

# Taxonomy of the genus *Pelargonium* (Geraniaceae): the section *Polyactium*.

## 1. Circumscription and intrasectional classification

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The historical subdivision of the section *Polyactium* DC. of the genus *Pelargonium* L'Hérit. (Geraniaceae) was traced. This subdivision was re-assessed in view of new information that had become available since the last intrasectional classification, as well as a better understanding of the taxonomical significance of floral and vegetative features. This resulted in the recognition of four subsections which are distinguished from one another by their floral (and in one subsection, vegetative) morphology. The subsections are circumscribed and a key to their identification is provided. Species excluded from the section are listed with reasons for their removal.

Die historiese onderverdeling van die seksie *Polyactium* DC. van die genus *Pelargonium* L'Hérit. (Geraniaceae) is ondersoek. Hierdie onderverdeling is her-evalueer in die lig van nuwe inligting wat sedert die laaste klassifikasie binne die seksie beskikbaar geword het, asook 'n beter begrip van die taksonomiese betekenis van blom- en vegetatiewe kenmerke. Dit het die erkenning van vier subseksies wat van mekaar onderskei word op grond van hulle blom- (en in een subseksie, vegetatiewe) morfologie, tot gevolg gehad. Die subseksies word omskryf en 'n sleutel vir hulle identifikasie word voorsien. Spesies wat van die seksie uitgesluit is, word gelys met 'n motivering vir hulle uitsluiting.

**Keywords:** Geraniaceae, *Pelargonium*, *Polyactium*, taxonomy.

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### Introduction

The species of the genus *Pelargonium* L'Hérit. (Geraniaceae) largely fall into fairly easily recognizable groups, although the borders between the groups can sometimes be obscured, and the issue may be clouded by species of uncertain affinity. Traditionally the genus has been divided into sections, and because this subdivision seems to be reasonably natural, we have followed this practice in our taxonomic treatment of this genus.

The section *Polyactium* DC. is unusual in the genus in that the reproductive structures within each of the four recognizable groups within the section offer no taxonomically useful characteristics at specific level, so that vegetative characteristics have to be used instead to delimit species. Since the section was last treated taxonomically (Knuth 1912), a wealth of additional material and information has become available. The aim of this investigation is to re-assess the classification of the section *Polyactium* at the level of subsections and species.

The present account of the section consists of five parts:

- (i) Circumscription and intrasectional classification.
- (ii) The subsection *Caulescentia*.
- (iii) The subsection *Polyactium*.
- (iv) The subsection *Magnistipulacea*.
- (v) The subsection *Schizopetala*.

### History

The first species in the currently recognized section *Polyactium*, *Geranium triste* L., was described at the very starting point of botanical nomenclature (Linnaeus 1753). In 1789 the genus *Pelargonium* was separated from *Geranium* (L'Héritier 1789), yet it was only in 1820 (Sweet 1820), after another 15 species had been described in what is today considered to constitute the section *Polyactium*, that any attempt was made to classify the species. Sweet (1820) divided the genus into eight entities, each of which was given the rank of genus. One of these genera was *Pel-*

