

Notes on *Gardenia* and *Acranthera* (Rubiaceae) from Peninsular Malaysia

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Summary

The genus *Gardenia* (Rubiaceae) is represented in Peninsular Malaysia by seven species of which two are shrubs and five are trees. Within the most variable species, *G. tubifera* Wall., two varieties are recognised, i.e. var. *tubifera* and var. *subcarinata* Corner; the former variety is shown to exist as two forms, forma *tubifera* and forma *elata* (Ridl.) Wong. Two species, *G. coronaria* Buch.-Ham. and *G. pterocalyx* Val., have not been previously recorded in accounts of the genus in Peninsular Malaysia. A key to all seven species is provided. Three taxa formerly included under *Gardenia* are transferred to *Acranthera*, providing the first record of the latter genus in Peninsular Malaysia; the new combinations are *Acranthera pulchella* (Ridl.) Wong and *A. didymocarpa* (Ridl.) Wong.

Introduction

Since Ridley's account of the genus *Gardenia* in the Malay Peninsula (Ridley, 1923) the only amendment has been that by Corner (1938) who reduced three of the species listed by Ridley to synonymy, under *G. tubifera*.

The present study provides an updated list of *Gardenia* species indigenous to the Malay Peninsula; of the seven species, *G. tubifera* is the most variable, and an account of the variation is therefore presented. These seven species may be keyed out by distinctive features of the flowers and fruits.

Although sectional delimitation within the genus cannot be dealt with prior to a worldwide revision, it is shown that the section *Gardeniella* Ridley (Ridley, 1909) was founded on three species which cannot be admitted within *Gardenia*, but which belong to the genus *Acranthera* instead.

Variation and Synonymy in *Gardenia tubifera*

Corner (1938) had already proposed that *G. speciosa* (Hk.)Hk.f., *G. elata* Ridl. and *G. resinifera* Korth. are conspecific with *G. tubifera* Wall.

The type specimen of *G. elata* (described in 1918) matches the details of *G. speciosa* (in *Ic. Pl.*, 1852, t.824, as *Randia speciosa* Hk.). Craib (1932) realised that *G. speciosa* (Hk.)Hk.f. (described in 1880) was a homonym of *G. speciosa* Salisb. (described in 1796) and renamed Hooker's species as *G. lobbii*.

When Ridley (1923) elaborated on these identities, he had the impression that *G. tubifera* was generally small-leaved ("leaves . . . 3.75 to 6 in. long, 1.5 to 2 in. wide") in contrast with *G. elata* ("leaves . . . 9 in. long, 3.5 in. across"); this is borne out by the specimens he had annotated at Singapore. That there is great variation in the dimensions

of mature open flowers is seen in the type specimen of *G. elata*, where two such flowers had the contrasting corolla-tube lengths of 6.6 cm and 11.4 cm. I agree with Corner (1938) who, in discussing the variations in leaf size, lengths of calyx-tube and corolla-tube, regarded the specimens *SFN 32440* and *SFN 32368* as intermediates between *G. speciosa*, *G. elata* and *G. tubifera*. I further agree with him in considering *G. resinifera* (with ribbed calyx-tubes) as a variety of *G. tubifera* (which otherwise has smooth calyx-tubes), named by him as *G. tubifera* var. *subcarinata* (Corner, 1938).

As *G. tubifera* Wall. (described in 1824) is the earliest name for this species, it takes precedence over the others. The synonymy for *G. tubifera* is thus :

G. speciosa (Hk.)Hk.f., *Fl. Brit. Ind.* 3 (1880) 117, non Salisb. (1796);

G. elata Ridl., *J. Str. Br. As. Soc.* 79 (1918) 81;

G. resinifera Korth. in Ridley, *Fl. Mal. Peninsula* 2 (1923) 82;

G. lobbii Craib, *Fl. Siam. En.* 2 (1932) 120.

The two varieties of *G. tubifera* are keyed out as follows:

Calyx-tube smooth	<i>G. tubifera</i> var. <i>tubifera</i>
Calyx-tube ribbed	<i>G. tubifera</i> var. <i>subcarinata</i> Corner,
	<i>Gard. Bull. S.S.</i> 10 (1938) 48.

While Corner was correct in observing that these entities formed a continuous range with regard to the characters mentioned, there is a tendency among the specimens with smooth calyx-tube (i.e. agreeing with *G. tubifera* var. *tubifera*) to group in two different directions (Fig. 1).

