

## REVISION OF THE GENUS *BROMHEADIA* (ORCHIDACEAE)

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### SUMMARY

This paper is a taxonomic revision of the genus *Bromheadia*. In *Bromheadia* sect. *Bromheadia* seven species and two varieties are recognized. One species, *B. pendek*, and one variety, *B. borneensis* var. *longiflora*, are described as new. *Bromheadia philippinensis* Ames & Quisumb. is here reduced to synonymy. *Bromheadia* sect. *Aporodes* has 19 species; 12 species (*B. cecieliae*, *B. coomansii*, *B. devogelii*, *B. gracilis*, *B. graminea*, *B. grandiflora*, *B. humilis*, *B. latifolia*, *B. lohaniensis*, *B. longifolia*, *B. robusta*, and *B. srilankensis*) are here newly described. Keys to the species are provided, together with a description of each species. Information on colours, distribution, habitat and ecology, general notes, and illustrations are given for each species where available.

### INTRODUCTION

The genus *Bromheadia* was established by Lindley in 1841 (Bot. Reg. 27: 89, misc. 184), based on a plant that he earlier, in 1833, had referred to *Grammatophyllum*. The genus was named after Sir Edward French Bromhead, "whose investigations of the natural affinities of plants are well known to systematical Botanists." The systematic position of this genus in the classification system of the Orchidaceae has been subject to changes. Bentham (1881: 319) classified it together with *Polystachya* in the subtribe Cymbidieae, repeating this in Gen. Pl. 1883: 540. Pfitzer (1888: 133) placed *Bromheadia* in the tribe Polystachyaeae, and so did Schlechter (1926: 587). Hooker f. (1890: 671) considered it to belong in the tribe Vandaeae subtribe Cymbidieae. Ridley (1891: 331) only stated that the genus was related to *Cymbidium* or *Polystachya*. Dressler & Dodson (1960: 48) placed it with a question-mark near *Thunia* in the Thuniinae, while Dressler (1981: 254) classified *Bromheadia* in the tribe Cymbidieae subtribe Cyrtopodiinae. Seidenfaden (1983: 11) discussed the history of the position of *Bromheadia* in the orchid hierarchy in some detail, and summarized the opinion of former authors. He agreed with a position in the tribe Cymbidieae, based on similarities in flower structure, and maintains this in his 'Orchids of Indochina' (1992: 320). Senghas (1990: 1455) referred to the consensus of former authors that *Bromheadia* should be accommodated in either the Cymbidieae/-inae or Polystachyaeae/-inae, but also stated that the genus has too many unique characters to determine with certainty the place of this genus in the system of Orchidaceae. Dressler (1990: 124) formally raised *Bromheadia* to the level of subtribe and included it in the tribe Cymbidieae subtribe Bromheadiinae. *Claderia*, which he regards as one of the problem groups in the classification of the Orchidaceae, is stated to have two stigmatic flaps reminiscent of the flaps that remain when the pollinarium of *Bromheadia* is removed. Since this genus has Corallorhiza-Eulophia seed type (and, in addition, the inflorescence type is similar to that of most species of *Bromheadia*) its affinity is by

him considered to be in or near the Cymbidiinae. Dressler (1993: 164) maintained this opinion. In the short discussion under *Bromheadia* he points to the unique structure of the stipe which is not clearly divided into a viscidium and stipe and which is formed behind two flaps, and concludes that the genus is in this respect, as well as in habit, quite unlike the Eulophiinae. He states that "*Bromheadia* might well merit tribal status, as it is very distinctive and tied to other Cymbidieae only by the velamen type." In this statement he disregards the fact that the seed structure is of the Eulophia type (in Dressler 1990: 119 named *Corallorhiza-Eulophia* type), which supplies another argument for inclusion in the Cymbidiinae. In the present investigation no arguments are found to object to Dressler's recent interpretation of the position of *Bromheadia* in the Cymbidieae.

The division of *Bromheadia* into the sections *Eu-Bromheadia* and *Aporodes* was established by Schlechter (1914: 366). According to the International Rules of Botanical Nomenclature, the first is now to be named section *Bromheadia*. The sections *Bromheadia* and *Aporodes* represent two natural groups which are vegetatively extremely different. They can be distinguished easily by the shape of the leaves: section *Bromheadia* has dorso-ventrally flattened leaves, and section *Aporodes* has laterally flattened leaves. This striking difference between these two groups is acknowledged by the formal recognition of the two sections by Senghas (in Schlechter, 1990) and in the present study; in other literature these two sections are mentioned but not formally distinguished by name. The two groups are kept together in one genus *Bromheadia*, notwithstanding the differences in habit, because of the unique structure of the rostellum that is formed by two lateral flaps which meet over the viscidium.

Herbarium specimens of *Bromheadia* are in general sufficient for identification, since most species can be recognized by characters of the vegetative parts. In *Bromheadia* sect. *Bromheadia* especially the shape of the leaf blade, the incision of the leaf sheath, and the position and morphology of the inflorescence offer in general good diagnostic characters. In *Bromheadia* sect. *Aporodes* the dimensions of the leaf, the leaf index, and the relative length of the upper stem internode compared with those lower down the stem offer diagnostic characters.

There are, in addition, floral characters which are important for identification. In most herbarium specimens, however, only one or very few flowers are present or they are even wanting. When flowers are present they are often in a badly preserved state. In most species the flower parts are membranous and when pressed during drying the parts stick together, which makes the flower difficult to analyze without damaging the parts. And because of the very short period of anthesis, which lasts only a few hours, collected flowers of herbarium specimens are often either in bud or in a more or less decayed state. The flower remains on the plant when anthesis is over, but the top of the column turns slimy and disintegrates. The same happens when the period between collecting and conservation or drying is too long. The best way to collect *Bromheadia* flowers in the field for scientific study is to preserve them immediately in spirit, FAA or FAPA. This leaves the shape of the floral parts intact, and no parts will stick together. Even better is to collect live specimens, which can be grown under regular observation and from which flowers can be harvested when they are in the right stage of anthesis. Without the live plants grown in the Leiden Hortus Botanicus this study would have been near impossible.

In the present revision only the drawings of floral parts based on spirit collections have a high rate of reliability, those based on dried flowers represent a reconstruction of various

structures which were squeezed and deformed in various degrees. In the legends to the Plates the type of conservation of the flower used for the illustration is indicated. The line drawings of *Bromheadia* sect. *Bromheadia* are made by De Vogel, except the drawings of the bracts which are made by Van Scheindelen. The drawings of *Bromheadia* sect. *Aporodes* are by De Vogel, based on pencil sketches made by Kruizinga.

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## CULTIVATION

*Bromheadia* species are very rare in cultivation. Only *B. finlaysonian* is sometimes encountered, a common and widespread species which grows terrestrial on loamy to sandy soils in more or less disturbed and rather open habitats where it is exposed to sunshine. Both terrestrial and epiphytic species can be grown successfully in pots with a loose mixture of fern roots and hardwood bark or charcoal which allows good drainage. Watering should be regular, and aerial humidity is best kept high, because water storing tissues are not present. The pot mixture should be allowed to dry out, but not for too long. In the Leiden Hortus Botanicus the plants are grown under partially shaded conditions, by which they thrive well. Occasionally, however, well established and healthy plants for no apparent reason lose their vitality and die off very quickly.

The epiphytic species of sect. *Bromheadia*, as well as all species of sect. *Aporodes* are also grown with success on fern slabs. In nature these grow on thicker branches of trees, often in the axil, where a smaller or greater amount of humus is accumulated between the rhizomes and the stem bases.

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Living plants of the following species were grown and studied in the Leiden Hortus Botanicus: *B. brevifolia*, *B. ceciliae*, *B. devozelii*, *B. ensifolia*, *B. finlaysonianana*, *B. graminea*, *B. grandiflora*, *B. lohaniensis*, *B. longifolia*, *B. pendek*, *B. robusta*, *B. scirpoidea*, *B. tenuis*, and *B. truncata*. The Hortus personnel, and especially the prefect and the keeper of the glasshouses are thanked for their efforts to cultivate the plants.

Further we would like to express our gratitude to Dr. G. Seidenfaden, who sent his alcohol collections of *B. aporoides* and *B. truncata* for study. Thanks are also due to Dr. J.F. Veldkamp for translating the diagnoses of the new species into Latin.

#### BROMHEADIA Lindley

For literature see under the sections.

Terrestrial or epiphytic, erect, more or less woody plants. *Roots* glabrous. *Rhizome* creeping, short to somewhat elongated. Stems unbranched, rather flexible to stiff, terete to laterally compressed, not swollen. *Leaves* distichous, alternating, articulate, (stiff) herbaceous to hard-coriaceous; in sect. *Bromheadia* dorso-ventrally flattened, articulation more or less perpendicular to the stem; in sect. *Aporodes* laterally flattened or terete, articulation more or less parallel to the stem. Leaf sheaths tubular, clasping the stem, imbricate. Leaf blade in sect. *Bromheadia* (ob)ovate to linear, with bilobed top, in sect. *Aporodes* obliquely triangular to linear, with acute top. *Inflorescence* accrescent, a raceme with sometimes one or several raceme-like branches, in *B. divaricata* a laxly branched panicle, either terminal, lateral or both. *Bracts* more or less imbricate, alternating in 2 rows, stiff, rarely more membranous, many-nerved, midrib keeled; in sect. *Aporodes* at the base with few sterile, membranous bracts. *Flowers* resupinate, opening in succession or very few open at the same time, short- to very short-lived. *Sepals* oblong or elliptic to linear-lanceolate, the lateral ones slightly asymmetric, thin to fleshy, the lateral ones in most species not keeled but in some either or not keeled; nerves 7(–9). *Petals* elliptic or oblong to (linear-)lanceolate, slightly asymmetric, usually thinner than the sepals, not keeled, base narrowed; nerves 3, lateral ones with several branches from near the base. *Lip* boat-shaped, 3-lobed. *Hypochilium* thin, mostly median swollen, glabrous or with scattered hairs; lateral lobes variable in size, erect, in front more or less pronounced; callus when present more or less ligulate, more pronounced to the top, often more or less densely hairy or papillose. *Epi-chilium* triangular to (sub)orbicular to ligulate, more or less flat to recurved, in few species of sect. *Bromheadia* with upturned margins, with a more or less pronounced, narrow to broad, more or less ruminant, glabrous to papillose or hairy callus. *Column* slender, slightly curved; seams lateral, wing-like, rather narrow, at the base each with or without a semi-orbicular auricle; hood rather small, covering at least the base of the anther. *Stigma* cup-shaped; top margin laterally on either side with a more or less triangular to semi-orbicular flap which is bent to cover the median part of the top rim (but in *B. pendek* of sect. *Bromheadia* without these lateral flaps); rostellum detachable, relatively large, semi dome-shaped, thin, covering most of the stigma. *Anther* bilocular, from above obovate to elliptic in outline. Pollinia 2, porate, rather flat, lanceolate-ovoid to triangular-ovoid. *Fruit* a capsule with 6 longitudinal ribs, perianth persistent on top.

Distribution — Sri Lanka and mainland SE Asia to New Guinea.

## KEY TO THE SECTIONS

- 1a. Leaves dorso-ventrally flattened, top bilobed, leaf blade more or less narrowed at the base, articulation with the sheath more or less perpendicular to the stem . . . . . Section **Bromheadia**
- b. Leaves laterally flattened, top acute, leaf blade not narrowed at the base, articulation with the sheath more or less parallel with the stem . . . . . Section **Aporodes**

### BROMHEADIA SECTION BROMHEADIA

(H. J. van Scheindelen & E. F. de Vogel)

The very first specimens of *Bromheadia* were collected in Singapore by Mr. Finlayson and stored in Dr. Wallich's herbarium (Wall. Cat. 7361). When Lindley examined the specimens he found them almost destroyed by insects. With great doubt he referred the species to the genus *Grammatophyllum*, under the name *G. ? Finlaysonianum* (Lindley, 1833). After studying a living specimen found by Mr. Cuming which was sent to J. D. Llewelyn with the memorandum that it had been "dug out of a bog in Sumatra," Lindley established a new genus based on the distinct structure of the flowers. Although he referred this live plant to his *Grammatophyllum Finlaysonianum*, he renamed it to *Bromheadia palustris* (Lindley, 1841), and gave a new description.

Although Reichenbach f. has generally been considered the author of the combination *B. finlaysoniana*, he used it for the first time in 1863, whereas Miquel used this combination already in 1859 (Seidenfaden, 1983).

Most species of sect. *Bromheadia* are relatively easy to distinguish vegetatively, in particular by the bracts and the shape of the leaf blade.

*Bromheadia finlaysoniana*, the most common and widespread species, which is distributed from mainland Southeast Asia over Malesia to Australia, is very variable in appearance. The many forms cover a wide range with many intermediates. Three described species and one variety are forms of *B. finlaysoniana* which fall within the variability of this species: *B. sylvestris*, *B. palustris* var. *papuana*, *B. pulchra* and *B. venusta*.

*Bromheadia borneensis* (J. J. Smith, 1917) superficially resembles *B. finlaysoniana*, but is easy to distinguish by the deeply incised leaf-sheaths, and by the in general much broader leaf blades. The here newly described *B. borneensis* var. *longiflora* has much longer flower parts, and a lip different in size and proportions, but is in a vegetative state indistinguishable from the type variety.

One species has all inflorescences lateral on the basal part of the stem: *B. rupestris* (Ridley, 1896).

The fleshy flowers of *B. crassiflora* (J. J. Smith, 1931) resemble those of *B. rupestris* and *B. divaricata*, but *B. crassiflora* has much longer and narrower leaves.

*Bromheadia alticola* (Ridley, 1891) differs distinctly from the other species of the genus by the large, inflated bracts. *Bromheadia philippinensis* (Ames & Quisumbing, 1936), known from only two collections, is here considered a synonym of this species in spite of the absence of flowers, as it is in the vegetative state indistinguishable from *B. alticola*.

The only species of sect. *Bromheadia* with widely branching inflorescences is *B. divaricata* (Ames & Schweinfurth, 1920).

## Section Bromheadia

*Bromheadia* Lindley, Bot. Reg. 27 (1841) 89, misc. 184; Ridley, J. Linn. Soc. 28 (1891) 331; Schltr. in Fedde, Rep., Beih. 1 (1914) 367; Holttum, Orch. Malaya (1964) 540; Dressler, Orch.: Nat. Hist. & Class. (1981) 38, 96; Seidenf., Opera Bot. 72 (1983) 11; Senghas in Schltr., Die Orch., ed. 3 (1990); Dressler, Phyl. & Class. Orch. Fam. (1993). — Type species: *Bromheadia finlaysoniana* (Lindley) Miq.

Terrestrial or epiphytic plants to 1.5 m high. *Roots* to 25 cm long. *Rhizome* terete. *Stems* close together to rather wide apart, terete or laterally compressed, internodes to 8.5 cm long. *Leaves* dorso-ventrally flattened, (stiff) herbaceous to coriaceous. *Leaf sheaths* to 5.5 cm long, usually with an incision opposite the blade. *Leaf blade* (ob)ovate to linear, 6–21 by 0.8–4 cm, index 2.5–19; base more or less narrowed; top bilobed; midrib above sunken, below prominent, in *B. borneensis*, *B. finlaysoniana* and *B. pendek* the blades of the upper leaves entirely reduced. *Inflorescence* a raceme or in *B. divaricata* a laxly branched panicle ending in many raceme-like branches, (sub)sessile, sometimes with one or few (sub)sessile flower-bearing raceme-like branches, either all lateral especially along the lower stem portion, or terminal with occasionally in addition lateral ones only in the top portion of the stem; flower-bearing rachis more or less clearly zigzag, internodes 1–7 mm long; lateral inflorescences breaking through a leaf sheath. *Bracts* more or less quadrangular to triangular, mostly clasping the base of the bract above, not inflated except in *B. alticola*, and sometimes rather angular as in both varieties of *B. borneensis* and in *B. finlaysoniana*; top entire, acute and free except in *B. rupestris* where the top is bilobed, rounded and appressed to the bract above. *Flowers* per raceme one or few open simultaneously; *B. alticola* and *B. finlaysoniana* plants sometimes flower gregariously. *Pedicel* and *ovary* elongating in fruit. *Sepals* elliptic to linear-lanceolate, index 3–8, acute, fleshy to thin, in *B. finlaysoniana*, *B. borneensis* and *B. alticola* mostly the lateral ones keeled and sometimes also the median sepal less prominently keeled. *Petals* elliptic to linear-lanceolate, index 2–7, acute. *Lip* boat-shaped, 3-lobed. *Hypochilium* thin, mostly median swollen and there puberulous to about halfway the lip; lateral lobes in front pronounced. *Epichilium* triangular to (sub)orbicular to (linear-)lanceolate; top truncate to acute apiculate. *Column* spatulate when flattened, in *B. finlaysoniana* more or less lanceolate.

Colours — Flowers white, yellow to (yellow-)orange or reddish, with a yellow callus and in most species violet or purplish markings on the lip.

Distribution — Thailand, Laos, Cambodia, Vietnam; all over Malesia (with the exception of Java, Lesser Sunda Islands, Celebes and northern Moluccas), to Queensland (Australia).

Habitat & Ecology — Terrestrials, some species epiphytic. Altitude 0–3000 m. See further under the species.

Notes — 1. All columns are measured in natural position, at the widest part of the column, which is at the level of the stigma.

2. The incision in the top of the leaf sheath is measured from the articulation with the leaf blade.

3. Flowers of *B. alticola* have masses of fine papillae-like hairs on the lip (observed in one alcohol collection), in dried specimens these look like wart-like calli. In other species with similar calli only dried specimens were studied; the calli may have the same structure in fresh flowers.

4. The size and shape of the rostellum given in this paper are not always reliable as the rostellum does not keep its shape in dried conditions.

KEY TO THE SPECIES OF SECTION BROMHEADIA

- 1a. Leaves on the top part of the flowering stem reduced to scales, without developed leaf blade. (Inflorescence seemingly with elongated peduncle) . . . . . 2
- b. Leaves on the top part of the flowering stem with developed leaf blade. (Inflorescence seemingly sessile) . . . . . 4
- 2a. Plant small, when flowering less than 25 cm long. Leaf blade (1.5–)4–8.5 cm long . . . . . **6. B. pendek**
- b. Plant tall, when flowering over 50 cm long. Leaf blade (6–)10–21 cm long . . . . . 3
- 3a. Stem almost terete. Leaf sheath opposite leaf with a shallow, 1–3 mm deep, U-shaped incision. Top of the leaf blade distinctly bilobed, lobes slightly to distinctly unequal . . . . . **5. B. finlaysoniana**
- b. Stem rather flattened. Leaf sheath opposite the leaf with a deep, V-shaped, (5–)7–12 mm deep incision. Top of the leaf blade almost entire, lobes subequal . . . . . 3
- 4a. Lip 10–13 mm long, lateral lobes in front projecting for 1.7–2.2 mm . . . . .
- . . . . . **2a. B. borneensis var. borneensis**
- b. Lip 17–23 mm long, lateral lobes in front projecting for 0.7–1.5 mm . . . . .
- . . . . . **2b. B. borneensis var. longiflora**
- 5a. Inflorescences never terminal, all lateral lower down on the stem. Bracts imbricating up to their top, the top bilobed and rounded . . . . . **7. B. rupestris**
- b. Inflorescences terminal on the stem, sometimes in addition one or few lateral on the top part of the stem. Bracts with most of the top part free from the bract above, their top entire and acute . . . . . 6
- 6a. Bracts inflated. Margins of leaf blade straight, more or less parallel . . . . . **1. B. alticola**
- b. Bracts not inflated. Margins of leaf blade curved, or tapering to the top . . . . . 7
- 7a. Leaf blade 0.8–1.3 cm wide, index 10–19. Terminal inflorescence a raceme, without or with a few branches . . . . . **3. B. crassiflora**
- b. Leaf blade 2.2–3.5 cm wide, index 2.5–4.5. Terminal inflorescence a more or less lax, few- to much-branched panicle . . . . . **4. B. divaricata**

**1. Bromheadia alticola** Ridley — Fig. 29

*Bromheadia alticola* Ridley, J. Linn. Soc. Bot. 28 (1891) 338, t. 42; *ibid.* 32 (1896) 339; J. Str. Br. Roy. As. Soc. 33 (1900) 161; *ibid.* 35 (1901) 23; Mat. Fl. Mal. Pen. 1 (1907) 144; Fl. Mal. Pen. 4 (1924) 151; M. R. Hend., Mal. Wild Flow. (1949) 106, f. 59 & 60; Holttum, Orch. Malaya, ed. 3 (1964) 539, f. 160; Seidenf., Bot. Tidsskr. 66 (1971) 335, f. 247; Opera Bot. 72 (1983) 13, f. 2 & 4; Wood & Cribb, Checkl. Orch. Borneo (1994) 110 — Type: not designated, only a series of localities is given; Ridley s. n., 1890, Jurung (hololecto AMES, iso BRI, CAL, MEL), here chosen.

