

A NEW SPECIES OF DIPLOGLOTTIS (SAPINDACEAE) AND ITS SYSTEMATIC POSITION

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SUMMARY

Description of a new species, *Diploglottis bracteata* Leenh., from Queensland, Australia. Reduction of *Euphorianthus* (E. Malesia) to *Diploglottis* (NE. Australia). Discussion of the occurrence of actinomorphic and zygomorphic flowers in the *Sapindaceae* in nearly all tribes and even within ten genera. Discussion of the systematic position of *Diploglottis bracteata*: this species seems distinctly allied to and more derived than the New Caledonian genus *Storthocalyx*, and thus may belong to an old element of the Queensland flora allied with that of New Caledonia. On the other hand, *D. bracteata* is within *Diploglottis* closest to the East Malesian species, whereas the further Australian species are distinctly more derived. They may belong to a younger element in the Queensland flora of Malesian derivation.

I. INTRODUCTION

In recent years, a few collections were made of an unknown Sapindacea from Queensland, Australia. These were variously identified as belonging to the genera *Synima*, *Lepiderema*, *Storthocalyx*, and *Euphorianthus*. Analysis of the specimens available to me, both flowering and fruiting, made clear that the identity of the species concerned could easily be narrowed down to a group of three genera, which are mutually distinctly allied, viz. *Diploglottis*, *Euphorianthus*, and *Storthocalyx*. The inclusion into one of these three genera, however, gave difficulties: the new species shows vegetatively a great resemblance to the New Caledonian genus *Storthocalyx*, its flowers are in nearly complete agreement with those of the East Malesian genus *Euphorianthus*, and it occurs in the same area as the NE. Australian genus *Diploglottis*. Accordingly, a closer comparison of these three genera appeared necessary.

II. SYSTEMATICS

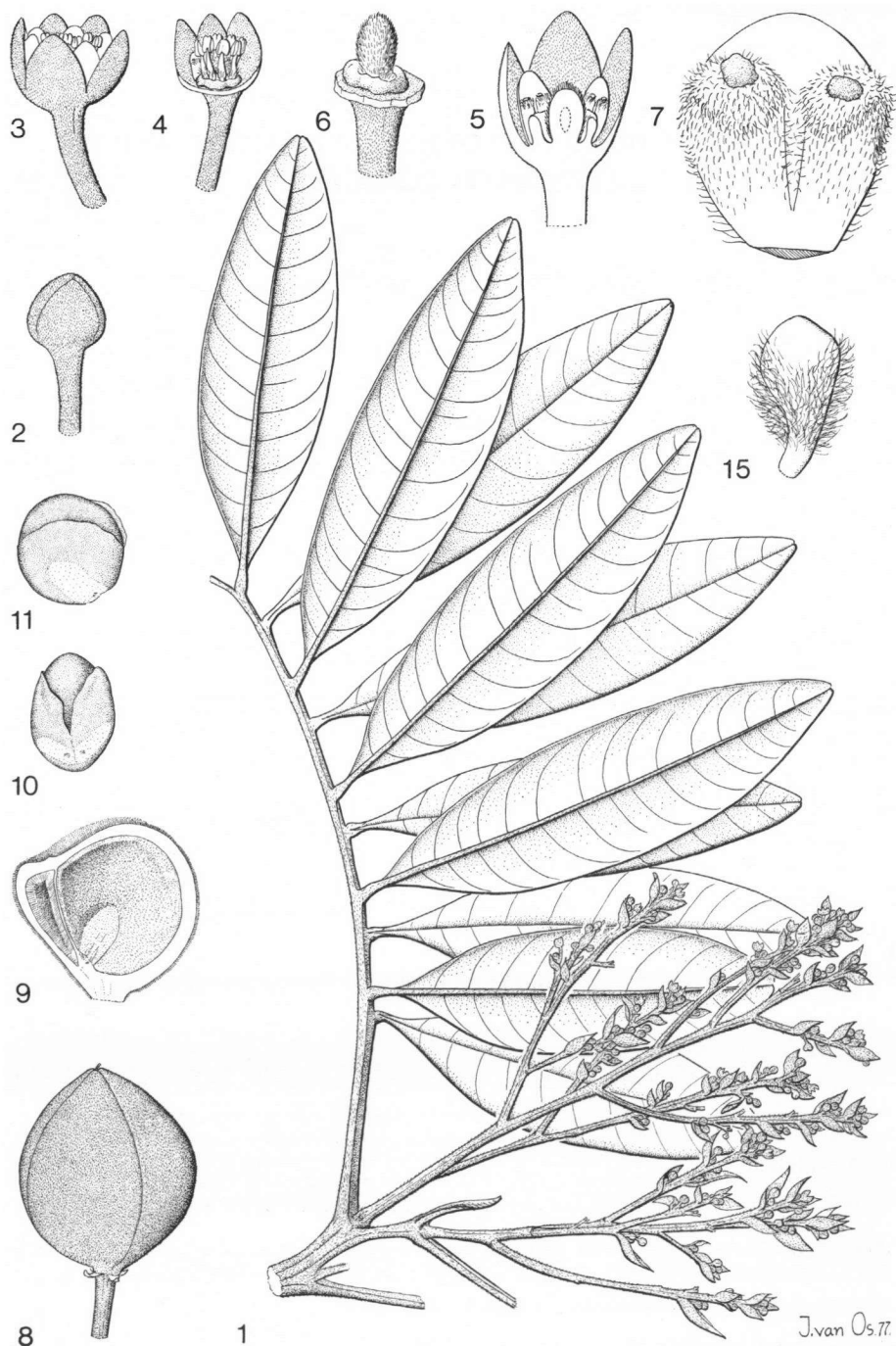
The four allied taxa *Storthocalyx*, *Euphorianthus*, *Diploglottis*, and the new species mainly differ in the following characters:

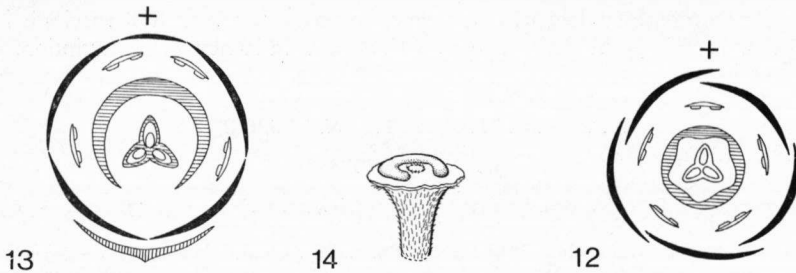
Storthocalyx: sclerophyllous; flowers actinomorphic; sepals free, valvate to narrowly imbricate, equal; petals 5, woolly at both sides, without a scale but sometimes with a pair of auricles at the base of the plate; disk annular; fruit probably incompletely 3-celled. New Caledonia.

Material studied: *S. chryseum*: Godefroy 1450; Thorne 28184. *S. pancheri*: McKee 4483.

New species: subsclerophyllous; flowers actinomorphic; sepals free, imbricate, equal; petals 5, outside subglabrous, inside thin-woolly, with 2 crested scales about as long as the petal; disk annular; fruit completely 3-celled. Queensland.

Material studied: see Chapter III.





Diploglottis bracteata. Fig. 1. habit, $\times \frac{1}{2}$; 2. flower bud, $\times 3\frac{1}{2}$; 3. open flower, $\times 3\frac{1}{2}$; 4. ditto, calyx and corolla partly removed, $\times 3\frac{1}{2}$; 5. ditto, longitudinal section, $\times 7$; 6. disk and pistillode, $\times 7$; 7. petal from inside, showing the deeply divided, crested scale, $\times 15$; 8. fruit, $\times 1$; 9. ditto, in longitudinal section, showing a sterile locule to the left and one half of the large placenta, $\times 1$; 10 and 11. seed with ariloid, note the large hilum, $\times 1$; 12. flower diagram (the stamens are omitted). — *Diploglottis cunninghamii*. Fig. 13. flower diagram (stamens omitted); 14. disk, $\times 7$. — *Storthocalyx pancheri*. Fig. 15. petal from inside, $\times 7\frac{1}{2}$. (1—7: L. S. Smith 10157; 8—11: Webb & Tracey 8219; 14. Dallachy s.n. in herb. L sh. 908.269—550; 15: H. S. McKee 4483).

