London) 67, Suppl. 1 (1973) 91] reported $n = c. 132$; Tsai [J. Sc. Engin. 10 (1973) 261] reported $n = 75$, under the name of *Plagiogyria formosana* Hayata.

Note — Clarke (1880) considered this to be only a variety of *P. pycnophylla*, and correctly pointed out that some of the Javanese specimens are much larger than those from Khasia. M.G. Price (pers. comm.) informed us that *P. glauca* and *P. pycnophylla* grow together in the Philippines. *Plagiogyria glauca* and *P. pycnophylla* coexist in most of their area of distribution except in Sichuan (the northern limit of *P. pycnophylla*), S Yunnan to Thailand, Indochine and Peninsular Malaya where *P. glauca* is absent, and in Taiwan where the other is wanting. The Taiwan population of *P. glauca* is rather constant with a terminal pinna. Perhaps *P. glauca* is distinguished from *P. pycnophylla* only because of the very obvious white wax under the laminae. However, when the wax is lost on herbarium specimens, probably the name *P. pycnophylla* will be given. In this case, the suggestion is to use a binocular to trace the white colour at the recurved pinna margins (the same situation applies to *P. assurgens*, another glaucous *Plagiogyria*).

The function of the wax is not well clear for this kind of ferns, mainly distributed in humid mountain forests. Certainly it protects the stomata from losing much water during the dry season of year.

6. *Plagiogyria pycnophylla* (Kunze) Mett.

Plagiogyria pycnophylla (Kunze) Mett., Farngett. II (1858) 272, t. 4, f. 22; Bedd., Ferns Brit. India 1 (1865) pl. 52; Kuhn, Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 291; Copel., Philipp. J. Sc. 1, Suppl. (1906) 154; Sarawak Mus. J. 2 (1917) 388, p.p., excl. var. *integra*; Ridl., J. Malayan Branch Roy. Asiat. Soc. 4 (1926) 36; Copel., Philipp. J. Sc. 38 (1929) 390; C. Chr. & Holttum, Gard. Bull. Str. Settle. 7 (1934) 224; Backer & Posth., Varenfl. Java (1939) 31; Copel., Fern Fl. Philipp. 2 (1960) 194; Parris et al., Pl. Mount Kinabalu 1 (1992) 97. — *Lomaria pycnophylla* Kunze, Bot. Zeitung (Berlin) 6 (1848) 143; Hook., Sp. Fil. 3 (1860) 21, t. 148; Racib., Pteridoph. Buitenzorg 1 (1898) 161. — *Stenochlaena* ? *pycnophylla* C. Presl, Epim. Bot. (1851) 165. — [*Lomaria scandens* De Vriese ex Hook., Sp. Fil. (1860) 22, nom. nud., pro syn., non Willd.] — Lectotype (proposed here): *van Gesker s.n.* (L sh. 908.325-138), Java, Mt Gede. See note.

Lomaria pycnophylla forma *major* Racib., Pteridoph. Buitenzorg 1 (1898) 162. — Type: *Raciborski s.n.* (L sh. 908.316-303), Java, Mt Gede.

Lomaria pycnophylla forma *alpina* Racib., Pteridoph. Buitenzorg 1 (1898) 162. — Type: *Raciborski s.n.* (L sh. 938.297-304, iso in K, P), Java, Mt Pangerango. See note 3.

Lomaria glauca var. *C* Blume, Enum. Pl. Javae (1828) 204. — Lectotype: *Blume s.n.* (L sh. 908.316-296), Java.

[*Lomaria glauca* var. *concolor* Moritz, Syst. Verz. (1844) 112, nom. nud.] — Voucher: *Zollinger 232z* (iso L), Java, G. Salak, alt. 2000 m, 2/4-XI-1843.

Lomaria callosa Fée, Mém. Foug. 5. Gen. Filic. (1853) 70. — Type: *Lobb 274* (holo P, n.v.; iso BM, K), Java, 1847.

