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PLATE 1.—*Sarcocaulon ciliatum* Moffett.



# The genus *Sarcocaulon*\*

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## ABSTRACT

A revision of *Sarcocaulon* (Geraniaceae) is presented in which 14 species are recognized. Descriptions, illustrations, distribution data and two keys to the species are provided. The following new names are published: *S. salmoniflorum* Moffett (nom. nov. for *S. l'heritieri* DC. var. *brevimucronatum* Schinz), *S. camdeboense* Moffett, *S. ciliatum* Moffett and *S. peniculinum* Moffett. Because the iconotype of *S. spinosum* (Burm.f.) Kuntze and *S. burmannii* (DC.) Sweet depicts discordant elements, which cannot be equated to any known taxa of *Sarcocaulon*, these species are treated as *species incertae*.

## RÉSUMÉ

### LE GENRE SARCOCAULON

On présente une révision du genre *Sarcocaulon* (Geraniaceae) dans lequel 14 espèces sont reconnues. Des descriptions, des illustrations, des données de distribution et deux clés pour l'identification des espèces sont fournies. Les nouveaux noms suivants sont publiés *S. salmoniflorum* Moffett (nom. nov. pour *S. l'heritieri* DC. var. *brevimucronatum* Schinz), *S. camdeboense* Moffett, *S. ciliatum* Moffett et *S. peniculinum* Moffett. Du fait que l'iconotype de *S. spinosum* (Burm. f.) Kuntze et de *S. burmannii* (DC.) Sweet représente des éléments discordants qu'on ne peut identifier à aucun des taxa connus de *Sarcocaulon*, ces espèces sont traitées comme *species incertae*.

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## INTRODUCTION

Some of the most interesting and beautiful plants in Southern Africa are found in the arid regions. Among these are the so-called "bushman candles" belonging to the genus *Sarcocaulon* of the Geraniaceae. These strange plants attracted the attention of early travellers and Paterson (1789; 1790) figured a number of species in his works.

The flowers of *Sarcocaulon*, which Bolus (1932) described as having a frail beauty, even more delicate-looking than those of *Monsonia*, are particularly striking when contrasted with the fleshy, spiny shrublets in their harsh, desert surroundings. The most remarkable feature of the plants, however, is that the stems and branches are covered with a fairly hard, translucent bark which is inflammable due to being impregnated with wax (Schulze, 1906).

## Taxonomic history of *Sarcocaulon*

In this account of the taxonomic history of *Sarcocaulon* the names of taxa and authors are cited as originally used. The earliest record of this genus is the engraving and description in Burman (1738), entitled "*Geranium spinosum & nodosum*..." etc. Burman *filii* in 1759 based his description of *Geranium spinosum* on this figure, which thus became the iconotype for that species. An almost identical figure may be seen in Cavanilles (1787). In Cavanilles's figure, which is patently a copy of Burman's figure, the stem and branches are slightly exaggerated and appear tuberculate.

A second species was published in 1792 by L'Héritier who, recognizing that it was closer to *Monsonia* L. than *Geranium* L., named it *Monsonia spinosa*. Although *Monsonia* L. had been published in 1767, Thunberg (1823) retained the name *Geranium* for the species. In 1789 Paterson published an excellent colour plate of a species from the mouth of the Orange River. This plate bears the name *Geranium spinosum*.

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De Candolle (1824), realizing that this genus was different from other groups in *Monsonia*, divided the latter genus into sections, introducing the name *Sarcocaulon* for his first section. In this section, De Candolle published two new names, *M. burmannii* DC. and *M. l'heritieri* DC., based on Burman's and L'Héritier's figures respectively, and one new species, *M. patersonii* DC., based on Paterson's figure.

Sweet was the first to raise *Sarcocaulon* to generic level, publishing *S. l'heritieri* DC. and *S. burmannii* DC. in 1826. *M. patersonii* DC. was omitted by Sweet, but in the same year Sprengel cited it as a synonym of *Pelargonium spinosum* Willd. Don (1831) listed both Sweet's two species and reinstated *S. patersonii* DC.

Ecklon and Zeyher in 1835 listed the same three species as in Don (1831), *S. l'heritieri* DC., *S. patersonii* DC., and *S. burmannii* DC. Their publication was the first to give localities for the species. In 1843 Meyer published *Monsonia multifida* without description (Drège, 1843).

Harvey (1860) provided the first reasonably detailed information about the species. He recognized the same three species listed by Ecklon and Zeyher and provided a description, literature references and detailed localities and collectors.

The fourth species to be described was collected by Welwitsch near Mossamedes in Angola. Oliver (1868) preferred to name it *Monsonia mossamedensis* Welw. mss. In 1888, Schinz described *S. rigidum* Schinz and in 1889, Engler published *S. marlothii* Engl., both these two species being from South West Africa. Hiern (1896) transferred *M. mossamedensis* Welw. ex Oliver to *Sarcocaulon*. A seventh species, which was published in error by Heckel in 1908 as *S. currali* Heckel, actually represented a species of *Kalanchoe* Adans.

In his monograph of the Geraniaceae, Knuth (1912) described *S. multifidum* (E. Mey.) R. Knuth and treated *S. marlothii* Engl., as a synonym of *S. mossamedense* (Welw.) Hiern. In this "magnum opus", Knuth recognized the following species:

- S. multifidum* (E. Mey.) R. Knuth
- S. mossamedense* (Welw.) Hiern
- S. burmannii* (DC.) Sweet
- S. patersonii* (DC.) "Eckl. & Zeyh."
- S. rigidum* Schinz
- S. l'heritieri* Sweet

Bolus (1930) returned *S. multifidum* Knuth to *Monsonia*.

Although a number of collections by Pearson and Dinter in particular, was made in the southern part of South West Africa towards the beginning of this century, no new species were described until 1932, when Bolus published *S. herrei* L. Bol., and *S. vanderietiae* L. Bol. A further name, *S. ernii* Dinter ex Range, was published in 1934 without description (Range, 1934).

Among the many plants in the Botanical Garden at Göttingen, which had been collected by Wettstein and son in 1929 in Southern Africa, was a number of *Sarcocaulon* species. The Wettstein collection, together with specimens from certain European herbaria, provided the material for the revision of *Sarcocaulon* by Rehm (1935). The 17 taxa recognized by Rehm included three new species and a number of infraspecific taxa. The genus, according to Rehm (1935), comprised:

- S. multifidum* R. Knuth
- S. herrei* L. Bolus
- S. mossamedense* (Welw.) Hiern

- S. inerme* Rehm
- S. crassicaule* Rehm
- S. flavescens* Rehm
- S. spinosum* (Burm.) O. Ktze. emend. Rehm
- S. spinosum* (Burm.) O. Ktze. emend. Rehm var. *hirsutum* Rehm
- S. l'heritieri* Sweet
- S. burmannii* Sweet emend. Rehm
- S. rigidum* Schinz subsp. *typicum* Rehm
- S. rigidum* Schinz subsp. *glabrum* Rehm
- S. rigidum* Schinz subsp. *glabrum* Rehm forma *parviflora* Rehm
- S. vanderietiae* L. Bolus
- S. patersonii* (DC.) "Eckl. & Zeyh." subsp. *typicum* Rehm
- S. patersonii* (DC.) "Eckl. & Zeyh." subsp. *badium* Rehm
- S. patersonii* (DC.) "Eckl. & Zeyh." subsp. *curvatum* Rehm.

Merxmüller and Schreiber (1966) treated *S. flavescens* Rehm as a synonym of *S. spinosum* (Burm. fil.) O. Kuntze and also did not recognize any of Rehm's infraspecific taxa. According to Merxmüller and Schreiber (1966) the following species occur in South West Africa:

- S. herrei* L. Bolus
- S. inerme* Rehm
- S. mossamedense* (Welw. ex Oliver) Hiern
- S. multifidum* Knuth
- S. patersonii* (DC.) "Ecklon & Zeyher"
- S. rigidum* Schinz
- S. spinosum* (Burm. fil.) O. Kuntze

Although obviously not intending it to be a new species, Stiles (1972) described *S. herrei* L. Bol. in error as *S. lorrei*.

In 1976, Schreiber and Merxmüller, on further evidence, separated *S. marlothii* Engl. from *S. mossamedense* (Welw. ex Oliver) Hiern, thus supporting Engler who, in 1915, accused Knuth of "falsely" including *S. marlothii* in *S. mossamedense*.

#### *Aim, material and method*

This revision of *Sarcocaulon* formed part of the revision of the Geraniaceae of Southern Africa, a project undertaken by the Department of Botany at the University of Stellenbosch.

One of the major problems faced in this revision was that herbarium specimens were generally poor and incomplete. This was because of the spiny, succulent nature of the plants and also because they are leafless for most of the year. The poor specimens, together with the fact that three species are typified by figures only, has made it very difficult for taxonomists to apply the names of the different taxa correctly. The compilation of suitable keys to the species was therefore one of the most important tasks of the revision.

The material used in this revision comprised herbarium material, plants in their natural habitats and plants grown in botanical gardens. A valuable source of information was the private herbarium of Mr H. Erni of Aus, South West Africa (cited as ERNI).

All the species were studied in their natural habitats. The collection of complete material for each species, necessitated field trips during February, March, April, June, September, November and December of 1975, June and October of 1976, and March and September of 1977.

Plants of each species were collected and planted in the Botanical Garden of the University of Stellenbosch (SUG) for further study. The collections of Mr R. Rawe at Kommetjie, Cape Province, (HORT. RAWE) and of the Karoo Garden of the National Botanic Gardens of South Africa at Worcester, Cape Province, were also studied.



Although this revision followed basically the method proposed by Leenhouts (1968), the need for a detailed study of living plants *in situ* and cultivated, resulted in a broader approach.

As knowledge of the behaviour of the plants in the field and in the botanical garden progressed, it became apparent that certain characters were ecologically more stable than others. These characters, which are considered to be of taxonomic value, are the following:

1. Leaf type: segmented or unsegmented
2. Leaf margin: outline
3. Petiole: persisting as a spine or short stump
4. Spine: structure
5. Branch: thickness
6. Petal: colour
7. Leaf shape: basic outline
8. Sepal mucro: length
9. Mericarp base: length
10. Stipules: persistent or caducous
11. Roots: swollen or not swollen
12. Vesture: types and number of trichomes
13. Habit

In order to produce a workable and useful classification of the genus in a reasonable amount of time, the approach was one of designating taxonomic species as defined by Briggs and Walters (1969) and Grant (1971). The taxa were separated by making use of discontinuous variation in the thirteen ecologically stable characters. These characters are considered to be probably genetically distinct and discontinuous variation between at least three of any of them was the criterion required for the recognition of the level of species.

Because the number of discontinuous characters between the individual species varied from 3–11, a more natural grouping was obtained by arranging the 14 species in four sections, each section having the nature of the leaf margin as its basic identifying character.

Information about early collectors and authors was taken from Stafleu (1967) and Stafleu & Cowan (1976). Descriptive terminology was based on the glossaries in Lawrence (1951) and Exell & Wild (1960), and colour descriptions were according to the colour chart of the Royal Horticultural Society of London. The word "Code" as used in the text, refers to the International Code of Botanical Nomenclature (1972).

Geographic distribution was cited according to the grid reference method of Leistner & Morris (1976). Only those specimens actually seen were cited. Unpublished records obtained from Mr J. P. H. Acocks of Middelburg, Cape Province were, however, used to fill gaps in the distribution maps of the two most widespread species.

"Veld types" when used in the text refers to veld types in Acocks (1975). "Vegetation types" when used in the text refers to vegetation types in Giess (1971). Unless otherwise stated, "Botanical Garden" in the text, refers to the Botanical Garden of the University of Stellenbosch.

### SARCOCAULON

*Sarcocaulon* (DC.) Sweet, Hort. Brit. ed. 1:73 (1826); G. Don, Gen. Syst. 1:715 (1831); Eckl. & Zeyh., Enum. 1:57 (1835); Harv. in Fl. Cap. 1:256 (1860); Engl. in Bot. Jb. 10:31 (1889); Reiche in

Pflanzenfam. 3, 4:9 (1897); Knuth in Pflanzenr. 4, 129:311 (1912); Dinter in Reprim. nov. Spec. Regni. veg. Beih. 23:228 (1926); Knuth in Pflanzenfam. 2, 19a: 58 (1931); L. Bol. in S. Afr. Gdng Country Life 22:109 (1932); Range in Reprim. nov. Spec. Regni. veg. 36:244 (1934); Rehm in Bot. Jb. 67:264 (1935); Merxm. & A. Schreib. Prod. Fl. S. W. Afr. 64:13 (1966). Type species: *S. l'heritieri* Sweet.

*Monsonia* L., sect. *Sarcocaulon* DC., Prodr. 1:638 (1824).

*Geranium* sensu auct. mult. pro parte: Burm.f. in Spec. Bot. de Geran. :16 (1759); L., Mant. :98 (1767); Burm.f., Prodr. Fl. Cap. :20 (1768); Murr., Syst. Veg. :618 (1784); Cav., Diss. 4:195 (1787); Lam., Encycl. 2:651 (1788); Thunb., Prodr. 1:112 (1794); Pers., Syst. Veg. :656 (1797); Willd., Sp. Pl. 13,1:696 (1800); Thunb., Fl. Cap. 2:509 (1823).

*Monsonia* sensu ex auctt. pro parte: L'Hérit., Geran. t.42 (1792); Poir. in Lam., Encycl. 4:270 (1797); Willd., Sp. Pl. 3,1:719 (1800); Ait. f., Hort. Kew. ed. 2,4:192 (1812); Spreng., Syst. Veg. 3:83 (1826).

Monoecious perennial, rigid, fleshy, short-stemmed shrublets, decumbent or semi-erect; roots swollen or not swollen; branches covered with a hard, waxy, translucent bark with or without persistent spiny petioles. *Leaves* dimorphic—long and short petioled, stipulate, stipules semi-persistent or caducous; long petioles occurring singly and remaining as blunt or sharp spines; short petioles occurring singly or in tufts in the axils of the spines; blades generally somewhat folded together, simple, green or glaucous, hairy or glabrous, cuneate, obcordate, elliptic, obovate or orbicular, entire, toothed, lobed or segmented, deciduous. *Flowers* regular, bisexual, hypogynous, pedunculate, solitary, axillary; bracts 2, opposite, subulate, ciliate, caducous. *Sepals* 5, free, imbricate, oblong-elliptic, naviculate, glabrous or vestured, margins membranous, mucronate or mucronulate. *Petals* 5, free, slightly ruffled, sessile, obovate to subtruncate at apex, apical margin undulate to erose, glabrous, sparsely pilose or ciliate; base clawed, hairy. *Stamens* 15, all perfect, monadelphous in 5 groups of 1 long and 2 short filaments each, fused at the base, filaments sericeous towards the base and tapering towards the apex, base of long filament slightly swollen and glandlike; anthers 2-thecate, linear, extrorse, centrifixed. *Ovary* superior, 5 carpellate, rostrate, narrowly obovate, sericeous, with 2 ovules in each chamber; style glabrous or tomentose; stigmas 5, subterete, obtuse. *Fruit* schizocarp of 5 one seeded mericarps; mericarp base scaberulous, oblanceolate, sharp pointed; tail thin, hygroscopic, villous. *Seed* oblong, terete, exalbuminous.

### Diagnostic features

Rigid, fleshy, short-stemmed shrublets covered with a hard, waxy bark. *Leaves* dimorphic—long and short petioled; petioles persisting as long spines or short blunt stalks; stipules persistent, semi-persistent or caducous. *Flowers* regular, solitary; bracts 2; sepals mucronate; stamens 15, 10 shorter filaments  $\frac{3}{4}$  length of 5 longer filaments. *Fruit* schizocarp, base of mericarp 7–14 mm long.

### Distribution

*Sarcocaulon* is confined to Southern Africa, where the 14 species are widely distributed over the more arid areas from the Fish River valley near Grahamstown



in the east to just north of Mossamedes in Angola. The folded mountains of the Cape form the southern boundary, while in the interior plants occur as far as Lückhoff in the southern Orange Free State and the Kalahari Gemsbok National Park.

#### Habitat

Usually found in cracks and sandy places among rocks in dry localities. Also occasionally found on hard, compacted sandy plains. Substrates vary and include quartz, tillite and dolerite ridges, shaly flats, granite hills, dark igneous and metamorphic rocks as well as wind-polished limestone in the Namib Desert. This genus occurs over a wide range of altitude, varying from sea-level to between 1 200 and 1 800 m above sea level. FIGS 5-7.

#### Ecology

*Sarcocaulon* species are nearly always found growing in the open, where vegetation cover is sparse. The plants always occur singly and no plant collected in this study has been found touching another or under the canopy of another similar species.

The plants are leafless for most of the year and only produce leaves after sufficient rain or fog. Leafless plants often flower and plants have been recorded as living for up to 11 years unplanted after removal from the ground (Werdermann, 1932). Water loss is most probably prevented by the impervious waxy bark. It has been observed in the field that in hot and dry conditions the leaf-blades fold together in some species, protecting the glabrous upper surface.

#### General note

The genus is divided into the following four sections: *Sarcocaulon*, *Crenatum* Moffett, *Denticulatum* Moffett and *Multifidum* Moffett. This division is based primarily on the nature of the leaf margin, a feature considered to be ecologically stable in the genus. The resulting grouping appears to be natural and further similarities within the groups are the glabrous leaves in section *Sarcocaulon*, the puberulous leaves and yellow flowers in section *Crenatum*, the undulate leaves and pink to purple flowers in section *Denticulatum* and the hairy leaves in section *Multifidum*.

### KEY TO THE SECTIONS AND SPECIES BASED ON MINIMUM GROSS MORPHOLOGY

To be used for herbarium material and plants as usually found in the field, i.e. without fresh leaves or flowers. Dried leaves can, however, generally be found on the ground at the base of the plant. In this and the following key, branch thickness refers to the mid-diameter of branches two seasons old, and the R.H.S. colour chart numbers for colours referred to are: cadmium lemon to pyrethrum—3B; primrose yellow—4C; pale mimosa—6D, 8D, 11D; sulphur—6C; salmon to carrot—29B, 29C; pale pink—55D; rose—55A, 55B; white suffused pink—158D, 36D; magenta—57C; pale magenta—57D, 66C; purple—68B, 76A.

- Leaf blade without lateral incisions or indentations. . . . . Section *Sarcocaulon*
- Branches rarely exceeding 10 mm thick, pliable; bark wrinkled in dried specimens; spines thin, mid-diameter about 1 mm:
- Branches generally between 5 and 10 mm thick; spines straight, base adnate-obovate to obovate; petals almost as broad as long:
- Bark pale, greyed yellow; spines generally exceeding 25 mm in length, base obovate; sepal mucro exceeding 2 mm in length. . . . . 1. *S. Pheritieri*
- Bark dark, greyed olive; spines rarely exceeding 25 mm in length, base obovate; sepal mucro less than 1 mm in length:
- Shrublet semi-erect to erect; leaves narrow elliptic to narrow obovate; petals pale mimosa. . . . . 4. *S. camdeboense*
- Shrublet low spreading; leaves broadly elliptic to broadly obovate; petals pale pink to white flushed with pink. . . . . 5. *S. vanderietiae*
- Branches rarely exceeding 4 mm thick; spines straight or curved, base decurrent; petals twice as long as broad. . . . . 3. *S. salmoniflorum*
- Branches generally exceeding 10 mm thick, rigid; bark not wrinkled in dried specimens, forming a hard, glossy shell; spines thick, mid-diameter about 2 mm. . . . . 2. *S. patersonii*
- Leaf blade with lateral incisions or indentations:
- Leaf unsegmented:
- Leaf margin lobed or coarsely toothed, irregularly crenate or dentate. . . . . Section *Crenatum*
- Branches generally exceeding 10 mm thick; spines thick (mid-diameter about 2 mm); petals generally exceeding 20 mm in length; sepals glabrous, puberulous or pilose. . . . . 6. *S. crassicaule*
- Branches rarely exceeding 10 mm thick; spines thin (mid-diameter about 1 mm); petals rarely exceeding 20 mm in length; sepals glabrous:
- Petals apically ciliate; spines chestnut brown; leaf blade generally incised halfway to midrib, obovate to elliptic. . . . . 7. *S. ciliatum*
- Petals apically glabrous; spines greyed brown; leaf blade generally incised to less than halfway to midrib, obovate, elliptic or orbicular. . . . . 8. *S. flavescens*
- Leaf margin not lobed, minutely toothed, erose-denticulate, undulate. . . . . Section *Denticulatum*
- Branches with blunt spines exceeding 15 mm in length; stipules persistent and prominent; leaves glabrous below:
- Leaf blade smooth, base cordate; petiole reddish; sepal mucro rarely exceeding 2 mm in length; peduncle rarely exceeding 5 mm in length; erect shrublet, occasionally semi-erect. . . . . 9. *S. marlothii*
- Leaf blade somewhat wavy, base truncate to obtuse, petiole not reddish; sepal mucro generally exceeding 2 mm in length; peduncle generally exceeding 5 mm in length; low and spreading shrublet. . . . . 10. *S. mossamedense*
- Branches spineless or occasionally with blunt spines rarely exceeding 8 mm in length; stipules caducous or if persistent, not prominent; leaves hairy below. . . . . 11. *S. inerme*



- Leaf segmented.....Section *Multifidum*  
 Branches with spines exceeding 12 mm in length.....12. *S. herrei*  
 Branches spineless or occasionally with blunt spines rarely exceeding 6 mm in length:  
 Branches off ground, rarely exceeding 20 mm thick; blunt spines up to 6 mm long; roots swollen;  
 petals with dark throat marking.....13. *S. multifidum*  
 Branches on ground, generally exceeding 20 mm thick; blunt spines rarely exceeding 2 mm in length;  
 roots not swollen; petals without dark throat marking.....14. *S. peniculinum*

#### KEY TO THE SECTIONS AND SPECIES BASED ON MAXIMUM GROSS MORPHOLOGY

- Leaf blade without lateral incisions or indentations.....Section *Sarcocaulon*  
 Sepal mucro exceeding 2 mm in length; petals cadmium yellow to pyrethrum; mericarp base longer  
 than 13 mm.....1. *S. l'heritieri*  
 Sepal mucro rarely exceeding 2 mm in length; petals not cadmium lemon to pyrethrum; mericarp base  
 less than 13 mm long:  
 Branches generally exceeding 10 mm thick, rigid; spines thick (mid-diameter about 2 mm); petals  
 rose, pale magenta or purple.....2. *S. patersonii*  
 Branches rarely exceeding 10 mm thick, pliable; spines thin (mid-diameter about 1 mm), petals not  
 as above:  
 Petals narrow, generally twice as long as broad, salmon to carrot red; spines curved or straight,  
 base decurrent; branches rarely exceeding 4 mm thick.....3. *S. salmoniflorum*  
 Petals broad, generally only slightly longer than broad, colour not as above; spines straight, base  
 adnate, obovate to oblate; branches generally between 4 mm and 10 mm thick:  
 Petals pale mimosa; leaves narrow elliptic to narrow obovate; semi-erect to erect shrublet.....  
 4. *S. camdeboense*  
 Petals pale pink or white suffused pink; leaves broadly elliptic to broadly obovate; low spreading  
 shrublet.....5. *S. vanderietiae*
- Leaf blade with lateral incisions or indentations:  
 Leaf unsegmented:  
 Petals pale mimosa, sulphur or primrose yellow; leaf margin lobed or coarsely toothed, irregularly  
 pinnatifid, pinnatifid or dentate, not undulate.....Section *Crenatum*  
 Sepal mucro generally exceeding 2 mm in length; branches generally exceeding 10 mm thick; petals  
 generally exceeding 20 mm in length, pale mimosa to sulphur; sepals glabrous, puberulous or  
 pilose.....6. *S. crassicaule*  
 Sepal mucro rarely exceeding 1 mm in length, branches rarely exceeding 10 mm thick, petals rarely  
 exceeding 20 mm in length, primrose yellow; sepals glabrous:  
 Petals apically ciliate; spines chestnut brown; leaf blade generally incised halfway to midrib,  
 obovate to elliptic.....7. *S. ciliatum*  
 Petals apically not ciliate; spines greyed brown; leaf blade generally incised less than halfway to  
 midrib, obovate, elliptic or orbicular.....8. *S. flavescens*  
 Petals rose to purple; leaf margin not lobed; minutely toothed, erose-denticulate, undulate to sinuous  
 Section *Denticulatum*  
 Branches with blunt spines exceeding 15 mm in length; stipules persistent and prominent; leaf blade  
 glabrous below, margin undulate:  
 Leaf margin shallowly undulate, blade fairly smooth, base cordate; petiole reddish; sepal mucro  
 rarely exceeding 2 mm in length; petals rose to purple without pale throat; peduncle rarely  
 exceeding 5 mm in length; erect shrublet, thicker branches with rigid, fleshy shoots up to 50  
 mm long.....9. *S. marlothii*  
 Leaf margin markedly undulate, blade somewhat wavy, base truncate to obtuse; petiole not  
 reddish; sepal mucro generally exceeding 2 mm in length; petals rose with white throat;  
 peduncle generally exceeding 5 mm in length; low and spreading shrublet, thicker branches  
 without rigid erect shoots.....10. *S. mossamedense*  
 Branches spineless or occasionally with blunt spines rarely exceeding 6 mm in length; stipules  
 caducous or if persistent hidden in leaf bases, leaf blade hairy below; margin markedly undulate  
 to sinuous.....11. *S. inerme*
- Leaf segmented.....Section *Multifidum*  
 Branches with spines exceeding 12 mm in length; petals pale mimosa with scattered hairs on adaxial  
 surface.....12. *S. herrei*  
 Branches spineless or occasionally with blunt spines rarely exceeding 6 mm in length; petals not pale  
 mimosa, adaxial surface glabrous:  
 Petals white, pale pink or magenta with dark throat marking, rarely plain white; branches off ground  
 and rarely exceeding 20 mm thick; blunt spines up to 6 mm long; roots swollen...13. *S. multifidum*  
 Petals rose to pale pink without throat marking; branches usually on ground and generally exceeding  
 20 mm thick; blunt leaf bases rarely exceeding 2 mm in length; roots not swollen.....  
 14. *S. peniculinum*

#### Section *Sarcocaulon*

Type species: *S. l'heritieri* Sweet

Fleshy, spiny shrublets up to 0,75 m high and 0,6 m in diameter; roots swollen or not swollen; branches pale olive to grey and greyed yellow. *Leaves* long and short petioled, long petioles persisting as hardened spines, bases oblate or decurrent; blade glabrous and/or glaucous, without lateral incisions or indentations, orbicular, narrowly to broadly obovate, narrowly elliptic, apex emarginate to obcordate, often mucronate; stipules semi-persistent or caducous. *Sepals* glabrous or puberulous.