*argonium*, which contained all the species treated by Sweet that are currently placed in section *Polyactium*. De Candolle (1824) extended Sweet's division into 12 entities with sectional rank within the genus *Pelargonium*. Three of these sections contained species which are currently included in the section *Polyactium*, namely his sections *Dimacria* (*Pelargonium heracleifolium* Lodd.), *Polyactium* (*P. multiradiatum* Wendl.), and *Pelargium* (a new name for the typical section) [*P. amoenum* Salisb., *P. bicolor* (Jacq.) L'Hérit., *P. filipendulifolium* (Sims) Sweet, *P. flavum* (Burman f.) L'Hérit., *P. gibbosum* (L.) L'Hérit., *P. lobatum* (Burman f.) L'Hérit., *P. quinquevulnerum* (Andr.) Pers., and *P. triste* (L.) L'Hérit.]. These species in the section *Pelargium* were fairly evenly divided between the subseries *Tristia* and *Bicolora* which were distinguished from each other by supposed differences in tuber morphology, leaf division and petal colour. It is, however, at present realized that these presumed distinctions do not hold. *P. gibbosum*, together with *P. apifolium* Burman. f. which we consider to be a hybrid, was placed in the subseries *Gibbosa*. The subseries *Fulgida* contained 17 species, including *P. amoenum* Salisb. which we consider to be a synonym of *P. lobatum*. Many of these names have since then gone into synonymy, and clues to their identities can be found in the nomenclatural index at the end of Part 3 of the present series of articles. At the time none of the species in subsection *Schizopetala* Knuth had been described; and the single species in section *Magnistipulacea* Knuth then known, *Geranium luridum* Andr., was omitted by De Candolle. Ecklon and Zeyher (1835) raised *Polyactium* to generic level, and greatly expanded its circumscription to include some 21 species, several of which were newly described. Also included were one species of the current subsection *Magnistipulacea*, and three of the current subsection *Schizopetala*. With the exception of *Polyactium fulgidum* (L.) Ecklon & Zeyher, all these species are still placed in the section *Polyactium*, either as good species or as synonyms. Harvey (1860) again reduced

*Polyactium* to sectional level. With the exception of *Pelargonium fulgidum* (L.) L'Hérit., all the species which Harvey included in the section were correctly placed according to our current concept of the section. Harvey subdivided the section into four anonymous groups without formal taxonomic status. These were two groups corresponding roughly to De Candolle's (1824) subseries *Tristia* and *Bicolora*, respectively, and include the species then known of the current subsections *Polyactium* and *Caulescentia* Knuth as well as *P. fulgidum*, and two groups corresponding to the current subsections *Magnistipulacea* and *Schizopetala*, respectively. Kuntze (1891) transferred practically the whole genus *Pelargonium* as known at that time to *Geranospermum*, which was merely a new name without implying any taxonomical changes. He made no attempt at subgeneric subdivision. Harvey's (1860) subdivision of the section formed the basis of Knuth's (1912) almost identical subdivision, which differed in that Knuth afforded formal taxonomic status as subsections to the subdivisions of the section.

The oldest name applied to any division of the currently recognized genus *Pelargonium* containing species which are now placed in section *Polyactium*, is *Dimacria* Sweet (1820) which was established in generic rank. It was reduced to sectional rank by De Candolle (1824) to accommodate several species now placed in the section *Hoarea* (Sweet) DC. as well as *P. heracleifolium* of the present section *Polyactium*. However, this name is unacceptable, as no species presently recognized in section *Polyactium* formed part of the protologue. De Candolle (1824) placed the majority of the species now placed in section *Polyactium* in his section *Pelargium*, a name which is an untenable orthographic modification of *Pelargonium*, where he accommodated them in the subseries *Gibbosa*, *Tristia*, *Bicolora* and *Fulgida*. At present, and in accordance with the I.C.B.N., the sectional name *Pelargonium* is applied to another section of the genus (Van der Walt & Vorster 1981). By elimination, the only applicable name in sectional rank is *Polyactium*. Previously Knuth (1912: 317) had designated *P. lobatum* as lectotype species, but as it does not form part of the protologue of the name *Polyactium*, it is considered to be an arbitrary designation. In accordance with Art. 8 of the I.C.B.N. (Greuter *et al.* 1994), *P. lobatum* was rejected as type species in favour of *P. multiradiatum*, which is the sole element of its protologue (Vorster & Maggs 1992).