Euphorianthus: mesophyllous; flowers actinomorphic; sepals free or nearly so, imbricate, equal; petals 5, glabrous at both sides, with 2 scales about half as long as the petal, crested or not; disk annular; fruit incompletely 3-celled. East Malaysia.

Material studied: *E. longifolius*: Hort. Bot. Bogor VII.E.2a.

Diploglottis: mesophyllous; flowers hardly to distinctly zygomorphic; sepals confluent, imbricate, the outermost one hardly to much smaller than the others; petals 5 or 4, more or less unequal, outside glabrous or hairy at base only, inside thin-woolly to glabrous, with 2 crested scales as long as the petal; disk slightly unequal to interrupted; fruit probably incompletely 3-celled. Queensland and New South Wales.

Material studied: *D. cunninghamii*: Dallachy s.n. in herb. L sh. 908.269—550; Fraser & Vickery s.n. in herb. L sh. 937.312—23. *D. sp.*: Brass 19520; Hyland 2026; Schodde 3260.

Not included are seed characters as well developed seeds were not available for all taxa. Radlkofer (1933) mentioned slight differences in the ariloid but my impression is that the seeds of all four taxa are principally identical.

The above enumeration clearly demonstrates the close coherence between the four taxa. The only sharp demarcation is between *Storthocalyx*, with the petals at most auricled (fig. 15), and the other three, the petals of which bear large, often crested scales (fig. 7). The only real difference between the genera *Euphorianthus* and *Diploglottis* is a tendency towards zygomorphic flowers in the latter. This tendency varies from an actinomorphic flower with only the disk slightly unequal to a completely zygomorphic flower with one sepal strongly reduced, the petal opposite that sepal completely suppressed, and the disk interrupted in front of the lacking petal (fig. 13). The completely zygomorphic condition was apparently the only one known to Radlkofer, and accordingly he considered the genera *Diploglottis* and *Euphorianthus* well differentiated. However, from the material studied by me it became clear that within Australian *Diploglottis* there is a gradual transition from this kind of flower to a kind indistinguishable from that of *Euphorianthus*. This breaks down the only difference between the two genera and, consequently, *Euphorianthus*, being the younger name, has to be reduced to *Diploglottis*.

Finally, and notwithstanding its resemblance to *Storthocalyx*, the new species is in all essential characters in good accordance with *Diploglottis* in its new circumscription.

III. DESCRIPTION OF THE NEW SPECIES

DIPLOGLOTTIS

Diploglottis Hook. f. in B. & H., Gen. Pl. 1 (1862) 395; Radlk., Pfl. R. Heft 98 (1933) 1224. — Type: *Cupania cunninghamii* Hook.

Euphoropsis Radlk., Sapind. Holl.-Ind. (1879) 19, 58, 98, nom. illeg., non *Massalunga* (1852). — *Euphorianthus* Radlk., Sitz. Ber. K. Bayer. Akad. Wiss. M.-Ph. Kl. Münch. 9 (1879) 673; Pfl. R. Heft 98 (1933) 1227. — Type: *Euphoropsis longifolia* Radlk.

Diploglottis bracteata Leenh., nov. sp. — Fig. 1–12.