*Bromheadia philippinensis* Ames & Quisumb., Philipp. J. Sc. 59 (1936) 6, pl. 1, 4; Valmayor, Orchid. Philipp. 1 (1984) 101. — Type: *PNH 3000* (Day) (holo lost, iso AMES).

Epiphytes, to 75 cm high. *Stem* flattened, 6–9 mm wide; internodes to 7 cm long; flowering stems on the basal part with 3–5 bladeless sheaths, upper part with 5–11 leaves, blades of basal leaves dropping soon. *Leaf* sheath 4–5.5 cm long, mostly overlapping the subsequent sheath, opposite the blade with a 3–5 mm deep V-shaped incision; without mucro in the incision. Leaf blade linear, 13–19 by 1.5–2.2 cm, index 6–15; base decurrent in the incision of the sheath, 10–15 mm above the articulation petiole-like; margins

more or less parallel; top bilobed, lobes 2–5 mm long, very unequal, difference 2–3 mm. *Raceme* terminal, to 12 cm long, sometimes branched; scape absent; internodes 3–7 mm long. *Bracts* about quadrangular to rectangular in lateral outline, rather inflated, top part along the midrib flat and wing-like; 10–13-nerved; midrib curved, 9–17 mm long, top margin straight to slightly curved, 5.5–8 mm long. *Flowers* up to 80 per inflorescence. *Pedicel* and *ovary* 14–20 mm long. *Sepals* elliptic to (linear-)lanceolate, 20–25 by 3.5–5.5 mm, index 4.2–6, often the lateral sepals keeled, sometimes also the median sepal. *Petals* elliptic to (linear-)lanceolate, 18–24 by 3–4 mm, index 5–6.5. *Lip* when flattened obovate in outline, 15–20 by 7–9 mm. *Hypochilium* lanceolate-triangular when flattened, median sometimes somewhat swollen; lateral lobes relatively big, in front triangular to rounded and shortly projecting for 2–3 mm. *Epichilium* suborbicular to elliptic, 3.5–7 by 3.2–5 mm, centrally swollen and there with irregular masses of slender papillae-like hairs; base not constricted; margins undulate, ciliate; top apiculate. *Column* 13–15 by 3.5–4 mm, dorsally with a strong median rib; seams 0.6 mm wide, diminishing to the top; top hood-like, 1 mm high; rostellum broadly triangular. *Anther* elliptic in outline, c. 2.5 by 1.5 mm, with a low median crest; pollinia triangular-ovoid, c. 1.5 mm long, with a short longitudinal groove. *Fruit* not seen.

Colours — Flowers creamy white or pale yellow. Lateral lobes on front edges purple. Median band of hypo- and epichilium yellow.

Distribution — Thailand (Peninsula), 2 collections (C, K). Malay Peninsula (Kelantan, Pahang, Malacca), 10 coll. (K, SING). Singapore, 1 coll. (SING). ?Borneo (Sarawak), ?1 coll. (K), see note 2 below. Philippines (Mindanao), 2 coll. (AMES, ?PNH, L), see note 3 below.

Habitat & Ecology — Epiphytes on tall trees in primary forest. Ridley (1891) described the plants as: sun-loving, all flower at the same time, flowers rare, open in the early morning and perishing soon, sweetly scented. Holttum (1949) suggested that the gregarious flowering is probably a response to an unusually prolonged cool period. Altitude 0–600 m. Fl. records in March, May–June and Oct.–Nov.

Notes — 1. The epithet *alticola* means: inhabitant of higher altitudes.

2. Seidenfaden (1983) cited one record of *B. alticola* (Ridley *s.n.*, K) from Sarawak. Although the vegetative parts resemble those of this species it cannot with certainty be identified as such, since in this specimen flowers and inflorescence are lacking.

3. The holotype of *B. philippinensis*, PNH (Day) 3000, was burnt in the Manila herbarium fire. The isotypes preserved in AMES have no flowers. An additional sterile specimen, PNH (Mendoza) 41906, was detected in Leiden. The plants are vegetatively identical with *B. alticola*. In addition, the drawings of the flowers by Ames & Quisumbing are identical with spirit material of *B. alticola* from the Malay Peninsula. There are no arguments to keep *B. philippinensis* as a species separate from *B. alticola*, in spite of the uncertain presence of this species in Borneo.

4. Additional note. A sterile living specimen of what appears to be *B. alticola* was recently (March 1997) collected by Schuiteman et al. in Sarawak (Kelabit Highlands) at 1000 m altitude. It is recorded as a terrestrial in open kerangas vegetation.

## 2. *Bromheadia borneensis* J.J. Smith

For literature, see under the varieties.

**a. var. borneensis** — Fig. 30

*Bromheadia borneensis* J.J. Smith, Bull. Jard. Bot. Buitenzorg II, 25 (1917) 18; Ames in Merr., Bibl. Enum. Born. Pl. (1921) 180; Wood & Cribb, Checkl. Orch. Borneo (1994) 110. — Type: *Amdjah 980* (holo BO, iso BO, K, L).

Plants terrestrial, to 120 cm high. *Stem* rather flattened, 4–6 mm wide; internodes to 7 cm long; flowering stems on the basal part with 4–6 bladeless sheaths, central part with 6–9 leaves, upper part for 20–60 cm long with 7–11 bladeless sheaths. *Leaf* sheath 3–5 cm long, sometimes overlapping the subsequent sheath; nerves prominent; opposite the blade with a 7–12 mm deep, V-shaped incision; mucro in the incision short, stiff, to 1 mm long. *Leaf* blade elliptic to (ob)ovate, 7–14 by 2–4 cm, index 3–5; base decurrent in the incision of the sheath, for 4–5 mm above the articulation petiole-like; margins not parallel, regularly curved; top with a short, curved mucro, almost entire, the sides subequal. *Raceme* terminal, to 10 cm long, sometimes branched; scape 5–12 mm long; internodes 2–3 mm long. *Bracts* quadrangular to triangular in lateral outline; 3- or 4-nerved or nerves inconspicuous; over the midrib halfway more or less abruptly curved, 3–4 mm long; top margin more or less abruptly incurvate, 3–4 mm long. *Flowers* up to 25(–100) per inflorescence. *Pedicel* and *ovary* 4–5 mm long. *Sepals* elliptic to (linear-)lanceolate, 14–21 by 2–5 mm, index 3.5–7.5; often the lateral ones keeled, sometimes also the median one. *Petals* elliptic to (linear-) lanceolate, 13–17 by 2–4 mm, index 3.5–7. *Lip* when flattened elliptic to (ob)ovate in outline, 10–13 by 4.5–7 mm. *Hypochilium* when flattened elliptic to obovate in outline, thin, median somewhat swollen and there with fine, relatively long, erect hairs; lateral lobes rather large, far projecting in front, projecting part rather broad and rounded, 1.7–2.2 mm long, top broadly rounded. *Epichilium* semi-orbicular to elliptic, 3–4.5 by 2.5–3.5 mm, centrally swollen and there with cross-bands of low, irregular warts; base not constricted; margins shallow crispate, undulate; top usually acuminate. *Column* 9–10 by 1.5–1.8, dorsally with a strong median rib; seams 1–1.2 mm wide, to the top distinctly narrowing; top hood-like, c. 1.2 mm high; rostellum about as big as the anther. *Anther* from above elliptic in outline, c. 1 by 0.8 mm, with a low median crest; pollinia lanceolate-ovoid, c. 0.9 by 0.3 mm, with a longitudinal groove. *Fruit* not seen.

Colours — Flowers cream coloured or pale yellow to reddish; lip yellowish inside, the lateral lobes (sometimes?) reddish, midlobe yellowish; column yellowish, in front (sometimes) with red spots; anther almost white.

Distribution — Malay Peninsula (Johore), 1 collection (SING). Borneo: Kalimantan (Kalimantan Timur, Kalimantan Tengah). Sabah (Sandakan Residency, Interior Residency). Sarawak (4th Div.). Brunei (Belait Distr.), 12 coll. (B, K, KYO, L, P, SAN, SING).

Habitat & Ecology — Terrestrial plants in primary forest. Altitude 0–500 m. Fl. records in Feb., April, June, Aug. and Oct.–Dec.

Notes — 1. The epithet *borneensis* refers to Borneo from where the species was described.

2. *Bromheadia borneensis* var. *borneensis* cannot be distinguished from var. *longiflora* when the plants are not in flower. Sterile plants of this species are present from: Malay Peninsula (Johore), 3 collections (BO, K, L, P). Sumatra (Sumatera Utara, Riau), 2 coll. (BO, L). Borneo: Sabah (Bahagian Pedalaman, Sandakan), Sarawak (Bah. Miri), Kalimantan (Kalimantan Timur) and Brunei (Tutong and Belait Distr.), 13 coll. (BO, BRUN, K, KYO, L, P, SAR, SAN).

**b. var. longiflora** Scheindelen & de Vogel, *var. nov.* — Fig. 31

*Bromheadia borneensis* var. *borneensis* similis, partibus floralibus distincte longioribus angustioribusque, labello 17–23 mm longo, lobis lateralibus 0.7–1.5 mm longis antice paulo eminentibus differt; var. *borneensis* labello 10–13 mm longum, lobis lateralibus 1.7–2.2 mm longis, antice distincte eminentibus gaudet. — Typus: *Ridley s.n.*, 1894 (holo BM), Sungei Morai.

Plants terrestrial, slender, to 110 cm high. *Stem* rather flattened, 4–6 mm wide; internodes to 7 cm long; flowering stems on the basal part with 3 or 4 bladeless sheaths, central part with 4–9 leaves, upper part for 20–50 cm with 7–12 bladeless sheaths. *Leaf* sheath 2.5–4.5 cm long, sometimes overlapping the subsequent sheath; opposite the blade with a (5–)7–12 mm deep, V-shaped incision; mucro in the incision short, stiff, to 1 mm long. Leaf blade elliptic to (ob)ovate, 6.5–16 by 1.8–3.2 cm, index 3–5; base decurrent in the incision of the sheath, for 4–5 mm above the articulation petiole-like; margins not parallel, regularly curved; top shortly mucronate, almost entire, the sides subequal. *Raceme* terminal, to 4 cm long, sometimes branched; scape 5–12 mm long; internodes 2–3.5 mm long. *Bracts* quadrangular to triangular in lateral outline; 3- or 4-nerved or nerves inconspicuous; over the midrib halfway more or less abruptly curved, 3–4 mm long; top margin more or less abruptly incurvate, 3–4 mm long. *Flowers* up to 35 per inflorescence. *Pedicel* and *ovary* 6–12 mm long. *Sepals* elliptic to (linear-)lanceolate, 20–28 by 3.5–5 mm, index 5.4–8; often the lateral ones keeled, sometimes also the median sepal. *Petals* elliptic to (linear-)lanceolate, 20–25 by 3.5–6 mm, index 4.1–6. *Lip* when flattened long elliptic in outline, 17–23 by 5–8 mm. *Hypochilium* when flattened long elliptic to slender spatulate in outline, thin, median somewhat swollen and there with fine, relatively long, erect hairs; lateral lobes small, not far projecting in front, projecting part rather triangular, 0.7–1.5 mm long, top almost acute to rounded. *Epichilium* semi-orbicular to elliptic or obovate, 3.5–6 by 3.5–4.5 mm, median with a (narrowly) triangular, swollen patch with cross-bands of low irregular warts; base sometimes constricted; margins undulate; top acuminate. *Column* 13–17 by 2–4 mm, top part dorsally with a strong median rib; seams 1–1.5 mm wide, to the top gradually narrowing; top hood-like, c. 1.2 mm high; rostellum not seen. *Anther* from above elliptic in outline, c. 1.5 by 1 mm, with a low median crest; pollinia not seen. *Fruit* c. 4 cm long by 7 mm in cross section.

Colours — Flower dull golden yellow, lip distantly veined crimson on lateral lobes and speckled crimson on the middle, epichilium rich yellow with paler margins. Less detailed records: flower orange yellow or yellow.

Distribution — Singapore, 5 coll. (SING). Borneo: Kalimantan Tengah, 1 coll. (BO).

Habitat & Ecology — Lowland, primary forest, peat forest. Altitude: lowlands, record to 5 m above sea level. Fl. once recorded, Sept.

Notes — 1. The name of this variety refers to the flower length which is considerably longer than that of the type variety.

2. The flowers of *B. borneensis* var. *longiflora* are much longer and the lateral lobes are relatively much smaller than those of var. *borneensis*. Vegetatively they cannot be distinguished; a status as variety seems appropriate.

**3. Bromheadia crassiflora** J.J. Smith — Fig. 32

*Bromheadia crassiflora* J.J. Smith, Bull. Jard. Bot. Buitenzorg III, 11 (1931) 149; Wood, Beaman & Beaman, Pl. Mt. Kinabalu 2, Orchids (1993) 34, 99; Wood & Cribb, Checkl. Orch. Borneo (1994) 6, 111. — Types: *Enderit 4386* (holo L, iso BO); *Enderit 4273* (para BO).

Epiphytes, slender to rather sturdy, to 1 m high. *Stem* terete or somewhat flattened, 3–6 mm diam.; internodes 2–3.5 cm long; flowering stems with 20–40 leaves, blades of basal ones dropping soon. *Leaf* sheath 1.5–3.5 cm long, each overlapping the subsequent sheath, basal sheaths where leaves have fallen off transversely wrinkled when dried; opposite the blade with a shallow, 1–2 mm deep, U-shaped incision; without a mucro in the incision. Leaf blade ovate, 8–21 by 0.8–1.3 cm, index 10–19; base not petiole-like; margins over the full length tapering towards the apex; top bilobed, lobes very unequal, difference 2–5 mm. *Racemes* terminal with in addition occasionally lateral ones in the top portion of the stem, (sub)sessile, to 5 cm long, 5–12 mm wide, sometimes branched; scape absent; internodes 1–2 mm long. *Bracts* about triangular; not nerved or sometimes with 2 nerves; midrib curved, 4–7 mm long, top margin curved, 5–8 mm long; remains of petiole often present in the bract. *Flowers* up to 65 per inflorescence. *Pedicel* and *ovary* 11–20 mm long. *Sepals* ovate to elliptic to (linear-)lanceolate, 23–37 by 5–11 mm, index 3.3–6, fleshy, thick especially towards the top. *Petals* ovate to ovate-oblong, 19–31 by 4.5–11 mm, index 2.7–4.1. *Lip* when flattened ovate-oblong in outline, 15–27 by 5–9 mm. *Hypochilium* when flattened elliptic in outline, median swollen and there with small warts; lateral lobes small, projecting in front, projecting part 1–1.5 mm long, top rounded to acute. *Epichilium* ovate in outline, longitudinal strongly folded double, when flattened obovate-oblong to spatulate in outline, 7–10 by 4.5–5 mm, top part for one third or less connate; with cross-bands of small irregular warts; base constricted or claw-like over a length of up to 5 mm; margins slightly undulate, sometimes on the top part somewhat connate; top not apiculate. *Column* c. 13–17 by 3 mm; seams c. 0.5 mm wide, to the top narrowing; top hood-like, 1–1.2 mm high; rostellum triangular, almost as big as the anther. *Anther* from above obovate in outline, 1.5–2 by 1.5 mm; median crest short, low, broadly triangular; pollinia triangular-ovoid, c. 1.8 mm long. *Fruit* 3.5–5 cm by 0.6–0.7 mm.

Colours — Sepals inside pale yellow or cream coloured, outside mottled red or reddish violet. Petals pale yellow, lip mottled red or purple. Column reddish violet at base, yellow at apex. Less detailed notes: flowers yellow, honeymark purplish; cream coloured, sepals, petals and midlobe spotted purple at the base. Flowers creamy white, lip with purple veins.

Distribution — Borneo: Sabah (Interior and West Coast Residency); Sarawak (4th & 5th Div.); Kalimantan (Kalimantan Timur), 15 collections (AMES, BO, BM, E, K, L, NY, SAN, SAR, SING).

Habitat & Ecology — Terrestrial or epiphytic in more or less open montane and moss forest. Altitude 1300–2300 m. Fl. records in Jan., April, and Jun–Oct.

Notes — 1. The epithet *crassiflora* refers to the consistency of the flower, which is very thick compared with the flowers of most other species of this genus.

2. Two specimens from Mt Kinabalu in Sabah, *Clemens* 50490 and *SF* (Carr) 27783, resemble *B. crassiflora* in most respects but have thin instead of thick, hard, and leathery leaves, and much less stout stems and inflorescences. One insect-damaged mature flower bud was present on the Carr specimen. The lip resembles that of *B. crassiflora* in all aspects except that the callus on the claw of the epichilium seems broader and more pronounced. The flowers are recorded to be salmon coloured. Until better material becomes available no decision can be made whether these specimens represent a different taxon.

3. Plants from Gunung Murud in Sarawak (*Nooteboom & Chai* 2054; *S* 44482 (Yii); *Burt & Martin* B 5463/A) have all bigger bracts, 10–12 mm wide, than those from other areas which are 5–7 mm wide.

4. The flowers of *B. crassiflora* resemble those of *B. rupestris* which also has lateral inflorescences, especially in the folded and on the upper side connate epichilium, but the plants are completely different in the shape and size of the leaf blades and bracts.

**4. *Bromheadia divaricata* Ames & Schweinf. — Fig. 33**

*Bromheadia divaricata* Ames & Schweinf., Ames Orch. 6 (1920) 155; Wood, Beaman & Beaman, Pl. Mt. Kinabalu 2, Orchids (1993) 23, 99, pl. 10; Wood & Cribb, Checkl. Orch. Borneo (1994) 111. — Type: *Clemens 389* (holo AMES, iso BM, BO, NY).

Terrestrial plants, sturdy to very stout, to 90 cm high. *Stem* flattened, 8–12 mm wide; internodes to 4 cm long; flowering stems with more than 13 leaves (basal part not seen). *Leaf* sheath 2.5–3.5 cm long, to the top somewhat widening, overlapping the subsequent sheath, coriaceous, strongly nerved, opposite the blade without or with an up to 5 mm deep V-shaped incision; without a mucro in the incision. *Leaf blade* elliptic to obovate, 10.5–12 by 2.2–3.5 cm, index 2.5–4.5, coriaceous; base not petiole-like, amplexicaul; margins not parallel to almost parallel, at both ends tapering strongly; top bilobed, lobes 1–4 mm long, very unequal, difference 3–4 mm. *Lateral inflorescences* on the top part of the stem, sessile, often with one to few sessile branches, further as the terminal inflorescence. *Terminal inflorescence* a lax, few- to many-branched panicle branched to the first or second degree, terminal branches consisting of a flower-bearing rhachis to 7 cm long; scape 1–3.5 cm long; internodes 1.7–2 mm long. *Bracts* about triangular; nerves absent; midrib curved, 3.5–4.5 mm long, top margin straight to slightly curved, 5–6 mm long. *Flowers* up to 150 per inflorescence. *Pedicel* and *ovary* 14–18 mm long. *Sepals* elliptic to ovate to (linear-) lanceolate, 21–27 by 6–8 mm, index 3–5.6. *Petals* elliptic to ovate, 21–27 by 5–8 mm, index 2.3–5.4. *Lip* when flattened ovate-lanceolate in outline, 14–22 by 5–10 mm when flattened. *Hypochilium* elliptic in outline when flattened, median with a  $\pm$  swollen band with in front a few low warts, the swollen band with fine, relatively long erect hairs; lateral lobes in front small, pointing outward, projecting part rounded, 0.5–1 mm long. *Epichilium* top part strongly folded double, in lateral view ovate-elliptic to suborbicular, 6–7 by 4–5.5 mm, fleshy, median somewhat thickened and there with low irregular warts; base constricted, sometimes claw-like, this part 2–3 mm long; margins on the top part shallowly undulate, connate; top apiculate. *Column* 15–18 by 2–3.5 mm; seams 1–2 mm wide, grading into the hood, at the base each with a distinct, rounded auricle; top hood-like, 2–2.5 mm high. *Anther* from above obovate in outline, 2 by 1 mm, with a low longitudinal median crest from base to halfway the anther; pollinia ovoid, 2.2 by 1.3 mm. *Fruit* 4 by 0.7 cm.

