

Numerical taxonomic studies in the subtribe Ruschiinae (Mesembryanthemaceae) — *Astridia*, *Acrodon* and *Ebracteola*

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ABSTRACT

A numerical taxonomic study of three genera of the Ruschiinae (Mesembryanthemaceae) is presented. Seven species are recognized in *Astridia*. Four species are recognized in *Acrodon* and two new combinations are made: *A. leptophyllus* (L. Bol.) Glen and *A. duplessiae* (L. Bol.) Glen. Five species are recognized in *Ebracteola* and two new combinations are made: *E. wilmaniae* (L. Bol.) Glen and *E. fulleri* (L. Bol.) Glen. This study is largely based on the cited herbarium material, and the characters used are mainly the following: dimensions of plants, leaves and internodes, number and dimensions of parts of flower and fruit, colour of petals, and colour, dimensions and surface structure of seeds.

UITTREKSEL

'n Numeriese taksonomiese ondersoek van drie genera van die Ruschiinae (Mesembryanthemaceae) word aangebied. Sewe spesies word in *Astridia* erken. Vier spesies word in *Acrodon* erken en twee nuwe kombinasies word gemaak: *A. leptophyllus* (L. Bol.) Glen en *A. duplessiae* (L. Bol.) Glen. Vyf spesies word in *Ebracteola* erken en twee nuwe kombinasies word gemaak: *E. wilmaniae* (L. Bol.) Glen en *E. fulleri* (L. Bol.) Glen. Hierdie ondersoek is in 'n groot mate gegrond op die gesiteerde herbariummateriaal en die kenmerke wat gebruik is, is hoofsaaklik die volgende: afmetings van plante, blare en litte, aantal en afmetings van blom- en vrugdele, kleur van kroonblare, en kleur, afmetings en oppervlakstruktuur van sade.

INTRODUCTION

The subtribe Ruschiinae is one of the largest groups in the family Mesembryanthemaceae, with some 540 described species and infraspecific taxa in 17 described genera. Most of these genera have not been revised since they were first described, except for partial revisions of the genera occurring in SWA/Namibia (Friedrich 1970). The only exception is the genus *Astridia*, of which a brief account was published by Bolus (1961b, key revised in Bolus 1966a).

The subtribe is defined by the fruits, which are 5-locular, with covering membranes and placental tubercles, and (usually) without valve wings. In habit, members of this subtribe range from dwarf succulents which are not as reduced as, for example, *Lithops* or *Conophytum*, to some of the largest shrubs in the family Mesembryanthemaceae. The leaves are always opposite, and are usually triquetrous to semiterete. Flowers are solitary or in larger or smaller cymose inflorescences, and individual flowers vary from among the smallest to among the largest in the family. Petal colours found in this subtribe include the full range of yellows, reds, pinks, magentas and whites found in the family; in some species each petal has a central dark-coloured longitudinal stripe, but petals in which the base and apex are of different colours are very rare.

Taxonomic work on this group was started with the intention of producing a comprehensive account for the *Flora of southern Africa*. Rising costs and increasingly stringent limits on what was financially vi-

able rendered this goal unattainable in the foreseeable future, and so it was determined to complete treatments of the minor genera where this could be done with minimum extra input. In the case of both *Ebracteola* and *Acrodon*, about half of the species have, until this treatment, been included in the genus *Ruschia*. This illustrates one of the major difficulties in the taxonomic treatment of this subtribe, namely the generally poor delimitation of genera. The apparently ambiguous limits of genera in the Ruschiinae is, no doubt, due to the fact that newly-discovered species have been described in great numbers over a long period of time, and assigned to genera which have not been revised since they were first described. In particular, it appears that a revision of the over 300 species at present assigned to the genus *Ruschia* would, if it were to be of benefit to the users of taxonomic treatments, distribute these species among about three major genera and some (extant) minor ones. This process is started in this paper.

METHODS AND MATERIALS

Both dried and living specimens, the latter mainly cultivated, were examined in the course of this study. For numerical processing, both scored and measured characters were recorded, and an Operational Taxonomic Unit (OTU) was defined as being equivalent to one micro-taxon as recognized by L. Bolus. As her stated aim (Bolus 1936–1958: iii) was to describe as much as possible of the variation in the family as new taxa, so that the types would remain in South Africa 'for the convenience of future workers', it was found that the danger of overlooking any variation in the specimens examined by her was negligible. Very few, if any, specimens not referable to any of her micro-taxa have been collected since her

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death. Scored characters were taken as being for all obtainable specimens that could be regarded as belonging to the OTU in question. Measured characters were taken from as many individuals as possible with a maximum of 25, subject to the same constraint.

Eighty-six characters were recorded; some of these were noted as minimum, mean and maximum and others as minimum and maximum without a mean, yielding a total of 121 character strings (Hall 1973), as listed in Table 1. A preliminary examination of a very incomplete portion of this matrix was made using the BOLAIID package of programs for numerical taxonomy (Hall 1973); this was the basis for the taxonomic observations of Glen (1984). It was found to be financially unviable to continue processing data for the whole of the subtribe Ruschiinae (538 OTU's) using BOLAIID, so a cheaper and faster system was sought and found in NT-SYS (Rohlf *et al.* 1977). BOLAIID was used on the Burroughs B7700 of the Department of Agriculture and Water Supply, while NT-SYS was made available by the CSIR on their CDC computer. The present account is derived from an examination of 103 OTU's drawn from all genera recognized as belonging to the subtribe Ruschiinae.

TABLE 1.—List of 86 characters used. Character strings (Str.): 3 = minimum, mean and maximum; 2 = minimum and maximum; 1 = mean or invariant except where otherwise stated

No.	Str.	Description
1	3	Leaf length (greater leaf of a pair)
2	3	Leaf breadth (greater leaf of a pair)
3	3	Leaf thickness (greater leaf of a pair)
4	3	Leaf length (lesser leaf of a pair)
5	3	Leaf breadth (lesser leaf of a pair)
6	3	Leaf depth (lesser leaf of a pair)
7	1	Plant height
8	1	Plant diam.
9	2	Flower colour (betacyanin)
10	2	Flower colour (betaxanthin)
11	1	no. of bracts
12	1	no. of sepals
13	2	no. of petals
14	2	no. of stamens
15	2	no. of staminodes
16	1	no. of stigmas
17	1	max. length of bracts
18	1	max. width of bracts
19	1	max. length of outer sepals
20	1	max. width of outer sepals
21	1	max. length of inner sepals
22	1	max. width of inner sepals
23	3	length of petals
24	1	max. width of petals
25	3	length of stamens
26	3	length of staminodes
27	3	length of stigmas
28	1	length of pedicel
29	1	diam. of pedicel
30	1	diam. of flower
31	1	diam. of capsule
32	1	length of capsule
33	1	± no. of flowers per inflorescence
34	1	width of central discolor. stripe in petals (0 if no stripe)
35	2	stripe colour (betacyanin)
36	2	stripe colour (betaxanthin)
37	1	no. of locules per capsule
38	1	extent of covering membrane

39	1	length of covering membrane
40	1	width of covering membrane
41	1	length of valve wings
42	1	width of valve wings
43	1	radial diam. of placental tubercle
44	1	extent to which expanding-keels diverge
45	1	extent of fringe on expanding-keels
46	1	length of internodes
47	1	stem diam.
48	1	length of leaf decurrence on stem
49	1	length of leaf apiculus
50	1	amount of leaf wax (arbitrary scale)
51	1	% specimens flowering in Jan.
52	1	% specimens flowering in Feb.
53	1	% specimens flowering in Mar.
54	1	% specimens flowering in April
55	1	% specimens flowering in May
56	1	% specimens flowering in June
57	1	% specimens flowering in July
58	1	% specimens flowering in Aug.
59	1	% specimens flowering in Sept.
60	1	% specimens flowering in Oct.
61	1	% specimens flowering in Nov.
62	1	% specimens flowering in Dec.
63	3	length of seed
64	3	width of seed
65	3	thickness of seed
66	1	seed colour (red scale)
67	1	seed colour (yellow scale)
68	1	seed colour (grey scale)
69	1	length of micropylar region
70	1	baculae height, embryo region
71	1	baculae height, micropylar region
72	1	baculae length, embryo region
73	1	baculae length, micropylar region
74	1	baculae width, embryo region
75	1	baculae width, micropylar region
76	1	baculae spacing, embryo region
77	1	baculae spacing, micropylar region
78	1	baculae, boundary line irregularity, embryo region
79	1	baculae, boundary line irregularity, micropylar region
80	1	microbacular height
81	1	microbacular length
82	1	microbacular width
83	1	microbacular spacing
84	1	no. of teeth per leaf
85	1	extent of separation betw. valve & valve wings (capsule)
86	1	chromosome no.

The first step in processing the data with NT-SYS was to standardize the raw matrix so that each character had a mean of zero and a standard deviation of one. The standardized data matrix was then used for further processing, thus ensuring that all characters would be strictly equally weighted in later computations. A matrix of correlations was calculated according to an algorithm described by Rohlf *et al.* in the NT-SYS manual. An 'average taxonomic distance' matrix, giving a measure of the dissimilarity between pairs of OTU's, was calculated according to the algorithm of Sokal (1961). This gives, in effect, a normalized matrix of Euclidean distances between pairs of OTU's. Finally, NT-SYS calculated cophenetic matrices and dendrograms for both distance and correlation matrices using UPGMA (unweighted pair-group method with arithmetic averages; Sneath & Sokal 1973). The dendrograms are referred to below as distance and correlation phenograms, respectively.

The classification and circumscriptions of taxa presented here were derived from both distance and correlation phenograms, with constant reference back to the original specimens.

In the specimen citations below, the following abbreviations, which are not found in *Index Herbariorum* (Holmgren *et al.* 1981), indicate garden accession numbers:-

KG – Karoo Garden, Worcester

NBG – National Botanical Garden, Kirstenbosch. Used where the number is of the form <accession number>/<date>. e.g. 1234/56 is no. 1234 of 1956

SUG — Stellenbosch University Garden

All other abbreviations in the specimen citations indicate herbaria and are according to *Index Herbariorum*.

1. ASTRIDIA

The genus is a very natural and cohesive group of species, not only very similar in appearance but also confined to a small area in the lower reaches of the Orange River.

In habit, *Astridia* Dinter is very similar to *Ruschianthemum* and *Stoeberia*, all three of which occur in the same area. *Ruschianthemum* and *Stoeberia* differ markedly from *Astridia* in having small (± 10 mm in diameter) white flowers rather than large showy ones, in having capsules showing varying degrees of schizocarpy rather than the hygrochastic capsules of *Astridia*, and non-baculate seeds with well differen-

tiated embryo and micropylar regions (see Figure 1). *Astridia* can be separated from species of *Ruschia* of similar habit by its flower size, bracts, stamens, seed surfaces, and by the leaf surface, which is glabrous in *Ruschia* but velutinous in *Astridia*. In addition, the flowers of *Astridia* are solitary, whereas those of *Ruschia* are typically borne in large, repeatedly branched cymes. The overall appearance of plants of the genus *Astridia* is so distinctive that they are unlikely to be confused with any other group of Mesembryanthemaceae.

Dinter (1926) published the new combination *Astridia velutina* Dinter for the plant which he had named *Mesembryanthemum velutinum* Dinter (non L. Bol.), but he gave only a very brief description of his new genus. Schwantes (1927) supplied an amended generic description in the following year, and recognized a second species, *A. maxima* (Haw.) Schwant., based on *M. maximum* Haw. The distinguishing characters of the new genus were stated to be the seeds, which appeared to be covered with hollow spines, and the overall form of the plants.

N. E. Brown (1928) noted that although no distinguishing characters could readily be found for the genus, plants were so distinctive in overall appearance that the genus was possibly a good one. He also noted that the seed character mentioned by

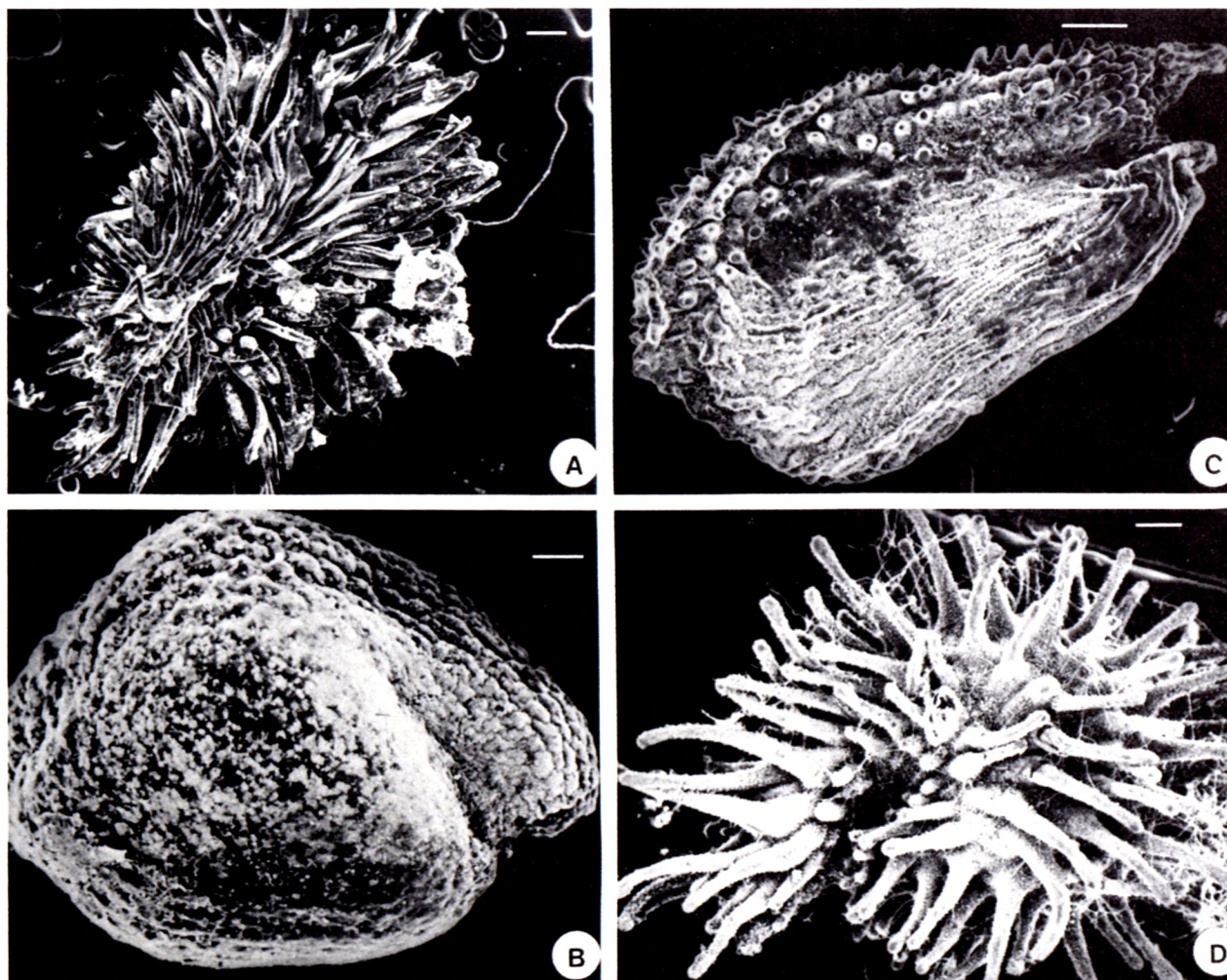


FIGURE 1. — SEM photographs of seeds of A. *Astridia velutina*; B. *Ruschia maxima*; C. *Stoeberia beetzii*; D. *Braunsia geminata*. Scale bar=100 μ m.

Schwantes was not unique in Mesembryanthemaceae. Bolus (1961b) noted a number of relatively subtle characters by which *Astridia* can be distinguished from *Ruschia* and other genera. These include:

- 1, the manner of attachment of the leaves to the stem (in *Ruschia* old leaves may be broken off complete, but in *Astridia* a portion of leaf base always adheres to the stem);
- 2, the form of the bracts (cymbiform in *Astridia* but semi terete to triquetrous in *Ruschia*);
- 3, the ciliate inner stamens of *Astridia*, as opposed to the glabrous stamens of *Ruschia*.

Bolus admitted the possibility that any or all of these characters may be found in the genus *Ruschia*, but the combination of all three, together with the growth habit, appears to define a natural group.

Friedrich (1970) distinguished between *Astridia* and species of *Ruschia* of similar habit by

- 1, the large flowers of *Astridia* (± 50 mm in diameter when open in *Astridia*; ± 20 mm in *Ruschia*);
- 2, the form of the bracts (cymbiform in *Astridia*; semiterete to triquetrous in *Ruschia*);
- 3, the stigmas, which are always six in *Astridia* and usually five in *Ruschia* (this difference is not as significant as it may seem at first sight: carpel numbers are variable throughout the Mesembryanthemaceae, and this variability increases in proportion to the usual number of carpels).