Descriptio typi. — Arbor parva, in partibus juvenilibus dense adpresse minute ferrugineo-pilosa. *Ramuli* 5-sulcati, 5–7 mm diam., pilosi. *Folia* 5–6-jugata; petiolus sicut rhachis supra inter costas marginales planus vel excavatus vel costatus; petioluli 0.75–1 cm longi, tenues, supra profunde anguste sulcati, dimidio inferiore turbinati. *Foliola* alterna, 11.5–14.5 cm longa, 3.5–4 cm lata, anguste oblonga, pergamentacea vel chartacea, subtus pallida, supra costa media sparse tomentella, subtus costa media nervisque subdense, inter nervos secundarios sparse pilosa; nec domatia nec glandulae presentes; basis acuta, longe attenuata; margo integer, revoluta; apex obtusus usque ad emarginatus; costa media supra in sulco profundo abscondita, subtus prominens; nervi secundarii inter se 0.5–1 cm distantes, patentes, curvati, parte apicali foliorum modo conjuncti, supra prominuli, subtus prominentes. *Thyrsi* in axillis foliorum summorum digesti, ad 25 cm longi, puberuli, parce ramificati; rhachis sectione triangulata, profunde sulcata; rami erecto-patentes; bractae conspicuae, subpersistentes, basales lanceolatae, 3 cm longae, 4 mm latae, apicales oblongo-ovatae, 2 mm longae, 0.7 mm latae; cincinni subsessiles ca. 5-flori; pedicelli teretes, usque ad 4 mm longi. *Flores* unisexuales; arbor probabiliter dioica; gemma florum turbinata. *Sepala* 5, aequalia, libera, imbricata, ovato-delloidea, 3 mm longa, 2.5 mm lata, non petaloidea, extus dense fulvo-puberula, intus parte majore dense pilosa. *Petala* 5, truncato-obovata, 1.5 mm longa, 1.75 mm lata, extus parte basali pilosa, parte dimidio inferiore dense ciliata, intus sparse lanata; squama usque ad basin divisa, dorso cristata, lanata. *Discus* annulatus, completus, glaber. *Stamina* 8; filamenta in dimidio inferiore pilosa; antherae glabrae. *Pistillodium* dense pilosum, 3-locularis, loculis 1-ovulatis, ovulo parte inferiore inserti.

Type: L. S. Smith 10157, Australia, Queensland, Cook Dist., Gadgarra and Ghurka Pocket, 17°17'S 145°39'E, 5–9–1957, ♂ fl. (L).

Small tree, the young parts densely appressedly fulvous to ferruginous minute-hairy. *Twigs* deeply 5-grooved, 5–7 mm Ø. *Leaves* paripinnate, 4–6-jugate; petiole above flat between marginal ribs to hollowed, 3–10 cm long, 2–3 mm broad; rachis above flat between faint marginal ribs, to the apex slightly hollowed and sometimes 3-ribbed; petiolules ca. 0.75–1.75 cm long (becoming shorter from basal to apical ones), slender, conically thickened in the lower half, above narrowly deeply grooved; all axial parts densely hairy. *Leaflets* subopposite to alternate, 5.5–15 × 2–4.25 cm, ratio 2.75–5, widest in or sometimes slightly below the middle, convex with the margin slightly to strongly revolute, pergamentaceous to chartaceous, dull beneath, above sparsely tomentellous on midrib, beneath hairy on midrib and nerves, in between with scattered, appressed, minute hairs; neither domatia, nor glands present; base acute, long-attenuate; margin entire; apex rounded, blunt, or slightly tapering-acuminate, very apex rounded, often slightly emarginate, often mucronulate; midrib above hidden in a deep narrow groove, beneath strongly prominent, rounded; nerves 0.5–1.5 cm distant along midrib, diverging at an angle of 80–90°, ± strongly curved, ending free but for the uppermost ones, above prominulous, beneath prominent; intercalated veins common, variably developed; veins coarsely transversely reticulate, prominulous at both sides; veinlets rather coarsely retic-