Colours — Flower cream coloured or purplish with cream-coloured inner lip.

Distribution — Borneo: Sabah (Bahagian Pantai Barat), 7 collections (AMES, BM, BO, K, L, LAE, NY, SING).

Habitat & Ecology — Terrestrial and epiphytic in low montane forest, on logs or rocks. Altitude (1350–)2100–3000 m. Fl. records in Feb., June and Nov.

Note — The epithet *divaricata* refers to the much branched inflorescence of which the branches spread widely.

**5. *Bromheadia finlaysoniana* (Lindley) Miq. — Fig. 34; Plate 4b**

*Bromheadia finlaysoniana* (Lindley) Miq., Fl. Ind. Bat. 3 (1859) 709; *ibid.*, Suppl. 1 (1861) 275; Rchb. f. in Walp., Ann. 6 (1863) 630, (1864) 882; Rolfe, Orch. Rev. 16 (1908) 200; Ames in Merr., Bibl.

- Enum. Born. Pl. (1921) 180; Merr., Philipp. J. Sc. 29 (1926) 359; Holttum, Mal. Nat. J. 1 (1940) 108; Gard. Bull. Sing. 12 (1949) 295; Latif, Bunga Anggerik (1953) 71; Seidenf. & Smitinand, Orch. Thailand (1960) 325; Holttum, Orch. Malaya, ed. 3 (1964) 539, f. 160; Backer & Bakh. f., Fl. Java 3 (1968) 324; Phamh., Ill. Fl. S. Vietnam 2 (1972) 1083, f. 5217; Yong, Nat. Mal. 3 (2) (1978) 29; Seidenf., Opera Bot. 72 (1983) 13, f. 2, f. 4; Valmayor, Orchid. Philipp. 1 (1984) 101; Averyanov, Prelim. List Vietn. Orch. (1994) 293; Seidenf., Opera Bot. 114 (1992) 322, f. 215; Wood, Beaman & Beaman, Pl. Mt. Kinabalu 2, Orchids (1993) 52, 99; Averyanov, Ident. Guide Vietn. Orch. (1994) 293. — *Grammatophyllum ?finlaysonianum* Lindley, Gen. & Sp. Orch. (1833) 173. — *Bromheadia palustris* Lindley, Bot. Reg. 27 (1841) 89, misc. 184; Hook. f., Bot. Mag. 96 (1843) t. 4001; Lindley, Bot. Reg. 30 (1844) t. 18; Wight, Icon. Pl. Ind. Or., Fig. Pl. 5 (1852) pl. 1740; Ridley, J. Linn. Soc. Bot. 28 (1891) 336, t. 42; J. Str. Br. Roy. As. Soc. 26 (1894) 32; J. Linn. Soc. Bot. 32 (1896) 339; J. Str. Br. Roy. As. Soc. 33 (1900) 161; Mat. Fl. Mal. Pen. 1 (1907) 144; J. Str. Br. Roy. As. Soc. 59 (1911) 196; Constantin, Atl. Orch. Cult. (1913) pl. 16; Schltr., Die Orch. (1914) 292; Ridley, Fl. Mal. Pen. 4 (1924) 151; Burkill & M. R. Hend., Gard. Bull. Str. Settl. 3 (1925) 439; Gagnep. in Lecomte, Fl. Gén. Indo-Chine 6 (1933) 431, f. 39 3-8; Coomans de Ruiter, Borneo Orch. (1935) 22. — Type: *Finlayson*, Wallich Cat. 7361 B (hololecto K-W), Wallich Cat. 7361 A (syn K).
- Coelogyne caulescens* Griff., Not. 3 (1851) 282, p.p. — Type: *Griffith s.n.* (holo, K); only the inflorescence.
- Bromheadia sylvestris* Ridley, J. Linn. Soc. Bot. 28 (1891) 337. — *Bromheadia palustris* var. *sylvestris* (Ridley) Holttum, Orch. Malaya, ed. 3 (1964) 543. — Type: *Ridley s.n.* (syn AMES, BM), Kranji.
- Bromheadia palustris* var. *papuana* J.J. Smith, Nova Guinea 8 (1909) 26, t. 9; *ibid.* 12 (1914) 215. — Type: *Versteeg 1296* (holo BO, iso AMES, BO, CAL, K, L, SING).
- Bromheadia pulchra* Schltr. in Fedde, Rep., Beih. 1 (1914) 367; *ibid.* 21 (1923) t. 493; van Bodegom, Orch. West Nieuw Guinea (1973) 169; Lavarack, Clemens & Howcroft, Orchadian 7 (1984) 291. — Types: *Schlechter 19288* (holo B, lost; iso AMES, BO, E, GRAY, K); *Schlechter 19212*.
- Bromheadia venusta* Hunt, Austr. Orch. Rev. 18 (1953) 101; Lavarack, Clemens & Howcroft, Orchadian 7 (1984) 291. — Type: *Barnes 1949* (holo BRI); type specimen meagre, without flowers.

Terrestrial plants, slender to very stout, to 1.5 m high. *Stem* almost terete, 3–12 mm diam.; internodes 3–8.5 cm long; flowering stems on the basal part with 3–5 bladeless sheaths, central part with 9–18 leaves, upper part for 6–45 cm long with 3–8 bladeless sheaths. *Leaf* sheaths to 3–5 cm long, mostly not overlapping, nerved, opposite the blade with a shallow 1–3 mm deep U-shaped incision; mucro in the incision short, stiff, c. 1 mm long. Leaf blade ovate to elliptic, 6–21 by 1.2–4 cm, index 4–10; base for 1–3 mm petiole-like; margins not parallel, regularly curved; top bilobed, lobes slightly to very unequal, sometimes with a short mucro. *Raceme* terminal, to 17 cm long, sometimes branched; internodes 3–4 mm long. *Bracts* triangular to quadrangular in lateral outline; 4–6 nerved; midrib regularly curved, 5–6 mm long, top margin curved, 5–6 mm long; remains of petiole often present in the bract. *Flowers* up to 75 per inflorescence. *Pedicel* and *ovary* 5–20 mm long. *Sepals* ovate to elliptic to (linear-)lanceolate, 26–50 by 5.5–11 mm, index 3.2–6.7; often the lateral ones keeled, sometimes also the median one. *Petals* ovate to ovate-oblong, 26–45 by 6–13 mm, index 2–5. *Lip* when flattened elliptic in outline, 18–32 by 7–17 mm. *Hypochilium* when flattened triangular or elliptic in outline, median somewhat swollen and there with fine papillose warts; lateral lobes large, far projecting in front, mostly pointing forward, sometimes outward, projecting part rounded, 3–6 mm long, top sometimes ciliolate. *Epichilium* subquadrate to elliptic, 8–11 by 5–9 mm, centrally swollen and there with irregular warts, sometimes with cross-bands; base not constricted; margins undulate, sometimes ciliolate; top usually acuminate. *Column* about lanceolate when flattened, 13–20 by 1.5–2.5 mm, sometimes dorsally with a strong median rib; seams 0.8–1.5 mm wide, to the top narrowing; top hood-like, 1.5–2 mm high; rostellum triangular, about as

big as the anther. *Anther* elliptic in outline, 1.8–2.4 by 1.2–1.5 mm; median crest almost not raised to 0.2 mm high; pollinia ellipsoid to ovoid, c. 1.3 by 0.8 mm long, with a longitudinal groove. *Fruit* 4–7 by 0.5–0.8 cm, perianth persistent on top.

Colours — Sepals and petals white to cream coloured, lip white to cream coloured with lateral lobes purple veined and epichilium with a central yellow patch; sometimes flowers yellow or orange, or sepals purple outside.

Distribution — Burma, 1 collection (K, NY). Thailand (Eastern, Southeastern and Peninsular), 20 coll. (BK, C, K, L). Cambodia, 4 coll. (K, P). Laos, 1 coll. (P). Vietnam, 4 coll. (K, P). Anambas Islands, 1 coll. (BO, K, NY, SING). Malay Peninsula (Kedah, Kelantan, Terengganu, Perak, Pahang, Selangor, Negeri Sembilan, Johore, Malacca), 40 coll. (AMES, BM, BO, C, E, G, K, KLU, L, P, SING). Singapore, 7 coll. (C, K, L, P, SING). Sumatra (Aceh, Sumatera Utara, Riau, Sumatera Barat, Mentawai Isl., Sumatera Selatan, Bangka, Biliton), 36 coll. (AMES, BM, BO, E, K, L, NY, P, PNH, SING). Borneo: Kalimantan (Kalimantan Timur, Kalimantan Barat, Kalimantan Selatan); Sabah (Bahagian Pantai Barat, Pedalaman, Sandakan); Sarawak (Bahagian Kuching, Miri, Limbang); Brunei (Belait and Tutong Distr.), 78 coll. (AMES, BM, BO, BRU, E, G, K, KYO, L, LAE, MO, NY, P, PNH, SAN, SAR, SING). ?Philippines [recorded by Valmayor, 1984, but without localities. Ames, *Orch.* 5 (1915) 6 stated that he had not seen material from the Philippines; Vidal, *Phan. Cuming. Philipp.* (1885) 88 excluded *Cuming 2054* as being collected in Singapore instead of in the Philippines]. Moluccas (Aru Isl.), 1 coll. (BO, L, PNH, SING). New Guinea: Irian Jaya (Pegunungan Jayawijaya, Yapen Waropen, Teluk Cenderawasih, Jayapura, Fakfak); Papua New Guinea (Rambuso), 25 coll. (AMES, BO, CANB, G, K, L, LAE, MAN, US). Australia: Queensland (Cape York Peninsula, Cook District), 1 coll. (L); Dockrill, *Austr. Indig. Orch.* (1969) 644, mentions a few records from the northern half of Cape York Peninsula.

Habitat & Ecology — Terrestrial plants in open places in the forest, along roadsides, on open ground, in swamps, on peaty soil or white sands. Ridley (1891) pointed to a preference for hot sunny places, and recorded that the flowers are sweetly scented, opening in the early morning and closing very soon. Rolfe (1908) stated that the flowers are pollinated by a species of carpenter bee (*Xylocopa*). Holttum (1949) recorded that flowering is irregular and gregarious, although all buds appear to be developing continuously. Altitude up to 1100 m. Fl. throughout the year.

Vernacular names — Sumatra: loppar tano, pagar-pagar, boeloe apit, boeloe soma, attor-tor, doehoet si holos, doehoet gong-gong, doehoet si sarsar, doehoet ramba poso, padang-padang, si bansari, saga-saga solpa, daoersa-daoersa. Borneo: similan, serungi. New Guinea: ipoenoemoe (Esnania) poko suraman (Ridley, 1907, 1924).

Notes — 1. *Bromheadia sylvestris* from Singapore was published in 1891 by Ridley who found it different from *B. finlaysoniana* in being weak and slender and in the orange-yellow flower. Holttum (1964) considered it a variety of *B. finlaysoniana*. Examination of the type specimen showed no significant difference.

2. *Bromheadia palustris* var. *papuana* from New Guinea was described by J.J. Smith in 1909. Schlechter (1914) considered it probably synonymous with his *B. pulchra*.

3. According to Lavarack (1984) *B. pulchra* is distinct from *B. finlaysoniana* by the shorter and broader floral segments of *B. pulchra*, by the longer and more slender column of *B. finlaysoniana*, by the different calli on the lip, by the degree of opening, and by the colour. The indices of the petal, lateral sepal and lip of *B. pulchra* calculated from the draw-

ing in his article (Lavarack, 1984) are resp. 1.7, 2.9, 1.2. The indices calculated from isotypes from *B. pulchra* from Kew, Bogor and Harvard are resp. 2–2.5, 3.4–4, 1.6–2.1. The indices for *B. finlaysoniana* in his article are resp. 2.2, 6.0 and 1.4. The morphology of the calli on the lip of *B. pulchra* falls within the variability of the calli of *B. finlaysoniana*. As a result of the comparisons of *B. pulchra* and *B. finlaysoniana* the conclusion is here drawn that *B. pulchra* and *B. finlaysoniana* are conspecific.

4. Lavarack (1984) considered *B. venusta* conspecific with *B. pulchra*. The latter is here in note 3 demonstrated to fall within the variability of *B. finlaysoniana*. On these grounds also *B. venusta* is considered conspecific with *B. finlaysoniana*.

5. The peduncle is bitter and is chewed for curing cough (Sarawak, collector's notes).

## 6. *Bromheadia pendek* de Vogel, *spec. nov.* — Fig. 35; Plate 4c

*Bromheadia finlaysoniana* similis, multo minore in partibus vegetativis floralibusque, sepalis petalisque gracilioribus, labelli lobi medialis callo minus ruminato, absentia stigmati laciniis stipitem tegentibus, stipite viscidio constanti ex crista tumida proviso differt. — Typus: Leiden, cult. (Wong) 27682.

Terrestrial plants, rather slender, to 21 cm high. *Stem* somewhat flattened, to c. 3 mm diam.; internodes 10–15 mm long; flowering stems on the basal part with c. 4 bladeless sheaths, central part with c. 6 leaves, upper part for c. 9 cm long with c. 8 bladeless sheaths. *Leaf* sheaths to 10–15 mm long, overlapping, nerved, opposite the blade with a distinct, 4–7 mm deep U-shaped incision; mucro in the incision short, stiff, c. 1 mm long. Leaf blade elliptic, 1.5–8.5 by 0.7–2.2 cm, index 1–3.9; base for 1–2 mm petiole-like; margins not parallel, regularly curved; top bilobed, lobes equal to very slightly unequal, with a short mucro. *Raceme* terminal, to c. 1 cm long (but continuing to grow), not branched; internodes c. 4 mm long. *Bracts* triangular in lateral outline; 1-nerved, midrib regularly curved, c. 3 mm long, top margin curved, c. 4 mm long. *Flowers*: number per inflorescence not known. *Pedicel* and *ovary* c. 4 mm long. *Sepals* long elliptic, c. 15 by 4 mm, index c. 3.7; top more or less obtuse; nerves 7; not keeled. *Petals* long elliptic, c. 14 by 4 mm, index c. 3.5; top more or less obtuse; nerves 3, the lateral ones with several branches from the base. *Lip* when flattened about elliptic in outline, c. 13 by 6 mm. *Hypochilium* when flattened obovate-lanceolate in outline, median somewhat swollen and there with fine scattered hairs, c. 2 mm from the tips of the lateral lobes the swollen part truncate and abruptly lowering into a semi-orbicular smooth depression; lateral lobes rather far projecting in front, pointing forward, projecting part rounded, c. 1.5 mm long. *Epichilium* orbicular-subquadrate, c. 4.3 by 4 mm, centrally swollen, swollen part obcordate and ruminant with irregular cross-grooves; base slightly constricted; margins undulate; top slightly acuminate. *Column* c. 11 by 2.5 mm; seams c. 1 mm wide, close to the top narrowing; top hood-like, c. 2 mm high; rostellum semi-orbicular, about as big as the anther. *Anther* about orbicular in outline, c. 1.2 by 1.3 mm; pollinia about ellipsoid, c. 0.8 by 0.4 mm, with a longitudinal groove. *Fruit* not seen.

Collector's notes — Sepals and petals pale yellowish cream. Lip pale yellowish cream, front callus slightly more yellow, basal half of basal callus tinged pale violet, median stripe and margins darker so. Column pale yellowish cream, median in front in basal half with faint, small pale violet spots. Anther, viscidium and stipe creamy white. Pedicel and ovary pale green.

Distribution — Borneo: Brunei (Belait District). Only known from the type.

Habitat & Ecology — Terrestrial plants in mixed Dipterocarp forest to 40 m high, with rather little undergrowth, on hill ridge. Terrain sloping to very steep, soil rather loamy. Altitude c. 150 m. Fl. observed in Feb.–April, but inflorescence continuing growth.

Notes — 1. The epithet *pendek* refers to the size of this species, which is the smallest in sect. *Bromheadia*. Pendek is the Malay word for short.

2. This species resembles *B. finlaysoniana* in habit, but is very much smaller in its dimensions. It is very peculiar in the total absence of the rostellar flaps. This absence could be confirmed in three fresh flowers when the plant flowered in the Hortus Botanicus in Leiden. In all other species of *Bromheadia* these flaps are well developed, and this feature is a key character to distinguish the genus from all other Orchidaceae except from *Claderia*. The character state 'absence of rostellar flaps' either constitutes the plesiomorph condition of the rostellum and then this species could be considered the sister group of the genus *Bromheadia*, or their absence is the result of a secondary reduction, and then this character state represents an autapomorphic condition.

## 7. *Bromheadia rupestris* Ridley — Fig. 36

*Bromheadia rupestris* Ridley, J. Linn. Soc. Bot. 32 (1896) 340; J. Str. Br. Roy. As. Soc. 35 (1901) 23; Mat. Fl. Mal. Pen. 1 (1907) 144; Fl. Mal. Pen. 4 (1924) 151; Holttum, Orch. Malaya, ed. 3 (1964) 539, f. 160. — Type: not designated, two localities given: Malay Peninsula, Kedah Peak, Gunung Mering (Ophir range). No collections that could have been used by Ridley for his description in 1896 were located in the holdings of SING or BM.

*Bromheadia spec. nov.* (*B. pandurata* Scheindelen, ined.), Seidenf. & Wood, Orch. Penins. Malaysia & Sing. (1992) 527. — Specimen: Maingay 2671 (K)

Epiphytes or terrestrial plants, to 1.50 m high. *Stem* flattened, 6–9 mm wide; internodes to 2.5 cm long; flowering stems with more than 25–35 leaves (basal part not seen), blades of basal leaves dropping soon. *Leaf* sheath 1–2.5 cm long, overlapping the subsequent sheath, finely rugose, opposite the blade without or with a shallow incision, mucro absent. *Leaf* blade linear, 7.5–12 by 1.2–1.7 cm, index 5–9, fleshy or coriaceous; base broadly connected, hardly narrowed, for 2–5 mm above the articulation petiole-like, almost directly bending from the axis or the basal 8–10 mm erect, then bending from the axis; margins almost parallel; top bilobed, lobes 0.5–3 mm long, unequal, difference 1–2 mm. *Racemes* (sub)sessile, all lateral, on the basal part of the stem, to 2 cm long and 4 mm wide, sometimes branched; scape absent; internodes 0.9–1 mm long. *Bracts* about triangular, top part along the midrib flat and crest-like; not nerved; midrib curved, 2.5–3 mm long, top margin straight to slightly incurvate, 3–4 mm long; top bilobed, rounded, clasping the bract above. *Flowers* up to 40 per inflorescence. *Pedicel* and *ovary* 10–15 mm long. *Sepals* long elliptic, 23–27 by 5–6 mm, index 4.3–4.6. *Petals* long elliptic to ovate-oblong, 22–25 by 5 mm, index c. 5. *Lip* when flattened elliptic to obovate-oblong in outline, 20–22 by 7–8.5 mm. *Hypochilium* when flattened elliptic, median zone swollen and there with irregular low warts; lateral lobes small, projecting front part rounded, 1 mm long. *Epichilium* top part strongly folded double, from above as well as in lateral outline triangular, 8 mm long, 4–5 mm wide at the base, 3.5–4 mm high and for about one third connate in the middle, fleshy; base not constricted; margins on the top part connate; top apiculate. *Column* 14 by 3.5 mm, seams widening to the top, 1.5 mm wide, at the base without an auricle; top hood-like, 1 mm high; rostellum broadly triangular, about as big as the anther. *Anther*

obovoid in outline, 2.5 by 1.5 mm, with a 0.4–0.5 mm high median crest from the base to half way the anther; pollinia ovoid, c. 1.5 by 0.8 mm. *Fruit* not seen.

Colours — Sepals and petals cream or pale yellow, sometimes tinged pink or red on the back. Lip white, lateral lobes veined red or purple, epichilium yellow and red or purple dotted. Column yellow, the base pink. (Ridley, 1896, 1924; Holttum, 1964).

Distribution — Malay Peninsula (Johore, Kedah, Pahang, Malacca, Tioman Isl.), 7 collections (K, SING).

Habitat & Ecology — Terrestrial on rocks and epiphytic on trees. Altitude 800–1300 m. Fl. July–Sept., Nov.

Notes — 1. The epithet *rupestris* means inhabitant of rocks, and refers to the habitat preference of the type collection.

2. All flowers available for study are in a badly preserved state and better material is urgently needed, especially flowers preserved in spirit.