Five species, widely distributed in Southern Africa ranging from near Grahamstown in the east to the Brandberg in South West Africa, are recognized.

De Candolle (1824) was the first to use the taxon section in *Sarcocaulon*. He used it "*sensu lato*", however, including all the then known species in his section *Sarcocaulon* of *Monsonia* L., at the same time suggesting that it could be a genus.

1. *Sarcocaulon l'heritieri* Sweet, Hort. Brit. ed. 1:73 (1826); G. Don, Gen. Syst. 1:715 (1831) Harv. in Fl. Cap. 1:257 (1860), as "L'Heretieri."; Knuth in Pflanzenr. 4, 129:316 (1912); L. Bol. in S. Afr. Gdng



Country Life 22:109 (1932); Rehm in Bot. Jb. 67:266 (1935). Iconotype: L'Hérit., Geran. t. 42 (1792).

*Monsonia l'heritieri* DC., Prodr. 1:638 (1824); Spreng., Syst. Veg. ed. 16, 3:83 (1826); Steud., Nom. Bot. ed. 2,2:158 (1841); nom. superfl.

*M. spinosa* L'Hérit., Geran. t. 42 (1792); Poir. in Lam., Encycl. 4:270 (1797); Willd., Sp. Pl. 3,1:719 (1800); Ait.f. Hort. Kew. ed. 2,4:192 (1812).

*M. obcordata* E. Mey. in Drège, Zwei Pfl. Doc. 26:203 (1843) pro parte, nom. nud.

Fleshy, spiny, shrublet up to 0,75 m high and 0,6 m in diameter; stem branching repeatedly from 30–100 mm above ground level; roots not swollen; branches pale olive to grey, generally less than 10 mm thick, with rows of single, straight, long spines, very dark when young, and tufts of short stalks in the axils of the spines; bark often with longitudinal stretch marks. *Leaves* long and short petioled; stipules scale-like, caducous; blade entire, glaucous, glabrous. *Long petioled leaves* almost decussate; petioles persistent and hardened into straight, thin (mid-diameter c. 1 mm) spines (16–) 20–40 (–61) mm long with flattened oblate base 3–4 mm broad; blade broadly obovate to orbicular (4–) 7 (–10) mm long, (3–) 6 (–10) mm broad, apex emarginate to obcordate, base rounded. *Short petioled leaves* 2–4 in number in axils of spines; petioles persisting as blunt stalks up to 2 mm long after abscission of the blades; blade broadly obovate (7–) 11 (–15) mm long, (6–) 9 (–11) mm broad, apex emarginate to obcordate; base cuneate to rounded. *Flowers* when open up to 25 mm long (excluding pedicel), 35 mm broad; peduncle glabrous, 2–5 mm long; pedicel glabrous, (6–) 20 (–24) mm long. *Sepals* glaucous, glabrous, 9–14 mm long, 4–5 mm broad, mucro 2–4 mm long. *Petals* obovate, cadmium lemon or pyrethrum (R.H.S. No. 3B), (16–) 22 (–26) mm long, (10–) 17 (–18) mm broad. *Stamens* with long filaments 12–14 mm long, short filaments 9–10 mm long; basal 2–3 mm of filaments fused; anthers 3–4 mm long. *Ovary* sericeous, style glabrous, stigmas 2 mm long. *Mericarp* 70–110 mm long; base 13–15 mm long, tail 60–100 mm long. *Seed* 4 mm long. PLATE 2a; FIGS 1 & 2.

#### Diagnostic features

Erect shrublet; branches thin; bark pale, waxy, often with vertical stretch markings; spines dark brown to almost black, thin and perfectly straight. *Leaves* entire, glaucous, apex emarginate to obcordate. *Sepals* with a mucro longer than 2 mm. *Petals* slightly longer than broad, cadmium lemon to pyrethrum yellow. *Mericarp*: base longer than 13 mm.

Confined to Namaqualand in the Cape Province (FIG. 2), where it is scattered throughout a long, narrow area stretching from about 3 km south of the Olifants River between Lutzville and Papendorp, to Klipbokberg, about 3 km south of Eksteenfontein in the Richtersveld. The boundary in the east is where the Namaqua granites run into the plains of western Bushmanland and in the west where the mountains meet the coastal plain. Plants are occasionally found as far west as Wallekraal.

CAPE.—2817 (Vioolsdrift): Klipbokberg, Eksteenfontein (–CD), *Moffett 941* (STE; SUG); near Vioolsdrift (–DC), *Hall s.n.* (NBG). 2917 (Springbok): Klipfontein, Steinkopf (–BA), *Herre s.n.* (PRE); Klipfontein, Steinkopf (–BA), *Herre s.n.* (STE); near Steinkopf (–BA), *Verdoorn & Dyer 1820* (K; PRE); Anenous (–BA), *Tucker s.n.* (BOL); Kabinaskop, Steinkopf (–BB), *Moffett 925* (PRE; STE; SUG); Kabinaskop, Steinkopf (–BB), *Moffett 1122* (PRE; STE); Koringhuis (–DA), *Beukes s.n.* (STE); near O'Okiep, 910 m (–DB), *Bolus* in *BOL 6656* (BOL); 6 km W. of Springbok (–DB), *Compton 22053* (NBG); 11 km from O'Okiep (–DB), *Pole Evans 2362* (PRE);



FIG. 1.—Iconotype of *Sarcocaulon l'heritieri*. Geraniologia t.42(1792).

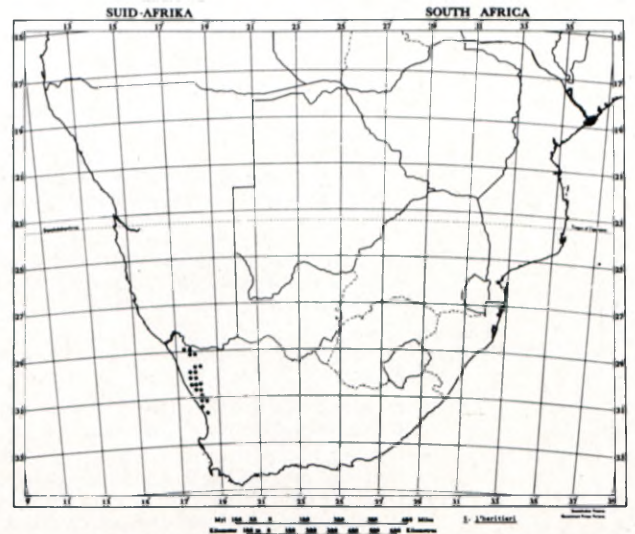


FIG. 2.—Geographic distribution of *Sarcocaulon l'heritieri* in Southern Africa.

Wild Flower Reserve (–DB), *Rösch & Le Roux 1127* (STE-U); Springbok (–DB), *Scully s.n.* (SAM); near Springbok (–DB), *Van Hille 1940* (BOL); Messelpad (–DC), *Compton 20671* (NBG); 3 km S. of Sannagas Farm (–DC), *Moffett 916* (PRE; STE); 1 km N. E. of Komaggas (–DC), *Moffett 920* (STE); 16 km S. of Springbok (–DD), *Lewis 2791* (SAM). 2918 (Gamoep): Copperberg (–CA), *Pillans 5684* (BOL; K). 3017 (Hondeklipbaai): Kilians Pass (–BA), *Moffett 909* (PRE; STE; SUG); 5 km E. of Kamieskroon, 1070 m (–BB), *Acocks 14993* (M; PRE); 6 km N. of Kamieskroon (–BB), *Moffett 630* (PRE; STE); Bowesdorp (–BB), *Moffett 1118* (NBG; STE); Kamieskroon (–BB), *Thorne s.n.* (SAM); 6 km N. of Kamieskroon (–BB), *Wisura 792* (NBG); 1 km from Wallekraal (–BC), *van der Walt s.n.* (STE-U); Brakdam (–BD), *Barker 1144*



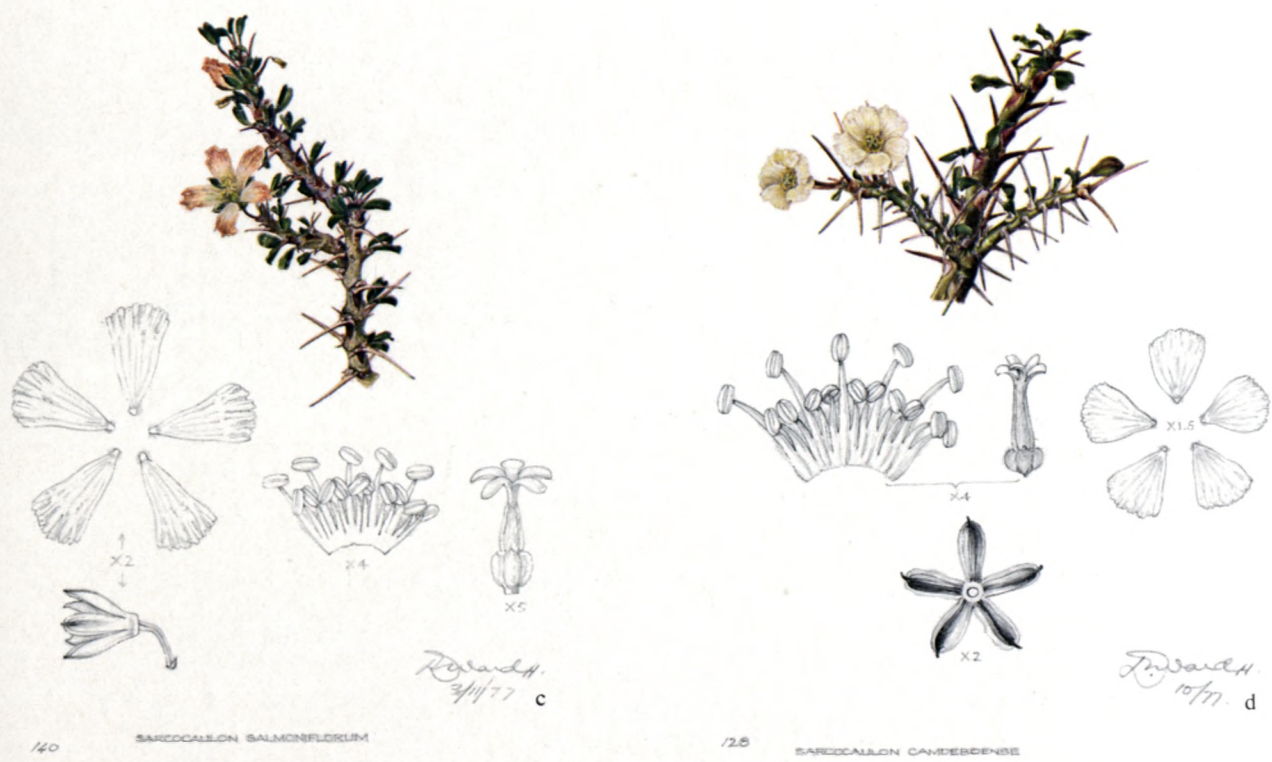


PLATE 2.—a, *Sarcocaulon lheritieri* Sweet; b, *Sarcocaulon patersonii*, (DC.) G. Don; c, *Sarcocaulon salmoniflorum* Moffett; d, *Sarcocaulon camdeboense* Moffett. Magnifications indicated do not apply.







(NBG); between Garies and Kamieskroon (-BD), *Lewis 4990* (SAM); Brakdam (-BD), *Martin 828* (NBG); 8 km N. of Garies (-DB), *Moffett 906* (STE). 3018 (Kamiesberg): Kamiesberg South, 1220 m (-AC), *Oliver 5966* (NBG; PRE; STE); Garies (-CA), 1915, *Caporn* in *NBG 853/15* (NBG); Doornkraal (-CA), *Thorns* in *NBG 7625* (NBG); between Bitterfontein and Garies (-CC), *Lewis* in *NBG 2061/32* (BOL). 3118 (Van Rhynsdorp): 14 km N.W. of Bitterfontein (-AA), *Moffett 905* (STE); 11 km S. or S.W. of Bitterfontein (-AA), *Pearson 3442* (BOL; K); near Nuwerus (-AB), *Marloth 8264* (PRE); Stuurman Farm, N. of Koekenaap (-AC), *Moffett 902* (PRE; STE; WIND); near Ebenezer (-CB), *Drège s.n.* (BM; G; K); between Papendorp and Lutzville (-CB), *Moffett 888* (PRE; STE); between Papendorp and Lutzville (-CB), *Moffett 901* (NBG; PRE; STE); between Driefontein and Heerenlogement (-CB), *Pearson 6844* (BOL; K). Without precise locality: Buffels River, *Compton 17261* (NBG); near Olifants River, *Ecklon & Zeyher 438* (G; GOET; K; M; W); Buffels River, *Leighton 1399* (BOL); Buffels Rivers kloof, *Lewis 1290* (SAM); between Hondeklip Bay and Zwartlinterivier, *Pillans* sub. *BOL 17955* (BOL); between Springbok and Kamieskroon, *Salter 1448* (BM). Without locality: *Drège s.n.* (G); *Ecklon & Zeyher 437* (GRA); *Herre 7703* (BOL); *Herre 7717* (BOL); *Leipoldt s.n.* (PRE); *Niven 13* (BM); *Scholl 606* (W); *Scully 65* (BM; BOL); *Von Wettstein s.2* (M); Without collector or locality: (G); (W).

Apart from the localities at the southern and northern extremities of its distribution range, this species is wholly confined to the granite hills of Namaqualand, where it is generally found growing in cracks between the rocks or at the base of the large granite domes. In the far south it is found in deep, red sand which is also partly derived from granite, while in the southern Richtersveld it is usually found growing amongst rocks along quartz veins, often in association with *S. herrei*. *S. l'heritieri* occurs mainly in Veld Type 33, but can also be found in Veld Type 31.

Like most other Namaqualand plants, this species displays a marked seasonality. Among all the species of *Sarcocaulon*, its phenology is the most predictable. For the greater part of the year, i.e. during the dry season from December to July, the plant is leafless. With the onset of the winter rains in May or June, leaf buds develop and by August the plant is in full leaf. Flowers are fully developed by late August–September and the fruit is dispersed in September–October. By November all the leaves have dried up. Late rains may extend the flowering period to October.

The earliest published record of this species is James Sowerby's illustration named *Monsonia spinosa* in L'Héritier's *Geraniologia* of 1792. As it is accompanied by a detailed analysis of the plant, the illustration satisfies Article 44 of the International Code of Botanical Nomenclature (1972), and the name *Monsonia spinosa* L'Hérit., is thus validly published. The specific epithet cannot, however, be taken up in *Sarcocaulon* as the combination *S. spinosum* (Burm. f.) Kuntze has already been made in 1893 for another species.

The name *Sarcocaulon l'heritieri* Sweet (1826) is accepted as the correct name of this species since, although *Monsonia l'heritieri* DC. is illegitimate, being a superfluous name for *M. spinosa* L'Hérit., the epithet *l'heritieri*, when used in *Sarcocaulon*, is treated as new (Article 72 of the Code) and the resulting combination is attributed to Sweet.

The earliest actual record of this species is a fine painting among the set of Paterson watercolours in the Oppenheimer Library in Johannesburg. Paterson could have painted this picture during August or September of 1778 when he first visited the Copper Mountains, or a year later on his way to the mouth of the Orange River (Paterson, 1789).

This species was introduced into cultivation at Kew in 1790 by Masson (Aiton f., 1812). Don (1831) mentioned that it flowers in May and June and that it is a shrub of two foot. His description of the plant is a direct translation of De Candolle (1824), except that Don has included the flower colour, albeit, incorrectly, which De Candolle did not describe. *S. l'heritieri* does not have purple flowers. Seed collected near Lutzville in November 1975 and sown in February 1976 in the Botanical Garden of the University of Stellenbosch, germinated within 5–7 days. Propagation by 10 cm-long branch cuttings has also been moderately successful.

Although this species cannot be confused with any other species, it has closest affinities to *S. patersonii* (DC.) G. Don. and *S. camdeboense* Moffett.

**Common name:** Known as "Ghoena" at Koringhuis near Springbok (information from herbarium specimen).

**2. *Sarcocaulon patersonii* (DC.) G. Don, Gen. Syst. 1:715 (1831); Iconotype: t. 14 in Paters. itin. 2:116 (1790).**

*Monsonia patersonii* DC., Prodr. 1:638 (1824).

*Geranium spinosum* sensu Paters. in Paters. itin. 2:116 t. 14 (1790).

*Sarcocaulon rigidum* Schinz in Verh. bot. Ver. Prov. Brandenb. 29:59 (1888); Knuth in Pflanzenr. 4, 129:314 (1912); Engl., Pflanzenw. Afr. 3, 1:707 (1915); Phill. in Flower. Pl. S. Afr. 1:t.40 (1921); Dinter in Reprium nov. Spec. Regni veg. Beih. 23:228 (1926), in Mschr. Kakteenk. 2, 7:145 (1930); Knuth in Pflanzenf. 2, 19a:58 (1931); Schmid in Mitt. bot. Mus. Univ. Zurich 141:36 (1932); Werderm. in Mschr. Kakteenk. 4, 2:34 (1932); Range in Reprium nov. Spec. Regni veg. 36:245 (1934); Rehm in Bot. Jb. 67:266 (1935); Merxm. & A. Schreib., Prodr. Fl. S. W. Afr. 64:16 (1966). Type: South West Africa, Lüderitz, *Schinz 256* (Z, lecto!).—subsp. *glabrum* Rehm in Bot. Jb. 67:266 (1935). Syntypes: South West Africa, Garub, *Pearson s.n.*? (B†?); Aus, *Wettstein s.n.* (M!); *Pearson 4176* (BOL, lecto!).—forma *parviflora* Rehm in Bot. Jb. 67:266 (1935). South West Africa, near Witpütz, *Erni s.n.* (B†?).

Fleshy, spiny, prostrate to semi-erect shrublet up to 0,5 m high and 0,5 m in diameter; stem branching 20–50 mm above ground; roots not swollen; branches generally exceeding 10 mm thick, covered with a thick, hard, waxy bark with rows of single, thick (mid-diameter c. 2 mm) spines and tufts of short stalks in the axils of the spines; bark pale grey to almost golden. *Leaves* long and short petioled; stipules scale-like, ciliate, caducous; blade laterally entire, glaucous, glabrous. *Long petioled leaves* almost decussate; petioles persistent and hardened into straight, sharply tapered spines (9–) 19 (–52) mm long with flattened, oblate base up to 5 mm broad; blade narrowly obovate to broadly obovate (10–) 12 (–14) mm long, 7–8 mm broad, apex emarginate to retuse, occasionally mucronulate, base attenuate to cuneate. *Short petioled leaves* 2–5 in number in axils of spines; petioles persisting as blunt stalks up to 3 mm long after abscission of the blades; blade narrowly obovate to broadly obovate (5–) 12 (–26) mm long, (4–) 8 (–16) mm broad, apex emarginate to retuse, rarely mucronulate. *Flowers* when open up to 25 mm long (excluding pedicel) and 32 mm broad; peduncle glabrous, sub-sessile; pedicel glabrous (5–) 17 (–32) mm long. *Sepals* puberulous to glabrous (7–) 10 (–14) mm long, 3–5 mm broad, mucro less than 1 mm long. *Petals* obovate, rose, pale magenta or purple (R.H.S. No's 55A to B, 57C or 76A), (15–) 21 (–32) mm long, (12–) 15 (–25) mm broad. Stamens with long filaments 9–11 mm long, short filaments 6–7 mm long; basal 2–3 mm of filaments fused; anthers 3–4 mm long. *Ovary* sericeous, style glabrous, stigmas



2 mm long. *Mericarps* 42–70 mm long; base 8–11 mm long, tail 35–60 mm long. *Seed* 3 mm long. PLATE 2b; FIGS 3 & 4.



FIG. 3.—Iconotype of *Sarcocaulon patersonii*. Paters. itin. 2:116, t.14(1790).

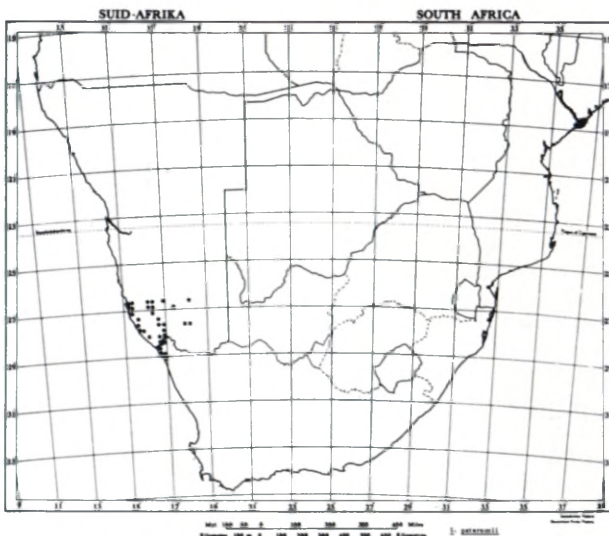


FIG. 4.—Geographic distribution of *Sarcocaulon patersonii* in Southern Africa.

#### Diagnostic features

Erect or prostrate, rigid shrublet; branches thick; bark extremely hard, pale; spines thick and straight. *Leaves* entire, glaucous; apex emarginate to retuse. *Sepals* with mucro less than 1 mm long. *Petals* slightly longer than broad, rose, pale magenta or purple. *Mericarps*: base 8–11 mm long.

