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REVISION OF PACHYCENTRIA (MELASTOMATACEAE)

GUDRUN CLAUSING

Institut für Spezielle Botanik und Botanischer Garten, Johannes Gutenberg-Universität, 55099 Mainz, Germany

SUMMARY

A revision of *Pachycentria* Blume, which includes the monotypic *Pogonanthera* Blume, is presented. *Pachycentria* comprises eight species and one subspecies. Two species, *P. vogelkopensis* and *P. hanseniana*, are newly described. The genus is distinguished from other genera in the Medinillinae by a small ovary in an urceolate hypanthium, and by seeds with comb-shaped testa cells. Andromonoecy is recorded for three species of the genus. Pollination by bees and dispersal by birds and ants has been observed in the field. *Pachycentria* is distributed in Burma, Thailand, Peninsular Malaysia, Sumatra, Java, Borneo, Philippines, Sulawesi, and New Guinea.

Key words: Dissochaeteae, Medinillinae, *Pogonanthera*, andromonoecy, extraovarian chambers, hypanthium.

INTRODUCTION

In 1831 Blume established *Pachycentria* and *Pogonanthera*. *Pachycentria* was described on the basis of two specimens that Blume had collected in Java and described as *Melastoma constrictum* Blume and *M. varingiifolia* Blume in 1826, whereas *Pogonanthera* was based on *M. pulverulenta* Jack described in 1823. Prior to this revision there exist 28 valid names in *Pachycentria* and eight in *Pogonanthera* (Index Kewensis, 1993). After Bakhuizen van den Brink Jr.'s work on Asian Melastomataceae (1943) *Pachycentria* comprises ten species while *Pogonanthera* is monotypic.

Pogonanthera and *Pachycentria* are difficult to distinguish. The leaf base and the shape of the dorsal connective appendage are considered the only differences between the two genera (Blume, 1831; Bakhuizen van den Brink Jr., 1943; Maxwell, 1978). In this revision *Pogonanthera* is regarded as congeneric with *Pachycentria* because of continuous morphological variation between the two.

Pachycentria and *Pogonanthera* show a strong morphological similarity to *Medinilla* Gaudich. (Blume, 1831; Bakhuizen van den Brink Jr., 1943; Maxwell, 1978). The absence of extraovarian chambers and ventral connective appendages, and a constricted urceolate hypanthium have been used to distinguish the two genera from *Medinilla*. Careful investigation of these characters within the subtribe Medinillinae, however, shows that only the constricted hypanthium and small ovary hold for *Pachycentria* (incl. *Pogonanthera*). In addition, *Pachycentria* (incl. *Pogonanthera*) has seeds with comb-shaped testa cells in contrast to the interdigitate testa cells in other genera of the tribe Dissochaeteae. The distinctness of *Pachycentria* and *Pogonanthera* from *Medinilla* is further supported by a phylogeny of the Dissochaeteae based on molecular

data in which they form a monophyletic lineage separate from *Medinilla* (Clausing, 1999; Clausing & Renner, in press).

The following eight species and one subspecies are treated in *Pachycentria*: *P. constricta* (Blume) Blume, *P. glauca* Triana subsp. *glauca*, *P. glauca* subsp. *maingayi* (C.B. Clarke) G. Clausing, *P. hanseniana* G. Clausing (spec. nov.), *P. microsperma* Becc., *P. microstyla* Becc., *P. pulverulenta* (Jack) G. Clausing, *P. varingiifolia* (Blume) Blume, and *P. vogelkopensis* G. Clausing (spec. nov.).

MATERIAL AND METHODS

This revision is based on the study of c.700 specimens from the following herbaria: A, AAU, B, BKF, BM, BO, C, HAST, HBG, K, KEP, KLU, L, SAN, SAR, SING, U, UKMS. The measurements in the descriptions were made from dried and boiled material. The seeds of all species were examined with a scanning electron microscope.

Field observations for *P. constricta*, *P. glauca*, *P. microsperma*, and *P. pulverulenta* were made in Sabah and Sarawak (Malaysia) from March to June 1995 and from July to August 1996.

WHY POGONANTHERA IS REDUCED TO PACHYCENTRIA

Two characters are commonly used to distinguish *Pogonanthera* from *Pachycentria*. These are the shape of the dorsal connective appendage and the leaf base which has two tiny auricles in *Pogonanthera* (Fig. 8a). Both these characters, however, show continuous variation between the two genera.

A leaf base with small auricles is not a consistent character in *Pogonanthera*, it has been found in *Pachycentria microstyla*, and auricles are sometimes absent in *Pogonanthera*. This character, therefore, cannot be regarded as unique to *Pogonanthera*.

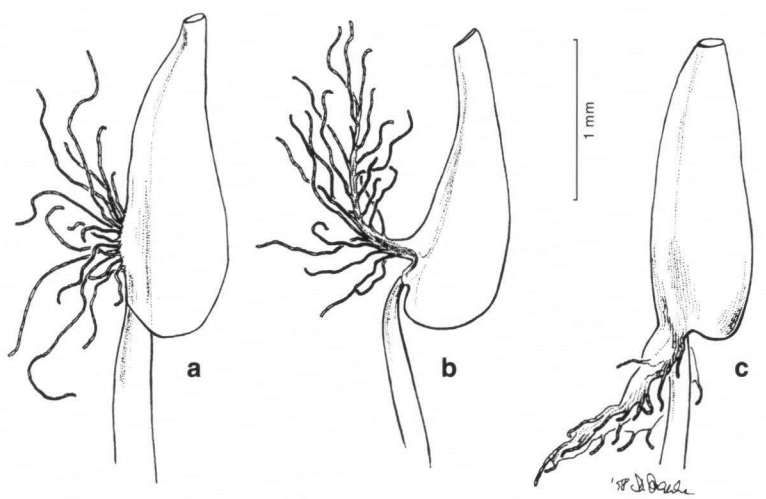


Fig. 1. Stamens. a. *Pachycentria pulverulenta* (Jack) G. Clausing; b. *P. vogelkopensis* G. Clausing; c. *P. microsperma* Becc.

In *Pogonanthera* the dorsal connective appendage consists of a tuft of hairs derived from a thickened zone on the connective (Fig. 1a & 8f), and in *Pachycentria* the connective is elongated into a dorsal spur (Fig. 4c, 6f, 7c). These two types of dorsal appendages, however, are connected through continuous morphological variation (Fig. 1a–c). In most species of *Pachycentria* (e.g. *P. constricta* and *P. glauca*) the dorsal connective spurs are nearly glabrous (Fig. 4c). *Pachycentria microsperma*, however, has a dorsal spur that is covered with the same type of hair that forms the connective tufts in *Pogonanthera* (Fig. 1c, 7c). Furthermore, *P. vogelkopensis* has a dorsal appendage that is strongly frayed but at its base still recognisable as a spur (Fig. 1b). This species shows the transition between a dorsal connective spur and the dorsal tuft of hairs in *P. pulverulenta* (Fig. 1). The hairs in all cases are unbranched chains of cells that are not only found on the connective but sometimes also on other floral parts such as petals or hypanthium.

As a consequence of these arguments, the monotypic *Pogonanthera* is here included in *Pachycentria*.

THE DISTINCTNESS OF PACHYCENTRIA FROM MEDINILLA

Pachycentria, together with *Medinilla* Gaudich., *Catanthera* F. Muell., *Kendrickia* Hook.f. and *Plethiandra* Hook.f. belongs to the Medinillinae (Benth. & Hook.f.) J.F. Maxwell (Clausing, 1999). The morphological and molecular delimitation of *Medinilla* from *Plethiandra*, *Catanthera* and *Kendrickia*, and the phylogeny of *Medinilla* is not resolved satisfactorily (Clausing, 1999). *Medinilla* with more than 300 species shows extensive morphological variation with many intermediates connecting it with *Plethiandra*, *Catanthera*, *Kendrickia*, and formerly segregated genera such as *Hypenanthe* (Blume) Blume, *Cephalomedinilla* Merr., and *Carionia* Naudin (Regalado, 1995). Molecular and morphological data indicate that *Medinilla* probably is best interpreted as a highly paraphyletic base group of the Medinillinae (Clausing, 1999).

The morphological similarity of *Pachycentria* to *Medinilla* has long been recognised (Blume, 1831; Bakhuizen van den Brink Jr., 1943; Maxwell, 1978). The absence of extraovarian chambers, a constricted hypanthium, the absence of ventral connective appendages, and the characteristic dorsal connective appendages (large dorsal spurs or tuft of hairs) have been considered the main differences to *Medinilla* (Blume, 1831; Bakhuizen van den Brink Jr., 1943; Maxwell, 1978).

Extraovarian chambers and constricted hypanthium

Extraovarian chambers (sometimes also called stamen pockets) are shallow or deep depressions between ovary wall and hypanthium tissue which contain the anthers before anthesis (Fig. 2a). The absence or reduction of extraovarian chambers in the Medinillinae is not restricted to *Pachycentria* as claimed by Maxwell (1978). It is also known in all species of *Plethiandra* and *Kendrickia*, and in some species groups of *Medinilla*. In *Medinilla*, lack of extraovarian chambers is known from many species from Madagascar (Clausing, pers. obs.). Relatively shallow extraovarian chambers are known from the *Medinilla myrtiformis*-alliance (Veldkamp, 1978) and the *Medinilla cephalophora*-group (Clausing, 1999). The absence of extraovarian chambers in the Medinillinae is not a structurally homologous character state. There exist two aspects

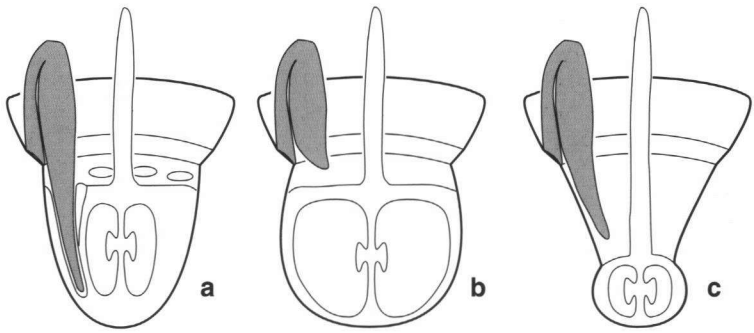


Fig. 2. a. Presence of extraovarian chambers; b. absence of extraovarian chambers due to ratio of filament and anther length; c. absence of extraovarian chambers due to a small ovary.

of floral morphology that are relevant for the absence of extraovarian chambers. The first is the ratio of anther to filament length (Fig. 2b). In buds where the folded stamens have long filaments and relatively short anthers that do not reach beyond the top of the ovary, extraovarian chambers are missing, and the ovary which in most cases is as long as the hypanthium is totally adnate. This can be observed in *Plethiandra*, *Kendrickia*, in most species of *Medinilla* from Madagascar which lack extraovarian chambers, and also in *M. versteegii* Mansf. [= *Pachycentria versteegii* (Mansf.) Bakh.f.]. The second aspect is an ovary which is small relative to the hypanthium. In this case the folded stamens are contained in the upper part of the hypanthium (Fig. 2c). A relatively small ovary (about half as long as the hypanthium) connected with shallow or rarely missing extraovarian chambers can be observed in some species groups of *Medinilla* [e.g. *M. myrtiformis*-alliance (Veldkamp, 1978, 1988), *M. cephalophora*-group and *M. muricata*-group (Clausing, 1999)]. In *Pachycentria* the ovary is half to one quarter as long as the hypanthium and totally adnate. In addition, the hypanthium is constricted above the ovary resulting in a characteristic urceolate shape.

Therefore, the absence of extraovarian chambers can be derived in a number of ways (Fig. 2), and cannot be used as a homologous character state for an intergeneric classification suggested by Bakhuizen van den Brink Jr. (1943).

Stamen appendages

Ventral and dorsal connective appendages are best interpreted as independent stamen characters because their development during the ontogeny of the stamen is temporally and structurally separated (Ziegler, 1925; Leinfellner, 1958). The typical stamen appendages of Medinillinae consist of a spur located dorsally on the connective, and two ventral auricled or filiform extensions at the base of the locules. The dorsal appendage of *Pachycentria* (except the tuft of hairs in *P. pulverulenta*) is similar to that in many species of *Medinilla*, *Catanthera* and *Kendrickia*. The absence of ventral appendages is found in several species of *Medinilla* (e.g. *Medinilla* sect. *Heteroblemma* and *M. myrtiformis*-alliance) and in all species of *Plethiandra*.

With regard to the variation of extraovarian chambers and stamen appendages, *Pachycentria* lies within the range of variation of *Medinilla*. A small ovary in a constricted, urceolate hypanthium, however, is characteristic of *Pachycentria*. Moreover, the study of seed characters showed that *Pachycentria* differs from all other Medinil-

linae in having comb-shaped testa cells (Fig. 11g). These two morphological autapomorphies support the results of the molecular analysis which also indicates the distinctness of *Pachycentria* from *Medinilla* (Clausing, 1999; Clausing & Renner, in press).

