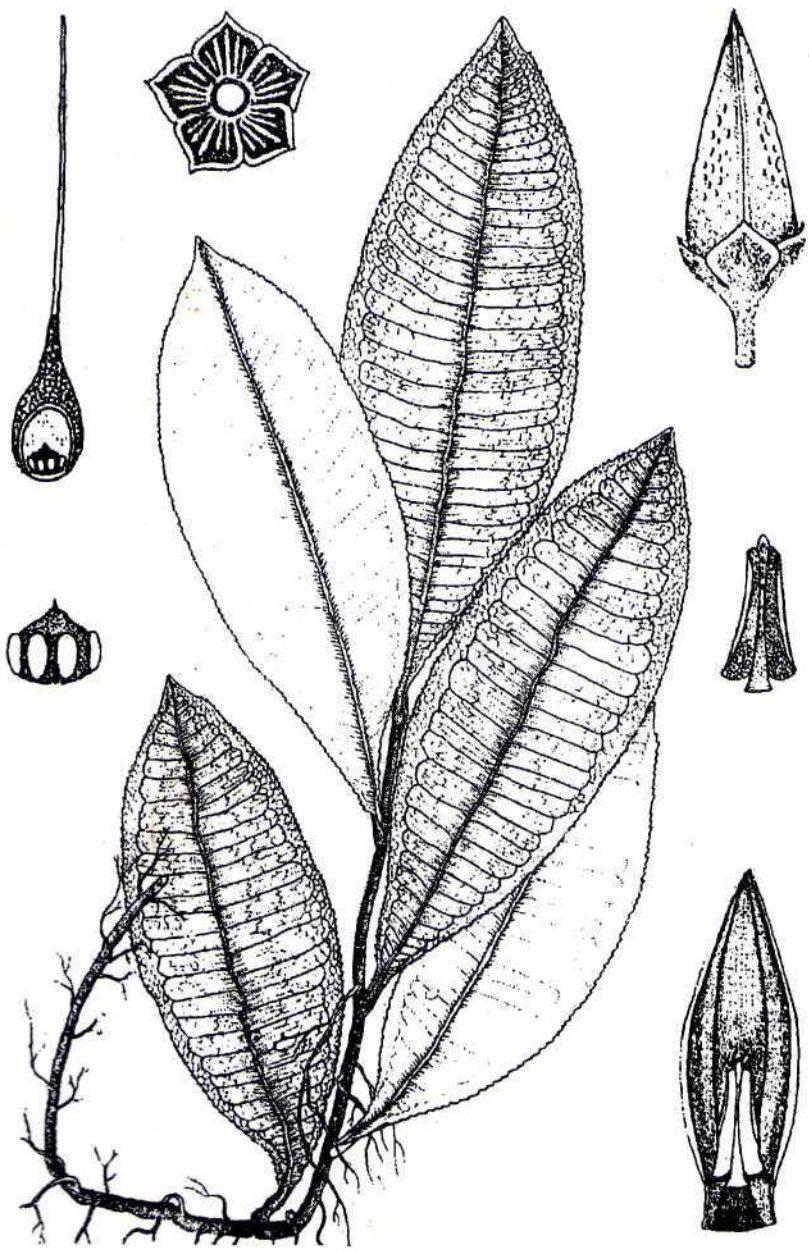
A JOURNAL ON TAXONOMIC BOTANY, PLANT SOCIOLOGY AND ECOLOGY



REINWARDTIA

12(1)

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A JOURNAL ON TAXONOMIC BOTANY,
PLANT SOCIOLOGY AND ECOLOGY

Vol. 12(1): 1-128.22 July 2002

Correspondence and subscriptions of the journal should be addressed to

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BOGOR, INDONESIA

REINWARDTIA
Vol 12, Part 1, pp: 95 – 116

THE BORNEAN GENUS HYPOBATHRUM (RUBIACEAE) AN INVESTIGATION OF ITS CHARACTERS AND TAXONOMIC STATUS

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ABSTRACT
MULYANINGSIH, TRI. & RIDSDALE, C. E. 2002. The Bornean genus *Hypobathrum* (*Rubiaceae*). An investigation of its characters and taxonomic status. *Reinwardtia* 12(1): 95–116. — The investigation on the characters and taxonomic status of the Bornean genus *Hypobathrum* was based on morphological observations of 140 specimens in Herbarium Borgoriense. The present study shows that there are 24 species that can be recognised. There are six species already placed in the genus (*H. frutescens, H. longifolium, H. microcarpum, H. racemosum, H. salicinum* and *H. venulosum*), three species require new combinations (*H. coniocarpum, H. gracile*, and *H. rufidulum*), one species requires a new combination and a new status (*H. hirtum*), a new name in *Hypobathrum* is required for one species (*H. lancifolium*). In the present study twelve new species are proposed (*H. bangueyense, H. caudifolium, H. collinum, H. ellipticifolium, H. glaberrimum, H. glabrum, H. lithophilum, H. palustre, H. rheophyticum, H. riparium, H. sampitense*, and *H. subulatum*). In addition, one incompletely known species is mentioned.

Keywords: *Hypobathrum, Rubiacaeae*, Borneo, taxonomy

ABSTRAK
MULYANINGSIH, TRI. & RIDSDALE, C. E. 2002. Marga *Hypobathrum* (*Rubiaceae*) di Kalimantan. Penelitian ciri dan status taksonominya. *Reinwardtia* 12(1): 95–116. — Penelitian karakter-karakter dan status taksonomi marga *Hypobathrum* di Kalimantan dilakukan dengan mengunakan 140 spesimen di Herbarium Bogoriense. Dari hasil penelitian tersebut disimpulkan bahwa marga *Hypobathrum* di Kalimantan ada 24 jenis. Enam jenis yang telah dikenal yaitu: *H. frutescens, H. longifolium, H. microcarpum, H. racemosum, H. salicinum* dan *H. venulosum*; tiga jenis kombinasi baru yaitu: *H. coniocarpum, H. gracile* dan *H. rufidulum*; satu jenis kombinasi baru dan status baru yaitu: *H. hirtum*; satu nama jenis baru yaitu: *H. lancifolium*. Dari hasil penelitian diusulkan dua belas jenis baru yaitu: *H. bangueyense, H. caudifolium, H. collinum, H. ellipticifolium, H. glaberrimum, H. glabrum, H. lithophilum, H. palustre, H. rheophyticum H. riparium, H. sampitense* dan *H. subulatum*. Satu jenis yang tidak lengkap juga disebutkan.

Kata Kunci: *Hypobathrum, Rubiaceae*, Kalimantan, taksonomi

INTRODUCTION

Hypobathrum is one of the small genera belonging to the tribe Octotropideae (Rubiaceae), with about 26 described species from the Old World in Tropical Africa & Madagascar and Comoro islands and Mainland S. E. Asia and Malesia to the Philippines and Celebes (Robbrecht, 1980; Baillon, 1879; Index Kewensis, 1997). Some species of this genus are recorded as being used as vegetables and medicines by local people (Burkill, 1935; Siemonsma & Piluer, 1994).

The typical characters of plants of this genus are small understorey treelets with horizontal branchlets and bilocular, baccate fruits and superficially resemble coffee, which is also reflected in the local names of the plants – Kopen (Java) or Kikopi (Sunda).

The name *Hypobathrum* was created by Blume in 1826, for a plant which Junghuhn collected from Burangrang mountain, West Java. From 1826 to 1875, it remained a monotypic genus that was characterised by the axillary inflorescences, flowers are arranged in dense cymes.

In 1814, a related species of the genus was described by Roxburgh from a plant collected by Buchanan in 1796 from Lukshmeepoora, Chitagong, India. At the time he named the taxon as *Randia racemosa*. In 1829, the same taxon was described by Richard as *Spicillaria leschenaultii*, but a year latter in 1830, De Candolle changed

this name to *Petunga roxburghii*, then it became the type of the genus *Petunga*. Lastly, in 1877 Kurz transferred the taxon to the genus *Hypobathrum* as *H. racemosum*.

In 1851, Korthals considered the genus *Petunga*, and he found four species in Sumatra, Java and Borneo, three of them were found in Borneo, one of which is *Petunga lanceolata* Korth. Baillon (1879) treated *Hypobathrum* in Tropical Africa, Madagascar and Comoro islands, and he recognised 14 species, six of which were knew species and a further eight new combinations, one of which was *H. lanceolatum* (Sond.) Baill., which was based on *Krausia lanceolata* Sond. This plant has typical characters such as the flowers in a cyme, turbinate, pentamerous, corolla throat sparsely villous, stamens exerted, anthers basifixed and ovule 1 per locule and is not related to the Bornean species which requires a new name.

Hooker (1882) was the first author who considered that *Petunga* should be placed into *Hypobathrum*, but without clearly stating his reasons. Later, Backer (1956) accepted this treatment, because the differences between the two genera were only in the absolute length of the spike axis.

On 1902, Koorders and Valeton stated that genus *Hypobathrum* was different from *Petunga*, and they recorded three species of *Hypobathrum*: *H. brevipes* K. & V., *H. frutescens* Blume and *H. parviflorum* Miquel and four species of *Petunga*: *P. brevispica* K. & V., *P. glomerata* (Blume) DC, *P. longifolia* DC and *P. microcarpa* (Blume) DC in Java. Six decades later, Backer and Bakhuizen van den Brink *f.* (1965) revised them; *P. glomerata* (Blume) DC was placed in the synonym of *H. frutescens* Blume; *H. brevipes* K. & V. and *P. brevispica* K. & V. were placed in the synonym of *H. parviflorum* Miquel, and *P. longifolia* DC was placed in the synonym of *H. microcarpum* (Blume) Bakh. *f.* The authors thus accepted four species of *Hypobathrum* in Java. Later Wong (1989), considered that *P. longifolia* DC to be a different from *H. microcarpum* (Blume) Bakh. *f.*, and made the combination *H. longifolium* (DC) Wong. In Malaya, Wong (1989), treated *Hypobathrum* and described four species and ten incompletely known species.

It was considered essential to do an in-depth study of the Bornean genus *Hypobathrum*, especially to solve the taxonomic problems, such as misidentifications of *H. longifolium* (DC) Wong var. *hirta* (Ridley) Wong in Malaya by Wong (1989).

The present study has attempted to ascertain the correct names of the taxa, improve the classification, and to determine relationships between the species. An identification key and data on the distribution of the taxa are also given.

The study is based on an investigation of the herbarium materials from BO and fresh material from Bogor Botanical Garden. From the collections studied by the authors, details and whereabouts are given only for those specimens used for an in-depth morphological study. Measurements and descriptions are from dried materials, except for floral and fruit sizes, which are based on rehydrated (boiled in water) materials. The observations were made using a binocular microscope

MORPHOLOGICAL CHARACTERS

Habit

The *Hypobathrum* species are usually shrubs or small trees or treelets, seldom trees, but specimens of *H. frutescens* can reach up to 16 m tall.

Branchlet

Shape. Most species have quadrangular branchlets when young and becoming subterete with age, or always subterete (*H. lithophilum* and *H. subulatum*), or always quadrangular (*H. coniocarpum* and *Hypobathrum* sp.).

Surface. The young branchlets usually have a puberulous indumentum with simple hairs only, in most species the hairs disappear with age. However some species have glabrous branchlets. There are two species with persistent hairs. *H. rufidulum* has a tomentose indumentum and *H. hirtum* has a hirsute indumentum.

Leaves

General. The attachment of the leaves is decussate in all species. Most leaves are petiolated with a subterete petiole, but *H. salicinum* and *H. subulatum* have sub sessile leaves with flattened petioles. The texture of the leaves is coriaceous.

Shape. The species have various leaf shapes, for example: elliptic leaf (*H. bangueyense, H. collinum, H. ellipticifolium, H. glabrum* and *H. rufidulum*); lanceolate (*H. frutescens, H. glaberrimum, H. lancifolium, H. microcarpum, H. racemosum* and *H. riparium*); varying between elliptic and lanceolate (*H. hirtum* and *H. longifolium*); ovate (*H. palustre* and *H. sampitense*); linear (*H. lithophilum, H. rheophyticum, H. Salicinum* and *H. subulatum*).

Base. The base of the leaves mainly vary between acute and cuneate or between cuneate

and attenuate. Often the base of the leaves are obtuse (*H. collinum* and *H. gracile*).

Apex. Normally vary between acuminate and cuspidate, often acute (*H. longifolium*), or cuspidate e. g. *H. hirtum*, or caudate (*H. caudifolium, H. collinum, H. glaberrimum, H. lithophilum, H. rheophyticum, H. subulatum* and *H. venulosum*). In the latter case the transition to the leaf apex can be gradual.

Upper and lower surface. The upper surface is always smooth. Often the upper surface is also shining such as on *H. palustre*. The lower surfaces are normally more rough and are different in colour (lighter than above). All the Borneo species have glabrous leaves on upper surface but on lower surface the veins are normally glabrous, often with a caducous indumentum (*H. caudifolium* and *H. frutescens*), or some times species have persistent hairs, such as *H. hirtum* which has hirsute veins, *H. bangueyense, H. gracile, H. longifolium, H. palustre* and *H. rheophyticum* have puberulous veins and *H. rufidulum* has a tomentose indumentum all over.

Venation. The venation is usually depressed on the upper surface, rarely the primary veins are prominent on the upper surface (*H. racemosum* and *H. salicinum*). Venation is raised on lower surface. Primary veins vary between massive and stout or between stout to moderate, or between moderate and weak. Normally the angle of divergence of the secondary vein varies between acute and moderate. The number of secondary veins varies between 5–11 pairs. Most tertiary veins are conspicuously reticulate. Often the tertiary veins are inconspicuously reticulate, such as *H. lithophilum, H. rheophyticum, H. salicinum* and *H. subulatum.* The marginal veins are arcuate or looped.

Margin. The leaf margins are always entire and they are usually glabrous, but some species have a caducous puberulous indumentum such as *H. frutescens, H. longifolium, H. palustre* and *Hypobathrum* sp. However *H. rufidulum* has a persistent indumentum on its leaf margins.