3. The specimen *Maingay 2671* (K) was considered to represent an undescribed species by Van Scheindelen, but it appears to be a mixtum. Based on information from the present monographers of the genus it was recorded as a new species in Seidenf. & Wood, *Orch. Penins. Malaysia & Sing.* (1992) 527, with pre-publication of the intended name *Bromheadia pandurata*. The specimen consists of a stem with leaves and inflorescences, pencil drawings of the dissected flower parts on the herbarium sheet, and several flower buds and parts of a dissected flower. The flower parts and the buds are all in a very badly preserved state, the latter so glued together that they were near impossible to open without severe damage of the parts. Closer examination of the characters of the torn flower parts and the drawings revealed characters not present in *Bromheadia* species, these may belong to *Arundina graminifolia*. The flower buds belong without doubt to *Bromheadia rupestris*.

## BROMHEADIA SECTION APORODES

(J. Kruizinga & E.F. de Vogel)

Most species of *Bromheadia* sect. *Aporodes* are quite easy to distinguish vegetatively, in particular by the shape, length and width of stems and leaves. In addition the length of the terminal stem internode is very useful, this either ranging from shorter to slightly longer than the lower internodes, or being much longer. Of lesser overall importance for diagnostic purposes are characters found in the bracts and the flowers. The roots supply no reliable characters. Possibly some additional characters are present in the fruit, but of most species fruits are not known.

### Section Aporodes

*Bromheadia* sect. *Aporodes* Schltr. in Fedde, Rep., Beih. 1 (1914) 366; Senghas in Schltr., *Orch.*, ed. 3, I/B (1990) 1456, f. 1321, 1322. — Type species: *Bromheadia aporoides* Rchb. f.

Plants tufted, compact to very slender. *Rhizome* short, much branched. Stems short to long, terete or laterally compressed; terminal internode shorter to much longer than lower internodes. *Leaves* stiff to rather flexible, rather soft to hard coriaceous, articulation more or less parallel to the stem; sheaths imbricate, or in some species several internodes with exposed upper part; blade laterally compressed or terete, obliquely triangular to linear, straight

to curved, base not narrowed; top acute, not apiculate; nerves inconspicuous, 7–33 per side. *Raceme* short, terminal, one- or few-flowered, unbranched or with up to 9 branches, completely covered by or extending from the sterile bracts; peduncle very short. *Bracts* many-nerved, in lateral view more or less triangular in outline; sterile bracts 1–6 at the base of the raceme, membranous, sometimes disintegrating into fibres, with or without a keel on the midrib; floral bracts not disintegrating into fibres, midrib keeled, hard and thick, but in *B. scirpoidea* and *B. gracilis* rather membranous. *Pedicel* very short; *ovary* twisted, rather distinctly ribbed. *Flowers* opening widely (in *B. tenuis* sometimes the flowers stay closed). *Sepals* oblong to linear-lanceolate, with broadly sessile base and acute top; nerves 7–9, midrib not keeled. *Petals* oblong to lanceolate; base narrowed; top acute. *Lip* rather narrowly attached, 3-lobed, when flattened in outline elliptic. *Hypochilium* when flattened in outline triangular to elliptic, glabrous or with scattered hairs; lateral lobes small to distinct, in front not to distinctly projecting; callus raising from near the base to about halfway the hypochilium, ending near its top and there swollen, in outline ligulate, minutely papillose to densely hairy. *Epichilium* broadly attached, in outline ligulate or semi-elliptic to obovate, glabrous or with scattered hairs; margin irregular; top truncate to slightly emarginate, its tip not to distinctly apiculate; callus high, broad, distinctly swollen, ruminant and brain-shaped to very low, narrow and ligulate, either glabrous, minutely papillose or with scattered hairs. *Column* long spatulate; seams on the stalk widening below the stigma or in some species drawn out into broadly triangular wings, at the base each with or without a semi-orbicular auricle; top hood-like, covering at least the base of the back of the anther, obtuse to distinctly emarginate. *Stigma* transversely elliptic, largely covered by the rostellum; rostellum large, semi-dome-shaped, covering most of the stigma, consisting of three parts; central part easily detached as the viscidium; the lateral parts almost triangular with rounded top to about semi-orbicular, partly covering the middle part. *Anther* broadly attached to the column, not detachable, in outline transversely elliptic; top truncate. Pollinia ovoid, on the side attached to the viscidium, the depression turned to the middle of the viscidium. Viscidium half dome-shaped, open at the back; top acute or rounded, base exsculptate. *Fruit* body ellipsoid; perianth persistent on top; valvae long elliptic, jugae band-like, both without keels or ridges.

Colours — Flowers white, green, yellow to purple.

Distribution — Sri Lanka, Laos, Burma and Thailand, through Malaysia, Sumatra, Borneo (most species), Celebes, New Guinea and the Philippines (Mindanao).

Habitat & Ecology — Epiphytes, or *B. tenuis* rarely terrestrial, in lowland to montane forests. Growing low on tree-trunks and on major branches high up in trees and on lianas, in rather dense shade to very exposed. Altitude up to 2000 m.

Notes — 1. Specimens recorded from Celebes and New Guinea and formerly preserved in B were not available for this study, they were probably destroyed during the second world war. They may represent species not described in this revision.

2. Some drawings are from fresh or alcohol-preserved material, others are from dried specimens. The size and shape of the dried flowers and flower parts are not always reliable.

3. The leaves at the very top and base of the stem vary very much in size, and are often much smaller than typical for the species. Those in the middle portion of the stem vary much less in size, and determine the habit of the plant. Only the measurements of these latter leaves and their indexes are given in the descriptions.

KEY TO THE SPECIES OF SECTION APORODES

- 1a. Terminal internode of the stem distinctly longer than lower internodes . . . . . 2
- b. Terminal internode of the stem shorter to slightly longer than the lower internodes 8
- 2a. Stem 3–6 mm wide in the widest part. Widest leaves 2.7–5.5 mm wide . . . . . 3
- b. Stem less than 3 mm wide in the widest part. Widest leaves less than 2.1 mm wide 4
- 3a. Stem less than 4.5 mm wide in the widest part. Widest leaves less than 4 mm wide.  
Auricles at the base of the column absent . . . . . **13. B. ensifolia**
- b. Stem 5.2–6 mm wide in the widest part. Widest leaves 4.6–5.5 mm wide. Column at  
the base with two semi-orbicular auricles 0.6–0.8 by 1–1.5 mm . . . . .  
. . . . . **16. B. grandiflora**
- 4a. Stem internodes all completely covered by leaf sheaths. Terminal internode more than  
twice as long as lower internodes . . . . . 5
- b. Stem internodes not all covered by leaf sheaths, in the lower part of the stem some with  
exposed upper part. Terminal internode less than twice as long as lower internodes 7
- 5a. Leaves 2 or 3 on each side of the stem, often strongly recurved. Sterile bracts in the  
lower portion of the inflorescence 3–6 mm long . . . . . **23. B. scirpoidea**
- b. Leaves 3–6 on each side of the stem, hardly recurved. Sterile bracts in the lower por-  
tion of the inflorescence 5–11 mm long . . . . . 6
- 6a. Stem less than 8 cm long. Internodes 4–6.5 mm long. Sterile bracts 5–8 mm long . .  
. . . . . **17. B. humilis**
- b. Stem more than 13 cm long. Internodes 7–42 mm long. Sterile bracts 8–11 mm long  
. . . . . **14. B. gracilis**
- 7a. Leaf blades only slightly laterally flattened, almost terete, stiff, hardly flexible . . . . .  
. . . . . **25. B. tenuis**
- b. Leaf blades distinctly laterally flattened, less stiff, rather flexible . . . **15. B. graminea**
- 8a. Longest leaves less than 2.7 cm long. Leaf obliquely triangular to linear-lanceolate, in-  
dex 2.8–7.7 . . . . . 9
- b. Longest leaves 3.2–57 cm long. Leaf linear-lanceolate to linear, index 9.6–230 . . 10
- 9a. Column at the base with two semi-orbicular auricles 0.1–0.8 by 0.8–1 mm. Callus on  
epichilium distinctly raised. — Longest internode on each stem 2–5.8 mm long. Leaves  
5 to many on each side of the stem . . . . . **9. B. brevifolia**
- b. Auricles at the base of the column absent or hardly visible. Callus on epichilium hardly  
raised. — Longest internode of each stem 5–9 mm long. No more than 7 leaves on  
each side of the stem . . . . . **19. B. lohaniensis**
- 10a. Longest leaves 14.5–57 cm long, index 50–230 . . . . . 11
- b. Leaves all less than 15 cm long, index less than 53 . . . . . 13
- 11a. Stem 2–3 mm wide in the widest part. Widest leaves 1.8–2.6 mm wide . . . . .  
. . . . . **15. B. graminea**
- b. Stem 3–10 mm wide in the widest part. Widest leaves 2.4–8.5 mm wide . . . . . 12
- 12a. Longest leaves 31.5–57 cm by 5–8 mm. Raceme up to 67 mm long **22. B. robusta**
- b. Longest leaves less than 30.5 cm long, up to 3.2 mm wide. Raceme up to 15 mm  
long . . . . . **20. B. longifolia**
- 13a. Widest part of the stem more than 9 mm wide. Leaves 8–12.5 mm wide . . . . .  
. . . . . **18. B. latifolia**
- b. Widest part of the stem less than 7.5 mm wide. Leaves less than 7 mm wide . . . . 14

- 14a. Widest leaves per stem less than 3.6 mm wide. Stem less than 3.7 mm wide in the widest part ..... 15
- b. Widest leaves per stem 3.5–7 mm wide. Stem 3.8–7.5 mm wide in the widest part ..... 16
- 15a. Callus on epichilium narrow, ligulate, 3.5–5.6 by 1–2 mm. Callus on the hypochilium in front distinctly elevated. Seams on the column stalk below the stigma drawn out into broadly triangular wings 1–1.7 mm high. — Sepals and petals pale greenish to golden yellow. Lateral lobes of the lip without purplish red veins, epichilium purple below the callus ..... **10. B. cecieliae**
- b. Callus on the epichilium ovate, c. 3 by 2.5 mm. Callus on the hypochilium in front not elevated, about equally high over its entire length. Seams on the column stalk below the stigma not drawn out into triangular wings. — Sepals and petals pure white. Lateral lobes of the lip with fine purplish red veins, epichilium without a purple blotch ..... **24. B. srilankensis**
- 16a. Stem 3–12 cm long. — Longest internodes 3.5–11 mm long ..... 17
- b. Stem 14–48 cm long. — Longest internodes 16–33 mm long ..... 18
- 17a. Raceme distinctly extending from the sterile bracts, which not or rarely disintegrate into fibres. Sidelobes of lip projecting in front for 0.7–3.2 mm. Hypochilium when flattened in outline elliptic. Callus on epichilium much wider than callus on hypochilium. Viscidium wider than high ..... **8. B. aporoides**
- b. Raceme completely covered by sterile bracts or by the fibres in which they often disintegrate. Sidelobes of lip not to only slightly projecting in front for up to 0.6 mm. Hypochilium when flattened in outline about triangular. Callus on epichilium not wider than callus on hypochilium. Viscidium higher than wide .... **26. B. truncata**
- 18a. Leaves in a less acute angle to the stem, total width over both stem and leaves more than 7 cm. Upper leaves 6–10.5 cm overtopping the raceme ..... **12. B. devogelii**
- b. Leaves in a very acute angle to the stem, total width over both stem and leaves not more than 5 cm. Upper leaves not to up to 5 cm overtopping the raceme ..... 19
- 19a. Stem straight, up to 21 cm long. Leaves almost straight, less than 6.5 cm long .... **21. B. pungens**
- b. Stem slightly curved, 30–48 cm long. Leaves slightly curved, on one side towards the stem, on the other side away from the stem. Longest leaves 9.5–12.5 cm long .. **11. B. coomansii**

**8. Bromheadia aporoides** Rchb. f. — Fig. 37

*Bromheadia aporoides* Rchb. f., *Otia Bot. Hamb.* (1874) 44; Hook. f., *Fl. Brit. India* 6 (1890) 20; Ridley, *J. Linn. Soc. Bot.* 28 (1891) 338; Grant, *Orch. Burma* (1895) 234; Ridley, *J. Linn. Soc. Bot.* 32 (1896) 340; *J. Bot.* 36 (1898) 214; *J. Str. Br. Roy. As. Soc.* 33 (1900) 161; *ibid.* 35 (1901) 24; *Mat. Fl. Mal. Pen.* 1 (1907) 145; *Fl. Mal. Pen.* 4 (1924) 151; J.J. Smith in Fedde, *Rep.* 32 (1933) 340; M.R. Hend., *Mal. Wild Flow. Monocot.* (1954) 106, f. 60a; Seidenf. & Smitinand, *Orch. Thailand* 2 (1960) 325, f. 247; Holttum, *Orch. Malaya*, ed. 3 (1968) 545; Kerr, *Nat. Hist. Bull. Siam Soc.* 23 (1969) 197; Seidenf., *Bull. Mus. Nat. Hist. sér. 3, Bot.* 5 (1972) 108; Kerr, *Amer. Orch. Soc. Bull.* 41 (1972) 208; Seidenf., *Contr. Rev. Orch. Fl. Cambodia Laos Vietnam* (1975) 12; *Opera Bot.* 72 (1983) 13, f. 4, col. pl. 1a; Senghas in Schltr., *Orch.*, ed. 3, I/B (1990) 1457, f. 1321, 1322; Seidenf., *Opera Bot.* 114 (1992) 322, f. 215; Seidenf. & Wood, *Orch. Penins. Malaysia & Sing.* (1992) 529, f. 238, pl. 37a. — Type: *Parish 346* (holo W, photocopy seen).

Compact, erect epiphytes. *Roots* up to 7 cm by 1–2.5 mm. Stem entirely covered by leaf sheaths, 3–9 cm by 3.7–6 mm, laterally compressed; basal part with 2–4 bladeless sheaths; internodes 3–9.5 mm, terminal internode not much longer. *Leaves* stiff, hard-coriaceous, the upper 1 or 2 around the inflorescence short; leaf blade linear-lanceolate to linear, sabre-shaped, laterally flattened, slightly curved, 24–66 by 3.8–6.5 mm, index 5.3–16.5; nerves 18–25 per side. *Racemes* unbranched or with up to 5 branches, up to 17 mm long, extending from the sterile bracts; sterile bracts 3 or 4 at the base of the raceme, long persistent, not disintegrating into fibres, midrib keeled, 3–8 by 4–6 mm; floral bracts hard and thick, 2.5–3 by 2.2–4 mm, top part along the midrib keeled. *Flowers* up to 30 per inflorescence. Pedicel and ovary 8–15 mm long. *Median sepal* oblong to lanceolate, 14.5–26 by 4–6.4 mm, index 2.9–4.6; nerves 7–9. *Lateral sepals* oblong to lanceolate, 14.5–23 by 5.5–7 mm, index 2.6–4.2; nerves 7–9. *Petals* oblong to lanceolate, 13–23 by 5–7.5, index 2.5–3.8 mm; nerves 7–9, at the base 3, the lateral ones branching. *Lip* 12–19 by 7–11.6 mm. *Hypochilium* when flattened about elliptic in outline, with scattered hairs, 8–14 by 7–11.6 mm; lateral lobes distinct, in front triangular, distinctly projecting for 0.7–3.2 mm, 1.8–4 by 7–13.5 mm; callus with scattered hairs. *Epichilium* obovate, glabrous, 4.5–8 by 3.6–7.3 mm; top not emarginate, its tip distinctly apiculate; callus high, broad, distinctly swollen, ruminant, brain-shaped, minutely papillose, 4–8 by 2–4 mm. *Column* 9.5–15.5 by 2–3.5 mm, at the base without auricles; seams on the stalk 0.3–1 mm wide, below the stigma wider to 0.7–1.7 mm, but not drawn out into broadly triangular wings; top covering the basal part of the back of the anther, emarginate to truncate. *Stigma* 1.2–3 by 2–3.3 mm; rostellum 1–1.6 by 2–3.3 mm. *Anther* 1.1–1.5 by 1.7–2.5 mm. Pollinia 1–1.7 by 0.6 mm. Viscidium 1.1–1.5 by 1.6–2.4 mm; top acute. *Fruit* 22–28 by 3.8–4 mm.

Colours — Sepals and petals white to yellowish. Lip white to pale yellowish; hypochilium with light green to yellowish callus and a purple area on either side of the midlobe, side-lobes with rose-pink to purple veins; epichilium with bright yellow callus. Column light green with rose-pink margins.

Distribution — Laos (Vientiane), 2 collections (coll. Seidenfaden, P). Burma (Tenasserim), 1 coll. (W). Thailand (North, North-East, Central), 13 coll. (coll. Seidenfaden, K). Singapore (K, not seen, on authority of Seidenfaden).

Habitat & Ecology — Epiphytes in hill Dipterocarp to lower montane forests. Altitude 330–1600 m. Fl. records in April–May and Oct.

Notes — 1. See note 1 under *B. truncata* for a discussion on the interpretation of sterile specimens.

2. The epithet *aporoides* refers to the vegetative shape of this species which resembles that of species of *Dendrobium* sect. *Aporum*.

## 9. *Bromheadia brevifolia* Ridley — Fig. 38; Plate 4d

*Bromheadia brevifolia* Ridley, J. Linn. Soc. Bot. 32 (1896) 340; Mat. Fl. Mal. Pen. 1 (1907) 145; Burkill & M.R. Hend., Gard. Bull. Str. Settl. 3 (1923) 439; Ridley, Fl. Mal. Pen. 4 (1924) 151; Holttum, Orch. Malaya, ed. 3 (1968) 545; Seidenf. & Wood, Orch. Penins. Malaysia & Sing. (1992) 527, f. 238; Segerbäck, Orch. Mal. (1992) 121, f. 176, 177; Wood, Beaman & Beaman, Pl. Mt. Kinabalu 2, Orchids (1993) 99. — Syntypes: *Haviland s.n.*, 19-12-1892 (lecto SING, here chosen); *Ridley s.n.*, Perak, Hermitage hill, not seen (see note 1).

*Bromheadia* aff. *aporoides* Rchb. f.; Wood, Beaman & Beaman, Pl. Mt. Kinabalu 2, Orchids (1993) 98.

Compact epiphytes. *Roots* to 8 cm by 1–2 mm. Stem entirely covered by leaf sheaths, 3.7–26 cm by 2.3–4.5 mm, laterally compressed; basal part with 2–4 bladeless sheaths; internodes 1.5–5.8 mm, terminal internode not much longer. *Leaves* stiff, hard-coriaceous, the upper 1 or 2 around the inflorescence short; leaf blade obliquely triangular to linear-lanceolate, laterally flattened, straight, 5–27 by 2.5–3.9 mm, index 2.7–7.7; nerves 11–16 per side. *Racemes* unbranched or with up to 3 branches, up to 11 mm long, completely covered by sterile bracts or by its fibres; sterile bracts 3–5 at the base of the raceme, often disintegrated into fibres, midrib not keeled, 5–13 by 3–4 mm; floral bracts hard and thick, 2.5–3.5 by 3–3.5 mm, top part along the midrib keeled. *Flowers* up to 12 per inflorescence. *Pedicel* and *ovary* 2–6 mm long. *Median sepal* oblong to lanceolate, 11–13.7 by 2.3–4.5 mm, index 2.9–5.7; nerves 7. *Lateral sepals* lanceolate, 9.8–13.2 by 2.3–4.2 mm, index 3–5.7; nerves 7. *Petals* oblong to lanceolate, 8.7–12.3 by 2.5–5, index 2.4–4.8 mm; nerves 9, at the base 3, the lateral ones branching. *Lip* 9.7–13.1 by 7–9.8 mm. *Hypochilium* when flattened about triangular in outline, with few scattered hairs, 4.5–7.6 by 7–9.8 mm; lateral lobes rather small triangular, with more or less rounded top, almost not projecting in front, 0.8–2 by 1.5–3.3 mm; callus with few scattered hairs. *Epichilium* ligulate to semi-elliptic, glabrous, 4.7–7 by 4–7; top slightly emarginate, its tip minutely apiculate; callus low, broad, slightly swollen, sometimes longitudinally grooved, to the top more swollen and ligulate, glabrous, 3.2–4.8 by 0.8–1.3 mm. *Column* 9–10.4 by 1.9–2.1 mm, at the base with 2 fleshy, semi-orbicular, 0.1–0.8 by 0.8–1 mm big auricles; seams on the stalk 0.1–0.3 mm wide, below the stigma drawn out into broadly triangular, to 0.6–1.2 mm high wings with broadly rounded top; top covering the back of the anther, truncate to obtuse. *Stigma* 1–1.5 by 1.5–2 mm; rostellum 0.6–1 by 1.5–2 mm. *Anther* 0.6–1 by 0.8–1.2 mm. Pollinia 0.6–1 by 0.4–0.6 mm. Viscidium 1–1.2 by 1–1.3 mm; top rounded. *Fruit* 19 by 3.3 mm.