### Present subdivision

In the present context the section *Polyactium* is acknowledged as a distinct natural entity, characterized by an unbranched peduncle carrying a many-flowered pseudo-umbel; 5-petalled semi-regular flowers which tend to be dull-coloured and dusk-scented and have short genitalia, a hypanthium exceeding the pedicel; almost always a well-developed naked underground tuber; almost invariably practically no perennial stem development above ground level; and a basic chromosome number of  $x = 11^*$ . *P. gibbosum*, the sole species in the subsection *Caulescentia*, deviates from this pattern by lacking an underground tuber and having instead a well-developed perennial stem system above ground. Nevertheless, the morphology of its inflorescence and flowers, the unusual pigmentation of the petals, and its basic chromosome number, correspond so closely to those of species in the section *Polyactium* that we have no hesitation in placing it in this

section. We exclude *P. fulgidum* from the section (see under heading 'Excluded species' below).

We recognize four subsections in the section *Polyactium*. In doing so, we do not advocate the general use of the subsectional rank, and wish to stress that our usage of it in this instance is a result of circumstances. In our research on *Pelargonium* we have followed Knuth (1912) in awarding the subdivisions of the genus sectional rather than subgeneric rank (Van der Walt 1985; Van der Walt *et al.* 1990; Van der Walt & Boucher 1986; Van der Walt & Van Zyl 1988; Van der Walt & Vorster 1983). Had the primary divisions of the genus been awarded subgeneric rank, the present subsections would have held sectional rank. The present four subsections are so distinct from each other that we consider it desirable that they should have formal taxonomic status rather than be recognized as nameless and rankless groups within the section. These subsections are:

- (i) Subsect. *Caulescentia* Knuth. No underground tubers known; stems well developed above ground level, semi-succulent with substantial internodes and conspicuously swollen nodes; peduncle up to 120 mm long, petals pale greenish yellow and without markings, flowers *ca.* 15 mm in diameter, pedicel inconspicuously short, stipules ovate with apices acute. Confined to the sandy coastal areas of the Western Cape province, under winter rainfall conditions. Contains a single species, *P. gibbosum*.
- (ii) Subsect. *Polyactium*. Peduncle usually not much longer than 250 mm, petals pale yellow with or without a variably developed blackish centre, flowers normally *ca.* 15 mm but occasionally up to 20 mm in diameter, pedicels insignificantly short, stipules ovate to cordiform, leaves prostrate to erect. The species are concentrated in the winter rainfall region of the Northern Cape, Western Cape and the southern Eastern Cape province, with one species (*P. pulverulentum*) extending northwards along the east coast to southern KwaZulu-Natal. The species in this subsection are: *Pelargonium anethifolium*, *P. lobatum*, *P. multiradiatum*, *P. pil-lansii*, *P. pulverulentum*, *P. radulifolium* and *P. triste*.
- (iii) Subsect. *Magnistipulacea* Knuth. Peduncle usually 400–800 mm long; petals pale pink, yellow or white, without markings; flowers 20–25 mm in diameter, pedicel up to 15 mm long, stipules subulate, leaves erect. The species occur in the summer rainfall region, on the eastern highlands from the Eastern Cape province to Tanzania, and extend westwards to the highlands of Angola. This subsection contains a number of distinct species which are currently lumped under the name *P. luridum*.
- (iv) Subsect. *Schizopetala* Knuth. Peduncle up to 500 (usually *ca.* 300) mm long; petals repeatedly forked into fimbriate segments, pale yellow to dark maroon-black without markings but sometimes with darker-coloured veins; flowers 20–50 mm in diameter, pedicel up to 25 mm long, stipules subulate, leaves erect. Confined to the grasslands of the Eastern Cape and KwaZulu-Natal, more or less under summer rainfall conditions. This subsection contains *P. amatymbicum*, *P. bowkeri*, *P. caffrum*, *P. schizopetalum* and *P. woodii*.

The known geographical distribution of the four subsections is illustrated in Figure 1.

### Key to the subsections

- 1a Underground tuber absent; extensive stem development above ground level with conspicuously swollen nodes . . . . . **subsect. *Caulescentia***
- 1b Underground tuber well-developed; little or no stem development above ground level and if so, without conspicuously swollen nodes . . . . . **2**

\*Chromosome numbers were determined by one of us (G.L.M.) and Dr M. Gibby of the Natural History Museum in London. Some numbers were later confirmed by Prof. F. Albers of the Westfälische Wilhelms-Universität in Münster.

