SPHENOSTEMONACEAE (C.G.G.J. van Steenis, Leyden)

The taxonomic position and rank of the only genus *Sphenostemon* has a chequered history. In the course of time it has, under various names, been attributed to the *Aquifoliaceae* (by BAILLON, as *Sphenostemon*, 1875), to the *Icacinaceae* (as a species of *Phlebocalymna*, by F. VON MUELLER, 1875), to the *Guttiferae* (as *Nouhuysia*, by LAUTERBACH, 1912), and to the *Trimeniaceae* (by GIBBS, as *Idenburgia*, 1917).

BAILEY & SWAMY (1953) and BAILEY (1956) examined the anatomy and concluded that the genus could not belong to either *Guttiferae* or *Trimeniaceae cq. Monimiaceae*, but they gave no clear alternative. When I summarised the complete generic synonymy (1955), I found it likely to retain *Sphenostemon* in *Aquifoliaceae*.

An other opinion approached that of F. VON MUELLER, *viz.* that by INGLE & DADSWELL (1961) who suggested, on the strength of the wood anatomy, a likeness with *Platea* in the *Icacinaceae*, and possibly also an affinity to *Polyosma* (*Saxifragaceae*).

HUTCHINSON (1959) and AIRY SHAW (1972) stuck to the Monimiaceous affinity, and I must admit that there is a distinct resemblance, in androecium in particular, with *Trimenia*, but this is overruled by the anatomical and other differences. They felt possibly also strengthened by the fact that LOESENER (1942) had expelled *Sphenostemon* from the *Aquifoliaceae*, and had suggested affinity with *Theaceae* or *Ochnaceae*, or as representative of a separate family.

In a good overview BERNARDI (1964) concluded that *Sphenostemon* should remain in *Aquifoliaceae*. In this he is followed by CRONQUIST (1981).

A very thorough anatomical research of *Aquifoliaceae* led BAAS (1975) to the conclusion that *Sphenostemon* is anatomically allied to both *Aquifoliaceae* and *Icacinaceae*, probably more to the latter. In fact, in comparing the macromorphological characters it appears that all of them occur in *Icacinaceae*. He proposed that the genus should be accommodated in a family of its own, an idea already advanced by AIRY SHAW (1972), allied to both *Aquifoliaceae* and *Icacinaceae*; this view is also held by THORNE (1983). The removal of *Sphenostemon* from *Aquifoliaceae* is well sustained by the seed structure. The fruit was mostly defined as a drupe containing a pyrene. BAILEY (1956) showed that the sclerified tissue is, however, not derived from the endocarp and that the fleshy envelope of it is really the whole of the pericarp. He accepted the sclerified tissue as derived from the testa. I expressed my doubt about this interpretation to Dr. W.A. VAN HEEL (Leyden), who found that the sclerified tissue surrounding the seed is of chalazal nature and that the seed belongs to a type characterized by CORNER (1976) as pachychalazal, a peculiar feature occurring in a limited number of families, amongst them *Icacinaceae*, but not *Aquifoliaceae*. Although not too fond of split families, I feel this new observation gives additional strength to recognize *Sphenostemon* representing a family of its own.

DICKISON & BAAS (1977) noted a remarkable similarity in vegetative anatomy and some gross morphological features between *Sphenostemon* and *Paracryphiaceae*, a monotypic family from New Caledonia. This is compatible with the gradually accepted transfer of *Aquifoliaceae, Icacinaceae*, and *Sphenostemonaceae* from the heterogeneous order of the *Celastrales* to the *Theales*.