Colours — Sepals pale yellow with irregular purple streaks to dark red on the outside and pale violet on the inside. Petals white or pale yellow with a purple streak to dull violet on both sides. Lip pale yellow to purplish violet with yellow base; midlobe with a violet cross band, top white, calli yellow; sidelobes white to dull violet. Column pale green with violet base. Anther pale yellow.

Distribution — Malay Peninsula (Pahang, Perak), 2 collections (K), one other record by Ridley (1896). Borneo: Sarawak (1st, 4th and 7th Div.), Sabah (Interior and West coast Residency), Brunei (Temburong), 16 coll. (AMES, B, BM, K, L, NY, SING).

Habitat & Ecology — Epiphytes on trees, dead logs and lianas in lower montane to montane Kerangas forests, primary hill Dipterocarp or Oak Laural forests. Altitude 600–1660 m. Fl. throughout the year.

Notes — 1. Ridley cited in his type description a specimen from Perak (Hermitage hill). The specimen was not included in the loan from SING, it is possible that no herbarium was made.

2. The present species is much alike *Bromheadia lohaniensis*. See note 2 under that species.

3. This species varies in number of leaves. Some specimens flower when only 5 leaves per side are present, others have up to 25 leaves per side.

4. Only one, probably immature fruit could be studied.

5. The epithet *brevifolia* refers to the short leaves of this species.

10. *Bromheadia cecieliae* Kruizinga, *spec. nov.* — Fig. 39

Caulis 5–32 cm longi ad 3.7 mm diam. Internodium terminale internodiis ceteris non longior. Folia parum applanata 5.1–11 cm longa 2–3.6 mm lata. Sepala 11–20 mm longa. Hypochilium ambitu triangulare, lobis lateralibus parvis. Epichilii callus angustus lingulatus. Columna in pedunculo suturas gaudens quae sub stigmatibus in alis triangularibus extensae sunt. — Typus: Leiden cult. (de Vogel) 913892 (holo L).

Slender erect epiphytes. *Roots* up to 8 cm by 1–2 mm. Stem entirely covered by leaf sheaths, 5–32 cm by 1–3.7 mm; basal part terete, with 2–5 bladeless sheaths; top part laterally compressed; internodes 7–24 mm, terminal internode not much longer. *Leaves* stiff, hard-coriaceous, the upper 1 or 2 around the inflorescence short; leaf blade linear, laterally flattened to subterete, straight to slightly curved, 5.1–11 cm by 2–3.6 mm, index 16.7–52.5; nerves 15–18 per side. *Racemes* unbranched or with up to 7 branches, up to 16 mm long, extending from the sterile bracts; sterile bracts 2–6 at the base of the raceme, long persistent, not disintegrating into fibres, midrib not keeled, 4–7 by 4–5 mm; floral bracts hard and thick, 1.5–4 by 2–4 mm, top part along the midrib keeled. *Flowers* up to 25 per inflorescence. *Pedicel* and *ovary* 6–11 mm long. *Median sepal* lanceolate, 12–20 by 3.4–4 mm, index 3.5–5; nerves 7–9. *Lateral sepals* lanceolate, 11–20 by 3–4 mm, index 3.3–5; nerves 7–9. *Petals* oblong to lanceolate, 11–18 by 2.6–4 mm, index 2.8–4.5; nerves 7–9, at the base 3, the lateral ones branching. *Lip* 10–15.5 by 6.8–9 mm. *Hypochilium* when flattened about triangular in outline, glabrous, 6–10 by 6.8–9 mm; lateral lobes distinct, in front triangular with rounded top, distinctly projecting for 0.5–1 mm, 1.4–2 by 3–5 mm; callus to the front distinctly swollen and elevated, with scattered hairs. *Epichilium* ligulate to semi-elliptic, glabrous, 4–6 by 4–5 mm; top not emarginate, its tip distinctly apiculate; callus low, narrow, slightly swollen, to the top more swollen and ligulate, glabrous, 3.5–5.6 by 1–2 mm. *Column* 9–11 by 1.5–2.1 mm, at the base without auricles; seams on stalk 0.2–0.4 mm wide, below stigma drawn out into broadly triangular, to 1–1.7 mm high wings with broadly rounded top; top covering the back of the anther, truncate to obtuse. *Stigma* 1.2–1.4 by 1.4–2 mm; rostellum 0.7–1.2 by 1.4–2 mm. *Anther* 1–1.1 by 1.2–1.5 mm. *Polinia* 1–1.3 by 0.6–0.7 mm. *Viscidium* 1.1–1.3 by 1.5–1.6 mm; top rounded. *Fruit* not seen.

Colours — Sepals and petals pale greenish to golden yellow. Base of lip with a yellow keel, and a few dark spots near the base on either side of the keel. Sidelobes pale green to cream coloured. Epichilium with white margins and a large, yellow, papillose callus; blade purple below the callus. Column pale green to cream coloured, with a few purple spots along the base. Anther yellow.

Distribution — ?Malay Peninsula (Selangor), 1 collection (K) (see note 2). Borneo: Sarawak (7th Div.), Sabah (Interior and West coast Residency), 8 coll. (B, BM, K, L, NY, SING).

Habitat & Ecology — Epiphytes on trunks or high in trees in lower montane to montane mixed or Dipterocarp forest. Altitude 1200–1700 m. Fl. records in Feb., July, Nov.–Dec.

Notes — 1. This species varies much in stem length.

2. The specimen *Segeback 2055* is very similar to this species. It is, however, questionable whether it belongs to this species because it is the only specimen from outside Borneo and occurs in the lowland instead of in lower montane areas. Until further specimens can be studied it is judged safer to postpone a conclusion on its identity. The measurements of *Segeback 2055* are not given in the description above.

3. This species is named after my wife, Ceciel Velthuis (J.K.).

**11. *Bromheadia coomansii* J.J. Smith ex Kruizinga & de Vogel, *spec. nov.* — Fig. 40**

Caules 30–48 cm longi ad 7.5 mm in diam. Internodium terminale internodiis ceteris non longior. Folia ad caulem pertinet cum angulo acuto parum curvata 5–12.5 cm longa racemo usque ad 5.5 cm longiora 3.5–5.8 mm lata. Caulis foliorumque latitudo tota 5 cm non attingens. Sepala 20–21.5 mm longa. Hypochilium ambitu triangulare, lobis lateralibus magnis. Epichilii callus ruminatus. Columna in pedunculo suturas gaudens quae sub stigmate in alis triangularibus extensae sunt. — Typus: Bogor cult. (Coomans de Ruiter), HLB 934.10.55 (holo L).

Rather slender erect epiphytes. *Roots* not seen. Stem entirely covered by leaf sheaths, 30–48 cm by 2.3–7.5 mm; basal part terete, with 2 or 3 bladeless sheaths; top part laterally compressed; internodes 1.4–3.3 cm, terminal internode not much longer. *Leaves* stiff, hard-coriaceous, upper 1 or 2 around the inflorescence short; leaf blade linear, laterally flattened, slightly curved, 5–12.5 cm by 3.5–5.8 mm, index 12.1–26.6; nerves 23–28 per side. *Racemes* unbranched or with up to 9 branches, up to 35 mm long, extending from the sterile bracts; sterile bracts 2–6, at base of raceme, long persistent, not disintegrating into fibres, midrib not keeled, 5–12 by 4–6 mm; floral bracts hard and thick, 2–3.5 by 2–4 mm, top part along midrib keeled. *Flowers* up to 25 per inflorescence. *Pedicel* and *ovary* 16–22 mm long. *Median sepal* lanceolate, 21 by 4.5–6 mm, index 3.5–4.7; nerves 9. *Lateral sepals* lanceolate, 20–21.5 by 4.5–6.5 mm, index 3.3–4.4; nerves 9. *Petals* lanceolate, 20–21.5 by 4.5–5.5 mm, index 3.9–4.4; nerves 9, at the base 3, the lateral ones branching. *Lip* 17.3–17.5 by 10.5–12 mm. *Hypochilium* when flattened about triangular in outline, glabrous or with few scattered hairs, 13 by 10.5–12 mm; lateral lobes distinct, in front triangular, distinctly projecting for 1.4–2.4 mm, 2.8–3.1 by 12–13 mm; callus minutely papillose. *Epichilium* ligulate to obovate, glabrous, 6–7 by 5.2–8 mm; top not emarginate, its tip distinctly apiculate; callus high, broad, distinctly swollen, ruminated, brain-shaped, minutely papillose, 5.5 by 3.3–5 mm. *Column* 14–15.5 by 3 mm, at base without auricles; seams on stalk 0.3 mm wide, below stigma drawn out into broadly triangular, to 1–1.3 mm high wings with broadly rounded top; top covering the base of the back of the anther, emarginate. *Stigma* 1.5–1.7 by 2.5–2.6 mm; rostellum 1.2–1.4 by 2.5–2.6 mm. *Anther* 1.3–1.4 by 2.2 mm. Pollinia 1.2 by 1.6–1.7 mm. Viscidium 1.5–1.6 by 2 mm; top acute, base exsculptate. *Fruit* not seen.

Colours — Flowers white to yellow, no further details.

Distribution — Borneo: Sarawak (no locality cited), Sabah (Interior Residency), Kalimantan (Kalimantan Barat), 4 collections: Bogor cult. (Coomans de Ruiter), HLB 934.10.55 (L), *Collenette* 2272 (K), *Native collector* 919 (K), *J.J. Vermeulen* 1179 (L).

Habitat & Ecology — Epiphytes in podzolic or *Dacrydium* forests. Altitude 400–600 m. Fl. Feb.

Notes — 1. Description based on 4 collections, 1 flower on alcohol and 1 dried flower.

2. This species is different from *B. pungens* because of its curved stems and leaves. The leaves of *B. pungens* are shorter.

3. This species is named after L. Coomans de Ruiter, who collected the type specimen. J.J. Smith annotated this specimen as *B. coomansii*, but never published its name.

**12. *Bromheadia devogelii* Kruizinga, *spec. nov.* — Fig. 41**

Caules 14–32 cm longi ad 5 mm diam. Internodium terminale internodiis ceteris non longior. Folia racemo 6–12 cm longiora. Caulis foliorumque latitudo tota plus quam 7 cm. Sepala 17–21 mm longa. Hypochilium ambitu triangulare, lobis lateralibus magnis. Epichilii callus latus ruminatus. Columna in pedunculo suturas gaudens quae sub stigmate in alis triangularibus extensae sunt. — Typus: Leiden cult. (de Vogel) 27571 (holo L).

Rather slender erect epiphytes. *Roots* up to 25 cm by 1.5–3 mm. Stem entirely covered by leaf sheaths, 14–32 cm by 2–5 mm; basal part terete, with 2 or 3 bladeless sheaths; top part laterally compressed; internodes 1–2.5 cm, terminal internode not much longer. *Leaves* stiff, hard-coriaceous, the upper 1–3 around the inflorescence short; leaf blade linear, laterally flattened, slightly curved, 6–15 cm by 2.7–4.8 mm, index 14.6–38.5; nerves 18–25 per side. *Racemes* unbranched or with up to 7 branches, up to 18 mm long, extending from the sterile bracts; sterile bracts 2–4 at the base of the raceme, long persistent, not disintegrating into fibres, midrib keeled, 3–7 by 3–4 mm; floral bracts hard and thick, 2–4 by 4–5 mm, top part along the midrib keeled. *Flowers* up to 35 per inflorescence. *Pedicel* and *ovary* 12–21 mm long. *Median sepal* lanceolate, 17–22 by 5–5.3 mm, index 3.4–4.2; nerves 9. *Lateral sepals* lanceolate, 17–21.5 by 4.7–5.5 mm, index 3.4–4.3; nerves 9. *Petals* lanceolate, 15–21 by 4–5 mm, index 3.8–4.2; nerves 9, at the base 3, the lateral ones branching. *Lip* 17–20 by 8–12.3 mm. *Hypochilium* when flattened about triangular in outline, glabrous, 10.5–12.7 by 8–12.3 mm; lateral lobes distinct, in front triangular, distinctly projecting for 0.7–2 mm, 2–3.4 by 10–10.2 mm; callus with scattered hairs. *Epichilium* obovate, glabrous, 6–7 by 5–7 mm; top slightly emarginate, its tip distinctly apiculate; callus high, broad, distinctly swollen, ruminant, brain-shaped, minutely papillose, 4–6 by 2.5–4.3 mm. *Column* 10.5–13.8 by 3–3.5 mm, at the base without auricles; seams on the stalk 0.1–0.2 mm wide, below the stigma drawn out into broadly triangular, to 0.6–1 mm high wings with broadly rounded top; top covering the base of the back of the anther, emarginate. *Stigma* 1.2–2 by 2.5–3 mm; rostellum 1 by 2.5–2.6 mm. *Anther* 1.3–1.6 by 1.7–2.2 mm. Pollinia 1.6–1.8 by 1–1.1 mm. Viscidium 1.4–1.6 by 1.9–2.6 mm; top acute. *Fruit* up to 2.9 cm long.

Colours — Sepals and petals pale greenish yellow. Lip white; crests on epichilium yellow; lobes of hypochilium with reddish purple veins. Column pale greenish yellow. Anther cream coloured.

Distribution — Borneo: Sarawak (1st Div.), 1 collection: Leiden cult. (de Vogel) 27571 (L). Philippines: Mindanao, 1 coll.: *PNH (Mendoza) 41917* (K, L, SING).

Habitat & Ecology — Epiphytes in lowland heath forest. Altitude up to 350 m. Fl. records in June and Sept.

Notes — 1. Description based on 2 collections and several duplicates.

2. The two collections could represent two different species. Leiden cult. (de Vogel) 27571 is from Borneo and *PNH (Mendoza) 41917* is from Mindanao. I have only seen flowers from the specimen of Borneo, the Philippine specimens are, however, vegetatively much alike.

3. This species is dedicated to E.F. de Vogel who collected the type specimen.

### 13. *Bromheadia ensifolia* J.J. Smith — Fig. 42; Plate 5a

*Bromheadia ensifolia* J.J. Smith, Bull. Jard. Bot. Buitenzorg III, 8 (1926) 45; *ibid.*, Suppl. 2 (1930) t. 38, 1. — Type: *Jacobson 1629* (holo L; iso BO).

Slender erect epiphytes. *Roots* up to 20 cm by 1.3–4 mm. Stem not entirely covered by leaf sheaths, 26.5–96 cm by 1.5–4.5 mm; basal part terete, with 2–4 bladeless sheaths; top part laterally compressed; internodes 2.4–9.3 cm, the terminal internode much longer, 5–14 cm. *Leaves* rather flexible, hard-coriaceous, the upper 1 or 2 around the inflorescence short; leaf sheaths 2.1–8.5 cm; leaf blade linear, laterally compressed, curved, 10.8–55 cm

by 1–4 mm, index 36–183.3; nerves 9–20 per side. *Racemes* unbranched or with up to 6 branches, up to 17 mm long, extending from the sterile bracts; sterile bracts 2–5 at the base of the raceme, long persistent, not disintegrating into fibres, midrib not keeled, 2–14 by 3–4.2 mm; floral bracts hard and thick, 2–4.2 by 2–4 mm, top part along the midrib keeled. *Flowers* up to 20 per inflorescence. *Pedicel* and *ovary* 14–21 mm long. *Median sepal* lanceolate to linear-lanceolate, 19.3–25 by 3.7–5.8 mm, index 3.3–6.3; nerves 7–9. *Lateral sepals* lanceolate to linear-lanceolate, 18.5–25 by 4–7.5 mm, index 2.9–5.3; nerves 7–9. *Petals* lanceolate, 17–24 by 4.2–6.4, index 3.1–4.8 mm; nerves 7–9, at the base 3, the lateral ones branching. *Lip* 15–18 by 8–10 mm. *Hypochilium* when flattened about elliptic in outline, with scattered hairs, 9.5–15 by 8–10 mm; lateral lobes distinct, in front triangular, distinctly projecting for 1–2.5 mm; 2–3 by 10–12 mm; callus minutely papillose. *Epichilium* obovate, glabrous, 4–6.4 by 3.5–6.5 mm; top slightly emarginate, its tip minutely apiculate; callus on the central 3 nerves high, broad, distinctly swollen, ruminate; on the lateral nerves low, papillose, discontinuous, 4–5.7 by 3–3.7 mm. *Column* 14–15 by 3.5–4 mm, at the base without auricles; seams on the stalk 0.2–1 mm wide, below the stigma wider to 1.2–1.8 mm, but not drawn out into broadly triangular wings; top covering the basal part of the back of the anther, emarginate to truncate. *Stigma* 1.3–1.7 by 2.2–3 mm; rostellum 1.2–1.7 by 2.2–3 mm. *Anther* 1.2–2.1 by 2–2.6 mm. Pollinia 1.8–2.6 by 1–1.6 mm. Viscidium 2–2.4 by 1.9–2.1 mm; top acute. *Fruit* not seen.

Colours — Sepals cream coloured. Petals white to pale yellow. Lip cream coloured, tinged purple in basal half; sidelobes veined dark purple; midlobe white with 2 purple spots lateral on the base, callus bright yellow. Column cream coloured, front with tiny purple spots.

Distribution — Sumatra (Sumatera Barat), 1 collection (BO, L). Borneo: Sarawak (1st Div.), Sabah (Interior and West coast Residency), Brunei (Temburong), Kalimantan (Kalimantan Tengah and Timur), 12 coll. (AMES, BM, BO, E, K, L, NY, SING).

Habitat & Ecology — Epiphytes on trees in Kerangas, podzolic, hill Dipterocarp forest or montane forest. Altitude 60–1660 m. Fl. June (2 coll.).

Notes — 1. Sterile and floral bracts of this species seem to vary in size and shape.

2. The epithet *ensifolia* refers to the sword-like leaves of this species.

#### 14. *Bromheadia gracilis* Kruizinga & de Vogel, *spec. nov.* — Fig. 43

Caules 13.5–30 cm longi ad 2 mm diam. Internodium terminale ceteris multo longior. Folia utroque caulis laterale 3–6, 3.5–9.5 cm longa 1.1–1.5 mm lata. Bracteae florales membranaceae. Sepala 12–13 mm longa. Hypochilium ambitu triangulare, lobis lateralibus parvis. Epichilii callus angustus lingulatus. Columna in pedunculo suturas gaudens quae sub stigmatibus triangularibus extensae sunt. — Typus: *Vermeulen & Duistermaat 1075* (holo L).

Slender erect epiphytes. *Roots* up to 10 cm by 1–2 mm. Stem entirely covered by leaf sheaths, 13.5–30 cm by 0.8–2 mm; basal part terete, with 1 or 2 bladeless sheaths; top part laterally compressed; internodes 0.7–4.2 cm, terminal internode much longer, 5.3–9 cm. *Leaves* rather flexible, soft, the upper 1 or 2 around the inflorescence short; leaf blade linear, laterally flattened, slightly curved, 3.5–9.5 cm by 1.1–1.5 mm, index 25–79.2; nerves 7–9 per side. *Racemes* unbranched or with up to 2 branches, up to 20 mm long, extending from the sterile bracts; sterile bracts 3 or 4 at the base of the raceme, long persistent, not disintegrating into fibres, midrib not keeled, 7–11 by 3 mm; floral bracts rather membranous, 3–4 by 3 mm, top part along the midrib keeled. *Flowers* up to 15 per inflo-

rescence. *Pedicel* and *ovary* 4–5.5 mm long. *Median sepal* lanceolate, 12–13 by 2.7–3 mm, index 4–4.8; nerves 7. *Lateral sepals* lanceolate, 12–13 by 3 mm, index 4–4.3; nerves 7. *Petals* not seen. *Lip* 11–12 by 6 mm. *Hypochilium* when flattened about triangular in outline, 6–6.8 by 6 mm; lateral lobes rather small, triangular, with acute top, not projecting in front, 1 mm long; details callus not seen. *Epichilium* ligulate to semi-elliptic, 5–5.5 by 3.4–4.4 mm; top not seen; callus low, narrow, slightly swollen, to the top more swollen and ligulate, 4–5 by 1–1.5 mm. *Column* 7.6–10 by 1.8 mm, at the base without auricles; seams on the stalk 0.1–0.2 mm wide, below the stigma wider to 0.8–0.9 mm, but not drawn out into broadly triangular wings; top covering the back of the anther, truncate to obtuse. *Stigma* 1–1.3 by 1.6–1.8 mm; rostellum 1 by 1.6–1.8 mm. *Anther* 0.7–0.9 by 1.1–1.2 mm. Pollinia 0.6 by 0.4 mm. Viscidium 1.4 by 1.7 mm; top rounded. *Fruit* not seen.