These two groups are two recognisable forms, keyed out as follows:

1. Leaves glabrous below, with widths not exceeding 6 cm; calyx-tube 0.8 – 2.0 cm long; corolla-tube 2.5 – 7.5 cm long; fruits to 3.5 cm across; plants usually found in lowland sites near the coast or swampy areas
..... *G. tubifera* var. *tubifera* forma *tubifera*
1. Leaves with puberulent veins on the undersurfaces, with widths often reaching 6 – 12 cm although smaller leaves may be present; calyx-tube 1.5 – 3.5 cm long; corolla-tube often 6.5 – 14 cm long; fruits to 5 cm across; plants found in lowlands to hill forest *G. tubifera* var. *tubifera* forma *elata* (Ridl.) Wong, stat. nov.

Basionym : *G. elata* Ridl., *J. Str. Br. As. Soc.* 79 (1918) 81.

Synonyms : *G. speciosa* (Hk.)Hk.f., *Fl. Brit. Ind.* 3 (1880) 117, non Salisb. (1796); *G. lobbii* Craib, *Fl. Siam. En.* 2 (1932) 120.

Type : *Wray 4265*, Perak, Selama (SING; also syntype of *G. elata*).

It is possible that the range of variation present within *G. tubifera* reflects incipient evolutionary changes such that the modifications in floral characters have not yet progressed to the stage where they fall into discrete groups.