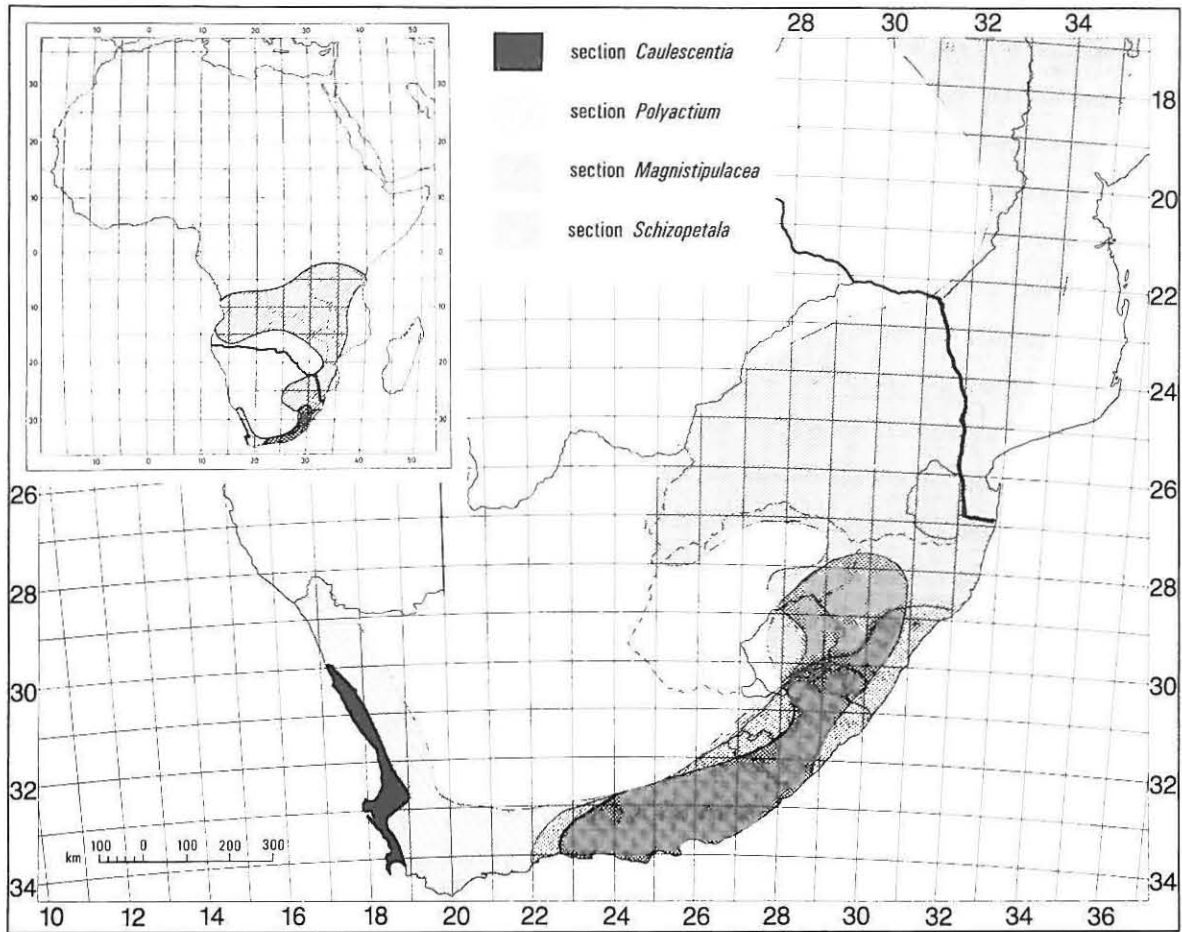


Figure 1 *Pelargonium* section *Polyactium*: known geographical distribution.