Colours — Sepals and petals very pale greenish. Lip very pale greenish with some purple halfway beneath.

Distribution — Borneo: Sabah (Interior Residency), 2 collections: *Vermeulen & Duistermaat 1010, 1075* (L).

Habitat & Ecology — Epiphytes in montane *Fagaceae–Dipterocarpus–Agathis* forest. Altitude 1600–1700 m. Fl. Dec.

Notes — 1. The description is based on 2 collections and 1 duplicate.

2. Only two badly preserved flowers were available for this study, details of the calli and sidelobes of the lip may be inaccurate.

3. This species has an overlap in several characters with *B. scirpoidea*. It is treated here as a separate species because of its longer stems, its greater number of leaves and the much longer sterile bracts. Its true status can only be determined when more and better preserved material becomes available.

4. The epithet *gracilis* refers to the elegant, slender habitus of this species.

## 15. *Bromheadia graminea* Kruizinga & de Vogel, *spec. nov.* — Fig. 44

*Caules* 13–50 cm longi ad 3 mm diam. *Vaginis* non omnino tecti. *Internodium terminale* ceteris brevior ad paulo longior. *Folia* 7–35 cm longa 1.3–2.6 mm lata. *Sepala* 17–21 mm longa. *Hypochilium* ambutu ellipticum, lobis lateralibus magnis. *Epichilii* callus latus ruminatus. — *Typus*: *S* (*Martin*) 37575 (holo SAR; iso SING).

Slender erect epiphytes. *Roots* up to 10 cm by 1–3.2 mm. Stem not entirely covered by leaf sheaths, 13–50 cm by 1.2–3 mm, basal part terete, with 2 or 3 bladeless sheaths; top part little flattened; internodes 1.5–5.2 cm, terminal internode shorter to little longer, 1–1.1 cm. *Leaves* rather flexible, soft, the upper 1 or 2 around the inflorescence short; the leaf sheaths 1–5 cm; leaf blade linear, laterally flattened, straight to slightly curved 7–35 cm by 1.3–2.6 mm, index 84.4–230; nerves 12–17 per side. *Racemes* unbranched or with up to 5 branches, up to 15 mm long, extending from the sterile bracts; sterile bracts 2 or 3 at the base of the raceme, long persistent, not disintegrating into fibres, midrib not keeled, 3–8 by 2.5–3 mm; floral bracts hard and thick, 1.5–3.4 by 2.6–4 mm, top part along the midrib keeled. *Flowers* up to 22 per inflorescence. *Pedicel* and *ovary* 10–15 mm long. *Median sepal* lanceolate, 18–21 by 4.2–5 mm, index 4.2–4.3; nerves 7. *Lateral sepals* lanceolate, 17–19 by 4.4–5 mm, index 4.2–4.3; nerves 7. *Petals* lanceolate, 16–18.5 by 4.4–5 mm, index 3.8–3.9; nerves 7, at the base 3, the lateral ones branching. *Lip* 13.5–15 by 8.5–9

mm. *Hypochilium* when flattened about elliptic in outline, with scattered hairs, 12–13.2 by 8.5–9 mm; lateral lobes distinct, in front triangular, distinctly projecting for 2.1–2.3 mm, 2.3–2.7 by 10–13 mm; callus with scattered hairs. *Epichilium* obovate, glabrous, 4.2–5 by 5 mm; top slightly emarginate, its tip distinctly apiculate; callus high, broad, distinctly swollen, ruminant, brain-shaped, minutely papillose, 4–5 by 2 mm. *Column* 13–15 by 2.5–3.1 mm, at the base without auricles; seams on the stalk 0.2 mm wide, below the stigma wider to 1–1.3 mm, but not drawn out into broadly triangular wings; top covering the back of the anther, truncate to slightly emarginate. *Stigma* 1.2–1.3 by 2.5–3 mm; rostellum 1.4–1.5 by 2.5–3 mm. *Anther* 1.2–1.5 by 1.7–2 mm. Pollinia 1.5–1.6 by 1 mm. Viscidium 1.7–2 by 2.3–2.4 mm; top acute. *Fruit* not seen.

Colours — Sepals yellow with indistinct purple streaks down the middle. Petals white. Lip hypochilium cream coloured; lateral lobes with fine bright red nerves, to the back of the lip changing in rows of dots. Claw of epichilium with red dots, callus bright yellow, margins white. Column cream coloured, seams white, in front with tiny reddish violet spots. Anther cream coloured.

Distribution — Borneo: Sarawak (1st and 7th Div.), Kalimantan (Kalimantan Timur), 4 collections: Leiden cult. (Schuiteman et al.) 933152 (L), Leiden cult. (de Vogel) 913435 (L), *S* (Martin) 37575 (SAR, SING), *S* (Yii Puan Ching) 48472 (SAR).

Habitat & Ecology — Epiphytes in primary ridge forest or transitional forest between mixed Dipterocarp and submontane forests. Altitude 780–1300 m. Fl. Aug.

Notes — 1. Description based on 4 collections and 1 duplicate.

2. The epithet *graminea* refers to the grass-like leaves of this species.

## 16. *Bromheadia grandiflora* Kruizinga & de Vogel, *spec. nov.* — Fig. 45

Caulis 17–63 cm longa ad 6 mm diam. Vaginis non omnino tecti. Internodium terminale ceteris longior. Folia 10–31.5 cm longa 3.8–5.5 mm lata. Sepala 17–28 mm longa. Hypochilium ambitu ellipticum, lobis lateralibus magnis. Epichilii callus latus ruminatus. Columna basi tuberculis 2. — Typus: Leiden cult. (de Vogel) 914280 (holo L).

Slender erect epiphytes. *Roots* up to 13 cm by 1–2 mm. Stem not entirely covered by leaf sheaths, 17–63 cm by 2.5–6 mm, laterally compressed; basal part with 1–3 bladeless sheaths; internodes 1.7–6 cm, terminal internode longer, 2.5–15 cm. *Leaves* rather flexible, hard-coriaceous, the upper 2–4 around the inflorescence short; leaf sheaths 3.5–5 cm; leaf blade linear, laterally flattened, curved, 10–31.5 cm by 3.8–5.5 mm, index 21.7–76.8; nerves 21–24 per side. *Racemes* unbranched or with up to 5 branches, up to 14 mm long, extending from the sterile bracts; sterile bracts 2 or 3 at the base of the raceme, long persistent, not disintegrating into fibres, midrib not keeled, 5–8 by 4–5 mm; floral bracts hard and thick, 2–4 by 3–4 mm, top part along the midrib keeled. *Flowers* up to 25 per inflorescence. *Pedicel* and *ovary* 14–24 mm long. *Median sepal* lanceolate, 18–28 by 3.7–7 mm, index 3.7–5.1; nerves 7–9. *Lateral sepals* lanceolate, 17–28 by 5–8 mm, index 3–4.1; nerves 7–9. *Petals* lanceolate, 16–26 by 3.7–7 mm, index 3.1–4.6; nerves 7–9, at the base 3, the lateral ones branching. *Lip* 15–20 by 7–11.5 mm. *Hypochilium* when flattened about elliptic in outline, with scattered hairs, 9–12 by 7–11.4 mm; lateral lobes distinct, in front triangular, distinctly projecting for 1–3 mm, 1.8–3.2 by 8.5–14 mm; callus more densely hairy than the rest of hypochilium. *Epichilium* obovate, glabrous, 5–8.5 by 4.5–9 mm; top slightly emarginate, its tip not to slightly apiculate; callus high, broad, dis-

tinctly swollen, runcate, brain-shaped, glabrous, 4.5–8 by 3–5 mm. *Column* 11.5–18 by 2.8–4 mm, at the base with 2 fleshy, semi-orbicular, 0.6–0.8 by 1–1.5 mm big auricles; seams on the stalk 0.2–0.5 mm wide, below the stigma wider to 1.4–2 mm, but not drawn out into broadly triangular wings; top covering the back of the anther, emarginate. *Stigma* 1–2.2 by 2–3.5 mm; *rostellum* 1.2–1.6 by 2.8–3.5 mm. *Anther* 1.5–2 by 2–2.8 mm. *Pollinia* 1.8–3 by 1.2–2 mm. *Viscidium* 2–2.3 by 2–2.6 mm; top rounded. *Fruit* not seen.

Colours — Sepals creamy white to yellow; lateral sepals sometimes with a faint violet flush on midrib. Petals creamy white to yellow. Hypochilium cream coloured including the callus; lateral lobes violet with distinct violet nerves. Epichilium white with 2 lateral purple spots on the base; callus bright yellow. Column pale greenish cream, front with tiny violet spots. Anther creamy white to pinkish ochre.

Distribution — Malay Peninsula (Johor), 1 collection (SING). Borneo: Sarawak (7th Div.), Brunei (Temburong), Kalimantan (Kalimantan Selatan), 5 coll. (BO, L).

Habitat & Ecology — Epiphytes in hill to lower montane Dipterocarp or Kerangas forests. Altitude 800–1100 m. Fl. June–Sept.

Notes — 1. Description based on 6 collections.

2. The epithet *grandiflora* refers to the large flowers of this species.

#### 17. *Bromheadia humilis* Kruizinga & de Vogel, *spec. nov.* — Fig. 46

Caulis 5.5–7.5 cm longi ad 2.5 mm diam. Internodium terminale ceteris multo longiore. Folia caulis utroque latere 3–5, 3.2–4.9 cm longa 1.7–2.1 mm lata vix recurvata. — Typus: *Lamb 1226B/90* (holo K).

Rather erect slender epiphytes. *Roots* up to 7 cm by 1–2 mm. Stem entirely covered by leaf sheaths, 5.5–7.5 cm by 1–2.5 mm; basal part terete, with 2 or 3 bladeless sheaths; top part laterally compressed; internodes 4–6.5 mm, terminal internode much longer, 11–16 mm. *Leaves* rather flexible, soft to hard-coriaceous, the upper 1 or 2 around the inflorescence short; leaf blade linear, laterally flattened, straight to slightly curved, 3.2–4.9 cm by 1.7–2.1 mm, index 18.8–23.3; nerves 9–13 per side. *Racemes* unbranched or with up to 4 branches, up to 10 mm long, extending from the sterile bracts; sterile bracts 3 at the base of the raceme, long persistent, not disintegrating into fibres, midrib not keeled, 5–8 by 3 mm; floral bracts not seen. *Flowers* and *fruits* not seen.

Distribution — Borneo: Sabah (Interior Residency), only known from the type (K).

Habitat & Ecology — Epiphytes in mixed hill Dipterocarp forest. Altitude 800 m. No fl. records.

Notes — 1. Description based on 1 collection.

2. This species is different from *B. scirpoidea* because of its greater number of hardly recurved leaves in conjunction with the small size of the plant.

3. No flowers were available on the type specimen

4. The epithet *humilis* refers to the small stature of this species.

#### 18. *Bromheadia latifolia* Kruizinga & de Vogel, *spec. nov.* — Fig. 47

Caulis ad 24 cm longus 11 mm diam. Internodium terminale ceteris non longior. Folia 5.5–12.2 cm longa 8–12.5 mm lata. Sepala 24–25.5 mm longa. Hypochilium ambitu ellipticum, lobis lateralibus magnis. Epichilii callus latus ruminatus. — Typus: Bogor cult. 983-VIII-205 (holo L).

Sturdy epiphytes. *Roots* not seen. Stem entirely covered by leaf sheaths, 24 cm by 7–11 mm, laterally compressed; basal part with 1 or 2 bladeless sheaths; internodes 14–26 mm, terminal internode not much longer. *Leaves* stiff, hard-coriaceous, the upper 2 around the inflorescence short; leaf blade linear-lanceolate to linear, laterally flattened, straight to slightly curved, 5.5–12.2 cm by 8–12.5 mm, index 6.9–11.4; nerves 28–33 per side. *Racemes* unbranched, up to 22 mm long, extending from the sterile bracts; sterile bracts 4 at the base of the raceme, long persistent, not disintegrating into fibres, midrib not keeled, 8–13 by 5–7 mm; floral bracts hard and thick, 3.8–5 by 6–7 mm, top part along the midrib keeled. *Flowers* up to 7 per inflorescence. *Pedicel* and *ovary* c. 17 mm long. *Median sepal* lanceolate, c. 25.5 by 7.6 mm, index 3.4; nerves 9. *Lateral sepals* lanceolate, c. 24 by 7 mm, index 3.4; nerves 9. *Petals* lanceolate, c. 22 by 7 mm, index 3.1; nerves 11, at the base 3, the lateral ones branching. *Lip* c. 20 by 11 mm. *Hypochilium* when flattened about elliptic in outline, with scattered hairs, c. 15 by 11 mm; lateral lobes distinct, in front triangular, distinctly projecting for 4.5–5 mm, c. 3 by 14.6 mm; callus with scattered hairs. *Epichilium* ligulate to semi-elliptic, glabrous, c. 8.5 by 8 mm; top slightly emarginate, its tip minutely apiculate; callus high, broad, distinctly swollen, ruminant, brain-shaped, minutely papillose, c. 7 by 4.4 mm. *Column* c. 15.4 by 3.5 mm, at the base without auricles; seams on the stalk 0.8 mm wide, below the stigma wider to 1.7 mm, but not drawn out into broadly triangular wings; top covering the back of the anther, truncate. *Stigma* 2.4 by 3.3 mm. Rostellum 1.4 by 3.3 mm. *Anther* 2 by 3 mm. Pollinia 2.4–2.6 by 1.3–1.4 mm. Viscidium 2 by 2.4 mm; top rounded. *Fruit* not seen.

Colours — Sepals ochrish yellow, fleshy. Petals creamy yellow. Lip creamy yellow, lateral lobes inside with violetish stripes, callus on midlobe light yellow. Column cream coloured, in front with purplish blotches.

Distribution — Borneo: Kalimantan (Kalimantan Tengah), only known from the type (L).

Habitat & Ecology — Fl. Nov.

Notes — 1. Description based on 1 stem with leaves and 1 flower.

2. The epithet *latifolia* refers to the broad leaves of this species.

### 19. *Bromheadia lohaniensis* Kruizinga & de Vogel, *spec. nov.* — Fig. 48

Caulis 4.6–8 cm longi ad 3.8 mm diam. Internodium terminale ceteris non longior. Folia 1.6–2.1 cm longa 3.8–4.1 mm lata. Sepala 12.2–13 mm longa. Hypochilium ambitu triangulare, lobis lateralibus parvis. Epichilii callus latus lingulatus humilissimus. Columna in pedunculo suturas gaudens quae sub stigmate in alis triangularibus extensae sunt, basi sine tuberculis.—  
Typus: Leiden cult. (Vermeulen, J.J.) 26690 (holo L).

Compact erect epiphytes. *Roots* up to 6 cm by 1–1.5 mm. Stem entirely covered by leaf sheaths, 4.6–8 cm by 3–3.8 mm; basal part terete, with 2 or 3 bladeless sheaths; top part laterally compressed; internodes 3.5–9 mm, terminal internode not much longer. *Leaves* stiff, hard-coriaceous, the upper 1 or 2 around the inflorescence short; leaf blade obliquely triangular to linear-lanceolate, laterally flattened, straight, 16–21 by 3.8–4.1 mm, index 4.2–5.1; nerves 14–16 per side. *Racemes* unbranched or with up to 1 branch, up to 10 mm long, completely covered by the sterile bracts or by its fibres; sterile bracts 3 or 4 at the base of the raceme, often disintegrated into fibres, midrib not keeled, 9–10 by 4–6 mm; floral bracts not seen. *Flowers* up to 10 per inflorescence. *Pedicel* and *ovary* 4.5–6 mm long. *Median sepal* lanceolate, 12.8–13 by 3.5–3.9 mm, index 3.3–3.7; nerves 7. *Lateral*

*sepals* lanceolate, 12.2–12.3 by 3.8–4 mm, index 3.1; nerves 7. *Petals* oblong, 11.2–12.3 by 4.4–4.5 mm, index 2.1–2.7; nerves 7, at the base 3, the lateral ones branching. *Lip* 10.7–11 by 9 mm. *Hypochilium* when flattened about triangular in outline, with few scattered hairs, 5.7 by 9 mm; lateral lobes rather small, triangular, with rounded top, obtuse, 0.6–0.8 by 1.7–2 mm; callus with few scattered hairs. *Epichilium* ligulate, with few scattered hairs, 5.4 by 7 mm; top slightly emarginate, its tip distinctly apiculate; callus very low, almost not visible, broad, with few scattered hairs, 2.5 by 1 mm. *Column* 10 by 2.1 mm, at base without auricles; seams on the stalk 0.1 mm wide, below the stigma drawn out into broadly triangular, to 0.7 mm high wings with broadly rounded top; top covering the base of the back of the anther, truncate. *Stigma* 13 by 2 mm; rostellum 1 by 2 mm. *Anther* 1 by 1.3 mm. Pollinia 1.2 by 0.7 mm. Viscidium 1.3 by 1.4 mm; top rounded. *Fruit* 12 by 4 mm.

Colours — Sepals greenish tinged violet. Petals light greenish. Lip violetish, tip cream coloured; calli yellow.

Distribution — Borneo: Sabah (West coast Residency), only known from the type (L).

Habitat & Ecology — Not known. Altitude 600 m. No flowering records.

Notes — 1. Description based on 1 collection.

2. This species is different from *B. brevifolia* in its longer internodes, the smaller index of the petals, the rounded sidelobes of the hypochilium and the absence of auricles at the base of the column.

3. The epithet *lohaniensis* refers to the Lohan river in Sabah where the type specimen was collected.

## 20. *Bromheadia longifolia* Kruizinga & de Vogel, *spec. nov.* — Fig. 49

Caulis 8–21 cm longi ad 4 mm diam. Internodia basalia ad 3.6 cm longa sursum decrescentia.

Folia 4.5–30.5 cm longa 1–4 mm lata. — Typus: SAN (*Leopold et al.*) 71909 (holo and iso K).

Rather slender erect epiphytes. *Roots* up to 22 cm by 1–2.5 mm. Stem entirely covered by leaf sheaths, 8–21 cm by 1–4 mm, laterally compressed; basal part with 2 or 3 bladeless sheaths; internodes 6–36 mm, terminal internodes shorter than basal ones. *Leaves* stiff to rather flexible, hard-coriaceous, the upper 1 or 2 around the inflorescence very long; leaf blade linear, laterally flattened, straight to curved, 4.5–30.5 cm by 1.8–3.2 mm, index 15–152.5; nerves 13–20 per side. *Racemes* unbranched or with up to 2 branches, up to 15 mm long, extending from the sterile bracts; sterile bracts 3 or 4 at the base of the raceme, long persistent, not disintegrating into fibres, midrib not keeled, 4–8 by 2.4–3.2 mm; floral bracts hard and thick, 1.2–2.4 by 2–3.2 mm, top part along the midrib keeled. *Flowers* not seen, up to 14 per inflorescence. *Fruit* not seen.

Distribution — Borneo: Sabah (Interior and West coast Residency), Brunei (Temburong), 2 collections: SAN (*Leopold et al.*) 71909 (K), SF (*Carr*) 27455 p.p. (AMES).

Habitat & Ecology — Epiphytes in hill Dipterocarp forest. Altitude 600–1500 m. No flowering records.

Notes — 1. Description based on 2 collections and 1 duplicate.

2. The specimens are quite diverse in shape, and flowers were not available. The specimens have in common that the length of the internodes decreases towards the top of the stem. The leaves resemble those of *B. ensifolia* in size and shape.

3. The epithet *longifolia* refers to the long leaves of this species that are often longer than the stem.

## 21. *Bromheadia pungens* Ridley — Fig. 50

*Bromheadia pungens* Ridley, J. Linn. Soc. Bot. 32 (1896) 340; J. Str. Br. Roy. As. Soc. 35 (1901) 23; Mat. Fl. Mal. Pen. 1 (1907) 145; J. Fed. Mal. St. Mus. 6 (1915) 182; Fl. Mal. Pen. 4 (1924) 151; Holttum, Orch. Malaya, ed. 3 (1968) 545; Seidenf. & Wood, Orch. Penins. Malaysia & Sing. (1992) 527. — Type: *Ridley s.n.*, 07-1911 (neo K)

Rather slender erect epiphytes. *Roots* not seen. Stem entirely covered by leaf sheaths, 21 cm by 4–7 mm; basal part terete, with 2 or 3 bladeless sheaths; top part laterally compressed; internodes 0.7–1.8 cm, terminal internode not much longer. *Leaves* stiff, hard coriaceous, the upper 1 or 2 around the inflorescence short; leaf blade linear-lanceolate to linear, laterally flattened, straight, 4.8–6.5 cm by 5.5–5.8 mm, index 8.7–11.2; nerves 26–28 per side. *Racemes* unbranched, up to 12 mm long, extending from the sterile bracts; sterile bracts 4 at the base of the raceme, long persistent, not disintegrating into fibres, midrib not keeled, 5–8 by 3–4 mm; floral bracts hard and thick, 2.5–3 by 2.2–3 mm, top part along the midrib keeled. *Flowers* not seen, up to 5 per inflorescence. *Fruit* not seen.