GENERAL MORPHOLOGY

Vegetative morphology

All species of *Pachycentria* are epiphytic or terrestrial shrubs, rarely treelets, and are between 0.25 and 8 m tall. The two subspecies of *P. glauca* always grow as epiphytes. *Pachycentria constricta, P. hanseniana, P. pulverulenta,* and *P. varingiifolia* predominantly grow as epiphytes or hemi-epiphytes while *P. microsperma, P. microstyla,* and *P. vogelkopensis* were often found growing on the ground.

The branches are often stunted and compressed and sometimes covered with lenticels. Adventitious roots are common in the epiphytic species. In some species these are irregularly swollen to elongated (*P. constricta, P. varingiifolia, P. pulverulenta*) or globose (*P. glauca*) tubers which have the anatomical structure of a storage root. These root swellings result from a hypertrophic development of the cortical parenchyma of the root. They probably serve as water storage organs to avoid insufficient water supply during temporary droughts. When they dry out, the cortex shrinks, and the bark bursts in some places because its lignified cells are incapable of adjusting to the shrinking. Apparently the plants are not harmed when some of their root swellings dry out. Dry and hollow root swellings are readily colonised by ants. Details of the root swellings were described by Beccari (1884–1886) and Clausing (1998).

Van Vliet (1981) studied the wood anatomy of *P. constricta* and *P. pulverulenta*. He noticed that these two taxa are very closely allied because they share most wood anatomical features. Both species lack distinct growth rings. The vessels are diffuse, solitary or in bundles of 2–5. The inter-vessel pits are scalariform, whereas the vessel-ray and vessel-parenchyma pits can be scalariform or oval to elongate. The fibres are dimorphic and septate. The rays are usually uniseriate, sometimes with a biseriate portion.

The leaves are highly polymorphic in shape and size in *P. constricta* and *P. pulverulenta*. For example, in *P. constricta* leaf size ranges from 6–23 cm in length and 1.5–9 cm in width, varying from a linear, acuminate leaf with a narrowed base to an obovate, truncate leaf with a cordate base (Fig. 3). Furthermore, some individuals have rather thin, fragile leaves with a smooth texture while others have coriaceous or somewhat succulent leaves with a rough or smooth texture. The length of the petiole differs from 0.3–1.5 cm, such that the leaves become subsessile to long-petiolate. For several authors, the differences in leaf shape, size and structure were sufficient to describe new species, e.g., *P. elliptica* Blume or *P. oligosperma* Schwartz. A clear separation of phenotypes, however, is impossible, and there exist no geographical clines for leaf shape in *P. constricta*. A similar pattern of variability in leaf size and shape can be found in *P. pulverulenta*. The leaves of *P. pulverulenta*, however, are characterised by two small auricles at the base (Fig. 8a).

The high phenotypic variation of leaf shape and size in *Pachycentria* is also shown in *P. glauca* subsp. *glauca*, which has small (2–4 by 0.5–2 cm), elliptic to lanceolate, 1-nerved leaves when growing on ant-plants (see below) but develops much longer and broader, ovate, 3-nerved leaves under greenhouse conditions (Clausing, pers. obs.).

Reproductive morphology

The inflorescences are usually terminal, rarely axillary more or less condensed thyrses, which in most species are many-flowered. In a few species (e.g. *P. glauca* and *P. microsperma*) the axillary or terminal thyrses are few-flowered or even reduced to paired or solitary flowers. The number of flowers, number of inflorescence axes, and their length and thickness vary considerably especially in those species that have many-flowered thyrses. Again *P. constricta* shows the greatest variation.

The bracts and bracteoles are minute in all species and not longer than 1 mm. The flowers are 4-merous and diplostemonous. Very rarely, 4- and 5-merous flowers are found on the same individual (e.g. *P. pulverulenta*). Mature buds are mostly between 6 and 12 mm long, and the size of the flowers ranges from 4–16(–20) mm. *Pachycentria varingiifolia* has exceptionally large flowers (16–20 mm long), while *P. pulverulenta* has the smallest flowers (c. 4 mm long).

The hypanthium is constricted above the globose ovary, which gives its characteristic urceolate shape. The length of the hypanthium ranges from 1.5 mm (*P. microstyla*, *P. pulverulenta*) to 4(–8) mm (*P. hanseniana*, *P. varingiifolia*). The calyx tube is very short (0.5–2 mm) and has lobes or teeth. The hypanthium and calyx tube of *P. pulverulenta* appear powdered (or pulverulent) because it is covered by yellow-whitish unbranched hairs.

The petals are ovate, elliptic, or oblong, acute at the apex and often clawed at the base. The colour varies from white to pink in most of the species. Commonly they are white with a pinkish base or with pinkish spots or patches. The petals of *P. pulverulenta* and *P. vogelkopensis*, however, are white to yellow, rarely pinkish. The colour and the colour pattern on the petals can differ among flowers even in one individual. The petals are glabrous, except for those of *P. pulverulenta* and *P. vogelkopensis* which are sometimes covered by unbranched hairs.

The androecium is rather uniform except for the shape of the dorsal connective appendage. All species except *P. varingiifolia* have 8 isomorphic stamens, which are 3–6 mm long. *Pachycentria varingiifolia* has slightly dimorphic stamen whorls and much longer stamens. Filaments and anthers are more or less of the same length. The anthers are either cylindrical, straight and relatively short (e.g. *P. microstyla* and *P. pulverulenta*), or slender with a long thin and curved tip (e.g. *P. constricta*, *P. glauca*, and *P. microsperma*). While the filaments are normally white to yellowish, the anthers are often bright yellow or pink with white or yellow tips, sometimes white or white with pink tips, rarely purplish. The two locules fuse in the upper third of the anther. They open by a single terminal, sometimes slightly oblique pore. In all species the connective has a dorsal appendage. A ventral connective appendage is present only in *P. varingiifolia*. *Pachycentria microstyla* and *P. microsperma* have a flattened dorsal connective appendage, which in *P. microsperma* is narrower and covered with unbranched hairs. In *P. pulverulenta* the dorsal appendage consists only of unbranched hairs that arise on a thickened zone of the connective.

The style is slenderly terete, normally white and slightly to distinctly longer than the stamens. It is topped by a punctiform or capitate stigma. In *P. microstyla*, *P. hanseniana* and *P. microsperma* a certain percentage of the styles are vestigial (see below).

The ovary does not exceed more than half of the hypanthium length. It is 0.6–2 mm diameter and 4-locular at least in the young bud stage. In *P. constricta* and *P. glauca* the septae disappear already in young buds. Then the young ovules are

embedded in the disintegrating placenta, endocarp and mesocarp tissue, and distinct locules are missing. In the other species the placenta and septae disintegrate during the ripening of the fruits. At maturity the seeds are embedded in fleshy pulp which is derived from the disintegrated placenta, endocarp and mesocarp. Extraovarian chambers are lacking in *Pachycentria*. In bud the anthers are contained in the upper half of the hypanthium above the small ovary.

The fruit is a fleshy, globose or subglobose berry capped by a distinct, persistent rim that consists of the upper part of the hypanthium and the dentate or lobed calyx tube. The pericarp is smooth or mucronate, and can be thin or thick.

Typical seeds of *Pachycentria* are shown in Fig. 11a–e. Seeds are 0.5–2.5 mm long, and embedded in a fleshy pulp. Large (2–2.5 mm long) cylindrical seeds are found in *P. constricta* and *P. glauca* (Fig. 11a, b). The seeds of the other species are smaller (0.5–1 mm) and ovoid or compressed ovoid (Fig. 11c–e). Seed size and seed number are correlated; either there are 6–12 large seeds or 40–60 small seeds in one fruit. The testa cells are comb-shaped (Fig. 11g) and in some species papillose.

ECOLOGY

Breeding system

Normally the flowers are hermaphroditic. Outcrossing is achieved by two different ways of spatial separation of anther tips and stigma. First, in some species the anthers are bent upwards while the style points downwards (e.g. *P. constricta* and *P. glauca*). Later, during anthesis the style moves towards the anthers, and the pores come into contact with the stigma so that selfing is possible. Second, spatial separation of stigma and anther tips is achieved by a considerable difference in style and stamen length (e.g. *P. pulverulenta*).

Pachycentria microstyla, *P. hanseniana*, and *P. microsperma* have vestigial pistils in a certain percentage of their flowers. In these flowers the pistils are stunted and extremely short, or sometimes absent. Presumably these flowers are functionally male. In *P. hanseniana*, for example, 16 (c. 40%) of a total of 41 flowers from four different collections (*Hansen 1336*, *Main 1831*, *Alston 13420*, *Mamit 34401*) have a reduced style. Two collections of *P. hanseniana* (*Chai 36775*, *James 34401*), however, have only hermaphroditic flowers. The stigma of the hermaphroditic flowers of *P. hanseniana* is capitate, relatively large and has papillae. Stunted pistils were already reported by Beccari (1884–1886) for *P. microstyla* Becc. In a total of 72 flowers from four different collections (*Beaman 11046*, *Paie 42506*, *Haviland 169*, *1944*) 38 were hermaphroditic and 34 flowers showed a vestigial pistil. Thus, on average 47% of the flowers of these collections of *P. microstyla* are functionally male.

Andromonoecy of Melastomataceae has only been reported from *Lijndenia* (Bremer, 1982), a member of the Memecyleae not closely related to *Pachycentria* (Clausing, 1999). Bertin (1982) states that large fruits relative to flower size, large numbers of flowers per inflorescence, and pollen rewarding flowers are the main reproductive characters that enhance andromonoecy. The third criterion applies to *Pachycentria* for which pollen is the only reward like in the majority of melastome flowers (Renner, 1989, 1993). The berries of *Pachycentria,* however, do not appear to be particularly energetically expensive, but the berries of *P. hanseniana* and *P. microsperma* are the

largest in the genus. Likewise, many-flowered inflorescences do not seem to be a reason for andromonoecy in *Pachycentria* because *P. microsperma* has few-flowered inflorescences.

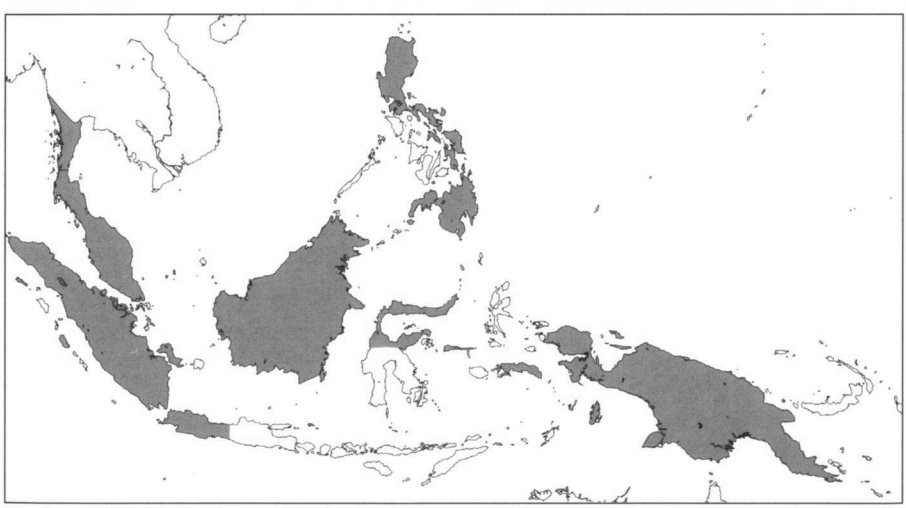
Pollination

Those species of *Pachycentria* observed in the field (*P. constricta*, *P. glauca*, *P. microsperma*, and *P. pulverulenta*) are pollinated by bees that collect pollen by vibration (buzz pollination). In open flowers of *P. constricta*, *P. glauca*, and *P. microsperma* the stamens are bent to one side of the flower and their tips are arranged in close proximity while the style remains in the middle or points to the other side. By vibration the bees extract pollen grains from the poricidal anthers. After pollination the petals reflex and the stamens spread. In *P. constricta* 1–3 flowers open per day and inflorescence, in *P. microsperma* and *P. glauca* only one. The pollination of *P. pulverulenta* differs slightly from that described because the stamens are not bent to one side but surround the style.

The flowering of one inflorescence of *P. constricta* lasts between 2 and 6 weeks. Because there normally are several inflorescences of different age, the whole flowering period of this species can last several months.

Dispersal

The ripening of the fruits takes 4–8 weeks. There are often unripe fruits in inflorescences that still have many buds. Inflorescences with ripe berries, however, never contain flowers. The fruits of those species of *Pachycentria* observed in the field were eaten and dispersed by small to middle-sized birds. For *P. constricta* and *P. glauca* there is strong evidence that the seeds are dispersed by ants, too. The ants might take the seeds from bird droppings or directly from ripe fruits and carry them into their nests. Seedlings of *P. glauca* and *P. constricta* can be observed on ant plants or in ant gardens (Janzen 1974; Kiew & Anthonysamy, 1987; Clausing, 1998).



Map 1. Distribution of *Pachycentria* Blume.