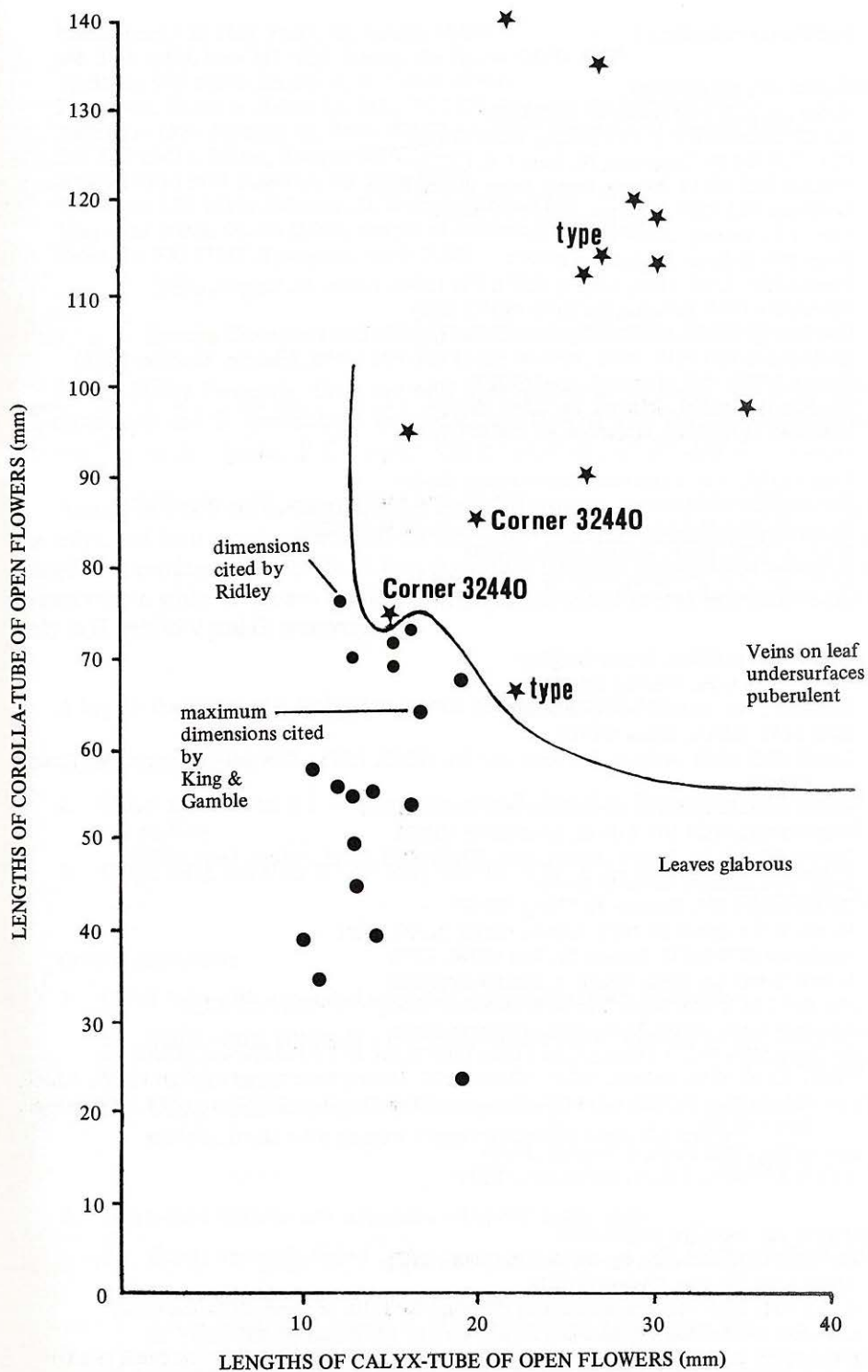


Figure 1. Corolla-tube and calyx-tube lengths compared between specimens of *Gardenia tubifera* sensu Ridley (•) and *G. elata* sensu Ridley (*).

Specimens examined :

G. tubifera var. *subcarinata*

- Alvins s.n. 23.3.1886. Malacca, Jus (SING)
 Burkill & Haniff SFN 17129. Pahang, Pekan (SING)
 Chan FRI 25155. Trengganu, Bt. Bauk F.R. (KEP)
 Chelliah KEP 98143. Penang, Pantai Acheh (SING, KEP)
 Cockburn FRI 7300. Kelantan, Relai F.R. (KEP)
 Curtis 686. Penang, Govt. Hill (SING)
 Derry 360. Malacca, Bt. Sadanau (SING)
 Everett FRI 13596. Perak, Taiping (KEP); FRI 13766. Kedah, Bt. Enggang (KEP)
 Foxworthy 7960. Selangor, Sg. Buloh (SING, KEP)
 Goodenough s.n. 25.1.1890. Singapore, Changi (SING)
 Kochummen FRI 2919. Perak, Maxwell Hill (KEP); FRI 11496. Selangor, Kanching (KEP)
 Mat Ariff KEP 7501. Kedah, G. Jerai (SING)
 Md. Nur SFN 34129. Selangor, Sg. Tinggi (SING)
 Ngadiman SFN 34926. Singapore, Bt. Timah (SING)
 Phytochem. Survey of Malaya KL 2989. Selangor, 26 m.s. K.L. to Selangor (SING)
 Ridley 2588; 4416. Singapore, Garden Jungle (SING)
 Sinclair SFN 10863. Johore, Sg. Bang (SING); SFN 39695. Penang, Tiger Hill (SING)
 Stone, Sharif & Mahmud KLU 12264. Pahang, Tasek Bera (KEP)
 Wray, Jr. 2522. Perak, Matang Jambu (SING)
 Yeok KEP 4753. Selangor, Kelambu F.R. (SING)
 Zahir Yusoff KEP 99132. Pahang, Ulu Krau (SING)

G. tubifera var. *tubifera* forma *tubifera*

- Alvins 11. Malacca, Selandar (SING)
 Bain KEP 5985. Johore, Sg. Johol (KEP)
 Bidin 3151. Johore, Endau (SING)
 Burkill HMB 2640. Malacca, Bt. Berendam Rd. (SING, KEP) : SFN 1434. Malacca, Sg. Tebong (SING)
 Burkill & Haniff SFN 16374. Malacca, Alor Gajah (SING)
 Burn-Murdoch SFN 304. Pahang, Tasek Chini (SING)
 Corner SFN 24625. Johore, Bagan Limau (SING); SFN 25971. Johore, Darau (SING)
 Derry 199. Malacca, Merlimau (SING)
 Goodenough 1699. Malacca, Sg. Udang (SING)
 Hardial S. & Samsuri HS 1092. Johore, Kluang (SING, KEP)
 Henderson SFN 24126. Pahang, Sg. Bera (SING, KEP)
 Lake & Kelsall s.n. 1892. Johore, K. Sembrong (SING)
 Mat Asri FRI 25738. Negeri Sembilan, Simpang Pertang - K. Pilah road (KEP)
 Md. Shah & Md. Ali MS 3147. Pahang, Rompin (KEP)
 Ngadiman SFN 16114. Pahang, Lubok Paku (SING); s.n. 14.1.1938 & s. loc. (SING)
 Ridley 1375; 1388. Pahang, Pekan (SING); 4209. Johore, Kota Tinggi (SING); 11139. Johore, Bekok River (SING); s.n. 1895. Singapore, Choa Chu Kang (SING); s.n. 20.8.1909. Pahang, Pekan (SING)
 Scortechini 1775. Perak, K. Depang (SING)
 Watson KEP 5816. Johore, Ulu Mersing (KEP)