References: P. BAAS, Blumea 22 (1975) 311–407, especially 339–340; H.E. BAILLON, Bull. Mens. Soc. Linn. Paris no 7 (1875) 53; Adansonia 11 (1875) 307; I.W. BAILEY, J. Arn. Arb. 37 (1956) 360–365, 9 fig.; I.W. BAILEY & B.G.L. SWAMY, J. Arn. Arb. 34 (1953) 77–87, fig. 1–3, tab. 1–3; L. BERNARDI, Candollea 19 (1964) 199–205; E.J.H. CORNER, The seeds of dicotyledons (1976) 5–6; A. CRONQUIST, Integrated system, *etc.* (1981) 720; W.C. DICKISON & P. BAAS, Blumea 23 (1977) 417–438, especially 429–431; L.S. GIBBS, Contrib. Flora & Phytogr. Arfak Mts (1917) 136; J. HUTCHINSON, Families of flowering plants, ed. 2, 1 (1959) 139; The genera of flowering plants 1 (1964) 124; H.D. INGLE & H.E. DADSWELL, The anatomy of the secondary xylem of SW. Pacific tree species and their taxonomy, in mimeogr. 12 pp. pamphlet offered in a symposium of the 10th Pacif. Sci. Congr., Hawaii (1961) especially 5–7, table 1; C. LAUTERBACH, Nova Guinea 8 (1912) 844; TH. LOESENER, in E. & P. Nat. Pfl. Fam. ed. 2, 20b (1942) 36; F. VON MUELLER, Fragmenta phytographiae Australiae 9 (1875) 151; H.K. AIRY SHAW, Kew Bull. 27 (1972) 325–326; in Willis, Dict. ed. 8 (1973) 1087; C.G.G.J. VAN STEENIS, Svensk Bot. Tidskr. 49 (1955) 19–23; R.F. THORNE, Nordic J. Bot. 3 (1983) 103.

1. SPHENOSTEMON

BAILL. Bull. Mens. Soc. Linn. Paris *no* 7 (1875) 53; Adansonia 11 (1875) 307; STEEN. Svensk Bot. Tidskr. 49 (1955) 19. — *Nouhuysia* LAUT. Nova Guinea 8 (1912) 844; ENGLER in E. & P. Nat. Pfl. Fam. ed. 2, 21 (1925) 197; STEEN. Acta Bot. Neerl. 1 (1952) 94, f. 2; HATUS. Bot. Mag. Tokyo 65 (1952) 109. — *Idenburgia* GIBBS, Fl. Phyt. Arfak (1917) 136, f. 10, 11; GILG & SCHLTR, Bot. Jahrb. 58 (1923) 246, f. 2; PERKINS, Gatt. Monim. (1925) 23, f. 14. — **Fig. 1.**

Shrubs or small trees. *Leaves* simple coriaceous, exstipulate, almost entire to distinctly glandular-dentate, penninerved, scattered, subopposite to pseudo-whorled, articulate at base. *Racemes* terminal or axillary, bracteate at base, at most as long as the leaves. Floral bracts early caducous. *Flowers* bisexual, actinomorphic, the pedicel articulate at the base, all opening about simultaneously, white. *Sepals* 4, free, decussate, widely imbricate, mostly hooded, sometimes less convex, rounded, outer ones mostly ± saccate at base, and with prominent midrib. *Petals* free, 0 or 4 similar to the sepals but of more fleshy texture, all caducous at anthesis. Disk 0. *Stamens* 1-seriate, 4, 6, or 8–13, ± sessile, after being exposed appearing as a globular body, sometimes with a few (1–3) flimsy appressed persistent appendages added (? staminodes), at anthesis free and expanded; connective firm, brown outside; anther-cells introrse and lengthwise dehiscent. *Ovary* superior, sessile on a thickened receptacle, often with grooves from the pressure of the stamens in bud, ± fusiform or cylindric, capped by a fleshy, cap-shaped, sessile, slightly bisected stigma; cells 2, each with one pendent, apically attached, apotrophic ovule. *Pseudo-drupe* broad-ellipsoid to subglobular, not rarely asymmetric, crowned by the stigma. *Pericarp* fleshy, finally black. *Seed(s)* 1 and having the shape of the fruit, or 2 and then plano-convex. *Embryo* small, surrounded by a thick, chalazal envelope, of which the outer layer is hard and bony and whether or not ruminate functioning as and superficially resembling the structure of a pyrene; this bony layer sometimes ridged outside and star-shaped in CS.