DISTRIBUTION

The distribution of *Pachycentria* ranges from Burma and Thailand through the Malayan Archipelago (Peninsular Malaysia, Sumatra, Java, Borneo, Philippines, Sulawesi) to New Guinea (Map 1). The centre of diversity is Sarawak (Borneo) where six of the seven species occur. *Pachycentria glauca* and *P. hanseniana* are endemic to Borneo, and *P. microstyla* is endemic to Sarawak (Borneo). *Pachycentria constricta* and *P. pulverulenta* show the widest distribution range of the genus. Only these two species are present in the Philippines and Sulawesi. *Pachycentria pulverulenta* and *P. vogelkopensis* are the only species that occur in New Guinea.

SYSTEMATIC TREATMENT

Pachycentria

Pachycentria Blume, Flora 14 (1831) 519; Mus. Bot. Lugd.-Bat. 1 (1849) 22; Naudin, Ann. Sc. Nat. III, 15 (1850) 318; Triana, Trans. Linn. Soc. London, Bot. 28 (1871) 89; Becc., Malesia 2 (1884–1886) 236; Cogn., Monogr. phan. 7 (1891) 605; Bakh.f., Rec. Trav. Bot. Néerl. 40 (1943) 120; J.F. Maxwell, Gard. Bull. Sing. 31 (1978) 201.

Pogonanthera Blume, Flora 14 (1831) 520; Mus. Bot. Lugd.-Bat. 1 (1849) 24; Naudin, Ann. Sc. Nat. III, 15 (1850) 321; Triana, Trans. Linn. Soc. London, Bot. 28 (1871) 89; Becc., Malesia 2 (1884–1886) 240; Cogn., Monogr. phan. 7 (1891) 609; Bakh.f., Rec. Trav. Bot. Néerl. 40 (1943) 127; J.F. Maxwell, Gard. Bull. Sing. 31 (1978) 201. Syn. nov.

Medinilla Gaudich., Frey. Voy. Bot. (1826); Blume, Flora 14 (1831) 464; Mus. Bot. Lugd.-Bat. 1 (1849) 17; Naudin, Ann. Sc. Nat. III, 15 (1850) 285; Triana, Trans. Linn. Soc. London, Bot. 28 (1871) 85; Cogn., Monogr. phan. 7 (1891) 572; Bakh.f., Rec. Trav. Bot. Néerl. 40 (1943) 147; J.F. Maxwell, Gard. Bull. Sing. 31 (1978) 201; Regalado, Blumea 35 (1990) 5; 40 (1995) 113. In part.

Epiphytic or terrestrial shrubs up to 2.5 m tall, or rarely terrestrial treelets up to 8 m tall; with adventitious roots, these sometimes irregularly swollen; branches terete, flattened or obscurely 4-angled, striate, 2-grooved or smooth, furfuraceous or glabrous, often stunted; nodes thickened; leaf scars often prominent. *Leaves* opposite, simple, petiolate; blade lanceolate, ovate to orbicular; base narrowed or rounded, sometimes with small auricles; apex acute or rounded; lamina 1–3-nerved, mid-rib prominent, secondary veins mostly faint, coriaceous to thin; highly variable in size. *Inflorescences* terminal or axillary, many- or few-flowered thyrses, sometimes reduced to paired or solitary flowers; axes flattened, 4-angled or winged, red to orange; pedicels distinct; bracts and bracteoles minute, linear to triangular, caducous or persistent. *Flowers* 4-merous (or very rarely 5-merous); hypanthium urceolate, strongly constricted above the globose ovary, often ribbed on outside; calyx tube 0.5–2 mm long, margin with or without 4 teeth or lobes; petals 4, ovate, elliptic or oblong, apex acute, base clawed, 3–6 by 2–3 mm, white, yellow, orange, pink or red; stamens 8, equal in size and shape (subequal in size in *P. varingiifolia*); anthers straight, opening with a single terminal pore, 1.2–3 mm long; dorsal connective appendage a basal or subbasal spur, thick or flattened, margin smooth, irregular, or frayed (a tuft of hairs in *P. pulverulenta*); ventral appendages lacking (present as two beaks only in *P. varingiifolia*); ovary 1/4 to 1/2 as long as the hypanthium, 4-locular, totally adnate to hypanthium, extraovarian

chambers lacking; placentation axile with 6 to many ovules per locule; style slender or vestigial, often with a collar at the base; stigma punctiform or capitate. *Fruit* a fleshy and soft berry, globose to subglobose, 3–7 mm wide; capped by a distinct rim; pericarp thin or thick, smooth or muricate. *Seeds* 6 to many, ovoid, compressed ovoid, or cylindrical, 0.6–2.5 mm long, testa cells comb-shaped, often with papillae.

KEY TO THE SPECIES

1a. Inflorescence a terminal or axillary, few-flowered thyrse (not more than 10 flowers) or flowers in pairs or solitary 2
b. Inflorescence a terminal, many-flowered thyrse with more than 10 flowers .. 5
2a. Seeds ovoid, c. 1 mm long or less, more than 20 per fruit; anther appendage a dorsal, flattened, slightly frayed spur or a short spur and two ventral beaks .. 3
b. Seeds cylindrical, 2–2.5 mm long, 6–12 per fruit; anther appendage a thick dorsal spur with smooth margin 4
3a. Flowers small (hypanthia c. 4 mm long, petals c. 6 mm long, anthers c. 3 mm long); anthers with a dorsal spur with frayed margin, ventral appendages absent; style often vestigial; erect shrubs commonly on limestone **4. P. microsperma**
b. Flowers large (hypanthia 4–8 mm long, petals 12–18 mm long, anthers 5–7 mm long); anthers with a short dorsal spur not frayed at margin and two ventral beaks; style not vestigial; scandant or erect shrub, often climbing on trees with adventitious roots ..... **7. P. varingiifolia**
4a. Leaves 1.5–4 by 0.5–2 cm wide; adventitious roots often with globose swellings; flowers mostly axillary in simple few-flowered cymes, paired or solitary; plant often growing on ant plants ..... **2. P. glauca**
b. Leaves 6–23 by 1.5–9 cm wide; adventitious roots often with elongate swellings; flowers in a terminal, usually many-flowered thyrse; plant growing terrestrially, epiphytically, or in ant nests ..... **1. P. constricta**
5a. Seeds cylindrical, 2–2.5 mm long, 6–12 per fruit; anther appendage a thick dorsal spur with smooth margin ..... **1. P. constricta**
b. Seeds ovoid or compressed ovoid, c. 1 mm long or less, more than 20 per fruit; anther appendage a flattened dorsal spur with irregular or frayed margins, or bifurcate, or a tuft of hairs 6
6a. Fruit ovoid or drop-shaped, 10–12 by 5–6 mm wide; leaves distinctly acuminate, acumen 5–10 mm long, base without auricles; flowers large (hypanthia 3–4 mm long, petals c. 5 mm long, anthers 2.5–3 mm long); connective appendage flattened and sometimes bifurcate, not frayed and without hairs ..... **3. P. hanseniana**
b. Fruit globose or subglobose, 4–6 mm diam.; leaves acute or with a short acumen, base with or without auricles; flowers small (hypanthia 1–2 mm long, petals 3–3.5 mm long, anthers 1.5–2 mm long); connective appendage a flattened spur with irregular or frayed margin, or a tuft of hairs 7
7a. Dorsal connective appendage flattened; pericarp thick, muricate; style often vestigial ..... **5. P. microstyla**
b. Dorsal connective appendage a strongly frayed spur or a tuft of hairs; pericarp thin, smooth; style not vestigial 8

8a. Leaf base with two auricles; dorsal connective appendage a tuft of hairs (Fig. 1a); seeds ovoid without crests (Fig. 11d) ..... **6. P. pulverulenta**

b. Leaf base without auricles; dorsal connective appendage a strongly frayed spur (Fig. 1b); seeds compressed ovoid with distinct crests (Fig. 11e) ..... **8. P. vogelkopensis**

1. Pachycentria constricta (Blume) Blume — Fig. 3, 11a, Map 2

Pachycentria constricta (Blume) Blume, Flora 14 (1831) 520. — *Melastoma constrictum* Blume, Bijdr. Flor. Ned. Ind. no. 17 (1827) 1072. — Lectotype: *Blume s.n.* (L 908.132-896, designated here), Indonesia, Java.

Pachycentria elliptica Blume, Mus. Bot. Lugd.-Bat. 1 (1849) 23. — Lectotype: *Korthals s.n.* (L 908.132-885, designated here), Indonesia, Kalimantan, Martapoera, Lake Kalahien.

Pachycentria elliptica var. *subcordata* Blume, Mus. Bot. Lugd.-Bat. 1 (1849) 23. — Lectotype: *Korthals s.n.* (L 908.132-884, designated here), Indonesia, Kalimantan, Martapoera, at river Dusun.

Pachycentria formicaria Merr., Philipp. J. Sc. 1, Suppl. (1906) 215. — Lectotype: *M.S. Clemens 433* (A, designated here, PNH†), Philippines, Mindanao, Lake Lanao (Camp Keithley).

Pachycentria javanensis Hochr., Candollea 2 (1924) 475. — Type: *Hochreutiner 1852* (iso L), Indonesia, Java, Buitenzorg (Kampong de Tij Mandala).

Pachycentria junghuhniana Miq., Fl. Ned. Ind. 1 (1856) 552. — Lectotype: *Junghuhn 28* (L 908.132-893, U 000874, designated here), Indonesia, Java, Mt Praoe.

Pachycentria lanceolata Schwartz, Mitt. Inst. Allg. Bot. Hamburg 7, 3 (1931) 255. — Type: *Winkler 1425* (holo HBG), W Borneo, Sungei Bika.

Pachycentria laxiflora Blume, Mus. Bot. Lugd.-Bat. 1 (1849) 23. — *Pachycentria varingiifolia* (Blume) Korth., Flora 14 (1831) 520. — Lectotype: *Korthals s.n.* (29; L 908.132-882, designated here).

Pachycentria macrorhiza Becc., Malesia 2 (1884) 237. — Type: *Beccari 157* (holo FI, photo), Malaysia, Sarawak, Kuching.

Pachycentria macrorhiza var. *acuminata* Becc., Malesia 2 (1884) 238. — Type: *Beccari 678* (holo FI, photo; iso K), Malaysia, Sarawak, Kuching.

Pachycentria macrorhiza var. *ovalifolia* Becc., Malesia 2 (1884) 238. — Type: *Beccari 408, 2063* (holo FI, photo; iso K), Malaysia, Sarawak, Kuching, Mt Matang.

Pachycentria oligosperma Schwartz, Mitt. Inst. Allg. Bot. Hamburg 7, 3 (1931) 256. — Type: *Winkler 731* (holo HBG; iso BO), W Borneo, Bukit Mehipit.

Pachycentria rigida Blume, Mus. Bot. Lugd.-Bat. 1 (1849) 23. — Lectotype: *Korthals s.n.* (L 908.132-881, designated here), Indonesia, Sumatra, Mt Malintang.

Pachycentria tuberculata Korth., Verh. Nat. Gesch. Ned. Overz. Bezitt., Bot. 3 (1844) 246, pl. 63, f. 1–6. — Lectotype: *Korthals s.n.* (L 908.132-180, designated here), Indonesia, Kalimantan, Mt Pamatton.

Pachycentria tuberculata var. *obtusifolia* Blume, Mus. Bot. Lugd.-Bat. 1 (1849) 24. — *Pachycentria cordata* Korth., Herb. Korthals. — Lectotype: *Korthals s.n.* (L 908.132-189, designated here), Borneo.

Pachycentria zollingeriana Naudin, Ann. Sc. Nat. III, 15 (1851) 301. — *Pachycentria varingiifolia* Moritzi, Syst. Verz. (1845–1846) 11, nom. illeg. — Syntypes: *Zollinger 1361* (A, U) and *Zollinger 1008* (L), Indonesia, Java, Bantam.

Pogonanthera pulverulenta var. *lanceolata* Baker f., J. Bot. 62, Suppl. 1 (1924) 41 [not seen, synonym of *Pachycentria constricta* in Bakhuizen van den Brink Jr. (1943)].