This species is distributed over the extremely arid succulent desert between Port Nolloth and Lüderitz (FIG. 4). It has also been recorded from the southern inland plateau between Bethanie and Klein Karas. The southernmost record is from near the Holgat River about 30 km north of Port Nolloth, while the northern limit is the southern Namib dune-sea just to the north of the Lüderitz–Aus national road. Because of the area's inaccessibility, it is not known whether it occurs in the inland coastal area which appears as a blank on the distribution map. Judging by the adjoining areas, however, there appears to be no reason why this area should also not be well populated by this species.

S.W.A.—2615 (Lüderitz): Lüderitz (–CA), *Erni* 107 (ERNI; STE); Lüderitz peninsula (–CA), *Giess & van Vuuren* 719 (K; M; PRE; WIND); Lüderitz (–CA), *Hobart-Hampden s.n.* (BM); Lüderitz (–CA), *Littlewood s.n.* (NBG); Lüderitz (–CA), *Marloth 1150* (PRE); Lüderitz (–CA), *Marloth 8402* (PRE); Kolmanskop, 160 m (–CA), *Marloth s.n.* (PRE); Stürmvogelbucht (–CA), *Merxmüller 2242* (M); Halifax Bay (–CA), *Moffett 1186* (SUG); Halifax Bay (–CA), *Moffett 1387* (PRE; STE); between Lüderitz and Diaz Point (–CA), *Nordenstam 2242* (M); Lüderitz, 20 m (–CA), *Range 494* (SAM); Lüderitz (–CA), *Schinz 256* (Z); Lüderitz (–CA), *Volk 12832(a)* (M); Halenberg (–CB), *Dinter 6672* (M); Rotkop (–CB), *Erni 102* (ERNI; STE); Kavisberg Flats (–CB), *Moffett 1383* (STE); near Kolmanskop (–CB), *Moffett 1384* (STE); Rotkop station (–CB), *Moffett 1385* (SUG); Halenberg (–CB), *Herb. NBG 1803/27* (NBG); 10 km S. of Kolmanskop (–CC), *Moffett 1388* (STE); 20 km S. of Grasplatz (–CD), *Moffett 1389* (SUG). 2616 (Aus): Klein Aus (–CA), *Erni 559* (ERNI); Garub (–CA), *Pearson 4176* (BOL); Garub (–CA), *Range 517* (SAM); Augustfelde (–CB), *Erni 372* (ERNI); Aus, 1220 m (–CB), *Macdonald 242* (BM); Aus (–CB), *Merxmüller 2686* (M); Aus (–CB), *Von Wettstein s.n.* (M); Tsirub, 1400 m (–CC), *Range 1145* (SAM); Tsirub, 1200 m (–CC), *Range 1146* (SAM); between Aus and Kuchaus (–CC), *Schenck 141* (PRE; Z); 88 km N. of Witpütz (–CD), *Moffett 1175* (SUG); Kuibis (–DB), *Herb. NBG 1864/27* (BOL). 2617 (Bethanie): 12 km W. of Sandverhaar, 1070 m (–CD), *Pearson 4597* (BOL; BM). 2618 (Keetmanshoop): Gobas (–CA), *Herb. NBG 953/27* (BOL). 2715 (Bogenfels): Pomona (–AB), *Dinter 6402* (B; BOL; M; Z); 8 km E. of Prinzenbucht (–AB), *Moffett 1196* (SUG); 77 km S. of Grasplatz (–AD), *Moffett 1390* (SUG); Klinghardt mountains (–BC), *Moffett 1391* (SUG); flats S. of Klinghardt mountains (–BC), *Moffett 1392* (SUG); Buntfeldschüh (–DA), *Merxmüller 2458* (M); Buntfeldschüh (–DA), *Merxmüller 2466* (M; PRE); 2 km S. of Buntfeldschüh (–DA), *Moffett 1394* (SUG); 7 km S. of Buntfeldschüh (–DA), *Moffett 1395* (STE; WIND); 3 km E. of Chameis Bay (–DC), *Moffett 1396* (PRE; STE); Buchberg Flats (–DD), *Dinter 6587* (AMD; B; BM; G; GRA; M; SAM); 15 km S. of Chameis Gate (–DD), *Moffett 1397* (STE); Buchberg Flats (–DD), *Moffett 1399* (SUG). 2716 (Witpütz): Pockenbank (–AB), *Moffett 1344* (STE); 73 km S. of Aus (–BC), *Moffett 1142* (STE); Witpütz-South (–DA), *Merxmüller 2569* (M); 1 km E. of Witpütz (–DB), *Moffett 1362* (STE); 22 km N. of Lorelei Copper Mine (–DD), *De Winter & Giess 6391* (M; PRE; WIND); Namuskluft (–DD), *Moffett 1148* (STE). 2717 (Chamaïtes): Hoologberg (–DB), *Erni s.n.* (ERNI). 2718 (Grunau): Klein Karas (–CA), *Hall 510* (NBG). 2816 (Oranjemund): 60 km N. of Oranjemund (–AA), *Moffett 1400* (STE; WIND); Obib (–BA), *De Winter 6488* (PRE); Obib Flats (–BA), *De Winter & Giess 6197* (K; M; PRE; WIND); 6 km S. of Obib Water (–BA), *Giess 12990* (M; WIND); Schakalsberg (–BA), *Merxmüller 2311* (M); Schakalsberg (–BA), *Merxmüller 2638a* (M); Schakalsberg (–BA), *Merxmüller s.n.* (M; PRE); Lorelei (–BB), *De Winter 6391* (PRE); Schimmelkuppe (–BB), *Erni 100* (ERNI); Lorelei (–BB), *Merxmüller 2567* (M); between Rosh Pinah and Sendelingsdrift (–BB), *Moffett 1163* (SUG); 6 km N. of Dreigratdrif (–BB), *Moffett 1354* (STE; WIND); between Hohenfels and Daberas (–BC), *Moffett 1401* (STE-U). Without precise locality: Great Namaland, 1889, *Hermann s.n.* (Z); South West Africa, *Holloway s.n.* (BOL); Great Namaland, *Steingröver 54* (Z). Without locality: *Dinter 2601* (SAM); *Lewis 13* (PRE); *Von Wettstein s5a; s5c; s6; s7; s.n.* (M).

CAPE.—2816 (Oranjemund): Sendelingsdrift (–BB), *Pearson 6103* (BOL; BM); Brandkaros (–BC), *Munro s.n.* (PRE); Brandkaros (–BC), *Werdermann & Oberdieck 604* (B; PRE); Bloeddrif (–BD), *Moffett 953* (STE); near Alexander Bay (–DA), *Buckley s.n.* (SUG); between Swartwater and Arriesdrif (–DA), *Herre 1023* (BOL); Beauvalon (–DA), *Moffett 642* (NBG; PRE; STE); Kortdoringberg (–DA), *Moffett 644* (STE); Beauvalon (–DA), *Moffett 968* (SUG); near mouth of



Orange River (-DA), *Pillans 5589* (BOL); Alexander Bay (-DA), *Roux 1* (BOL); hills N. of Witbank (-DC), *Pillans 5133* (BOL); Swartwater (-DD), *Herre 1023* (STE). 2916 (Port Nolloth): near Port Nolloth (-BB), *Erni 705* (ERNI). Without precise locality: Namaqualand, *Tucker s.n.* (BOL); Springbok District, *Von Wettstein sl* (M).

This species occurs in three distinct habitats and possibly a fourth on the upper plateau. On the Lüderitz peninsula and its immediate environs, it grows in shallow, windblown sand in cracks in the dark, igneous outcrops, and is found right down to the shore line. In the other parts of the lowland desert, the plants grow in stabilized sand. They are especially plentiful at the foot of mountains or hills where the sand overlies rocks, such as at Kavisberg (Fig. 5) and Halenberg. Just south of Aus, the plants may be found growing in a calcrete plain. The only habitat record for the upper plateau is from a herbarium specimen, which indicates "top of sandstone ridge, 12 km west of Sandverhaar, S.W.A." In South Africa, *S. patersonii* occurs in Veld Types 31 and 34, while in South West Africa it occurs in Vegetation Type 3a.

With its extremely hard and durable bark, this species appears to withstand the most harsh conditions. It tolerates salt spray at Lüderitz, extreme heat over most of its area and frost in the higher areas. It can flower and produce fruit in the leafless state. Flowers have been recorded for all months of the year except October and November. This lack of a clearly defined seasonality can be attributed to the area being outside the winter rainfall region which, in effect, does not reach much beyond Port Nolloth, and to the regular coastal fogs, which drench those plants near the coast.

The earliest record of this species is the fine engraving on Page 116 of Paterson's Travels. In Edition 1 of 1789 it appears as Fig. 13, while in Edition 2 of 1790, it is Fig. 14. Both figures are identical and De Candolle (1824), cited the latter in the basionymic type description. In a rare, coloured copy of Edition 1 of this work in the South African Public Library's Fairbridge Collection, the flower and leaf colour is faithfully represented. Paterson would have seen this species while at the mouth of the Orange River in August 1779, during his fourth journey to the interior.

On Page 116 he writes "the following day, we made an excursion through the adjacent country, but found no great variety of plants, except Geraniums" (Paterson, 1790).

With such an unambiguous iconotype, it is unfortunate that apart from Don (1831), who was the first to use it in *Sarcocaulon*, and Hooker (1868), all subsequent authors used the name *S. patersonii* for another taxon. Sprengel (1826), clouded the issue by citing *M. patersonii* DC., as a synonym of *Pelargonium spinosum* and this might have contributed to Sweet (1826) unaccountably omitting *S. patersonii* in his original description of the genus.

Schinz (1888) described this species as *S. rigidum*, by which name it is universally known today. In his revision of the genus in 1935, Rehm recognized two subspecies: a coastal form based on Schinz's type and an inland form, which he named *S. rigidum* subsp. *glabrum*. The coastal form, which is found on the Lüderitz peninsula, has grey, lichen-covered, prostrate branches with tufted fascicles, glabrous leaves and pale rose flowers. The inland form has a more upright habit, polished golden branches, glaucous leaves and dark rose to cerise flowers. This morphological difference is apparently influenced by the environment. At Kolmanskop, only 10 km from Lüderitz, the plants show features of both forms, while prostrate plants from near Alexander Bay have produced vertical branches within one season in the Botanical Garden at Stellenbosch University. What is noticeable is a gradual change in habit, leaf colour and size, spine length and flower colour from the coast to the high plateau.

Rehm also described a new form, *S. rigidum* subsp. *glabrum* forma *parviflora* from Witpütz.

Because of the gradual variation over its whole range, it is not regarded as desirable to split this species into infraspecific taxa. Neither Dinter (1930) nor Merxmüller and Schreiber (1966), considered this as more than one taxon. The species is distinct in the genus.

Because it is such a remarkable plant, *S. patersonii* soon attracted the interest of scientists such as Schinz and Dinter. The waxy bark is inflammable



FIG. 5.—Kavisberg plain near Lüderitz, South West Africa. Typical habitat of *Sarcocaulon patersonii*.



and Dinter (1930b), mentioned that in 1897 when he first arrived in Lüderitz, this plant was a valuable source of fuel, being used for fires for distilling sea water. Large heaps of living, as well as dead, material were collected every night. It was planted in terraces around houses and in the cemetery, and watered with bath and cooking water. Today, it is only found in profusion from about 25 km inland near Kosisberg.

This species has provided material for a number of German researches. According to Schmid, Schulze, Köhler and Karrer & Schwarz published on the chemistry of the bark, while Schmid himself published a general morphological study (Schmid, 1932). Its tenacity is legendary. Among the examples mentioned by Werdermann (1932), was that of a plant which Gilg exhibited in Berlin in 1896. It had been sent to the museum ten years previously by the collector Hermann and housed in a glass case. During the exhibition, which was held in damp surroundings, the "dried-up" plant produced up to 10 cm long, luxuriant green shoots.

This species grows readily in cultivation. Don (1831) stated that it was cultivated in Britain in 1827 and flowered in May and June. Schmid (1932) went into considerable detail concerning its cultivation. He also stated that it was not a "true" succulent. Seed collected near Alexander Bay in March 1975 and sown in April 1975 germinated after 28 hours, while the same collection sown in February 1976, germinated after 20 hours. Of two seeds removed from a 20 year old herbarium specimen, and sown in July 1976, one germinated after nine days and the other failed to germinate.

The resinous, inflammable "desert pearls" which are occasionally found in the desert, are the result of wind action on the thick skeletal remnants of these plants.

**Common name:** It is generally known as Bushman Candle, "Boesmankers", "Buschmannkerze" and also, according to Hooker (1868), as "Gifdoorn", "Inkruipdoorn" and "Novra". Smith (1966) mentions the name "Norab", while Barkhuizen (1967) adds "heldoring" and "kinkhoesbos", the latter indicating that the plant is used for treating whooping cough.

### 3. *Sarcocaulon salmoniflorum* Moffett, nom. nov. Type: South West Africa, Aus, Schinz 257 (Z, lecto.!).

*S. pheritieri* DC. var. *brevimucronatum* Schinz in Verh. bot. Ver. Prov. Brandenb. 29:58 (1888).

*S. patersonii* sensu auct. mult.: Eckl. & Zeyh. in Enum.: 57 (1835); Harv. in Fl. Cap. 1:26 (1860) pro parte; Engl. in Bot. Jb. 10:30 (1889); Marloth in Wiss. Ergebn. Dt. ZentAfr.—Exped. :229, t.90, :325, t.137 (1908); Knuth in Pflanzenr. 4, 129:312 (1912) pro parte, Engl., Pflanzenw. Afr. 3, 1:707 (1915); Dinter in Reprim nov. spec. Regni veg. Beih. 23:228 (1926); Knuth in Pflanzenfam. 2, 19a:58 (1931); Dyer in Kew Bull. 9:443 (1932) pro parte; Merxm. & A. Schreib., Prod. Fl. S.W.Afr. 64:15 (1966); non (DC.) G. Don.

*S. patersonii* (DC.) G. Don subsp. *typicum* Rehm in Bot. Jb. 67:268 (1935). Syntypes: various from South West Africa.—subsp. *badium* Rehm in Bot. Jb. 67:269 (1935). Syntypes: Cape, Bushmanland, Hantam Mtns, Meyer s.n. (?B†); near Bitterfontein, Zeyher s.n. Lectotype: Eckl. & Zeyh. 164 (SAM!).—subsp. *curvatum* Rehm in Bot. Jb. 67:269 (1935) Syntypes: South West Africa, Namib, Marloth 1222 (?B†); Dinter 1470 (Z!), 226 (?B†); Engler 6654 (?B†); Neineis—Uis & Nauchas, Wettstein s.n. (?B†). Lectotype: Dinter 1470 (Z!).

*Monsonia obcordata* E. Mey. in Drège, Zwei Pfl. Doc. 26:203 (1843) pro parte, nom. nud.

*M. apiculata* E. Mey. in Drège, Zwei Pfl. Doc. 26:203 (1843) nom. nud. Fide Knuth (1912). Specimen not seen.

*M. macilenta* E. Mey. in Drège, Zwei Pfl. Doc. 26:203 (1843) nom. nud. Fide Knuth (1912). Specimen not seen.

Fleshy, spiny shrublet up to 0,4 m high and 0,6 m in diameter; stem branching repeatedly from 15–40 mm above ground level; roots not swollen; branches pale olive to grey, rarely exceeding 4 mm thick with rows of single, thin (mid-diameter c. 1 mm) straight or curved spines and tufts of short stalks in the axils of the spines. *Leaves* long and short petioled; stipules scale-like, ciliate, semi-persistent; blade entire, glabrous. *Long petioled leaves* almost decussate; petioles persistent and hardened into thin spines (4–) 12 (–30) mm long with decurrent, flattened, oblanceolate base 4–9 mm long, 2–4 mm broad; blade narrowly to broadly elliptic (4–) 5 (–7) mm long, (3–) 4 (–5) mm broad, apex emarginate, base cuneate to obtuse. *Short petioled leaves* 1–3 in number in axils of spines; petioles semi-persistent as blunt stalks up to 2 mm long after abscission of the blade; blade narrowly to broadly elliptic, occasionally broadly ovate, (2–) 6 (–10) mm long, (2–) 4 (–5) mm broad, apex emarginate, occasionally acute. *Flowers* when open up to 20 mm long (excluding pedicel), 30 mm broad; peduncle sessile; pedicel glabrous (5–) 7 (–9) mm long. *Sepals* puberulous or glabrous, 5–9 mm long, 2–3 mm broad, mucro less than 0,5 mm long. *Petals* narrowly obovate, salmon to carrot (R.H.S. No. 29B or 29C), (9–) 13 (–17) mm long, (4–) 6 (–8) mm broad. *Stamens* with long filaments 7–9 mm long, short filaments 4–6 mm long; basal 2 mm of filaments fused; anthers 3 mm long. *Ovary* sericeous, style glabrous, stigmas 2 mm long. *Mericarps* 60–90 mm long; base 7–9 mm long, tail 50–80 mm long. *Seed* 2–3 mm long. PLATE 2c; FIGS 6 & 7.

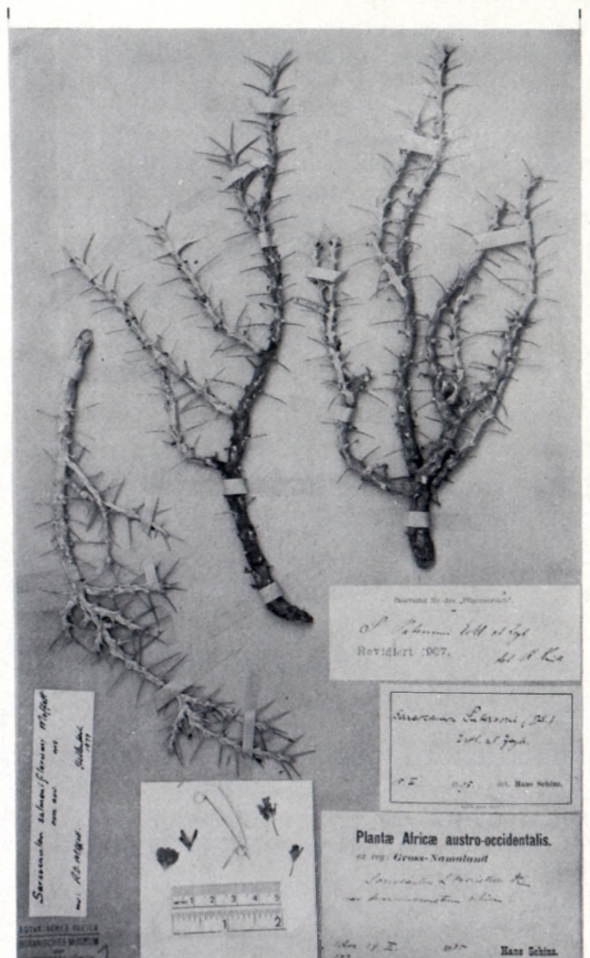


FIG. 6.—*Sarcocaulon salmoniflorum*, Aus, South West Africa, (lectotype: Schinz 257 in Z).





FIG. 7.—*Sarcocaulon salmoniflorum*, near Kenhardt, Cape (Moffett 996, height  $\pm 0.4$  m).

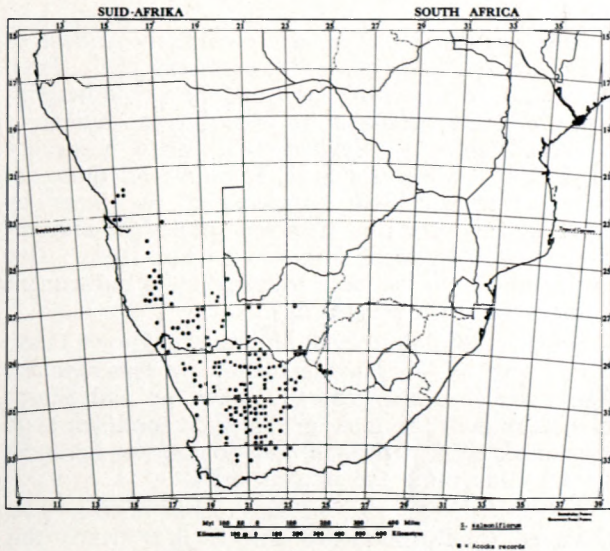


FIG. 8.—Geographic distribution of *Sarcocaulon salmoniflorum* in Southern Africa.

### Diagnostic features

Erect to semi-prostrate shrublet; branches very thin; spines curved or straight and with a decurrent base; stipules semi-persistent. Leaves entire, glabrous, elliptic. Petals twice as long as broad, salmon to carrot in colour. Mericarp: base 7–8 mm long.

This species has the widest distribution of all the species of the genus (Fig. 8). It occurs from near Usakos in South West Africa to the south-eastern Great Karoo between Prince Albert and Willowmore. Its northern limit reaches the Kalahari Gemsbok National Park as well as the southern Orange Free State near Lückhoff and Fauresmith. In the south, it is plentiful around Laingsburg and the Tanqua Karoo north of Ceres, with a few plants reaching into the Little Karoo between Touws River and Ladismith. Apart from isolated occurrences near Lekkering in the Richtersveld and Rosh Pinah in South West Africa, this species is not found in the western coastal plain of Namaqualand or southern South West Africa.

S.W.A.—2115 (Karibib): Pforte, mile 82 (–CD), Dinter 6716 (B); Sandamap, Usakos (–CD), Kers 662 (WIND). 2214 (Swakopmund): 55 km E. of Walvis Bay (–BD), Giess, Volk & Bleissner 5122 (WIND); Welwitschia Flats (–BD), ded. Rehm

s.n. (M). 2215 (Trekkoopje): 80 km E. of Swakopmund, 1070 m (–AA), Macdonald 517 (BM); 30 km W. of Usakos (–AB), De Winter 3212 (K; M; PRE; WIND); 30 km W. of Usakos (–AB), De Winter 3213 (WIND). 2314 (Sandwich Harbour): 30 km E. of Walvis Bay (–BB), Nordenstam 2422 (M). 2315 (Rostock): Gungochoab, N. of Vogelfederberg (–AA), Jensen 248 (WIND); 6 km W. of Vogelfederberg (–AA), Moffett 1339 (PRE; STE; WIND). 2317 (Rehoboth): Rehoboth (–AC), Herre 9139a (BOL). 2416 (Maltahöhe): Bullsport Flats (–AB), Dinter s.n. (SAM); Bullsport (–AB), Herre 48 (STE); Bullsport (–AB), Volk 879 (M); Friedland Farm (–CB), Walter 2076 (M). 2516 (Helmeringhausen): Naudaus, Duwisib (–BC), Volk 12655 (M); Sinclair Mine (–CB), Giess 2291 (K; M; WIND); Maguams Farm (–DB), Giess, Volk & Bleissner 8214 (M; WIND); Maguams Farm (–DB), Walter 2124 (M; WIND); Barby, 1710 m (–DC), Macdonald 295 (BM); 3 km S. of Goais Farm (–DD), Moffett 1209 (PRE; STE); Goais (–DD), Müller 40 (WIND). 2616 (Aus): Weissenborn Farm (–AB), Kinges 2413 (M; WIND); 20 km N. of Aus (–AD), Schulze 580 (STE-U); 76 km N.E. of Aus, 1520 m (–BA), Moffett 1207 (PRE; WIND); Klein Aus (–CA), Moffett 1381 (STE); Aus, 1400 m (–CB), Dinter 1121 (SAM); Aus (–CB), Dinter s.n. (SAM); Aus (–CB), Dinter 6049 (B; BOL; BM; G; M; STE; Z); Plateau Farm (–CB), Hall 1841 (NBG); Aus (–CB), Marloth 4649 (PRE); Aus (–CB), Marloth 9345 (PRE); 4 km S. of Aus (–CB), Moffett 1141 (PRE; STE); Aus (–CB), Moffett 1342 (STE; WIND); Aus (–CB), Rogers 29571 (GRA); Aus (–CB), Schinz 257 (Z); Aus (–CB), Van Son s.n. (PRE); Plateau Farm (–CB), Walter 2546 (WIND); Aus (–CB), Von Wettstein 56 (M); Aar, Plateau (–DA), Erni 104 (ERNI; STE); Guibis, 900 m (–DB), Dinter 1231 (SAM); 42 km W. of Goageb (–DB), Moffett 1139 (PRE; STE); Guibis (–DB), Pearson 8015 (GRA; K; SAM); Guibis, 1350 m (–DB), Range 856 (SAM); Guibis, 1300 m (–DB), Range 1599 (SAM). 2617 (Bethanie): 12 km W. of Sandverhaar (–CD), Pearson 4273 (BOL; K); Seeheim (–DD), Boss s.n. (PRE). 2716 (Witpütz): 3 km S. of Swartkloofberg (–DA), Moffett 1345 (PRE; WIND). 2717 (Chamaite): Ais Ais (–CD), Marloth 3736 (PRE); 46 km S. of Fish River Canyon View-point (–DC), Schulze 660 (STE-U). 2718 (Grünau): Kraikluft, 1520 m (–BA), Pearson 8293 (K); Pieterskloof Farm (–BB), Giess & Müller 11999 (M; WIND); 99 km S. of Keetmanshoop (–BC), Moffett 1210 (PRE; STE; WIND); 13 km E. of Klein Karas (–CA), Macdonald 212 (BM); Kanus (–DC), Engler 6677 (K); Kanus (–DC), Dinter 228 (SAM). 2817 (Violsdrift): 12 km S.E. of Ais Ais (–BB), Moffett 1136 (PRE; STE). 2818 (Warmbad): 66 km S. of Grünau (–AA), Moffett 1322 (PRE; STE; WIND); Witpütz Farm (–CA), Bleissner 266 (M); 20 km N. of Ramansdrift (–CD), Pearson 4353 (BOL; GRA; K; PRE; SAM). 2819 (Ariamsvlei): Velloorbank (–CA), Dinter s.n. (B). Grid ref. unknown: Sphinx, Dinter 228 (SAM); Kolom 121, Dinter 1470 (Z); Naidas, Fleck 230a (Z); Keiap Ravine, Pearson 7899 (BOL; K); Wasserfall, Great Karasberg, Pearson 8023 (K). Without precise locality: Karasbergen, Fenchel 81 (Z); Hereroland, Fleck 134 (Z); Lüderitz District, Rogers 29621 (K).