Friedrich was the first to suggest that too many taxa had been described in the genus, and he recognized six species and no infraspecific taxa in SWA/Namibia.

The seed character, used by Schwantes in the original delimitation of the genus, is best seen in the type species, *A. velutina*, where long, spine-like baculae cover the entire surface of the seed (Figure 1A). These characteristic baculae are not generally as well developed in the other species of the genus, and may be restricted to the micropylar region of the seed, the surface of the cells of the embryo region of such seeds being in the form of low, roughly conical baculae (Figure 4A–D). As Brown (1928) has pointed out, this character is not unique to *Astridia*, being present, and in fact better developed, in *Braunsia* (see Figure 1), *Antegibbaeum* and possibly other genera.

On the south bank of the Orange River, the genus is found in the Richtersveld, in Acocks's (1975) Western Mountain Karoo, Succulent Karoo and Namaqualand Broken Veld, in an area no more than 100 km \times 100 km; on the north bank, it is restricted to a hardly larger area of Giess's (1971) 'Desert and succulent steppe (winter rainfall area)'.

The phenograms used to generate the classifications are shown in Figures 2 & 3. The overall correlation coefficient of the distance phenogram was slightly less than that of the correlation phenogram (0.75 as against 0.80). Nevertheless, it was found by checking back against the original specimens that the former yielded groups that were less likely to lead to the misidentification of new specimens than the latter. In cases where the two phenograms differ, the distance rather than the correlation dendrogram was followed in the construction of groups and recognition of taxa.

Astridia Dinter in Gardeners' Chronicle, series 3, 80: 430 (1926); Dinter & Schwant. in Schwant.: 16 (1927); N. E. Br.: 266 (1928); L. Bol.: 173 (1961b);

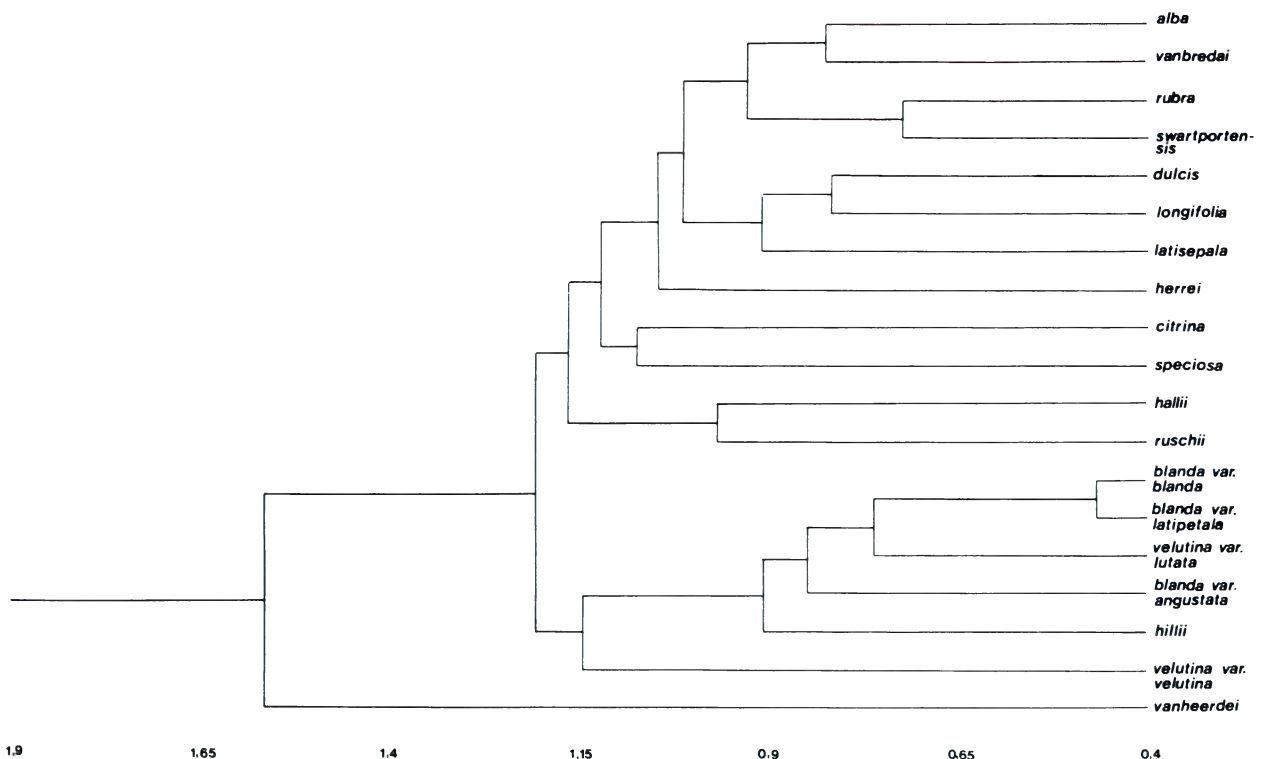


FIGURE 2. — Phenogram of *Astridia* calculated from a distance matrix using UPGMA. Irrelevant OTU's are omitted.

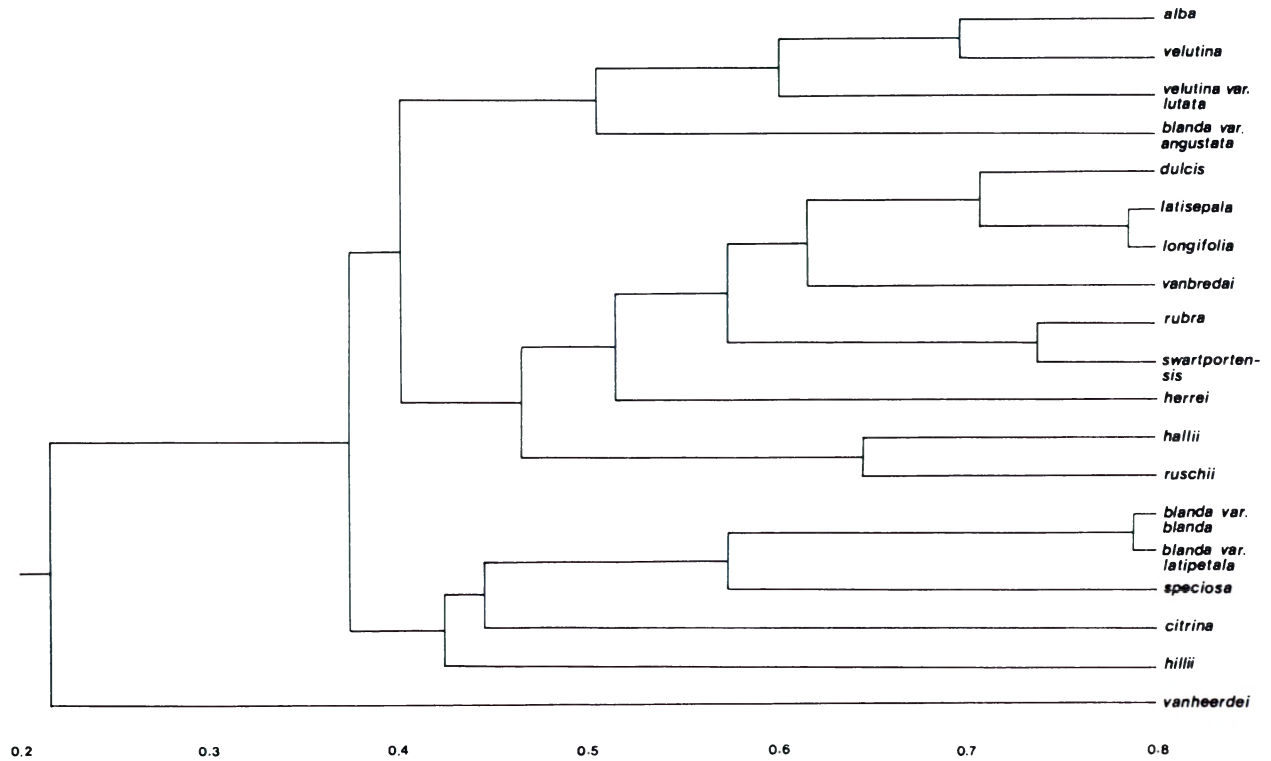


FIGURE 3. — Phenogram of *Astridia* calculated from a correlation matrix using UPGMA. Irrelevant OTU's are omitted.

Friedrich: 17 (1970); Herre: 88 (1971); Dyer: 99 (1975). Type species: *Astridia velutina* Dinter & Schwant.

Robust, erect, woody shrubs. *Leaves* opposite, succulent, not toothed, velutinous, obscurely triquetrous, usually grey, blue-grey or glaucous green, usually firmly attached and not falling readily. *Flowers* solitary, on relatively short pedicels or subsessile, the pedicels each with a pair of relatively small, distinctively boat-shaped bracts which tend to remain attached to the plant on drying. *Sepals* 6, in two se-

ries, the outer 2 fleshy, the inner 4 less so, and with membranous margins. *Petals* 40 or more, in 1 to many series, lorate, narrowly oblanceolate or narrowly obovate, apices obtuse, white to pale yellow, orange-red or scarlet. *Staminodes* present or absent. *Stamens* numerous, inner filaments densely ciliate. *Stigmas* 6, subulate to filiform. *Capsules* 6-locular; covering membranes well developed; valve wings absent or awn-like; placental tubercles present; expanding keels diverging, unadorned. *Seeds* various shades of maroon to black, with long, spine-like baculae at least on the micropylar region.

KEY TO THE SPECIES OF *ASTRIDIA*

- 1a Leaves 2–3 times as long as broad:
 2a Pedicels 5–6 mm long..... 1. *A. velutina*
 2b Pedicels over 10 mm long, usually 13–14 mm long:
 3a Staminodes absent: fruit diameter about 1.5 times fruit depth, fruit about 14 mm in diameter; petals pink to white..... 6. *A. hallii*
 3b Staminodes present: fruit diameter roughly equal to fruit depth, fruit about 11 mm in diameter; petals yellow to white..... 4. *A. citrina*
 1b Leaves (3.5–) 4–10 times as long as broad:
 4a Stigmas longer than the stamens, about 9 mm long; flowers about 70 mm in diameter..... 5. *A. speciosa*
 4b Stigmas roughly as long as the stamens, about 7 mm long; flowers about 50 mm in diameter:
 5a Internodes about 15 mm long..... 3. *A. herrei*
 5b Internodes about 25 mm long:
 6a Staminodes absent: flowers and fruit subsessile..... 7. *A. vanheerdei*
 6b Staminodes present; flowers and fruit distinctly pedicellate..... 2. *A. longifolia*

1.1 *Astridia velutina* Dinter & Schwant. in *Zeitschrift für Sukkulantenkunde* 3: 16 (1927). *A. dinteri* L. Bol.: 170 (1961b), nom. nov. pro *A. velutina*.

Mesembryanthemum velutinum Dinter: 149 (1923), non L. Bol. (1922). Type: SWA/Namibia, Klinghardtgebirge, 15 September 1922, Dinter 3792 (B. holo.!; Z. iso.!).

A. velutina Dinter & Schwant. var. *lutata* L. Bol.: 95 (1928–1935; published 1929). *A. dinteri* L. Bol. var. *lutata* L. Bol. ex Jacobsen: 413 (1974), nom. nov. pro *A. velutina* var. *lutata*. Type: Cape, between Arris and Sendelingsdrift, October 1926, Pillans 5725 (BOL!).

A. blanda L. Bol.: 123 (1961c); Jacobsen: 413 (1974). Type: SWA/Namibia, without exact locality, cultivated in Windhoek Government Garden, January 1937. *Holloway 1* (BOL!).

A. blanda L. Bol. forma *angustata* L. Bol.: 171 (1961b); Jacobsen: 413 (1974). Type: SWA/Namibia, without precise locality, cultivated in Windhoek Government Garden, January 1937, Rusch & Erni sub *Holloway 33*.

A. blanda L. Bol. forma *latipetala* L. Bol.: 171 (1961b); Jacobsen: 413 (1974). Type: SWA/Namibia without precise locality, cultivated in Windhoek Government Garden, January 1937, Rusch & Erni sub *Holloway 17* (BOL!).

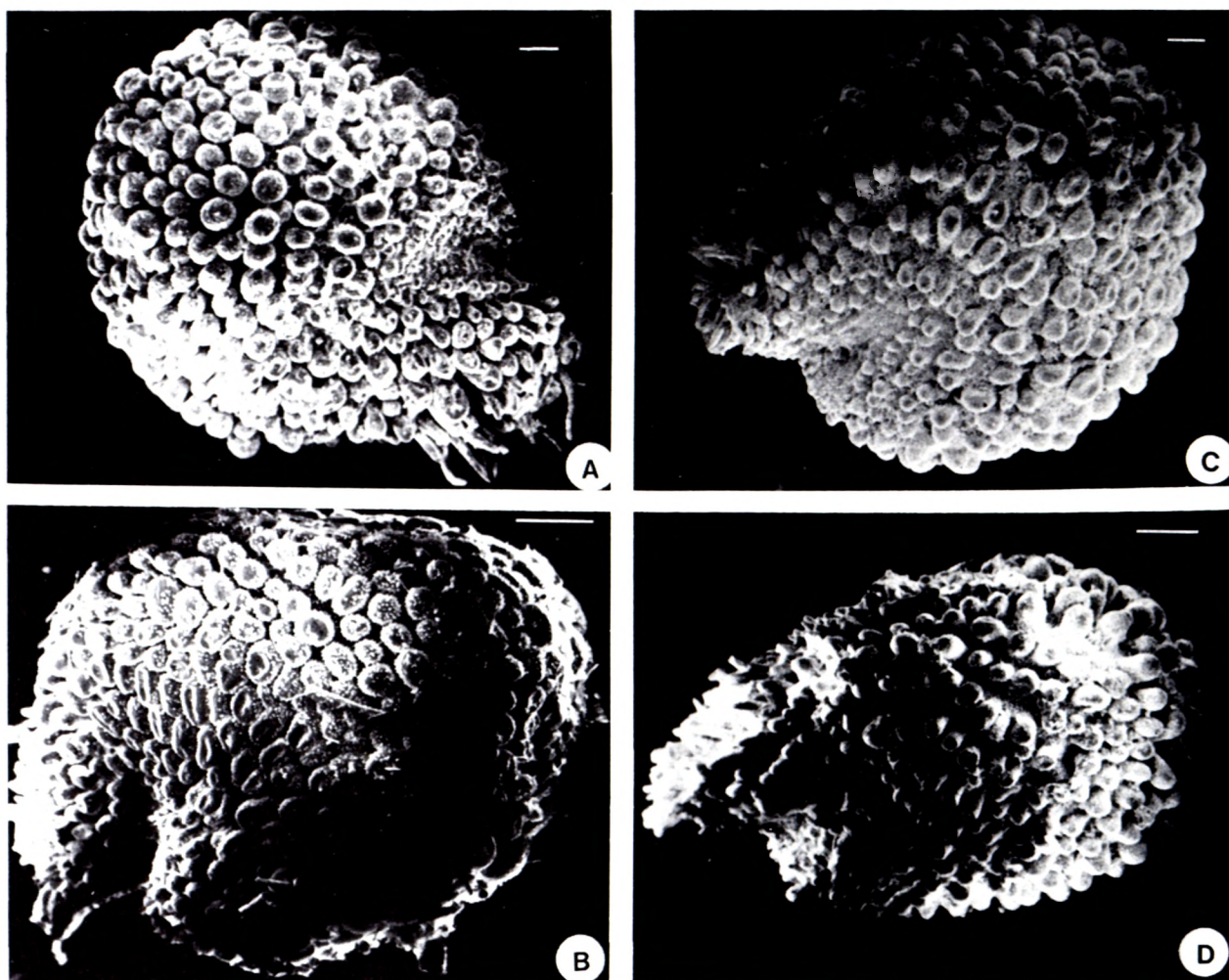


FIGURE 4. — SEM photographs of seeds of A. *Astridia longifolia*; B. *A. hallii*; C. *A. herrei*; D. *A. citrina*. Scale bar=100 μ m.

A. hillii L. Bol.: 301 (1962b); L. Bol.: 172 (1965); Jacobsen: 413 (1974). Type: Cape, Grootderm, August 1956, L. J. Hill s.n. in BOL 27253 (BOL!).

Robust shrubs 200–300 mm tall. *Stems* pale buff to dark brown when young; internodes $\pm 15 \times 4$ mm. *Leaves* minutely velutinous, 15–34 mm long, obscurely keeled, 7–14 mm wide and slightly less thick. *Pedicel* $\pm 7 \times 2.5$ mm. *Bracts* up to 12 mm long and 6 mm thick. *Flowers* ± 30 mm in diameter when open. *Sepals* 6, outer pair up to 7×6 mm, inner 4 up to 7×5 mm. *Petals* 40–70 in 1–2 series, white to pink, $12\text{--}23 \times$ up to 3 mm, but often narrower. *Staminodes* present, 2–10 mm long, distinct from petals. *Stamens* many; filaments 6–9 (–11) mm long. *Stigmas* subulate to filiform, shorter than longest stamens, 4–8 mm long. *Capsule* dark grey, broadly obconical, ± 11.5 mm in diameter when closed and 8.5 mm long; valve wings absent; placental tubercles large, radial diameter 1.2 mm. *Seeds* pale yellow to dark brown, echinate, $1.1\text{--}1.5$ (–1.85) \times $0.7\text{--}1.3 \times 0.5\text{--}1.2$ mm, micropylar region 0.3–0.55 mm long; baculae very prominent; microbaculae long but variable.