Epiphytic or rarely terrestrial shrubs up to 2.5 m tall; adventitious roots with tuberous, orange to brown swellings; branchlets flattened, grooved with two ridges, becoming terete and smooth when older, with a red-brown indumentum or glabrous. *Leaves* variable in shape (Fig. 3), lanceolate to elliptic or obovate; petiole flattened, dorsally

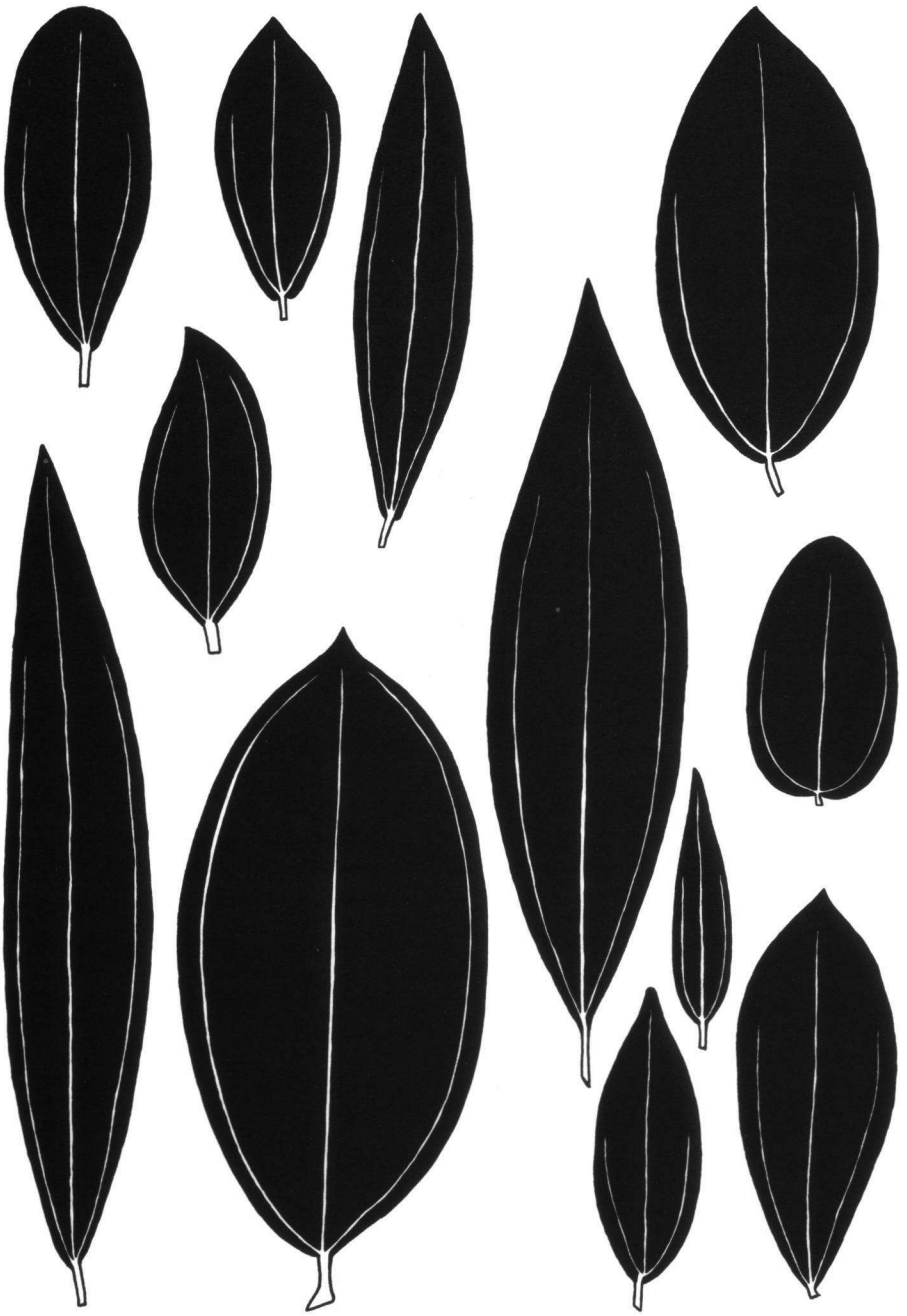
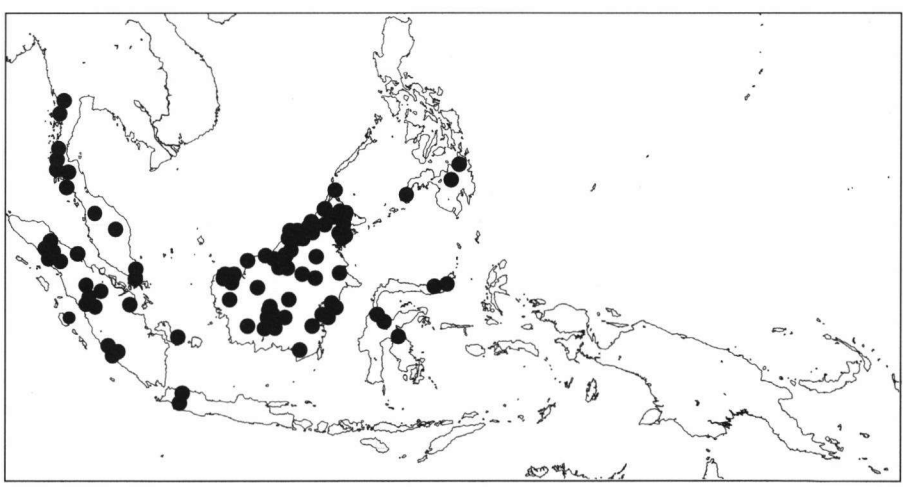


Fig. 3. Leaf shape variation of *Pachycentria constricta* (Blume) Blume.

grooved, 3–15 mm long; base cuneate, sometimes rounded or weakly cordate; apex obtuse or acuminate; lamina 3-nerved, coriaceous to thin, glabrous, often purplish below; 6–23 by 1.5–9 cm. *Inflorescence* many-flowered (rarely with less than 10 flowers), terminal thyrse, 2–6 cm long; axes flattened, often with two membranous wings or striate, sometimes furfuraceous, red, orange or pink; bracts and bracteoles minute, c. 1 mm long, furfuraceous, triangular, persistent. *Flowers* with 3–4 mm long hypanthia, cream to pink; calyx tube 0.5–1 mm high, c. 2 mm wide, margin with 4 thickened teeth, sparsely furfuraceous; petals oblong-obovate, acuminate and thickened at the apex, clawed at the base, c. 5 by 2 mm, white to pink, often both colours in various patterns, glabrous; filaments flattened, c. 2.5 mm long; anthers cylindric, distinctly curved backwards at tip, c. 2.5 mm long, pink to whitish-yellow, often the locules pink and the curved tip yellow or whitish; connective with 0.5–0.75 mm long, whitish-yellow dorsal spur on lower half; ovary 1–1.5 mm diam., septae dissolved in older buds, then distinct locules lacking, ovules 20–25; style c. 6 mm long, glabrous, with a membranous collar at the base, whitish, stigma punctiform. *Berries* urceolate when young, globose when ripe, c. 5 mm diam.; yellow to green when immature, orange to dark red when ripe; rim 1–2 mm high with 4 thickened teeth; pericarp smooth or with slightly roughened texture, very thin in ripe fruits. *Seeds* 6–12 per fruit, cylindrical, 2–2.5 mm long; testa cells smooth.

Distribution — S Burma, Thailand, Peninsular Malaysia, Sumatra, Borneo, Java, Philippines (Mindanao, Zamboanga), Sulawesi.

Habitat — Dry to wet and nutrient-poor to nutrient-rich sites in many forest types from 0–2000 m elevation. *Pachycentria constricta* has been collected in primary, logged or disturbed lowland forests, lower montane rain forests, peat swamp forests, marshy forests, riverine forests, on trees along riverbanks, in heath forests, kerangas forests, and rarely in secondary forests. It mostly grows epiphytically on trees (at 1–30 m height, most frequently at 3–10 m), rarely terrestrially. The adventitious roots



Map 2. Distribution of *Pachycentria constricta* (Blume) Blume.

are often swollen orange tubers that store water. The seeds of *P. constricta* are collected by ants, and the species is found growing in ant nests (Clausing, 1998).

Uses — In Indonesia the roots of *P. constricta* are cooked and used by women in the first week after childbirth (*Veldkamp 8023*).

Vernacular names — Binalu (Kadazan), Singga (Indonesia), Penawar racun (Dusun), Binalu Kaya Ara (Brunei).

2. **Pachycentria glauca** Triana

Small epiphytic shrub, 20–60 cm tall, with numerous hanging, creeping or erect branches; adventitious roots with irregular, globose swellings, 0.5–2 cm diam.; branchlets terete, minutely furfuraceous, older branches stunted and with thickened nodes. *Leaves* elliptic-lanceolate or obovate-suborbicular; petiole 2–6 mm long; base cuneate; apex truncate, rounded or acute; lamina 1-nerved, fleshy, glabrous, smooth or sometimes rough, often red below; 1.5–4 by 0.5–2 cm. *Inflorescences* terminal or axillary, flowers solitary or in pairs or in few-flowered cymes (not more than 5 flowers per inflorescence), 1–1.5 cm long; bracts and bracteoles minute, c. 0.5 mm long, ovate, acute, persistent. *Flowers* with c. 3 mm long hypanthia, cream to pink; calyx tube c. 1.5 by 2 mm, margin with 4 tiny thick teeth, sparsely furfuraceous; petals oblong to obovate, acuminate, c. 4 mm long, c. 2 mm wide, white to pink, glabrous; filaments c. 2 mm long; anthers c. 3 mm long, curved backwards at the tip, locules white or pink, tip often white; connective with a c. 0.5 mm long thickened smooth spur at the base; ovary c. 1 mm diam., 4-locular in young buds, later the septae dissolve and distinct locules are missing, ovules 20–25; style slender, 4–6 mm long, with a membranous collar at the base, white, stigma punctiform. *Berries* urceolate when young, later globose, c. 5 mm diam., green with reddish rim when immature, red when ripe; rim c. 2 mm high with 4 thick teeth; pericarp smooth or with slightly roughened texture, very thin in ripe fruits. *Seeds* 5–10, cylindrical, 2–2.5 mm long; testa cells smooth.

Note — Maxwell (1978) has already discussed the great similarity between *P. glauca* Triana and *P. maingayi* (C. B. Clarke) J. F. Maxwell. He distinguished *P. maingayi* from *P. glauca* in the shape and size of the leaves, the length of the inflorescence and the presence of a collar at the base of the style. The length of the inflorescence, however, is not distinctively different between the two taxa, but varies between 1–1.5 cm. In addition, *P. glauca* has been found to have a collar at the base of the style. Their geographical separation and the consistently different leaf shapes justify the maintenance of the two taxa at subspecies rank.

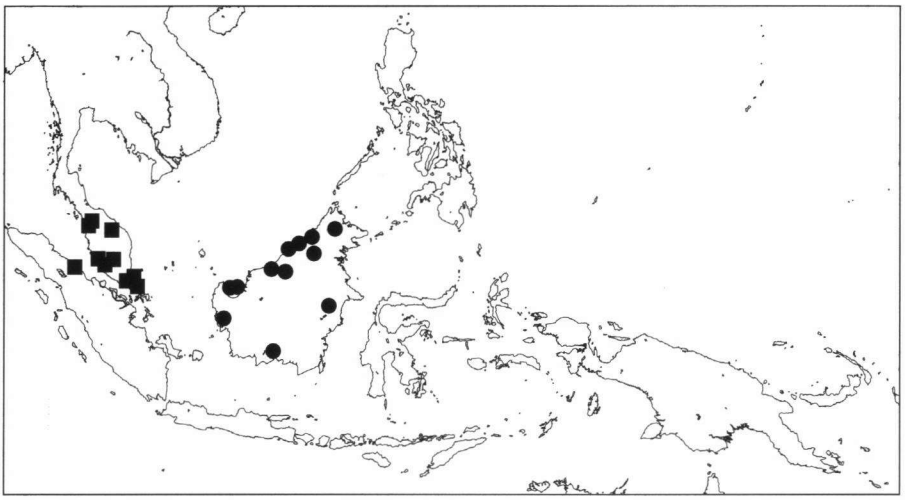
KEY TO THE SUBSPECIES

1a. Leaves elliptic-lanceolate, apex acute. — Borneo ..... **a.** subsp. **glauca**
b. Leaves obovate-suborbicular, apex truncate or rounded. — Peninsular Malaysia and Sumatra ..... **b.** subsp. **maingayi**

2a. subsp. **glauca** — Fig. 4, 11b, Map 3

Pachycentria glauca Triana subsp. *glauca*, Trans. Linn. Soc. London, Bot. 28 (1871) 89. — Type: *Beccari 415* (holo FI, photo; iso K), Malaysia, Sarawak.

Fig. 4. *Pachycentria glauca* Triana subsp. *glauca*. a. Habit; b. bud; c. longitudinal section of flower; d. fruit (*Clausing 156*, MJG).



Map 3. Distribution of *Pachycentria glauca* Triana subsp. *glauca* (●) and subsp. *maingayi* (C.B Clarke) G. Clausing (■).

Distribution — Borneo.

Habitat — In kerangas forest, dry hill forest, and in old secondary forest from 0–1100 m elevation. *Pachycentria glauca* subsp. *glauca* grows as an epiphyte most frequently (maybe exclusively) on ant plants such as *Hydnophytum*, *Myrmecodia*, and *Lecanopteris*, which themselves are epiphytes. Several collectors have observed that the root swellings of *P. glauca* subsp. *glauca* were inhabited by ants (Clausing, 1998).

2b. subsp. **maingayi** (C.B. Clarke) G. Clausing, *comb. nov.* — Map 3

Medinilla maingayi C.B. Clarke, Fl. Brit. India 2 (1879) 549. — *Pachycentria maingayi* (C.B. Clarke) J.F. Maxwell, Gard. Bull. Sing. 31 (1978) 203. — Syntypes: *Maingay 806 (3329)*, Singapore (not seen) and *807 (2960)* (K), Malaysia, Malacca.

Distribution — Peninsular Malaysia and Sumatra.

Habitat — In primary lowland forest, kerangas forest, and heath forest. It occurs from sea level up to 1100 m elevation. Like subspecies *glauca* it grows epiphytically at up to 40 m height mostly on trees, on other epiphytes, and on ant plants. Some collectors report that the root swellings are inhabited by ants.