Distr. New Caledonia, N. Queensland and *East Malesia:* New Guinea (incl. also New Britain, New Ireland and adjacent isles), Moluccas (Ceram) and Central Celebes. Four species in New Caledonia, 1 in Queensland and 3 in New Guinea.

Ecol. Montane rain-forest.

Morph. The New Caledonian species differ from the others in having 4 petals; all of them have few stamens (4 or 6) and often subentire leaves. According to BAAS (1975) they are also distinct from the species of *ser. Apetalae* in their vegetative anatomy. As exposed in the introduction, the structure of the seed is different from that hitherto assumed as a pyrene with the bony tissue derived from the endocarp; or, as BAILEY (1956) assumed, from the testa. As a matter of fact the fleshy 'pericarp' is on its inside lined by an epidermis against the bony tissue. The bony tissue, continued inside by soft tissue, is again demarcated against the seed proper; the envelope of the seed is derived from the chalaza which, during development of the fruit, completely surrounds the seed. In *ser. Apetalae* the bony outer part of the pachychalaza extends ruminations in the soft part of it.

However, in the New Caledonian *S. pachycladus* of *ser. Sphenostemon*, the bony outer part of the pachychalaza is circular, without ruminations. Unfortunately I have not succeeded to obtain ripe fruit of the other three New Caledonian species to check the structure of their seed, although I found a slight indication of it in *S. oppositifolius* HÜRL.

Taxon. The differences found between the New Caledonian species and those from East Malesia and Queensland induce me to raise the series to the rank of section, as follows.

Section Sphenostemon

Ser. Sphenostemon; STEEN. Svensk Bot. Tidskr. 49 (1955) 21.

Petals 4. Stamens 4 or 6. Sclerified outer tissue of the pachychalaza in fruit circular, not ruminated. Leaves with a hypodermis and closed vascular system in midrib.

Distr. Four species in New Caledonia.

Section Apetalae (STEEN.) STEEN., *stat. nov.*

Ser. Apetalae STEEN. Svensk Bot. Tidskr. 49 (1955) 22.

Petals absent. Stamens 6 or 9–13. Sclerified outer tissue of the pachychalaza in mature fruit ruminated in its softer inner tissue. Leaves without a hypodermis and with a simple open vascular system. Anatomy different from species of *sect. Sphenostemon*.

Distr. North Queensland and East Malesia.

KEY TO THE SPECIES

1. Stamens (5–)6. Inflorescences short, 1–2 cm. Pedicels even in fruit only *c.* 1/2 cm. Leaves usually not conspicuously toothed to almost entire.
   2. Racemes puberulous, few-flowered. Stigma grooved, cupular, appressed to fruit apex, 2–3 mm ø. Habit rather delicate, twigs thin. Leaves ovate- to obovate-lanceolate, acute-acuminate to caudate, 5–11 by 1 3/4–3 1/4 cm; petiole 4–7 mm ..... **2. S. arfakensis**
   2. Racemes mostly glabrous. Stigma punctate in flower, flat and ± elevated in fruit, hardly 3/4 to 1 mm wide, not cap-shaped and grooved. Habit not delicate, twigs rather sturdy. Leaves mostly oblanceolate, rather short- and mostly blunt-acuminate, 5–13 by 2 1/2–4 cm; petiole 10–20 mm . **3. S. lobosporus**
1. Stamens 8–13. Inflorescences 1 1/2–11 cm in fruit. Pedicels in flower 1/2–1 1/2 cm, in fruit up to 2 cm. Stigma sessile, grooved and cap-shaped, appressed to fruit apex, 2–3 mm ø. Leaves almost always conspicuously toothed ..... **1. S. papuanus**