Voucher specimens:

SWA/NAMIBIA. — 2715 (Bogenfels): Sargdeckel (–BC/BD) Dinter 3792 (B, Z).

CAPE. — 2816 (Oranjemund): between Arris and Sendelingsdrift (–BD), Pillans 5725 (BOL, K); Grootderm (–DA), L.J. Hill

s.n. in BOL 27253 (BOL); Wisura 626 (NBG), 2817 (Violsdrift): Dolomite Peaks (–CA), Wisura 1588 (NBG).

The name *Mesembryanthemum velutinum* Dinter (1923) is a later homonym of *M. velutinum* L. Bol. (1922), and is therefore invalid in *Mesembryanthemum*. However, there is no earlier homonym of the combination *Astridia velutina* Dinter & Schwant., with *Mesembryanthemum velutinum* Dinter non L. Bol. as basionym, nor is there any earlier name for this species. According to Art. 72 note 1 of the Rules of Botanical Nomenclature, this combination must be accepted. For this reason, the name *Astridia dinteri* L. Bol. was superfluous when published and is to be rejected as illegitimate (Art. 63.1).

It will be seen from the scatter diagram in Figure 5 that the various entities included in this species cannot be distinguished on the basis of their leaves. The same is true for all other characters examined, and so several previously-accepted names, as listed in the synonymy above, must become synonyms of *A. velutina*.

The combination of white to pink flowers, short pedicels (even of the capsules) and relatively short, wide leaves distinguishes this species from all others in the genus. Although the flowers fall rapidly, the fruits stay on their pedicels for up to two years, and so may be used for diagnostic purposes at any season. The distribution of this species is shown in Figure 6.

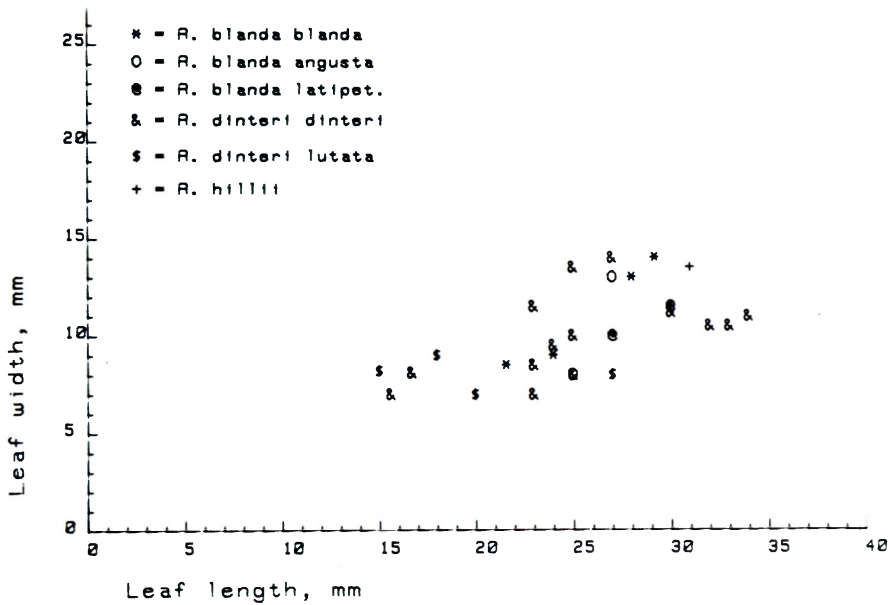


FIGURE 5. — Leaf measurements of plants included in *Astridia velutina*.

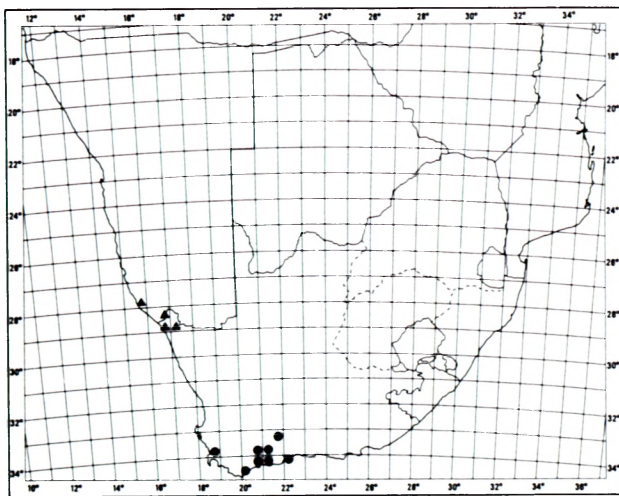


FIGURE 6. — Distribution of *Astridia velutina*, ▲; and *Acrodon bellidiflorus*, ●.

1.2 *Astridia longifolia* (L. Bol.) L. Bol. in Journal of South African Botany 27: 170 (1961b); Jacobsen: 413 (1974). Type: Cape, between Sendelingsdrift and Doornpoort, October 1926, Pillans 5830 (BOL!).

Mesembryanthemum longifolium L. Bol.: 196 (1928). *Ruschia longifolia* (L. Bol.) L. Bol.: 220 (1936–1958; published 1950); Rowley: 61 (1956), non L. Bol. (1935).

M. rubrum L. Bol.: 275 (1928–1935; published 1931). *Lampranthus ruber* (L. Bol.) L. Bol.: 169 (1936–1958; published 1939). *R. rubra* (L. Bol.) L. Bol.: 220 (1936–1958; published 1950). *A. rubra* (L. Bol.) L. Bol.: 170 (1961b). Type: Cape, Swartwater, October 1930, H. Herre s.n. in *SUG* 9202 (BOL!).

A. latispala L. Bol.: 169 (1961b); Jacobsen: 413 (1974). Type: Cape, Helskloof, April 1961, H. Hall s.n. in *NBG* 120/58 (BOL!).

A. rubra (L. Bol.) L. Bol. var. *alba* L. Bol.: 170 (1961b). *A. alba* (L. Bol.) L. Bol.: 229 (1966b); Jacobsen: 413 (1974). Type: Cape, Swartpoort, March – April 1961, H. Hall 1308a = *NBG* 107a/58 (BOL!).

A. swartpoortensis L. Bol.: 137 (1963a); Jacobsen: 413 (1974). Type: Cape, Swartpoort, April 1963, H. Hall s.n. in *NBG* 107/58 (BOL!).

A. dulcis L. Bol.: 173 (1963b); Jacobsen: 413 (1974). Type: SWA/Namibia, 5 miles north of Sendelingsdrift, March 1960, H. Hall 1869a = *NBG* 175a/60.

A. vanbredai L. Bol.: 127 (1966a); Jacobsen: 414 (1974). Type: Cape, Helskloof, June 1962, P.A.B. van Breda 1694/60 (BOL!).

Robust shrubs 200–300 mm tall. *Stems* pale buff to dark brown when young, internodes $\pm 26 \times 4,5$ mm. *Leaves* minutely velutinous, 17–55 (–96) mm long, strongly keeled, $\pm 4-8$ (–15) mm wide, 5–10 (–20) mm thick, sheathing stem for 3–5,5 mm. *Pedicel* $\pm 9 \times 4$ mm. *Bracts* up to 21 mm long and 12,5 mm thick. *Flower* 45–50 mm in diameter when open. *Sepals* 6, outer pair up to 17×9 mm, inner 4 up to $9,5 \times 7,5$ mm. *Petals* 50–90 in 1 – several series, white to scarlet red, 14–31 \times up to 4 mm. *Staminodes* few to many, 6,5–13 mm long, distinct from petals. *Stamens* many; filaments 2,5–12,5 mm long. *Stigmas* subulate to filiform, shorter or longer than longest stamens, 2–10 (–15) mm long. *Capsule* dark grey, broadly obconical, $\pm 12,5$ mm in diameter when closed and 9,5 mm long; valve wings present or absent, if present then awn-like; placental tubercles large, radial diameter $\pm 1,1$ mm. *Seeds* deep maroon, echinate, $0,9-1,45 \times (0,65-)$ $0,85-1,05 \times 0,7-0,9$ (–1,0) mm, micropylar region 0,3–0,55 mm long; baculae prominent, usually more so on the embryo region; microbaculae long to very long, roughly cylindrical. *Chromosome number* $2n=18$ (De Vos 1947).

Voucher specimens:

SWA/NAMIBIA. — 2716 (Witputs): Spitskop LU 111 farm (–DC). Giess & Muller 14380 (M). 2816 (Oranjemund): Kahanstal (–BB). Dinter 8395 (B).

CAPE. — 2816 (Oranjemund): Swartpoort (–BB), H. Hall s.n. in *NBG* 107a/58 (BOL); between Sendelingsdrift and Doornpoort (–BB), Pillans 5830 (BOL. K); 6 miles south of Sendelingsdrift (–BB), Wisura 677 (NBG).

The scatter diagram in Figure 7 shows that the seven formerly accepted taxa included here can not be distinguished by their leaves; this also applies to their seeds. The same lack of distinction extends to other characters examined, and so the previously accepted names listed in the synonymy above must be regarded as synonyms of *A. longifolia*.

This, the commonest species in the genus, may be distinguished from all others by the long, relatively narrow leaves, which are distinctly narrowed at the

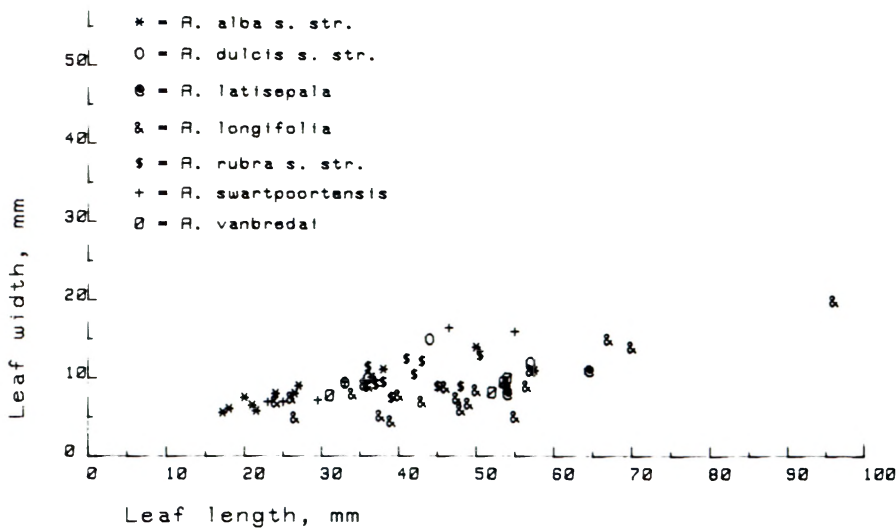


FIGURE 7. — Leaf measurements of plants included in *Astridia longifolia*.

base, and the relatively long pedicels supporting the large, usually red but rarely white flowers and charcoal-grey capsules. The distribution of this species is shown in Figure 8.

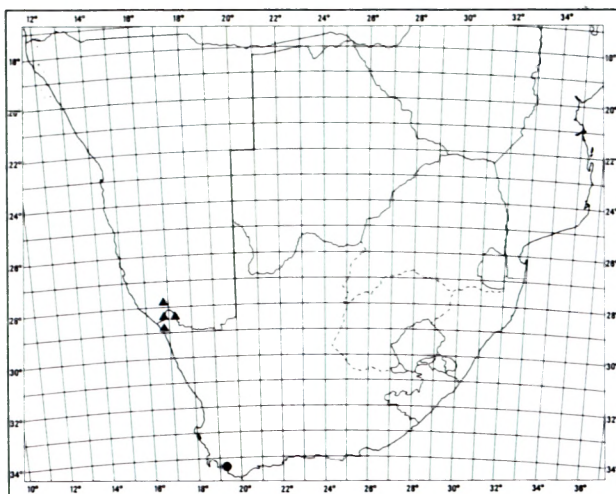


FIGURE 8. — Distribution of *Astridia longifolia*, ▲; and *Acrodon parvifolius*, ●.

1.3 *Astridia herrei* L. Bol. in *Journal of South African Botany* 30: 33 (1964); Jacobsen: 413 (1974). Type: Cape, Annisfontein, October 1961 and September 1963, H. Herre s.n. in *SUG 14693* (BOL!).

Robust shrubs ± 400 mm tall and 400 mm in diameter. *Stems* pale grey, with internodes about $15 \times 6-7$ mm when young. *Leaves* grey to pinkish, 31-51 $\times 6-10,5$ mm and as deep as wide, digitiform to subfalcate, obscurely keeled, sheathing the stem for about 8 mm. *Pedicel* $\pm 10 \times 4$ mm. *Bracts* up to 13 mm long and 6,5 mm thick. *Flower* ± 50 mm in diameter when open. *Sepals* 6, outer 2 up to $9,5 \times 8$ mm, inner 4 up to 8×5 mm. *Petals* many in about 6 series, magenta to scarlet red, 22-26 \times up to 3 mm, innermost petals merging with staminodes. *Staminodes* (7,5-) 9-13 mm long. *Stamens* many; filaments 5-12 mm long; anthers and pollen pale yellow. *Stigmas* narrowly subulate, 5-6 mm long. *Capsule* broadly obconical, $\pm 12,5$ mm in diameter when

closed and 9 mm long; valve wings absent; placental tubercles large, radial diameter $\pm 1,3$ mm; expanding keels slightly diverging, not fimbriate. *Seeds* deep maroon, $1,1-1,3 \times 0,85-1,00 \times 0,70-0,90$ mm, micropylar region 0,35-0,45 mm long; baculae prominent, those on embryo region somewhat more so than those on micropylar region; microbaculae very long, rod-shaped and conspicuous. *Chromosome number* $2n=18$ (Albers & Haas 1978).

Voucher specimens:

CAPE. — 2816 (Oranjemund): Annisfontein (-BD), Herre s.n. in *SUG 14693* (BOL); Cornellskop (-BD), Wisura 1579 (NBG).

The relatively short internodes sheathed by the leaves for half their length, and the long narrow leaves distinguish this species from others of the genus. The distribution of this species is shown in Figure 9.

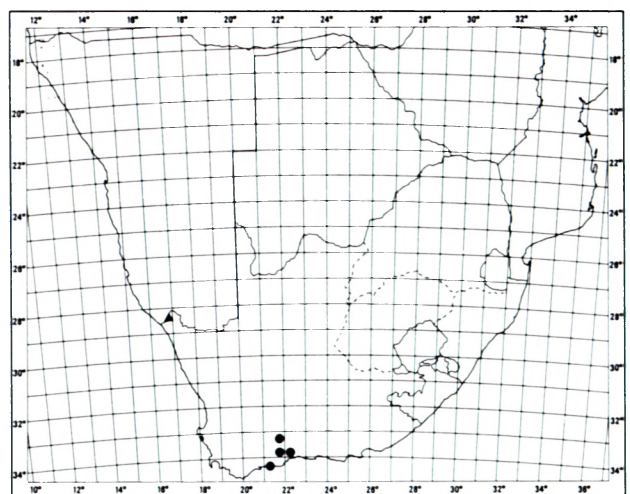


FIGURE 9. — Distribution of *Astridia herrei*, ▲; and *Acrodon duplessiae*, ●.

1.4 *Astridia citrina* (L. Bol.) L. Bol. in *Journal of South African Botany* 32: 230 (1966b); Jacobsen: 413 (1974). Glen: t. 1917 (1985). Type: SWA/Namibia, without precise locality, cultivated in Windhoek Government Garden, July-August 1937, Rusch & Erni sub Holloway 58 (BOL!).

A. rubra (L. Bol.) L. Bol. var. *citrina* L. Bol.: 170 (1961b).

Robust shrubs 300–400 mm tall. *Stems* pale buff to dark brown when young; internodes $\pm 20 \times 5.5$ mm. *Leaves* minutely velutinous, 30–55 (–70) mm long, strongly keeled, 11–19 mm thick. *Pedice*l $\pm 13 \times 3$ mm. *Bracts* up to 19 mm long and 10 mm thick. *Flower* ± 50 mm in diameter when open. *Sepals* 6, outer pair up to 12×8 mm, inner 4 up to 11×7 mm. *Petals* ± 50 in 1–2 series, white to yellow, $18\text{--}23 \times$ up to 3 mm. *Staminodes* present, 6–9 mm long, distinct from petals. *Stamens* many; filaments 4–9 mm long. *Stigmas* subulate to filiform, shorter or longer than longest stamens, 8.5–11 mm long. *Capsule* dark grey, broadly obconical, ± 11.5 mm in diameter when closed and 10 mm long; valve wings absent; placental tubercles small, radial diameter 0.5 mm. *Seeds* deep maroon, echinate, $1.1\text{--}1.4 \times 0.75\text{--}1.05 \times 0.5\text{--}0.9$ mm, micropylar region 0.3–0.55 mm long; baculae prominent, more so on micropylar region than embryo region; microbaculae large, elliptical-conical.