Colours — Sepals yellowish. Petals white. Midlobe lip with white edges and yellow callus, sidelobes cream coloured.

Distribution — Malay Peninsula (Malacca, Pahang), 1 collection (K), one other record by Ridley (1896).

Habitat & Ecology — Epiphytes on trees. Altitude 1300–1400 m. No flowering records.

Notes — 1. Ridley described this species after a specimen he collected in Malacca on Mt Ophir. He brought back live plants which flowered in the botanical gardens at Singapore. It is possible that he did not make any herbarium specimens, the type was not among the specimens received from SING. For that reason a neotype is designated.

2. This species resembles *B. coomansii*. See note 2 of that species.

3. No flowers were available for this study.

4. Description based on 1 collection and 2 descriptions (Ridley, 1907; Holttum, 1968).

5. The epithet *pungens* refers to the sharp-pointed leaves of this species.

## 22. *Bromheadia robusta* Kruizinga & de Vogel, *spec. nov.* — Fig. 51

Herba epiphytica erecta valida. Caules 36–42 cm longi ad 10 mm diam. Internodium terminale ceteris non longior. Folia 8.5–57 cm longa 5–8.5 mm lata. — Typus: Leiden cult. (Schuiteman et al.) 933130 (L, spirit material).

Sturdy erect epiphytes. *Roots* up to 20 cm by 1–3 mm. Stem entirely covered by leaf sheaths, 36–42 cm by 6–10 mm, laterally compressed; basal part with 2 or 3 bladeless sheaths; internodes 3.5–6 cm, terminal internode not much longer. *Leaves* rather flexible, hard-coriaceous, the upper 1 or 2 around the inflorescence very long; leaf blade linear, laterally flattened, curved, 8.5–57 cm by 5–8.5 mm, index 13.3–114; nerves 26–30 per side. *Racemes* unbranched, up to 67 mm long, extending from the sterile bracts; sterile bracts 2 at the base of the raceme, long persistent, not disintegrating into fibres, midrib not keeled, 7–10 by 6–8 mm; floral bracts rather hard and thick, 3–4 by 6–8 mm, the top part along the midrib keeled. *Flowers* up to 33 per inflorescence. *Pedicel* and *ovary* c. 15 mm long. *Median sepal* lanceolate, c. 24 by 6.5 mm, index c. 3.7; nerves 7; rather fleshy. *Lateral sepals* lanceolate, c. 23 by 7 mm, index c. 3.3; nerves 9; rather fleshy. *Petals* lanceolate, c. 23 by 7 mm, index c. 3.3; nerves 9, at the base 3, the lateral ones branching. *Lip*

c. 18 by 10 mm. *Hypochilium* when flattened in outline about elliptic, with scattered hairs, c. 15 by 10 mm; lateral lobes distinct, in front triangular, distinctly projecting for c. 3.5 mm, c. 2.5 by 14 mm; callus more densely hairy than the rest of the hypochilium. *Epichilium* about orbicular, glabrous, c. 7 by 7 mm; top truncate, its tip distinctly apiculate; callus high, broad, distinctly swollen, ruminant, brain-shaped, glabrous, c. 5 by 4.5 mm. *Column* c. 17 by 4 mm, at the base with 2 fleshy, semi-orbicular, c. 1 by 2 mm big auricles; seams on the stalk c. 0.5 mm wide, below the stigma hardly wider, not drawn out into broadly triangular wings; top covering the back of the anther, emarginate. *Stigma* c. 13 by 2 mm; rostellum c. 1.3 by 2 mm. *Anther* c. 2 by 2.5 mm. Pollinia c. 2.3 by 1.3 mm. Viscidium c. 2 by 2.7 mm; top rounded. *Fruit* not seen.

Colours — Sepals yellowish cream. Petals white. Lip white, lateral lobes veined with red purple, base of midlobe red purple, callus bright yellow. Column cream coloured, finely tinged and spotted purple in front below the stigma. Anther white.

Distribution — Borneo: Sarawak (1st Div.), Kalimantan (Kalimantan Barat), 2 collections: *Afriastini 01136* (BO), Leiden cult. (Schuiteman et al.) 933130 (L).

Habitat & Ecology — Epiphytes on open place in primary lowland to hill forest. Altitude 150–800 m. Fl. Sept., Oct.

Notes — 1. The description is based on 2 collections and 1 duplicate.

2. The epithet *robusta* refers to the large, robust habit of this species.

### 23. *Bromheadia scirpoidea* Ridley — Fig. 52

*Bromheadia scirpoidea* Ridley, J. Bot. 38 (1900) 71; Mat. Fl. Mal. Pen. 1 (1907) 145; Fl. Mal. Pen. 4 (1924) 151; M.R. Hend., Mal. Wild Flow., Monocot. (1954) 107; Holttum, Orch. Malaya, ed. 3 (1968) 546; Seidenf. & Wood, Orch. Penins. Malaysia & Sing. (1992) 529, f. 238; Segerbäck; Orch. Mal. (1992) 123, f. 180, 181; Wood, Beaman & Beaman, Pl. Mt. Kinabalu 2, Orchids (1993) 99. — Syntypes: *Ridley s.n.*, 08-1891 (lecto SING, here chosen); *Ridley s.n.*, Perak, near Ipoh, not seen (see note 1).

Slender erect epiphytes. *Roots* up to 11 cm by 1–3 mm. Stem entirely covered by leaf sheaths, 2.7–29 cm by 0.9–3 mm; basal part terete, with 1–3 bladeless sheaths; top part laterally compressed; internodes 0.2–2.3 cm, terminal internode much longer, 0.9–12.5 cm. *Leaves* rather flexible, soft, the upper 1 or 2 around the inflorescence short; leaf blade linear, laterally flattened, curved, 2.5–14.5 cm by 1–2.2 mm, index 16.7–100; nerves 7–11 per side. *Racemes* unbranched or with up to 4 branches, 4–16 mm long, extending from the sterile bracts; sterile bracts 2–5 at the base of the raceme, long persistent, not disintegrating into fibres, midrib not keeled, 3–6 by 2.5–4.2 mm; floral bracts rather membranous, 1.5–3 by 2–3 mm, top part along the midrib keeled. *Flowers* up to 40 per inflorescence. *Pedicel* and *ovary* 3–7 mm long. *Median sepal* oblong to lanceolate, 9.4–15 by 2–5 mm, index 2.9–4.7; nerves 7. *Lateral sepals* oblong to lanceolate, 10–15 by 2.1–5 mm, index 2.9–4.8; nerves 7. *Petals* lanceolate, 9–15 by 2.2–4.7 mm, index 3–4.1; nerves 7–9, at the base 3, the lateral ones branching. *Lip* 9.2–14.4 by 8–10 mm. *Hypochilium* when flattened about triangular in outline, with scattered hairs, 5–7.5 by 8–10 mm; lateral lobes distinct, in front obtuse to distinctly projecting for up to 1 mm, 1.5–3 by 4–7 mm; callus with scattered hairs. *Epichilium* ligulate to semi-elliptic, with scattered hairs, 4–7 by 2.5–6 mm; top not emarginate, its tip not to minutely apiculate; callus low, broad, slightly swollen, ruminant, with scattered hairs, 3–5.3 by 1.4–3 mm. *Column* 7–12.5 by 1.7–2.4 mm, at the base with or without 2 fleshy, semi-orbicular, 0.1–0.2 by

0.2–0.3 mm big auricles; seams on the stalk 0.1–0.3 mm wide, below the stigma drawn out into broadly triangular, to 0.7–1.3 mm high wings with broadly rounded top; top covering the back of the anther, truncate to obtuse. *Stigma* 1–1.4 by 1.4–2 mm; rostellum 1–1.1 by 1.2–1.6 mm. *Anther* 0.7–1.1 by 1.2–1.6 mm. Pollinia 0.7–1.3 by 0.5–1 mm. Viscidium 1.2–1.6 by 1.2–1.8 mm; top rounded. *Fruit* not seen.

Colours — Sepals and petals creamy green to pale yellow. Hypochilium pale yellow; sidelobes with purple spots; callus with bigger purple spots. Epichilium white to pale yellow, separated from the hypochilium by a light violet band which is dark violet in the middle; callus bright yellow.

Distribution — Malay Peninsula (Johor, Kelantan, Negeri Sembilan, Pahang, Perak, Selangor), 9 collections (AMES, E, K, L, PNH, SING). Borneo: Sarawak (1st Div.), Sabah (Interior Residency), Brunei (Temburong), 7 coll. (K, L, SAR).

Habitat & Ecology — Epiphytes in lowland to montane mixed Dipterocarp forest. Altitude up to 1500 m. Fl. June–Feb.

Notes — 1. Ridley cited in his type description a specimen from Perak (near Ipoh). This specimen was not included in the loan from SING, it is possible that no herbarium was made.

2. This species is rather diverse in habit and lip shape. This diversity is quite continuous. The new species *B. gracilis* and *B. humilis* were established because a discrete difference exists in stem length as well as in leaf number and shape.

3. The epithet *scirpoidea* refers to the habit of this species, which (slightly) resembles that of the genus *Scirpus* (Cyperaceae).

## 24. *Bromheadia srilankensis* Kruizinga & de Vogel, *spec. nov.* — Fig. 53

Caulis 5–32 cm longi ad 3 mm diam. Internodium terminale internodiis ceteris non longior. Folia parum applanata 6.5–15 cm longa 2.5–3 mm lata. Sepala 20–21.5 mm longa. Hypochilium ambitu triangulare, lobis lateralibus parvis. Epichilii callus angustus lingulatus. Columna in pedunculo suturas gaudens quae sub stigmate in alis triangularibus extensae sunt. — Typus: *Fernando s. n.*, 04-1977 (holo K).

Slender erect epiphytes. *Roots* not seen. Stem entirely covered by leaf sheaths, c. 32 cm by 2–3 mm; basal part somewhat flattened; top part laterally compressed; internodes 10–18 mm long, terminal internode not much longer. *Leaves* stiff, hard-coriaceous, upper one or two around the inflorescence short; leaf blade linear, laterally flattened, slightly curved, 6.5–15 cm by 2.5–3 mm, index 26–50; nerves 10–12 per side. *Racemes* branched with up to 2 branches, up to 8 mm long, extending from the sterile bracts; sterile bracts 7 at the base of the raceme, long persistent, not disintegrating into fibres, midrib not keeled, 4–6.5 by 3–4 mm; floral bracts hard and thick, 2–3 by c. 2 mm, top part along the midrib keeled. *Flowers* 13 or more per inflorescence. *Pedicel* and *ovary* c. 12.5 mm long. *Median sepal* lanceolate, c. 21.5 by 6 mm, index 3.5; top acute; nerves 9. *Lateral sepals* lanceolate, c. 20 by 5 mm, index 4; top acute; nerves 9. *Petals* lanceolate, c. 18.5 by 4.3 mm, index c. 4.1; top acute; nerves 7–9, at the base 3, the lateral ones branching. *Lip* c. 16.5 by 8 mm. *Hypochilium* when flattened about triangular in outline, glabrous, c. 11 by 8 mm; lateral lobes distinct, in front triangular with rounded top, distinctly projecting for c. 1 mm, c. 2 by 9 mm; callus ligulate, slightly swollen, in front not distinctly elevated, probably glabrous. *Epichilium* ligulate, probably glabrous, c. 5.2 by 4.5 mm; top obtuse, its tip more or less

apiculate; callus low, rather broad elliptic, slightly swollen, glabrous, c. 3 by 2.5 mm. *Column* 12–13 by c. 2 mm, at the base without auricles; seams on the stalk c. 0.4 mm wide, below stigma not drawn out into broadly triangular wings; top covering the back of the anther, truncate to obtuse. *Stigma* c. 1.5 by 1.5 mm; rostellum c. 1.5 by 1.7 mm. *Anther* c. 1.2 by 1.2 mm. Pollinia not seen. Viscidium c. 1.5 by 1.7 mm; top rounded. *Fruit* not seen.

Colours — Flower pure white, lateral lobes of the lip and margins of the midlobe with fine purplish red veins, calli on the lip bright yellow.

Distribution — Sri Lanka. Only known from the type.

Habitat & Ecology — Epiphyte. Altitude not known. Fl. in cultivation in May, flowers open in the morning and close by 9 am.

Note — 1. The epithet *srilankensis* refers to the country of origin of this species, Sri Lanka.

2. The occurrence of this species in Sri Lanka is remarkable, as the genus *Bromheadia* is not otherwise known to occur west of Burma.

## 25. *Bromheadia tenuis* J.J. Smith — Fig. 54; Plate 5b

*Bromheadia tenuis* J.J. Smith, Brittonia 1 (1913) 110. — Syntypes: *Clemens 20308* (lecto L, here chosen; iso NY, SAR), *20184* (L, NY), *22588* (L, NY).

Slender erect epiphytes, rarely terrestrial. *Roots* up to 16 cm by 1.2–3.5 mm. Stem not entirely covered by leaf sheaths, 13–77 cm by 0.7–2.5 mm, almost terete; basal part with 2–4 bladeless sheaths; internodes 0.9–10.2 cm, terminal internode little longer, 1.5–14.2 cm. *Leaves* stiff, hard-coriaceous, the upper 1 or 2 around the inflorescence short; leaf sheaths 2.1–6 cm; leaf blade linear, almost terete, straight to curved, 8.5–33 cm by 1–2.3 mm, index 47.5–275; nerves 8–14 per side. *Racemes* unbranched or with up to 7 branches, up to 20 mm long, extending from the sterile bracts; sterile bracts 1–4 at the base of the raceme, long persistent, not disintegrating into fibres, midrib not keeled, 3–8.5 by 2–4 mm; floral bracts hard and thick, 2–3 by 2–4 mm, top part along the midrib keeled. *Flowers* up to 30 per inflorescence, opening wide or staying closed. *Pedicel* and *ovary* 6.5–17 mm long. *Median sepal* lanceolate, 11–22 by 2.5–5.3 mm, index 4–5; nerves 7–9. *Lateral sepals* lanceolate, 10–22 by 2.1–6 mm, index 3.3–5; nerves 7–9. *Petals* lanceolate, 10–20 by 2.5–4.5 mm, index 4–5; nerves 7–9, at the base 3, the lateral ones branching. *Lip* 9–17 by 5–9.5 mm. *Hypochilium* when flattened about elliptic in outline, with scattered hairs, 6–13 by 5–9.5 mm; lateral lobes distinct, in front triangular, distinctly projecting for 1.5–2.5 mm, 1.4–2.7 by 5–11.5 mm; callus with scattered hairs. *Epichilium* obovate, glabrous, 4.7–7.3 by 3–6.5 mm; top slightly emarginate, its tip minutely apiculate; callus high, broad, distinctly swollen, ruminant, brain-shaped, minutely papillose, 3.5–5.3 by 2–3 mm. *Column* 7–15 by 2.2–3.1 mm, at the base with or without 2 fleshy, semi-orbicular, 0.1–0.3 by 1–1.5 mm big auricles; seams on the stalk 0.2–0.3 mm wide, below the stigma wider to 1–1.7 mm, but not drawn out into broadly triangular wings; top covering the back of the anther, truncate to obtuse. *Stigma* 1.1–1.7 by 1.7–2.5 mm; rostellum 1.3–1.6 by 2–2.5 mm. *Anther* 1.2–1.5 by 1.6–2 mm. Pollinia 1.2–2 by 0.9–1.5 mm. Viscidium 1.7–2 by 1.9–2.5 mm; top acute. *Fruit* not seen.

Colours — Sepals yellowish green to purple; the median sepal with tiny purplish spots at the base outside. Petals lighter yellow with a pale margin. Lip white; lateral lobes with

dark violet veins; on the junction of hypo- and epichilium with 2 violet blotches; some papillae on the yellow callus of hypochilium dark violet; callus on epichilium yellow. Column yellowish to brownish, in front with red spots. Anther almost white.

Distribution — Borneo: Sarawak (1st and 7th Div.), Sabah (Sandakan Residency), Kalimantan (Kalimantan Tengah, Kalimantan Timur), 13 collections (BM, K, L, NY, SAR, SING).

Habitat & Ecology — Terrestrial or epiphytes in upper hill to montane Kerangas or *Agathis* forest. Altitude 700–2000 m. Fl. Aug.–Dec.

Note — The epithet *tenuis* refers to the slender habit of this species.

## 26. *Bromheadia truncata* Seidenf. — Fig. 55

*Bromheadia truncata* Seidenf., Opera Bot. 72 (1983) 15, f. 5; Seidenf. & Wood, Orch. Penins. Malaysia & Sing. (1992) 529, f. 238; Segerbäck, Orch. Mal. (1992) 123, f. 178, 179; Wood, Beaman & Beaman, Pl. Mt. Kinabalu 2, Orchids (1993) 100. — Type: *Seidenfaden & Smitinand GT 2691* (holo coll. Seidenfaden).

Compact erect epiphytes. *Roots* up to 18 cm by 1–3 mm. Stem entirely covered by leaf sheaths, 2.5–12 cm by 3–6 mm; laterally compressed; the basal part with 2 or 3 bladeless sheaths; internodes 3–11 mm, terminal internode not much longer. *Leaves* stiff, hard-coriaceous, the upper 1 or 2 around the inflorescence short; leaf blade linear-lanceolate to linear, sabre-shaped, laterally flattened, slightly curved, 27–80 by 2.9–5.8 mm, index 5.7–17.9; nerves 15–20 per side. *Racemes* unbranched or with up to 4 branches, up to 15 mm long, often completely covered by sterile bracts or by its fibres; sterile bracts 3–5 at the base of the raceme, soon disintegrating into fibres, midrib keeled, 5–10 by 2.5–6 mm; floral bracts hard and thick, 3 by 2.5 mm, top part along the midrib keeled. *Flowers* up to 30 per inflorescence. *Pedicel* and *ovary* 3.5–10 mm long. *Median sepal* lanceolate to linear-lanceolate, 8.8–22 by 2.7–5 mm, index 3.3–5.5; nerves 7–9. *Lateral sepals* lanceolate, 8.7–22 by 2.7–5 mm, index 3.2–4.4; nerves 7–9. *Petals* lanceolate, 9–21 by 2.6–5, index 3.1–4 mm; nerves 7–9, at the base 3, the lateral ones branching. *Lip* 8.4–18 by 5.4–12.3 mm. *Hypochilium* when flattened about triangular in outline, with scattered hairs, 5.3–10 by 5.4–12.3 mm; lateral lobes rather small, triangular, with acute top, not to slightly projecting in front for up to 0.6 mm, 0.7–2.5 by 2.5–7 mm; callus with scattered hairs. *Epichilium* ligulate to semi-elliptic, with few scattered hairs, 2.6–9 by 3.3–12.3 mm; top slightly emarginate, its tip minutely apiculate; callus low, narrow, slightly swollen, to the top more swollen and ligulate, minutely papillose, 4–7 by 1–2.5 mm. *Column* 9–13 by 2.2–3 mm, at the base without auricles; seams on the stalk 0.2–0.3 mm wide, below the stigma drawn out into broadly triangular, to 0.5–1.7 mm high wings with broadly rounded top; top covering the basal part of the back of the anther, truncate to obtuse. *Stigma* 1.1–1.6 by 1.5–2.4 mm; rostellum 0.8–1.5 by 1.5–2.4 mm. *Anther* 0.7–1.3 by 1.1–2.2 mm. *Pollinia* 0.6–1.5 by 0.4–1 mm. *Viscidium* 1.2–2.3 by 1–2.4 mm; top rounded. *Fruit* 16–17.5 by 4.6–5 mm.

Colours — Sepals and petals cream coloured to pale yellow. Lip pale green to pale yellow; callus on hypochilium yellow with several longitudinal rows of irregular purple spots at the base; epichilium white with a large reddish violet blotch at the base and a yellow callus. Column pale yellow, base spotted with purple. Anther white.