1. Sphenostemon papuanus (LAUT.) STEEN. & ERDTMAN, Svensk Bot. Tidskr. 49 (1955) 22; v. ROYEN, Alpine Fl. New Guinea 3 (1982) 1252, f. 399. — *Nouhuysia papuana* LAUT. Nova Guinea 8 (1912) 844; STEEN. Acta Bot. Neerl. 1 (1952) 97, f. 2; HATUS. Bot. Mag. Tokyo 65 (1952) 110. — *Idenburgia novoguineensis* GIBBS, Fl. Phyt. Arfak (1917) 137, f. 10. — *Idenburgia pachyphylla* GILG & SCHLTR, Bot. Jahrb. 58 (1923) 246, f. 2 A–M. — *Idenburgia elaeocarpoides* GILG & SCHLTR, *l.c.* 247, f. 2 N–X. — *Idenburgia pauciflora* A.C. SMITH, J. Arn. Arb. 22 (1941) 234. — *Nouhuysia pauciflora* (A.C. SMITH) STEEN. Acta Bot. Neerl. 1 (1952) 97; HATUS. Bot. Mag. Tokyo 65 (1952) 109. — *Nouhuysia novoguineensis* (GIBBS) HATUS. Bot. Mag. Tokyo 65 (1952) 109. — *Nouhuysia pachyphylla* (GILG & SCHLTR) HATUS. *l.c.* — *Nouhuysia elaeocarpoides* (GILG & SCHLTR) HATUS. *l.c.* — *S. pauciflorum* (A.C. SMITH) STEEN. & ERDTMAN, Svensk Bot. Tidskr. 49 (1955) 22. — **Fig. 1.**

Treelet or tree, (2–)5–25 m tall, 4–50 cm ø, glabrous or innovations and inflorescences short-hairy or with small brown scales; branchlets rather sturdy; blaze and wood mostly orange brown. *Leaves* pseudo-opposite to pseudo-verticillate (3–7 leaves), coriaceous, dentate, elliptic to lanceolate or oblanceolate to obovate, rounded to acuminate at apex, distinctly nerved and veined, venation above sometimes shallowly sulcate, underneath pale or whitish green *in vivo*, 2 1/2–19 by 1 1/2–7 cm; petiole 1/2–3 cm. Racemes terminal and axillary or on short shoots, 1 1/2–11 cm at base mostly bracteate; bracts 4–10 by 3–5 mm, ciliate. *Flowers* white. Pedicels 3–15 mm, in fruit up to 20 mm. *Sepals* convex to hooded, the outer ± saccate at base, midrib elevated. *Petals* 0. *Stamens* 8–13, close together, thick, ±