Voucher specimens:

SWA/NAMIBIA. — 2816 (Oranjemund): Rooilepel (–BA), Hardy 4826 (PRE); Lorelei (–BB), Giess, Volk & Bleissner 5421 (WIND).

The yellow colour of the flowers in this species is unique in the genus. Other distinguishing characters are the combination of wide and deep leaves relative to their length, relatively long pedicels and long capsules. The distribution of this species is shown in Figure 10.

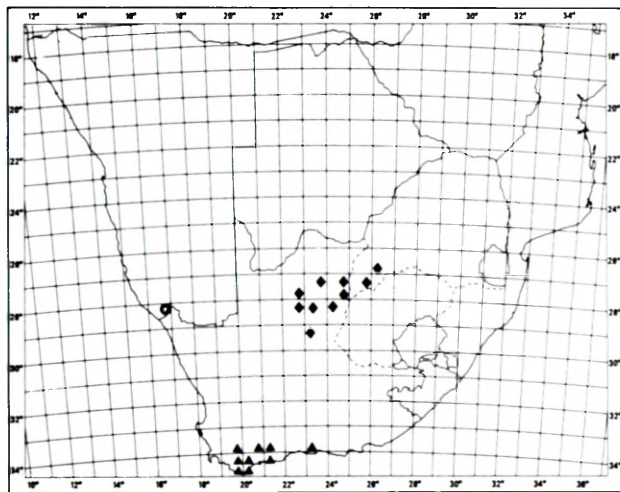


FIGURE 10. — Distribution of *Astridia citrina*, ☆; *A. speciosa*, ●; *Acrodon leptophyllus*, ▲; and *Ebracteola wilmaniae*, ◆.

1.5 *Astridia speciosa* L. Bol. in Journal of South African Botany 27: 111 (1961c); Jacobsen: 413 (1974). Type: SWA/Namibia, 5 miles north of Sendelingsdrift, March 1960, *H. Hall 1869* (BOL!).

Shrublets ± 200 mm tall and in diameter. *Branches* with internodes $\pm 25 \times 5$ mm when young. *Leaves* velvety, 20–63 mm long, 7–22 mm wide and thick, obscurely keeled, sheathing stem for ± 5 mm. *Pedicels* very short. *Bracts* up to 13 mm long and 8

mm thick. *Flowers* ± 70 mm in diameter when open. *Sepals* 6, outer pair up to 9×6.5 mm, inner 4 up to 8×4 mm. *Petals* many, red-orange, (23–) 25–33 \times up to 3.5 mm, grading into staminodes. *Staminodes* 11–12 mm long. *Stamens* very many; filaments 5.5–9 mm long; anthers and pollen golden. *Stigmas* filiform, (9–) 10–11 mm long, overtopping stamens. *Capsule* and *seeds* not seen.

Voucher specimens:

SWA/NAMIBIA. — 2816 (Oranjemund): north of Sendelingsdrift (–BB), *H. Hall 1869* = *NBG 175/60* (BOL); Kahans Mine (–BB), *Rusch sub Dinter 8394* (B).

The flowers of this species are the largest and showiest in the genus. Like *A. vanheerdei*, to which it is very similar, it may be distinguished from *A. longifolia* by its sessile flowers (and, presumably, capsules). It is similar to *A. longifolia* and different from *A. vanheerdei* in the narrowing of the leaf bases and the presence of staminodes. These three species are very close, and still more detailed studies may show that they are all one species. The distribution of this species is shown in Figure 10.

1.6 *Astridia hallii* L. Bol., Notes on Mesembryanthemum and allied genera 3: 298 (1958); Jacobsen: 413 (1974). Type: SWA/Namibia, Lorelei opposite Sendelingsdrift, July 1955, *H. Hall s.n. in NBG 489/55* (BOL!).

A. ruschii L. Bol.: 169 (1961b); Jacobsen: 413 (1974); Glen t. 1894 (1984). Type: SWA/Namibia, without precise locality, cultivated in Windhoek Government Garden, July–August 1937, *Rusch & Erni sub Holloway 24* (BOL!).

Robust shrubs 200–300 mm tall. *Stems* pale buff when young; internodes ± 30 mm long and 8 mm in diameter. *Leaves* glaucous, triquetrous, keeled, 42–78 (–118) mm long, (4–) 14–20 mm wide and thick, minutely velutinous, sheathing stem for ± 7 mm. *Pedicels* $\pm 13 \times 4$ mm. *Bracts* up to 24 mm long and 11 mm thick. *Flower* ± 60 mm in diameter when open. *Sepals* 6, outer pair up to 13×12 mm, inner 4 up to 10×6 mm. *Petals* ± 70 , white or rarely pale pink, $22\text{--}36.5 \times$ up to 3 mm. *Staminodes* absent. *Stamens* many, 3.5–11 mm long. *Stigmas* filiform, 4–11 mm long. *Capsule* broadly obconical, ± 13.5 mm in diameter when closed and 9.5 mm long; covering membranes present, covering most of interior; valve wings present or absent, if present then long and awn-like; placental tubercles large, radial diameter ± 1.4 mm; expanding keels slightly to widely diverging. *Seeds* medium brown to dark maroon, $0.95\text{--}1.5 \times 0.7\text{--}1.0 \times 0.6\text{--}0.9$ mm, micropylar region 0.3–0.55 mm long; baculae prominent, more so on embryo region than on micropyle; microbaculae conspicuous, long, cylindrical to elliptical.

Voucher specimens:

SWA/NAMIBIA. — 2715 (Bogenfels): Schlafkuppe (–BD), Hardy 4636 (PRE). 2716 (Witputs): 41 miles south of Witputs (–DD), *Littlewood s.n. in KG 756/61* (M). 2816 (Oranjemund): Kahanstal (–BB), *Dinter 8186* (B. K); Lorelei (–BB), *H. Hall s.n. in NBG 489/55* (BOL).

As will be seen from the scatter diagram in Figure 11, *Astridia ruschii* is quite indistinguishable from *A. hallii* in leaf characters. The same is true for all other characters examined. These two names must therefore be regarded as referring to the same species.

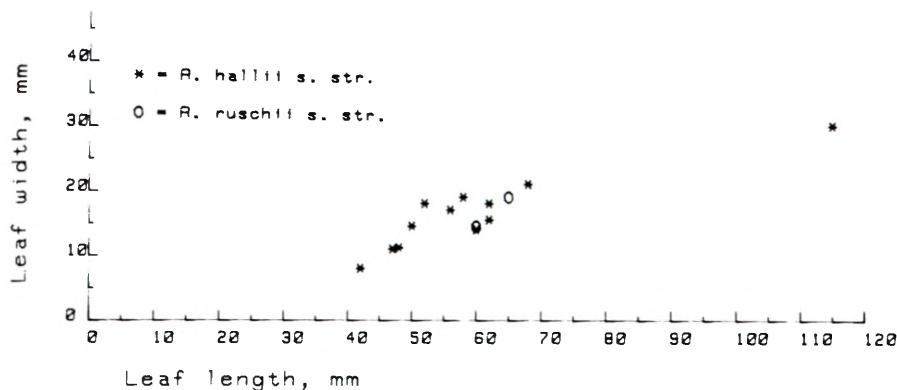


FIGURE 11. — Leaf measurements of plants included in *Astridia hallii*.

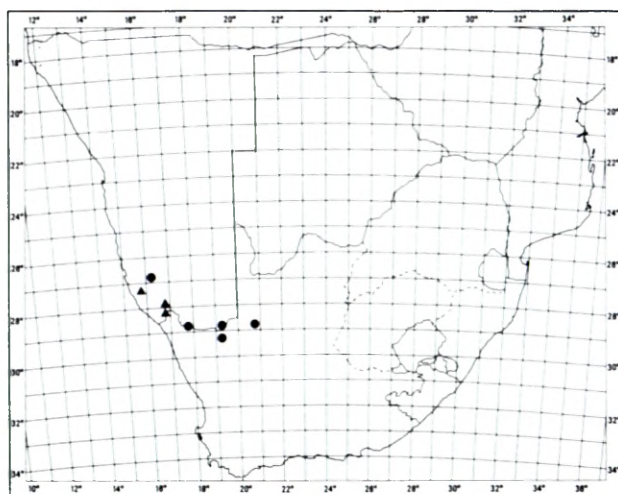


FIGURE 12. — Distribution of *Astridia hallii*, ▲; and *Ebracteola fulleri*, ●.

The relatively wide leaves, long pedicels and broad, shallow capsules distinguish this species from all others. The distribution of this species is shown in Figure 12.

1.7 *Astridia vanheerdei* L. Bol. in Journal of South African Botany 28: 219 (1962a); Jacobsen: 414 (1974). Type: Cape, between Annisfontein and Bloeddrift, April 1962, P. van Heerde s. n. in NBG 251/62 (BOL!).

Robust shrubs \pm 200 mm tall. *Stems* pale buff when young; internodes \pm 27 mm long and 5 mm in diameter. *Leaves* glaucous, triquetrous, keeled, 38–57 (–65) mm long, 10–13 (–14.5) mm wide and 16–21 (–23) mm thick, minutely velutinous, sheathing stem for \pm 7 mm. *Pedicels* very short. *Bracts* up to 17 mm long and 8.5 mm thick. *Flowers* \pm 50 mm in diameter when open. *Sepals* 6, outer pair up to 12 \times 8 mm, inner 4 up to 10 \times 6 mm. *Petals* \pm 70, magenta-red, 19–20 \times up to 2 mm. *Staminodes* absent. *Stamens* many, 4–9 mm long. *Stigmas* filiform, 6–7 mm long. *Capsule* and *seeds* not seen.

Voucher specimen:

CAPE. — 2816 (Oranjemund); between Annisfontein and Bloeddrift (–BD), P. van Heerde s.n. in NBG 251/62 (BOL).

This species differs from *A. longifolia* in the relatively broad leaf-bases, the sessile flowers and the absence of staminodes. The first of these charac-

ters distinguishes it from *A. speciosa*, as do the laterally compressed leaves and the absence of staminodes. The distribution of this species is shown in Figure 13.

This species is known only from the type specimen, and so must be regarded as the rarest and least-known member of this genus.

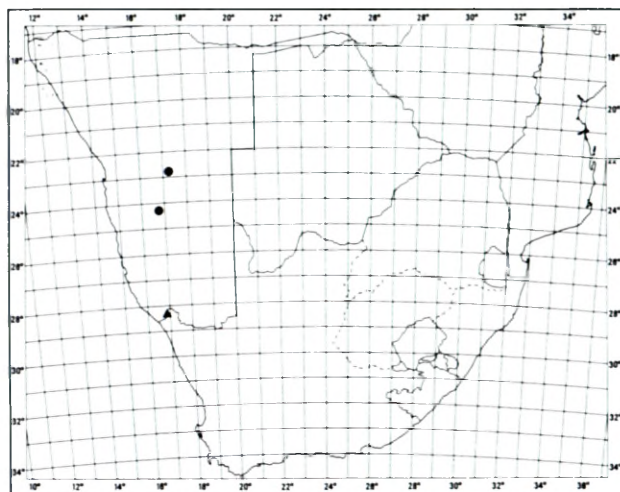


FIGURE 13. — Distribution of *Astridia vanheerdei*, ▲; and *Ebracteola montis-moltkei*, ●.

Excluded species

Astridia maxima (Haw.) Schwant. in Zeitschrift für Sukkulentenkunde 3: 16 (1927). This is based on *Mesembryanthemum maximum* Haw., and is correctly called *Ruschia maxima* (Haw.) L. Bol.

2. ACRODON

Acrodon N.E. Br. is a genus of four rather similar-looking species of dwarf habit. Two of these species have, until now, been included in *Ruschia*, and the arrangement of specimens in BOL indicates that L. Bolus and her co-workers were in some doubt as to whether these two genera should be retained or merged into one. *Ruschia* is regarded here as a genus of typically shrubby plants, most of which have flowers in cymose inflorescences. Only in the section *Uncinata* does one find plants in which the leaf keel is toothed; these plants are shrubs with leaves decurrent on the internodes, and flowers with petals of uniform colour, often arranged in five 'fascicles'.

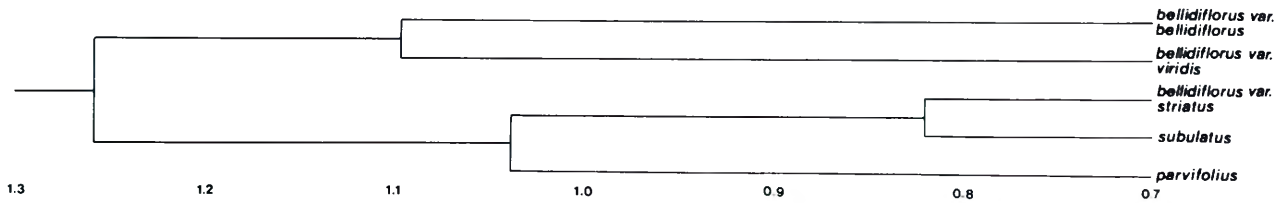


FIGURE 14. — Phenogram of *Acrodon* calculated from a distance matrix using UPGMA. Irrelevant OTU's are omitted.

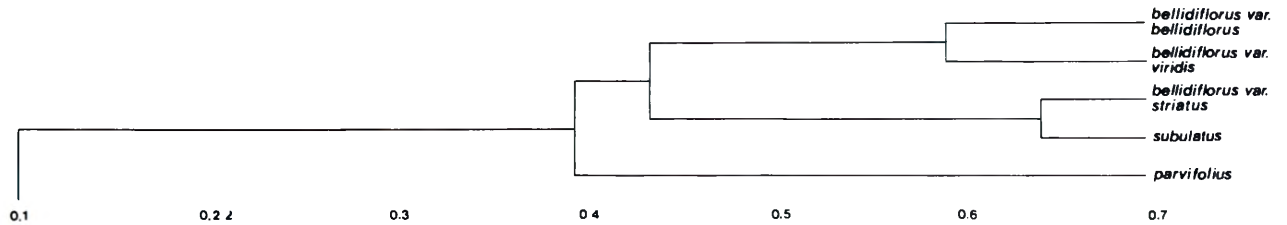


FIGURE 15. — Phenogram of *Acrodon* calculated from a correlation matrix using UPGMA. Irrelevant OTU's are omitted.

The leaves of *Acrodon* are longer and wider than those of *Ruschia* section *Uncinata*, and dark green rather than greyish. The flowers of *Acrodon* are solitary, and the petals are evenly spaced. They are characterized by a central longitudinal stripe of a darker colour than the rest of the petal. *Acrodon* is therefore among the more distinctive genera in the family Mesembryanthemaceae.

It may be distinguished from *Ruschia* section *Uncinata* not only on morphological but also on geographical grounds. *Ruschia* section *Uncinata* is characteristically found in the upper Karoo and SWA/Namibia, with outlying species in the Orange Free State and western Transvaal, while *Acrodon* is restricted to the southern Cape and Little Karoo, in Acocks's (1975) Fynbos, Coastal Rhenosterbosveld, Coastal Macchia, Succulent Mountain Scrub and Karroid Broken Veld types.

Plants of this small genus were among the first highly succulent members of the family Mesembryanthemaceae to become known in Europe. *Acrodon bellidiflorus* was well known in England (Bradley 1717; Dillenius 1731) and the Netherlands (Linnaeus 1738; Van Royen 1740) early in the eighteenth century. It appears that this species was introduced into cultivation, at least in England and Germany, as early as the end of the seventeenth century, as the first descriptions of it date from 1700 (Plukenet 1700; Volckamer 1700). Linnaeus evidently knew the plant from his period of work at Clifford's garden near Leyden in the Netherlands. His descriptions in the *Hortus Cliffortianus* and the *Species Plantarum* (1753) make use of the sharply triquetrous leaves and the small teeth on the leaf keel near the apex; these characters are still used to distinguish

Acrodon from others of the family. Haworth (1821) distinguished two varieties of *A. bellidiflorus*. The genus *Acrodon* was separated from *Mesembryanthemum* L. by N. E. Brown (1927), who at that time included only *A. bellidiflorus* in his new genus.

The classification presented here is based on the phenograms shown in Figures 14 & 15. The great similarity between species of *Acrodon* is shown by the scatter diagrams in Figures 17–19. From these it can be seen that the species are difficult to separate reliably on the basis of individual characters taken pairwise and plotted on scatter diagrams, but that multivariate methods using as many characters as possible together, not just two at a time, distinguish more certainly between very close species.

Acrodon N. E. Br. in *Gardeners' Chronicle*, series 3, 81: 12 (1927); Herre: 62 (1971); Dyer: 95 (1975). Type species: *A. bellidiflorus* (L.) N. E. Br.