- 2a Stipules ovate to cordiform; peduncle usually shorter than 250 mm; flowers ca. 15 mm (rarely up to 20 mm) in diameter with inconspicuously short pedicels; petals pale yellow or greenish yellow with or without a blackish centre; mostly confined to winter rainfall region but one species extending northwards along east coast to KwaZulu-Natal . . . . . **subsect. *Polyactium***
- 2b Stipules subulate . . . . . **3**
- 3a Petals fimbriate, yellowish to dark maroon-black; from Eastern Cape province and KwaZulu-Natal . . . **subsect. *Schizopetala***
- 3b Petals not fimbriate; peduncle usually 400–800 mm long; flowers 20–25 mm in diameter with pedicels variably developed; petals pale pink, yellow or white; widespread in moister summer rainfall grasslands . . . . . **subsect. *Magnistipulacea***

**Discussion**

While there is little use in tracing the historical placement of all the species described in this section, the classification of the currently recognized species is summarized in Table 1. Synonyms are represented by the correct names; and in cases where different synonyms of the same species were placed in different groups, the same name therefore appears more than once. In the case of subsect. *Magnistipulacea*, only the subsection, not the component species, is listed, as some decisions at specific level still have to be taken.

Apart from the macromorphological evidence applied above, there is at this stage little additional information available to test this classification. Anatomical surveys of various sections of the genus revealed that the genus is anatomically remarkably uni-

form, so that anatomical features do not seem to have taxonomical applications in this genus. A survey of pollen grain surface sculptures did, however, provide some support for our subdivision. Bortenschlager (1967) divided the pollen grains of *Pelargonium* into four groups on account of the tectal structure, namely reticulate, striate-reticulate, reticulate-striate, and striate. Except for striate-reticulate sculpturing, all the remaining types were found in section *Polyactium*, distributed as shown in Table 2.

From Table 2 it emerges that reticulate sculpturing was only observed in *P. luridum sensu lato* of the subsection *Magnistipulacea*; reticulate-striate sculpturing seems to be confined to the species of subsections *Polyactium* and *Caulescentia*, confirming the affinity between the two subsections suggested by their flower morphology; while a double-structure pattern (reticulate-striate at mesocolpia, striate at poles) was observed in species of the subsection *Schizopetala*, and also in *P. flabellifolium* Harvey of the section *Magnistipulacea*, suggesting a link between these two morphologically dissimilar summer rainfall subsections. Figure 2 illustrates the different pollen grain sculpturing types found in the section *Polyactium*.

The functional significance of the different surface sculptures is not understood, but it is not inconceivable that they relate to different pollen vectors, and thus constitute a physical barrier against gene flow between the subsections.

Within each of the subsections *Polyactium*, *Magnistipulacea* and *Schizopetala*, there is a series of leaf blade incisions from very shallowly lobed to repeatedly divided into very narrow, almost linear segments. Likewise, within each of these sub-

**Table 1** *Pelargonium* section *Polyactium*: historical placement of currently recognized species

AUTHOR	SWEET (1820+)	DE CANDOLLE (1824)				ECKLON & ZEYHER (1835)	HARVEY (1860+)				KUNTZE (1891)	KNUTH (1912)				PRESENT ACCOUNT			
CLASSIFICATION	Genus <i>Pelargonium</i>	Sect. <i>Dimactria</i> p.p.	Sect. <i>Polyactium</i>	Sect. <i>Pelargium</i> (sic.) Ser. <i>Isopetalobidea</i>				Genus <i>Polyactium</i>	Sect. <i>Polyactium</i>				Genus <i>Geranio-spermum</i>	Sect. <i>Polyactium</i>				Sect. <i>Polyactium</i>	
				Subser. <i>Gibbosa</i>	Subser. <i>Tristia</i>	Subser. <i>Bicolora</i>	Subser. <i>Fulgida</i>		Group 1	Group 2	Group 3	Group 4		Subsect. <i>Caulescens</i>	Subsect. <i>Subcaulia</i>	Subsect. <i>Magnistipulacea</i>	Subsect. <i>Schizopetala</i>		Subsect. <i>Caulescens</i>
SPECIES																			
<i>Pelargonium gibbosum</i>																			
<i>P. triste</i>																			
<i>P. lobatum</i>																			
<i>P. multiradiatum</i>																			
<i>P. pulverulentum</i>																			
<i>P. anethifolium</i>																			
<i>P. radulifolium</i>																			
<i>P. pillansii</i>																			
Subsect. <i>Magnistipulacea</i>																			
<i>P. schizopetalum</i>																			
<i>P. amatymbicum</i>																			
<i>P. caffrum</i>																			
<i>P. bowkeri</i>																			
<i>P. woodii</i>																			