Stipule

Shape. Normally the stipules vary from ovate keeled to triangular and keeled, or lanceolate, keeled. The position of stipules is interpetiolar.

Stipule base. The stipule base is usually free, or often connate. For example *H. hirtum* has ovate stipules with a connate base, while triangular stipules with connate bases are found on *H. rufidulum* and *H. collinum* has lanceolate stipules connate at the base.

Margin. The stipule margins are ciliated.

Inner and outer surface. Most species have stipules which are glabrous on the inner surface, often the base of the stipules are pilose such as on *H. racemosum.* The outer surface of the stipules vary: glabrous (*H. collinum, H. glaberrimum, H. lancifolium, H. longifolium, H. racemosum, H. riparium* and *H. venulosum*), or tomentose on the tip (*H. bangueyense* and *H. salicinum*) or tomentose on the base or along the midrib (*H. caudifolium, H. ellipticifolium, H. glabrum, H. gracile, H. microcarpum, H. palustre, H. rufidulum* and *H. sampitense*), or hirsute over the whole parts (*H. hirtum* and *H. subulatum*).

Duration. Mostly the stipules are caducous to sub-caducous, but some are persistent (*H. caudifolium, H. coniocarpum, H. glaberrimum, H. gracile, H. lithophilum, H. rufidulum* and *H. venulosum*).

Inflorescence

Inflorescence. The inflorescences are normally axillary, but they can be axillary to pseudoterminal (end bud still present), e. g. *H. racemosum.* Most inflorescences originate from the nodes but others are supra-axillary (*H. caudifolium, H. collinum, H. glaberrimum, H. gracile, H. rufidulum, Hypobathrum* sp., *H. subulatum* and *H. venulosum*).

Bracts and Bracteoles

Bracts. Bracts on the axis and on the dichasium are present. The bracts usually vary between ovate and triangular or between triangular to lanceolate, except on *H. subulatum,* where the shape of the bracts is spear like.

Inner and outer surface. In most species the bracts are glabrous on the inner surface**.** There are some exceptions where the base of the bracts are pilose on the inner surface (*H. ellipticifolium, H. microcarpum, H. racemosum, H. salicinum* and *H. sampitense*), or sericeous overall (*H. rufidulum*), or sericeous on the tip e. g. *H. coniocarpum* and *H. hirtum.*

Position. The bracts are usually compiled decussate on the elongate axis and opposite on dichasium, or often opposite and alternate on the elongate axis and opposite on the dichasium (*H. glabrum, H. lithophilum, H. rheophyticum,* and *H. subulatum*).

Bracteoles. Bracteoles are usually ovate, keeled or triangular, keeled, but sometimes narrowly triangular, keeled (*H. rheophyticum*).

Bracteoles base. Some species have bracteoles with the base free and some others have bracteoles with the base connate on one side. For example *H. bangueyense, H. collinum, H.*

coniocarpum, H. hirtum, H. lithophilum and *H. rheophyticum* have a triangular bracteoles with the base free. *H. caudifolium, H. frutescens, H. glabrum, H. gracile* and *H. longifolium* and *Hypobathrum* sp. have ovate bracteoles with the base free. *H. ellipticifolium, H. lancifolium, H. riparium* and *H. salicinum* have triangular bracteoles with the base connate on one side. *H. glaberrimum, H. microcarpum, H. palustre, H. racemosum, H. sampitense* and *H. venulosum* have ovate bracteoles with the base connate on one side and lanceolate bracteoles with the base connate on one side are found on *H. rufidulum.*

Inner and outer surface. The inner surfaces of the bracteoles are usually glabrous, but can be pilose on the base (*H. racemosum*); or sparsely sericeous on the top (*H. coniocarpum* and *H. hirtum*), or sparsely sericeous over the whole surface (*H. rufidulum*).

Position. Most bracteoles are inserted opposite to the base of the pedicel, or at the middle to the top of the pedicel (*H. glaberrimum* and *H. venulosum*); or one bracteole inserted on the base of the pedicel (*H. longifolium*); or only one bracteole inserted on the middle to the top of the pedicel (*H. subulatum*).

Margin. The bracteole margins are ciliated.

Flowers

General. Most flowers are small, at most up to about 2.5–5 mm long by 2–4 mm in diameter. The flowers are campanulate (corolla lobes united to compose a cup-shaped) or infundibular (funnel-shaped). The flowers are usually tetramerous. The exceptions are *H. hirtum, H. rufidulum* and *H. subulatum* which are the only species in the genus to have penta-merous flowers.

The arrangement of the flowers varies: a densely compound dichasia (fig. 1a.–Group of the false dichotomy with the flowers to open situated between two lateral flower or cluster e. g. *H. frutescens*); a compound verticillate dichasia (fig. 1b. *H. racemosum*); a simple verticillate dichasia (fig. 1c. Dichasium are compiled decussate on elongate axis, such as on *H. caudifolium, H. ellipticifolium, H. lancifolium, H. microcarpum, H. racemosum, H. riparium, H. salicinum, H. sampitense* and fig. 1d. Dichasium are compiled opposite and alternate on elongate axis, e. g. *H. glabrum*); a panicle (fig. 1e. The branches of the primary axis are racemose and the flowers pedicellate e. g. *Hypobathrum* sp.); sub raceme (fig. 1f.–Pedicelate flowers are compiled decussate on elongate axis, pedicel ≤ 1 (–2) mm long, e. g. *H. bangueyense, H. coniocarpum, H. glaberrimum, H. gracile, H. hirtum, H. lithophylum, H. longifolium, H. rheophyticum, H. subulatum* and *H. venulosum*; fig. 1g. Compiled opposite and alternate on elongate axis e. g. *H. lithophilum, H. rheophyticum* and *H. subulatum*); spike (fig. 1h.–Sessile flowers are compiled decussate on elongate axis e. g. *H. palustre* and *H. rufidulum*).

Peduncle. The peduncle lengths vary from extremely short (≤ 2 mm) to ≥ 20 mm, to long, *H. caudifolium* which has peduncle up to 45 mm long. Peduncle type varies between subterete and ensiform or ensiform and quadrangular. The peduncle surface is usually puberulous, sometimes hirsute (*H. coniocarpum* and *H. hirtum*), or glabrous (*H. bangueyense* and *H. racemosum*).

Pedicel. Most flowers are sub-sessile with an extremely short pedicel ≤ 1 (–2) mm long.

Calyx. The lobes are united to form cup- or funnel-shaped calyx which usually has four or five tiny ovate or triangular lobes. The calyx is usually extremely short (up to 1.5 mm long) and is always persistent on the fruit.

Surface. The calyx is usually glabrous on the inside, except in *H. coniocarpum* where it is sericeous on the apex of the lobes. On outside, the calyx is sometimes sericeous on the lobes or over the whole of the outer surface, but it also can be glabrous e. g. *H. venulosum.* The calyx lobes are ciliated on the margins.

Corolla. The corolla is usually campanulate or infundibular, usually four lobed, seldom 5 lobed. The corolla texture is usually thin, but it can be thick (*H. bangueyense, H. coniocarpum* and *H. ellipticifolium*). The shape of the corolla lobes is usually rotundate or ovate.

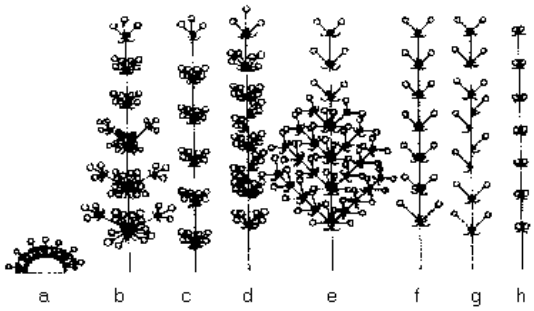

Fig. 1. The arrangement of flowers in inflorescence: a. densely compound dichasia; b. compound verticillate dichasia; c. and d. simple verticillate dichasia; e. panicle; f. and g. sub raceme; h. spike.

Surface. The corolla is usually glabrous on the outer surface, less frequently it is hairy, e. g. *H. hirtum, H. lithophilum, H. longifolium, H. rheophyticum, H. rufidulum* and *H. subulatum.*

The inner surface of the throat is usually sparsely to densely villous, but it can be glabrous e.g. in *H. coniocarpum*, *H. glaberrimum* and *H. lancifolium.* The margins of the lobes are ciliated.

Stamen. The stamen is usually sub-sessile (with filament up to 1 mm long) seldom sessile e. g. *H. collinum*, *H. glaberrimum*, *H. lithophilum*, *H. microcarpum*, *H. riparium* and *H. subulatum*. The stamens are usually inserted in the throat, sometimes around the middle of the tube (*H. ellipticifolium*, *H. sampitense* and *H. subulatum*).

Anther. The anthers are always slightly protruding (the tips of the anthers are exerted in open mature flowers), their shape varies from ovate, lanceolate, to linear. The apex is always acute and its base is always bilobed. The anther is usually dorsifixed around the middle, sometimes sub-basifixed, but rarely dorsifixed (*H. coniocarpum* and *H. microcarpum*).

Disc. Most species have an annular disc and few have annular swollen. In nature, the ring-like, green disc surrounding the base of the style is coated with nectar. Although actual observations are lacking, it is suggested that the flowers are visited by flies while in search of nectar they carry out pollination (Robbrecht & Puff, 1986).

Pistil. The ovary is always inferior and consists of two locules, with 1–9 ovules per locule. Placental position is apical and pendulous.

Style. The style is usually terete and smooth. The exception is *H. subulatum* where it is terete with vertical grooves. Most species have a style which is villous over the whole surface, if the surface is vertically grooved then the hairs are found on the grooves. According Robbrecht & Puff (1986), hairs and vertical grooves have function in pollen presentation. In some species the style is glabrous (*H. coniocarpum*, *H. glaberrimum* and *H. lancifolium*).

Stigma. The stigma is always bifid, with the lobes linear or oblong. The lobes open horizontal in the mature flowers to facilitate pollen reception but they are closed in the bud stage when pollen presentation may occur.

Fruit

Fruit (fig. 2). Most species have subglobose fruits, but other shapes occur: elliptic (*H. coniocarpum* and *H. salicinum*), or obovate (*H. ellipticifolium*, *H. rheophyticum* and *H. sampitense*), or pyriform (*H. gracile*, *H. lithophilum*, and *H. subulatum*), or turbinate (*H. venulosum*). The fruits are smooth, except in *H. gracile* and *H. venulosum* which are vertically grooved. The surface of the fruits are usually glabrous, but may also tomentose (*H. rufidulum*), hirsute (*H. hirtum* and *H. longifolium*), and puberulous (*H. subulatum*). The fruits are baccate (mesocarp fleshy and juicy).

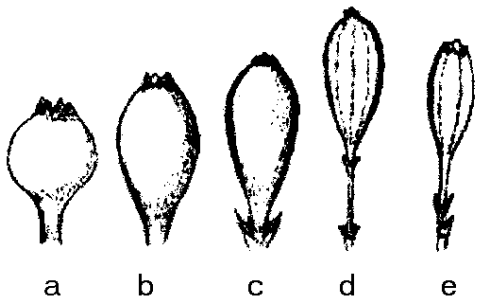

Fig. 2. The fruit shape: a. subglobose, b. elliptic, c. obovate, d. pyriform, e. turbinate.

Stalk. The stalk is terete and smooth, it may be glabrous or covered with hairs e. g. hirsute on *H. hirtum*, or puberulous on *H. venulosum.*

Seeds. In the majority of species the seeds are compressed, a few exceptions have been observed where the seeds are concave. The seeds are always pendulous and when there are several seeds per locule they are imbricate. The exotesta is always sulcate and composed of strong elongate fibrous cells. The seeds are ruminate except on *H. glaberium*. The type of embryo is always foliate (spatulate-shape) and incumbent. The position of embryo is always lateral base.

TAXONOMY

HYPOBATHRUM Blume

Hypobathrum Blume, Bijdr. (1826): 1007; Don, Gen. His. Dichl. Pl. III (1834): 547; Bentham & Hooker, Gen. Pl. II (1876): 92; Baillon, His. Pl. VII (1880): 315; Hooker, Fl. Brit. Ind. III (1882): 120–121; Backer & Bakhuizen *f.*, Flora of Java II (1965): 315–316; Robbrecht, Bull. Jard. Bot. Nat. Belg. L (1980): 69–77; Wong, Tree Fl. Malaya. IV (1989): 354–355. –Typus: *Hypobathrum frutescens* Blume

Petunga DC. Prodr. IV (1830): 398; Don, Gen. His. Dichl. Pl. III (1834): 509–510; Korthals, Nederl. Kruidk. Arch. ii II (1851): 171; Bentham & Hooker, Gen. Pl. II (1876): 92; King & Gamble, Journ. As. Soc. Beng. LXXII (1903): 221–224; Ridley, Fl. Malay Pen. II (1923): 84–85. –Typus: *Petunga roxburghii* DC.

Habit shrub, tree or treelet. *Trunk* straight with pairs of horizontal to divaricating branches. *Branchlets* quadrangular to subterete, bark smooth or vertically fissured, glabrous, or a caducous or persistent hairs.

Leaves ovate, elliptic, lanceolate or linear, coriaceous, decussate, symmetrical, above gla-

brous, drying colour pale green, grayish dark brown or dark brown, below glabrous or persistent hairs or hairs disappear by ages, on the primary or primary and secondary veins or over the whole parts, drying colour light brown, brown or dark brown; margins entire, glabrous, caducous or persistent hairs; veins above depressed or prominent, below prominent; primary veins weak to massive; secondary veins curved; 5–14 pairs, with acute to wide angle divergence, tertiary veins inconspicuous or conspicuous, marginal veins arcuate. *Petiole* subterete or flatten.

Stipules ovate, triangular or lanceolate, keeled, caducous, sub-caducous or persistent, base free or connate, inner and outer surface glabrous or hairy, margins ciliate.