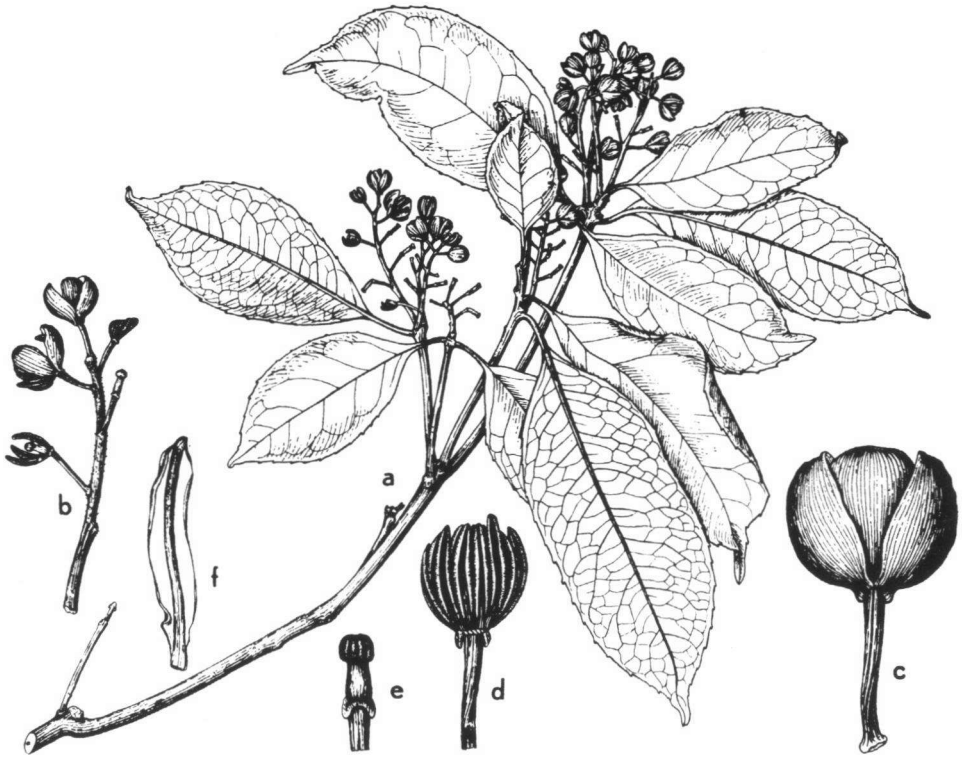

Fig. 1. *Sphenostemon papuanus* (LAUT.) STEEN. & ERDTMAN. *a.* Habit, ×1/2, *b.* inflorescence, nat. size, *c.* ripe bud, *d.* flower during anthesis, *e.* pistillum, all ×3, *f.* anther, dorsal side, ×5 (RUTTEN 2240).

triangular in CS, the connective dark brown, occasionally with 1–3 flimsy appendages adhering to the stamen-globe, later the stamens spreading. *Ovary* fusiform, thick, 2 mm; stigma sessile, slightly bilobed, cap-shaped, appressed, both with impressions from the stamens. *Fruit* broad-ellipsoid or obovoid, rarely oblique, very rarely with a stipe-like base, 1 1/2–2 1/2 by 3/4–1 3/4 cm, via red finally black. *Seeds* 1–2, broadly ellipsoid, (if 2) plano-convex, smooth or ribbed (lobed in CS); stigmatic cap 3–4 mm ø.

Distr. *Malesia:* Central Celebes, Moluccas (Ceram), and New Guinea (incl. Goodenough, Fergusson, New Britain and New Ireland Is.).

Ecol. A subsidiary small tree in primary mixed montane forest, or mossy forest, often associated with *Nothofagus, Quintinia, Elaeocarpus, Myrtaceae* and *Libocedrus*, also in old secondary forest, sometimes fire-induced; (500–)800–3000(–3300) m, rather common. *Fl.* June–Jan., *fr.* Jan.–Dec., not seldom *fl.* and *fr.* together; *c.* 130 collections.

Vern. Though no uses are mentioned the plant is well known, carrying a large number of names in New Guinea: *bukhane*, Mt Ne, W. Highl., *kemenabubodereh, kimnababoderreh*, Chimbu: Masul, *keramura, wehnagenaja*, Mairi: Watabung, *kibamo*, Kutubu, W. Highl., *konge*, Wahgi: Minj, *kup*, Hagan: Togoba, *mandam*², Sila lang., *medaboh*, Mt Ambua, *mem*, Mendi, *meme*, Mendi, Tomba, *mem(i)*, Enga, *menseh*², Tanah Merah, *mime*, Merimanta, *mogoro, mokoro, morogl, mororo*, Kapauku, *omipa*, Asaro: Kefamo, *ounatrok*, Hindenburg Ra., Sepik, *patiba*, Hagen, Minj, *soka*, Naho lang. New Britain: *napun, newala*, Mt Talawe.

Notes. By the large increase of specimens available (in 1952 *c.* 24, now *c.* 130) the variability has shown up and *S. pauciflorum* cannot be upheld. The number of tangible differential characters used in the key in 1952 has also become more vague.

This variability extends to the indument; several specimens (8) carry small brown scales on the racemes and innovations, in 7 the racemes and innovations are hairy to puberulous, the hairs sometimes

mixed with scales, 5 specimens have more or less bullate leaves and are hairy, some 8 specimens have ridged seeds, 3 have both ridged seeds and some hairs. In 8 specimens I found 1, 2 or 3 flimsy appendages which adhere to the anther-globe. Formerly I assumed that they could represent reduced petals (4 true petals are found in the New Caledonian species) but as these appendages are not decussate and persist with the stamen whorl, I am now inclined to regard them as reduced stamens. These independent variations do not allow to distinguish further taxa.