sections there is a series of chromosome ploidies ranging from  $2n = 22$  to as high as  $2n = 88$ , and in one instance even  $2n = ca. 104$ , which suggests parallel development in these three subsections. We believe that the morphological and karyological evidence suggests a common ancestry for all four subsections, but we do not believe that this ancestor should be sought amongst the living species.

### Excluded species

*Pelargonium apiifolium* Jacquin f., *Eclogae plantarum rariorum* ... 1: t. 27 (1812), non Andrews (1805). Not matched with any natural population, and presumed to be of hybrid origin.

*P. atrosanguineum* Dietrich in *Neues Botanisches Garten-Journal* 1: 163 (1820), & *Nachtrag zum vollständigen Lexicon der Gärtnerei und Botanik* 6: 61 (1820). Known to us from the description only, which does not match any known natural population. The blood-red petals with blackish centres suggest a hybrid between *P. fulgidum* and some species in subsection *Polyactium*.

*Pelargonium barklyi* Scott Elliot in *Journal of Botany* (London) 29: 68 (1891). Placed in section *Polyactium* when first described; but deviates far from the circumscription of the section with its small, regular, warty tuber; its comparatively stronger developed growth above ground level, small leaves with zonal markings and a shape foreign to the section, less rigid and sometimes branched inflorescence, cuneate rather than obovate petals, and a basic chromosome number of  $x = 9$  instead of 11. The floral morphology, zoned leaves and chromosome number suggest an affinity with the section *Ciconium* (Sweet) Harvey.

*Pelargonium fulgidum* (Linnaeus) L'Héritier in Aiton, *Hortus kewensis* ed. 1, 2: 422 (1789) [*Geranium fulgidum* Linnaeus, *Species plantarum* ed. 1: 676 (1753); *Polyactium fulgidum* (Linnaeus) Ecklon & Zeyher, *Enumeratio plantarum* ... 1: 67 (1835)]. Most authors since Sweet (1820) included this species in the present section *Polyactium*, usually alongside *P. gibbosum*, probably on account of the generally similar vegetative morphology. It differs, however, profoundly in the bright red pigmentation of the petals, and the markedly irregular flowers. Unlike the species which we recognize in the section *Polyactium*, it is not dusk-scented. In fact, no scent could be detected by us at any time. It occurs sympatrically with *P. gibbosum* as well as at least *P. triste* and *P. lobatum*, but no natural hybrids are known to us. Yet, with  $2n = 22$ , it shares the basic chromosome number of  $x = 11$  with the section *Polyactium*, and several artificial hybrids with *P. lobatum* are known to us. Some of the other excluded species are in fact suspected of being hybrids between *P. fulgidum* and other species in the section because of the unusual pigmentation of their petals, similar to that in *P. lobatum* × *P. fulgidum* hybrids. Vogel (1954) considered the pigmentation and orientation of the petals to indicate pollination by birds (fam. Nectarinidae?), and the flowers are indeed visited by these birds. It seems fairly certain, though, that it has a different pollen vector, as suggested by the pigmentation and morphology of the flowers, its lack of dusk-scentedness, and the apparent absence of natural hybrids.