Bracts decussate or opposite and alternate, ovate, triangular or lanceolate, keeled, inner and outer surface glabrous, sericeous or pilose, margins ciliate. *Bracteoles* ovate, triangular or lanceolate, keeled, one or pair inserted on the base or on the middle to the top of pedicel, inner and outer surface glabrous or hairy, margins ciliated, the base free or connate on one side.

Inflorescences axillary or axillary-pseudo-terminal, deflected, horizontal or erect, originating from the nodes or supra-axillary in origin. *Peduncle* extremely short or distinct, glabrous or with caducous or persistent hairs.

Flowers hermaphrodite, arranged in a densely compound dichasia, a simple or compound verticillate dichasia, sub raceme, a panicle, or a spike, sessile or sub sessile, tetra-merous or penta-merous. *Hypanthium* cup or funnel-shaped, glabrous or hairy. *Pedicel* extremely short or distinct, glabrous or with hairy. *Calyx* cup or funnel-shaped, inside and outside glabrous or with hairy, divided into 4–5 tiny ovate or triangular lobes, margins ciliate. *Corolla* cup- or funnel-shaped, thin or thick, tubes short, the throat glabrous or villous, divided into 4–5 rotundate or ovate lobes, contorted in the bud, margins ciliate. *Perianth* epigynous. *Ovary* inferior, bilocules, one to many ovules per locule. *Stamens* 4–5, sessile or sub sessile, inserted in the throat or around the middle of the tube. *Anthers* ovate, lanceolate or linear, with two lobes at the base, dorsifixed, or dorsifixed around the middle or sub-basifixed, erect, slightly protunding in the blossom flower. *Stigma* bifid, 2 oblong or linearly lobed, glabrous or villous, lobes open horizontal and exerted in the blossom flower. *Style* terete, smooth or vertical grooves, glabrous or villous. *Disc* annular or annular swollen. *Perianth* epigynous. *Ovary* inferior, 2 loculed with 1 to many ovules per locule.

Fruits baccate, subglobose, obovate, elliptic, pyriform or turbinate, smooth or vertical grooves, glabrous or hairy, with a persistent calyx; exocarp leathery, mesocarp fleshy, endocarp membranaceous. *Stalk* extremely short or distinct, glabrous or hairy. *Seeds* 1 to many, concave or compressed, arranged pendulous imbricate, exotesta was composed of elongate strongest fibrous cells, sulcate, embryo foliate, spatulate, basal lateral, cotyledon incumbent.

DISTRIBUTION: *World*. Africa: Tropical Africa, Madagascar & Comoro Islands. Continental South East Asia: India, North East & Nicobar Islands eastwards to Vietnam. Malesia: Malay Peninsula, Sumatra, Borneo, Java, Lesser Sunda islands, Celebes and Philippine islands.

Hypobathrum is found throughout Borneo, both Malaysian and Indonesian political areas.

KEY TO THE BORNEAN SPECIES OF HYPOBATHRUM

1. a. Branchlets with a persistent indumentum 2
   b. Branchlets glabrous or with a caducous indumentum 4
2. a. Bracts inside sericeous over the whole surface. Bracteoles inside sericeous over the whole surface. Flowers in a spike, sessile. Anthers sub-basifixed ..... 19. *H. rufidulum*
   b. Bracts inside not sericeous over the whole surface. Bracteoles inside sericeous on the top. Flowers in sub raceme, sub sessile. Anthers dorsifixed around the middle 3
3. a. Branchlets hirsute. Stipules ovate, persistent. Bracts inside sericeous on the top. Flowers pentamerous. Corolla funnel-shaped. Stamens sessile. Disc annular ..... 10. *H. hirtum*
   b. Branchlets puberulous. Stipule triangular, caducous. Bracts inside pilose on the base. Flowers tetramerous. Corolla cup-shaped. Stamens sub sessile. Disc annular swollen ..... 13. *H. longifolium*
4. a. Leaves linear, tertiary veins inconspicuous 5
   b. Leaves not linear, tertiary veins conspicuous ... 8
5. a. Leaves glabrous on lower surface. Bracts decussate. Bracteoles base connate on one side. Anthers sub-basifixed ..... 20. *H. salicinum*
   b. Leaves puberulous on the veins of the lower surface. Bracts opposite and alternate. Bracteoles base free. Anthers dorsifixed around the middle 6
6. a. Bracts spear like and the first bracts elongate. One bracteole inserted on the pedicel. Inflorescences supraaxillary in origin. Flowers pentamerous. Style vertically grooved ..... 22. *H. subulatum*
   b. Bracts not spear like and the first bracts do not elongate. A pair of the bracteoles inserted

oppositely to the pedicel. Inflorescences arising from the nodes. Flowers tetramerous. Style smooth 7

6. a. Petiole puberulous. Stipules persistent. Bracts outside sericeous. Bracteoles oppo-site at the middle to the top of the pedicel. Hypanthium funnel-shaped, puberulous. Corolla funnel-shaped. Fruits pyriform, vertically grooved. Stalk glabrous ..... 12. *H. lithophilum*
   b. Petiole glabrous. Stipules subcaducous. Bracts outside glabrous. Bracteoles opposite at the base of the pedicel. Hypanthium cup-shaped, glabrous. Corolla cup-shaped. Fruits obovate, smooth. Stalk puberulous ..... 17. *H. rheophyticum*
8. a. Bracts inside hairy 9
   b. Bracts inside glabrous 15
9. a. Stipules outside glabrous 10
   b. Stipule outside hairy 13
10. a. Stipules caducous to sub-caducous. Pedicel glabrous ..... 16. *H. racemosum*
   b. Stipules persistent. Pedicel hairy 11
11. a. Bracteoles inserted oppositely to the base of the pedicel. Inflorescences originating from the nodes ..... 4. *H. coniocarpum*
   b. Bracteoles inserted oppositely to the middle to the top of the pedicel. Inflorescences supra-axillary in origin 12
12. a. Bracts ovate. Hypanthium sparsely puberulous. Fruits turbinate, vertically grooved, sparsely puberulous. Stalk puberulous .... 23. *H. venulosum*
   b. Bracts narrowly triangular. Hypanthium glabrous. Fruits subglobose, smooth, glabrous. Stalk glabrous ..... 7. *H. glaberrimum*
13. a. Disc annular swollen. Fruits subglobose ..... 14. *H. microcarpum*
   b. Disc annular. Fruits obovate 14
14. a. Petiole glabrous. Bracteoles ovate. Hypan-thium funnel-shaped. Corolla thin, funnel-shaped. Anthers sub-basifixed ..... 21. *H. sampitense*
   b. Petiole puberulous. Bracteoles triangular. Hypanthium cup-shaped. Corolla thick, cup-shaped. Anthers dorsifixed around the middle ..... 5. *H. ellipticifolium*
15. a. Flowers in a spike, sessile 16
   b. Flowers not in a spike, sub sessile 17
16. a. Veins on lower surface and petiole glabrous. Stipules base connate. Bracteoles base free, one inserted on the middle to the top of the pedicel. Corolla cup-shaped. Anthers sub-basifixed ..... 3. *H. collinum*
   b. Lower surface of veins and petiole scattered puberulous. Stipules base free. Bracteoles base connate on one side, inserted oppositely to the base of the pedicel. Corolla funnel-shaped. Anthers dorsifixed around the middle ..... 15. *H. palustre*
17. a. Bracteoles base connate on one side 18
   b. Bracteoles base free 19
18. a. Corolla inside villous in the throat. Anthers sub-basifixed. Style villous on the middle to the top ..... 18. *H. riparium*
   b. Corolla inside glabrous. Anthers dorsifixed around the middle. Style glabrous ..... 11. *H. lancifolium*
19. a. Veins with a persistent indumentum on lower surface. Flowers in sub raceme 23
   b. Veins glabrous or with a caducous indumentum on lower surface. Flowers not in sub raceme.. 20
20. a. Bracts ovate, opposite and alternate. Peduncle glabrous ..... 8. *H. glabrum*
   b. Bracts triangular, decussate. Peduncle hairy... 21
21. a. Flowers in a panicle ..... 24. *Hypobathrum* sp.
   b. Flowers not in a panicle 22
22. a. Stipules triangular, subcaducous, outside glabrous. Inflorescences arising from the nodes. Peduncle ≤ 2 mm long. Flowers in a densely compound dichasia. Hypanthium glabrous. Anthers subbasifixed ..... 6. *H. frutescens*
   b. Stipules ovate, persistent, outside tomentose. Inflorescences supra-axillary in origin. Peduncle ≥ 15 mm long. Flowers in a simple verticillate dichasia. Hypanthium densely hirsute. Anthers dorsifixed around the middle... 2. *H. caudifolium*
23. a. Stipule ovate, persistent. Bracteoles inserted oppositely to the middle to the top of the pedicel. Inflorescences supra-axillary in origin. Peduncle and axis hairy. Anthers dorsifixed around the middle ..... 9. *H. gracile*
   b. Stipule triangular, caducous. Bracteoles inserted oppositely to the base of the pedicel. Inflorescences arising from the nodes. Peduncle and axis glabrous. Anthers sub-basi ..... *H. bangueyense*

1. Hypobathrum bangueyense Mulyaningsih & Ridsdale, *sp. nov.* —Fig. 3

Folia elliptica subtus venis puberulis, petioli hirti, stipulae triangulares caducae, bracteae triangulares decussatae glabrae, bracteolae triangulares basi liberae pedicelli basi opposite insertae, corolla crassa, lobi ovati, faux villosa, stylus stigma villosus, antherae subbasifixae. – Typus: *P. Castro & F. Melegrito* 1445 (BO–holotype), North East Borneo, Banggi (Banguey) island, VIII 1923. Fl.

Habit unknown. *Branchlets* divaricating, when young quadrangular and becoming subterete with age, bark smooth, glabrous; internodes 37–45 mm long, 2,5 mm wide, 2 mm thick, pilose on the young nodes after stipules have fallen.

Leaves elliptic, 75–108 mm long, 26–46 mm wide, above glabrous, drying colour pale green, below puberulous on primary and secondary veins, brown; apex cuspidate; the base cuneate; margins with caducous hairs; veins above depressed below prominent, primary veins stout, secondary veins ascending, curved, 7 pairs, moderate angle of divergence, tertiary veins

conspicuous. *Petiole* terete 6–7 mm long, hirsute on upper surface.

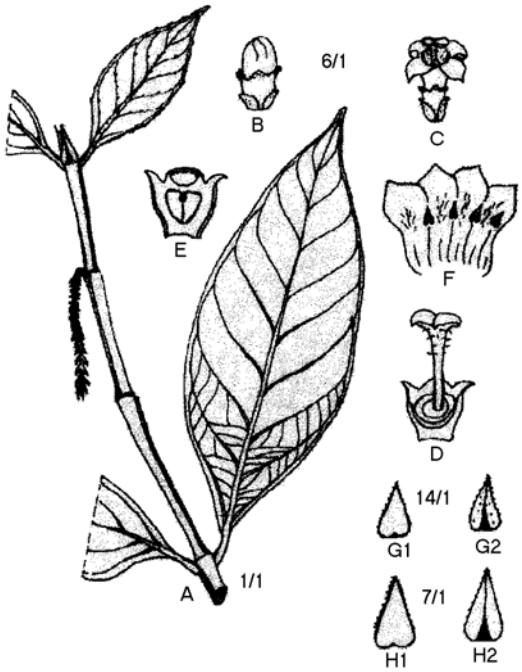

Fig. 3. *Hypobathrum bangueyense*; A. flowering shoot from *P. Castro & F. Melegrito* 1445; B. flower bud; C. mature flower; D. pistil; E. the longitudinal section of the hypanthium; F. corolla; G1. Bracteole inside; G2. bracteole outside; H1 bract inside; H2. Bract outside.

Stipules caducous, triangular, 7 mm by 5 mm, keeled, outer surface tomentose on the tip, inner surface glabrous, the base free, apex acute.

Bracts triangular, 2 mm by 0.5 mm, strongly keeled, decussate, the apex acuminate, glabrous on outer and inner surfaces. *Bracteoles* triangular 1 mm by 0.3 mm, keeled, opposite at the base of the pedicel, inside glabrous, outside sparsely sericeous, the base free.

Inflorescences deflected, arising from the nodes. *Peduncle* up to 2 mm long, glabrous. *Axis* glabrous, 15–50 mm long, 10–35 nodes, compressed below nodes, 4 mm space between nodes.

Flowers arranged in sub raceme, sub-sessile, tetra-merous, 2 mm by 1.1 mm. *Pedicel* 0.2 mm long, hirsute. *Hypanthium* funnel-shaped, 0.8 mm by 0.8 mm, glabrous. *Calyx* funnel-shaped, 0.5 mm by 1.2 mm, tubes glabrous, lobes 4, tiny ovate, 0.4 mm by 0.7 mm, inside glabrous, outside sparsely sericeous on the apex. *Corolla* thick, funnel-shaped, 1.8 mm by 1 mm (flower bud), glabrous on outer surface, tubes short, the throat sparsely villous; lobes 4, ovate, 0.8 mm by 1 mm. *Stamens* 4, sub sessile, inserted in the throat; filament 0.1 mm long; anthers sub-basifixed, 1 mm by 0.2 mm. *Style* smooth, terete, 0.6 mm long, sparsely villous on the middle to the top. *Stigma* bifid, lobes 0.6 mm long, sparsely villous on outer surface. *Disc* annular. *Ovules* 5 per locule.

Fruits not seen.

DISTRIBUTION AND ECOLOGY. The herbarium specimens were collected only from Banguey island, but no notes on habit and ecology were made.

2. Hypobathrum caudifolium Mulyaningsih & Ridsdale, *sp. nov.*—Fig. 4

Folia ovata ad elliptica glabra, stipulae ovatae persistentes extra tomentosae, bracteae triangulares decussatae extra sericeae, bracteolae basi liberae, pedicelli basi opposite insertae, inflorescentiae supra-axillariter ortae, flores in simplices dichasiis verticillatis, pedunculus plus quam 15 mm. longus axe pubescens, pedicellus glaber, hypanthium pubescens, corolla tenuis, lobi rotundati, faux sparse villosa, stylus cylindricus stigma bifidum villosus, antherae circa medium dorsifixae. – Typus*: H. Wiriadinata* 1310 (BO!–holotype; L, K, A, SING, SAN–isotype), East Borneo, Long Tesak, 14 III 1978. Fl.