3. Pachycentria hanseniana G. Clausing, *spec. nov.* — Fig. 5, 6, 11c, Map 4

Species *P. microspermae* affinis, sed foliis acuminatis, acumine 5–10 mm longo, hypanthio tubulare (perprofunde urceolare), antheris appendicibus dorsalibus calcariformibus bifurcatis, stigmate capitato, bacca ovoidea vel gutteformi. — Typus: *Hansen 1336* (holo C), Indonesia, Kalimantan, Tengah, Kualakuayan.

Epiphytic or terrestrial shrub up to 1.5 m tall; adventitious roots without swellings; branchlets subterete, later cylindric, smooth, with a red-brown indumentum on the young parts. *Leaves* elliptic to ovate; petiole terete, 8–12 mm long; base slightly cordate; apex distinctly acuminate, acumen 5–10 mm long; lamina 3-nerved, coriaceous, gla-

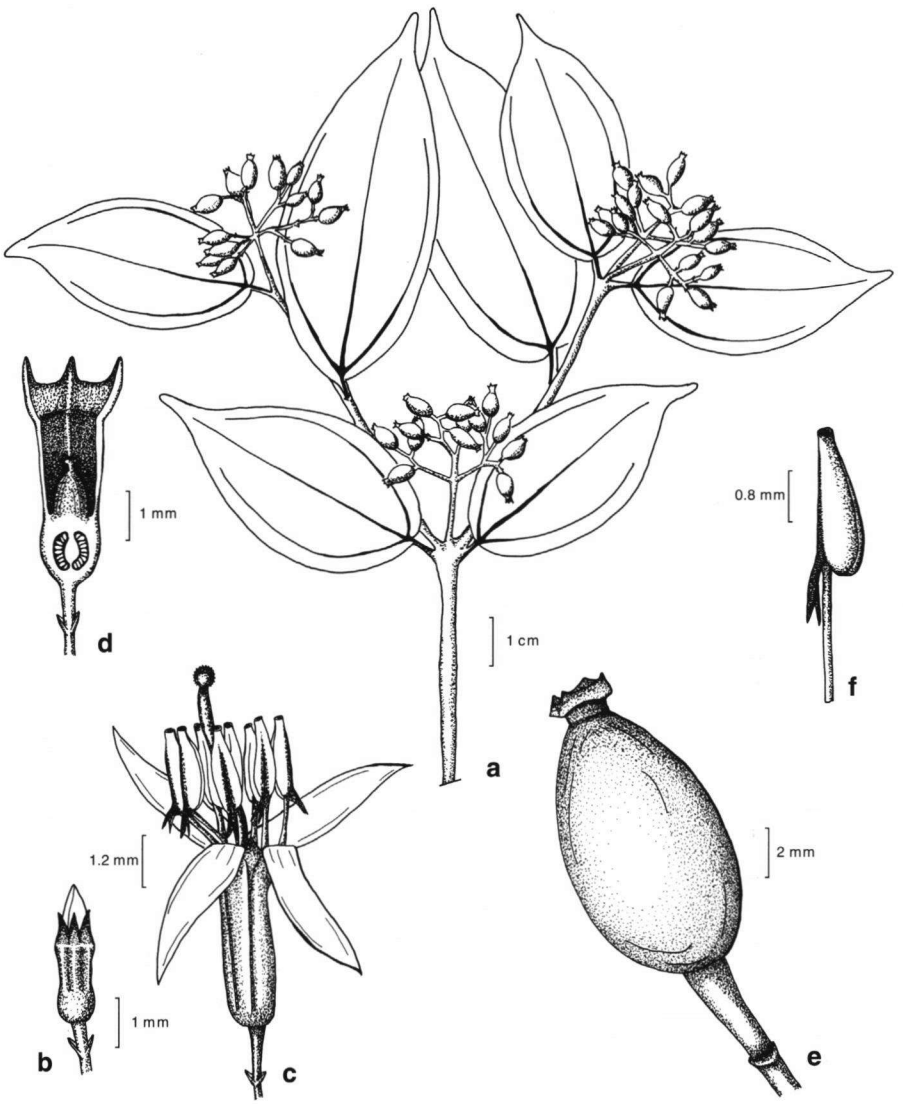


Fig. 5. *Pachycentria hanseniana* G. Clausing. a. Habit; b. bud; c. flower; d. longitudinal section of hypanthium and ovary with vestigial style; e. fruit; f. stamen (*Hansen 1336*, C).

brous, green above, light green below; 7.5–13.5 by 3–5 cm. *Inflorescence* a many-flowered, terminal or axillary, 3–6 cm long thyrse; axes flattened, striate, red or pink; bracts and bracteoles minute, triangular and persistent. *Flowers* with 3–4 mm long, narrowly-urceolate hypanthia, yellowish-green; calyx tube c. 1 mm high, c. 2 mm wide, margin with 4 thick, c. 0.5 mm high teeth; petals oblong-lanceolate, apex acuminate, base clawed, c. 5 mm long, c. 1.5 mm wide, white or yellow, glabrous; filaments c. 2.5 mm long, white, flattened; anthers cylindric with a rostrate tip, c. 2.5 mm long,

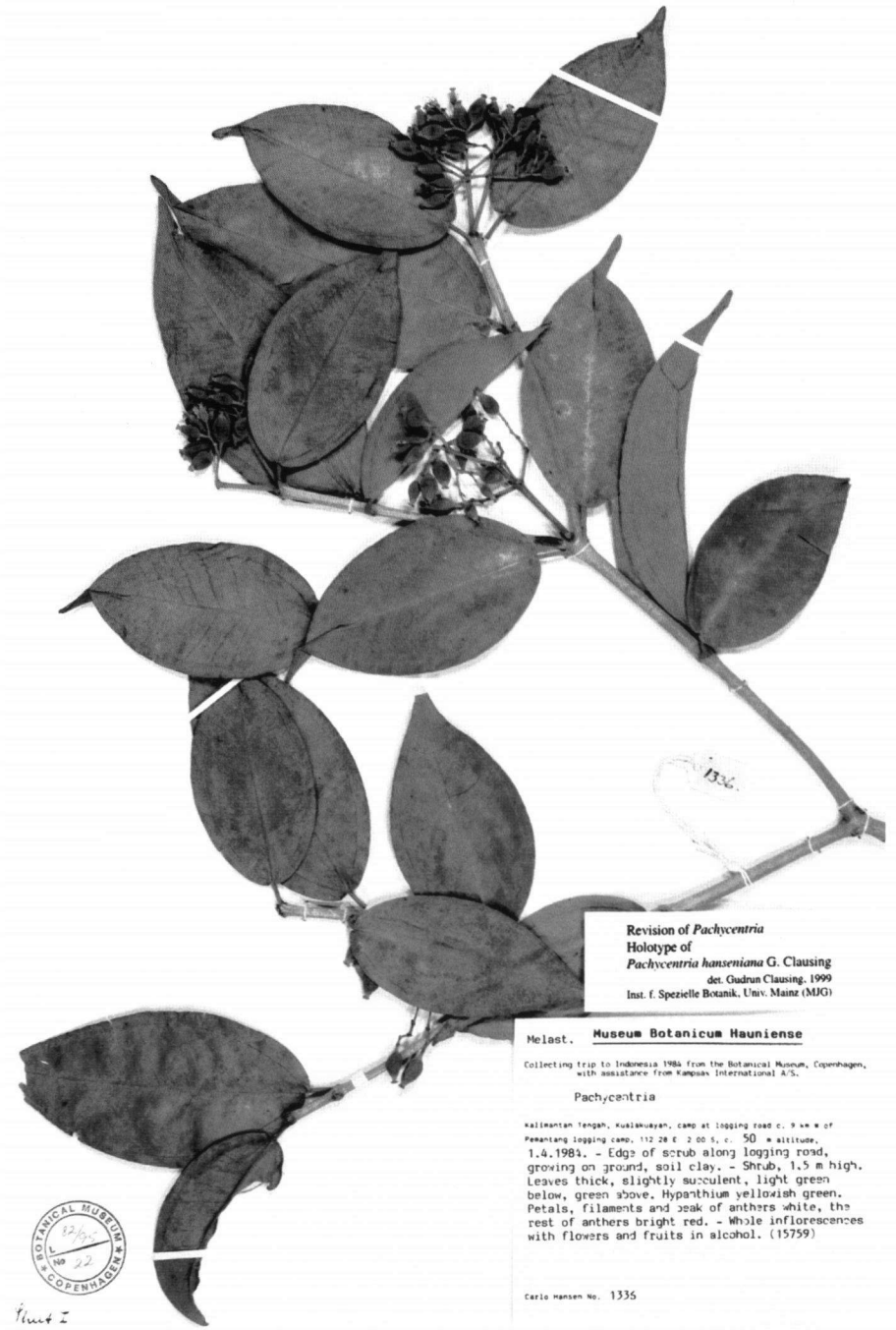
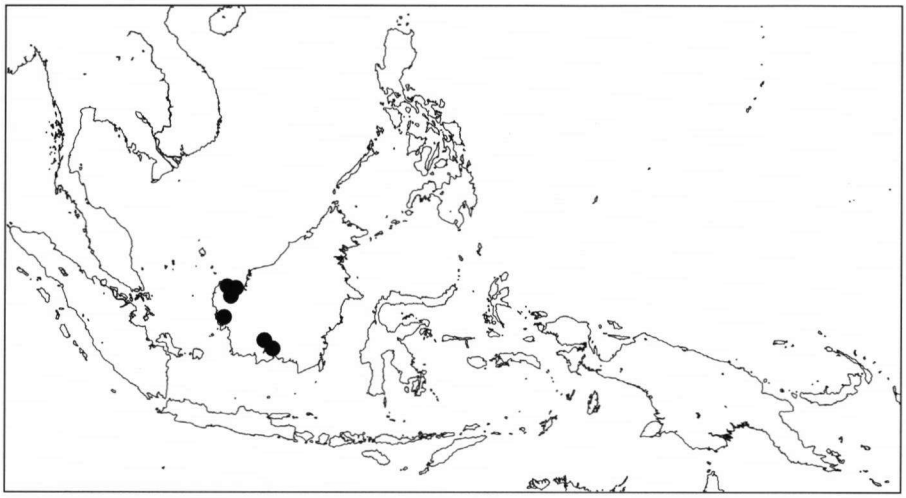


Fig. 6. *Pachycentria hanseniana* G. Clausing. Photograph of type specimen (*Hansen 1336*, C holotype).



Map 4. Distribution of *Pachycentria hanseniana* G. Clausing.

locules bright red, tip whitish or cream; connective with a 0.5–0.75 mm long, often bifurcate, white, dorsal spur rising from the base of the connective; ovary c. 1.5 mm diam., with numerous ovules; style vestigial (1–2 mm long) or non-vestigial (8–9 mm long), whitish with a reddish tip, glabrous, with a cushion of hairs at the base; stigma capitate. *Berries* ovoid or drop-shaped, 10–12 by 5–6 mm, yellow to green when immature, red when ripe; rim 1.5 mm high, 2 mm wide, with 4 thick teeth; pericarp thick, with roughened texture. *Seeds* numerous, compressed ovoid, c. 1 mm long; testa cells papillose.

Distribution — Borneo (Sarawak, Kalimantan).

Habitat — Only known from lowland forests in Kalimantan and Sarawak. It grows epiphytically and terrestrially.

Note — This species is named in honour of the late Carlo Hansen, Curator of the Botanical Museum at Copenhagen, who dedicated his life to the study of Asian Melastomataceae.

4. **Pachycentria microsperma** Becc. — Fig. 7, Map 5

Pachycentria microsperma Becc., Malesia 2 (1884) 238, t. 58, f. 1–9. — Type: *Beccari 404* (holo FI, photo; iso K), Malaysia, Sarawak.