Dwarf succulents with internodes completely hidden by leaf bases. Leaves bright green, sharply triquetrous, often with a few small teeth on keel near apex. Flowers solitary; pedicels with leaf-like bracts. Sepals 5, in two series, outer pair fleshy, inner 3 less so, with membranous margins and generally significantly smaller. Petals 30 or more, 1–3-seriate, white to pink, usually with conspicuous darker pink to magenta longitudinal stripes. Staminodes present or absent. Stamens numerous, erect; filaments papillate at least at base. Stigmas 5, subulate. Capsules relatively large, turbiniform, woody, 5-locular; covering membranes well developed; valve wings awn-like, rarely absent; placental tubercles relatively large. Seeds various shades of maroon to black, with conspicuous, well spaced baculae on the embryo region.

KEY TO THE SPECIES OF *ACRODON*

- 1a Leaves laterally compressed (thickness greater than breadth):
 - 2a Plants creeping; leaves less than 20 mm long; fruit usually less than 9 mm in diameter; pedicels ± 14 mm long 2. *A. parvifolius*
 - 2b Plants erect; leaves more than 30 mm long, usually much longer; fruit more than 10 mm in diameter; pedicels 27–58 mm long 4. *A. leptophyllus*
- 1b Leaves dorsally compressed (breadth greater than thickness) or not compressed (thickness equal to breadth):
 - 3a Leaves with marginal as well as dorsal teeth, glaucous green 3. *A. duplessiae*
 - 3b Leaves only with dorsal teeth, glaucous to bright green:
 - 4a Leaves bright green; capsule no more than 3/4 as long as in diameter 1. *A. bellidiflorus*
 - 4b Leaves glaucous green; capsule almost as long as in diameter 4. *A. leptophyllus*

2.1 *Acrodon bellidiflorus* (L.) N. E. Br. in Gardeners' Chronicle, series 3, 81: 12 (1927); Jacobsen: 404 (1974).

Mesembryanthemum bellidiflorum L.: 484 (1753); DC.: 424 (1828); Salm Dyck: § 12: t. 1 (1836-63; published 1840). Iconotype: *Mesembryanthemum bellidiflorum* Dill.: 244 t. 189 fig. 233 (1731).

M. subulatum Mill.: n. 10 (1768). *M. bellidiflorum* L. var. *subulatum* (Mill.) Haw.: 106 (1821); DC.: 424 (1828); Salm Dyck: § 12 t. 1y (1836-63; published 1840); Berger: 221 (1908). *A. subulatus* (Mill.) N. E. Br.: 77 (1928); Jacobsen: 404 (1974). Type not cited.

M. bellidiflorum L. var. *glaucescens* Haw.: 106 (1821); DC.: 424 (1828). Iconotype: Dillenius: fig. 233 (1731).

M. bellidiflorum L. var. *simplex* DC.: t. 41 (1798-1837; published 1799). Type not cited.

M. bellidiflorum L. var. *viride* Haw.: 106 (1821); DC.: 424 (1828); Salm Dyck: § 12: t. 1B (1836-63; published 1840); Berger: 221 (1908). Type not cited.

Ruschia longifolia L. Bol.: 500 (1928-35; published 1935); Jacobsen: 556 (1974). Type: Cape, Huis River Pass, November 1933, Herre s.n. in *SUG 10234* (BOL!).

Pre-Linnaean citations:

Ficoides africana mesembryanthemum triquetro folio, flore albo, parvo, polyanthos, Plukenet: 77 (1700); Ray: 364 n. 2 (1704).

Ficoides africana humilis, folio triangulari breviori nonnihil spinoso seu denticulato, Volckamer: 166 (1700). *Ficoides seu ficus aizoides africana folio triangulari crasso brevi glauco ad tres margines aculeata*, Boerhaave 1: 290 n. 21 (1720).

Dwarf succulents; internodes hidden by leaf bases. *Leaves* bright green, triquetrous, not compressed, 14-54 (-80) mm long, 2-8 (-10) mm wide and thick, with a number of small teeth on apical end of keel. *Pedicels* $\pm 38 \times 1,5$ mm, with a pair of bracts near base, these leaf-like, up to 22 mm long and 4,5 mm thick. *Flowers* ± 35 mm in diameter when open. *Sepals* 5, in two series, outer pair narrowly deltoid, up to 12×8 mm, inner 3 broadly deltoid to almost rectangular, up to 8×6 mm. *Petals* $\pm 40-60$, 2-seriate, white or pale pink with a central magenta stripe and magenta margins and apices, these usually obtuse, $7-19 \times$ up to 3 mm. *Staminodes* usually absent, if present then 4-5,2 mm long, white with pink apices, sharply distinct from petals. *Stamens* numerous; filaments 1-6 mm long, papillate at base, innermost filaments papillate in lower half; anthers magenta; pollen white. *Stigmas* 5, broadly subulate, 1-4 mm long. *Capsule* $9 \times \pm 11$ mm; covering membrane covering most of interior; valvewings present or absent, when present awn-like; placental tubercles large, radial diameter 1-1,5 mm; expanding keels narrowly diverging or almost parallel, fringed with small papillae or unadorned. *Seeds* dark maroon, $0,96-1,55 \times 0,81-1,14 \times 0,49-1,07$ mm, micropylar region 0,32-0,67 mm long; baculae hemispherical-cylindrical, well spaced, almost as well developed on micropylar region as on embryo region;

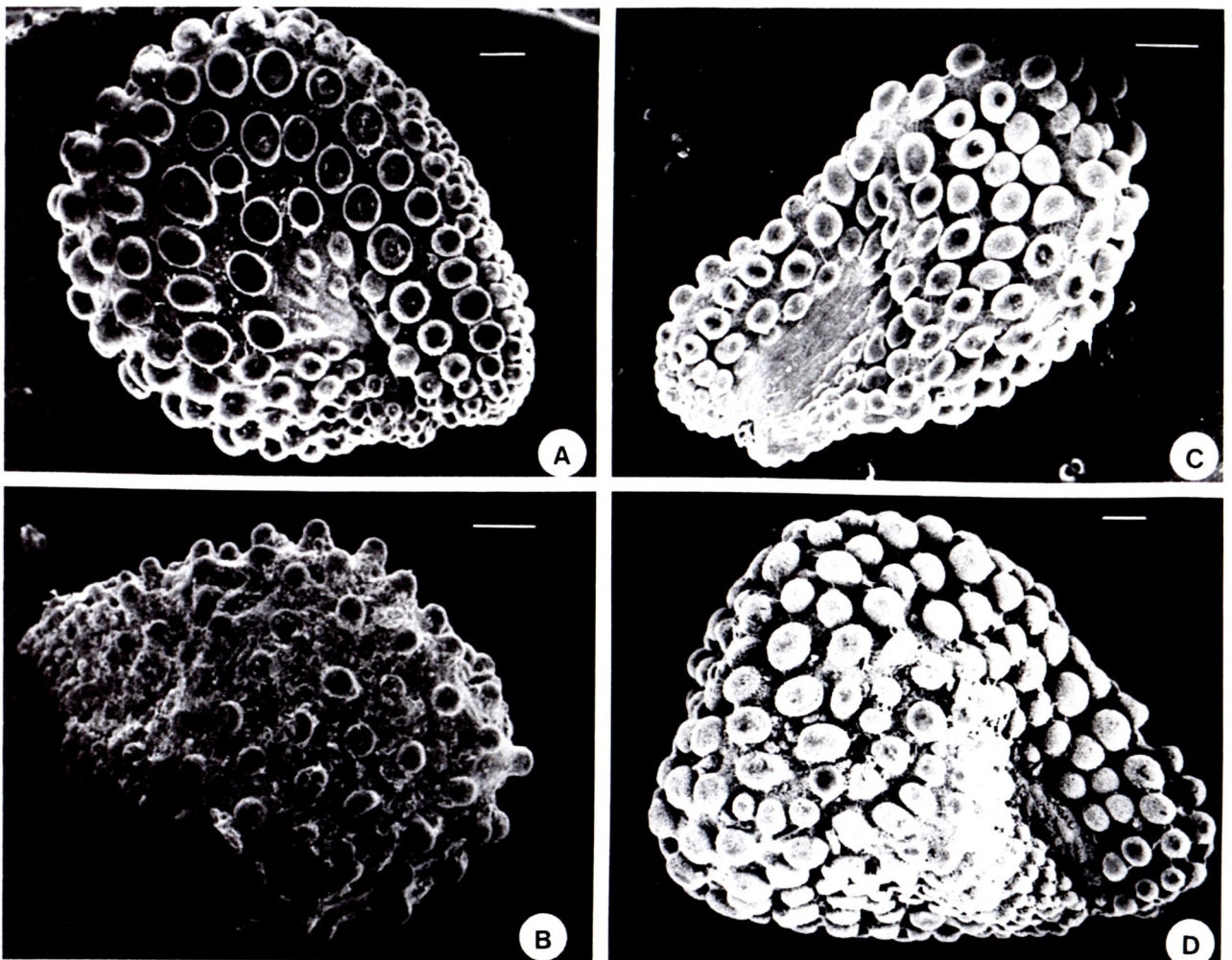


FIGURE 16. — SEM photographs of seeds of A, *Acrodon bellidiflorus*; B, *A. parvifolius*; C, *A. duplessiae*; D, *A. leptophyllus*. Scale bar=100 μ m.

microbaculae rod-shaped, conspicuous. *Chromosome number* $2n = 18$ (Riley & Hoff 1961). Figures 16–19.

Voucher specimens:

CAPE. — 3318 (Cape Town): Kalabaskraal (-DA), *L. Bolus s.n. in NBG 880/15* (K). 3320 (Montagu): Barrydale (-DC) *Muir s.n. (K)*. *Compton & Cook s.n. in NBG 1992/23* (BOL). 3321 (Ladismith): Huis River Pass (-BC) *Herre s.n. in SUG 10234* (BOL), *Herre s.n. in SUG 11601* (BOL).

A. bellidiflorus differs from *A. parvifolius* in that the former species grows in small tufts of long leaves and has large flowers and relatively larger fruits. *A. parvifolius* grows in large mats with trailing stems bearing short, wide leaves, small flowers and relatively small fruits. The leaves of *A. duplessiae* have marginal teeth, are glaucous green and are dorsally compressed, while those of *A. bellidiflorus* have teeth only on the keel, and are bright green and sym-

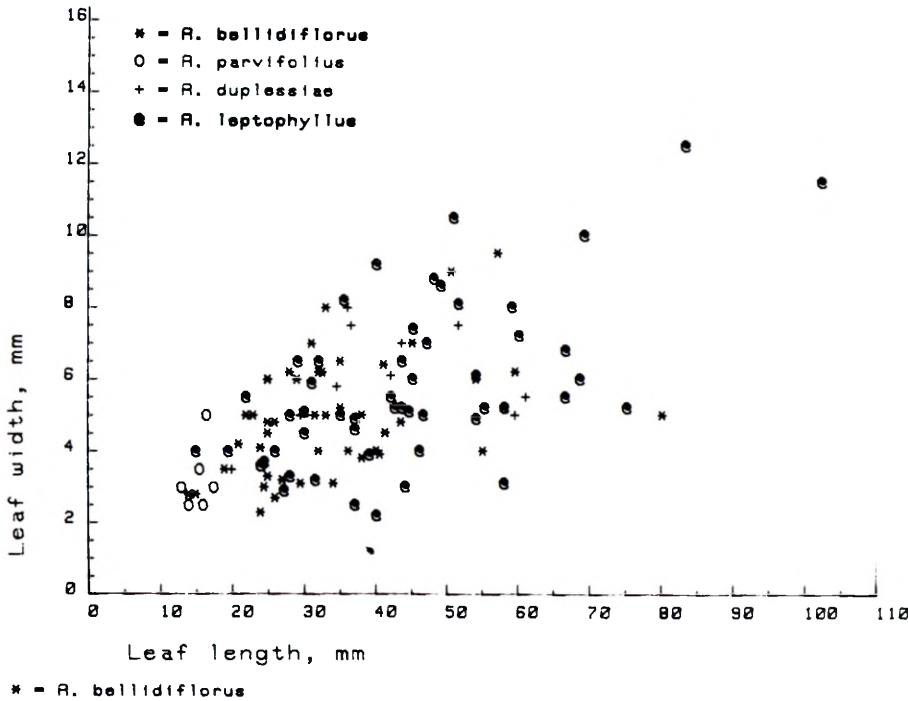


FIGURE 17. — Leaf measurements of *Acrodon* spp.

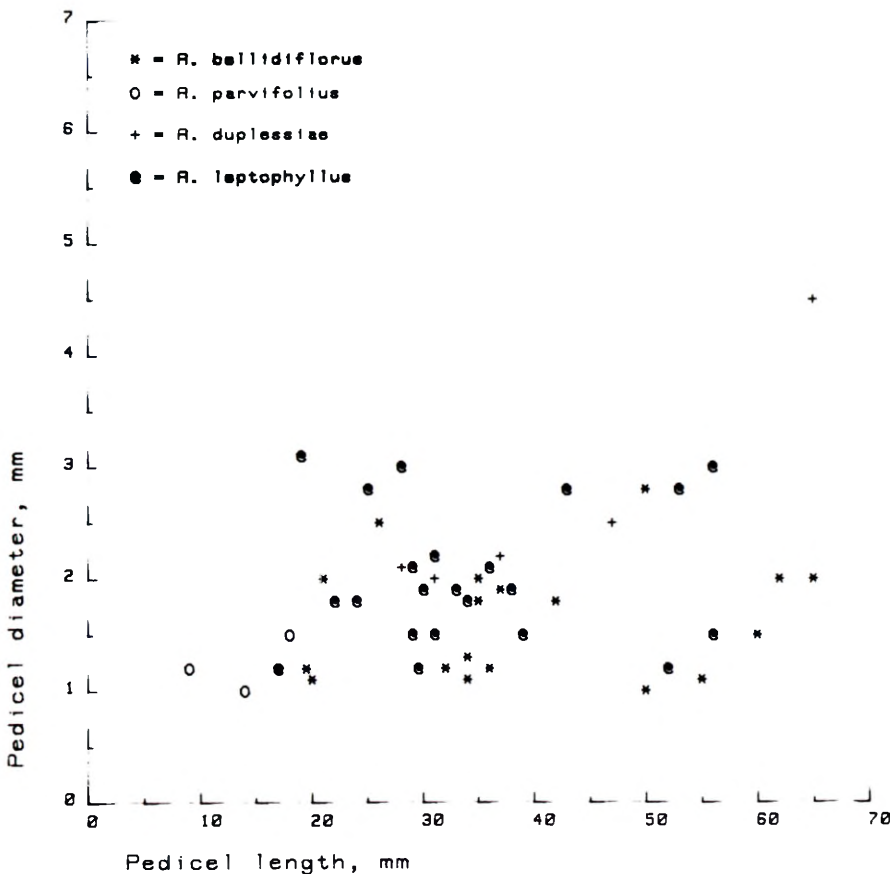


FIGURE 18. — Pedicel measurements of *Acrodon* spp.

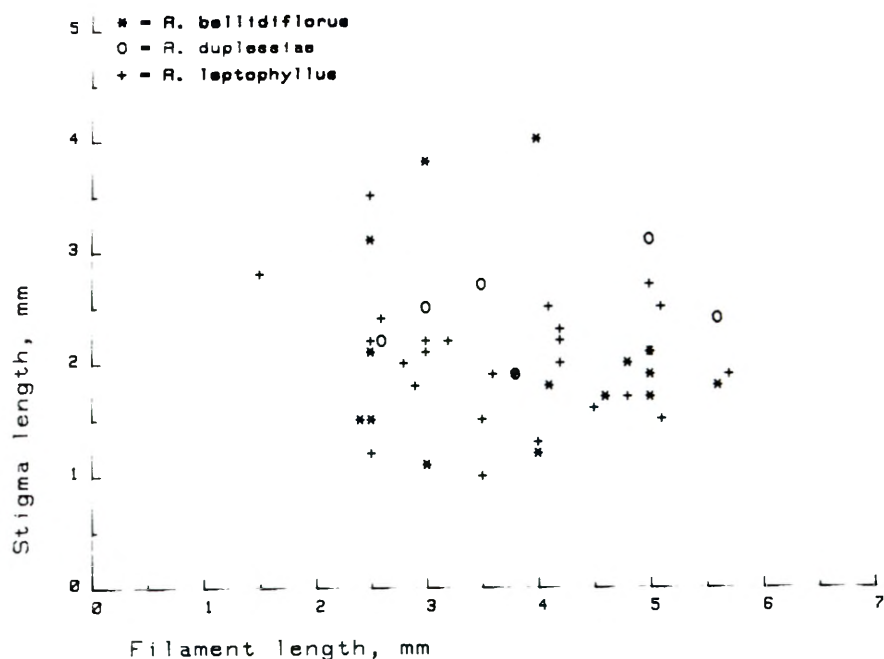


FIGURE 19. — Stigma and stamen measurements of *Acrodon* spp.

metrical in transverse section. Capsules of *A. duplessiae* are generally slightly broader in relation to their depth than those of *A. bellidiflorus*, and seeds are smaller and darker in colour. *A. leptophyllus* also has glaucous leaves, but these tend to be longer than those of *A. bellidiflorus*. The capsules of *A. leptophyllus* are significantly longer relative to their diameter than those of *A. bellidiflorus*.