Habit treelet, 3-4 m high, 3 cm diam. *Branchlets* divaricating, when young quadrangular and becoming subterete with age, bark smooth, glabrous but around the nodes scattered puberulous on young growth, internodes 50–73 mm long, 1.5–2 mm wide, 1.5–2 mm thick.

Leaves ovate to elliptic, 100–140 mm long, 28–60 mm wide, above glabrous, drying colour dark brown, below sparsely puberulous on the primary veins of the young growth, drying colour brown; apex caudate; the base acute; margins glabrous; veins above depressed, below prominent, primary veins moderate to weak, secondary veins curved, 7 pairs, ascending with acute to moderate angle of divergence, tertiary veins conspicuous. *Petiole* 7–10 mm long, above sparsely puberulous on the young growth.

Stipules persistent, ovate, 5–7 mm by 4.5–6 mm, keeled, apex acuminate to cuspidate, the base free, inside glabrous, outside scattered to-entose along the midrib.

Bracts triangular, 1.5 mm by 0.8 mm, keeled, decussate, inside glabrous, outside sericeous over the whole parts. *Bracteoles* ovate, 0.9–1 mm by 0.5–0.8 mm, faintly keeled, opposite at the base

of the pedicel, inside glabrous, outside densely sericeous on the midrib to the whole parts, the base free.

Inflorescences deflected, horizontal or erect; supra-axillary in origin. *Peduncle* 15–45 mm long; axis 70–100 mm long with 23-26 nodes, 3–7 mm between nodes, subterete to ensiform, sparsely hirsute.

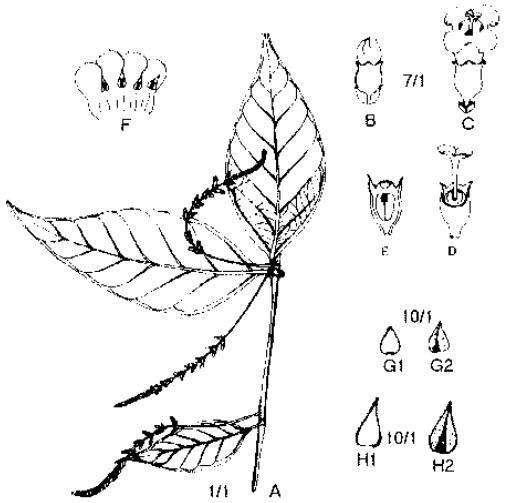

Fig. 4. *Hypobathrum caudifolium*; A. flowering shoot from *H. Wiriadinata* 1310; B. flower bud; C. mature flower; D. pistil; E. the longitudinal section of the hypanthium; F. corolla; G1. bracteole inside; G2. bracteole outside; H1. bract inside; H2. bract outside.

Flowers arranged in a simple verticillate dichasia, sub sessile, tetramerous, 4.5 mm by 2 mm. *Pedicel* 0.5 mm long, glabrous. *Hypanthium* cup-shaped, 0.5–1 mm by 0.7–1 mm, densely hirsute. *Calyx* funnel-shaped, 0.7–1 mm by 0.7–1 mm, outside densely sericeous, inside glabrous, lobes 4, ovate, 0.3–0.7 mm by 0.5 mm, faintly keeled. *Corolla* thin, funnel-shaped, 3.8 mm by 2 mm, outside glabrous, tubes up to 2 mm in long, inside sparsely villous in the throat, lobes 4, rotundate, inside sparsely villous on the base. *Stamens* 4, sub sessile, inserted in the throat, filaments 0.1 mm long, anthers linear, 1.7 mm by 0.2 mm, dorsifixed around the middle, the base with two lobes. *Style* terete, smooth, 1.25 mm long, densely villous on the middle to the top. *Stigma* bifid, lobes linear, densely villous on outside. *Disc* annular. *Ovule* 1 per locule.

Fruits not seen.

DISTRIBUTION AND ECOLOGY. This species has been found in the disturbed forest at 15–100 m above sea level, at Bucalung and Long Tesak (East Borneo).

VERNACULAR NAMES. BORNEO: Semampat (Kutai), Dejang (Dayak).

NOTES. This species strongly resembles *H. gracile* but differs in the following characters: hairy on primary veins below, inflorescence type, calyx and corolla shape and hypanthium hairy.

3. Hypobathrum collinum Mulyaningsih & Ridsdale, *sp. nov.*—Fig. 5

Folia elliptica glabra, stipulae caducae ad subcaducae basi connatae, inflorescentiae crassae deflexae supra-axillariter ortae, flores spiciformes. – Typus: *Jaheri* 333 (BO!– holotype), Central Borneo, Bukit Batu Milier, 1896-1897. Fl. bud & fr.

Habit unknown. *Branchlets* subterete when young quadrangular and becoming subterete with age, bark smooth, glabrous; internodes 45–65 mm long, 2.5–3 mm wide, 2–2.5 mm thick.

Leaves elliptic, 105–150 mm long, 33–53 mm wide, above glabrous, drying colour dark brown, lower surface glabrous, drying colour brown; apex caudate; the base obtuse; margins glabrous; veins above depressed, below prominent, primary veins moderate, secondary veins curved, 7–9 pairs, ascending with angle of divergence moderate, tertiary veins conspicuous. *Petiole* 3 mm long, 1mm diam., glabrous.

Stipules caducous to sub-caducous, lanceolate, 7 mm by 3 mm, keeled, the base connate, apex cuspidate, glabrous on inner and outer surfaces.

Bracts ovate, 1.2 mm by 0.8 mm, keeled, decussate, inside glabrous, outside sericeous on the top. *Bracteoles* triangular, 0.8 mm by 0.4 mm, keeled, one inserted on the middle to the top of pedicel, glabrous on inner and outer surfaces, the base free.

Inflorescences stout, horizontal to deflected, supra-axillary in origin. *Peduncle* ensiform, 3–4 mm long, 1 mm diam., puberulous. *Axis* ensiform, 15–25 mm long, 1 mm wide, 8–12 nodes, space between nodes 2–3 mm, glabrous.

Flowers arranged in a spike, sessile, tetramerous, 2 mm by 0.8 mm. *Hypanthium* funnel-shaped, 0.8 mm by 0.7 mm, glabrous. *Calyx* sub-campanulate, 0.8 mm by 0.8 mm, glabrous on inner surface; lobes 4, narrowly triangular, 0.5 mm by 0,3 mm, outside sparsely sericeous on the top. *Corolla* thin, campanulate, 1.6 mm by 0.8 mm; outer surface glabrous, inner surface densely villous in the throat; lobes 4, rotundate, 0.6 mm by 0.4 mm, glabrous on inner surface. *Stamens* 4,

sessile, inserted in the throat; anthers lanceolate to linear, 0.7 mm by 0.2 mm, sub-basifixed, base with two lobes. *Style* smooth, terete, 0.2 mm by 0.05 mm, villous on the middle to the top. *Stigma* bifid, 0.1 mm long, villous on the outer surface. *Disc* annular. *Ovules* 5 per locule.

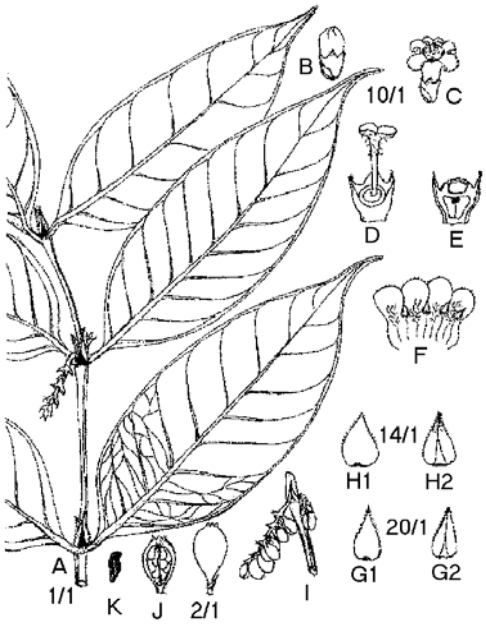

Fig. 5. *Hypobathrum collinum;* A. flowering shoot from *Jaheri* 333; B. flower bud; C. mature flower; D. pistil; E. the longitudinal section of the hypanthium; F. corolla; G1. bracteole inside; G2. bracteole outside; H1. bract inside; H2. bract outside; I. fruiting; J. the position of seeds in the fruit; K. seed.

Fruit smooth, subglobose, 7–8 mm by 4–5 mm, glabrous, exocarp thick, mesocarp fleshy, endocarp membranaceous. *Stalk* 1.5 mm long, 2 mm diam., glabrous. *Seeds* 1–2 per locule, concave to compressed, 5 mm long, 3 mm wide, 0.8 mm thick.

DISTRIBUTION. Bukit Batu Milier (Central Borneo).

4. **Hypobathrum coniocarpum** (Korth.) Mulyaningsih & Ridsdale, *comb. nov.*

Petunga coniocarpa Korth., in Nederl. Kruidk. Arch. ii II (1851): 173; Fl. Ind. Bat. II (1956): 202. –TYPUS: *Korthals s. n. Herb. Lugd. Bat.* No. 908 220-241 (L-holo, photocopy!), Borneo, South Borneo, Martapura.

DISTRIBUTION AND ECOLOGY. This species was found growing in the secondary forest near river bank at Binalik river (North Borneo), Martapura (South Borneo), and West Kutai (East Borneo), in the secondary forest at Ancalong (East Borneo) or in the hilly forest near Teluk Bajur, Berau (East Borneo). It is found within an altitudinal range of 15–250 m above sea level.

VERNACULAR NAMES. BORNEO: Semampat (Kutai), Lejang (Dayak).

NOTES. At a glance flowering plants are similar to *H. gracile*, but the attenuate of leaves base; bracts and bracteoles base free, sericeous on inside and outside are like *H. longifolium*.

5. **Hypobathrum ellipticifolium** Mulyaningsih & Ridsdale, *sp. nov.* –Fig. 6

Folia elliptica glabra, stipulae triangulares caducae, bracteae ovatae, bracteolae triangulares oppositae ad pedicelli basin, inflorescentiae deflexae ad nodos ortae, flores in simplices dichasiis verticillatis hypanthium cupuliforme, corolla crassa cupuliformis lobis ovatis, antherae ad medium dorsifixae, fructus obovatus. – Typus: *W. M. Polak* 1401 (BO! –holotype; L, SING–isotype), South Borneo, Banjarmasin, Tulungrejo, 3 X 1959. Fl. & fr.

Habit unknown. *Branchlets* subterete but quadrangular on young growth, bark smooth, glabrous but sparsely puberulous on below the nodes of the young growth, internodes 38–60 mm long, 2.5 mm wide, 2.5 mm thick.

Leaves elliptic, 70–75 mm long, 32 mm wide, glabrous, above pale green, below drying colour brown; apex acute; the base attenuate; margins glabrous; secondary veins curve, 9 pairs, ascending with moderate angle divergence, tertiary veins conspicuous. *Petiole* subterete, 5 mm by 1 mm, scattered puberulous on the upper part.

Stipules caducous, triangular, 7 mm by 4 mm, keeled, inside glabrous, outside sparsely puberulous along the midrib, the base free, apex obtuse.

Bracts ovate, 1 mm by 1 mm, keeled, decussate, inside pilose on the base, outside hirsute. *Bracteoles* triangular, 0.7 mm by 0.8 mm, keeled, opposite at the base of pedicel, outside sericeous on the top, inside glabrous, the base connate on one side.

Inflorescences deflected, originating from the nodes. *Peduncle* ensiform, 3 mm by 1.5 mm, sparsely puberulous. *Axis* 9–12 mm long, 30 nodes, space between nodes 2 mm, sparsely puberulous.

Flowers arranged in a simple verticillate dichasia, sub sessile, tetramerous, 3 mm by 1 mm.

Pedicel 1 mm by 1.5 mm, sparsely puberulous. *Hypanthium* cup-shaped, 1.5 mm by 1 mm, glabrous. *Calyx* campanulate, 0.5 mm by 1 mm, inside glabrous, outside scattered sericeous; lobes 4, triangular, 0.3–0.7 mm by 0.5–0.7 mm. *Corolla* thick, sub-campanulate, 2.2 mm by 1 mm, inside villous in the throat, outside glabrous; lobes 4, ovate 1.2 mm by 0.6 mm. *Stamens* 4, sessile, inserted around the middle of the tube; anthers dorsifixed around the middle, linear, 0.9 mm by 0.1 mm. *Style* smooth, terete, 0.4–1.25 mm, villous on the middle of the top. *Stigma* bifid, linear, 0.6 mm by 0.1 mm, villous on outer surface. *Disc* annular. *Ovules* 7 per locule.

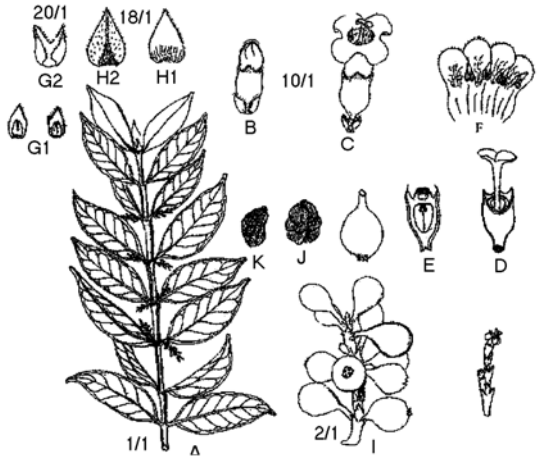

Fig. 6. *Hypobathrum ellipticifolium*; A. flowering shoot from *IGG Mudhitha cs. s. n.;* B. flower bud; C. mature flower; D. pistil; E. longitudinal section of the hypanthium; F. corolla; G1. bracteole inside with flowers bud; G2. bracteole outside; H1. bract inside; H2. bract outside; I. fruiting; J. the position of seeds in the fruit; K. seed.