2. Sphenostemon arfakensis (GIBBS) STEEN. & ERDTMAN, Svensk Bot. Tidskr. 49 (1955) 22. — *Idenburgia arfakensis* GIBBS, Fl. Phyt. Arfak (1917) 139, f. 11. — *Nouhuysia arfakensis* (GIBBS) STEEN. Acta Bot. Neerl. 1 (1952) 97; HATUS. Bot. Mag. Tokyo 65 (1952) 110.

Shrub or small tree, 5 m. Twigs rather delicate. *Leaves* lanceolate, to oblanceolate, distinctly acute-acuminate, rather obscurely toothed, to almost entire, tending to be opposite, not in pseudo-whorls, 5–11 by 1 3/4– 3 1/4 cm; petiole thin, 4–7 mm. *Racemes* short, puberulous, few-flowered, *c.* 2–3 cm. Buds 5 mm. *Sepals* shallow-convex, not hooded. *Stamens* 6. *Stigma* grooved, cupular, appressed to the apex of the ovary, 2–3 mm ø. *Fruit* 10 by 7 mm.

Distr. *Malesia:* New Guinea (Arfak Mts), 2 collections.

Ecol. On open summit of Mt Kubré, *c.* 2700 m. *Fl.* Dec.

Notes. Though some dozen collections of *Sphenostemon* were made on the Arfak Mts, the only specimen known, besides the type (GIBBS 6003), is KOSTERMANS 2217, found near Angi Gita Lake at 1800 m.

By the stigma it resembles *S. papuanus* and differs from *S. lobosporus*, but the 6 stamens point the reverse way. By its delicate habit it differs from both.

3. Sphenostemon lobosporus (F.v.M.) L.S. SMITH, Proc. R. Soc. Queensl. 68 (1957) 43. — *Phlebocalymna lobospora* F.v.M. Fragm. 9 (1875) 151.

Tree, 5–9 m high, *c.* 20 cm ø. *Leaves* elliptic, obovate, or oblanceolate, mostly almost entire, opposite or 3 or 4 in pseudo-whorls, marginal teeth usually few and faint, apex acuminate, 5–10 by 2–4 cm; petiole 1–1 1/2 cm. *Racemes* short, few-flowered, 1–2 cm, mostly glabrous. Pedicels 3–5 mm in fruit. Bracts 4 1/2–5 mm. *Stamens* (5–)6. *Ovary* slender, hardly ridged; stigma small knob-shaped. *Fruit* as in the other species, but crowned by a punctate stigma which is also in fruit non-appressed and hardly 1 mm ø.

Distr. N. Queensland (Cook & S. Kennedy Distr.); in *Malesia:* SE. New Guinea (Milne Bay Distr.: Simpson Ra.; Mt Dayman; W. Highl. Prov.: Jimi valley); 3 collections.

Ecol. Subsidiary tree in mixed, montane rainforest, 1200–1500 m (in Queensland 500–1150 m). *Fl.* Aug., *fr.* June, Aug.

Notes. Of the three specimens from Papua, one (SCHODDE 5550) has flowers and fruit which enabled to examine the stamens: one flower had 6 and another 5 + a staminode. This specimen agrees also in the inconspicuously dentate leaf margin. The other sheet (BRASS 23154) has only fruits, but the stigma is typical for *S. lobosporus*; however, it has distinctly dentate leaves and racemes up to 5 cm in fruit, which is atypical for *S. lobosporus*. The third specimen (For. Coll. Herb. Bulolo 8458) has hairy infructescences, the two others being glabrous, reducing differences with *S. arfakensis* to the stigma only!

In Queensland the species attains a height of 6–24 m and a stem diameter of 50 cm.