No individual character or group of characters can be used to distinguish between specimens hitherto assigned to *A. bellidiflorus*, *A. subulatus* and *Rus-*

chia longifolia (cf. Figure 20). It is therefore necessary to regard these three names and their nomenclatural synonyms as referring to the same species, the correct name being *A. bellidiflorus*. The distribution of this species is shown in Figure 6.

2.2 *Acrodon parvifolius* *R. du Plessis* in Notes on Mesembryanthemum and allied genera 3: 386 (1958); Jacobsen: 404 (1974). Type: Cape, between Hawston and Hermanus, October 1955, *R. du Plessis* 164 (BOL!).

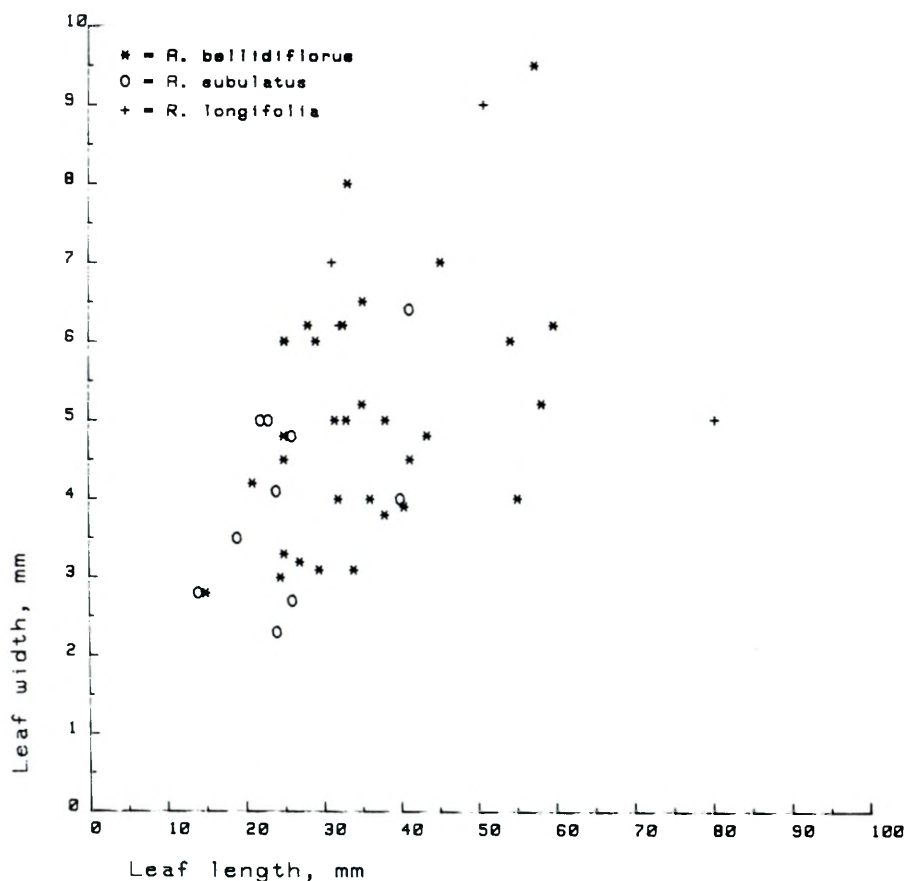


FIGURE 20. — Leaf measurements of *A. bellidiflorus*, *; '*A. subulatus*', O; and '*Ruschia longifolia*', +.

Creeping, succulent-leaved herbs forming mats up to 1 m in diameter. *Stems* with internodes not completely hidden by leaf bases; young internodes, when visible, pale brown and shiny. *Leaves* bright green to olive green, reddish brown at apices, laterally compressed, sharply triquetrous, 13–17.5 mm long, 2–3 (–4) mm wide and 2.5–5 mm thick, with a few small teeth on keel at apex. *Pedicels* \pm 14 mm long and slightly over 1 mm in diameter, with a pair of leaf-like bracts at base. *Flowers* opening about midday, small for genus, 17–20 mm in diameter when open. *Sepals* 5, in two series, outer pair up to 5×4 mm, inner 3 up to 4×3 mm. *Petals* \pm 35, white to pink, with a central longitudinal pink to magenta stripe and magenta margins, $6\text{--}8 \times 1$ mm. *Staminodes* few, sharply distinct from petals, white with pink apices, 3.5–4.5 mm long. *Stamens* in several series; filaments papillate at base or in lower half, pink, 2–3 mm long; anthers deep purple; pollen pink. *Stigmas* subulate, pink. *Capsule* $6.5 \times \pm 8.5$ mm; covering membranes covering most of the interior; valve wings awn-like; placental tubercles small, radial diameter ± 0.8 mm; expanding keels almost parallel, unadorned. *Seeds* deep brown, $0.7\text{--}0.9$ (–1.0) \times $0.6\text{--}0.7 \times 0.45\text{--}0.65$ mm, micropylar region 0.22–0.38 mm long; baculae large, hemispherical-cylindrical and well spaced on embryo region, less regular on micropylar region; microbaculae rod-shaped, conspicuous.

Voucher specimen:

CAPE. — 3419 (Caledon): between Hawston and Hermanus (–AC). *R. du Plessis* 164 (BOL).

Individual differences between this species and *A. bellidiflorus* are dealt with under that species. The coastal habitat (Figure 8) of this species may be a useful character in distinguishing between *A. parvifolius* on the one hand and *A. duplessiae* and *A. leptophyllus* on the other.

2.3 *Acrodon duplessiae* (L. Bol.) Glen, comb. nov.

Ruschia duplessiae L. Bol.: 431 (1928–35; published 1934); Jacobsen: 551 (1974). Type: Cape, near Oudtshoorn, June–July 1933. *R. du Plessis* s.n. in NBG 1048/32 (BOL!).

Dwarf succulents; internodes hidden by leaf bases. *Leaves* glaucous green, triquetrous, dorsally compressed, 20–61 mm long, 7–16 mm wide and half as thick, with a number of small teeth on margins near apex, as well as on apical end of keel. *Pedicels* about 40 mm long, with a pair of bracts near base, these leaf-like, up to 26 mm long and 4 mm thick. *Flowers* ± 35 mm in diameter when open. *Sepals* 5, in two series, outer pair narrowly deltoid, up to 12×7.5 mm, inner 3 broadly deltoid to almost rectangular, up to 7.5×5.5 mm. *Petals* ± 45 , 3-seriate, white or pale pink with a central magenta stripe and magenta margins and apices, these usually emarginate, rarely obtuse, (11.5–) $13\text{--}21 \times 3$ mm. *Staminodes* absent. *Stamens* numerous; filaments pink, 2.5–5.5 mm long, papillate at base, innermost filaments papillate in lower half; anthers magenta; pollen white. *Stigmas* 5, broadly subulate, 2–3 mm long. *Capsule* $9 \times \pm 12$ mm; covering membranes covering most of interior; valve-wings awn-like; placental tubercles

large, radial diameter 1.4 mm; expanding keels widely diverging, fringed with small papillae. *Seeds* very dark maroon to black, $0.9\text{--}1.2 \times 0.61\text{--}0.73$ (–0.80) $\times 0.53\text{--}0.65$ (–0.71) mm, micropylar region $0.34\text{--}0.47$ mm long; baculae large, hemispherical-cylindrical, well spaced, almost as well developed on micropylar region as on embryo region; microbaculae rod-shaped, conspicuous.

Voucher specimens:

CAPE. — 3321 (Ladismith): Huisrivierberg (–BC DA). *Herre* s.n. in SUG 11608 (BOL). 3322 (Oudtshoorn): near Oudtshoorn (–CA). *R. du Plessis* s.n. in NBG 1048/32 (BOL); Robinson Pass (–CC). *I. de Jager* s.n. in BOL 24718 (BOL). 3421 (Riversdale): Melkhoutfontein (–AD). *L. Bolus* s.n. (BOL).

Differences between *A. duplessiae* on the one hand and *A. bellidiflorus* and *A. parvifolius* on the other are discussed under those species. Leaves of *A. duplessiae* are generally much broader and slightly shorter than those of *A. leptophyllus*; they also have marginal teeth, which are lacking in the latter species. In *A. duplessiae* the petals are somewhat longer than in *A. leptophyllus*, and the capsules are shallower in relation to their diameter. Distribution of this species is shown in Figure 9.

2.4 *Acrodon leptophyllus* (L. Bol.) Glen, comb. nov.

Ruschia leptophylla L. Bol.: 333 (1928–1935; published 1932); Jacobsen: 555 (1974). Type: Cape, Hermanus, August–September 1931. *H. L. de Villiers* s.n. in NBG 958/31 (BOL!).

R. macrophylla L. Bol.: 351 (1928–1935; published 1932); Jacobsen: 556 (1974). Type: Cape, near MacGregor, July 1929. *R. H. Compton* s.n. in NBG 1188/24 (BOL!).

R. constricta L. Bol.: 496 (1928–1935; published 1935); Jacobsen: 549 (1974). Type: Cape, near Bredasdorp, April 1933. *L. Bolus* s.n. in NBG 718/33 (BOL!, holo.: K!, iso.).

Dwarf succulents; internodes hidden by leaf bases. *Leaves* glaucous green, triquetrous, dorsally, laterally or not compressed, 15–75 (–102) mm long, 2.2–9.8 (–12.5) mm wide and half to twice as thick, with a number of small teeth on apical end of keel. *Pedicels* $\pm 34 \times 2$ mm, with a pair of bracts near base, these leaf-like, up to 27 mm long and 5 mm thick. *Flowers* ± 30 mm in diameter when open. *Sepals* 5, in two series, outer pair narrowly deltoid, up to 12×7.5 mm, inner 3 broadly deltoid to almost rectangular, up to 9.5×7.5 mm. *Petals* 45–60, 2-seriate, white or pale pink with a central magenta stripe and magenta margins and apices, these usually emarginate, rarely obtuse, $8\text{--}17 \times \pm 2$ mm. *Staminodes* usually absent, if present then (2–) 3–5 mm long, distinct from petals, white with pink apices. *Stamens* numerous; filaments pink, (1.5–) 2.5–5.5 mm long, papillate at base, innermost filaments papillate in lower half; anthers magenta; pollen white. *Stigmas* broadly subulate, 1–3.5 mm long. *Capsule* $11 \times \pm 12$ mm; covering membranes covering almost all of interior; valve-wings awn-like, rarely absent; placental tubercles large, radial diameter 1.5 mm; expanding keels almost parallel, fringed with small papillae or unadorned. *Seeds* maroon to black, $1.00\text{--}1.50 \times 0.84\text{--}1.10 \times 0.75\text{--}0.97$ (–1.04) mm, micropylar region 0.39–0.68 mm long; baculae hemispherical-cylindrical, well spaced, almost as well de-

veloped on micropylar region as on embryo region; microbaculae rod-shaped, conspicuous.

Voucher specimens:

CAPE. — 3319 (Worcester): Villiersdorp (–CD), *Middlemost* s.n. in NBG 2703/27 (BOL); MacGregor (–DD), *Compton* s.n. in NBG 1188/24 (BOL), *Leipoldt* s.n. (BOL). 3320 (Montagu): Barrydale (–DC), *E. Esterhuysen* s.n. (BOL). 3321 (Ladismith): mountains facing karoo, Riversdale Div. (–CC/CD), *Ferguson* s.n. in NBG 1296/27 (BOL).

Differences between this species and others in the genus are discussed above, under the species concerned. Distribution of this species is shown in Figure 10.

The name '*Ruschia leptophylla*' was published in a fascicle of *Notes on Mesembryanthemum and allied genera* dated 29th January 1932, while the fascicle in which the name '*R. macrophylla*' was published is dated 24th June 1932. The reason for choosing the epithet *leptophylla* rather than *macrophylla* for this species, therefore, rests on consideration of a priority of about six months.

The only difference between plants identified as *Ruschia macrophylla* and those previously called *R. leptophylla* and *R. compressa* is in the ratio of leaf thickness to leaf length, and even in this character there is a small degree of overlap (Figure 21). In all other measured characters the overlap is complete (see, for example, Figures 18 & 19), and the states of 'multi-state' characters are the same for all the taxa included in the present species. For this reason the taxa united here are not retained as separate species.

3. EBRACTEOLA

This genus comprises five remarkably similar-looking species. They are readily distinguished from most genera in the subtribe Ruschiinae by their dwarf habit, leaves without teeth and petals without longitudinal stripes, and from most Mesembryanthemaceae of dwarf habit by their thickened, woody rootstocks. The whitish colour of the seeds and the

absence of bracts are useful accessory characters but do not appear in all species of *Ebracteola*.

The first species of *Ebracteola* Dinter & Schwant. to become known was described under the name *Mesembryanthemum wilmaniae* from near Kimberley (Bolus 1916). This was followed by *M. montis-moltkei* from the other extremity of the range of this genus, near Windhoek (Dinter 1922), *M. derenbergianum* in the following year (Dinter 1923), *Ruschia fulleri* a few years later (Bolus 1929) and finally, after a thirty-year interval, *Ebracteola candida* (Bolus 1961a). The genus was first described to accommodate *M. montis-moltkei* and *M. derenbergianum* (Dinter & Schwantes 1927).

Apart from Friedrich's (1970) study of the SWA/Namibian material, no critical study of the genus has been published until now. Three species of the genus were examined in the course of a study of the subtribe Lampranthinae (Glen 1978), but the only conclusion to be drawn at that time was that *Ebracteola* was not a member of that subtribe, and was probably better placed in the subtribe Ruschiinae.

The generic name refers to the absence of bracts in most specimens of these two species, with a diminutive ending to indicate the dwarf habit of plants of this genus.

The phenograms used to generate the classification presented here are shown in Figures 22 & 23. The great similarity between the different species of *Ebracteola* is shown graphically by the scatter diagrams in Figures 24–26. From these it can be seen that the species are difficult to separate reliably on the basis of character pairs plotted on scatter diagrams, but that multivariate methods using as many characters as possible together, not just two at a time, distinguish more certainly between very close species.

The protologue of the genus does not indicate which of the two first-accepted species was to be

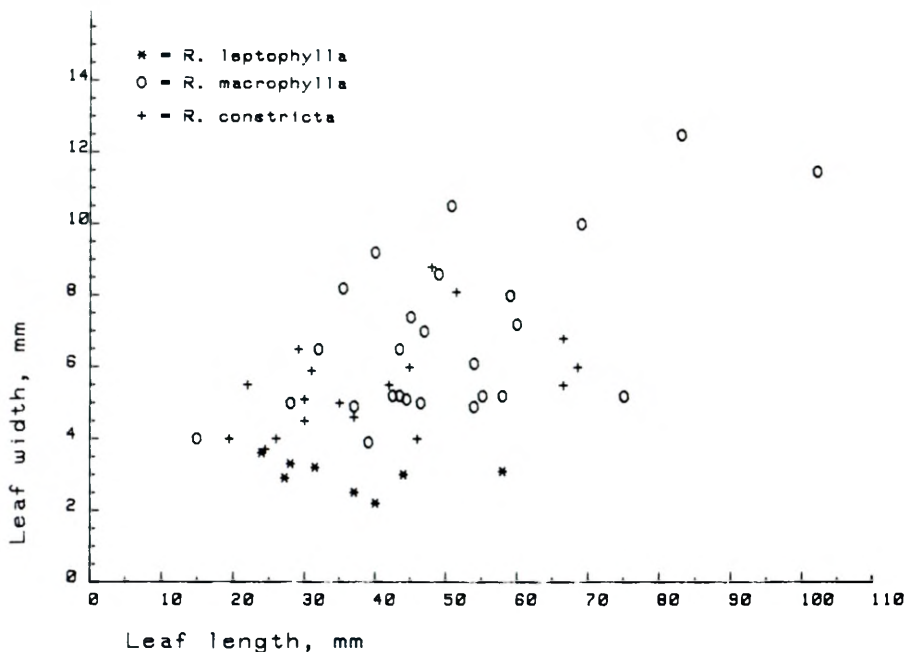


FIGURE 21. — Leaf measurements of *A. leptophyllus*.

taken as the type of the genus. The choice of *E. montis-moltkei* (Dinter) Dinter & Schwant. was made by Von Poellnitz (1933: 40), without any reason being given. This choice must necessarily be followed, but it may be pointed out that the other species placed in their new genus by Dinter & Schwantes, *E. derenbergiana* (Dinter) Dinter & Schwant., was alone transferred from *Ebracteola* to *Ruschia* by Bolus (in Jacobsen 1955) and Weber (1968).