ulate, above inconspicuous, beneath only partly visible. *Inflorescences* in the axils of the upper, partly caducous leaves, together pseudo-terminal, thyrsoid, lowermost ones up to ca. 25 cm long, completely puberulous; rachis at base globular-swollen, in cross section about triangular with deep grooves; just above the base not rarely with a branch, further with few distant, spreading, angular branches, each bearing in the lower part a few much feebler side branches, in the upper part some distant oblique-erect monochasia; flowers in subsessile, ca. 5-flowered cincinni; bracts rather persistent, the lower lanceolate, 3×0.4 cm, the upper oblong-ovate to ovate, $2-7 \times 0.7-4$ mm; pedicels up to ca. 4 mm long, terete. *Flowers* unisexual (only ♂ available), the tree probably dioecious; buds conical. *Sepals* 5, equal, free, imbricate, ovate-triangular, 3×2.5 mm, not petaloid, outside densely fulvous-puberulous, inside for the greater part densely hairy. *Petals* 5, truncate-obovate, 1.5×1.75 mm, outside hairy at the base, margin in lower half densely ciliate, inside thin-woolly; scale divided to the base, equalling the petal, crested, densely woolly. *Disk* thick-annular, not interrupted, glabrous. *Stamens* 8; filament hairy in the lower half; anther glabrous. *Pistillode* densely hairy, 3-celled; 1 ovule per cell, attached in the lower half. Calyx in fruit persistent. *Fruit* a capsule, irregularly globular, ca. 3 cm Ø, brown tomentellous, dehiscence loculicidal with 3 valves; exocarp probably thin-fleshy, wrinkled when dry, ca. 1 mm thick, mesocarp woody, 1.5 mm thick, endocarp smooth, brown sericeous; placenta in the basal half, transverse elliptic, ca. 0.75×1 cm. *Seed* somewhat flattened globular, 1.5×1.2 cm, hilum ca. $16-17 \times$ up to 5 mm, testa smooth, divided in two flats and a broad, rounded, marginal plate; arilloid attached around the hilum, covering about 75% of the seed, dorsally and ventrally deeply cleft.

AUSTRALIA. Queensland. L. S. Smith 10157, Gadgarra and Ghurka Pocket, $17^{\circ}17' S$ $145^{\circ}39' E$ (L); E. Volck 3464, Gadgarra, Toohey logging area, For. Res. 310 (BRI, L); E. Volck 4062 (L); L. J. Webb & J. G. Tracey 8219, Atherton Tableland, Butchers Creek near Boonjic (BRI).

E c o l.: Edge of rain forest on basaltic soil; alt. 750 m. Fl. Sept.; fr. Dec.

IV. ADDITIONAL NOTES

T a x o n o m y. The number of species under *Diploglottis* cannot be stated without a revision of the whole genus. Out of the three species of *Euphorianthus* distinguished by Radlkofer (1933) one, *E. pallidus*, seems clearly different, both others, *E. longifolius* and *E. obtusatus*, may have to be combined. If the latter two may turn out to be good species, however, there may be more under the still unnamed collections. These latter include the type of *Dysoxylum euneuron* Miq., Ann. Mus. Bot. Lugd. Bat. 4 (1868) 22, the epithet of which is older than any one used in *Euphorianthus* (the late Mr. F. H. Hildebrand, Rijks-herbarium, Leiden, rightly identified this specimen as belonging under *Euphorianthus*). Because of the uncertainty regarding specific delimitation in this group I consider it premature to recombine any name under *Diploglottis*.

In the Australian part of the genus, specific delimitation is as unclear. The differences between the two species mentioned by Radlkofer, viz. *D. australis* and *D. campbellii*, seem not very impressive. Notwithstanding this, they have always been accepted in modern Australian literature. On the other hand, however, I found rather great differences among the few specimens I could study. Either especially the collections Brass 19520 and Hyland 2026 may represent new species, or all typical *Diploglottis* in the sense of Radlkofer is but one variable species.

M o r p h o l o g y. Radlkofer separated the genera *Diploglottis* and *Euphorianthus* mainly on the strength of one character, viz. disk interrupted or not. Interruption of the

disk as a first step from actinomorphic to zygomorphic or even asymmetrical flowers is not uncommon in *Sapindaceae*. Following steps are usually the suppression of the petal in front of the interruption of the disk, and reduction, finally also suppression, of the sepal opposite to the suppressed petal. Finally, this may lead from an actinomorphic 5-merous flower via a zygomorphic partly 5-merous flower to an actinomorphic 4-merous flower in which the disk is uninterrupted again. Doubtless, this tendency does not represent one straight evolutionary line; to the contrary, nearly all tribes of the family include as well genera with actinomorphic 5-merous flowers as those with zygomorphic partly 5-merous flowers, as well as sometimes those with actinomorphic 4-merous flowers. Exceptions are the *Koelreuterieae*, which show a development from zygomorphic flowers with 4 petals to asymmetrical flowers with 3 or 4 petals (zygomorphic in *Erythrophysa* incl. also *Erythrophysopsis*, zygomorphic to irregular in *Koelreuteria*, irregular in *Stocksia*); the closely allied family *Hippocastanaceae* in which the flowers are always zygomorphic but with a development from 5 to 4 petals and from a complete to an interrupted disk; and the family *Aceraceae*, like the former hardly more than a tribe of the *Sapindaceae*, with actinomorphic 5- and 4-merous flowers.