G. tubifera var. *tubifera* forma *elata*

- Abu KEP 4652. Selangor, Sg. Buloh F.R. (SING, KEP)
 Alvins 2364. Malacca, Chaban (SING)
 Burkill SFN 2509. Malacca, Kemandore (SING); KEP 3313. Selangor, Sg. Buloh (KEP)
 Chan FRI 6777. Kedah, Ulu Muda (KEP)
 Corner SFN 28736. Johore, Sg. Berassau (SING, KEP); SFN 32440. Johore, Sg. Sedili (SING)
 Everett FRI 13631. Pahang, north of Kg. Teris (KEP)
 Hullett 445. Singapore, Bt. Timah (SING)
 Kiah SFN 32368. Johore, Sg. Kayu (SING); SFN 35148. Kedah, Koh Mai F.R. (SING)

Kochummen FRI 2457. Perak, Kg. Kangsar (KEP)
 Md. Shah & Md. Noor MS 1833. Pahang, Ulu Sg. Sat (SING, KEP)
 Ngadiman SFN 35595. Singapore, Bt. Timah (SING)
 Phytochem. Survey of Malaya KL 2018; KL 2138. Selangor, Ulu Langat (KEP)
 Ridley s.n. 1891. Selangor, Sg. Buloh (SING); s.n. 1907. Singapore, Bt. Timah (SING)
 Soh KEP 15411. Pahang, Rompin (SING)
 Suppiah FRI 11681. Kelantan, Ulu Lebir (KEP)
 Symington KEP 24190. Selangor, Bt. Enggang (SING, KEP)
 Wray 4265. Perak, Selama (SING, syntype of *Gardenia elata* Ridley)
 Zainuddin FRI 17945. Trengganu, Jerleh (KEP)

Species Characters and a Key To Peninsular Malaysian *Gardenia*

In the Malay Peninsula, there are only two species of *Gardenia* which are shrubs (*G. campanula* and *G. tentaculata*), and these have flowers with the corolla campanulate whereas the tree species are all characterised by a salverform corolla (Fig. 2).

Among the five arborescent species, the most reliable distinguishing characters are the calyx and fruit structure, whether the calyx-tube and fruit are smooth, ribbed or bear wing-like appendages. The length of the corolla-tube seems an undependable character, as shown earlier, while the extent to which the calyx ensheaths the corolla-tube is significant only in *G. griffithii* and *G. pterocalyx*.

A key to the Peninsular Malaysian species of *Gardenia* follows:

1. Corolla campanulate
 2. Calyx teeth often 0.5 — 1 cm long; corolla less than 2 cm long; fruits ribbed on the surface *G. tentaculata* Hk. f.
 2. Calyx teeth less than 0.3 cm long, corolla often 3 — 4 cm long; fruits smooth *G. campanula* Ridl.
1. Corolla salverform
 2. Calyx-tube with expanded wing-like appendages down its length
 3. Calyx wings triangular, the wings at the top of the calyx-tube; fruits ribbed *G. carinata* Wall.
 3. Calyx wings running down the entire calyx-tube, the wings broadest at their middle; fruits with narrow wings continuing from the calyx *G. pterocalyx* Val.
 2. Calyx-tube without any expanded wing-like appendages
 3. Fruits obovoid, ribbed *G. coronaria* Buch.-Ham.
 3. Fruits globose, smooth
 4. Calyx-tube sheathing to half the length of the corolla-tube *G. griffithii* Hk. f.
 4. Calyx-tube sheathing only to a third the length of the corolla-tube, or less *G. tubifera* Wall.