The species here transferred to *Ebracteola* from *Ruschia*, namely *E. wilmaniae* and *E. fulleri*, are

dwarf cushion-forming succulents with essentially semiterete leaves, although forms of *E. wilmaniae* with sharply triquetrous leaves are known. They also have solitary flowers which are very similar to each other and to other species previously included in *Ebracteola*. These characters are rare in the *Ruschianae*, and so these species were found to be closer to other species classified under *Ebracteola* than to any species of *Ruschia*, regardless of which measure of similarity was used. For this reason they are transferred from *Ruschia* to *Ebracteola*.

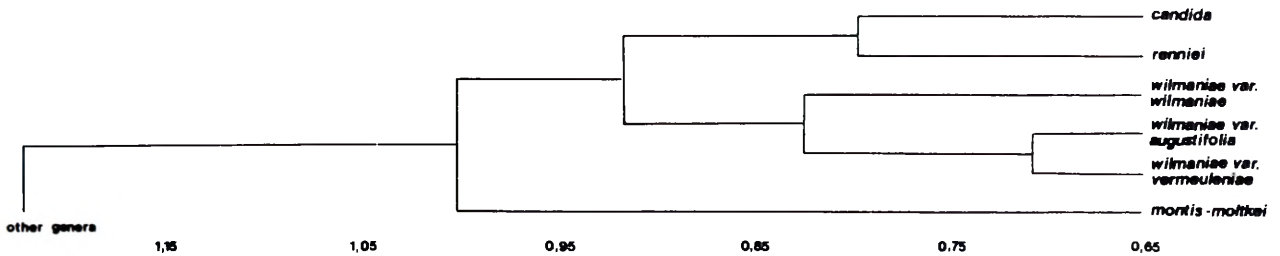


FIGURE 22. — Phenogram of *Ebracteola* calculated from a distance matrix using UPGMA. Irrelevant OTU's are omitted.

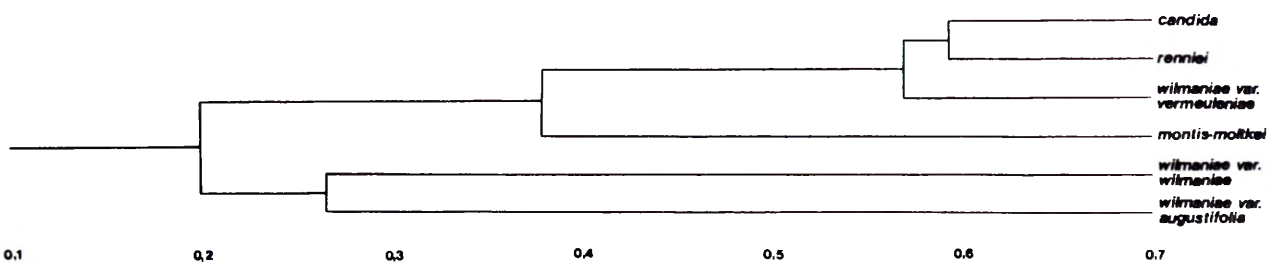


FIGURE 23. — Phenogram of *Ebracteola* calculated from a correlation matrix using UPGMA. Irrelevant OTU's are omitted.

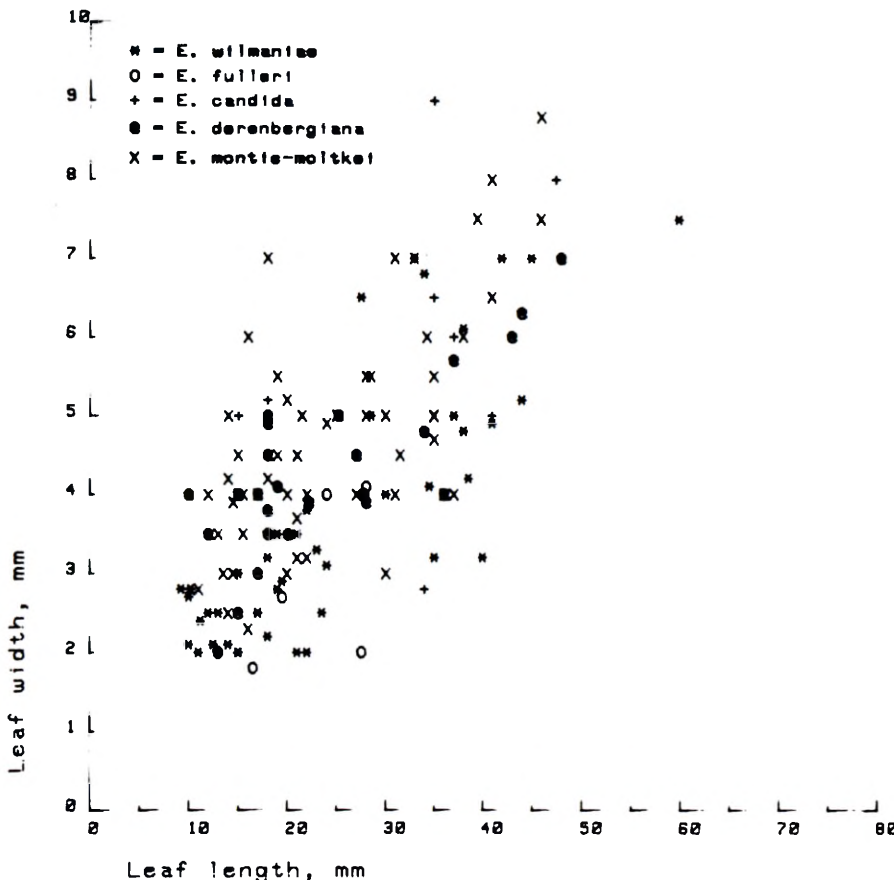


FIGURE 24. — Leaf measurements of all species of *Ebracteola*.

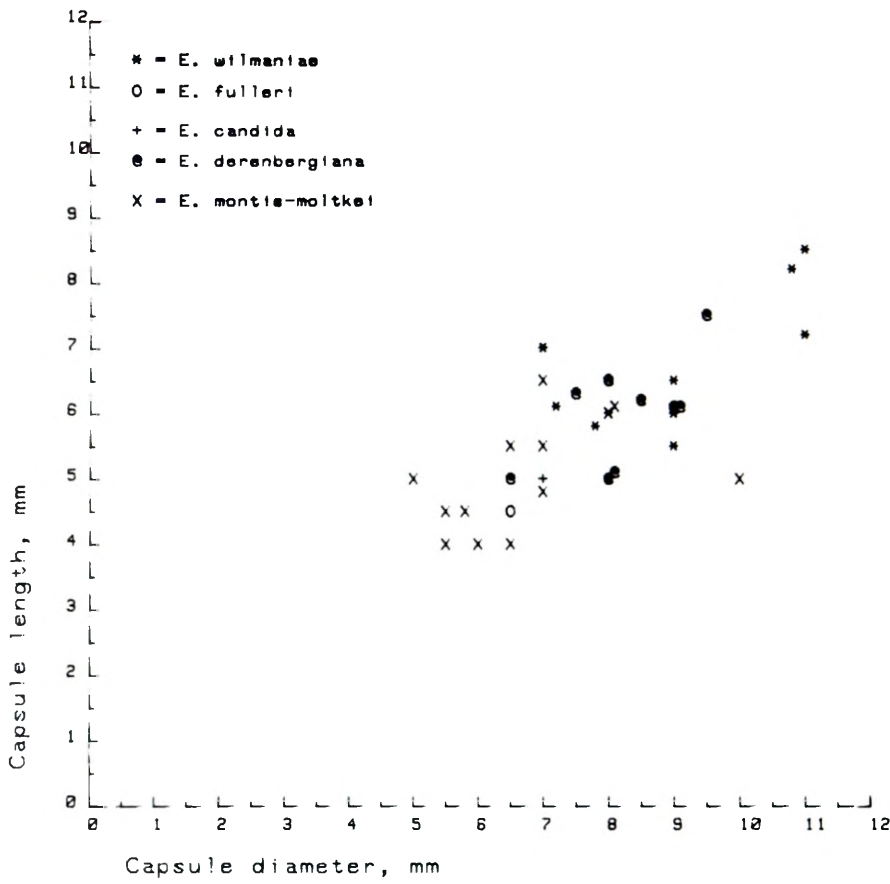


FIGURE 25. — Capsule measurements of all species of *Ebracteola*.

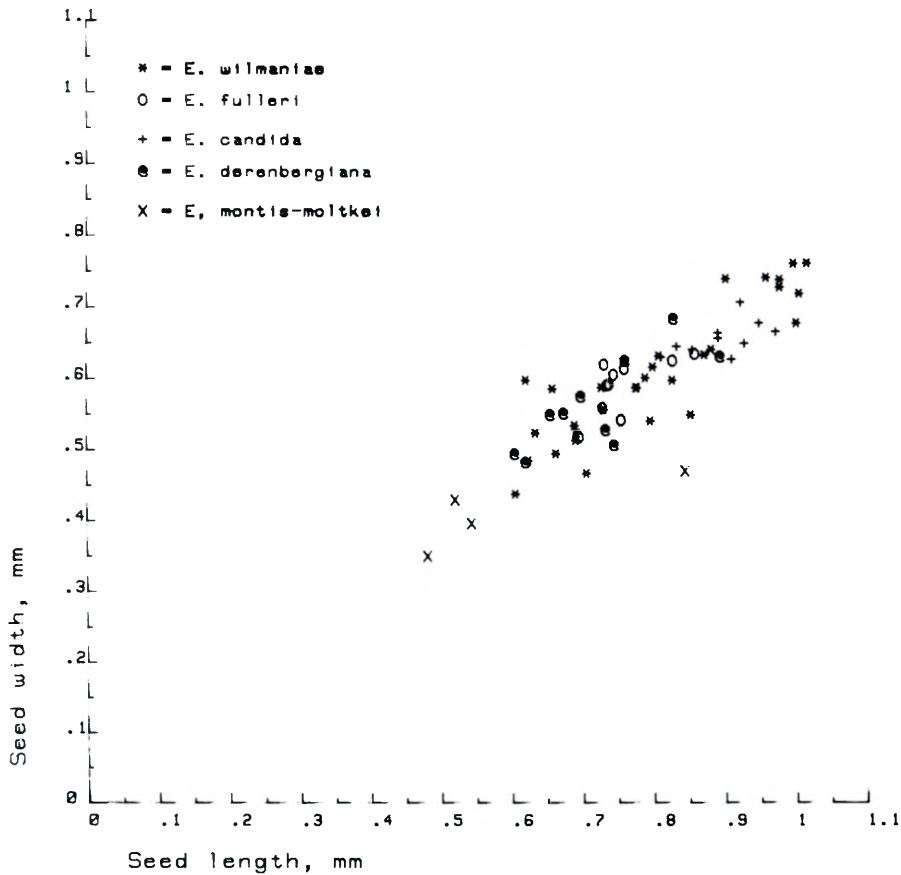


FIGURE 26. — Seed measurements of all species of *Ebracteola*.

Ebracteola Dinter & Schwant. in Zeitschrift für Sukkulantenkunde 3: 24 (1927); Friedrich: 44 (1970); Herre: 146 (1971); Dyer: 110 (1975). Lectotype species: *E. montis-moltkei* (Dinter) Dinter & Schwant. (cited by Von Poellnitz 1933: 40).

Dwarf clump-forming succulents with strongly enlarged, caudiciform rootstocks and internodes completely hidden by leaf bases. *Leaves* elongate, triquetrous to terete, without teeth, glabrous, apple-green to glaucous, yellowish or reddish. *Flowers* usu-

ally solitary, rarely ternate; pedicels with 2 bracts, or bracts absent. *Sepals* 5, in two series, outer pair fleshy, inner 3 slightly smaller, with membranous margins. *Petals* \pm 25–60, in 1–2 series, lorate, narrowly oblanceolate or narrowly obovate. *Staminodes* present. *Stamens* many, erect. *Stigmas* 5, subulate. *Capsules* turbinate, grey, woody, 5-locular; covering membranes well developed; valve wings absent or if present then awn-like to wing-like; placental tubercles usually present, rarely absent. *Seeds* small, cream to maroon, with distinct baculae. Figure 27.

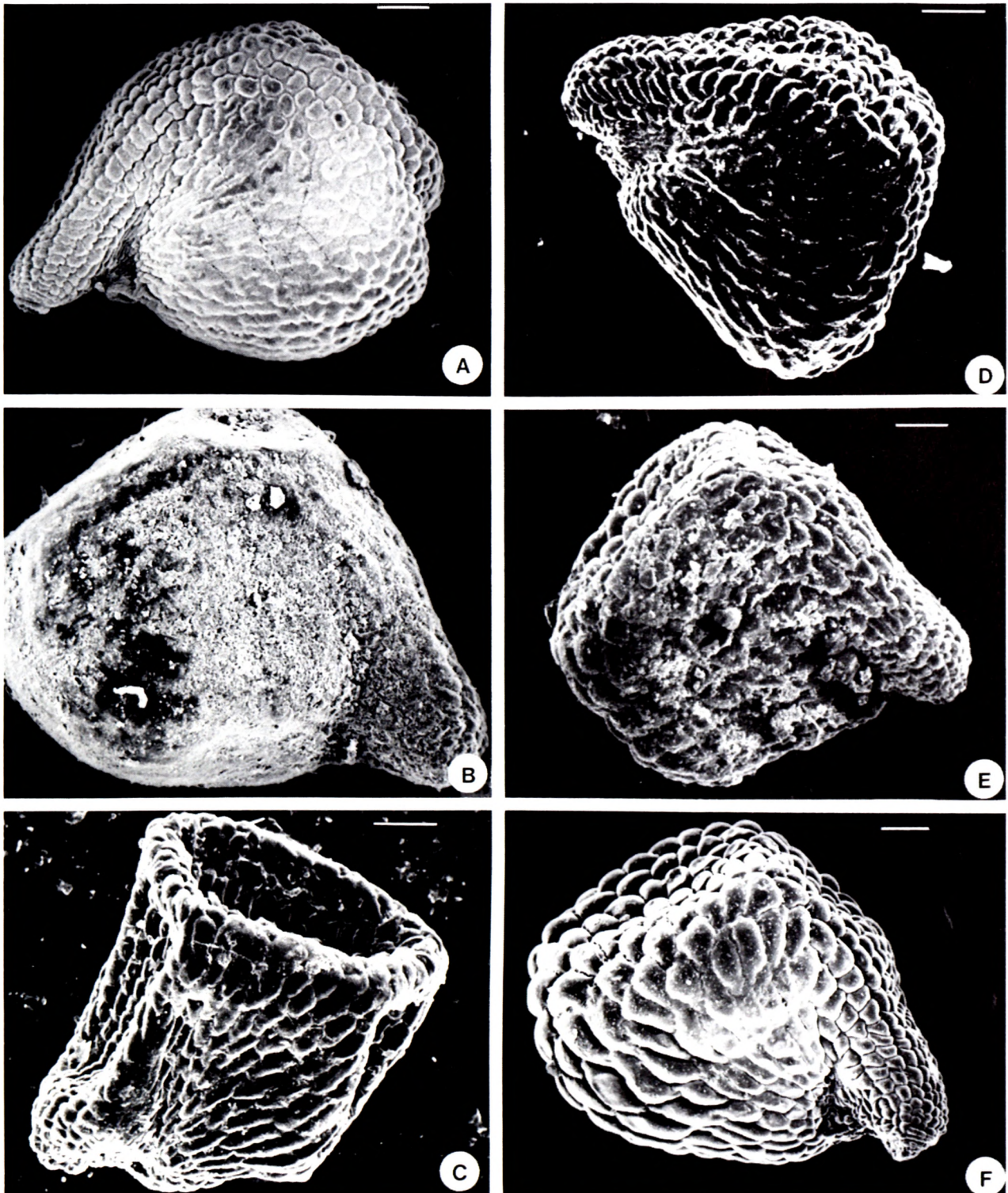


FIGURE 27. — SEM photographs of seeds of A, *Ebracteola candida*; B, *E. fulleri*; C, '*E. renniei*'; D, *E. derenbergiana*; E, *E. wilmaniae*; F, *E. wilmaniae* 'var. *augustifolia*'. Scale bar=100 μ m. B. \times 90.

KEY TO THE SPECIES OF *EBRACTEOLA*

- 1a Leaves sharply triquetrous:
 2a Flowers \pm 30 mm in diameter; capsules 8–9 mm in diameter and 6–7 mm long; bracts present; petals white to pale pink; plants found in the northern Cape and western Transvaal 1. *E. wilmaniae*
 2b Flowers \pm 25 mm in diameter; capsules 6–7 mm in diameter and 4–5 mm long; bracts absent; petals bright magenta-pink; plants found in SWA/Namibia (Windhoek District) 5. *E. montis-moltkei*
- 1b Leaves obscurely triquetrous to almost terete:
 3a Bracts absent; flowers \pm 20 mm in diameter; petals bright pink 4. *E. derenbergiana*
 3b Bracts present; flowers 25–30 mm in diameter; petals white to pale pink:
 4a Bracts scale-like, not over 5 mm long; leaves 13–28 mm long, 2–4 mm wide and thick; petals pale pink 2. *E. fulleri*
 4b Bracts leaf-like, 8 mm long or longer; leaves 9–60 mm long, 2–7,5 mm wide and thick; petals white to pale pink:
 5a Flowers often ternate; found in SWA/Namibia (Lüderitz District); leaves thicker than wide 3. *E. candida*
 5b Flowers solitary; found in the northern Cape and western Transvaal; leaves wider than thick or equally wide and thick 1. *E. wilmaniae*

3.1 *Ebracteola wilmaniae* (L. Bol.) Glen, comb. nov.