O.F.S.—2924 (Hopetown): Rose Marie Farm (–DA), Verdoorn 2186 (PRE); Vissersdrift (–DC), Henrici 1597 (BOL; PRE); Vissersdrift (–DC), Verdoorn 1597 (BOL; K); Spitskop, Lückhoff (–DD), Moffett 1011 (PRE; STE); 1012 (NBG; PRE; STE). 2925 (Jagersfontein): Wheeldon, Fauresmith (–CC), Henrici 2442 (PRE).

CAPE.—2520 (Mata Mata): 3 km S.W. of Mata Mata (–CC), Leistner 2246 (K; KMG). 2720 (Noenieput): 6 km S. of Abiquas Puts (–AC), Leistner 1774 (K; KMG; M). 2721 (Telly Pan): Visch Gat, 900 m (–AA), Leistner 2158 (KMG; PRE); 32 km W. of Vanzylsrus (–BA), Lang s.n. (PRE). 2723 (Kuruman): Cotton End (–AB), Acocks 2512 (BOL; K; KMG; PRE). 2816 (Oranjemund): Jakkalsputs (–DB), Moffett 951 (PRE; STE). 2817 (Violsdrift): 7 km N. of Uitspanpoort (–CC), Moffett 974 (STE-U). 2820 (Kakamas): near Augrabies Waterfall (–CB), Moffett 1097 (STE); Augrabies National Park, 700 m (–CB), Werger 326 (PRE). 2823 (Griquaastad): between Campbell and Griquatown (–DC), Acocks 1426 (PRE). 2917 (Springbok): Wild Flower Reserve (–DB), Rösch & Le Roux 960; 1291 (STE-U). 2918 (Gamoep): Gamoep, 1 000 m (–CD), Werdermann & Oberdieck 622 (B; PRE). 2920 (Boom Rivier): 56 km W. of Kenhardt (–DA), Pole-Evans 2364 (PRI); 40 km S.W. of Kenhardt (–DB), Moffett 996 (PRE; STE). 2921 (Kenhardt): Putsunderwater (–BB), Compton 24013 (NBG); Jagbult, 64 km W. of Marydale (–DA), Story 1102; 1161 (PRE). 2922 (Prieska): Buisvlei (–DA), Hafström & Acocks 756 (BOL; PRE). 2923 (Douglas): Katlani (–BA), Anderson 741 (BOL; STE); Mazelsfontein (–BB), Anderson in BOL 19518 (BOL). 3018 (Kamiesberg): between Platbakkies and Stofvlei (–BC), Hugo s.n. (STE-U); Modderfontein, 460 m (–CD), Drège s.n. (K). 3020 (Brandvlei): between Sakrivier and Brandvlei (–CB), Moffett 994 (STE-U). 3023 (Britstown): Leeuwfontein (–CB), Lindeberg, Hafström & Acocks 1304 (KMG; PRE); 34 km W. of De Aar (–DA), Pole-Evans 2383 (PRE). 3118 (Vanrhynsdorp): 13 km S. or S.W. of Bitterfontein (–AB), Pearson 3443



(K); Krom River (-BB), *Goatcher* in *BOL* 10015 (BOL); Bitterfontein (-CB), *Ecklon & Zeyher* 164 (G; PRE; SAM; W; Z). 3121 (Fraserburg): Rietfontein (-CB), *Moffett* 992 (SUG). 3123 (Victoria West): Victoria West, *Whitlock* 552 (PRE). 3219 (Wuppertal): 96 km N. of Karooport (-BA), *Hall* 2046 (NBG); between Tulpfontein and Tanqua River (-BC), *Moffett* 651 (PRE; STE); 5 km N.E. of Tulpfontein (-DB), *Moffett* 827; 849 (SUG); 850 (STE); 852 (PRE; STE); 3 km N.E. of Tulpfontein (-DB), *Moffett* 872 (PRE; STE); 873 (NBG; STE); 10 km N.E. of Tulpfontein (-DB), *Moffett* 1226 (STE); near Karooport (-DD), *Davis s.n.* (BOL; NBG); Skitterykloof (-DD), *Moffett* 653 (SUG); Skitterykloof (-DD), *Moffett* 855 (STE); 863 (PRE; STE). 3221 (Merweville): Between Merweville and Koup (-CB), *Moffett* 990 (STE); 4 km S. of Koelfontein (-CD), *Moffett* 989 (STE). 3320 (Montagu): Bo-plaas (-AD), *Moffett* 1294 (SUG); Eierpoort (-CB), *Moffett* 1266 (SUG). 3321 (Ladismith): Saai (-AB), *Moffett* 703 (STE); Blaauwkrantz (-BA), *Moffett* 720; 746 (STE); 735; 743; 772 (SUG); 31 km N.W. of Prins Albert (-BB), *Moffett* 1035 (NBG; PRE; STE). 3322 (Oudtshoorn): Between Haelrugplaas and Tierbergkloof (-AB), *Moffett* 1033 (STE); 3 km N. of Tierbergkloof (-AB), *Moffett* 1034 (SUG). 3323 (Willowmore): 4 km W. of Strydomsvlei (-AA), *Moffett* 1032 (PRE; STE). Grid ref. unknown: Thornly, Orange River, *Acocks* 2542 (KMG; PRE); Klein Witboom, Hay Div., *Cawood* in *KMG* 672a (KMG); The Halt, Upington, *Glover* in *BOL* 10422 (BOL). Without precise locality: Gamka River, *Burke* 38 (Z); Gamka River, *Burke s.n.* (G); Sundays River, 305 m, *Ecklon & Zeyher* 34.7 (PRE; Z); Gamka River, *Ecklon & Zeyher* 437 (GRA); Beaufort Karoo, *Ecklon & Zeyher* 437 (GRA; SAM); Springbok-Garies, *Godman* 738 (BM); Sutherland District, *Herre* 1035 (BOL); near Springbok, *Lewis* 893 (SAM); between Upington and Kenhardt, *Middlemost* in *NBG* 1152/38 (NBG); between Carnarvon and Williston, *Stayner* in *NBG* 86.984 (NBG); Namaqualand, *Tucker s.n.* (BOL); Laingsburg District, *Von Wettstein* 12a (M). Without locality: *Burke & Zeyher* 163 (G; K; SAM); *Krebs s.n.* (G-DC); *Masson s.n.* (BM); *Pole Evans* 2363 (PRE); *Thunberg* in *Herb. Thunb.* 15788 (UPS; STE-U, microfiche!).

Because of its very wide distribution, this species is found in habitats varying from exposed marble outcrops to level deep red sand. It is, however, chiefly a plant of the plains (Fig. 9). In the central, southern and south-eastern Karoo it grows on a shaly substrate, while in the Touws River—Ladismith and Witpütz, South West Africa, area it is found on white quartz patches. In the Orange Free State and the southern part of South-West Africa, it grows in grassland among dolerite boulders, whereas at the northern end of its range, near Usakos, it is found on limestone. In the Namib National Park, dwarf plants grow in cracks in bare exposed marble ridges. In the southern Kalahari and south-western Bushmanland, this species grows in deep red soil.

In South Africa, *S. salmoniflorum* is found in Veld Types 16, 25, 26, 29, 31, 32, 33, 35, 36, 39 and 40, while in South West Africa it occurs in Vegetation Types 2, 3a, 4, 9 and possibly in the southernmost part of 13.

This species occurs largely in the summer rainfall area. In South West Africa it has been recorded in flower in every month of the year, while June, July and August appear to be the flowerless months in South Africa. This is probably due to the South West African plants being nearer the sea and the resulting milder winter climate. Minimum temperature appears to be a limiting factor in the distribution of this species. Not only does it not flower in the coldest months of the year, but the plant apparently does not grow along the very cold Great Karoo escarpment, occurring just below, in the Tanqua and Moorde-naars Karoo up to Beaufort West and then again where the plateau is lower, about 50 km inland from the escarpment. Like the other species of the genus, plants often flower and develop fruit in the leafless state.

This species is at present incorrectly known in literature and herbaria as "*S. patersonii* (DC.) Eckl. & Zeyh.". While citing De Candolle's type description, with its reference to Fig. 14 in Paterson's Travels, Ecklon & Zeyher (1835) cited a locality "Beaufort", where the true *S. patersonii* does not occur. Harvey (1860), perpetuated the error by equating this very thin stemmed species (*S. salmoniflorum*) with Paterson's thick stemmed figure. This misidentification has been followed by all subsequent authors up to the present day.

Schinz (1888), described a hitherto unknown taxon from Aus as *S. l'heritieri* var. *brevimucronatum*. The name was not generally taken up and Schinz himself altered the label on the type specimen soon afterwards to *S. patersonii*, thus joining the incorrect stream concerning the latter species.

*S. l'heritieri* DC. var. *brevimucronatum* Schinz was, however, validly published and, as it is clearly this species, the specimen on which it is based forms the type for *S. salmoniflorum* (Article 7 of the Code). The specific epithet "*salmoniflorum*" is chosen as being more appropriate than "*brevimucronatum*", as more than half the species have *brevimucronate*



FIG. 9.—Habitat of *Sarcocaulon salmoniflorum* between Lückhoff and the Orange River, Orange Free State.



sepals. The latter epithet would have priority at varietal level, but may be discarded when raised to the level of the species (Article 60 of the Code).

Rehm (1935) distinguished three subspecies assigning them to "*S. patersonii* (DC.) Eckl. & Zeyhr.", thus citing the incorrect authors of the combination and following Ecklon & Zeyher's misidentification of the species. The subspecies are as follows: *S. patersonii* subsp. *typicum* with light grey branches, pale straight thorns and red flowers from the highlands around Aus and to the Orange River; *S. patersonii* subsp. *badium* with chestnut brown thorns, dark brown branches and small leaves from Namaqualand southwards towards Clanwilliam and *S. patersonii* subsp. *curvatum* with small brown branches mostly curved downward, short, brittle thorns and small flowers from the Namib.

Merxmüller & Schreiber (1966) regarded the South West African forms as one species, but mentioned that pink and yellowish flowered specimens are found.

*S. salmoniflorum* occurs in basically two forms: a semi-erect, fairly long-branched shrublet with straight to slightly curved spines and a dwarf, small-leaved form with curved spines. The larger form is widely distributed over the higher parts of the southern part of South West Africa, in Bushmanland, southern Kalahari, northern Great Karoo and southern Orange Free State. The dwarf form can be found in the Namib National Park, occasionally near Rosh Pinah and Lekkersing, in the southern Great Karoo from Matjiesfontein to Strydomsvlei near Willowmore and in the Montagu-Touws River Karoo. Plants intermediate between the dwarf and the semi-erect form occur in the Ceres and Tanqua Karoo. South from Kenhardt towards the escarpment in the vicinity of Williston and Fraserburg, the plants become progressively smaller.

In all the different geographic forms, the basic diagnostic characters which separate this species from others remain unchanged, including the flower colour which, although varying from light to dark, always has a salmon to carrot hue. The new growth of all the various slightly different looking specimens in the Botanical Garden of the University of Stellenbosch is virtually identical. For this reason, this taxon is treated as a single species without subdivision into infraspecific taxa.

Stapf (1931) listed Dietrich's colour plate in *Flora Universalis* of 1849 as the first pictorial record of this species. Rehm (1935) also cited this plate under *S. patersonii* subsp. *typicum*. Unfortunately, this extremely rare work could not be obtained to verify the identity of the plate. Figures 90 and 137 in Marloth (1908), are labelled *S. patersonii* Eckl. & Zeyh., but they could also be *S. camdeboense*. The first authentic figure of the species is the line drawing, Fig. 39 in Knuth (1912). A fine watercolour painting by G. J. Lewis of the Ceres Karoo form of *S. salmoniflorum* is filed with the *G. A. Davis* s.n. specimen at the Bolus Herbarium, Cape Town. Lewis, in the accompanying manuscript, named it *S. aureum*, under which name it is also found in the Herbarium at Kew.

After two and half years in the botanical garden, *S. salmoniflorum* appears to grow fairly well in cultivation. It propagates readily from seed. Seed collected in the Tanqua Karoo in June 1975 and sown in February 1976, germinated after 1-4 days. Seed collected near Lückhoff in the Orange Free

State in December 1975 and sown in February 1976, germinated after 1-6 days.

*S. salmoniflorum* is distinct in the genus with affinities to *S. camdeboense* and *S. vanderietiae*.

**Common name:** Bushman candle, candlebush (Palmer, 1966). "Boesmankers", "klein kersbossie", "heldoring" (Barkhuizen, 1967), "maagdoring" (Smith, 1966). In the Helmeringhausen area of South West Africa, the local population call it "Qorab" and use an infusion of it for colds (own observation).

4. *Sarcocaulon camdeboense* Moffett sp. nov., *S. vanderietiae* L. Bol. affinis, sed habitu erecto, foliis brevibus, radicibus tumidis et petalibus pallide flavis differt.

*S. patersonii* sensu Harv. in Fl. Cap. 1:256 (1860) pro parte; sensu Knuth in Pflanzenr. 4, 129:313 (1912) pro parte, non (DC.) G. Don.

*S. vanderietiae* sensu Dyer in Kew Bull. 9:443 (1932) pro parte, non L. Bol.

Suffrutex succulentus, spineus usque ad 0,4 m altus et 0,5 m in diametro; caulis repetite ramificans a 20-50 mm supra solum; radices generatim tumidae; rami olivei vel atrogriisii, generatim 4-10 mm lati, spinis singularibus rectis serialibus et caepitibus minutis stipitum in axillaribus spinarum. *Folia* longe et breve petiolata; stipulae squamiformes, ciliatae, caducae; lamina integer, glabra. *Folia late petiolata* paene decussata; petioli persistentes, indurati et formantes spinas (7-) 15 (-29) mm longas et quoque base complanata, adnata, obovato-obolata, 2-4 mm lata; lamina anguste obovato vel anguste elliptica, (5-) 9 (-12) mm longa, (3-) 4 (-6) mm lata, margine apicali non serrulato, apice emarginato rare mucronato, base cuneata. *Folia breve petiolata* 2-5 axillaribus spinarum; petioli semipersistentes obtusi, usque ad 2 mm longi ubi lamina abscissa; lamina anguste obovata vel elliptica (6-) 10 (-13) mm longa, (3-) 4 (-5) mm lata, apice emarginato rare mucronato; base cuneata. *Flores* ubi apertae usque ad 18 mm longae (pedicello excluso), 30 mm latae; pendunculus subsessilis; pedicellus glabrus (8-) 13 (-18) mm longus. *Sepala* puberula vel glabra, subinde ferugineo-tincta, 7-10 mm longa, 3-4 mm lata. *Stamina* filamentis longis 8-9 mm longis, filamentis brevibus 6 mm longis, filamentis connatis 2 mm ad basim; antherae 3 mm longae. *Ovarium* sericeum, stylo puberulo vel glabro, stigmatibus 2 mm longis. *Mericarpia* 55-75 mm longa, basibus 7-9 mm longis, caudis 50-60 mm longis. *Semen* 4 mm longum.

TYPE.—Cape, Graaff-Reinet, *Moffett* 1021 (STE, holo.!; K!; NBG!; PRE!).

Fleshy, spiny, semi-erect shrublet up to 0,4 m high and 0,5 m in diameter; stem branching repeatedly from 20-50 mm above ground level; roots generally swollen; branches olive to dark grey, generally 4-10 mm thick with rows of single straight spines and minute tufts of stalks in the axils of the spines. *Leaves* long and short petioled; stipules scale-like, ciliate, caducous; blade entire, glabrous. *Long petioled leaves* almost decussate; petioles persistent and hardened into straight thin spines (7-) 15 (-29) mm long with flattened, adnate, obovate-oblate base 2-4 mm broad; blade narrowly obovate to narrowly elliptic (5-) 9 (-12) mm long, (3-) 4 (-6) mm broad, apical margin not serrulate, apex emarginate, rarely mucronulate, base cuneate. *Short petioled leaves* 2-5 in number in axils of spines; petioles semi-persistent as blunt stalks up to 2 mm long after abscission of the blade; blade narrowly obovate to



elliptic (6–) 10 (–13) mm long, (3–) 4 (–5) mm broad, apex emarginate, rarely mucronulate, base cuneate. *Flowers* when open up to 18 mm long (excluding pedicel), 30 mm broad; peduncle sub-sessile; pedicel glabrous (8–) 13 (–18) mm long. *Sepals* puberulous or glabrous, occasionally rusty tinged, 7–10 mm long, 3–4 mm broad, mucro less than 1 mm long. *Petals* obovate, pale mimosa, (R.H.S. No. 8D), (11–) 13 (–15) mm long, (9–) 11 (–14) mm broad. *Stamens* with long filaments 8–9 mm long, short filaments 6

mm long; basal 2 mm of filaments fused; anthers 3 mm long. *Ovary* sericeous, style puberulous to glabrous, stigmas 2 mm long. *Mericarps* 55–75 mm long; base 7–9 mm long, tail 50–66 mm long. *Seed* 4 mm long. PLATE 2d; FIG. 10.

#### Diagnostic features

Semi-erect shrublet; branches thin; spines thin and straight, base adnate, obovate to oblate; roots generally swollen. *Leaves* entire, glabrous, narrowly obovate to elliptic; apex emarginate, base cuneate, *Petals* as broad as long, pale mimosa. *Mericarp*: base 7–9 mm long.

Scattered throughout the eastern Great Karoo (Fig. 11) in a large roughly elliptical area centred around Graaff-Reinet and bounded more or less by the following towns: Willowmore, Steytlerville, Klipplaat, Pearston, Cradock, Schoombee, Middelburg, Murraysberg and Nelspoort.

CAPE.—3123 (Victoria West): Without precise locality: Murraysberg District, 1220 m, *Tyson* 19 (SAM). 3124 (Hanover): Sneeuberg, between Kompasberg and Renosterberg, 1520 m–1830 m (–DB), *Drège* 7515 (BM; G; K; PRE; W); between Middelburg and Renosterberg (–DB), *Joubert s.n.* (SUG). 3125 (Steynsburg): Middelburg (–AC), *Du Toit* in *BOL* 13449 (BOL); Boesmankop, Grootfontein College (–AC), *Moffett* 1100 (NBG; PRE; STE); Grootfontein, Middelburg (–AC), *Theron* 364 (PRE); 28 km E. of Middelburg (–AD), *Fischer* 58 (SUG); 32 km N.W. of Cradock (–DC), *Herb NBG* in *NBG* 1620/50 (NBG). 3222 (Beaufort West): Without precise locality: Beaufort West District, 910 m, *Thode* 3974 (STE). 3223 (Rietbron): Courlands Kloof, Nelspoort (–AA), *Pearson* 822 (NBG); 20 km S.E. of Aberdeen (–DB), *Van der Walt s.n.* (STE-U). 3224 (Graaff-Reinet): Munnik Pass 10 km W. of Graaff-Reinet (–AD), *Drijfhout s.n.* (STE-U); around Graaff-Reinet (–BC), *Bolus* 39 (BOL; K); Graaff-Reinet (–BC), *Marloth* 9346 (PRE); De Nek Farm (–BC), *Moffett* 1021 (K; NBG; PRE; STE); flats east of Graaff-Reinet (–BC), Nov. 1913, *Peter* 51313 (B); De Nek Farm (–BC), *Thompson s.n.* (NBG; PRE; STE); 19 km S.W. of Aberdeen (–CA), *Horn s.n.* (PRE); near Aberdeen (–CA), *Taylor* 463 (BOL); 3 km S. of Vrede, Kendrew (–CB), *Hartmann* 8889 (SUG). 3225 (Somerset East): 53 km W. of Cradock (–AA), *Barker* 7079 (NBG); Doornberg, Cradock (–AA), *Herre* 1024 (BOL); Cradock (–BA), *Rawe s.n.* (Hort Rawe); near Cradock (–BA), *Shaw s.n.* (W); 13 km S.W. of Pearston, 760 m (–CA), *Acocks* 11993 (PRE); Blyde River, 760 m (–CA), *MacOwan s.n.* (Z); 10 km E. of Pearston (–CA), *Moffett* 1022 (PRE; STE); 20 km S.W. of Pearston (–CC), *Zimmerman s.n.* (NBG; PRE; STE). Without precise locality: Cradock District, *Cooper* 491 (BM; W; Z); Cradock District, *Herre* 1021 (BOL); Cradock District, *Meterlekamp* in *NBG* 1509/29 (NBG). 3323 (Willowmore): 22 km N.E. of Willowmore (–AB), *Wisura* 1010 (NBG); Oven siding, Willowmore (–BA), *Moffett* 1031 (STE). 3324 (Steytlerville): 2 km W. of Klipplaat (–AB), *Moffett* 1030 (PRE; STE); 25 km W. of Steytlerville (–AC), *Moffett* 1320 (SUG); Springbok Flats (–BD), *Compton* 20308 (NBG). Without precise locality: Uitenhage Karoo, *Prior s.n.* (K). Grid ref. unknown: Spitskop, *Burt Davy* 13623 (PRE). Without locality: *Bolus s.n.* (BOL); *Burke s.n.* (K; PRE; Z); *Burke & Zeyher* 164 (SAM); *Ecklon & Zeyher* 164 (SAM); *Ecklon & Zeyher* 34.7 (W); *Krebs s.n.* (G–DC).

This species is found on the flat Karoo plains such as around Klipplaat and Pearston, where it generally grows in rocky situations. Between Willowmore and Steytlerville it forms part of the rich succulent flora of the Springbokvlakte. Around Graaff-Reinet, Cradock and Middelburg, it favours a shale substrate or weathered dolerite ridges. It is found in the following veld types: 26, 30, 31, 36, 38 and 60.