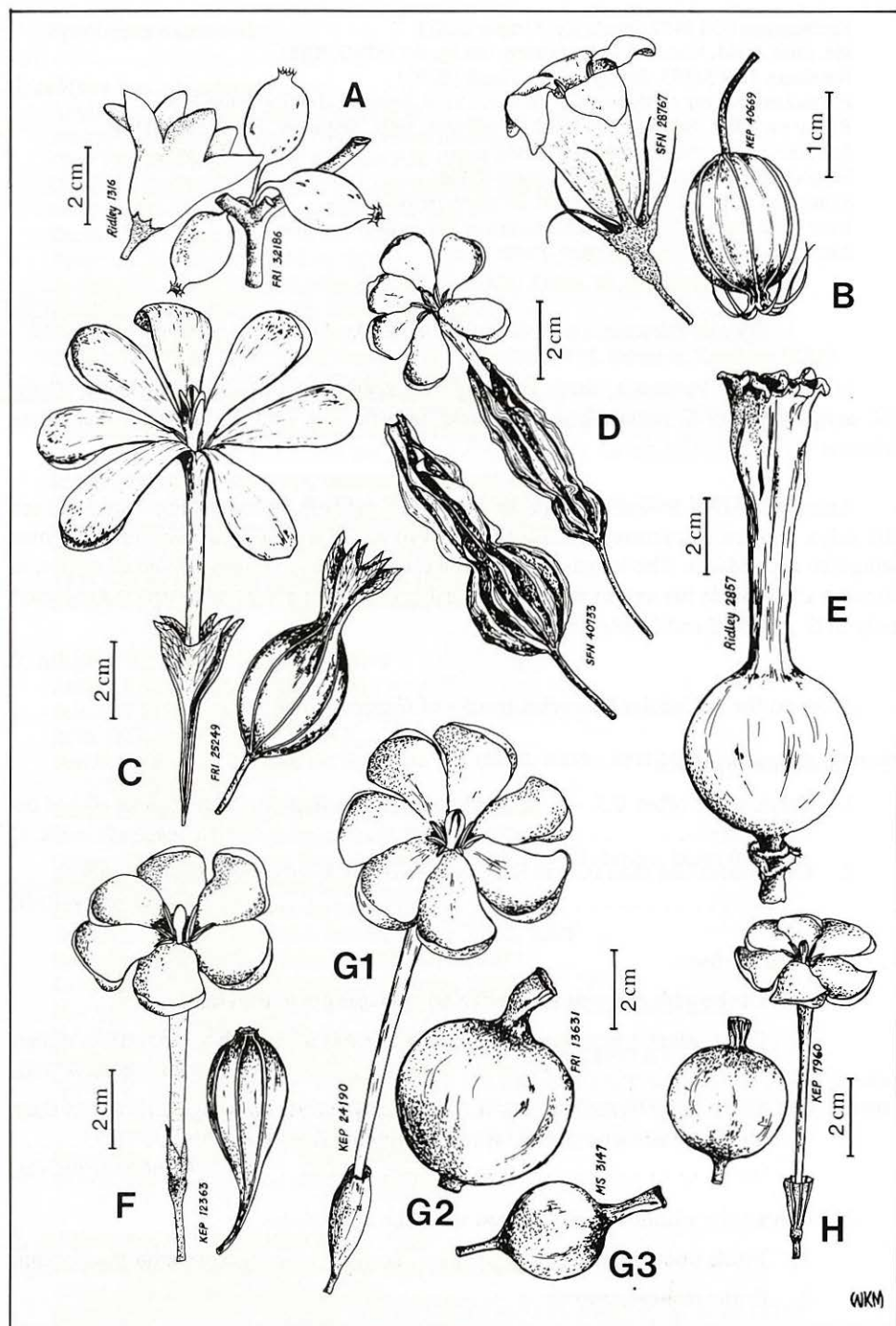


Figure 2. Flowers and fruits of *Gardenia* species. A. *G. campanula*; B. *G. tentaculata*; C. *G. carinata*; D. *G. pterocalyx*; E. *G. griffithii*; F. *G. coronaria*; G. *G. tubifera* var. *tubifera* (G1 and G2, flower and fruit, respectively, of forma *elata*; G3, fruit of forma *tubifera*); H. *G. tubifera* var. *subcarinata*.

The species *G. coronaria* and *G. pterocalyx* were not included by Ridley (1923). *G. coronaria* was first recorded by Craib (1932) to occur in the Malay Peninsula and is known only from Langkawi in the extreme north-west; it is mainly an Indo-Chinese species. Malayan specimens of *G. pterocalyx*, a species not previously recorded from the Malay Peninsula, have rounded leaf apices while Bornean specimens seen have leaves with a short tip. The specimens examined are listed below.