Fruits smooth, obovate, 6–7 mm by 2.5–3 mm, glabrous, exocarp thick, mesocarp fleshy, endocarp membranaceous. *Stalk* 6 mm by 0.7 mm, sparsely puberulous. *Seeds* 7 per locule, compressed, 4 mm long, 1 mm wide, 0.1 mm thick.

DISTRIBUTION AND ECOLOGY. This species was found growing on the clayey ground near marshy forest at Tulungrejo, Banjarmasin (South Borneo).

NOTES. This species differs from *H. ellipticum* Baill., which has the following typical characters: leaves chartaceous, ovate, lateral vein 3–4 pairs, inconspicuous, stipule apiculate, disc inconspicuous.

6. HYPOBATHRUM FRUTESCENS Blume

DISTRIBUTION AND ECOLOGY. This species has been recorded from a variety of habitats. Moist primary and secondary forests growing in the fertile top-soil on the slopes of mountains in Sumatra, Java, Lesser Sunda Islands. Also in the forest near the beach of Pelabuhan Ratu.

In Borneo this species has been found in the riparian forest at Martapura (South Borneo) and Kombeng mountain, West Kutai (East Borneo). It is found at an altitudinal range 30–2100 m above sea level. Flowering: September, fruiting: November (middle Java); flowering and fruiting: January–April, or June–August (West & East Java).

VERNACULAR NAMES. Apit, Hapit, Kopian, Kopen (Java); Resberesan (Madura); Kikopi (Sunda).

7. **Hypobathrum glaberrimum** Mulyaningsih & Ridsdale, *sp. nov.* –Fig. 7

Folia lanceolata glabra, stipulae persistentes, bracteolae pedicelli e medio ad apicem insertae, inflorescentiae supra-axillariter ortae, flores in subracemosae, corolla utrinque glabra, stylus teretus stigma bifidum glaber. – TYPUS: *Amdjah* 346 (BO!–holotype, L–isotype) Central Borneo, Untung river, 27 XII 1898. Fl. bud & fr.

Habit unknown. *Branchlets* divaricating, subterete but quadrangular on young growth, bark smooth with rounded scars made by insects, glabrous, internodes 40–75 mm long, 2–3 mm wide, 1–2 mm thick.

Leaves lanceolate, 90–198 mm long, 23–66 mm wide, glabrous, upper surface (grayish) dark brown and lower surface drying colour brown; apex cuspidate to caudate; the base attenuate to cuneate; margins glabrous; veins above depressed, below prominent, primary veins stout to moderate, secondary veins curved, (6–) 8–11 pairs, ascending with moderate angle divergence, tertiary veins conspicuous reticulate. *Petiole* subterete, 2–7 mm by 1–2 mm, glabrous.

Stipules persistent, triangular to lanceolate, 5–11 mm by 4–7 mm, faintly keeled, glabrous on inside and outside, the base connate, apex acute to narrowly acuminate.

Bracts narrowly triangular, 1.5–3 mm by 0.5–1.5 mm, keeled, decussate, inside pilose on the base, outside sericeous along the midrib. *Bracteoles* ovate, faintly keeled, 1–1.5 mm by 0.8–1 mm, apex acuminate, opposite at the middle to the top of the pedicel, inside glabrous, outside

sericeous on the top, the base connate on one side.

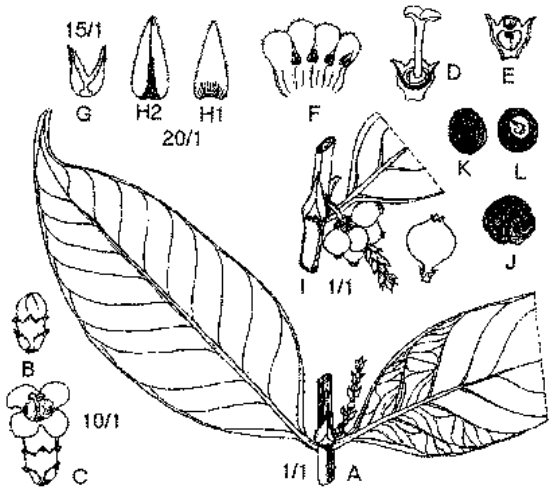

Fig. 7. *Hypobathrum glaberrimum*; A. flowering shoot from *Amdjah* 346; B. flower bud; C. mature flower; D. pistil; E. longitudinal section of the hypanthium; F. corolla; G bracteole; H1. bract inside; H2. bract outside; I. fruit; J. the position of seeds in the fruit; K. seed; L. the position of the embryo in the seed.

Inflorescences erect to deflected, supra-axillary in origin. *Peduncle* quadrangular or subterete to ensiform, 2.5–5 mm by 1–1.5 mm, sparsely puberulous. *Axis* quadrangular or subterete or ensiform, 13–34 mm long, 13–34 nodes, space between nodes 1–2 mm, sparsely puberulous.

Flowers arranged in sub raceme, sub sessile, tetramerous, 0.5–0.7 mm by 0.5–0.6 mm, still in bud. *Pedicel* up to 0.5 mm by 0.3 mm, sparsely puberulous. *Hypanthium* funnel-shaped, 0.2–0.5 mm by 0.1–0.3 mm, glabrous. *Calyx* campanulate, 0.2–1 mm by 0.5–1 mm, glabrous on inner and outer surfaces; lobes 4, ovate to narrowly triangular, 0.1–0.8 mm by 0.2–0.3 mm, faintly keeled, glabrous on inner surface, sericeous on the top of outer surface. *Corolla* thin, subcampanulate, 0.5–0.6 mm by 0.5–0.7 mm, glabrous on inner and outer surfaces; lobes 4, rotundate, 0.3–0.4 mm by 0.2–0.3 mm, glabrous on inner and outer surfaces. *Stamens* 4, sessile, inserted in the throat; anthers sub-basi-fixed, lanceolate, 0.3–0.4 mm long, base with two lobes. *Style* smooth, terete, 0.4–1.25 mm, glabrous. *Stigma* bifid, ovate, 0.1–0.3 mm by 0.05 mm, glabrous. *Disc* annular. *Ovules* 2–3 per locule.

Fruits smooth, subglobose, 5–8 mm by 4–7 mm, glabrous, exocarp thick, mesocarp fleshy, endocarp membranaceous. *Stalk* 1.5–3 mm by 4–7 mm, glabrous. *Seeds* compressed to con-cave, 1–3 per locule, 3–6 mm long, 2–2.5 mm wide, 0.5–2.5 mm thick, endosperm homogeneous.

DISTRIBUTION AND ECOLOGY. This species has been found near river banks, at Untung river, Lelebulan (Central Borneo), Magne river (East Borneo) and in North Borneo.

8. Hypobathrum glabrum Mulyaningsih & Ridsdale, *sp. nov*. – Fig. 8

Folia elliptica glabra, stipulae triangulares caducae extra in costa tomentosae, bracteae ovatae oppositae vel alternatae, bracteolae basi liberae extus omnino sericeae, inflorescentiae e nodis ortae, flores in simplices dichasiis verticillatis, pedunculus, axis pedicelli glabri. – Typus: *E. G. Sauver* 1031 (BO!–holotype), Central Borneo, Tanah Laut, Tunggel mountain. 2 VIII 1965. Fl. bud.

Habit treelet to tree, 7 m high. *Branchlets* when young quadrangular and becoming subterete with age, bark smooth, glabrous; internodes 51–60 mm long, 2 mm wide, 2.5 mm thick, pilose on the young nodes after stipules have been fallen.

Leaves elliptic, 92–102 mm long, 32–37.5 mm wide, glabrous, above drying colour dark brown, below drying colour brown; apex cuspidate; the base cuneate, margins entire; veins above depressed, below prominent, primary veins moderate, secondary veins curved, 7–8 pairs, ascending with acute to moderate angle of divergence, tertiary veins conspicuous. *Petiole* subterete, 3 mm long, 1 mm diam., glabrous.

Stipules caducous or sub-caducous, triangular, 7 mm by 1.5 mm, apex obtuse, inside glabrous, outside tomentose along the midrib.

Bracts ovate, keeled, 1.9 mm by 0.8 mm, opposite and alternate, inside glabrous outside sericeous. *Bracteoles* ovate, keeled, 1 mm by 0.7 mm, opposite at the base of pedicel, inside glabrous, outside sericeous, the base free.

Inflorescences erect, originating from the nodes. *Peduncle* subterete, 5 mm long, 1 mm diam., glabrous. *Axis* subterete, 18–24 mm long, 0.8 mm wide, 7–10 nodes, space between nodes irregular glabrous.

Flowers arranged in simple verticillate dichasia, sub sessile, tetramerous, 3 mm by 1.7 mm. *Pedicel* 0.3 mm long, 0.3 mm diam., glabrous. *Hypanthium* funnel-shaped, 0.5 mm by 0.7 mm, glabrous. Calyx funel-shaped, 0.5 mm by 0.7 mm, glabrous on inner surface; lobes 4, ovate, 0.3–0.4 mm by 0.8 mm, keeled faintly, outside sparsely sericeous on the top. *Corolla* funnel-shaped, 2.5 mm by 0.9 mm, thin; outer surface glarous, inner surface densely villous in the throat;

lobes 4, rotundate, 1 mm by 0.9 mm, glabrous on inner surface. *Stamens* 4, sub sessile, inserted in the throat; filaments 0.3 mm by 0.1 mm; anthers lanceolate to linear, 0.2–1.3 mm by 0.05–0.1 mm, dorsifixed around the middle, the base with two lobes. *Style* smooth, terete, 0.8 mm by 0.1 mm, densely villous on the middle to the top. *Stigma* bifid, 0.1 mm long, villous on outer surface. *Disc* annular. *Ovules* 4–per locule.

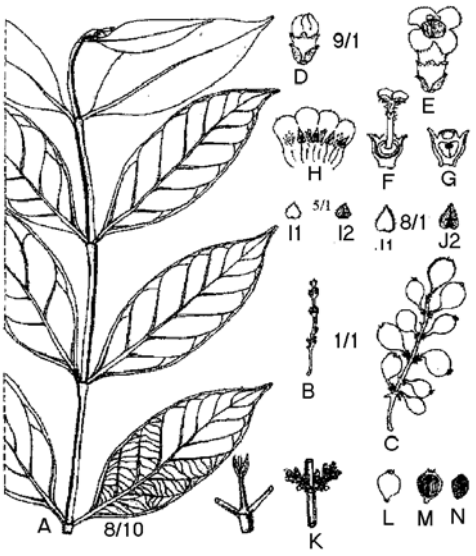

Fig. 8. *Hypobathrum glabrum;* A. shoot, B. inflorescence and C. fruiting from *H. Winkler 2577*; D. flower bud; E. mature flower; F. pistil; G. longitudinal section of the hypanthium; H. corolla; I1. bracteole inside; I2. bracteole outside; J1. bract inside; J2. bract outside; K. flowering from *E. G. Sauver* 1031; L. fruit; M. the longitudinal sections of the fruit; N. seed.

Fruits subglobose, smooth, 7 mm by 5.5 mm, glabrous, exocarp thick, mesocarp fleshy, endocarp membranaceous. *Stalk* 0.5 mm long, 0.8 mm diam., glabrous. *Seeds* 6 per locule compressed, 4 mm long, 2.5 mm wide, 1 mm thick.

DISTRIBUTION AND ECOLOGY. This species has been found in fields on wet land at the base of Tunggel mountain, Tanah Laut (Central Borneo) at 2 m above sea level.

9. **Hypobathrum gracile** (Korth.) Mulyaningsih & Ridsdale, *comb. nov.*

Petunga gracilis Korth., Nederl. Kruidk. Arch. ii II (1851): 173; Miquel, Fl. Ind. Bat. II (1856): 201. – Type: *Korthals s. n. Herb. Lugd. Bat. No. 908, 220–256* (L–holo, photocopy!) *Herb. Lugd. Bat. No. 908, 220–251, 255, 258, 260* (L–iso, photocopy!) Borneo, South Borneo, Banjarmasin, Prarawin mountain.

DISTRIBUTION AND ECOLOGY. This species was found growing on periodically inundate land near Kelai river at the base of Nyapa mountain on 20 m above sea level, and in the disturbed forest and in the marshy calcareous forest at Kelinjau river, and in the secondary forest at Sak river (East Borneo) and Prarawin mountain, Banjarmasin (South Borneo).

VERNACULAR NAMES. BORNEO: Semampat (Kutai), Dejang (Wai-Dayak).

10. **Hypobathrum hirtum** (Ridley) Mulyaningsih & Ridsdale, *comb. nov. & stat. nov.*

Petunga hirta Ridley, Journ. Mal. Br. Roy. Soc. I (1923): 69. *Hypobathrum longifolium* (DC) Wong var. *hirta* (Ridley) Wong, Tree Fl. Malaya (1972) I: 345. – Typus: *Nur Muhamed* 7405 (SING–holo), Sumatra, Sibolangit, Bukit Kluang.

DISTRIBUTION AND ECOLOGY. This species has been found on the middle slopes of limestone ridge at Teng Bukap, Kuching, and in the plain of primary forest (30 m above sea level) at Kombeng mountain, West Kutai (East Borneo).

VERNACULAR NAMES. BORNEO: Kopi hutan (Melayu), Kupi tarun.

NOTES. *H. hirtum* (Ridley) Mulyaningsih & Ridsdale is based on *Petunga hirta* Ridley. Wong (1989) described this taxon as *H. longifolium* (DC) Wong var. *hirta* (Ridley) Wong. During the present study on *Muhamad Nur* 7405, it was noted that the taxon has the following typical characters: stipules persistent, ovate, outside hirsute over the whole parts; flowers pentamerous; calyx infundibular, lobes outside sericeous over the whole parts and seed one per locule. These characters differ significantly from *H. longifolium* (DC) Wong var. *hirta* (Ridley) Wong is distinct species, it should be excluded from *H. longifolium* (DC) Wong and hence the taxon is once again recognised as a distinct species.