Being confined to an entirely summer rainfall region, it is not surprising that the greater majority of specimens is on record as flowering in November, December and January. There are, however, also a few flower records for February, March, June and July. Even though the plant is leafless during the winter months, a light shower of rain may induce it to flower.



FIG. 10.—*Sarcocaulon camdeboense*, Graaff-Reinet, Cape (holotype: *Moffett* 1021 in STE).

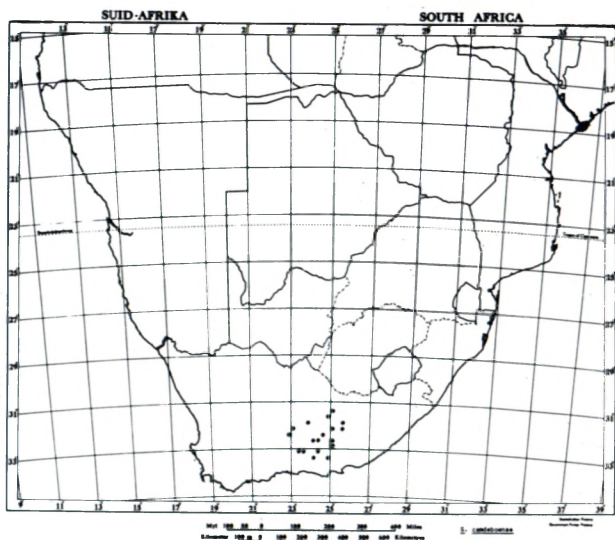


FIG. 11.—Geographic distribution of *Sarcocaulon camdeboense* in Southern Africa.



This species appears to be frost tolerant, as Drège collected it in the Sneeuberg at a height of between 1 520 and 1 830 m.

"Camdebo", which means green elevations, is the Hottentot name given to the mountains and river near Aberdeen and subsequently also used for the plains towards Pearston (Botha, 1926). On these plains, immortalized in Eve Palmer's book, "The plains of Camdeboo", stand many fine examples of this species (Palmer, 1966).

Burke & Zeyher's Gamke River specimen, cited by Harvey (1860) under *S. patersonii* (DC.) is the first record of this species. It was also included in *S. patersonii* (DC.) Eckl. & Zeyh. by Knuth (1912), who cited the following specimens: *Burke* (Gamke River), *Drège* 7515 (Sneeuberg), *Cooper* 491 (Cradock) and *MacOwan* (Blyde River). The latter locality was erroneously attributed to the Transvaal in his geographic distribution. Following the publication of *S. vanderietiae* L. Bol. in 1932, Dyer (1932) attributed the Drège, Cooper and MacOwan specimens to this newly established species. These specimens, together with one by Prior (Uitenhage Division), also cited by Dyer, all represent *S. camdeboense*.

*S. camdeboense* occupies a large area between *S. salmoniflorum* and *S. vanderietiae*. Because it is sufficiently uniform over this area and transitional forms have not been found, it is regarded as sufficiently distinct to warrant description as a new species. Heavily grazed, stunted and flowerless plants may, however, be confused with *S. vanderietiae* to which it is closely allied.

Seed collected at Graaff-Reinet in December 1975 and sown in February 1976, germinated after 1-2 days.

A colour plate of this species may be seen under *S. vanderietiae* in Hobson *et al.* (1975). These authors stated that flowers and leaves are readily grazed, the stems are eaten if the stock are under great pressure, and dried plants are extensively used for lighting fires.

**Common name:** "Kersbos", candle bush. (Hobson *et al.*, 1975).

5. *Sarcocaulon vanderietiae* L. Bol. in S. Afr. Gdng Country Life 22:10 (1932); Dyer in Kew Bull. 9:443 (1932); Rehm in Bot. Jb. 67:269 (1935). Type: Albany, ex horto Grahamstown, *van de Riet* sub NBG 2031/29 (BOL, holo.!).

*S. patersonii* sensu Harv. in Fl. Cap. 1:256 (1860) pro parte; sensu Knuth in Pflanzenr. 4, 129:313 (1912) pro parte, non (DC.) G. Don.

*S. l'heritieri* sensu Eckl. & Zeyh., Enum. No. 436, 57 (1835) non Sweet.

*S. burmannii* sensu Hook. in Curtis's bot. Mag. t.5729 (1868) sensu Knuth, Pflanzenr. 4, 129:313 (1912) pro parte; sensu Rehm in Bot. Jb. 67:267 (1935), non (DC.) Sweet, nom. illeg.

Fleshy, spiny, low-growing shrublet up to 0,15 m high and 0,30 m in diameter; stem branching repeatedly from 10-30 mm above ground level; roots not swollen; branches olive to dark grey, generally 4-10 mm thick with rows of short, single, straight spines and minute tufts of stalks in the axils of the spines. *Leaves* long and short petioled; stipules scale-like, ciliate, caducous; blade laterally entire, glabrous. *Long petioled leaves* almost decussate; petioles persistent and hardened into straight, thin spines (4-) 11 (-20) mm long with flattened, adnate obovate-oblate base 2-4 mm broad; blade broadly elliptic, broadly obovate to cordate (8-) 10 (-14) mm long, (6-) 7 (-8) mm broad, apical margin occasionally

serrulate, apex retuse, deeply incised, often mucronulate, base cuneate. *Short petioled leaves* 2-4 in number in axils of spines; petioles semi-persistent as blunt stalks up to 2 mm long after abscission of the blade; blade cordate to broadly obovate, (3-) 7 (-10) mm long, (4-) 6 (-8) mm broad, apex retuse, often mucronate, base cuneate. *Flowers* when open up to 21 mm long (excluding pedicel), 34 mm broad; peduncle sessile; pedicel glabrous, (4-) 11 (-20) mm long. *Sepals* puberulous or glabrous, 5-10 mm long, 3-4 mm broad, mucro less than 1 mm long. *Petals*

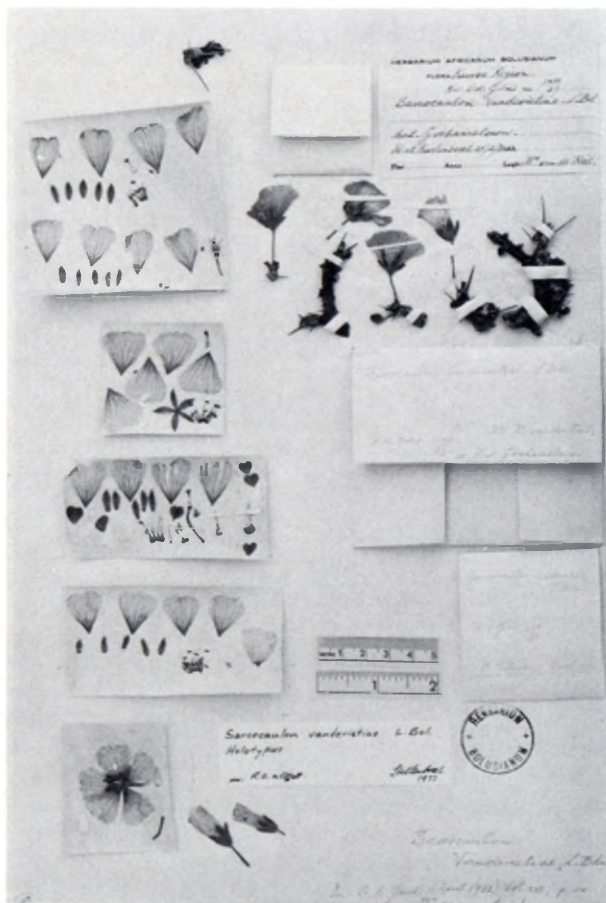


FIG. 12.—*Sarcocaulon vanderietiae*, Albany, ex horto Grahams-town (holotype: *Van de Riet* sub NBG 2031/29 in BOL).

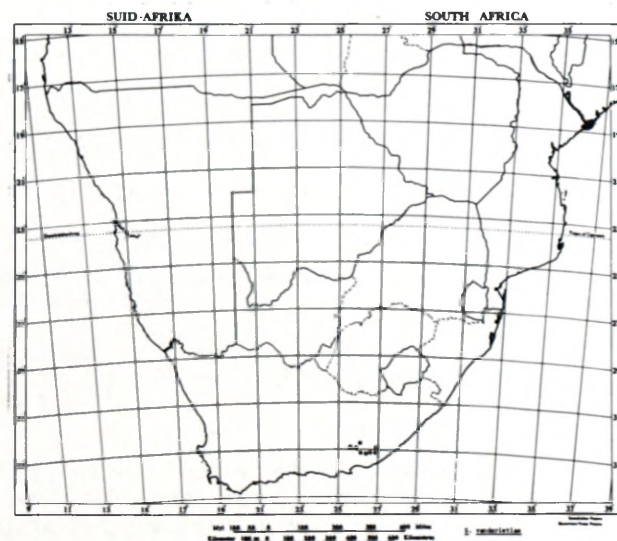


FIG. 13.—Geographic distribution of *Sarcocaulon vanderietiae* in Southern Africa.



obovate, pale pink to white suffused pink, (R.H.S. No. 55D to 158D and 36D), (10–) 18 (–20) mm long, (9–) 15 (–18) mm broad. *Stamens* with long filaments 8–9 mm long, short filaments 6 mm long; basal 2 mm of filaments fused; anthers 3 mm long. *Ovary* sericeous, style puberulous to glabrous, stigmas 2 mm long. Fruit not seen. PLATE 3a; FIG. 12.

#### Diagnostic features

Low growing to prostrate shrublet; branches thin; spines thin and straight, base adnate, obovate to oblate. *Leaves* entire, glabrous, broadly elliptic to cordate, apical margin emarginate, often serrulate. *Petals* as broad as long, pale pink to white suffused pink.

This species is limited to the eastern Cape (FIG. 13), occurring in the valley of the Great Fish River and its immediate tributaries from just south of Somerset East and the Middleton area to Hunts' Drift on the road between Grahamstown and Peddie.

CAPE.—3225 (Somerset East): 24 km S. of Somerset East (–DC), *Rawe s.n.* (HORT. RAWE); near Middleton, 510 m (–DD), *Rogers s.n.* (BOL). 3226 (Fort Beaufort): Bedford District (–CA), *Maguire 671* (NBG); Junction Farm (–DD), *Crampton 15* (GRA). 3326 (Grahamstown): Boschfontein, Riebeek-Oos (–AA), *Moffett 1036* (STE; SUG); Hounslow (–AB), *Galpin 13249* (BOL; K; PRE); Bothasberg (–BA), *Ecklon & Zeyher 436* (G; GOET; M; SAM; W); between Queens Pass and Fort Brown (–BA), *Moffett 1318* (SUG); between Peddie and Committees, 400 m (–BB), *Bokelmann s.n.* (NBG); between Breakfast Vlei and Grahamstown (–BB), *Denman 40* (GRA); between Committees and Hunt's Drift, 460 m, (–BB), *Dyer 909* (GRA); Trumpeters Drift (–BB), *Leach & Bayliss 12574* (K; Z); 20 km S.W. of Peddie (–BB), *Moffett 1311* (NBG; PRE; STE). Without precise locality: King William's Town District, *Hobson s.n.* (PRE); Fish River, *Krook 2231* (W); Fish River, 490 m, *Schlechter 6114* (GRA; Z). Without locality: *Vanderiet* sub *NBG 2031/29* (BOL).

This species is usually found growing on shallow shaly soils on the more level areas on either side of the Fish River or occasionally in "Karooveld" in those parts of the valleys where the scrub is less dense. It occurs in Veld Types 23, 37 and on the verge of 68.

*S. vanderietiae* flowers mainly in the summer months from December to February. It has, however, also been recorded as being in flower in February, March, April, September and October. Batten and Bökelmann (1966) give the flowering time as October–November.

The earliest collection of this species was made by Ecklon in about 1830 in the Fish River valley and was incorrectly referred to as *S. l'heritieri* (DC.) Sweet by Ecklon & Zeyher (1835). Harvey (1860) cited this specimen under *S. patersonii* DC., as did Knuth (1912), the latter also citing Schlechter's Fish River specimen. A colour plate of this species is figured in the Botanical Magazine, t.5729, as *S. burmannii* (Hooker, 1868). The sepal mucros as depicted in the detailed dissection and one old flower in this figure are, however, too long for this species, and may represent material of *S. crassicaule* (*S. burmannii*). Dyer (1932) suggested that this figure might represent a cultivated form of *S. vanderietiae*, but he was puzzled by the minutely serrate apical leaf margin. This feature, however, has been observed in a population between Queens Pass and Fort Brown, north of Grahamstown (own observation).

Rehm (1935) cited the above figure as the type for *S. burmannii* (DC.) Sweet *emend.* Rehm. However, as he also included *S. vanderietiae* as another distinct species, the position became somewhat confused—so much so that the specimens cited by him under *S. burmannii* actually represent *S. l'heritieri* Sweet.

Furthermore, because a type is that element with which a name is permanently attached (Article 7 of the Code), the designation of a new type for the name *S. burmannii* is against the rules of the Code. *S. burmannii* (DC.) Sweet *emend.* Rehm is thus an illegitimate name.

This species has grown well in a garden at Kommetjie, Cape Peninsula, and the few plants in the Botanical Garden at the University of Stellenbosch appear to be doing well.

A coloured illustration of *S. vanderietiae* may be seen in Batten & Bökelmann (1966).

Section *Crenatum* *Moffett*, sect. nov., a sectionibus aliis marginibus lateralibus foliorum crenatis vel lobatis et floribus flavis specierum trium differt.

Type species: *S. crassicaule* Rehm

Fleshy, spiny shrublets up to 0,6 m high and 0,5 m in diameter; branches pale olive to grey and greyed yellow. *Leaves* long and short petioled, long petioles persisting as spines, bases oblate, often chestnut; blade puberulous, narrowly obovate to broadly obovate, rotund to orbicular, margin lobed or coarsely toothed, irregularly crenate or dentate. Stipules caducous, occasionally semi-persistent. *Sepals* glabrous, puberulous or pilose. *Petals* pale mimosa and sulphur to primrose yellow, apical margin smooth or ciliate.

Three species, widely distributed in Southern Africa ranging from Prince Albert in the Cape to near Lüderitz in South West Africa, are recognized.

6. *Sarcocaulon crassicaule* Rehm in Bot. Jb. 67:271 (1935). Type: north-western Cape, road Goodhouse–Steinkopf, *Wettstein s.n.* (M, *holo.*!).

*S. spinosum* sensu: Dyer in Kew Bull. 15:444 (1932); Rehm in Bot. Jb. 67:267 (1935). Merxm. & A. Schreib., Prod. Fl. S. W. Afr. 64:16 (1966); non (Burm f.) Kuntze.

*S. spinosum* sensu *emend.* Rehm var. *hirsutum* Rehm in Bot. Jb. 67:268 (1935). Syntypes: South West Africa, Gr. Namaland, *Dinter 6069* (Z, lecto. !; B!; BOL!; STE!); near Aus, *Wettstein 59* (M!).

*Sarcocaulon burmannii* sensu auct. mult.: Eckl. & Zeyher, Enum. No. 438, 57 (1835); Harv. in Fl. Cap. 1:256 (1860); Engl., Bot. Jb. 10:30 (1889); Reiche in Pflanzenfam. 3, 4:9 (1890); Weiss & Yapp in New Phytol. 5:112 (1906); Marloth in Wiss. Ergebn. Dt. ZentAfr.–Exped.:324, t.136 (1908); Knuth in Pflanzenr. 4, 129:313 (1912) pro parte maxima; Dinter in Reprium nov. Spec. Regni veg. Beih. 23:228 (1926); L. Bol. in S. Afr. Gdng Country Life 22:109 (1932); Range in Reprium nov. Spec. Regni veg. 36:244 (1934); non sensu Rehm in Bot. Jb. 67:267 (1935).

*Monsonia burmannii* sensu Drège, Zwei Pfl. Doc. 26:203 (1843); non DC.

Fleshy, spiny shrublet up to 0,5 m high and 0,5 m in diameter; stem branching repeatedly from 30–50 mm above ground; roots not swollen; branches generally exceeding 10 mm thick with rows of single, straight to slightly curved spines and tufts of short stalks in the axils of the spines; bark grey or greyed yellow, becoming olive green after rains. *Leaves* long and short petioled; stipules scale-like, ciliate, caducous; blade not entire, puberulous to tomentose, occasionally glabrous. *Long petioled leaves* almost decussate; petioles persistent and hardened into slightly curved or straight, fairly thick, spines, or straight thin spines (17–) 30 (–47) mm long with flattened rotund to oblate base up to 6 mm broad; blade narrowly obovate to broadly obovate, occasionally rotund to broadly ovate, irregularly pinnatilobate, crenate or dentate (10–) 15 (–19) mm long, (8–) 10 (–16) mm broad, apex emarginate, base cuneate. *Short petioled leaves* 1–4 in number in axils of spines; petioles persisting as blunt stalks up to 4 mm long



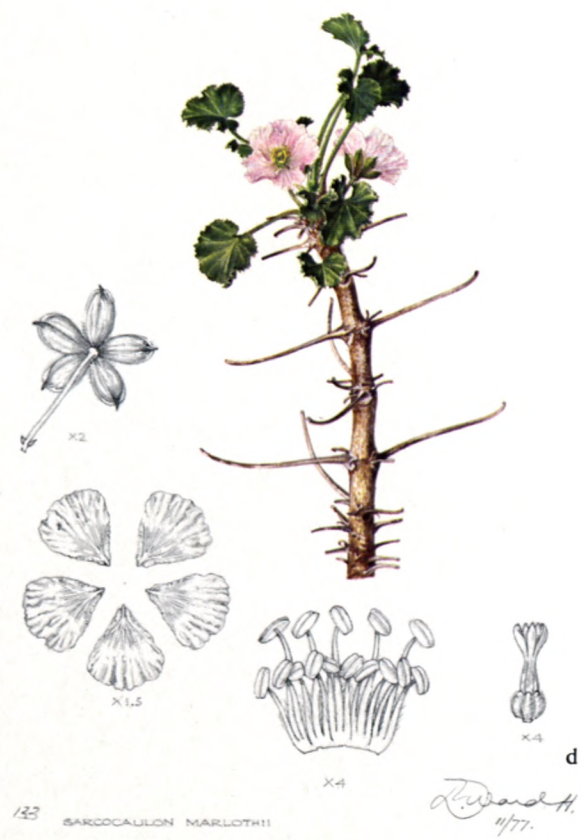
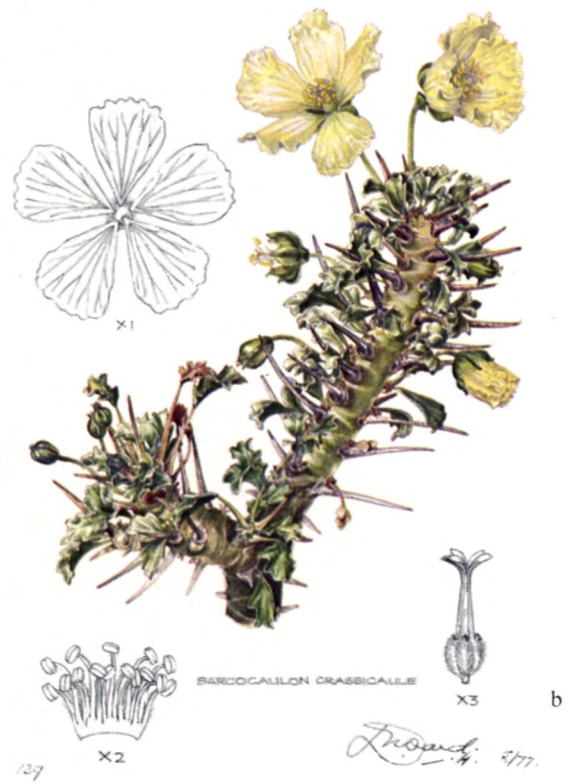


PLATE 3.—a, *Sarcocaulon vanderrietiae* L. Bol.; b, *Sarcocaulon crassicaule* Rehm; c, *Sarcocaulon flavescens* Rehm; d, *Sarcocaulon marlothii* Engl. Magnifications indicated do not apply.







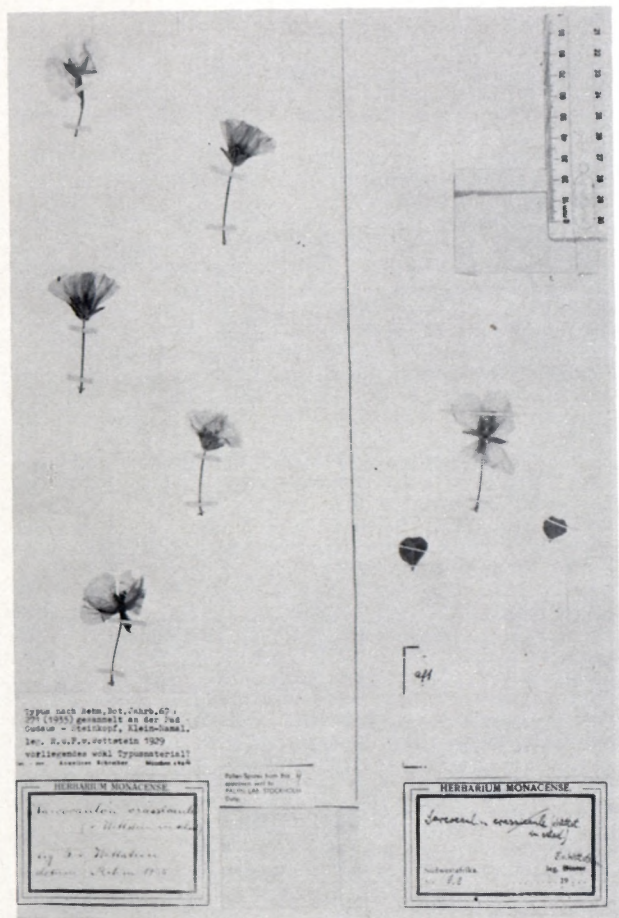


FIG. 14.—*Sarcocaulon crassicaule*, road Goodhouse–Steinkopf, north-western Cape (holotype: Wettstein s.n. in M).



FIG. 16.—Fine-spined form of *Sarcocaulon crassicaule*, Rosyntjieberg, Richtersveld, north-western Cape (Moffett 961, height  $\pm 0,4$  m).

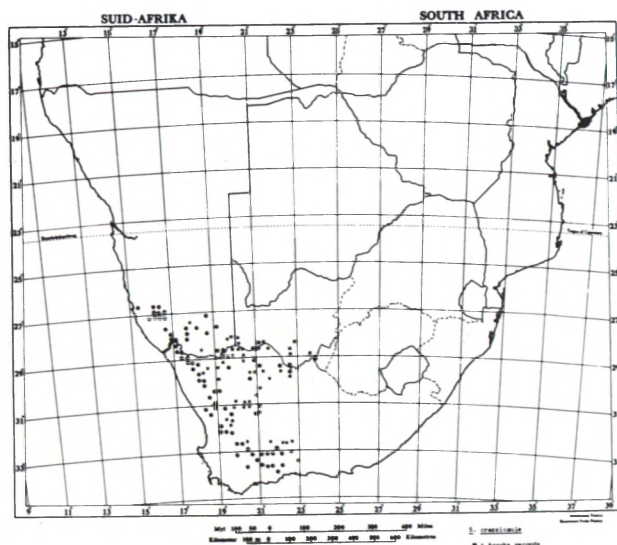


FIG. 17.—Geographic distribution of *Sarcocaulon crassicaule* in South Africa.