*P. havlasae* Domin in *Vestník královské české společnosti nauk* 11: 49 (1923), and

*P. rodneyanum* Lindley in Mitchell, *Three expeditions into the interior of eastern Australia*, ed. 2, 2: 144 (1839). Knuth (1912)

**Table 2** *Pelargonium* section *Polyactium*: distribution of pollen grain sculpturing types amongst species

SUBSECTION	SPECIES & SPECIMEN	TYPES OF POLLEN GRAIN SCULPTURING		
		RETICULATE	RETICULATE-STRIATE	DOUBLE-STRUCTURE PATTERN (RETICULATE-STRIATE AT MESOCOLPIA, STRIATE AT POLES)
CAULESCENTIA	<i>Pelargonium gibbosum</i> Van der Walt 597			
POLYACTIUM	<i>P. anethifolium</i> Van der Walt 1042			
	<i>P. lobatum</i> Boucher s.n. sub STEU 472 Drijfhout 1625			
	<i>P. multiradiatum</i> Van der Walt s.n. sub STEU 1465			
	<i>P. pillansii</i> Anon.			
	<i>P. pulverulentum</i> Van der Walt 537 Van der Walt 569 Van der Walt s.n. sub STEU 1070			
	<i>P. triste</i> Van der Walt s.n. sub STEU 793 Van der Walt s.n. sub STEU 867			
	MAGNISTIPULACEA	<i>P. flabellifolium</i> Van der Walt 998		
<i>P. luridum sensu lato</i> Buitendag s.n. sub STEU 778 Neser s.n. sub STEU 1297 Schonken 103 Van der Walt 599				
SCHIZOPETALA	<i>P. bowkeri</i> Van der Walt 996 Van der Walt 1004			
	<i>P. cafrum</i> Van der Walt 878			
	<i>P. schizopetalum</i> Van der Walt 871			

included *P. rodneyanum* in subsection *Polyactium*, probably on account of it having underground tubers. Carolin (1962: 291) considered it to be closely related to *P. havlasae*, so that the two species are best reviewed together. *P. havlasae* is a poorly known species, and we have not seen fresh material of it. Both species are natives of Australia, and both have undivided leaves which are not more than 50 mm in diameter. The pseudo-umbel consists of up to 7 flowers (usually less), the hypanthium is very short and the pedicel much longer, and the petals range in colour from white to deep pink. Their chromosome numbers are not known. We consider any relationship with the South African species in the section *Polyactium* to be tenuous, and therefore exclude them from this section. The interrelationships of the Australian species have yet to be established, and apart from a few species which seem to belong in the section *Peristera* DC., they have not been grouped into sections.

*Pelargonium sanguineum* Wendland, *Collectio plantarum* 2: 43, t. 53 (1809). This name is typified by the illustration accompanying the original description, enabling us to exclude it as unmatched with any known natural population. The bright-red petals with blackish centres, the well-developed pedicel, and the large tri-