Terrestrial, rarely epiphytic, shrubs up to 2.5 m tall; adventitious roots without swellings; branchlets flattened, compressed, slightly 4-angled, later terete, strongly stunted, smooth, furfuraceous or glabrous, nodes thickened. *Leaves* lanceolate to oblong; petiole cylindric, dorsally grooved, 5–10 mm; base narrowed; apex acute; lamina 1- or 3-nerved, subcoriaceous to coriaceous, often with a rugose to areolate texture on the surface, glabrous, shiny green above, pale green below; 6–10 by 1.5–4 cm. *Inflorescence* a few-flowered, terminal, rarely axillary thyrse, 2–4 cm long; axes flattened or cylindric, 4-angled, glabrous; bracts and bracteoles minute, 0.3–0.5 mm long, trian-

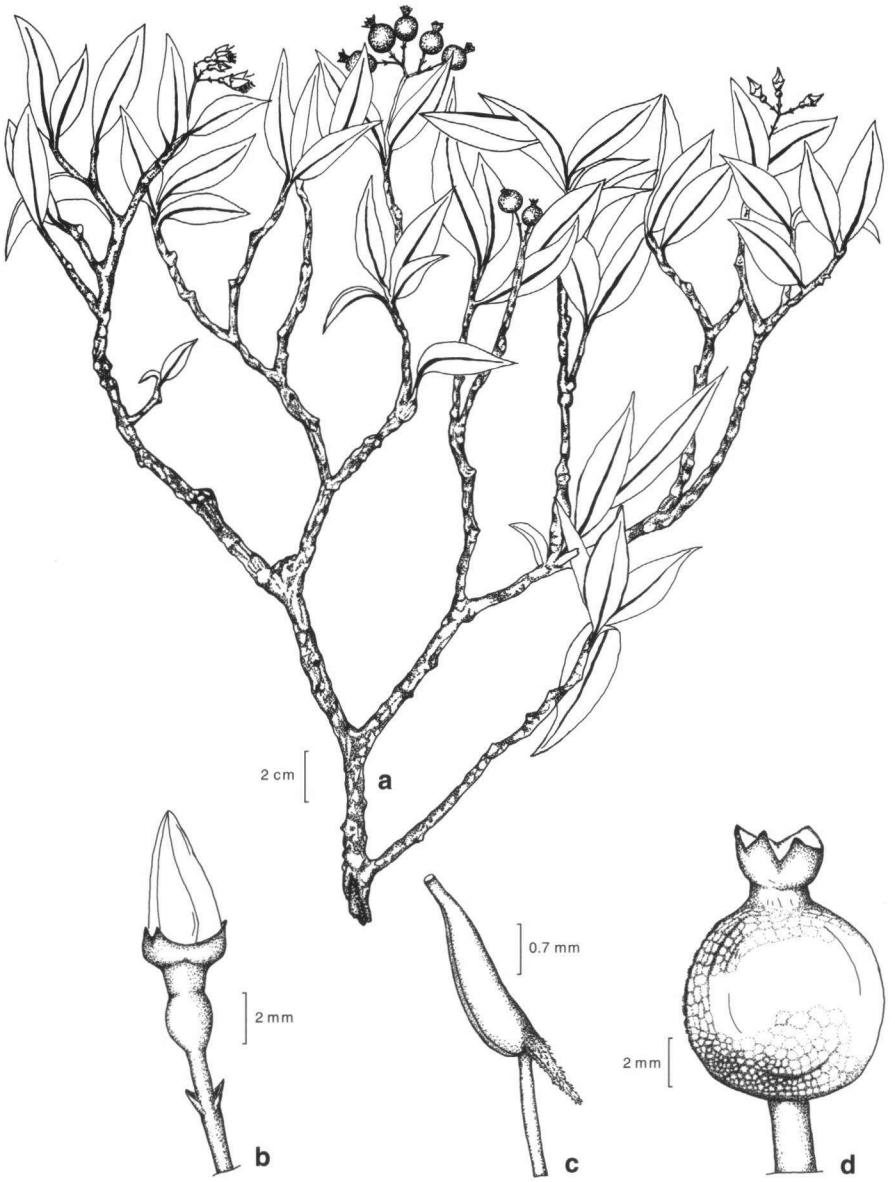
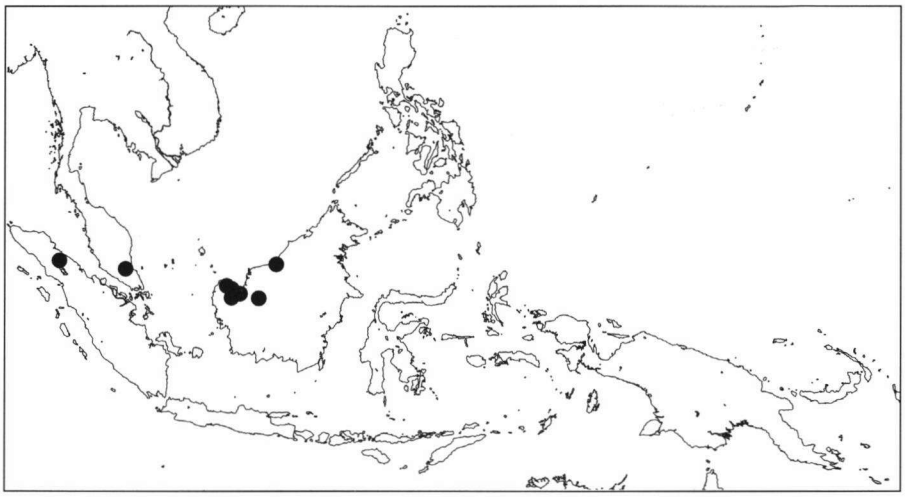


Fig. 7. *Pachycentria microsperma* Becc. a. Habit; b. bud; c. stamen; d. fruit (*Paie 28079*, L, SAR; *Giesen 42*, K, L).

gular, persistent. *Flowers* with 4 mm long hypanthia with distinct ribs, sparsely furfuraceous, green, with pink flush; calyx tube c. 1 mm high, margin with 4 triangular, 0.5–1 mm long lobes; petals lanceolate, acuminate, with visible venation, c. 6 by 2 mm, white; filaments c. 3 mm long, flattened; anthers c. 3 mm long, cylindric, curved at the tip, locules white to pink, tip purple to blue; connective with a c. 1 mm long,



Map 5. Distribution of *Pachycentria microsperma* Becc.

pilose (frayed) yellow, dorsal spur rising from the lower half of the anther; ovary c. 1 mm diam., ovules numerous; style vestigial (c. 1 mm long) or non-vestigial (c. 7 mm long), glabrous, with a membranous sheath at the base, whitish; stigma punctiform. *Berries* globose, 6–8 mm diam., light green to pale yellow when immature, dark pink when ripe; rim c. 2 mm high and c. 1.5 mm wide with 4 lobes; pericarp thick, rough-muricate. *Seeds* 25–35, c. 1 by 0.7 mm, compressed ovoid; testa cells slightly papillose (similar to the seeds of *P. hanseniana*, Fig. 11c).

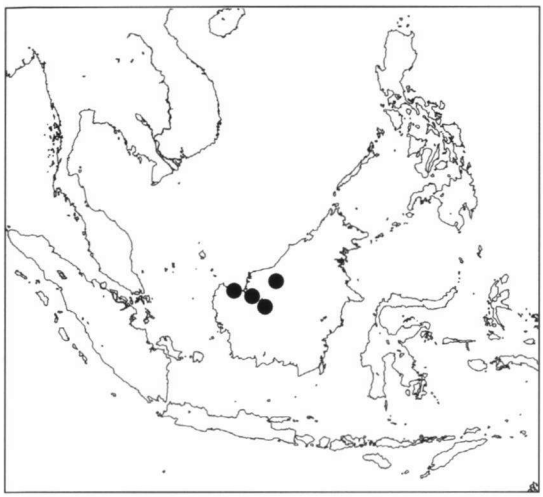
Distribution — Peninsular Malaysia, Sumatra, Borneo (Sarawak, Kalimantan).

Habitat — Under harsh conditions in dry limestone and sandstone sites reaching elevations of up to 700 m. It is often found on open, exposed limestone rocks, on coastal sandstone cliffs, or in sparse shrubby vegetation. It has also been collected growing as an epiphyte. Once it has been found growing in an ant nest (2.5–3.5 m tall) at about 8 m height on *Eugenia* spec. It occurs in places that have been disturbed by fire recently.

5. **Pachycentria microstyla** Becc. — Map 6

Pachycentria microstyla Becc., Malesia 2 (1884) 238, t. 58, f. 1–9. — Syntypes: *Beccari 604, 403* (FI, photo), Malaysia, Sarawak, near Kuching.

Terrestrial shrubs or treelets up to 4 m tall; adventitious roots without swellings; branchlets flattened, later terete, glabrous. *Leaves* broadly ovate or ovate-elliptic; petiole thick, purplish, 15–20 mm long; base narrowed and sometimes auricled; apex acute or shortly acuminate; lamina 3(–5)-nerved, main nerves dark red or brown, coriaceous, glabrous, purplish below; 18–22 by 7–11 cm. *Inflorescence* a many-flowered, terminal thyrse, 6–12 cm long, sometimes covered with glandular hairs, red, orange, or pink; bracts and bracteoles minute, triangular, persistent and sometimes with glandular hairs. *Flowers* with widely-urceolate hypanthia, 1–2 by 1–1.5 mm, yellowish, ribbed; calyx, 0.5–1 mm high, margin with 4 short, thickened teeth, pink; petals lanceolate, apex



Map 6. Distribution of *Pachycentria microstyla* Becc.

acuminate, clawed at the base, c. 3.5 by 2 mm, yellow, white or pink, glabrous; filaments 2–2.5 mm long; anthers cylindric, 1.5–2 mm long; connective with a 1–1.5 mm long, flattened, whitish-yellow, dorsal spur rising from the base, margin of the spur irregular or frayed; ovary 0.5–1 mm diam., ovules numerous; style vestigial (0.5–1 mm long) or non-vestigial (4–5 mm long), glabrous, with a dense tuft of hairs at the base, whitish, stigma capitate. *Berries* globose, c. 5 mm diam.; rim c. 0.5 mm high, with 4 teeth; pericarp thick, mucronate. *Seeds* numerous, ovoid, 0.6–0.8 mm long; testa cells papillose (similar to the seeds of *P. pulverulenta*, Fig. 11d).

Distribution — Endemic to Sarawak.

Habitat — In primary and secondary lowland forests, mostly growing as a terrestrial shrub. Only one collector reports the species as an epiphyte.

Note — The name of this species refers to the reduced pistil in c. 40% of the flowers. Like *P. hanseniana* and *P. microsperma* this species shows andromonoecy.

6. **Pachycentria pulverulenta** (Jack) G. Clausing, *comb. nov.* — Fig. 8, 11d, Map 7

Melastoma pulverulentum Jack, Trans. Linn. Soc. London, Bot. 14 (1825) 19. — *Pogonanthera pulverulenta* (Jack) Blume, Flora 14 (1831) 521. — Type: *Jack s.n.* (presumably lost), Sumatra.

Pogonanthera latifolia Schwartz, Mitt. Inst. Allg. Bot. Hamburg 7, 3 (1931) 252. — Type: *Winkler 1233* (holo HBG), W Borneo, Serawei.

Pogonanthera pauciflora Becc., Malesia 2 (1884) 241. — Type: *Beccari s.n.* (holo FI, Erbario No. 4208, photo), Indonesia, Sumatra, Padang, Ajer Mantjoer.

Pogonanthera pulverulenta (Blume) Korth., Flora 14 (1831) 521. — *Melastoma reflexa* Reinw., nomen. — *Pogonanthera reflexa* Reinw. ex Blume, Flora 14 (1831) 521. — Type: *Blume s.n.* (holo L 908.132-210; typification fide Bakhuizen van den Brink Jr., 1943), Indonesia, Java, Mt Pantjar.

Pogonanthera pulverulenta var. *grandiflora* Miq., Fl. Ned. Ind. 1 (1856) 533. — Type: *Horsfield s.n.* (holo U, No. 000879), Indonesia, Moluccas, Tjiandoer.

Pogonanthera reflexa var. *squamulata* Blume, Mus. Bot. Lugd.-Bat. 1 (1849) 24. — Syntypes: *Korthals s.n.* (L 908.132-198 & 908.132-209, typification fide Bakhuizen van den Brink Jr., 1943), Borneo, Bandjermasin.