Distribution — Thailand (North and Peninsular), 2 collections (coll. Seidenfaden). Malay Peninsula (Malacca, Selangor, Terengganu), 5 coll. (coll. Seidenfaden, E, K, SING). Singapore, 3 coll. (BM, SING). Sumatra (Jambi, Sumatera Utara), 2 coll. (BO). Borneo: Sarawak (2nd Div.), Sabah (West coast Residency), Brunei (Temburong), Kalimantan (Kalimantan Tengah), 6 coll. (AMES, BO, BM, K, L).

Habitat & Ecology — Epiphytes in lowland to hill Dipterocarp or primary forests. Altitude up to 1830 m. Fl. Aug.–Feb.

Notes — 1. Sterile material of *B. aporoides* cannot be distinguished with certainty from *B. truncata*. Since flowering specimens of *B. aporoides* are so far unknown from the Malay Peninsula, Sumatra and Borneo, all sterile material from these areas is here tentatively regarded as *B. truncata*. All records by Ridley, Smith and Holttum from the Malay Peninsula, Sumatra and Borneo probably also refer to *B. truncata*. New collections are needed to establish whether *B. aporoides* is native in the Malesian area.

2. Collection *Lohok 28* is aberrant in stem size and leaf width. The taxonomic status of this specimen is not clear and therefore its measurements are not included in the present description.

3. The epithet *truncata* refers to the truncate front edges of the sidelobes of the lip.

#### INSUFFICIENTLY KNOWN

##### 27. *Bromheadia falcifolia* Schltr.

*Bromheadia falcifolia* Schltr. in Fedde, Rep., Beih. 1 (1914) 369. — Type: *Schlechter 19919*.

Slender epiphytes. Stem entirely covered by leaf sheaths, 15–25 cm long; slightly flattened. *Leaves* stiff, hard-coriaceous; leaf blade linear, laterally flattened, curved, 7–18 cm by 2.5–3.5 mm. *Flowers* not known.

Distribution — New Guinea: Papua New Guinea (Morobe Prov.).

Habitat & Ecology — Epiphytes. Altitude 450 m.

Notes — 1. All known specimens were destroyed during the second world war.

2. The epithet *falcifolia* refers to the falcate leaves of this species.

##### 28. *Bromheadia spec. nov.*, Schltr.

*Bromheadia spec. nov.* Schltr. in Fedde, Rep. 21 (1925) 75. — Specimen: *Schlechter s.n.*, 01-1910.

Description not given. Stated to be related to *B. aporoides* and *B. falcifolia*.

Distribution — Celebes (Sulawesi Tengah).

Habitat & Ecology — Epiphyte. Altitude 300 m.

Note — All known specimens were destroyed during the second world war.

#### EXCLUDED SPECIES

*Bromheadia rigida* Ridley in Stapf, Trans. Linn. Soc. Bot. 4 (1894) 23 = *Dilochia rigida* (Ridley) J. J. Wood.

## LIST OF COLLECTIONS

### *Bromheadia* Lindley

#### Section *Bromheadia*

1. *alticola* Ridley (alt)
2. *borneensis* J.J. Smith (bo), flowerless specimens
- 2a. var. *borneensis* (bob)
- 2b. var. *longiflora* Scheindelen & de Vogel (bol)
3. *crassiflora* J.J. Smith (cra)
4. *divaricata* Ames & Schweinf. (div)
5. *finlaysoniana* (Lindley) Miq. (fin)
6. *pendek* de Vogel (pen)
7. *rupestris* Ridley (rup)

#### Section *Aporodes* Schltr.

8. *aporoides* Rchb. f. (apo)
9. *brevifolia* Ridley (bre)
10. *ceceliae* Kruizinga (cec)

11. *coomansii* J.J. Smith ex Kruizinga & de Vogel (coo)
12. *devozelii* Kruizinga (dev)
13. *ensifolia* J.J. Smith (ens)
14. *gracilis* Kruizinga & de Vogel (grc)
15. *graminea* Kruizinga & de Vogel (grm)
16. *grandiflora* Kruizinga & de Vogel (grn)
17. *humilis* Kruizinga & de Vogel (hum)
18. *latifolia* Kruizinga & de Vogel (lat)
19. *lohaniensis* Kruizinga & de Vogel (loh)
20. *longifolia* Kruizinga & de Vogel (lon)
21. *pungens* Ridley (pun)
22. *robusta* Kruizinga & de Vogel (rob)
23. *scirpoidea* Ridley (sci)
24. *srilankensis* Kruizinga & de Vogel (sri)
25. *tenuis* J.J. Smith (ten)
26. *truncata* Seidenf. (tru)

A. series see SAN A — Aban, see SAN series — Aet 648 (fin) — Aet & Idjan 473 (fin); 829 (fin) — Afriastini 985 (fin); 01136 (rob) — d'Alleizette s.n., 24-06-1909 (fin) — Alvins 151 (fin); 2117 (fin) — Amdjah 980 (bob) — Ambriansyah 623 (fin) — Ames & Schweinfurth 389 (div) — Anderson 174 (ten) — Anonymus s.n., 08-1938 (bo); 148 (fin); 11092 (fin).

Banjarmasin cult. (Delmaar 12) s.n. (grn) — Barnes s.n., 1949 (fin) — Bartlett s.n., 1893 (fin) — Batten Pool s.n., 3-10-1939 (fin) — Beaman, J.H. 10268 (bob); 10414 (cec); 10491 (bre) — Bels 204 (fin) — Blume s.n., 1859 (fin) — Bogor cult. (Coomans de Ruiter) 934.10.55 (coo); 938.8.205 (lat); (Spoel 1381) s.n., 16-09-1927 (tru) — Bois 2215 (fin) — van Borssum Waalkes 1965 (fin) — Brass 7094 (fin); 8883 (fin); 19646 (fin); 28193 (fin) — Brooke, W.M.A. 8583 (ten); 9418 (fin); 9690 (fin) — Brunig, see S series — BS series 64 (fin); 500 (fin); 1333 (bol); 1583 (fin); 2479 (fin); 2481 (fin); 5026 (fin) — Bünnemeijer 1423 (fin); 1551 (fin); 1714 (fin); 1992 (fin); 2118 (fin); 2284 (fin); 2389 (fin); 6340 (fin); 6557 (fin); 6577 (fin); 6578 (bo); 6711 (fin); 6920 (fin); 7292 (fin); 7771 (fin); 7787 (fin) — Burbidge s.n., s.d. (fin) — Burger 17 (fin) — Burkill s.n., 28-06-1913 (fin); s.n., 02-1914 (fin); s.n., 31-12-1913 (fin); s.n., 23-06-1913 (fin); 2283 (fin); 4659 (fin) — Burkill & Haniff s.n., 11-1924 (sci) — Burt & Martin B11669 (bob); B12992 (fin) — Burt & Martin B5463a (cra) — Burt & Woods B2249 (bo) — Buwalda 5508 (fin); 6235 (fin); 7764 (bol) — BW series 3157 (fin); 4303 (fin); 10664 (fin); 14972 (fin).

Carr (see also SF series) 29 (rup); 93 (bre); 145 (sci); 157 (alt) — Carrick & Enoch JC/46 (fin) — Chai, see S series — Clarkson 2888 (fin); 5328 (fin) — Clemens s.n., 7-12-1931 (fin); s.n., 24-09-1931 (fin); s.n., 4-08-1933 (cra); 2680 (fin); 20184 (ten); 20308 (ten); 20583 (fin); 22401 (fin); 22404 (fin); 25588 (ten); 26849 (fin); 27177 (div); 28818 (ens); 29788 (ens); 31011 (cra); 31049 (cra); 31930 (div); 32776 (cra); 32887 (div); 33004 (cra); 34322 (ens); 40465 (bre); 50490 (cra); 50701 (tru) — Collenette 2272 (coo); 2291 (sci) — Conn, Katik & Vinas 1704 (fin) — Corner s.n., 31-10-1935 (alt) — Croat 53199 (fin) — Cuadra, see SAN A. series — Cult. Hort. Lyon s.n., s.d. (fin) — Cult. Hort. Singapore s.n., 1905 (alt) — Cumberlege 1160 (apo) — Cuming 89 (fin); 2054 (fin).

Darnaedi D518 (fin) — Day, see PNH series — Derry 638 (fin) — Docters van Leeuwen 9812 (fin); 10268 (fin) — Dodson 8B3 (fin) — Dransfield 3139 (tru) — Dransfield & Hambali JD4333 (fin); 4337 (fin) — Dunleary 106 (rup)

Ender 2016 (fin); 4273 (cra); 4386 (cra) — Mohd. Enoch 345 (fin) — Evans, I.H.N. s.n., 07-1917 (fin). Fernando s.n., 04-1977 (sri) — Franck, C.W. 284 (fin); 285 (fin); 707 (fin).

Geesink, Hattink & Phengkklai 6544 (fin) — Gianni 275 (fin); 332 (fin) — Gibbot, see SAN series — Gittins 1864 (fin) — Gjellerup 660 (fin) — Goodenough s.n., 19-03-1889 (fin); s.n., 21-10-1889 (fin);

- s. n., 10-12-1889 (cra); s. n., 14-02-1890 (fin); s. n., 8-04-1890 (fin) — Grabowsky s. n., 10-1887 (fin) — Griffith s. n., 27-11-1902 (fin); 5271 (fin).
- Haan, J. H. de 8 (bo) — Hallier 1399 (fin); 1530 (fin); 1543 (fin); 3394 (ens) — Haniff, see SF series — Hansen & Smitinand 11936 (fin) — Harmand 187 (fin); 314 (fin) — Harvey s. n., s. d. (fin) — Haviland s. n., 11-1888 (fin); s. n., 19-12-1892 (bre); s. n., 09-1911 (bo) — Hendersone, see SF series — Hewitt 516 (ten); 517 (sci) — Hislop s. n., 06-1952 (pen) — Holtum s. n., 14-02-1926 (fin); see also SF series — Hoogland & Versteegh, see BW series — Horsfield 92 (fin) — Hume 8954 (fin).
- Iboet 3 (fin).
- Jacobson 1629 (ens) — Jaheri 938 (bo) — Joseph & Jarius, see SAN series.
- Kadim & Noor KN372 (fin) — Kadir, see SAN A series — Kartawinata 1463 (fin); 1477 (fin) — Kato & Wiriadinata B5815 (fin) — Keith A 642 (fin); 6717 (fin) — Kerr, A. D. 240 (apo) — Kerr, A. F. G. s. n., 28-04-1915 (apo); s. n., 9-05-1929 (alt); s. n., 04-1931 (apo); 23 (apo); 129 (fin); 380 (fin); 427 (fin); 467 (fin); 752 (alt); 831 (fin) — Kew cult. (Giles 847) E. N. 514-65 (sci) — King's Collector 1012 (alt); 1518 (fin); 4018 (fin) — Kloss 8818 (fin) — Kokawa & Hotta 217 (bo) — Koorders 22370 (fin) — Korthals s. n., s. d. (fin) — Kostermans (see also BW series) 8984 (bo); 9009 (bob); 9294 (fin); 12909 (ten) — Kostermans & Anta 1328 (fin) — Kostermans & Soegeng 636a (fin) — Kunstler 1518 (fin) — Kurz s. n., s. d. (fin).
- Lamb (see also SAN series) s. n., 1-06-1980 (cra); 1226B/90 (hum); 1423/92 (cec) — Lamb & Sawat 1303/91 (ens) — Lavarack 09-1976 (fin) — de Leeuw 19 (fin) — Lefroy s. n., 03-1894 (fin) — Leiden cult. (Franken & Roos) 20856 (tru); (Vermeulen, J. J.) 26467 (bre); (Vermeulen, J. J.) 26690 (loh); (de Vogel) 27571 (dev); (Wong) 27682 (pen); (de Vogel) 27695 (tru); (de Vogel) 27700 (grn); (de Vogel) 27709 (ens); (de Vogel) 27710 (sci); (de Vogel) 27721 (bre); (Wong) 27839 (ens); (de Vogel) 30180 (sci); (de Vogel) 913435 (grm); (de Vogel) 913663 (ens); (de Vogel) 913890 (cec); (de Vogel) 913892 (cec); (de Vogel) 913893 (bre); (de Vogel) 914176 (bre); (de Vogel) 914227 (grn); (de Vogel) 914280 (grn); (de Vogel) 914281 (ten); (de Vogel) 914310 (ten); (de Vogel) 914311 (grn); (de Vogel) 914313 (bre); (de Vogel) 914435 (bre); (de Vogel) 914471 (bre); (de Vogel) 914713 (ens); (de Vogel) 914911 (sci); (de Vogel) 914912 (ens); (Schuiteman) 932856 (bre); (Schuiteman) 933130 (rob); (Schuiteman) 933139 (bre); (Schuiteman) 933152 (grm); (Schuiteman) 933234 (tru) — Lewis 100 (tru) — Lohok 28 (tru?) — Lörzing 11599 (fin).
- Machado s. n., 10-1892 (fin) — Mahyar 924 (fin) — Main 1795 (fin) — Maingay 1657 (fin); 1680 (tru); 2671 (rup) — Martin, P. J., see S series — Meijer, W. (see also SAN series) 1053 (bob); 1881 (bob); 2515 (bo) — Mendoza 3706 (fin) — Merrill s. n., 27-11-1902 (fin) — Micholitz s. n., s. d. (fin) — Mondih 275 (fin) — Monod de Froideville 758 (fin) — Morton AM1552 (fin) — Motley 587? (tru) — Murata, Iwatski, Kato & Mogeia B-672 (fin); B-1768 (fin); B-2309 (bo); B-2319 (bob) — Muroh, see SAN series.
- Native collector S 540 (bre); 919 (coo); 2241 (sci) — Ngadiman, see SF series — NGF series: (Millar) 11779 (fin); (Ridsdale) 31705 (fin); (Ridsdale, Henty & Galore) 33240 (fin) — van Niel 4012 (fin) — Nin, see SF series — Nooteboom & Chai 1816 (fin); 2054 (cra).
- Paie, see S series — Paris cult. (1956, Laos) (apo) — Parish 346 (apo) — Pierre 314 (fin) — Ploem s. n., s. d. (fin) — PNH series: 3000 (alt); (Mendoza) 41917 (dev); 87666 (fin) — Polak 198 (fin); 211 (fin); 254 (fin); 438 (fin) — Poilane 14689 (fin) — Posthumus 901 (tru); 2160 (fin) — Purseglove 4899 (fin) — Put 1584 (fin).
- Quisumbing, see PNH series.
- Rahmat Si Boeca ('Toroes') 1591 (fin); 2017 (fin); 3384 (fin); 3448 (fin); 3770 (fin); 3840 (fin); 3899 (fin); 4161 (fin); 5839 (fin); 6066 (fin); 7062 (fin); 7363 (fin); 7383 (fin); 7777 (fin); 8051 (fin); 8513 (fin); 8767 (fin); 8909 (fin); 9195 (fin); 9950 (fin) — Ridley s. n., 05-18?? (tru); s. n., 30-10-1889 (tru); s. n., 6-11-1889 (tru); s. n., 10-1889 (alt); s. n., 1889 (fin); s. n., 1890 (alt); s. n., 1890 (fin); s. n., 8-01-1890 (cra); s. n., 9-01-1890 (alt); s. n., 08-1891 (sci); s. n., 1891 (alt); s. n., 1891 (cra); s. n., 1891 (fin); s. n., 21-01-1891 (fin); s. n., 06-1892 (alt); s. n., 06-1892 (fin); s. n., 06-1892 (tru); s. n., 10-11-1892 (fin); s. n., 1892 (fin); s. n., 1893 (fin); s. n., 1894 (bol); s. n., 1897 (bob); s. n., 1900 (fin); s. n., 06-1892 (tru); s. n., 1902 (alt); s. n., 12-1904 (fin); s. n., 1905 (fin); s. n., 03-1910 (fin); s. n., 07-1911 (pun); s. n., 01-1915 (ens); 638 (fin); 3143 (pun); 16118 (rup) — Rita s. n., s. d. (fin) — van Royen & Sleumer 6309 (fin); 6446 (fin) — Rycroft s. n., 14-02-1923 (fin).

S series: 102 (fin); 234 (fin); 299 (fin); 962 (bob); 2481 (fin); 5283 (fin); 7834 (fin); (Brunig) 9942 (bo); 12516 (fin); (Brunig) 17470 (ten); 28807 (fin); 28921 (fin); 35387 (fin); (Martin) 37575 (grm); 44482 (cra); (Yii Puan Ching) 48472 (grm) — SAN A series: (Kadir) 2711 (fin); (Alenadra) 4063 (fin) — SAN series: (Burgers) 22495 (fin); 22899 (bob); (Sam) 26511 (fin); 36685 (cra); (Pereira) 41058 (fin); (Donggop) 66305 (ten); (Gibot) 69143 (bo); (Leopold et al.) 71909 (lon); (Kumin Muroh) 74000 (fin); (Aban) 75935 (fin); (Nordin Abas) 85886 (fin); (Lamb) 87102 (cra); (Aban & Dewol Sundaling) 91609 (ten); 93455 (bob); (Gibot) 93991 (bo); (Joseph & Jarius) 107382 (fin); (Fidilis & Sumbing) 110298 (bo); (Madani & Ismail) 111455 (fin); (Sumbing & Asik) 112961 (fin); (Fidilis) 118656 (fin); (Fidilis) 121926 (fin); (Fidilis) 121987 (bo); (Dewol & Jumrafiah) 124134 (fin); (Fidilis & Sumbing) 125633 (fin); (Manotr) 127964 (bo); (Fidilis) 128074 (fin) — Schlechter 19288 (fin) — Schmutz 4932 (fin) — Schram, see BW series — Scortechini s.n., s.d. (fin) — Segerbäck 2055 (cec); 2085 (sci); 2128 (tru); 2136 (bre) — Seidenfaden 2464 (fin) — Seidenfaden & Smitinand GT 2691 (tru); GT 33447 (apo); GT 5001 (apo); GT 5203 (apo); GT 5250 (apo); GT 5651 (apo); GT 7535 (tru); GT 7651 (apo); GT 8724 (apo) — Seimund s.n., 11-1925 (fin); s.n., 5-12-1925 (fin); s.n., 9-03-1926 (fin) — SF series: (Haniff) 1091 (rup); 3260 (fin); 5324 (fin); 10853 (fin); (Nur & Foxworthy) 12033 (sci); 13109 (fin); 18931 (fin); 20439 (fin); (Carr) 27245 (bre); 27368 (fin); (Carr) 27455 p.p. (cec); (Carr) 27455 p.p. (lon); (Carr) 27455A (tru); (Carr) 27467 (div); (Carr) 27578 (ens); 27783 (cra); 36573 (div); 36685 (bo); (Sinclair) 38936 (sci) — Mohd. Shah (see also S series) 87 (sci); 231 (sci) — Mohd. Shah & Sidek 234 (fin); MS1185 (fin) — Shea 26241 (fin) — Sidek bin Kiah, see also S series — Sinclair (see also SF series) s.n., 1-11-1948 (fin); 8641 (tru) — Singapore cult. (Malakide) s.n. (Kew 20116) (apo) — Smythies, see S series — Stamps s.n., 30-09-1923 (fin) — Stefels, see BW series — Stone, Burkill & Yap 4831 (bo).

Talmy s.n., 1868 (fin) — Tan, see S series — Teijsmann 2047 (fin); 8446 (fin); 10936 (fin); 10979 (fin); 10981 (fin); 10986 (fin) — Thorel 1237 (fin) — Togashi s.n., 15-09-1966 (fin); s.n., 2-10-1966 (fin) — Tridel Busa 475 (apo) — Turkirin 378 (fin).

Vermeulen, J.J. 816 (bo); 865 (fin); 1179 (coo); 1263 (fin); 1286 (bob); 1302 (bre) — Vermeulen, J.J. & Duistermaat 1010 (grc); 1067 (cec); 1075 (grc); 1113 (fin) — Versteeg 1296 (fin) — de Vogel 8441 (bre); 8524 (cec); 9320 (bre); 9346 (bre); 9379 (ten) — de Vriese & Teijsmann s.n., 1859-1860 (fin).

Wallich Cat. 7361 (fin) — Whitters AJWP11 (fin) — Widjaja 202 (fin); 2177 (fin) — Wight s.n., 1893 (fin) — Winkler 6 (apo) — Wiriadinata 610 (fin) — Wiriadinata & Maskuri 633 (fin) — Wood 1764 (fin) — Wray 3121 (fin); 3390 (sci); 4019 (fin) — Wray & Robinson 5428 (alt) — Wrigley 479 (fin).

Yii, see S series.