G. coronaria

- Alphonso and Samsuri A128. Langkawi, Kuah (SING)
 Chelliah FRI 6916. Langkawi (KEP)
 Corner s.n. 12.11.1941. Langkawi, Kuah (SING)
 Curtis s.n. 3.1892. Langkawi, Trutow (SING)
 Holtum SFN 15082. Langkawi (SING)
 Md. Haniff & Md. Nur SFN 7560. Langkawi, Bt. Penarak (SING)
 Rahim KEP 12363. Langkawi, Penarak F.R. (SING)

G. pterocalyx

- Henderson SFN 24138. Pahang, Sg. Bera near Tasek Bera (SING)
 Mahmud bin Sider s.n. May 1970. Pahang, along the road to G. Ulu Kali alt. 1200 ft a.s.l. (KLU)
 Poore 951. Pahang, Tasek Bera, forest edge in swamp (KLU)
 Sinclair & Kiah SFN 40733. Trengganu, Paya Bt. Pakbeh, sandy gelam forest (SING)
 Stone 6614. Pahang, Tasek Bera, in the lake, lower part of trunk immersed (KLU)
 Stone 9484. Pahang, Tasek Bera, alt. 50 ft a.s.l. (KLU)

Species Transferred from *Gardenia* to *Acranthera*

Ridley's *Gardenia didymocarpus*, *G. pulchella* and *G. virescens* are not admissible to the genus *Gardenia* because of the following discrepancies:

- (i) The stamens have long filaments arising from the base of the corolla-tube and basifixed anthers which are connivent around the stigma. In *Gardenia*, the stamens are distinctly epipetalous, attached near the mouth of the corolla-tube, and the anthers are never connivent around the stigma.
- (ii) The fruit is a narrowly cylindric berry, with many tuberculate seeds. In typical *Gardenia*, the fruit is an ellipsoid to globose berry and the seeds have a non-tuberculate testa.
- (iii) The stipules are pronounced structures with long linear teeth on the margin, whereas in typical *Gardenia* the stipules have an entire margin.

There are only a few genera in the Rubiaceae which possess the feature of having the anthers connivent around the stigma, and borne on filaments inserted at the base of the corolla-tube. These genera include *Argostemma*, *Neurocalyx*, *Steenisia* and *Acranthera*. Table 1 provides a comparison of the main features of these genera with the species placed in *Gardenia* by Ridley (1909); it will be appreciated that Ridley's taxa in question belong to the genus *Acranthera*.

Argostemma is easily set apart from the other genera by its exsert anthers which often open by pores, as well as its entire stipules.

Table 1. Morphological comparisons between the genera *Argostemma*, *Neurocalyx*, *Steenisia*, *Acranthera* and specimens representing *Gardenia didymocarpus* Ridl., *G. pulchella* Ridl. and *G. virescens* Ridl.

	<i>Argostemma</i>	<i>Neurocalyx</i>	<i>Steenisia</i>	<i>Acranthera</i>	<i>G. didymocarpus</i> , <i>G. pulchella</i> & <i>G. virescens</i>
Stipules	Entire	Bifid to laciniate	Laciniate to fringed with long teeth	Entire to apically slightly dentate	Fringed with long teeth
Inflorescences	Terminal on main shoots	Axillary, racemes or heads	Axillary, thyrsoid	Terminal on main shoots or at ends of axillary short-shoots	At ends of axillary short-shoots
Stamen filaments	Very short, the anthers sub-sessile	Very short, the anthers sub-sessile	Very short, the anthers sub-sessile	Ranges from short to longer than the anthers	Long, much longer than the anthers
Anthers	Exsert from the corolla-tube, often opening by pores, sometimes longitudinally	Included within the corolla-tube, dehiscing longitudinally			
Ovary	2-celled, axile placenta	2-celled, axile placenta	2-celled axile placenta	1-celled, parietal placenta	1-celled, parietal placenta
Fruit	Globose capsule, dehiscing apically or operculate	Oblong-ovoid capsule, dehiscent	Oblong-ovoid capsule, dehiscent	Oblong to cylindric berry, indehiscent	narrowly cylindric berry, indehiscent

The Bornean genus *Steenisia* and the related Ceylonese-Indian *Neurocalyx* (Airy Shaw, 1937; Bakhuizen, 1952) possess stipular structures closely resembling those in Ridley's taxa here discussed, but differ in their axillary inflorescences, dehiscent capsules and two-celled ovaries with axile placentation.