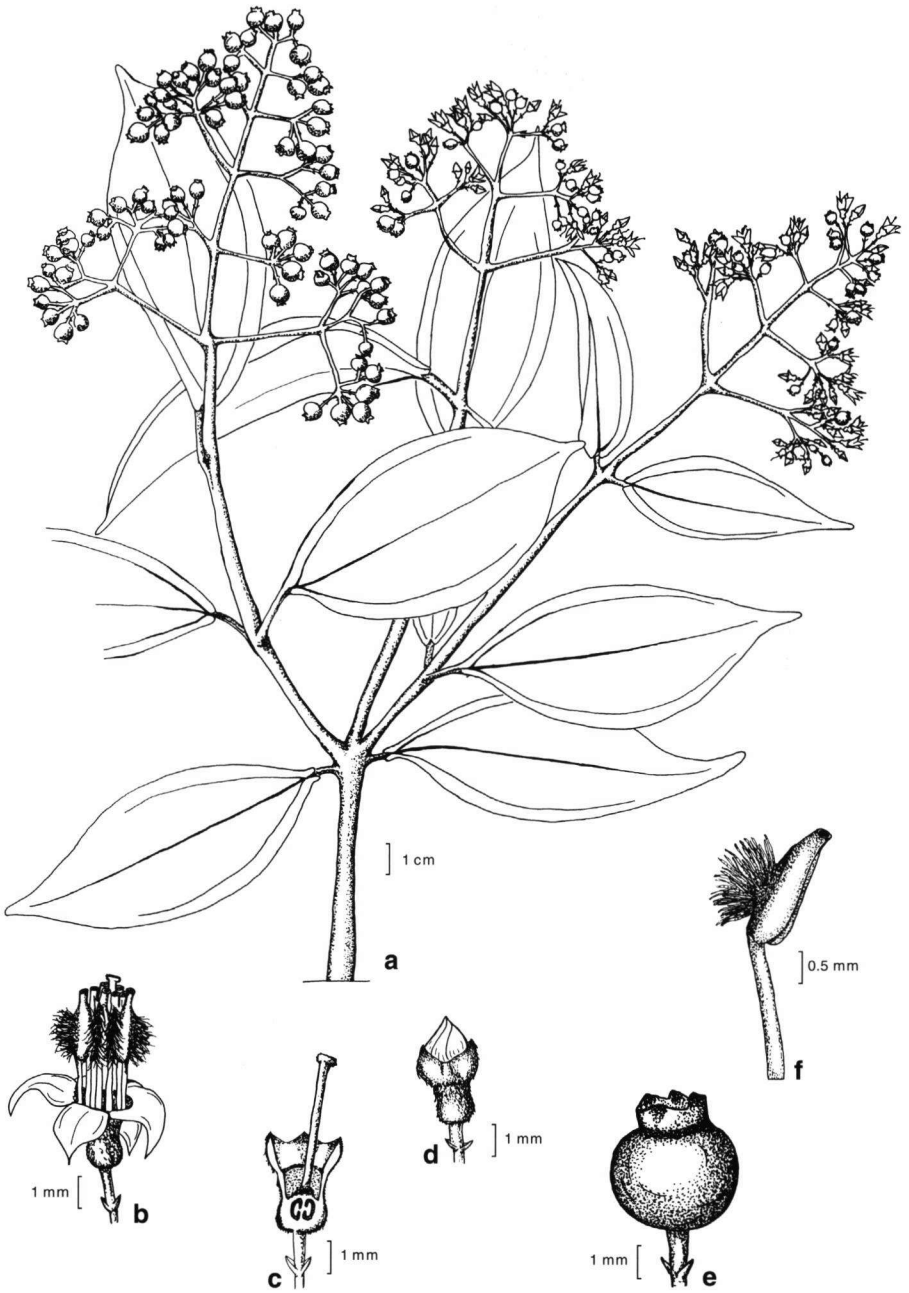
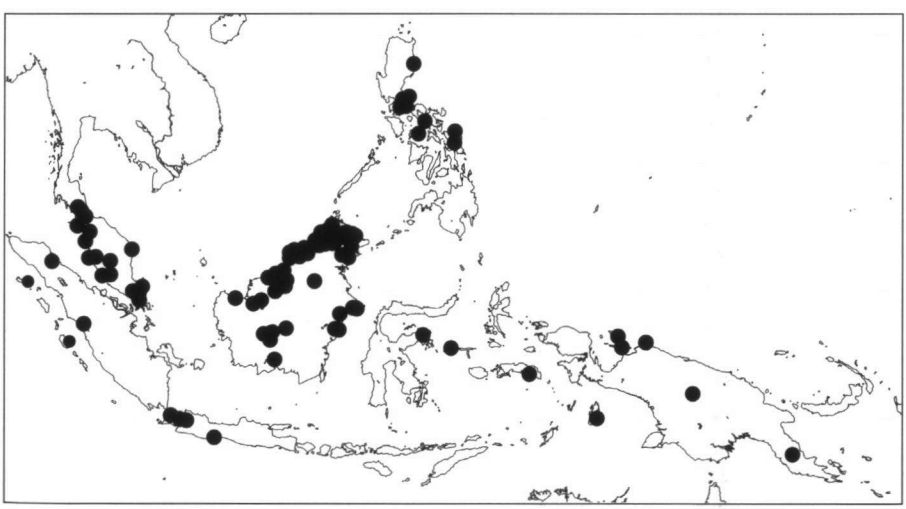


Fig. 8. *Pachycentria pulverulenta* (Jack) G. Clausing. a. Habit; b. flower; c. longitudinal section of hypanthium and ovary; d. bud; e. fruit; f. stamen (*Beaman 11259*, K).

Epiphytic or epilithic shrub 0.5–2.5 m tall or terrestrial treelets and shrubs, up to 4(–8) m tall; occasionally the adventitious roots with elongate tubers; branchlets terete, often slightly 4-angled with a red-brown indumentum, older branches smooth or sometimes pustulate, nodes swollen. *Leaves* of variable shape, obovate, elliptic, oblanceolate, and lanceolate; petiole 5–10(–20) mm long; base cuneate or rounded with two (1–3 mm long) auricles; apex acute to shortly acuminate; lamina 3(–5)-nerved; 4–10(–16) by 1–6(–8) cm. *Inflorescence* a terminal, many-flowered thyrse, axes flattened, often 4-angled, with minute red-brown indumentum, spreading umbellate, reddish; bracts and bracteoles minute, 1–1.5 mm long, lanceolate, acuminate, red-brown furfuraceous. *Flowers* with widely-urceolate, 1–1.5 mm long hypanthia, yellow, cream or reddish; calyx tube 0.3 mm high, margin with 4 triangular, often brown lobes; petals obovate, apex acute, with simple hairs on both surfaces, 3 mm long, 1.5 mm wide, yellow, pink or red; filaments 1.5 mm long, white; anthers cylindric, c. 2 mm long, yellow or cream, rarely lilac; connective with a dorsal tuft of hairs arising from a thickened zone; ovary globose, c. 1 mm diam., c. 25 ovules per locule; style c. 5 mm long, with a cushion-like collar at the base, stigma punctiform. *Berries* globose, 4–6 mm diam., yellowish green or reddish green when immature, dark red when ripe; rim c. 0.5 mm high and 3 mm wide; pericarp thin, smooth. *Seeds* 40–60 per fruit, ovoid, c. 0.5 mm long, testa cells papillose.

Distribution — Thailand, Peninsular Malaysia, Sumatra, Borneo, Java, Philippines, Sulawesi, Moluccas, New Guinea.

Habitat — In different types of lowland primary and secondary forests at up to 600 m elevation where it either grows on the ground or as an epiphyte at up to 25 m height in trees. It has been collected growing as an epiphyte on riverside trees, in heath forest, in kerangas forest, in old secondary forest, in primary swamp forest, and in primary lowland forest. Furthermore, it has been found growing terrestrially on limestone, in hill forest, in mossy forest, as undershrub in secondary growth, in heath forest, and exposed on rock bolders.



Map 7. Distribution of *Pachycentria pulverulenta* (Jack) G. Clausing.

Note — *Pachycentria pulverulenta* is an extremely variable species in terms of ecology. The variable height of the plant (0.6–8 m) as well as the different leaf sizes may illustrate its response to different ecological conditions. The sapwood of *P. pulverulenta* is reported to be yellow. All floral parts of this species are more or less covered with short, yellowish-white hairs which make them appear powdered.

7. **Pachycentria varingiifolia** (Blume) Blume — Fig. 9, Map 8

Pachycentria varingiifolia (Blume) Blume, Flora 14 (1831) 520; Bakh.f., Rec. Trav. Bot. Néerl. 40 (1943) 126. — *Melastoma varingiifolium* Blume, Bijdr. Flor. Ned. Ind. no. 17 (1827) 1071. — *Medinilla varingiifolia* (Blume) M.P. Nayar, Blumea 18 (1970) 569; J.F. Maxwell, Gard. Bull. Sing. 31 (1978) 189, pl. 6, 7 (photos). — Type: *Kuhl & van Hasselt s.n.* (holo L 908.132-158; iso L 908.132-168, 908.132-178), Indonesia, Java.

Medinilla varingiifolia (Blume) M.P. Nayar var. *bakhuizenii* (M.P. Nayar) J.F. Maxwell, Gard. Bull. Sing. 31 (1978) 194. — *Medinilla bakhuizenii* M.P. Nayar, Blumea 18 (1970) 569. — *Pachycentria speciosa* Ridl., J. Fed. Mal. St. Mus. 6 (1915) 149. — Type: *Ridley 16339* (not seen), Peninsular Malaysia, Pahang, G. Tahan.

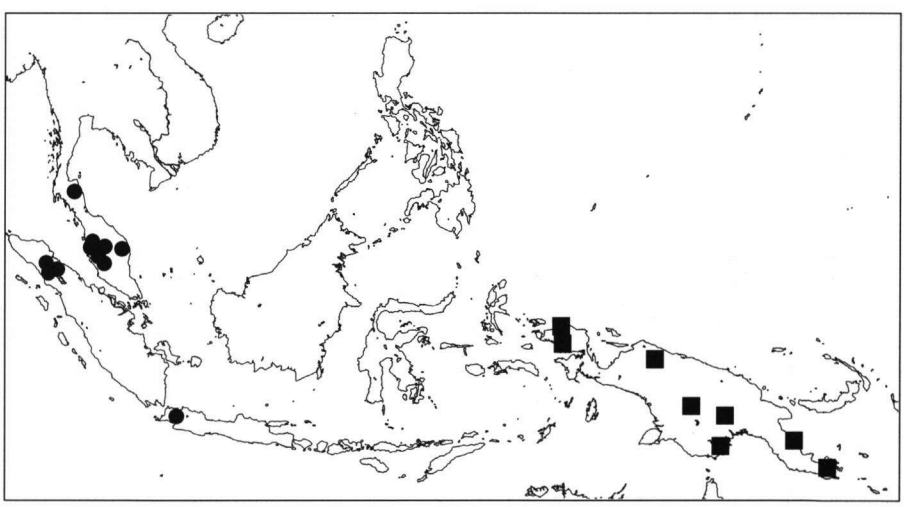
Medinilla ohwii M.P. Nayar, Blumea 18 (1970) 567. — Type: *Van Steenis 8992* (holo L; iso K), Indonesia, Sumatra, Gaju and Alas Lands, 2700 m.

Medinilla heteranthera King, J. Asiat. Soc. Bengal 69 (1900) 61. — Type: *Wray 397* (L), Peninsular Malaysia, Perak, G. Batu Puteh.

Medinilla heteranthera var. *latifolia*, King, J. Asiat. Soc. Bengal 69 (1900) 61. — Syntypes: *Wray 268* and *King's collector 8017* (not seen), Malaysia, Perak, G. Batu Puteh.

Pachycentria scandens Ridl., J. Straits Branch Roy. Asiat. Soc. 1 (1923) 61.

Terrestrial, hemi-epiphytic, or epiphytic shrubs, scandent or erect, up to 4.5 m high, climbing with adventitious roots; adventitious roots sometimes swollen and tuberous; branchlets terete, smooth, glabrous, becoming ridged and wrinkled when older, reddish. *Leaves* lanceolate or ovate; petiole 10–17 mm long; base narrowed or slightly rounded; apex acuminate; lamina 3-nerved, coriaceous, often with rugose texture on surface,



Map 8. Distribution of *Pachycentria varingiifolia* (Blume) Blume (●) and *P. vogelkopensis* G. Clausing (■).

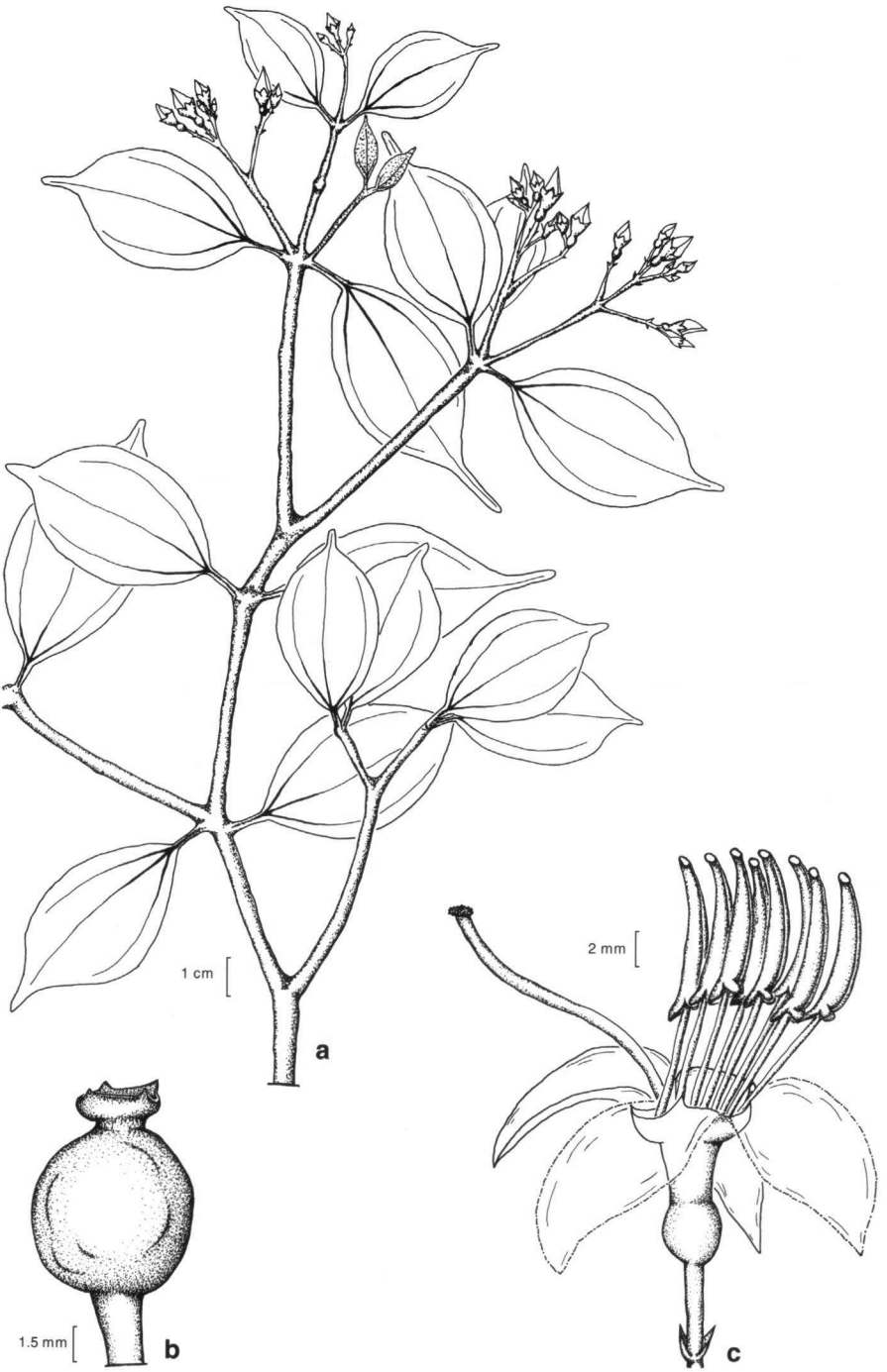


Fig. 9. *Pachycentria varingiifolia* (Blume) Blume. a. Habit; b. fruit; c. flower (*Maxwell 78-205*, L; *Smitinand 867*, AAU).