11. **Hypobathrum lancifolium** Mulyaningsih & Ridsdale, *nom. nov.*

Petunga lanceolatum Korth., Nederl. Kruidk. Arch. ii II (1851): 171; non *Hypobathrum lanceolatum* (Sond.) Baill. – Typus: *Korthals s. n. Herb. Lugd. Bat. No.908, 220–257* (L–holo, photocopy!) Borneo, Tewe river.

DISTRIBUTION AND ECOLOGY. Mempawah, Pontianak (West Borneo), Tewe river, Martapura (South Borneo), but no notes on habit and ecology were made.

NOTES. The specific epithet *lanceolatum* is already occupied in *Hypobathrum* with the combination *H. lanceolatum* (Sond.) Baill. based on *Krausia lanceolata* Sond. which is a different species. Hence a new specific epithet is required for the present taxon. *H. lanceolatum* (Sond.) Baill. has the following different characters: flowers turbinate, in a cyme, pentamerous, corolla throat sparsely villous, stamens exerted, anthers basifixed and ovule 1 per locule.

12. **Hypobathrum lithophilum** Mulyaningsih & Ridsdale, *sp. nov.* – Fig. 9

Folia linearia subtus venis primariis sparse puberulis venis tertiariis inconspicuis, petioli subtereti puberuli, stipulae persistentes, bracteae anguste triangulares oppositae vel alternatae extus sericeae, bracteolae binatae oppositae e medio ad apicem insertae, inflorescentiae e nodis ortae, hypanthium infundibuliforme puberulum, corolla infundibuliformis, stamina sessilia, fructus pyriformes verticaliter sulcati pedicellis glabris. – Typus: *H. Wiriadinata* 830 (BO! –holo, L–iso), East Borneo, Batu Penolong, 4 VII 1975. Fr.

Habit shrub, 1 m high. *Branchlets* divaricating, subterete, bark smooth, on below the nodes with caducous hairs, internodes 32–47 mm long, 1.5 mm wide, 2 mm thick.

Leaves linear, 95–133 mm long, 15–20 mm wide, above glabrous, drying colour grayish dark brown to dark brown, below sparsely puberulous on primary veins, drying colour brown; apex caudate; the base attenuate; margins glabrous; veins above depressed to prominent and below prominent, primary veins stout, secondary veins curved, 5–6 pairs, ascending with acute angle of divergence, tertiary veins inconspicuous. *Petiole* subterete, 5–9 mm long, 1 m diam, sparsely puberulous. *Stipules* persistent, triangular keeled, 4–6 mm by 3–4 mm, inside glabrous, outside scattered sericeous along midrib, the base free, apex acute to acuminate.

Bracts narrowly triangular, 1–1.5 mm long, 0.5–0.8 mm wide, faintly keeled, opposite and alternate, inner surface glabrous, outer surface sericeous over the whole parts or on the top. *Bracteoles* triangular, 0.5–0.8 mm long, 0.5 mm wide, keeled, opposite on the middle to the top of pedicel, inside glabrous, outside sericeous on the top, the base free.

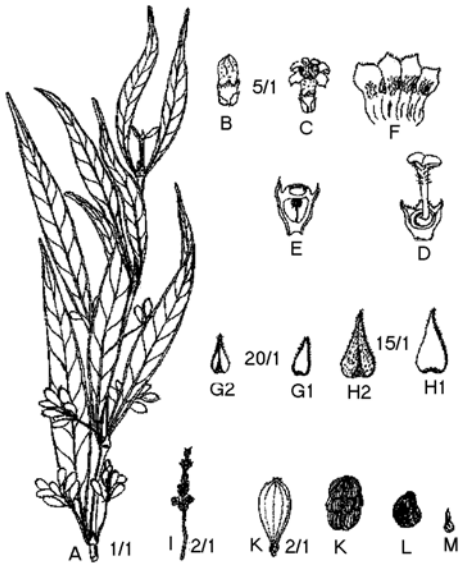

Fig. 9. *Hypobathrum lithophilum*, A. flowering shoot from *H. Wiriadinata* 830; B. flower bud; C. mature flower; D. pistil; E. the longitudinal section of the hypanthium, F. corolla, G1. bracteole inside; G2 bracteole outside; H1. bract inside; H2. bract outside; I. Inflorescence; J. fruit; K. the position of seeds in the fruit; L. seed; M. embryo.

Inflorescences erect, originating from the nodes. *Peduncle* quadrangular or ensiform, 1.5–4 mm long, 0.5–1 mm wide, sparsely pu-berulous, compressed below the nodes. *Axis* 7–35 mm by 0.5–1 mm, tomentose, 6–15 nodes, space between nodes up to 3–8 mm.

Flowers arranged in sub raceme, sub sessile, tetra-merous, 4 mm long, 2 mm diam. *Pedicel* 1–2 mm long 0.5 mm diam., glabrous. *Hypanthium* funnel-shaped, 1.5 mm long, 1 mm wide, puberulous. *Calyx* subcampanulate, 0.5–1 m by 1 mm, inside glabrous, lobes 4, ovate faintly keeled, 0.3 mm by 0.5 mm, outside sericeous. *Corolla* thin, funnel-shaped 2.6 mm long, 2.1 mm diam., outer surface sparsely puberulous; tubes ex-tremely short (up to 2 mm), inner surface densely villous in the throat, lobes 4, ovate, 1.1 mm long, 1 mm wide, margins ciliated. *Stamens* 4, sessile, inserted in the throat; anthers lanceolate, 1.2 mm by 0.2 mm, dorsifixed around the middle. *Style* smooth, terete, 1.5 mm long, included, villous. *Stigma* bifid, 0.8 mm by 0.2 mm, lobes lanceolate, villous. *Disc* annular. *Ovules* 5 per locule.

Fruits pyriform with vertical grooves, 8.5–10 mm by 3 mm, glabrous, exocarp thick, me-socarp fleshy, endocarp membranaceous. *Stalk* extremely short, 1–2 mm long, 0.5 mm diam., glabrous.

Seeds 3–5 per locule, compressed, 4 mm long, 1–1.5 mm wide, 0.8–1 mm thick.

DISTRIBUTION AND ECOLOGY. This species has been found dwelling stones in the primary forest on the banks of the Mahakam river bank, Batu Penolong, Toho river (East Borneo). It is found at an altitudinal range 100–150 m above sea level.

VERNACULAR NAME. BORNEO: Urvur (Dayak – Bahau).

13. HYPOBATHRUM LONGIFOLIUM (DC) Wong

DISTRIBUTION AND ECOLOGY. This species has been found in Thailand (by streams in evergreen forest at Surāt, in lowland in the evergreen forest at Pūket and on a hill near a stream at Pattānī); Malay Paninsula (in the forest at Pahang, Kwala Tembeling, Selangor, Labu river, Perak, Goping; near a waterfall at Tapah, Penang and on a hill at Kelantan, Chaning); Sumatra, Java (in lowland to hill forest at Banten, Preanger, Semarang, Jepara, Madiun and Banyuwangi), *Borneo* (on the over flood-plain at Dahun, West Kutai, East Borneo). It grows at an altitudinal range 10–1200 m above sea level.

VERNACULAR NAMES. BORNEO: Pangihu (Kutai), Beran nipa (Benuwa-Dayak); Kihapiet, Kiapiet, Kikopi-lalaki (Sunda); Babalan, Hapit, Klagu, urang-urangan (Java).

14. HYPOBATHRUM MICROCARPUM (Blume) Bakh. *f.*

DISTRIBUTION AND ECOLOGY. This species has been found in the mixed dipterocarp forest or primary forest, on the dry land to wet land on the slopes of mountain or plain throughout Sumatra, Java and Lesser Sunda islands, or on the margin of rivulet at Mukun river. (East Borneo) and Kabili-Sepilok, and on limestone hill at Balembangan insland (North Borneo). It grows at an altitudinal range 30 - 100 m above sea level, at Landak river, Kapuas river, Kuala Penjauh (West Borneo); Wanariset, Mukun river at Samarinda (East Borneo).

VERNACULAR NAMES. Kayu-bras, Bras, Bebras, Membras, Muntimagas (Dusun), Kiapit (Sunda), Klayu (Java).

USES. In Indonesia, the young leaves and shoot tips are eaten raw as a vegetable and used medicinally for making astringent.

15. **Hypobathrum palustre** Mulyaningsih & Ridsdale, *sp. nov.* – Fig. 10

Folia ovata subtus venis primariis secundariisque puberulis, petiolus disperse puberulus, stipulae basi leberae caducae, bracteae ovatae decussatae, bracteolae ovatae basi uno latere connatae oppositae ad pedicelli basin insertae, inflorescentiae ad nodos ortae, flores spiciformes, pedunculus axis hypanthium hirsutum, corolla tenuis infundibuliformis lobis rotundatis. – Typus: *v. Balgooy & v. Setten* 5466 (BO!–holo), West Borneo, Pontianak, Palung mountain, 16 VI 1986. Fl.

Habit sprawling shrub to treelet, up to 3 m high. *Branchlets* helicoid, subterete but quadrangular on young growth, bark smooth with a densely caducous hirsute; internodes 32–45 mm long, 1.5–2 mm wide, 1–1.5 mm thick.

Leaves ovate, 80–90 mm long, 28–35.5 mm wide; upper surface shinning; lower surface puberulous on primary and secondary veins, colour brown; apex cuspidate to caudate; the base attenuate; margins with caducous hairs; veins upper depressed, below prominent, primary veins stout to moderate, secondary veins 6–7 pairs, tertiary veins conspicuous. *Petiole* subterete, 4–6 (–9) mm long, scattered puberulous. *Stipules* caducous, triangular, 7–9 mm by 2.5–4 mm, inside glabrous, outside tomentose along the midrib or the base, apex acute, the base free.

Bracts ovate, 1 mm by 0.8 mm, faintly keeled, outside densely sericeous, inside glabrous, decussate. *Bracteoles* ovate, 0.4–1.3 mm by 1 mm, faintly keeled, opposite at the base of pedicel, outside densely sericeous over the whole parts, inside glabrous, the base connate on one side.

Inflorescences erect, originating from the nodes. *Peduncle* ensiform, 1–1.3 mm long, 0.75 mm wide, hirsute. *Axis* subterete to ensiform, (8–) 15–30 mm long, 8–15 nodes, 1.5 mm between nodes, hirsute.

Flowers arranged in a spike, sessile, tetramerous, 2–4 mm by 1–2 mm. *Hypanthium* subcampanulate, 0.5–1 mm by 0.7–1.2 mm, hirsute. *Calyx* funnel-shaped, 0.5–0.8 mm by 1– 1.5 mm, inside glabrous, lobes 4, ovate, 0.4–0.4 mm by 0.5 mm, faintly keeled, outside sericeous over the whole surface. *Corolla* thin, funnel-shaped, 1–3 mm by 0.7–2.1 mm, inside sparsely villous in the throat, outside glabrous; lobes 4, rotundate,

0.6–1.3 mm by 0.6–1 mm, all parts sericeous on outside. *Stamens* 4, sub sessile, inserted in the throat, filaments up to 0.2 mm; anthers linear, 0.8–1.3 mm long, dorsifixed around the middle. *Style* smooth, terete, 0.4–1.5 mm, villous on the middle to the top. *Stigma* bifid, stigma lobes linear 0.4–1.5 mm long, villous. *Disc* annular. *Ovules* 2–3 per locule.

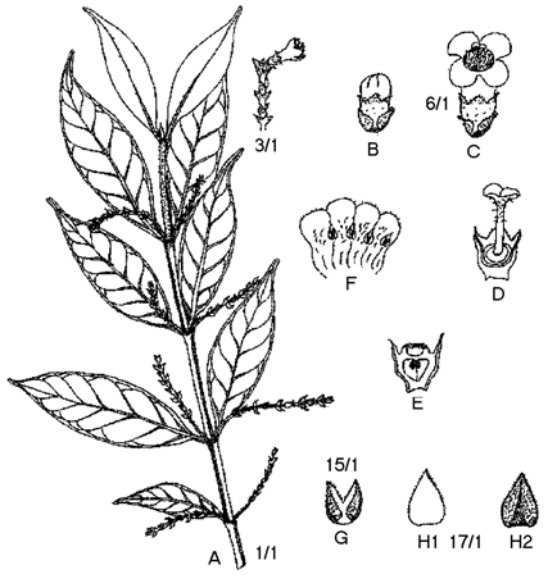

Fig. 10. *Hypobathrum palustre*; A. flowering shoot from *v. Balgooy & v. Setten* 5466*;* B. flower bud; C. mature flower; D. pistil; E. the longitudinal section of the hypanthium; F. corolla; G. bracteole; H1. bract inside; H2 bract outside.

Fruits not seen.

DISTRIBUTION AND ECOLOGY. Recorded as growing on alluvium in the peat swampy forest and in the dipterocarp forest on the base of Palung mountain (30 m above sea level) at Pontianak (West Borneo).

NOTES. This species resembles *H. gracile* on the flowering plant, but it differs on the following typical characters: e. g. bark of branchlets covered with caducous hairs, leaves below puberulous on primary and secondary veins, stipules triangular keeled, inflorescences originating from the nodes, bracteoles base connate on one side and hypanthium hirsute.