The breakdown of the character: disk interrupted or not, led not only to the combination of the genera *Diploglottis* and *Euphorianthus*, but introduced also a gradual development from actinomorphic to zygomorphic flowers into the resulting genus *Diploglottis*. However, though rare, this is not an exception in *Sapindaceae*; up till now this variation is known from the following genera: *Thinouia* (*Paullinieae*); *Sapindus*, *Thouinidium*, and *Toulicia* (*Sapindeae*); *Xerospermum* (*Nephelieae*); *Diploglottis*, *Guioa*, and *Mischocarpus* (*Cupanieae*); *Cossinia* (*Cossinieae*); and *Majidea* (*Harpullieae*). In some cases, this characterizes subgenera or sections, in others there is a gradual change like in *Diploglottis*. A possible cause for this phenomenon is lack of space on the growing apex, as ♀ flowers with the relatively big pistil may lead the development. An extreme example is *Xerospermum acuminatum* Radlk., where the ♀ flowers have an interrupted disk, the ♂ flowers either an uninterrupted one, or a disk interrupted in a different place! The flowers in both sexes are 5-merous; actinomorphic 4-merous flowers are more common in the genus, but characterize a different section. In *Thinouia* it are the ♀ flowers only that may show an oblique disk. Whether this also holds true for *Diploglottis* cannot be concluded from the few specimens analysed; *D. cunninghamii* showed in the two specimens studied in ♂ as well as in ♀ flowers reduction of the corolla and a wide interruption of the disk; the ♀ flowers of *Schodde 3260* were fully comparable; the ♀ flowers of *Hyland 2026* had an interrupted disk, but 5 petals, one of which smaller; the ♂ flowers of *Brass 19520* had 5 petals and the disk only slightly oblique; the ♂ flowers of *D. bracteata* were fully actinomorphic like the ♂ and ♀ ones of *Euphorianthus longifolius*.

Regarding the occurrence of actinomorphic and zygomorphic flowers in one and the same genus may also be referred to a paper by G. L. Stebbins & R. D. Hoogland (Plant Syst. Evol. 125, 1976: 139—154), mainly on *Hibbertia*. They knew of only seven genera showing this variation.

Phylogeny. The phylogenetic relationships between *Storthocalyx* and *Diploglottis* and those within the latter genus are interesting. The differences are mainly in the flower, as shown in Chapter II; there, the taxa are given in a sequence that in my opinion may reflect evolution within the group. The most original condition characterizes *Storthocalyx*, endemic to New Caledonia. It is clearly different from *Diploglottis* by the absence of scales to the petals; the auricles at the base of the petalar plate may be regarded as a first step in that direction. It is tempting to consider *D. bracteata* as the species in *Diploglottis* nearest to *Storthocalyx*, as it resembles very much *S. pancheri*, especially in its leaves; its

flowers are in complete agreement with those of the East Malesian representatives of *Diploglottis*, however. These East Malesian species are mesophyllous, like the further species from Australia; the latter show the more extreme flower characters. Summarizing, *Diploglottis bracteata* may on the one hand represent the old and rather rare 'New Caledonian' element in the Queensland flora, on the other hand, however, it seems to stand at the basis of a further development, primarily in East Malesia, whereas the other Australian species of *Diploglottis* may belong to the much younger Malesian element in the NE. Australian flora.

Pollen morphology. The rather close relationship between *Diploglottis* and *Storthocalyx* is also shown by pollen morphology. Similar parasyncolpate smoothwalled pollen (type B of Muller & Leenhouts in Ferguson & Muller (eds.), The evolutionary significance of the exine, 1976: 407—445) occurs in *Storthocalyx chryseum*, *Diploglottis cunninghamii*, and *D. bracteata*. The pollen of *Euphoranthus obtusatus* differs in having a finely striate-reticulate wall. (J. Muller).