glabrous, often reddish below, margin sometimes serrulate when dry; 5–10 by 2–5 cm. *Inflorescence* a terminal few-flowered thyrse, 2–6 cm long, rarely flowers solitary, the axes terete, glabrous; bracts and bracteoles minute, 1–3 mm long, lanceolate, glabrous. *Flowers* with 4–8 mm long hypanthia; calyx tube 1–1.5 mm high, margin undulate or with 4 triangular lobes or thickened teeth, rarely ciliate; petals ovate, 12–18 mm long, base truncate, apex acuminate, dorsally thickened at the apex, colour turning from pink to white from the base up to the tip; stamens subequal; outer stamens with c. 8 mm long flattened filaments and 6–10 mm long anthers; inner stamens with c. 6 mm long filaments and 5–7 mm long anthers; all anthers with a rostrate tip, either light yellow or purplish; connective with two ventral beaks and dorsally with short spur; ovary 1–2 mm diam., ovules numerous; style c. 20 mm long, whitish, glabrous, stigma punctiform. *Berries* subglobose, 6–8 mm diam., green when immature, red when ripe; rim 2–3 mm high and 4–5 mm wide; pericarp glabrous, rugose when dry. *Seeds* numerous per fruit, c. 0.8 mm long, ovoid; testa cells papillose.

Distribution — Thailand, Peninsular Malaysia (Pahang, Perak, Kemaman), Sumatra, Java.

Habitat — In evergreen forests or on exposed rocks from lowland up to 2700 m elevation.

8. Pachycentria vogelkopensis G. Clausing, *spec. nov.* — Fig. 10, 11e, Map 8

> Differt a *P. pulverulenta* antheris cum appendicibus dorsalibus calcariformibus fimbriatis crassis, seminibus ovoideis compressis cristis distinctis. — Typus: *Van Royen & Sleumer 7902* (holo L; iso A), New Guinea, Vogelkop Peninsula, Mt Nettoti, path Andjai-Wekari at 1650 m.

Terrestrial or epiphytic shrubs, erect, 0.5–1.2 m high, without adventitious roots; branchlets terete, smooth, with whitish indumentum on very young parts, becoming slightly ridged, wrinkled, and glabrous when older. *Leaves* elliptic; petiole 3–9 mm long; base narrowed; apex acuminate; lamina 3-nerved, coriaceous, glabrous, sometimes reddish; 7–16 by 2–5 cm. *Inflorescence* a terminal many-flowered thyrse, 4–7 cm long, the axes terete, slightly striate, reddish or yellowish, with or without yellowish indumentum of minute hairs; bracts and bracteoles minute, c. 1 mm long. *Flowers* with 1.5–2 mm long, widely-urceolate hypanthia, yellow, covered with yellowish or reddish indumentum of minute hairs; calyx tube c. 0.5 mm high, margin with 4 triangular, dark brown lobes; petals obovate, apex acute, with yellowish hairs on both surfaces, 3 mm long, 1.5 mm wide, yellow; filaments c. 1.5 mm long, whitish or cream; anthers cylindric, c. 2 mm long, yellow; connective with a strongly frayed dorsal spur; ovary globose, c. 1 mm diam.; style c. 5 mm long, with a cushion-like collar at the base, stigma punctiform. *Berries* globose, 5–6 mm diam., reddish green when immature, dark red when ripe; rim c. 0.5 mm high and 2.5 mm wide; pericarp thin, smooth. *Seeds* many per fruit, compressed ovoid with distinct crests, c. 0.9 mm long, testa cells papillose.

Distribution — Endemic to New Guinea.

Habitat — Terrestrially or rarely epiphytically in lowland rain forests, mountain rain forests, *Nothofagus* forests, and heath-shrub vegetation. It has been collected from sea level to up to 1750 m elevation.

Fig. 10. *Pachycentria vogelkopensis* G. Clausing. Photograph of type specimen (*Van Royen & Sleumer 7902*, A isotype).

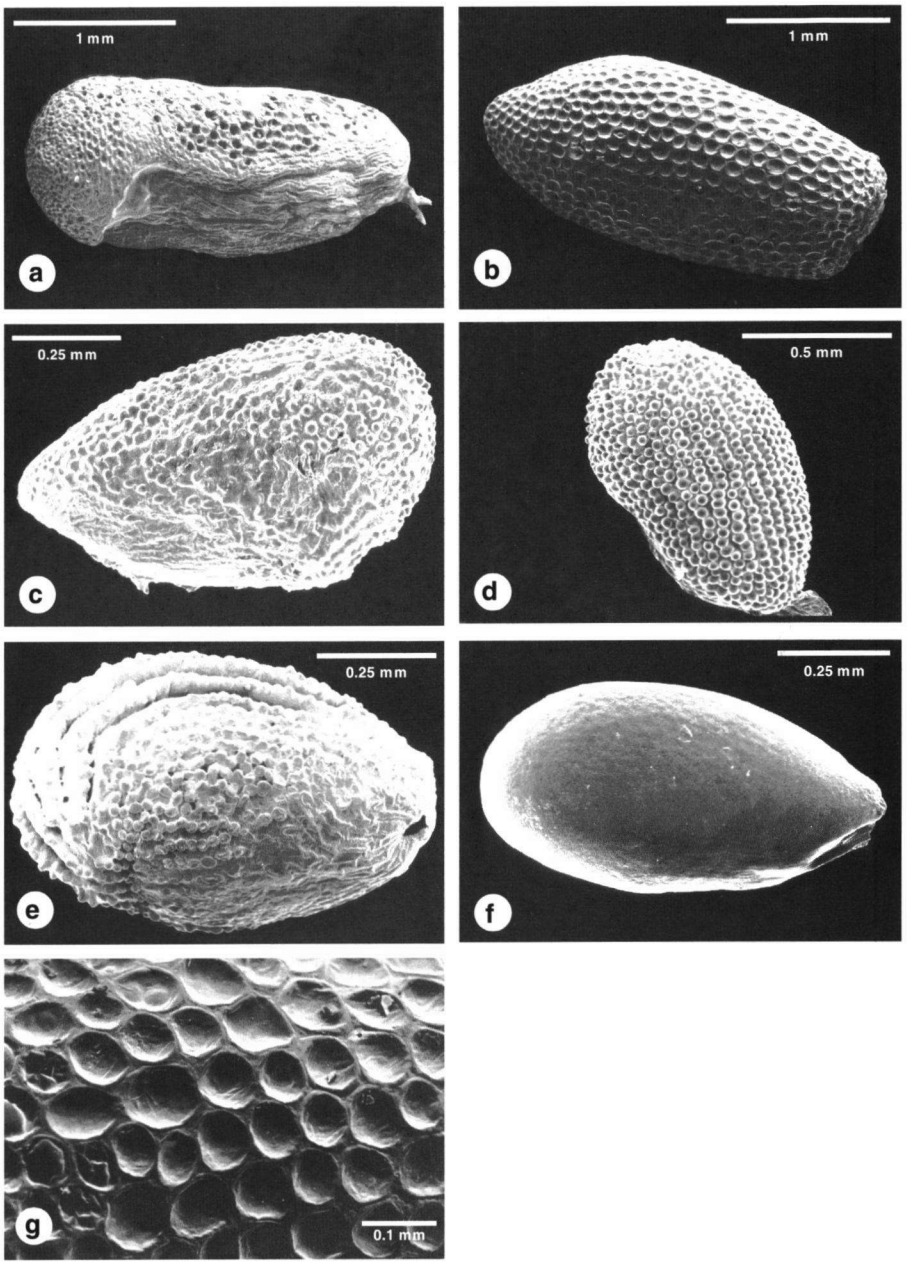


Fig. 11. Seeds. a. *Pachycentria constricta* (Blume) Blume; b. *P. glauca* Triana; c. *P. hanseniana* G. Clausing; d. *P. pulverulenta* (Jack) G. Clausing; e. *P. vogelkopensis* G. Clausing; f. *P. fengii* Hu (excluded species); g. comb-shaped testa cells.

EXCLUDED TAXA

9. *Medinilla hellwigii* Mansf., Bot. Jahrb. Syst. (Engl.) 60 (1926) 117, 125. — *Medinilla hellwigiana* Mansf., Nova Guinea XIV livr. II (1927). — *Pachycentria hellwigii* (Mansf.) Bakh.f., Rec. Trav. Bot. Néerl. 40 (1943) 123. — Type: *Römer 759* (L), New Guinea, Mt Hellwig.
Distribution — New Guinea, southern part, endemic.
Note — *Pachycentria hellwigii* belongs to *Medinilla*. It is excluded from *Pachycentria* because the hypanthium is cup-shaped, the dorsal connective spur is missing, and the seeds are cuneate and have interdigitate testa cells.

10. *Medinilla rubrovenia* Baker f., Trans. Linn. Soc. 9 (1916) 54, pl. 2, f. 40–42. — *Pachycentria rubrivenia* (Baker f.) Bakh.f., Rec. Trav. Bot. Néerl. 40 (1943) 121. — Type: *Wollaston Expedition s.n.*, New Guinea, Carstensz Mts (BM, not seen).
Distribution — New Guinea.
Note — *Pachycentria rubrivenia* belongs to *Medinilla*. It is excluded from *Pachycentria* because it has a campanulate hypanthium, the seeds are cuneate and have interdigitate testa cells. The leaf venation with 7–9-plinerved veins is not typical of *Pachycentria*.

11. *Medinilla versteegii* Mansf., Bot. Jahrb. Syst. (Engl.) 60 (1926) 117, 125. — *Pachycentria versteegii* (Mansf.) Bakh.f., Rec. Trav. Bot. Néerl. 40 (1943) 122. — Type: *Versteeg 1110* (iso K, L), New Guinea.
Medinilla versteegii Mansf. var. *tetragona* Mansf., Bot. Jahrb. Syst. (Engl.) 60 (1926) 125. — Type: *Versteeg 1563* (iso L, U), New Guinea.
Medinilla maidenii F. Muell., Wing's Southern Sc. Records new. ser. II (1886).
Distribution — Southern and eastern part of New Guinea.
Note — This species belongs to *Medinilla*. It is excluded from *Pachycentria* because of its cup-shaped hypanthium with a large ovary. Furthermore, extraovarian chambers are present in this species, seeds are cuneate, and the testa cells are slightly interdigitate.

12. *Pachycentria fengii* Hu, J. Arnold Arbor. 33 (1952) 170. — Type: *Feng 11789* (iso A), China, Yunnan, Si-chour-hsien, Faa-doou, 1500–1550 m.
Distribution — China (Yunnan).
Note — Excluded from *Pachycentria* because of its smooth seeds with interdigitate testa cells (Fig. 11f), perhaps it belongs to *Medinilla*.

13. *Pachycentria formosana* Hayata, Ic. Pl. Formos. 2 (1912) 109. — *Tashiroea okinawaensis* auct. non Matsumura: Hayata, Mater. Fl. Formos. (1911) 114, 449. — Type: *Mori 1434* (not seen), Taiwan, Shintiku, Kareisha.
Distribution — Taiwan.
Note — Excluded from *Pachycentria* because of its smooth, cuneate seeds with interdigitate testa cells; perhaps it belongs to *Medinilla*.

14. *Pogonanthera hexamera* Baker f., Contr. Arfak Mts (1917) 158. — Type: *Gibbs 5649* (holo BM), New Guinea, Arfak Mts, 3000 m.
Distribution — New Guinea.

Note — *Pogonanthera hexamera* is conspecific with *Medinilla rubiginosa* Cogn. [Monogr. Phan. 7 (1891) 598]. It has extraovarian chambers and 5- or 6-merous flowers. The shape of the testa cells is not known.

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The numbers between brackets refer to the corresponding numbers of accepted species names in this revision. A collection number followed by T indicates a type specimen.

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