16. HYPOBATHRUM RACEMOSUM (Roxb.) Kurz.

DISTRIBUTION AND ECOLOGY. This species has been found at an altitudinal range 50–100 m above sea level in India (in the swamp forest at Luekshmee-poora, Chittagong, not unfrequent in the coral-reef-forest of Katchall, especially near marshes at Nicobar islands); Myamar (not unfrequent in the swamp forests and in somewhat swampy places at Arracan, Pegu Mt.); Cambodia, Thailand (in the evergreen forest at Tā Ngaw, Bāng Son, Takō (Surāt); common on landward edge of mangrove at Krabī Lantā, Trang, Āo Tong or in the scrub by stream at Ranawng and Lam Lieng (Pūket); in the light evergreen forest at Kao Chum Tawng and Tungsong (Nakawn Srītamarāt)); Malay Peninsula (on the low marshy ground at Johor, Tebing Tinggi, Malaca, Merlimau Selangor, Batu tiga, Penang; on the waterfall at Perlis, Bersih Hangat and Kanga); Indonesia (in the forest throughout Sumatra, Java, Borneo/ Celebes (West Borneo: Sambas river, Sanggau and Batu Lessung, South Borneo: in the secondary vegetation at Martapura, or on the base of limestone hill at Muara Uya, East Borneo: on the small river bank in the disturbed primary forest at Long Bangun and Magne river); Philippines (in the forest at Palawan and Balabac).

VERNACULAR NAMES. Bras, Bebras (Dayak); Muntimagas (Dusun Kuyu, Malay Peninsula), Kayu Ekor Gajah, Tulang Betina (Melayu); Kan lên (Siamese, Peninsula).

USES. The Cambodians use this root as a part of decoction taken to treat yaws.

17. **Hypobathrum rheophyticum** Mulyaningsih & Ridsdale, *sp. nov.* – Fig. 11

Folia linearia subtus venis puberulis, petiolus subteretus puberulus, bracteae anguste triangulares oppositae vel alternatae, bracteolae binatae ad pedicelli basin insertae, inflorescentiae erectae ad nodos ortae, pedunculus plus quam 30 mm. longus, flores in sub-racemosae, tetrameri, hypanthium cupuliforme glabrum, corolla tenuis, faux sparse villosa, lobi ovati, stylus teretus stigma bifidum laevis glaber, fructus obovoidei laeves, pedicello hirsuto. – Typus: *J. A. Mc Donald & Ismail* 3473 (BO!–holo, A–iso) East Borneo, Punjungan, Kayan-Mentarang, Gong river. Fl. & fr.

Habit shrub, 1–1.5 m high. *Branchlets* divaricating, when young quadrangular and becoming subterete with age, bark smooth, glabrous, internodes 12–25 mm long, 1 mm wide, 1 mm thick.

Leaves linear, 95–135 mm long 9–12 mm wide, above glabrous, drying colour grayish dark brown; below puberulous on all veins; drying

colour brown; apex caudate; the base attenuate; margins glabrous; veins above depressed and below prominent, primary veins stout, secondary veins curved, 10 pairs, ascending with acute angle of divergence, tertiary veins inconspicuous. *Petiole* subterete, 5–8 mm long, 1–1.5 m diam, glabrous.

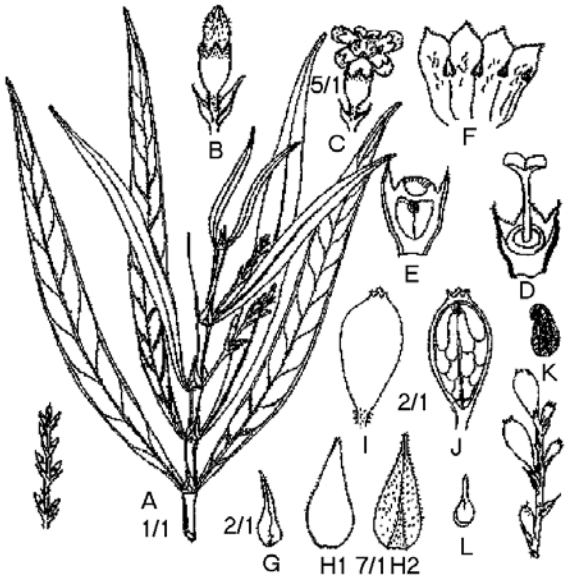

Fig. 11. *Hypobathrum rheophyticum*; A. flowering shoot from *J. A. McDonald & Ismail* 3473; B. flower bud; C. mature flower; D. pistil; E. the longitudinal section of the hypanthium; F. corolla; G. bracteole; H1. bract inside; H2. bract outside; I. fruit; J. the longitudinal sections of the fruit; K. seed; L. embryo.

Stipules sub-caducous, triangular, keeled, 10 mm by 3 mm, glabrous, apex acuminate, the base free.

Bracts narrowly triangular, 4 mm long, 1 mm wide, faintly keeled, opposite and alternate, glabrous over the whole surfaces. *Bracteoles* narrowly triangular, keeled, 1.2 mm long, 0.5 mm wide, opposite at the base of pedicel, inner surface glabrous, outside sericeous, the base free.

Inflorescences erect, originating from the nodes. *Peduncle* subterete, 30–75 mm long, 0.1 mm wide, sparsely puberulous, axis compressed below the nodes, 7–13 mm by 0.5 mm, puberulous.

Flowers arranged in sub raceme, sub sessile, tetramerous, 4 mm long, 1 mm diam. *Pedicel* 1 mm by 0.5 mm, tomentose. *Hypanthium* cup-shaped, 2 mm long, 1 mm wide, glabrous. *Calyx* subcampanulate, 0.8–1 mm by 1 mm, inside glabrous, lobes 4, ovate, 0.5 mm by 0.5 mm, faintly keeled, outside sericeous. *Corolla* thin, subcampanulate, 2.2 mm long, 1 mm diam., outer surface hirsute, inner surface villous scattered in the throat, lobes 4, ovate, 0.8 mm long, 0.8 mm wide, margins ciliated. *Stamens* 4, sessile, inserted in throat, anthers lanceolate, 1.2 mm by 0.2 mm, dorsofixed around the middle. *Style* smooth, terete, 0.8 mm long, glabrous. *Stigma* bifid, 0.8 mm by 0.2 mm, lobes lanceolate. *Disc* annular. *Ovules* 7 per locule.

Fruits smooth, obovate, 12.5 mm by 5 mm, glabrous, exocarp thick, mesocarp fleshy, endocarp membranaceous. *Stalk* extremely short, 1 mm long, 1 mm diam., puberulous. *Seeds* compressed, 5 mm long, 1.5 mm wide, 1 mm thick, seeds 7 per locule.

DISTRIBUTION AND ECOLOGY. This species has been found in the primary forest, on the floodplain at least 10 m from Gong river, Kayan-Mentarang, Punjungan (East Borneo). Species rich, associates include *Hopea, Shorea, Pometia, Eugenia, Dipterocarpus*, etc., on 425–450 m above level sea.

18. **Hypobathrum riparium** Mulyaningsih & Ridsdale, *sp. nov.* – Fig. 12

Folia lanceolata petiolo glabro, stipulae triangulares grabrae caducae, bracteae triangulares raro decussatae glabrae, bracteolae basi uno latere connatae oppositae ad pedicelli basin insertae, inflorescentiae graciles erectae ad nodos ortae, flores in simplices dichasiis verticillatis, hypanthium glabrum, corollae lobi rotundati, faux villosa, stamina sessilia, antherae subbasifixae, stylus teretus stigma bifidum villosus. – Typus: *H. Hallier 998* (BO!–Holo) West Borneo, Tanggi river., 1893–1894. Fl. & fr. immature.

Habit unknown. *Branchlets* when young quadrangular and subterete with age, bark smooth and rounded scars made by insects, glabrous to sparsely puberulous on below nodes on young growth, internodes 42–80 mm long.

Leaves lanceolate, 75–85 mm long, 20–40 mm wide, glabrous, above drying colour pale green, below drying colour brown; apex cuspidate; the base attenuate; margins glabrous; veins above depressed, below prominent, primary veins stout, secondary veins curved, 6–7 pairs, ascending, moderate angle of divergence, tertiary veins conspicuous. *Petiole* subterete, 3–5 mm long, 1 m diam, glabrous.

Stipules caducous, triangular, 6–7 mm, keeled, glabrous on inner and outer surface, the base free, apex acute.

Bracts triangular 1.8 mm by 0.9–1 mm, keeled, glabrous on outside and inside, decussate with rare distant. *Bracteoles* triangular 1–1.5 mm by 0.1–0.8 mm, keeled, inside glabrous, outside sericeous on the top, opposite at the base of pedicel, the base connate on one side.

Inflorescences erect, originating from the nodes. *Peduncle* ensiform, 2–5 mm long, 1.5–2 mm wide, puberulous. *Axis* 20–35 mm long, glabrous, 2–20 nodes.

Flowers arranged in a simple verticillate dichasia, sub sessile, tetramerous, 4 m long, 2 m diam. *Pedicel* extremely short, 0.2–0.8 mm long, puberulous. *Hypanthium* funnel-shaped, 0.3–0.7 mm long, 0.5–0.9 mm wide, glabrous. *Calyx* funnel-shaped, 0.7–0.9 mm long, tubes glabrous, lobes 4, ovate, 0.5–0.9 mm by 0.3–0.5 mm, faintly keeled, outside puberulous on the tip, inside glabrous. *Corolla* thin, funnel-shaped, 3 mm long, 2–3 mm diam, outside glabrous, tubes inside villous in the throat, lobes 4, rotundate, 1.4–1.5 mm long, 0.9–1.1 mm wide, glabrous, margins ciliate. *Stamens* 4, sessile, inserted in the throat; anthers lanceolate to linear, 1–2 mm long, sub-basifixed. *Style* smooth, terete, 0.9–0.1 mm long, villous on the middle to the top. *Stigma* bifid, 0.9–1 mm long, lobes linear, villous on outer surface. *Disc* annular. *Ovules* 2–5 per locule.

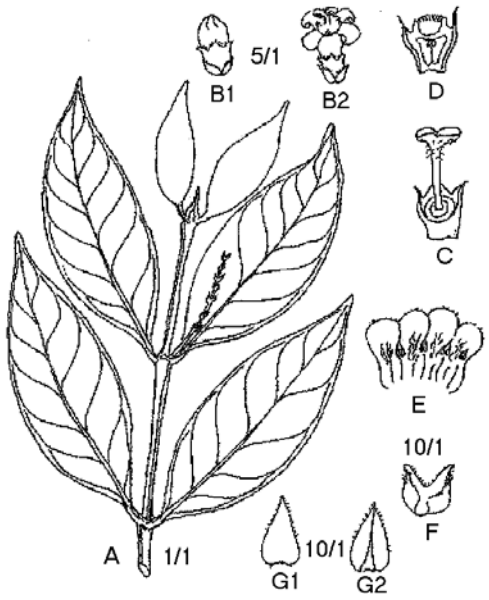

Fig. 12. *Hypobathrum riparium*; A. flowering shoot from *H. Hallier* 998; B1. flower bud; B2. mature flower; C. pistil; D. the longitudinal section of the hypanthium; E. corolla; F. bracteole; G1. bract inside; G2. bract outside.

Fruits smooth, subglobose, 2.1 mm by 1.8 mm, glabrous; exocarp thick, mesocarp fleshy, endocarp membranaceous. *Stalk* 1.2 mm long, glabrous. *Seeds* 2—5 per locule compressed, 0.5 mm long, 0.2 mm wide, 0.05 mm thick.

DISTRIBUTION AND ECOLOGY. This species has been found at North Borneo and Tanggi river (West Borneo) but no notes on habit and ecology were made.

19. **Hypobathrum rufidulum** (Miquel) Mulyaningsih & Ridsdale, *comb. nov.*

Petunga rufidula Miquel. – *Gynopachys? rufidula* Miquel, Fl. Ind. Bat 2 (1856): 221; Suppl. 1, Sum. (1861): 219. –*Petunga rufidula* (Miquel) Miquel. Ann. Mus. Bot. Lugd. Bat. IV (1869): 131. – Typus: *Junghuhn s. n. Herb. Lugd. Bat. No. 908, 220 –611* (L–holo, photocopy!), Sumatra.

DISTRIBUTION AND ECOLOGY. his species has been found at Sibolangit (Sumatra) and Semedum mountain, (West Borneo), but no notes on habit and ecology were made.

20. HYPOBATHRUM SALICINUM (Miquel) Bakh. *f.*

DISTRIBUTION AND ECOLOGY. This species has been found in the forest at river bank on low hills at Mentoko river, Martapura (South Borneo) and at Sompacti (North Borneo).

21. **Hypobathrum sampitense** Mulyaningsih & Ridsdale, *sp. nov.* – Fig. 13

Folia ovata petioli glabri, stipulae triangulares extus sparse tomentosae caducae, bracteae ovatae intus basi pilosae extus costa sericea, bracteolae basi uno latere connatae, inflorescentiae erectae ad nodos ortae, pedunculus axis glaber, flores in simplices dichasiis verticillatis, hypanthium infundibuliforme, corolla tenuis infundibuliformes lobis ovatis, fructus obovoidei. – Typus: *P. Buwalda* 7886 **(**BO!–holo; A, BH, K, L–iso) Central Borneo, Sampit, 7 X 1940. Fl & fr.

Habit unknown. *Branchlets* when young quadrangular and becoming subterete, bark smooth, a caducous puberulous above nodes, internodes 30–60 mm long, 2.5 mm wide, 3.5 mm thick.

Leaves ovate, 65–85 mm long, 27–39 mm wide, glabrous, above drying colour pale green, below brown; apex acuminate; the base attenuate;

margins glabrous; veins above depressed, below prominent, primary veins stout, secondary veins curved, 7 pairs, ascending and matching with moderate angle of divergence, tertiary veins conspicuous. *Petiole* subterete, 5–7 mm by 1 mm, glabrous.

Stipules caducous, triangular, 6 mm by 3 mm, faintly keeled, inside glabrous, outside sparsely tomentose along the midrib, apex acute.