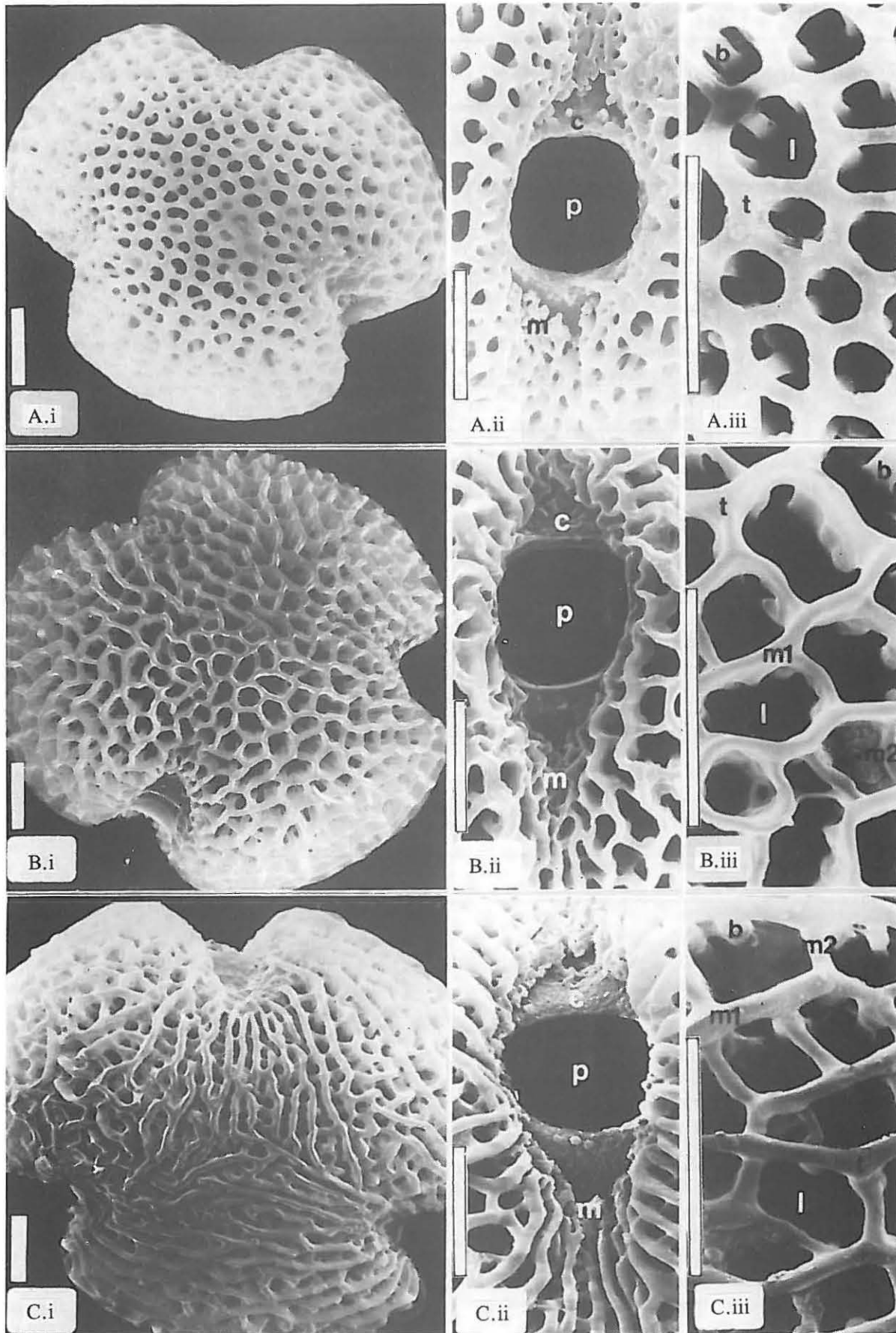
angular stipules suggest that it is another hybrid involving *P. fulgidum*, while the pinnate leaves with narrow segments suggest *P. multiradiatum* or *P. triste* as the other parent species. The iconotype is not so clear, but a plate in Sweet, *Geraniaceae* 1: t. 76 (1821) shows the very strong contribution from *P. fulgidum* in the irregular flower with characteristically orientated petals, the well-developed and hairy pedicel, and the characteristically semi-succulent stem.

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**Figure 2** *Pelargonium* section *Polyactium*: Pollen grain sculpturing types. A. Reticulate sculpturing in *P. luridum sensu lato*: i, pollen grain in polar view; ii, aperture detail; iii, wall sculpturing (from *Schonken 103*). B. Reticulate-striate sculpturing in *P. triste*: i, pollen grain in polar view; ii, aperture detail; iii, wall sculpturing (from *Marais 1*). C. Double-structure pattern (reticulate-striate at mesocolpia, striate at poles) in *P. bowkeri*: i, pollen grain in polar view; ii, aperture detail; iii, wall sculpturing (from *Van der Walt 1004*). Scale bar: 10  $\mu$ m.

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