Mesembryanthemum wilmaniae L. Bol.: 28 (1916). *Ruschia wilmaniae* (L. Bol.) L. Bol.: 158 (1928–1935; published 1929); Jacobsen: 566 (1974). Syntypes: Cape, Papkuil, August, *Lawson s.n.* (BOL!); *Wilman s.n. in NBG 3784/14*; locus ignotus, June 1915, (BOL!).

M. vermeuleniae L. Bol.: 123 (1922). *R. wilmaniae* (L. Bol.) L. Bol. var. *vermeuleniae* (L. Bol.) L. Bol.: 158 (1928–1935; published 1929); Jacobsen: 566 (1974). Type: Cape, Niekerkshoop, April 1921, *Wilman s.n. in BOL 15194* (BOL!).

R. wilmaniae (L. Bol.) L. Bol. var. *angustifolia* L. Bol.: 260 (1936–1958; published 1954); Jacobsen: 566 (1974). Type: Transvaal, Makwassie, April 1954, *L.C.C. Liebenberg s.n. in SUG 13156* (BOL!).

Dwarf clump-forming succulents with strongly enlarged, caudiciform rootstocks and internodes completely hidden by leaf bases. *Leaves* glaucous-green, triquetrous to semiterete, 9–39 (–60) \times 2–5 (–7,5) mm, narrowing towards apices, these often reddish. *Pedicels* \pm 10 \times 1,7 mm, with a pair of leaf-like bracts, these up to 13,5 mm long and 4 mm thick. *Flowers* \pm 30 mm in diameter when open. *Sepals* 5, outer pair up to 10 \times 5 mm, inner 3 up to 8 \times 4 mm. *Petals* pink to white, 30–50 in 1–2 series, 10–17,5 \times up to 3 mm. *Staminodes* few to many, sharply distinct from petals, 3–8 mm long, white with pink apices. *Stamens* many; filaments 2–5 (–6,5) mm long. *Stigmas* subulate, (2–) 3–4 mm long, roughly equalling stamens. *Capsule* turbinate, grey, 6,5 \times 8,5 mm; covering membranes covering most of interior; valve wings present, wing-like; placental tubercles small, radial diameter \pm 0,4 mm; expanding keels slightly to widely diverging, fringed. *Seeds* yellowish brown to maroon, 0,60–1,01 \times 0,44–0,76 \times 0,39–0,72 mm, micropylar region 0,20–0,37 mm long; baculae distinct, raised, but more so on the micropylar region; microbaculae small to moderate in size.

Voucher specimens:

CAPE. — 2722 (Olifantshoek): Langkloof (–DC), *Leistner 2101* (PRE), 2723 (Kuruman): Kuruman (–AD), *Minnaar s.n. in BOL 24266* (BOL); *Barkhuizen 69* (PRE); 6 miles north-east of Kuruman (–AD); *H. Hall s.n. in NBG 139b/56* (BOL), 2724 (Taung): Geluk (–AB), *H. Hall s.n. in NBG 139/56* (BOL).

E. wilmaniae is the easternmost member of the genus, and is hardly known west of Prieska. Its nearest neighbour is *E. fulleri*, which is not found east of Keimoes, about 150 km west of the westernmost record of the present species. The range of *E. wilmaniae* extends eastwards as far as Makwassie in the

Transvaal, northwards as far as Kuruman and southwards as far as Niekerkshoop, near Prieska (see Figure 10).

The leaves of this species may be sharply triquetrous to semiterete. Triquetrous-leaved forms approach *E. montis-moltkei* in general appearance, but differ from that species in having larger, paler-coloured flowers with distinct bracts, and in having larger capsules. Semiterete-leaved forms approach *E. candida* in appearance. That species, however, has ternate flowers and leaves laterally compressed so that they are thicker than wide.

3.2 *Ebracteola fulleri* (L. Bol.) Glen, comb. nov.

Ruschia fulleri L. Bol.: 159 (1928–1935; published 1929); Jacobsen: 552 (1974). Type: Cape, Pella, August 1929, *Fuller 48* (BOL!).

Dwarf clump-forming succulents with strongly enlarged, caudiciform rootstocks and internodes completely hidden by leaf bases. *Leaves* glaucous green, semiterete to terete, (13–) 15–28 mm long, 2–4 mm in diameter, narrowing towards apices, these often reddish. *Pedicels* \pm 12 mm long and 1 mm in diameter, with a pair of small bracts, these up to 4,5 mm long and 1 mm thick, otherwise similar to leaves. *Flowers* 25–30 mm in diameter when open. *Sepals* 5, outer pair up to 7 mm long and 3,5 mm wide at base, inner 3 up to 6 mm long and 4 mm wide at base. *Petals* pink to white, \pm 40 in 1–2 series, 12–18 mm long and up to 2 mm wide. *Staminodes* few, sharply distinct from petals, 3,5–6 mm long, white with pink apices. *Stamens* \pm 30; filaments 1–4 mm long. *Stigmas* subulate, 3,5–4 mm long, slightly longer than stamens. *Capsule* turbinate, grey, 5,5 \times 7 mm; covering membranes covering almost all of interior; valve wings absent; placental tubercles small, radial diameter \pm 0,8 mm; expanding keels slightly diverging, conspicuously fringed. *Seeds* whitish, 0,69–0,82 \times 0,52–0,63 \times 0,41–0,53 mm, micropylar region (0,23–) 0,25–0,33 mm long; baculae distinct, almost flat; microbaculae small.

Voucher specimens:

SWA/NAMIBIA. — 2616 (Aus): Aus (–CB), *Erni 235* (BOL).

CAPE. — 2817 (Vioolsdrift): Vioolsdrift (–DC), *Pillans 6603* (BOL), 2819 (Ariamsvlei): Pella (–CC), *Fuller 48* (BOL), 2820 (Kakamas): Kakamas (–DC), *Fuller 24* (K), 2919 (Pofadder): Pofadder (–AB), *G. van Zijl s.n.* (BOL).

Ebracteola fulleri is widely distributed in the lower Orange River Valley and along the edge of the Na-

mib Desert. Its distribution range extends from Aus through Vioolsdrift to Kakamas (see Figure 12).

The leaves of this species are semiterete to terete, distinguishing it from *E. montis-moltkei* and some forms of *E. wilmaniae*. The presence of small bracts distinguishes the present species from *E. derenbergiana*, in which bracts are absent, and from *E. candida* and semiterete-leaved forms of *E. wilmaniae*, both of which species have large, almost leaf-like bracts. Its distribution range also distinguishes this species from all other members of the genus.

3.3 *Ebracteola candida* L. Bol. in Journal of South African Botany 27: 50 (1961a); Friedrich: 45 (1970); Jacobsen: 472 (1974). Type: SWA/Namibia, 60 miles south of Aus, March 1960, *H. Hall 2006*=NBG 308/60 (BOL!).

E. vallis-pacis Dinter: 114 (1935), nom. nud.; Dinter ex Range: 255 (1938), nom. nud.

Dwarf clump-forming succulents with enlarged, caudiciform rootstocks and internodes completely hidden by leaves. *Leaves* glaucous-green, semiterete to obscurely triquetrous, 33–42 (–47.5) mm long, 4–6 (–7) mm wide and 5–8 (–9) mm thick. *Flowers* often ternate, otherwise solitary. *Pedicels* ± 12.5 × 1.5 mm, with a pair of leaf-like bracts up to 22.5 mm long and 4 mm thick. *Flowers* ± 25 mm in diameter when open. *Sepals* 5, outer pair up to 10 × 5 mm, inner 3 up to 8 × 4 mm. *Petals* white, ± 50, 12–19 × up to 2 mm. *Staminodes* many, white, 3.5–7 mm long. *Stamens* many; filaments 2–5.5 mm long. *Stigmas* subulate, 3–4.5 mm long, roughly equal in length to stamens. *Capsule* not seen. *Seeds* whitish, 0.80–0.97 × 0.63–0.71 × 0.55–0.67 mm, micropylar region 0.31–0.41 mm long; baculae low but distinct; microbaculae small to moderate in size.

Voucher specimens:

SWA/NAMIBIA. — 2615 (Lüderitz): Halenberg (–CB), *Merxmüller & Giess 3464* (M). 2616 (Aus): !Aus (–CB), *Schinz 2059* (Z). 2716 (Witputz): 60 miles south of Aus (–BC), *H. Hall 2006* = NBG 308/60 (BOL).

Plants of this species with ternate flowers are distinguished from all other species in the genus by this character. The presence of bracts on the pedicel distinguishes this species from *E. derenbergiana* and *E. montis-moltkei*; the much greater size of the bracts distinguishes this species from *E. fulleri*. The relatively broader, slightly laterally compressed leaves and the distribution range (Figure 28) distinguish *E. candida* from *E. wilmaniae*.

3.4 *Ebracteola derenbergiana* (Dinter) Dinter & Schwant. in Zeitschrift für Sukkulantenkunde 3: 24 (1927); Friedrich: 46 (1970).

Mesembryanthemum derenbergianum Dinter: 137 (1927). *Berg-eranthus derenbergianus* (Dinter) Schwant.: 180 (1926). *Ruschia derenbergiana* (Dinter) L. Bol. in Jacobsen 3: 1631 (1955), nom. invalid. *R. derenbergiana* (Dinter) C. Weber: 11 (1968); Jacobsen: 550 (1974). Lectotype: SWA/Namibia, Jakkalskuppe, 1 November 1922, *Dinter 3645* (B, holo.!, SAM, iso.!).

M. derenbergianum Dinter var. *interioris* Dinter: 105 (1928), nom. nud.

Dwarf clump-forming succulents with strongly enlarged, caudiciform rootstocks and internodes completely hidden by leaf bases. *Leaves* glaucous green, semiterete to terete, 10–39 (–48) × 2.5–7 mm, nar-

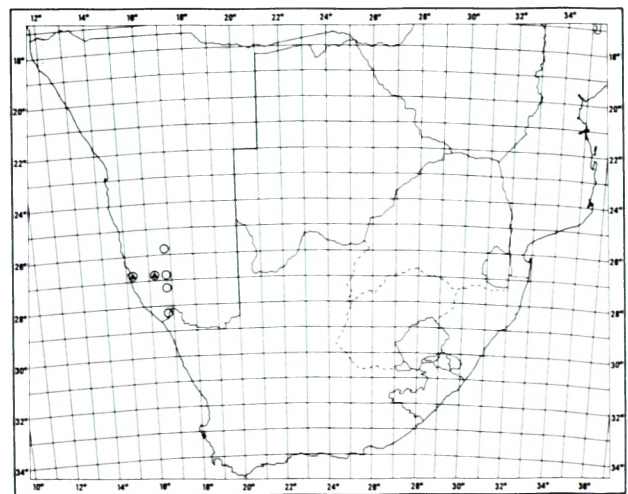


FIGURE 28. — Distribution of *Ebracteola candida*, ▲; and *E. derenbergiana*, ○.

rowing towards apices, these often reddish. *Pedicels* ± 10 × 2 mm, without bracts. *Flowers* ± 20 mm in diameter when open. *Sepals* 5, outer pair up to 9.5 × 4.5 mm, inner 3 up to 7.5 × 4 mm. *Petals* magenta, 50–60 in 1–2 series, 10–15 × up to 1.5 mm. *Staminodes* present, sharply distinct from petals, (4–) 5–7 mm long, white with pink apices. *Stamens* many; filaments 2.5–5.5 mm long. *Stigmas* subulate, 2–3 mm long, shorter than stamens. *Capsule* turbinate, grey, 6 × 8 mm; covering membranes covering most of interior; valve wings present, awn-like; placental tubercles large, radial diameter ± 1.2 mm; expanding keels slightly diverging, unadorned. *Seeds* yellowish brown, 0.60–0.89 × 0.48–0.68 × 0.33–0.53 mm, micropylar region (0.17–) 0.21–0.31 mm long; baculae distinct, almost flat; microbaculae small.

Voucher specimens:

SWA/NAMIBIA. — 2516 (Helmeringhausen): Helmeringhausen (–DC), *Merxmüller & Giess 3453* (M). 2615 (Lüderitz): Halenberg (–CB), *Dinter 2638* (B, SAM). 2616 (Aus): Plateau (–CB) *H. Hall s.n. in NBG 140/60* (BOL). 2716 (Witputz): Pockenbank (–BA), *Dinter 6221* (B, SAM). 2816 (Oranjemund): Schalksberge (–BA), *Giess 9115* (WIND).

Friedrich (1970) cites only one of the Dinter specimens in full, merely noting that four other specimens from different localities were cited in the protologue. This may be regarded as being equivalent to the choice of a lectotype, and to the extent that it is, the choice is followed here. The Berlin sheet is cited as holo-lectotype, as it was annotated by Friedrich, while the SAM sheet was not so annotated.

The semiterete to terete, rather than sharply triquetrous leaves distinguish this species from *E. montis-moltkei*. Other useful characters include the much thicker pedicels, narrower petals of generally deeper magenta colour, staminodes which do not merge into petals, and conspicuous placental tubercles in the capsules. The absence of bracts and different distribution range (Figure 28) distinguish this species from *E. fulleri* and *E. wilmaniae*. Differences between *E. derenbergiana* and *E. candida* are discussed under the latter species.

3.5 *Ebracteola montis-moltkei* (Dinter) Dinter & Schwant. in Zeitschrift für Sukkulantenkunde 3: 24 (1927); Friedrich: 46 (1970); Jacobsen: 472 (1974).

Mesembryanthemum montis-moltkei Dinter: 113 (1922). Syn-types: SWA/Namibia, östlicher Gipfel der Auasberge, 1899, *Dinter 1297* (M. holo-syn.!: SAM, iso-syn.!). SWA/Namibia, Moltkeblick, no date, *Dinter 1565*; Moltkeblick und Kempinskyberg, 5 May 1922, *Dinter 3509* (B. holo-syn.!: SAM, iso-syn.!).

M. renniei L. Bol.: 24 (1927). *Ruschia renniei* (L. Bol.) Schwant. ex Jacobsen: 58 (1949). Type: SWA/Namibia, Moltkeblick, August – September 1925, *Rennie s.n. in NBG 728/25* (BOL, holo.!: K, iso.!).

Dwarf clump-forming succulents with strongly enlarged, caudiciform rootstocks and internodes completely hidden by leaf bases. Leaves glaucous green, sharply triquetrous, 12–41 mm long, 2–7 (–9) mm thick, often somewhat thicker than wide, narrowing towards apices, these often reddish. Pedicels $\pm 7.5 \times 1.3$ mm, without bracts. Flowers 15–30 mm in diameter when open. Sepals 5, the outer pair up to 11×5 mm, inner 3 up to 9×4 mm. Petals magenta to white, 25–60 in 1–2 series, (6–) 8–14 \times up to 2 mm. Staminodes many, merging into petals, 2.5–7.5 mm long, white with pink apices. Stamens 35–75; filaments 2–4 (–6) mm long. Stigmas subulate, 2–4 mm long, shorter or longer than stamens. Capsule turbinate, grey, $5 \times \pm 7$ mm; covering membranes covering most of interior; valve wings present, awn-like to wing-like; placental tubercles absent or small, radial diameter ± 0.8 mm; expanding keels slightly to moderately diverging, fringed. Seeds whitish to maroon, $0.48\text{--}0.60$ (–0.84) \times $0.35\text{--}0.47 \times 0.45\text{--}0.51$ (–0.60) mm, micropylar region (0.14–) 0.19–0.31 mm long; baculae distinct, almost flat; microbaculae large.

Voucher specimens:

SWA/NAMIBIA. — 2217 (Windhoek): Ruschberg (–CA), *Dinter 2641* (B), *Dinter 4375* (HBG); Moltkeblick (–CB), *Dinter 3509* (B, SAM); *Giess 11511* (WIND). 2317 (Nauchas): Klein Aub (–DC), *Giess 8793* (WIND).

Again, the Dinter specimens cited as holo-syn-types above are those annotated by Friedrich.

The absence of bracts in this species and widely separated distribution ranges separate *E. montis-moltkei* on the one hand from *E. fulleri* and *E. wilmaniae* on the other. The sharply triquetrous leaves provide another useful character distinguishing this species from *E. fulleri*, while the staminodes merging into petals serve to distinguish *E. montis-moltkei* from *E. wilmaniae*. Differences between this species and others of the genus not mentioned above are discussed under those species. The distribution of this species is shown in Figure 13.

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