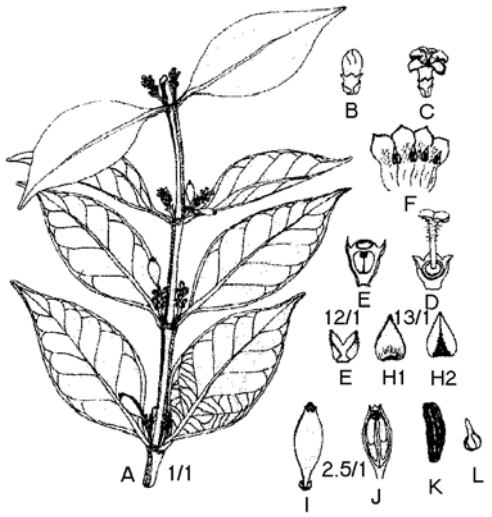

Fig. 13. *Hypobathrum sampitense*; A. flowering shoot from *P. Buwalda* 7886; B. flower bud; C. mature flower; D. pistil; E. the longitudinal section of the hypanthium; F. corolla; G bracteole; H1. bract inside; H2. Bract outside; I. fruit; J. the longitudinal section of the fruit; K. seed; L. embryo.

Bracts ovate, 1.2 mm by 1 mm, keeled, decussate, outside sericeous on the midrib, inside pilose on the base. *Bracteoles* ovate, 0.8–1 mm by 0.6 mm, faintly keeled, opposite at the base of pedicel, outside sericeous on the base of the midrib, inside glabrous, the base connate on one side.

Inflorescences erect, originating from the nodes. *Peduncle* ensiform, 3–6 mm by 1.5 mm, glabrous. *Axis* ensiform, 5–10 mm long, 10–15 nodes, space between nodes up to 1.5 mm, glabrous.

Flowers arranged in a simple verticillate dichasia, sub sessile, tetramerous, 3 mm by 3.5 mm. *Pedicel* up to 0.2 mm by 0.3 mm, scattered puberulous. *Hypanthium* funnel-shaped, 0.5 mm by 1 mm, glabrous. *Calyx* funnel-shaped, 0.7 mm by 1.1 mm, inside glabrous; lobes 4, ovate, 0.5 mm by 0.7 mm, faintly keeled, outside sericeous over the whole parts. *Corolla* thin, funnel-shaped, 2.5 mm by 3.5 mm, inside densely villous in the throat, outer surface glabrous; lobes 4, ovate, 1.3 mm 0.8 mm. *Stamens* 4, sessile, inserted in the middle of tube; anthers sub-basifixed, lanceolate, 1 mm by 0.2 mm. *Style* smooth, terete, 0.7 mm by 0.2 mm, villous on the middle to the top. *Stigma* lanceolate, 0.6 mm by 0.2 mm, villous on outer surface. *Disc* annular. *Ovules* 2 per locule.

Fruits smooth, obovate, with calyx tube elongate, 10 mm by 4 mm, glabrous, exocarp thick, mesocarp fleshy, endocarp membranaceous. *Stalk* 5 mm by 0.9 mm, sparsely puberulous. *Seeds* 1–2 per locule, compressed, 5 per locule, 5 mm long, 1–2 mm wide, 1 mm thick.

DISTRIBUTION AND ECOLOGY. This species has been found on the village plain at Sampit (Central Borneo).

VERNACULAR NAME. BORNEO: Sapit-sapit (Sampit).

22. **Hypobathrum subulatum** Mulyaningsih & Ridsdale, *sp. nov.* – Fig. 14

Folia linearia venis sparse puberulis, venis tertiariis inconspicuis, petiolus complanatus glaber, bracteae subulatae sed bractea prima elongata ad linearis oppositae vel alternatae, bracteolae ovatae ad pedicelli basin insertae, inflorescentiae erectae supra-axillariter ortae, flores subracemosae pentameri, stylus verticaliter sulcatus villosus, fructus pyriformes sparse puberuli pedicello brevissimo glabro. – Typus: *Amdjah* 215 (BO!–holo, L–iso) North Borneo, Sedalir mountain, 25 VII 1912. Fl. & fr.

Habit shrub, 1–1.5 m high. *Branchlets* divaricating, subterete, bark smooth, glabrous. internodes (10–) 25–40 mm long, 2–2.5 mm wide, 2–2.5 mm thick.

Leaves linear, 155–198 mm long. 15.5–20 mm wide, above glabrous drying colour grayish dark brown, below sparsely puberulous at the veins, drying colour brown; apex caudate; the base attenuate; margins glabrous; veins above depressed and below prominent, primary veins stout, secondary veins curved, 10–11 pairs, ascending with acute angle of divergence, tertiary veins inconspicuous. *Petiole* flatten, (0.5–) 5–8 mm long, 1–2 m diam., glabrous.

Stipules sub-caducous, triangular 7–14 mm by 3–5 mm, keeled, inside glabrous, outside sparsely sericeous over the whole surface, apex acuminate, the base free.

Bracts spear-like, 3.5–4 mm long, 0.9–1 mm wide, the first bracts elongate to linear, opposite

and alternate with irregular space, inside and outside glabrous. *Bracteoles* ovate 0.9–1.2 mm long, 0.5 mm wide, keeled, one inserted on the base of pedicel, inside pilose on the base, outside puberulous on the top, the base free.

Inflorescences erect, supra-axillary in origin. *Peduncle* quadrangular or ensiform, 1.5–4 mm long, 0.5–1 mm wide, sparsely puberulous. *Axis* 16–95 mm by 0.5–1 mm, tomentose, 6–20 nodes, space between nodes up to 3–6 mm.

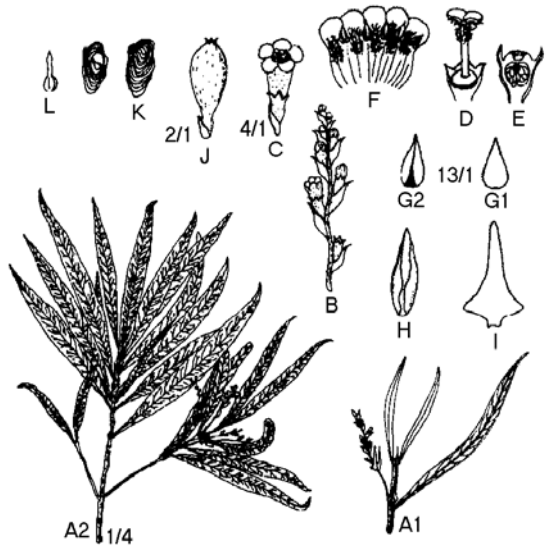

Fig. 14. *Hypobathrum subulatum*; A1. flowering and A2. fruiting shoot after *Amdjah* 215; B. inflorescence; C. mature flower; D. pistil; E. longitudinal section of the hypanthium; F. corolla; G1. bracteole inside; G2. bracteole outside; H. bract; I. the first bract; J. fruit; K. seed; L. embryo.

Flowers arranged in sub raceme, sub sessile, pentamerous, 4.7–6.4 mm long, 2–4 mm diam. *Pedicel* extremely short, 0.5–1 mm long, hirsute scattered. *Hypanthium* cup-shaped, 1–2 mm long, 0.7–1 mm wide, glabrous. *Calyx* subcampanulate, 0.7–1 mm by 0.7–1 mm, inside glabrous, lobes 5, ovate faintly keeled, outside glabrous. *Corolla* thin, funnel-shaped 2.2–3 mm long, 1–4 mm diam., inside villous in the throat, outside sparsely puberulous; lobes 5, rotundate, 0.8–1.2 mm long, 0.8–1 mm wide, margins ciliated. *Stamens* 5, sessile, inserted in the tube, anthers lanceolate, 1–1.5 mm by 0.2 mm, dorsifixed around the middle. *Style* smooth, terete, 0.8–1.3 mm long with 10 vertical grooves with villous on the middle to the top. *Stigma* bifid, 0.8–1.5 mm by 0.2–0.8 mm, lobes lanceolate, grooved with villous on the outer surface. *Disc* annular swollen. *Ovules* 3 –7 per locule.

Fruits smooth, pyriform, 8–12.5 mm by 2.5–5 mm, sparsely puberulous, exocarp thick, mesocarp fleshy, endocarp membranaceous. *Stalk* extremely short, 1 mm long, 1 mm diam., glabrous. *Seeds* 3–7 per locule compressed, 2.8–3 mm long, 0.8–1 mm wide, 0.3–1 mm thick.

DISTRIBUTION AND ECOLOGY. This species was found growing on the flood-plain at conluence of rivers on Sedalir mountain, Genderan village (North Borneo).

NOTES. The species resembles *H. lithophilum* on the flowering plant, but the present species has the following different characters: petiole flatten, glabrous; bracts spear-shaped but the first bract elongate to linear, opposite and alternate; bracteole one inserted on the base of pedicel; flower pentamerous; style vertical grooves; fruits pyriform and stalk glabrous.

23. HYPOBATHRUM VENULOSUM (Hook. f.) Wong

DISTRIBUTION AND ECOLOGY. This species has been recorded as growing in the mixed dipterocarp forest on basalt ridge (800 m above level sea) at Bukit Batu Mersing, Sarawak. This species has also been at Penang, Singapore (Malay Peninsula); Palembang (Sumatra) and in the research forest at Kenepai mountain (West Borneo).

VERNACULAR NAMES. MALAY PENINSULA: Kayu Gading, Tulang Betina, Susoh Pelanduk, Mempas Jantan, Jalok Hantu, Umpaong Puteh, Mali-mali, Beberas Payu, Lambai, Mengkudu Rimba, Pokok Pukal (Melayu).

USES. In Malaya, the pounded root is used to make a poultice used in small-pox, and the boiled roots for treating rheumatism.

24. HYPOBATHRUM SP.

Habit treelet, 2 to 4 m high, 10 cm diam. *Branchlets* divaricating, quadrangular, bark smooth, scattered puberulous below nodes disappear with age, internodes 24–43 mm long, 1–1.5 mm wide, 1.5–2 mm thick.

Leaves lanceolate, 70–85 mm long, 12–15 mm wide, glabrous, above drying colour pale

green; below drying colour brown; apex acuminate; the base attenuate; margins a caducous indumentum; veins above and below prominent, primary veins moderate, secondary veins curved, 7 pairs, ascending and matching with acute angle of divergence, tertiary veins conspicuous. *Petiole* subterete, 6–8 mm long, hirsute on upper surface.

Stipules caducous, ovate, 5 mm by 5 mm, faintly keeled, glabrous on inside and outside, the base free, apex acuminate.

Bracts narrowly triangular, 1.5 mm by 0.8 mm, keeled, decussate, inside glabrous, outside sparsely to densely hirsute. *Bracteoles* ovate, 1 mm by 1 mm, keeled, inside glabrous, outside sericous, opposite on the base of pedicel, the base free.

Inflorescences erect, supra-axillary in origin. *Peduncle* quadrangular, sub-terete or ensiform, 1–2 mm long, sparsely puberulous. *Axis* ensiform, 13–23 mm long, 20–30 nodes, 1.5–2.5 mm between nodes, puberulous.

Flowers arranged in a panicle, sub sessile, tetra-merous, incomplete. *Pedicel* up to 0.6 mm long, sparsely hirsute. *Hypanthium* cup- to funnel-shaped, 0.9 mm by 0.8–1 mm, scattered puberulous. *Calyx* funnel-shaped, 1 mm by 1.2 mm, glabrous on inner surface, hirsute on outer surface; lobes 4 ovate, 0.3–0.4 mm by 0.4–0.5 mm, faintly keeled. *Disc* annular. *Ovules* 2–4 per locule.

Fruits not seen.

DISTRIBUTION AND ECOLOGY. Found growing on the bank of a small rocky river, at 200 m above level sea at PT. ITCI area (East Borneo).

NOTES. *Harry Wiriadinata* 246 (from PT. ITCI area East Borneo) is provisionally mentioned here. It differs markedly *Inflorescences* erect, supra-axillary in origin and flowers arranged in a panicle. It possibly represents a separate taxon. However the flowers are incomplete, it does not permit an adequate description.

ACKNOWLEDGEMENTS

This paper forms part of a thesis for master degree submitted by one of us (TM) to the Bogor Institute of Agriculture in 2000. The first author would like to thank her supervisors Prof. Dr. Ir. H. Edi Guhardja, M.Sc. (IPB), Prof. Dr. Mien A. Rifai (LIPI) and Dr. Johanis P. Mogea (LIPI) for advice and guidance throughout the thesis.

She would like to express her gratitude to the Herbarium Bogoriense (LIPI), for granting her permission to conduct research and Rijksherbarium Leiden, for providing her some facilities. She especially would like to thank Dr. J.F. Veldkamp (National Herbarium of the Netherlands, Leiden Branch) who was so kindly help her correcting new epithet and latin description of the new species.

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APPENDIX IDENTIFICATION LIST OF HYPOBATHRUM SPECIMENS

ban	= *H. bangueyense*
cau	= *H. caudifolium*
col	= *H. collinum*
con	= *H. coniocarpum*
ell	= *H. ellipticifolium*
fru	= *H. frutescens*
gbe	= *H. glaberrimum*
gbr	= *H. glabrum*
gra	= *H. gracile*
hir	= *H. hirtum*
lan	= *H. lancifolium*
lit	= *H. lithophilum*
lon	= *H. longifolium*
mic	= *H. microcarpum*
pal	= *H. palustre*
rac	= *H. racemosum*
rhe	= *H. rheophyticum*
rip	= *H. riparium*
ruf	= *H. rufidulum*
sal.	= *H. salicinum*
sam	= *H. sampitense*
sub	= *H. subulatum*
ven	= *H. venulosum*
sp.	= *H.* sp.

Ambri & Arifin W 760: mic – *Amdjah* 211 & 215: sub – 346: gbe – 421: rac.

Balgooy & Setten 5466, 5519: pal – *Buwalda* 7886: sam.

Castro & F. Melegrito 1445: ban.

Endert 1721: lon – 2039: cau – 2996, 2034: con – 5235: hir 5257: fru – *Enggoh* 10513: mic.

Hallier 677: ruf – 904,1016: rac – 998: rip – 1841: ven – 712: rac – 830: lit – 1310: cau – *Henar* 67: lit – *H. L. B.* 163: lan

Jaheri 1721 (281a & b): gra – 333: col – 603: rac – 638, 885: gbe – 1602: lit.

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Vol. 12. No. 1.2002

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