Plagiogyria pycnophylla var. *remota* H. Christ, Bull. Herb. Boiss. 6 (1898) 150; Copel., Polypod. Philipp. Is. (1905) 97; Alderw., Malayan Ferns (1908) 343. — Type: *Loher 953* (holo K), Luzon, Mt Data, alt. 2250 m, II-1894.

Plagiogyria pycnophylla var. *mixta* Copel., Philipp. J. Sc. 1, Suppl. (1906) 154. — Type: *Copeland 1854* (n.v.) Mt Data, alt. 2000 m.

Plagiogyria wilhelmensis Nakaike, Bull. Nat. Sc. Mus. Tokyo 17 (1991) 93, f. 14. — Type: *Nakaike 280* (holo TNS, n.v.).

Rhizome short to c. 15 cm long, erect, narrow and very woody. *Stipes* stramineous or brownish, of sterile fronds 6–60 cm long, of fertile fronds 10–70 cm long, base strongly enlarged, 5–15 mm wide in the middle, in cross section one U-shaped vascular bundle, upper part of stipe tetragonal, terete, oval, or triangular, aerophores present on stipe and rachis, elongate, horn-like, with blunt apex; rachises glabrous to hairy to sometimes densely hairy. Fronds not covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis flattened, semiterete or grooved, not winged (or winged on ridges), rachis 1–4 mm wide in the middle part. *Sterile lamina* herbaceous, not glaucous, pinnate except the pinnatifid or pinnatilobed apex, widest medially, 15–100 by 6–40 cm, index (1.8–)2.3–2.8(–4.1); pinnae 20–50 pairs, widest near the base or below the middle, veins of pinnae simple or up to half forked, distinct on both surfaces, stomata scattered on the lower epidermis, margin serrulate, most pinnae (except the uppermost) with equilateral base, truncate or rounded; lowermost pinnae sessile to shortly stalked, slightly deflexed or not, gradually or slightly shortened, some pinnae vestigial on stipe sided by aerophores; middle pinnae 3–20 cm long, 0.6–2 cm wide in the middle, sessile, base truncate or rounded; apex of lamina pinnatifid, terminated by a pinnatilobed segment or by a pinna conform to lateral ones, base connected with 1 or 2 shorter lateral pinnae, 3–7 cm long. *Fertile fronds* usually longer than the sterile ones, dorsal side of rachis flattened, semiterete, or grooved, not or sometimes winged on the ridges (slightly, also along the corner line of the stipe); lamina pinnate throughout, pinnae shortly stalked or nearly sessile, 20–70 by 4–20 cm wide; pinnae glabrous, 16–40 pairs, margin erose; lowermost pinnae gradually shortened or some pairs aerophore-like vestiges on stipe together with aerophores, 2–4(–5) cm apart; middle pinnae (3–) 4.5–13(–21) cm long, 2–4 mm wide, base sessile, slightly cordate, or shortly stalked; apex pinnatifid, acuminate or caudate or terminated by a pinna conform to the lateral ones and often beaded at the base. Paraphyses few, mostly lost, dark brown or brown. *Spores* yellow to brown, not obviously tuberculate.

Distribution — China (Sichuan, Yunnan, Xizang), N Burma, Sikkim, Bhutan, Nepal, E India (Assam, Khasia and Jaintea Hills, Manipur); *Malesia*: Peninsular Malaysia, Sumatra, Java, Philippines (Luzon), Borneo (Mt Kinabalu), Sulawesi, New Guinea.

Habitat — In wet places of forest; altitude 1200–3500 m.

Note — Kunze's herbarium at Leipzig was destroyed (Stafleu & Cowan 1979). Gesker's specimen in L is selected as lectotype because it is in accordance with the original material of Kunze from Java that bears the name of "*Lomaria scandens* W." by De Vriese.