While Bentham & Hooker (1873) and Hooker (1882) have stated that the ovary in *Acranthera* is unilocular with parietal placentation, Bremekamp (1947) upheld Stapf's view (1894) that the ovary and fruit are perfectly bilocular, and (in Bremekamp's words) "may, however, easily be mistaken for unilocular, because the dissepiment is rather thin in the middle and, therefore, is easily torn when the razor, with which the sections are made, is not sufficiently sharp." Subsequently, Bakhuizen (1975) has affirmed, for species in Thailand at least, that the ovary is initially one-celled and afterwards two-celled in appearance, so caused by two intruding placentas. Serial sectioning of young and mature fruits from Bornean specimens of *Acranthera* support the observation by Bakhuizen. In Ridley's *G. didymocarpus*, *G. pulchella* and *G. virescens*, this is also the case, the ovary and young fruit being one-celled, with two parietal placentas which gradually meet and give the impression of a bilocular condition in mature fruits.

Ridley (1909) noted that "the genus *Acranthera* contains only plants with strongly peduncled terminal cymes." In *G. pulchella*, the flowers are in clusters of one to several on short axes from the leaf axils; in *G. didymocarpus*, the flowers are solitary but are borne on short axes which sometimes bear a few reduced bract-like appendages below the actual flower stalk. While most known *Acranthera* have well developed terminal inflorescences and are clearly hapaxanthic with regard to the main vegetative shoot, there are other species in the genus which have flowers on axillary short-shoots (Bremekamp, 1947) and are pleonanthic with regard to the main vegetative shoot.

On the basis of these species, Ridley (1909) erected a new section of the genus *Gardenia*, named *Gardeniella*, mentioning *G. tentaculata* as a connecting link between this section and typical *Gardenia*; however, he had effectively only commented that the seeds of *G. tentaculata* are "like those of *G. pulchella* pustular." *G. tentaculata* is a true *Gardenia* since it possesses single-celled ellipsoid fruits and compressed seeds. The only point which may need clarification would be the statement by King & Gamble (1903) that the anthers are "at the base of the corolla-tube" which sounds like the situation in *G. pulchella*, but the two are entirely different. In *G. tentaculata*, the anthers are sessile and dorsifixed just below the corolla mouth, with the lower end of the anther reaching the base of the corolla-tube, while in *G. pulchella* the anthers are borne on long filaments from the base of the corolla-tube.

From the above considerations, it may be concluded that both *G. pulchella* and *G. didymocarpus* should be transferred to *Acranthera*; I have found *G. pulchella* and *G. virescens* to be conspecific, with the former name taking precedence. It also follows that Ridley's section *Gardeniella* is merely a synonym of *Acranthera*.

These two species of *Acranthera* may be compared as follows:

1. Leaves short hairy below, flowers in clusters of 1-several, corolla greenish to white with pink spots inside *Acranthera pulchella* (Ridl.) Wong. comb. nov. (Fig. 3)
Gardenia pulchella Ridl., J.F.M.S. Mus. 4 (1909) 31, basionym;

Gardenia virescens Ridl., J.F.M.S. Mus. 4 (1909) 32, **syn. nov.**

Typification and specimens examined :

Ridley 13606, Pahang, Telom (SING; lectotype of *Acranthera pulchella*, here chosen)

Ridley, s.n. 1891, Perak, Taiping Hills, 5000 ft (SING; type of *Gardenia virescens*)

Henderson SFN 10941, Pahang, Lubok Tamang (SING)

Henderson SFN 11537, Pahang, Fraser's Hill (SING)

Burkill & Haniff SFN 13182, Perak, Maxwell Hill (SING)

Md. Nur SFN 11233, Pahang, Fraser's Hill (KEP)

Ridley did not designate any type for *G. pulchella* but mentioned "Common on banks at Telom" — his specimen from Telom, annotated by him as such, may be regarded as type material. Since Ridley also did not designate a type species for section *Gardeniella*, *G. pulchella* Ridl. is here selected as the lectotype species, henceforth to be cited as a synonym of *Acranthera*.

1. Leaves densely long hairy below, flowers solitary, corolla yellow with pink spots inside *Acranthera didymocarpa* (Ridl.) Wong, **comb. nov.**

Gardenia didymocarpus Ridl., J.F.M.S. Mus. 4 (1909) 32, basionym.