FIG. 15.—*Sarcocaulon crassicaule*, near Laingsburg, Cape (Moffett 629, height  $\pm 0,2$  m).

after abscission of blade; blade narrowly obovate to broadly obovate (6–) 15 (–25) mm long, (4–) 9 (–14) mm broad; apex emarginate; base cuneate. *Flowers* when open up to 33 mm long (excluding pedicel) and 55 mm broad; peduncle glabrous, up to 8 mm long; pedicel glabrous (10–) 28 (–50) mm long. *Sepals* puberulous and/or pilose, 7–13 mm long, 3–5 mm broad, mucro flattened 2–3 mm long. *Petals* sulphur to pale mimosa (R.H.S. No. 6D–8D–11D), (16–) 22 (–28) mm long, (10–) 17 (–25) mm broad; margin not ciliate. *Stamens* with long filaments 12–14 mm long, short filaments 8–10 mm long; basal 2–3 mm of filaments fused; anthers 3 mm long. *Ovary* sericeous, style tomentose to puberulous, stigmas 2–3 mm long, occasionally purple. *Mericarp* 60–90 mm long; base 11–12 mm long, tail 52–76 mm long. *Seed* 3–4 mm long. PLATE 3b; FIGS 14, 15 & 16.

*Diagnostic features*

Erect, spiny, rigid shrublets; branches thick; spines straight to slightly curved, generally thick *Leaf* blade puberulous to tomentose, seldom glabrous,



pinnatilobate, crenate or dentate, narrowly to broadly obovate, occasionally rotund to broadly ovate. *Sepals* puberulous and/or pilose, mucro exceeding 2 mm in length. *Petals* large, slightly longer than broad, sulphur to pale mimosa. *Merica*r*p*: base 11–12 mm long.

Widely distributed over the southern part of South West Africa and the northern, western and southern Great Karoo below about 1 300 m above sea level (Fig. 17). Its northern limit is the dune-sea north of Lüderitz–Aus and from here the plants are scattered over a wide area across to Prieska and Douglas. In the southern part of South West Africa, this species occurs west of the high plateau, though not reaching the sea. In South Africa, however, it does not occur west of the Namaqua granites or the mountains of the Richtersveld. It is plentiful in Bushmanland and is found in the Tanqua and Montagu–Oudtshoorn Karoo, as well as the lower Great Karoo as far east as Prince Albert. It has not been found in the intervening escarpment and high plateau that stretches from Sutherland to De Aar and further. Fig. 19.

S.W.A.—2615 (Lüderitz): Halenberg (–CB), *Moffett 1199* (SUG). 2616 (Aus): Klein Aus (–CA), *Erni 560*; s.n. (ERNI); between Garub and Aus (–CA), *Pearson 4168* (BOL; K); Aus (–CB), *Dinter 6069* (B; BOL; STE; Z); 10 km W. of Aus (–CB), *Giess & Van Vuuren 638* (K; M; PRE; WIND); 11 km W. of Aus (–CB), *Merxmüller 2370* (M); Aus (–CB), *Moffett 1343* (PRE; STE); Aus (–CB), *Range 1146* (SAM); Aus (–CB), *Schinz 255* (Z); Aus (–CB), *Van Son s.n.* (PRE); Aus (–CB), *Von Wettstein 59* (M); Tsirub, 1200 m (–CC), *Range 1145* (SAM); Tsirub, 1400 m (–CC), *Range 1146* (SAM); Arasab mountains (–CD), *Herre 7702* (BOL). 2618 (Keetmanshoop): 48 km E. of Narubis (–DC), *De Winter 3309* (K; M; PRE; WIND). 2716 (Witpütz): Kuchaus (–AA), *Schenck 140* (PRE; Z); 99 km N. of Rosh Pinah (–AB), *Moffett 1380* (STE-U); 48 km N. of Witpütz (–BA), *Moffett 1174* (SUG); Witpütz (–DA), *Merxmüller 2495* (M); Swartkloofberg (–DA), *Moffett 1346* (PRE; WIND); Numaisberge (–DD), *Dinter 8122* (B; K); without precise locality: Between Witpütz and Numais, *Giess 3748* (WIND). 2717 (Chamaites): Between Fish River Canyon and Hobas (–DA), *Walter 2398* (M); 19 km N.E. of Ais-Ais (–DC), *Moffett 1137* (SUG). 2718 (Grünau): Kraikluft (–BA), *Pearson 8024* (BOL; K); Klein Karas (–CA), *Erni 105* (ERNI); Klein Karas (–CA), *Erni 714* (ERNI); Kanus (–DC), *Dinter 3139a* (SAM). 2816 (Oranjemund): Lorelei Copper Mine (–BB), *Giess, Volk & Bleissner 5384* (M; WIND); Lorelei (–BB), *Merxmüller 2503* (M; PRE); Lorelei (–BB), *Moffett 1349* (PRE; STE; WIND). 2817 (Violsdrif): Kanabis, Ais-Ais, 800 m (–BA), *Marloth 4800b* (PRE). 2818 (Warmbad): 48 km S. of Grünau (–AA), *Bleissner 255* (M); Norachas Farm (–AA), *Giess, Volk & Bleissner 6906* (M; WIND); Sperlingspütz Farm (–CA), *Giess & Müller 12259* (WIND); 20 km N. of Raman's Drift (–CD), *Pearson 4378* (BOL; BM; GRA; K). 2819 (Ariamsvlei): 24 km N. of Onseepkans (–CA), *Moffett 1211* (STE; WIND); 10 km N. of Velloors Drift Bridge (–CB), *Nordenstam 3886* (M). Grid ref. unknown: Swart Ausberge–Löwenberg, *Erni 550* (ERNI); Kokerboom, *Herb. NBG 1625/27* (NBG); Mariental, Lüderitz South, *Merxmüller 2570* (M); Blinkoog Farm, Warmbad, *Walter 2398* (M). Without precise locality: Paviaanspforte, Great Karasberg, *Pearson 8155* (K); Lüderitz District, *Van Son s.n.* (PRE). Without locality: *Holloway 26* (BOL).

CAPE.—2816 (Oranjemund): Pokkiespramberg (–BB), *Moffett 966* (STE). 2817 (Violsdrif): Rooiberg (–AA), *Moffett 960* (PRE; STE); Kookrivier (–AA), *Moffett 961* (SUG); Goeroegap Pass (–AC), *Moffett 962* (SUG); between Kahams and Rosyntjeburg (–CA), *Moffett 946* (PRE; STE); 1 km S. of Klipbokkop (–CB), *Moffett 939* (STE); Klipbokkop (–CB), *Moffett 942* (STE); 5 km E. of Eksteenfontein (–CB), *Moffett 943* (STE); e nkinskop (–CB), *Moffett 945* (STE); Kleinhelskloof Gate (–CD), *Moffett 632* (NBG; PRE!); Blesberg Mine (–DC), *Moffett 1321* (PRE; STE). 2820 (Kakamas): Waterval (–CB), *Wasserfall 1028* (PRE); Augrabies National Park, 700 m (–CB), *Werger 327* (K); Keimoes (–DB), *Barnard in SAM 32362* (SAM). 2821 (Upington): 7 km N.E. of Keimoes (–CA), *Moffett 1003* (STE-U). 2917 (Springbok): Klipfontein (–BA), *Herre s.n.* (BOL); between Eenriet and Komkyp (–BB), *Moffett 926* (STE); Komkyp Mountain (–BB), *Moffett 1123* (STE); Komkyp Mountain (–BB), *Moffett 1129* (NBG); 24 km N.E. of Springbok (–BD), *Martin 538* (NBG); Spitskop (–BD), *Moffett 976* (SUG). 2918 (Gamooep): 42 km E. of Springbok (–CA), *Moffett 981* (PRE); Kaipfarm (–CA), *Rösch & Le Roux 265*

(STE); Wild Flower Reserve (–CA), *Rösch & Le Roux 1030* (STE); Wild Flower Reserve, 1070 m (–CA), *Rösch & Le Roux 1128* (STE); Rietfontein, 700 m (–CC), *Pearson 3441*; 3764 (K); 80 km S.E. of Springbok (–CD), *Moffett 982* (SUG). 2919 (Pofadder): Gannapoort (–BC), *Schlieben 8953* (K; PRE). 2920 (Boomrivier): Groot Rosynebos, 850 m (–BB), *Pearson 3847* (K); 80 km S. of Kenhardt (–DC), *Moffett 995* (STE-U). 2921 (Kenhardt): 17 km S. of Kenhardt (–AC), *Moffett 997* (PRE; STE); 8 km N. of Kenhardt (–AC), *Moffett 1000* (STE-U). 2922 (Prieska): 45 km N.W. of Prieska (–AC), *Moffett 1005* (STE-U); Prieska Outspan (–DA), *Acocks 2550* (BOL; KMG; PRE); Prieska (–DA), *Fuller 190* (BOL). 2923 (Douglas): Douglas (–BB), *Anderson 590* (BOL). 3018 (Kamiesberg): Near Aalwynfontein (–BD), *Pearson 3476* (K); Grootdrink (–DA), *Thompson 2852* (STE); between Rooimuskop and Langberg (–DD), *Moffett 983* (STE); Kromrivier (–DD), *Moffett 984* (PRE; STE); Kromrivier (–DD), *Moffett 1215* (SUG). 3019 (Loeriesfontein): Near Lospersplaats (–AC), *Ecklon & Zeyher 162a*; 162b (G; K; PRE; W; Z). 3118 (Vanrhynsdorp): 7 km E. of Nuwerus (–AB), *Thompson 2844* (STE); Soutrivier (–BC), *Moffett 650* (STE); Soutrivier (–BC), *Moffett 890*; 891 (SUG); 24 km S. of Nuwerus (–BC), *Moffett 1114* (SUG). 3119 (Calvinia): 9 km S. of Loeriesfontein (–AB), *Moffett 1216* (SUG); 26 km N. of Calvinia (–BC), *Johnson 587* (NBG); Doornbos (–CC), *Herb. BOL* (BOL). 3120 (Williston): Williston (–BD), *Herre 1022* (BOL). 3219 (Wuppertal): near Middelplaas, 400 m (–AA), *Leipoldt 3797* (BOL; PRE); Diamond Drift (–AB), *Leipoldt 3064* (BOL); Middelplaas (–AB), *Moffett 986* (STE); near Tulpfontein (–BA), *Moffett 652* (STE); 112 km N. of Ceres (–BA), *Moffett 889* (STE); Oudebaaskraal (–DB), *Moffett 836* (PRE; STE). 3220 (Sutherland): Houthoek (–CA), *Hanekom 1112* (PRE); Yuk River (–CC), *Burchell 1241* (K). 3319 (Worcester): Spes Bona, 640 m (–BB), *Marloth 10532* (PRE); Inverdoorn (–BB), *Moffett 865* (SUG). 3320 (Montagu): Soutkloofseberge (–BA), *Moffett 778* (STE); 5 km N. of Matjiesfontein (–BA), *Moffett 802* (SUG); Whitehill Station, 750 m (–BA), *Thompson 1237* (STE); 32 km W. of Ladismith (–BD), *Lewis in BOL 31448* (BOL); Witvlakte (–BD), *Moffett 1039* (PRE; STE); Eierpoort (–CB), *Moffett 1264* (SUG); between Bo-plaas and Allemorgens (–CB), *Moffett 1295* (SUG). 3321 (Ladismith): 7 km N.E. of Wyke Station (–AA), *Moffett 722* (SUG); Koup (–AB), *Bond 941* (NBG); Blaauwkrantz (–BA), *Moffett 748*; 749 (STE); 750 (NBG; PRE; STE); near Koup Station (–AB), *Moffett 803* (SUG); 99 km N.E. of Matjiesfontein (–BA), *Moffett 629* (STE); 7 km S. of Ladismith (–CA), *Hugo 197* (STE); 7 km S. of Ladismith (–CA), *Hugo s.n.* (SUG); 40 km N.E. of Barrydale (–CA), *Moffett 654* (STE); Rooiberg, 610 m (–CB), *Wurts 1279* (NBG); 5 km E. of Rietvlei (–DA), *Hartmann 8872* (SUG); Radleigh, 300 m (–DA), *Thompson 1416* (STE). 3322 (Oudtshoorn): 5 km E. of Prins Albert (–AA), *Hartmann 8920* (STE); Prins Albert (–AA), *Herb. BOL 4328/14* (BOL); Kandelaarsrivier (–CA), *Hugo 147* (STE). Grid ref. unknown: Grassdale, Hay Division, *Acocks 2563* (BOL; KMG; PRE); Klein Witboom, Hay Division, *Cawood s.n.* (KMG); Dawup River, *Pearson 6232* (K); Vassche River, *Pearson 6820* (K). Without precise locality: Gamka River, 1843, *Burke 38* (Z); Gamka River, *Burke 44* (BM; K); between Droogeheuvel and Jackals Fontein, 760 m–910 m, *Drège s.n.* (G; K; W); Gamka River, *Ecklon & Zeyher 162* (BM; G; GRA; SAM); South of Doornpoort, *Erni 709* (ERNI); between Springbok and Goodhouse, *Henrici 2223* (PRE); Calvinia District, *Henrici 3410* (PRE); near Upington, *Herb. NBG 1622/27* (NBG); near Springbok, *Lewis 1086* (SAM); Upington District, *Mostert 1629* (PRE); Dwyka River, *Rennie in NBG 1428/28* (BOL); Oudtshoorn District, *Taylor in NBG 978/23* (BOL); between Goodhouse and Steinkopf, *Von Wettstein 58* (M). Without locality: *Herb. NBG 1111/13* (BOL); Krebs (G); *Leipoldt s.n.* (PRE); *Masson* (BM); *Pillans s.n.* (BOL); *Von Wettstein slc* (M).

This species is generally found in rocky habitats. In southern South West Africa it is confined to the mountainous areas, while on the plateau it also occurs in and amongst rocks. In South Africa (Fig. 18) it is often found among dolerite boulders along the many dykes which occur in the Karoo. Near Laingsburg and in the Tanqua Karoo it grows on bare exposed tillite outcrops. In South Africa, *S. crassicaule* occurs in Veld Types 17, 25, 26, 28, 29, 31, 32, 33 and 39 and in South West Africa in Vegetation Types 3a and 9.

In South West Africa, this species has been recorded as flowering in every month except December. In South Africa it is predominantly Spring and Summer flowering except in the Tanqua and Montagu Karoo where, due to the winter rainfall, it flowers in May and June. February, March and April are on record



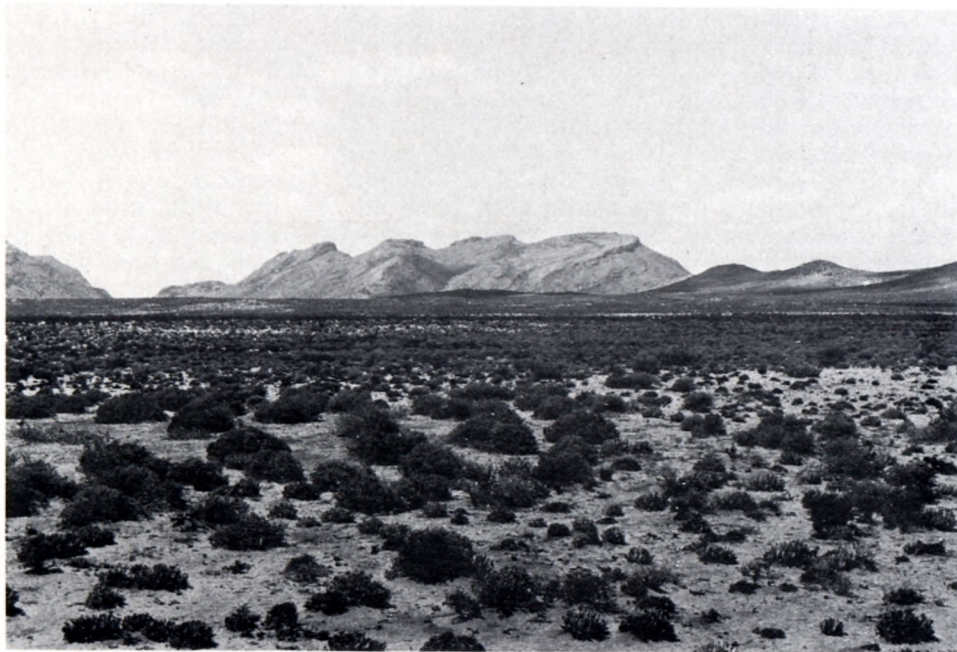


FIG. 18.—Typical habitat of *Sarcocaulon crassicaule* (plain) and *S. herrei* (mountain slopes). Plain north of Eenriet Mountain, near Steinkopf, north west Cape.

as flowerless months. This species appears to be unable to withstand very low temperatures, as it has not been found on the high escarpment and adjacent plateau of the southern Karoo, an area which is occasionally subject to snow.

This taxon, which is distinct in the genus, is at present known in nearly all herbaria as *S. burmannii* (DC.) Sweet or *S. spinosum* (Burm.f.) Kuntze. Both these names have as their type, Fig. 31, entitled "Geranium spinosum, nodosum, foliolis reflexis", in Burman (1738). As no known specimens or taxa match either this plate or the subsequent type description, *S. burmannii* and *S. spinosum* are included under "species incertae".

The earliest figure which depicts this taxon accurately is a sketch by Miss Emily Dust of a portion of a plant from Matjiesfontein, Cape Province (Weiss & Yapp, 1906). A further unambiguous figure is that on p.324 of *Das Kapland* (Marloth 1908), while a fine photograph of a flowering branch of this species may be seen in t.36 in Dinter (1914).

In his revision of the genus, Rehm (1935) described this new species from material collected between Goodhouse and Steinkopf by R. and F. von Wettstein in 1929. The type fragment as well as the description and figure in his publication show this taxon to be the same as *S. spinosum emend.* Rehm in the same publication. Rehm separates them in his key to the species chiefly on a difference in thickness of stem, *S. crassicaule* being 1,5–2,5 cm thick, and *S. spinosum* about 1 cm thick. The latter measurement is, however, not adhered to in the text where *S. spinosum* is described as from 0,9–1,5 cm thick.

The hairiness of the sepals appears to be a character of not much significance in this species. Pilose individuals, although fairly plentiful in the southern part of South West Africa, are also found scattered throughout the rest of its area.

A very fine-spined form of *S. crassicaule* is found in the area north of Eksteenfontein in the Richtersveld and in the Lorelei and Namuskluft areas of southern South West Africa. This population usually has a pale yellow bark and pilose sepals. Transitions between his form and the normal *S. crassicaule*, both at the

southern boundary near Jenkinskop, and at the northern end near Witpütz, preclude description of it as a separate subspecies.

A slightly thinner-branched form with an almost cushion-like habit occurs in the eastern Knersvlakte near Vanrhynsdorp. This habit appears to be the result of repeated heavy grazing by small stock and wild animals.

Seed of *S. crassicaule* collected near Laingsburg in November 1975 and sown in the Botanical Garden of the University of Stellenbosch in February 1976, germinated after 1–6 days. This species grows well in cultivation, often bearing masses of flowers while having no leaves. Watt and Breier-Brandwijk (1962) stated that this species has been used as a remedy for diarrhoea, and the powdered root as a poultice.

*Common names:* "Kaarsbos" (Marloth, 1917), "Boesmansdoring" (Smith, 1966), "Kersbos", "Heldoring" (Barkhuizen, 1967). A note in pencil in one copy of Marloth (1917) at the University of Stellenbosch, gives "Kaaingbos", which presumably refers to the bark which, when heated, melts or burns like "kaaing" or crackling.

7. *Sarcocaulon ciliatum* Moffett, sp. nov., *S. flavescenti* Rehm affinis sed foliis lobatioribus, spinis castaneis et apicibus petalorum ciliatis.

Suffrutex succulentus, spineus, usque ad 0,18 m altus et 0,3 m in diametro, subinde usque ad 0,3 m altus et 0,5 m in diametro habitione montana; caulis repetite ramificans a 20–50 mm supra solum; radices non tumidae; rami griseo-brunei, generatim usque ad 10 mm lati, spinis longis singularibus serialibus, tenuis (c.1 mm in diametro medio) rectis, castaneis et caespitibus stipitum brevium in axillaribus spinarum. *Folia* longe et breve petiolata; stipulae squamiformes, ciliatae, caducae vel semipersistentes; lamina non integer, puberula subinde glabra. *Folia longe petiolata* paene decussata; petioli persistentes, in durati et formantes spinas rectas (8–) 14 (–26) longas et quoque base complanata rotunda 3–5 mm lata; lamina anguste vel late obovata, late elliptica, irregulariter pinnatifida, (7–) 14 (–23) mm longa, (6–) 12 (–16) mm lata, apice emarginato, base attenuata vel cuneata. *Folia breve petiolata* 1–3 in axillaribus spinarum;



petioli persistentes obtusi usque ad 3 mm longi ubi lamina abscissa; lamina obovata vel late obovata (8-) 14 (-21) mm longa, (4-) 10 (-12) mm lata, apice emarginato, base attenuata vel cuneata. Flores ubi apertae usque ad 21 mm longae (pedicello excluso), 35 mm latae; pedunculus 0-2 mm longus. *Sepala* puberula vel tomentosa vel subinde glabra, 8-11 mm longa, 3-4 mm lata, mucrone usque ad 1 mm longo. *Petala* obovata, primulina (R.H.S. No. 4C), (11-) 16 (-20) mm longa, (6-) 10 (-15) mm lata, apicibus ciliatis. *Stamina* filamentis longis 7-10 mm longis, filamentis connatis 2-3 mm ad basim; antherae 3 mm longae. *Ovarium* sericeum, stylo tomentoso vel puberulo, stigmatibus 2,5 mm longis. *Mericaipia* 50-70 mm longa, basibus 8-9 mm longis, caudis 41-62 mm longis. *Semen* 3 mm longum.

TYPE.—North-western Cape, 10 km N. of Soebatsfontein, *Moffett* 911 (STE, holo!; PRE!).

Fleshy, spiny, low growing shrublet up to 0,18 m high and 0,3 m in diameter, occasionally up to 0,3 m high and 0,5 m in diameter in the mountains; stem branching repeatedly from 20-50 mm above ground; roots not swollen; branches greyed brown, generally less than 10 mm thick with rows of single, thin (mid-diameter c. 1 mm), straight, chestnut brown long spines and tufts of short stalks in the axils of the spines. *Leaves* long and short petioled; stipules scale-like, ciliate, caducous to semi-persistent; blade not entire, puberulous, occasionally glabrous. *Long petioled leaves* almost decussate; petioles persistent and hardened into straight, thin spines (8-) 14 (-26) mm long with flattened, rotund base 3-5 mm broad; blade narrowly to broadly obovate, broadly elliptic, irregularly pinnatifid, (7-) 14 (-23) mm long, (6-) 12

(-16) mm broad, apex emarginate, base attenuate to cuneate. *Short petioled leaves* 1-3 in number in axils of spines; petioles persisting as blunt stalks up to 3 mm long after abscission of the blade; blade obovate to broadly obovate (8-) 14 (-21) mm long, (4-) 10 (-12) mm broad; apex emarginate, base attenuate to cuneate. *Flowers* when open up to 21 mm long (excluding pedicel) and 35 mm broad; peduncle sessile or up to 2 mm long; pedicel glabrous, 5-23 mm long. *Sepals* puberulous to tomentose or occasionally glabrous, 8-11 mm long, 3-4 mm broad, mucro up to 1 mm long. *Petals* obovate, primrose yellow (R.H.S. No. 4C), (11-) 16 (-20) mm long, (6-) 10 (-15) mm broad; apically ciliate. *Stamens* with long filaments 7-10 mm long, short filaments 5-8 mm long; basal 2-3 mm of filaments fused; anthers 3 mm long. *Ovary* sericeous, style tomentose to puberulous; stigmas 2,5 mm long. *Mericarps* 50-70 mm long; base 8-9 mm long, tail 41-62 mm long. *Seed* 3 mm long. PLATE 1; FIG. 19.

#### Diagnostic features

Semi-erect, spiny shrublet; branches thin, chestnut to greyed brown; spines thin and straight, chestnut brown. *Leaves* puberulous to tomentose, to broadly obovate or elliptic, irregularly pinnatifid; base cuneate. *Petals* longer than broad, primrose yellow, apically ciliate. *Mericaipia*: base 8-9 mm long.

Confined to Namaqualand (Fig. 20), occurring in a narrow zone between the mountains and the sea from near Wallekraal in the south to just north of Lekkering.



FIG. 19.—*Sarcocaulon ciliatum*, near Soebatsfontein, north-western Cape (holotype: *Moffett* 911 in STE).