7. *Plagiogyria stenoptera* (Hance) Diels

Plagiogyria stenoptera (Hance) Diels in Engl. & Prantl, Nat. Pflanzenfam. 1, 4 (1899) 282; Copel., Philipp. J. Sc. 1, Suppl. (1906) 154; Alderw., Malayan Ferns (1908) 341; Copel., Fern Fl. Philipp. 2 (1960) 196. — *Blechnum stenopterum* Hance, J. Bot. 21 (1883) 268. — *Lomaria concinna* Baker, J. Bot. 23 (1885) 103, nom. superfl.; Baker in Hook., Icon. Pl. 7 (1886) pl. 1644. — *Lomaria stenoptera* Baker, Ann. Bot. (London) 5 (1891) 40, 220. — Type: *Hancock 39* (K; iso BM), Taiwan, 'Tamsui District', XI-1881. See note.

[*Plagiogyria auriculifera* Makino, Bot. Mag. (Tokyo) 23 (1909) 244, nom. nud., pro syn.]

Rhizome short, erect to suberect, thick with many stipe bases. *Stipes* stramineous, of sterile fronds (3-)4-8(-12) cm long, of fertile fronds (9-)11-22(-28) cm long, base slightly enlarged, 4-8 mm wide in the middle, in cross section one V-shaped vascular bundle, upper part of the stipe tetragonal, aerophores only present on base of stipe; rachises glabrous. Fronds not covered with an amorphous gelatinous mucilage layer when dry, dorsal side of rachis flattened or upwards carinate, with crisped wings on the two ridges or not, rachis 1-2 mm wide in the middle part. *Sterile lamina* herbaceous, not glaucous, pinnatifid, widest medially, 20-62 by 4-20 cm wide, index (2.6-)3.3-4.3(-5.5); pinnae 25-35 pairs (auricle pinnae excluded), widest near base or medially (in very large forms), veins of pinnae forked above base, distinct on both surfaces, stomata scattered on the lower epidermis, margin serrulate or towards the base becoming entire or nearly so, most pinnae except the uppermost with inequilateral base, adnate to rachis; 3-6(-11) pairs reduced to mere auricles; middle pinnae 2.5-10.5 cm long, 0.7-1.4 cm wide in the middle, acroscopic side of base adnate to the rachis into a wide wing, basisopic side like the acroscopic side or round (in large fronds); uppermost pinnae adnate, base about equal-sided, basisopically decurrent into rachis wing; apex of lamina pinnatifid. *Fertile fronds* usually longer to shorter than the sterile ones, dorsal side of rachis flattened to grooved, sometimes winged on the ridges, rachis 1-2 mm wide in the middle part; lamina pinnate throughout, pinnae nearly sessile or deeply pinnatifid, rachis slightly winged throughout (an abnormal state), (10-)35-55(-75) by 4-8(-12) cm (since pinnae are drooping to one side); pinnae sparsely bearing short glandular hairs (on the inner side), 15-30 pairs (vestigial ones excluded); margin of pinnae entire to subentire; some pairs of lowermost pinnae aerophore-like vestiges on stipe together with aerophores (or sometimes replaced by auricle pinnae like the sterile ones), 2 cm apart; middle pinnae (2.5-)4-6(-12) cm long, 2-3 mm wide, base shortly stalked; apex terminated by a pinna conform to the lateral ones and often beaded at the base. Paraphyses absent. *Spores* yellow, with reddish tubercles.

Distribution — Japan (Yakushima), China (Hubei, Hunan, Guangxi, Sichuan, Taiwan, Guizhou, Yunnan), Vietnam; *Malesia*: Philippines (Luzon).

Habitat — In moist dense mountain forests, or in ravines, rocky slopes; altitude 500-2500 m.

Chromosome number — Tsai [J. Sc. Engin. 10 (1973) 261] reported $n = 75$.

Note — Baker (1885) published *Lomaria concinna* based on *Hancock 39*, which is also the type of *Blechnum stenopterum* Hance (1883).