Typification and specimens examined :

Ridley 7573, Selangor, Ginting Bidai (SING; syntype of *Gardenia didymocarpus*; lectotype of *Acranthera didymocarpa*, here chosen)

Ridley s.n. 1897, Selangor, Pahang Track 15th mile (SING; syntype of *Gardenia didymocarpus*)

Burkill SFN 3183, Negeri Sembilan, G. Tampin (SING)

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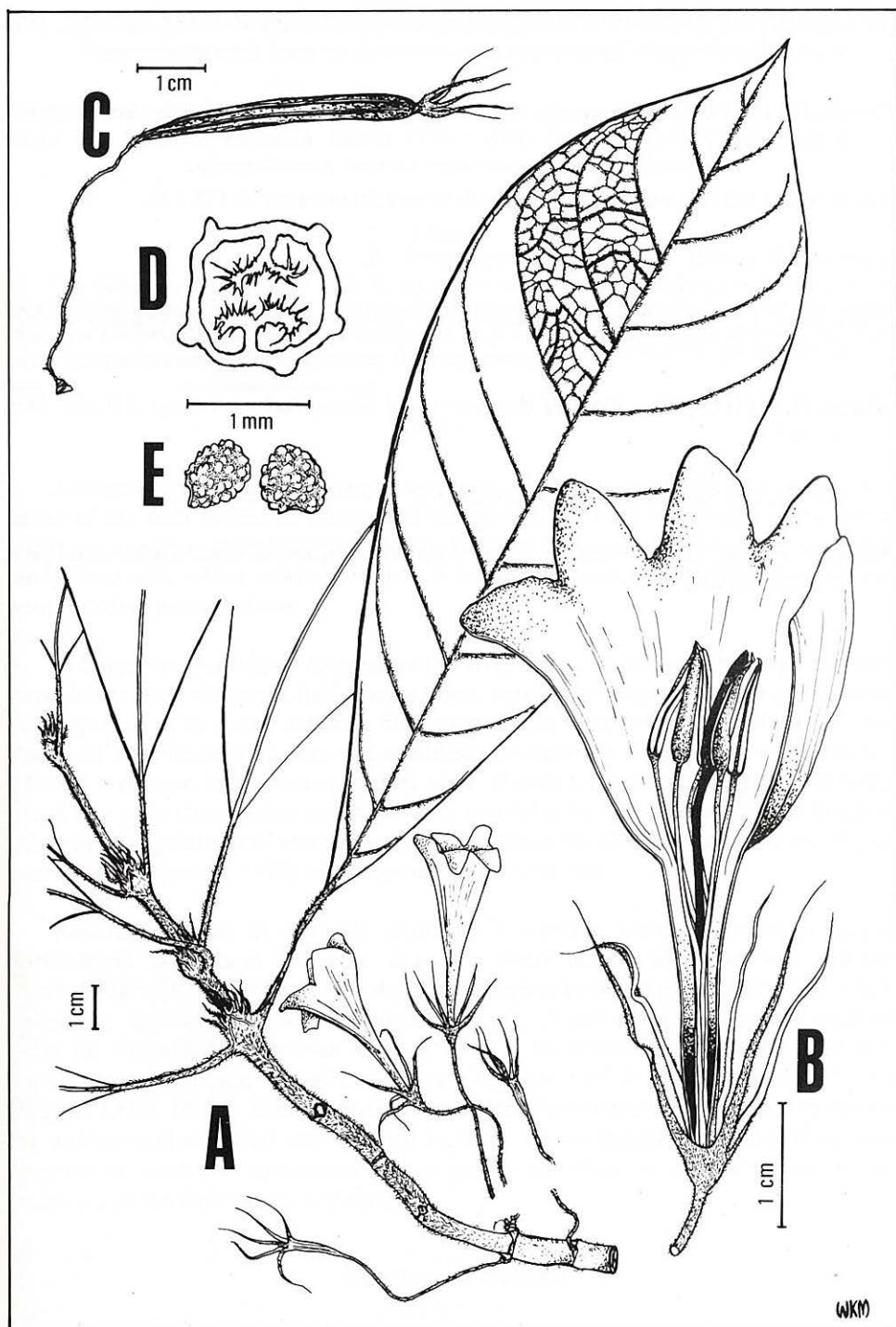


Figure 3. *Acranthera pulchella* (Ridl.) Wong. A. Twig with leaves and flowers; B. Flower with corolla-tube cut apart to reveal stamens and style; C. Mature fruit; D. Transverse section through young fruit showing two parietal placentas; E. Seeds from mature fruit. All based on the type specimen (Ridley 13606) except D (from SFN 10941).

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