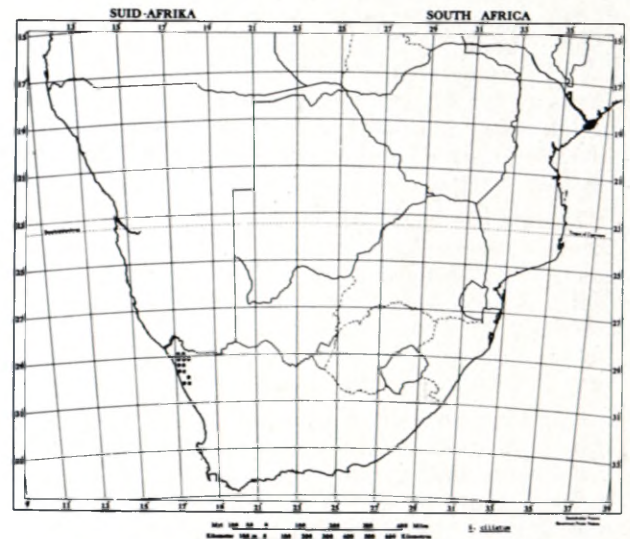


FIG. 20.—Geographic distribution of *Sarcocaulon ciliatum* in Southern Africa.

CAPE.—2817 (Vioolsdrif): 18 km N. of Uitspanpoort (-CC), *Moffett* 973 (STE-U); Kliphooigte, S. of Eksteenfontein (-CD), *Moffett* 934 (PRE; STE); 937 (STE-U). 2917 (Springbok): Near Augrabies (-AA), *Bolus* 12984 (BOL); near Grasvlakte, between Steinkopf and Eksteenfontein (-AB), *Moffett* 931 (STE); Skimmelberg, between Steinkopf and Eksteenfontein (-AB), *Moffett* 932 (STE); 933 (STE-U); 27 km E. of Port Nolloth (-AC), *Moffett* 645 (PRE; STE); 30 km E. of Port Nolloth (-AC), *Moffett* 975 (SUG); between Port Nolloth and Kleinzee (-AC), *Moffett* 1408 (STE-U); Naroegasberge (-AD), *Moffett* 1412 (STE-U); Anenus Pass (-BA), *Moffett* 928; 929; 930 (STE-U); between Port Nolloth and Kleinzee (-CA), *Moffett* 1409 (STE); Wolfberg (-CB), *Moffett* 922 (STE); Bontkoe Mine (-CB), *Moffett* 1411 (STE-U); Wolfberg (-CB), *Moffett* 1413 (K; NBG; PRE; STE; WIND); 8 km N. of Komaggas (-DC), *Compton* 22790 (NBG); Wildepaardehoek (-DC), *Moffett* 912 (STE); 913 (STE-U); 1 km N.E. of Komaggas (-DC), *Moffett* 918; 919 (STE). 3017 (Hondeklipbaai): Between Wildepaardehoek and Riethuis (-AB), *Rawe s.n.*



(HORT. RAWE); 4 km S. of Soebatsfontein (-BA), *Moffett 910* (PRE; STE); 10 km N. of Soebatsfontein (-BA), *Moffett 911* (PRE; STE; SUG). Grid ref. unknown: Vlakmine Flats, *Erni 710* (ERNI); Karrachabberg, *Erni 711* (ERNI); between Brakwater and Komaggas, *Martin 522* (NBG). Without precise locality: Little Namaqualand, *Tucker* sub. *BOL 6656* (BOL). Without locality: *Zeyher 164* (SAM).

This species grows in the red, sandy soils of the Namaqua coastal plain. It also occurs on the quartz ridges in this plain, as well as in cracks among granite boulders along the edge of the mountain chain west of Springbok. It occurs in Veld Types 31 and 33 and possibly reaches into 34.

*S. ciliatum* has flowered in March, September, November and December. The November and December records are for leafless plants. It inhabits a predominantly winter rainfall region, but early summer storms are not unusual in the northern part of its range.

The few specimens of this species collected prior to this study are all in South African herbaria and are referred to as *S. burmannii* (DC.) Sweet or *S. vanderietiae* L. Bol. The deeply incised leaf blades, the chestnut brown branches and spines and the ciliate petals, however, separate it from these other two species. These features, plus its semi-erect habit, also serve to distinguish it from its closest relative, *S. flavescens* Rehm.

Some of the few individuals of *S. ciliatum*, occasionally found in the more mountainous areas, have aciliate petals and are more upright in habit, possibly representing a transitional form between this species and *S. flavescens*.

A large specimen growing in the open in the garden of Mr R. Rawe at Kommetjie, Cape Province, has retained its typical low habit and ciliate petals after five Cape Peninsula winters. Three seedlings from this plant are also true to type (personal observation).

8. *Sarcocaulon flavescens* Rehm in Bot. Jb. 67:271 (1935). Type: South West Africa, Witpütz, *Erni* s.n. (B†; M†; GOET†). Lectotype: t.17, fig. 10 in Rehm in Bot. Jb. 67:271 (1935).

*S. spinosum* sensu Merxm. & A. Schreib., Prod. Fl. S.W.Afr. 64:16 (1966) pro parte, non (Burm. f.) Kuntze.

Fleshy, spiny shrublet up to 0,4 m high and 0,5 m in diameter; stem branching repeatedly from 20–40 mm above ground; roots not swollen; branches grey to greyed yellow, generally less than 10 mm thick with rows of single, thin (mid-diameter c. 1 mm), straight, long spines and tufts of short stalks in the axils of the spines. *Leaves* long and short petioled; stipules scale-like, ciliate, caducous; blade not entire, puberulous to tomentose, occasionally glabrous. *Long petioled leaves* almost decussate; petioles persistent and hardened into straight, thin spines (13–) 19 (–25) mm long with flattened broadly ovate base 3–4 mm broad; blade broadly obovate to orbicular, occasionally ovate, irregularly pinnatilobate, dentate, occasionally denticulate (7–) 10 (–18) mm long, (7–) 9 (–13) mm broad, apex rounded, occasionally emarginate, base cuneate to obtuse. *Short petioled leaves* 1–3 in number in axils of spines; petioles persisting as blunt stalks up to 3 mm long after abscission of the blade; blade broadly obovate to ovate and rotund (7–) 12 (–16) mm long, (6–) 10 (–12) mm broad; apex rounded to emarginate; base acute to obtuse. *Flowers* when open up to 21 mm long (excluding pedicel) and 30 mm broad; peduncle sessile or up to 2 mm long; pedicel glabrous 13–20 mm long. *Sepals* glabrous to puberulous, 6–9 mm long,

3 mm broad, mucro up to 1 mm long. *Petals* obovate primrose yellow (R.H.S. No. 4C), (14–) 15 (–17) mm long, (8–) 9 (–10) mm broad; margin not ciliate. *Stamens* with long filaments 8–9 mm long, short filaments 5–6 mm long; basal 2 mm of filaments fused; anthers 3 mm long. *Ovary* sericeous, style tomentose to puberulous; stigmas 2,5 mm long. *Mericarps* 50–65 mm long; base 9–11 mm long, tail 40–55 mm long. *Seed* 3 mm long. PLATE 3c; FIG. 21.



FIG. 21.—Iconotype of *Sarcocaulon flavescens*. Bot. Jb. 67:271 t.17, Fig. 10 (1935).

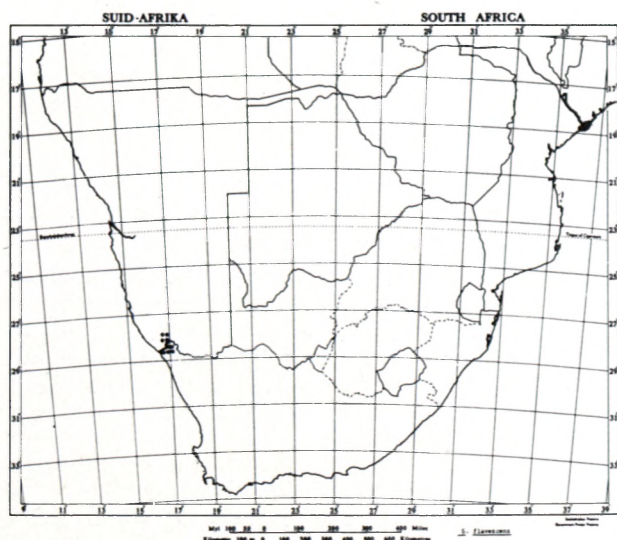


FIG. 22.—Geographic distribution of *Sarcocaulon flavescens* in Southern Africa.



*Diagnostic features*

Erect, spiny shrublet; branches thin, greyed brown to greyed yellow; spines thin and straight, greyed brown. *Leaves* puberulous to tomentose, occasionally glabrous, broadly ovate to orbicular, irregularly pinnatilobate, dentate and occasionally denticulate. *Petals* longer than broad, primrose yellow, apically smooth. *Merica*rps: base 9–11 mm long.

This species occurs in the succulent desert at the foot of the mountains on either side of the Orange River near its mouth (Fig. 22). Its distribution is bounded by Witpütz in the north, Schakalsberg in the west, near Kubus in the south and by the higher mountains towards the east.

S.W.A.—2716 (Witpütz): 5 km N.E. of Obib Water (–DC), *Giess 13002* (M; WIND); 33 km S. of Witpütz (–DC), *Moffett 1146* (STE); 35 km S. of Witpütz (–DC), *Moffett 1379* (STE); Numeisberg (–DD), *Dinter 8122* (B); Namuskluft (–DD), *Giess 12890* (M; WIND); Namuskluft (–DD), *Giess, Volk & Bleissner 5367* (M; PRE; WIND); Namuskluft (–DD), *Moffett 1167* (STE); Namuskluft (–DD), *Moffett 1378* (WIND). 2816 (Oranjemund): Schakalsberg (–BA), *Merxmüller 2304* (M); Schakalsberg (–BA), *Merxmüller 2638(b)* (M); between Daberas and Obib Mountain (–BA), *Moffett 1356* (NBG; PRE; STE; WIND); 1358 (WIND); Schakalsberg, southern foothills (–BA), *Moffett 1403* (SUG); between Schakalsberg and Obib Dunes (–BA), *Moffett 1404* (PRE; WIND); 1405 (STE; WIND); Rooilepel, Schakalsberg (–BA), *Moffett 1406* (SUG); Lorelei Copper Mine (–BB), *De Winter & Giess 6347* (M; WIND); 10 km N. of Sendelingsdrif (–BB), *Hall 1898* (NBG); 18 km S. of Rosh Pinah (–BB), *Moffett 1156* (SUG); 6 km N. of Dreigratdrif (–BB), *Moffett 1355* (PRE; STE). Without precise locality: Lüderitz interior, *Adrian s.n.* (Z); hort Whitehill ex S.W.A., *Compton s.n.* (NBG).

CAPE.—2816 (Oranjemund): Swartpoort (–BB), *Buckley 458* (1) (STE); Pokkiespramberg, Swartpoort (–BB), *Moffett 638* (PRE; STE); 639 (STE); Swartpoort (–BB), *Moffett 965* (PRE; STE); Helskloof (–BD), 1961, *Bayliss s.n.* (NBG); Helskloof (–BD), *Herre 7615*; 7616 (BOL); 1 km S. of Annisfontein (–BD), *Moffett 635* (SUG); 5 km N. of Annisfontein (–BD), *Moffett 636* (STE); 4 km N. of Annisfontein (–BD), *Moffett 955* (PRE; STE); Remhoogte, Numeis (–BD), *Moffett 956* (STE); Helskloof (–BD), *Moffett 963* (PRE; STE); hills N. of Annisfontein (–BD), *Pillans 5485* (BOL; K); hills N. of Witbank (–DA), *Pillans 5138* (BOL); flats near Arrisdrif, 100 m (–DB), *Marloth 12379* (PRE); between Doornpoort and Bloubos (–DB), *Moffett 970* (SUG). 2817 (Violsdrif): Bloubos, Ploegberg (–CA), *Moffett 971* (STE). Grid ref. unknown: Katberg, Richtersveld, 1962, *Erni 707* (STE). Without locality: *Von Wettstein s10*; *s11* (M).

Confined to extremely arid, rocky terrain on the lower slopes of the mountains, as well as in rocky outcrops in the lower lying succulent desert. It is nearly always found growing on a highly metamorphosed substrate such as phyllite. In South Africa, *S. flavescens* occurs in Veld Types 31 and 33, and in South West Africa in Vegetation Type 3a.

This species has been recorded as flowering in February, March, June, September and November. It is not subject to the cooling effect either of the fog from the Atlantic Ocean, or from high elevation, and among all the species, it probably has to contend with the highest temperatures. It is thus invariably leafless in the hot summer months.

In describing this species for the first time, Rehm (1935) cited a collection by Erni near Witpütz in 1930. No trace of this specimen has been found. Rehm (personal communication) thinks it might either have been in the Berlin Herbarium, in which case it was probably destroyed during World War II, as it is not included in the extant Berlin material, or else it might have been a plant in the glasshouse at Munich, or the plant in the Botanic Garden at Göttingen which is depicted in t.17, 10 of Rehm (1935). Both these collections, as well as Rehm's notes, were destroyed by bomb attacks, and *S. flavescens* is left without a type specimen. Article 9,

note 1, of the Code states that if a name is without a type specimen, the type may be a description or figure. Figure 10, on Plate 17 of Rehm's revision of the genus is reasonably clear and is chosen as the lectotype (iconotype). Merxmüller & Schreiber (1966), regarded this species as insufficiently distinct from the more widely distributed, short-haired-sepal form of *S. spinosum* (Burm. f.) Kuntze, to warrant the status of a separate taxon.

There are three slightly different forms of this species. A northern form is found in the area between the Orange River and Witpütz, with bark distinctly greyed brown and leaf blades obovate, irregularly pinnatilobate, whereas in the Swartpoort area of the northern Richtersveld, the bark is paler to almost yellow, and the leaf blades are almost orbicular. Around Annisfontein, individuals have a greyed brown bark and occasionally serrulate to denticulate leaf margins.

Section *Denticulatum* *Moffett*, sect. nov., a sectionibus aliis marginibus foliorum denticulatis differt.

Type species: *S. mossamedense* (Welw. ex Oliv.) Hiern.

Fleshy shrublets with or without spines to erect spiny shrubs up to 1,4 m high; branches pale olive to grey and up to 50 mm thick. *Leaves* long and short petioled, long petioles persisting as blunt (truncate) spines, short petioles deciduous or semi-persistent as blunt spines up to 4 mm long; stipules persistent or caducous; blade glabrous or tomentose below, occasionally sticky, obovate to broadly obovate, broadly ovate to orbicular; base cordate, reniform, obtuse or cuneate; margin minutely toothed erose-denticulate, weakly undulate to sinuous. *Petals* pale rose to purple; sepals glabrous, puberulous or weakly pilose.

Three species, confined to South West Africa and Angola, ranging from Rosh Pinah to Mossamedes, are recognized.

9. *Sarcocaulon marlothii* Engl. in Bot. Jb. 10:31 (1889); Hiern. Cat. Afr. Pl. Welw. 1:109 (1896); Reiche in Pflanzenfam. 3, 4:9 (1890); Engl., Pflanzenw. Afr. 3, 1:707 (1915); Dinter in Reprim nov. Spec. Regni veg. Beih. 23:228 (1926); Range in Reprim nov. Spec. Regni veg. 36:244 (1934); A. Schreib. & Merxm. in Mitt. Bot. StSamml. Münch. 12:394 (1976). Type: South West Africa, Haigamkab & Husab near Swakopmund, *Marloth 1217* (PRE, lecto.!; B?; BOL!; PRE!; SAM!).

*S. mossamedense* sensu ex auctt. pro parte: Knuth in Pflanzenz. 4, 129:312 (1912); in Pflanzenfam. 2, 19a:58 (1931); Rehm in Bot. Jb. 67:265 (1935); Merxm. & A. Schreib., Prod. Fl. S. W. Afr. 64:15 (1966);—non (Welw. ex Oliv.) Hiern.

Fleshy, spiny erect shrub from 0,2–1,4 m high, and up to 1,4 m in diameter; stem branching repeatedly from 50–100 mm above ground; branches greyed yellow to pale olive green, occasionally up to 80 mm thick in old plants, with rows of single, blunt spines curved towards the apex, ending in a blunt swollen point and occasional short stalks in the axils of the spines; thicker branches often have rows of rigid fleshy shoots up to 50 mm long arising from the surface. *Leaves* long and short petioled, stipules scale-like, lanceolate, ciliate, persisting as sharp pointed woody protuberances up to 5 mm long; blade glabrous, somewhat sticky below, broadly ovate to orbicular, margin minutely toothed, erose-denticulate, abaxial venation not extra prominent. *Long petioled leaves* almost decussate; petioles persistent and hardened into blunt spines (9–) 35 (–56) mm long,







for the late winter and spring months, could be due to insufficient collecting, it is possible that in the higher mountains, these months are too cold to promote flowering.

The type specimen of this species is presumed to have been at Berlin-Dahlem, where Engler was based. As it is not in the extant collection at Berlin, it was probably destroyed during the second World War. Isotypes, though somewhat fragmented, are in BOL, PRE and SAM. The specimen in the herbarium of the Botanical Research Institute, Pretoria (PRE) is chosen as the lectotype. Although the locality in the type description is given as Haigamkab only, the PRE label states "Haigamkab et Husab" (Husab is about 15 km from Haigamkab).

Engler (1889) in a footnote to his type description stated that this species could be distinguished from all the hitherto known species by the kidney-shaped leaves. When Dinter first collected the plant in 1900, he could not place it and named it *S. pelargonioides* on his herbarium sheet number 1479. The material in the Zürich Herbarium was determined as *S. mossamedense* by Schinz in 1902. The fact that Schinz had been to South West Africa, whereas he was only working from herbarium material, perhaps influenced Knuth (1912) in deciding that *S. marlothii* should be regarded as a synonym of *S. mossamedense*. Engler (1915) in defending *S. marlothii*, accused Knuth of falsely reducing an excellent species—"Eine ganz ausgezeichnete Art"—to synonymy. Rehm (1935) also included this species in *S. mossamedense* and suggested that it occurs in two forms: a lower growing form in the north and a more shrub-like form in the south and towards the interior. He also stated that there were no marked differences between the leaf and the form of the flower in the two forms.

Merxmüller and Schreiber (1966) followed Rehm in regarding this species as synonymous with *S. mossamedense*, but on the basis of further evidence, these authors re-instated it in 1976.

The population of *S. marlothii* 61 km inland from Henties Bay, consists of dwarf, short-spined plants which, if not in leaf and flower, could be confused with *S. mossamedense*, which is also found there. The presence of these two species, growing together at this locality, is one of the main reasons why *S. marlothii* is regarded as a separate taxon. Two plants from this locality, have retained the characteristic cordate leaf blade and reddish petiole after ten months under glass in the Botanic Garden of the University of Stellenbosch.

In the Duwisib area, *S. marlothii* reaches a height and diameter of 1,4 m with a stem up to 80 mm thick. The highly inflammable branches are used for starting fires, which explains why it is scarce in populated areas.

10. *Sarcocaulon mossamedense* (Welw. ex Oliv.) Hiern in Cat. Afr. Pl. Welw. 1:108 (1896); Knuth in Pflanzenr. 4, 129:312 (1912) pro parte; Engl., Pflanzenw. Afr. 3, 1:708 (1915); Knuth in Pflanzenfam. 2, 19a:58 (1931) pro parte; Rehm in Bot. Jb. 67:265 (1935) pro parte; Exell & Mendonca in Consp. Fl. angol. 1, 2:259 (1951); Merxm. & A. Schreib., Prod. Fl. S.W.Afr. 64:15 (1966) pro parte; A. Schreib. & Merxm. in Mitt. bot. StSamml. Münch. 12:395 (1976). Type: Angola, Serra de Montes Negros near Mossâmedes, *Welwitsch* 1607 (LISU, holo.!: BM!; COI!; G-DC!; K!).

*Monsonia mossamedensis* Welw. ex Oliv. in Fl. Trop. Afr. 1:290 (1868).

Fleshy, spiny, low-growing shrublet, up to 0,3 m high and 0,4 m in diameter; stem branching repeatedly from 30–50 mm above ground; branches grey to grey-white, rarely more than 25 mm thick, with rows of single, blunt spines curved toward the point, and occasional short stalks in the axils of the spines. *Leaves* long and short petioled; stipules scale-like, lanceolate, with papery margins, persisting as sharp pointed woody protuberances up to 5 mm long; blade glabrous, broadly ovate to orbicular, margin minutely toothed, erose-denticulate with abaxial venation prominent. Long petioled leaves almost decussate; petioles persistent and hardened into blunt spines (12–) 22 (–43) mm long, often ending in a swollen point, with a flattened, broadly ovate base up to 6 mm broad; blade markedly undulate (17–) 22 (–29) mm long, (15–) 19 (–29) mm broad, apex rounded, base truncate to obtuse. Short petioled leaves 1–3 in number in axils of spines; petioles persisting as blunt stalks (5–) 10 (–13) mm long, after abscission of the blade; blade wavy to ruffled, (12–) 15 (–17) mm long, (10–) 14 (–17) mm broad, apex rounded, base truncate to obtuse. *Flowers* when open, up to 22 mm long (excluding pedicel) and 35 mm broad; peduncle glabrous (2–) 8 (–18) mm long; pedicel glabrous (8–) 20 (–28) mm long. *Sepals* glabrous, (7–) 10 (–12) mm long, 3–4 mm broad, mucro generally 2–4 mm long, occasionally 1–2 mm long. *Petals* rose (R.H.S. No. 55B) with pale throat, (17–) 22 (–26) mm long, (12–) 15 (–18) mm broad. *Stamens* with long filaments 9–11 mm long, short filaments 7–8 mm long; basal 3 mm of filaments fused; anthers 2–3 mm long. *Ovary* sericeous; style glabrous; stigmas 3 mm long. *Mericarps* 70–80 mm long; base 9–11 mm long, tail 60–70 mm long. *Seed* 3 mm long. PLATE 4a; FIG. 25.

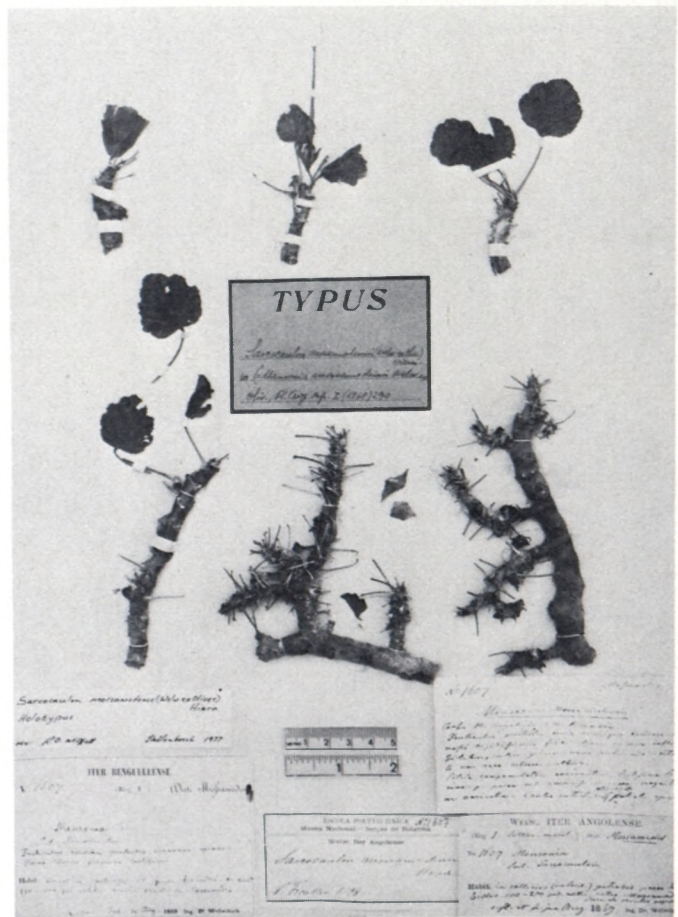


FIG. 25.—*Sarcocaulon mossamedense*, near Mossâmedes, Angola (holotype: *Welwitsch* 1607 in LISU).



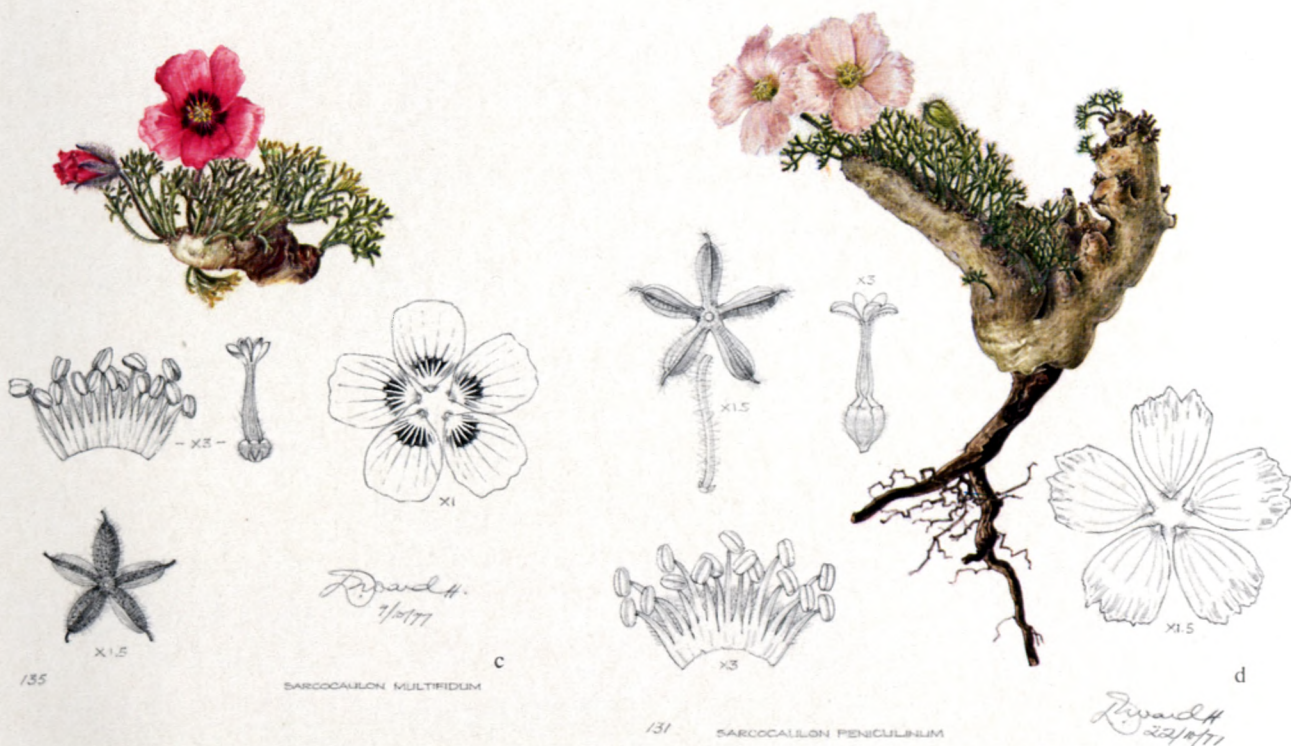
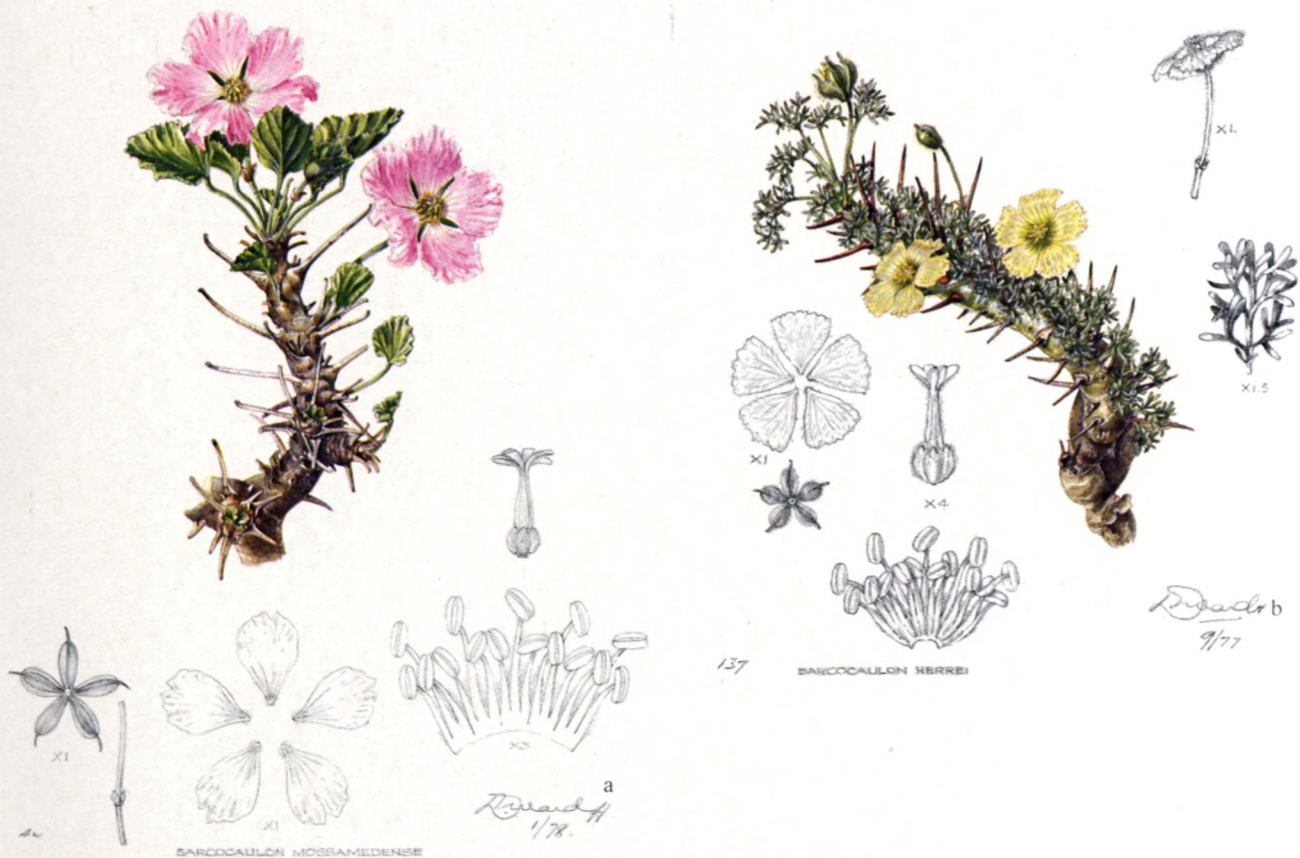


PLATE 4.—a, *Sarcocaulon mossamedense* (Welw. ex Oliv.) Hiern; b, *Sarcocaulon herrei* L. Bol.; c, *Sarcocaulon multifidum* E. Mey. ex Knuth; d, *Sarcocaulon peniculinum* Moffett. Magnifications indicated do not apply.







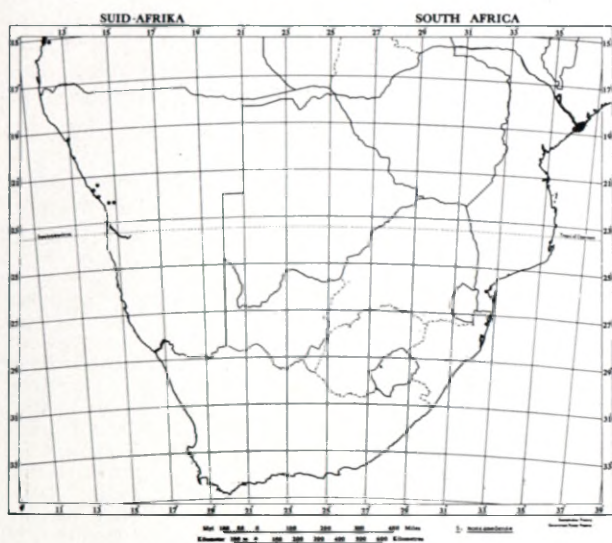


FIG. 26.—Geographic distribution of *Sarcocaulon mossamedense* in Southern Africa.

#### Diagnostic features

Semi-erect to prostrate spiny shrublet; branches less than 25 mm thick; spines curved towards the apex, ending in a blunt, swollen point, stipules persistent. *Leaf blade* glabrous, somewhat wavy, broadly ovate to orbicular; margin erose-denticulate; base truncate to obtuse, rarely cordate; abaxial veins prominent. *Peduncle* generally exceeding 5 mm in length. *Sepal* mucro generally exceeding 2 mm in length. *Petals* rose with white throat. *Merica*r*p*: base 9–11 mm long.

This species has been found near the coast of South West Africa, from Henties Bay in the south to Hoanib River on the Skeleton Coast (Fig. 26). It is furthest from the sea near Henties Bay and in the Messumberg near Cape Cross. It also occurs in southern Angola, just north and east of Mossamedes.

ANGOLA.—Baba, 40 km N. of Mossamedes, *Castro 103* (COI); Mossamedes, *De Abreu 50* (BM; COI); 70 km from Caminho de Ferro, 350–450 m, *Exell & Mendonca 2175* (BM; COI; LISC\*; M); Sierra de Montes Negros, Mossamedes, *Welwitsch 1607* (BM; COI; G; K; LISU).

S.W.A.—1912 (Hoanib Mouth): Ausis, Hoanib River (–BD), *Merxmüller & Giess 30667* (M). 2113 (Cape Cross): Cape Cross (–DB), *Dinter 8467* (B; K; M; Z). 2114 (Uis): Messumberg (–AC), *Giess 9165* (WIND); Messumberg (–AC), *Giess 9654* (M; WIND); Lagunenberg, Cape Cross (–CC), *Giess 3563* (M; PRE; WIND); 140 km N. of Swakopmund (–CC), *Herre 7729* (BOL); Lagunenberg (–CC), *Moffett 1331* (PRE; STE); 1332 (STE). 2214 (Swakopmund): 40 km E. of Henties Bay (–BA), *Moffett 1330* (STE); 63 km E. of Henties Bay (–BB) *Moffett 1325* (PRE; STE); 1327 (PRE; STE; WIND); 1329 (STE). Grid ref. unknown: Pforte, Swakopmund, *Herre 4* (BOL).

*S. mossamedense* grows in extremely arid and bare localities, usually among rocks. It has been found among granite boulders in the Messumberg and in calcite-rich soils around weathered igneous ridges inland from Henties Bay. Near Cape Cross it occurs between dark igneous rocks at the edge of a salt pan, while in the north it has been collected in the bed of the Hoanib River. In Angola, it is recorded as being found in a rocky area, in thorn scrub at the edge of the desert, and among limestones in the mountains. In South West Africa it is found in Vegetation Types 1 and 2.

In South West Africa it is recorded as flowering in February, March, April and June, while in Angola it has flowered in May and August. This species occurs in the most arid part of Southern Africa, and those plants near the coast must rely to a large extent on the coastal fogs for their water requirements.

Oliver (1868) referred to this species as a *Monsonia* in his type description of Welwitsch's 1859 collection from Angola. In cataloguing Welwitsch's Southern African plants, however, Hiern (1896) correctly placed it in *Sarcocaulon*. This species is closely related to *S. marlothii* Engl., which Hiern in his type description (Hiern, 1896) said differs from *S. mossamedense* in having "obtuse, not apiculate sepals". The only two surviving plants in the Botanic Garden of the University of Stellenbosch of *S. mossamedense* from near Henties Bay, have retained the obtuse leaf base after ten months under glass. Dinter, who collected *S. marlothii* and other *Sarcocaulon* species in South West Africa towards the beginning of this century, gave this species the manuscript name *S. promontorii-crucis*, after Cape Cross, where the species is found.

Type sheets from five herbaria were studied. The specimen in the herbarium of the University of Lisbon (LISU) is regarded as the holotype. The figure of *S. mossamedense* in Knuth (1912) represents *S. marlothii*. The cordate and obtuse based leaves seen in Fig. 8 of Exell and Mendonca (1951), is a rare feature which has only been seen in two *S. marlothii* specimens (*De Winter & Hardy 8048*, *Galpin 7601*) and one *S. mossamedense* specimen (*Giess 9654*). These specimens are from transition areas between the two species. If the Exell and Mendonca figure indicates a plant from such a transition area, it is possible that *S. marlothii* also occurs in Angola.

11. *Sarcocaulon inerme* Rehm in Bot. Jb. 67:269 (1935); Merxm. & A. Schreib., Prod. Fl. S.W.Afr. 64:15 (1966). Syntypes: South West Africa, road Witpütz-Sendelingsdrift, *Wettstein s13* (M, lecto.!); *Erni s.n.* (B†?).

Fleshy, dwarf shrublet up to 0,3 m high and 0,3 m in diameter, stem branching 30–70 mm above ground; branches few, 10–20 mm thick, greyed brown to greyed white, with four rows of leaves and/or stalks, *Leaves* long and short petioled; stipules minute, scale-like, broadly ovate, ciliate, caducous or persistent, hidden in leaf bases; blade sinuous, obovate to broadly obovate, upper surface glabrous, lower surface tomentose, especially along the veins, margin minutely toothed, erose-denticulate. *Long petioled leaves*: petiole (3–) 6 (–11) mm long, disarticulating low down to leave a persistent blunt stalk up to 6 mm long; blade (16–) 24 (–39) mm long, (10–) 14 (–18) mm broad, apex rounded, base attenuate. *Short petioled leaves* 1–3 in number, in axils of longer stalks; petioles 1–4 mm long, basal portion remaining as thin blunt stalk after abscission of blade; blade (7–) 12 (–18) mm long, 4–7 mm broad, apex rounded, base cuneate. *Flowers* when open, up to 19 mm long (pedicel excluded) and 30 mm broad; peduncle sessile; pedicel tomentose, (14–) 25 (–40) mm long. *Sepals* pilose and puberulous, (7–) 10 (–12) mm long, 2–4 mm broad, mucro 1–2 mm long. *Petals* rose/purple to purple (R.H.S. No. 68D), (14–) 19 (–27) mm long, (11–) 15 (–18) mm broad. *Stamens* with long filaments 7–9 mm long, short filaments 5–7 mm long, basal 2–3 mm of filaments fused; anthers 2–3 mm long. *Ovary* sericeous; style sericeous to puberulous;

\* Specimen not seen.



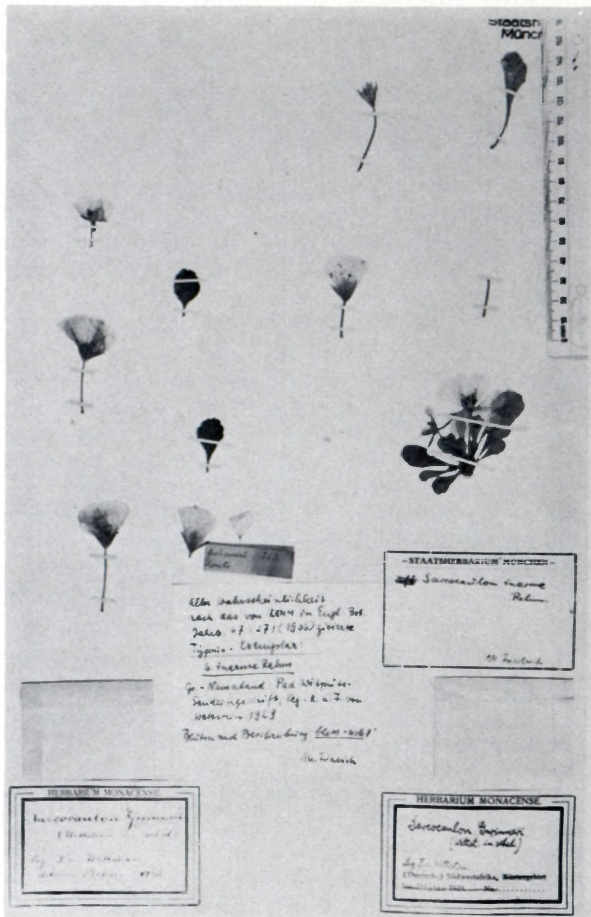


FIG. 27.—*Sarcocaulon inerme*, road Witpütz–Sendelingsdrift, South West Africa (lectotype: *Wettstein s13* in M).

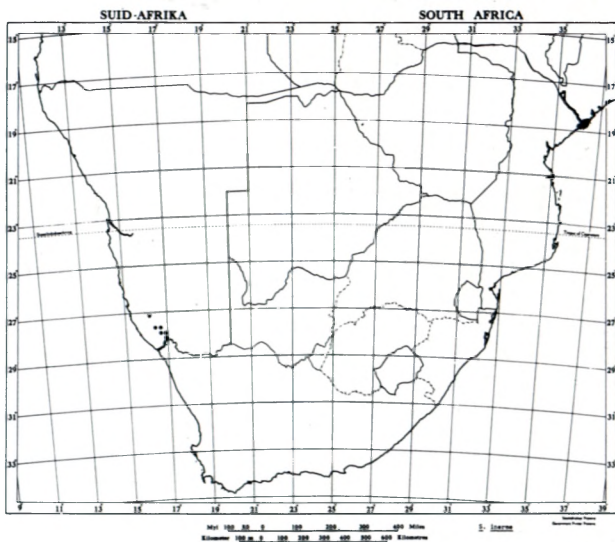


FIG. 28.—Geographic distribution of *Sarcocaulon inerme* in Southern Africa.

stigmas 2–3 mm long. *Merica*r*p* 50–75 mm long; base 10 mm long, tail 50–65 mm long. *Seed* 2–3 mm long. PLATE 5; FIG. 27.

#### Diagnostic features

Semi-erect to prostrate dwarf shrublet; branches greyed brown, generally spineless, with rows of leaves or short blunt petiole bases, or with short blunt spines rarely longer than 6 mm. *Leaf blade* obovate to

broadly obovate glabrous above, tomentose below, especially along the veins; margin markedly undulate, erose-denticulate; base attenuate. *Sepals* pilose and puberulous. *Petals* longer than broad, rose/purple to purple. *Merica*r*p*: base c.10 mm long.

This species has only been recorded from South West Africa (Fig. 28). It occurs in a narrow strip along the foot of the mountains from the Orange River near Rosh Pinah to just north of Witpütz.

S.W.A.—2716 (Witpütz): Kuchaus Mine (–AA), *Herre* 567 (BOL); Rooiberg, Lüderitz District (–CB), *Kinges* 111 (a) (BOL); Witpütz (–DA), *Erni* 198 (ERNI); 5 km N.E. of Obib Water (–DC), *Giess* 13003 (M; WIND); between Rosh Pinah and Obib Water (–DC), *Moffett* 1360 (PRE; STE); Rosh Pinah Golf Course (–DC), *Moffett* 1361 (PRE; STE; WIND); 31 km N. of Lorelei Copper Mine (–DD), *De Winter & Giess* 6393 (M; PRE; WIND); Namuskluft (–DD), *Giess, Volk & Bleissner* 5449 (WIND); 21 km N. of Sendelingsdrift (–DD), *Merxmüller & Giess* 3245 (M; WIND); Rosh Pinah (–DD), *Merxmüller & Gies* 28705 (M); Rosh Pinah (–DD), *Moffett* 1147; 1165 (SUG); 5 km N. of Rosh Pinah (–DD), *Moffett* 1173 (STE); 38 km S. of Witpütz (–DD), *Wisura* 1561 (NBG), 2816 (Oranjemund); 10 km N.E. of Sendelingsdrift (–BB), *Hall* 1893 (NBG); Lorelei Pass (–BB), *Rawe s.n.* (STE); Sendelingsdrift (–BB), *Wiss & Rusch* 2568 (M). Without precise locality: mountains S. of Windhoek, *Bär s.n.* (PRE); between Witpütz and Kahanstal, *Dinter* 8123 (B; K); Lüderitz District, *Herre s.n.* (BOL); road between Witpütz and Sendelingsdrift, *Von Wettstein s.13* (M).

This species is usually found in rocky situations where mountain slopes meet the plain and often near quartz veins. It occurs in Vegetation Type 3a.

Like *S. flavescens*, *S. inerme* has to endure a harsh climate. It has been recorded as flowering in February and March as well as in June, July, August and September. The June and July records are from leafless plants. The leaf blades are adapted to endure the arid and hot conditions. During hot periods, the sinuous-undulate blades close, thus protecting the glabrous upper surface and exposing the hairy abaxial surface. The undulations fit into one another, strengthening the lamina and preventing it from being opened by wind.

This species is unmistakable in the genus as it is the only unsegmented-leaved species having a petiole not persistent as a long and prominent spine. Flowerless and leafless specimens, however, closely resemble *S. multifidum* in a similar state, the only difference being the swollen roots of the latter species.

Wettstein's collection from between Witpütz and Sendelingsdrift in 1929 is chosen as the lectotype, as the other syntype, *Erni* 1930, could not be traced. Wettstein designated this species as *S. gwinneri* on the herbarium sheet. Dinter, who also recognized it as a new species, gave it the manuscript name *S. ernestiruschii* in 1934, (herbarium sheet *Dinter* 8123 in K & B).

*S. inerme* has only been found on the north side of the Orange River. The habitat just south of the river near Sendelingsdrift is similar, yet this species has not been found there. It is plentiful along the foot of Numais Mountain around Rosh Pinah, in an area mined for lead and zinc. Plants specific to heavy metal areas are not unknown and Epstein (1972) reported on work done by Wilkins on lead tolerance in *Festuca ovina*, and by Broker on zinc tolerance in *Silene inflata*. Whether *S. inerme* is perhaps lead or zinc specific needs to be investigated further.

*S. inerme* is placed in Section *Denticulatum* on account of the erose-denticulate leaf margin and the rose-purple petals. It does, however, perhaps warrant a section or sub-section of its own.





x3



— XI —



x4

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PLATE 5.—*Sarcocaulon inerme* Rehm.







Section *Multifidum* *Moffett*, sect. nov., a sectionibus aliis foliis profunde segmentatis, differt.

Type species: *S. multifidum* E. Mey. ex Knuth.

Fleshy, dwarf shrublets up to 0,25 m high and 0,40 m in diameter, with or without spines; roots swollen or not swollen; branches prostrate or semi-erect. *Leaves* long and short petioled. *Petioles* persisting as long sharp spines, or short blunt stalks up to 6 mm long. *Blades* segmented, bi-tripinnatisect, covered in dense hairs. *Petals* with or without dark throat marking; sepals pilose to sericeous.

Three species, confined to northern Namaqualand and southern South West Africa in a small area on either side of the Orange River near its mouth, are recognized.

12. *Sarcocaulon herrei* L. Bol. in S. Afr. Gdn Country Life 22:10 (1932); Rehm in Bot. Jb. 67:265 (1935); Glass and Foster in Cactus Succ. J. Los Ang. 42, 2:60 (1970). Type: north-western Cape, Klipbokberg, *Herre* 1025 (BOL, holo.!). K).

*S. lorrei* Stiles in Bull. Afr. Succ. Soc. 7:36 (1972) sphalm.

Fleshy, spiny shrublet up to 0,25 m tall and 0,40 m in diameter; stem branching repeatedly from 30–70 mm above ground; roots not swollen; branches generally exceeding 10 mm thick with rows of single, straight spines, pubescent and rusty when young and tufts of short stalks in the axils of the spines; bark greyed yellow. *Leaves* long and short petioled; stipules scale-like, ovate lanceolate, ciliate, caducous; blade bi-tripinnatisect, 4–6 jugate, villous and sericeous. *Long petioled leaves* almost decussate; petioles persistent and hardened into fairly thick (mid. diameter c. 2 mm) spines (12–) 19 (–30) mm long with flattened, rotund to oblate base up to 3 mm broad; blade very broadly elliptical to broadly ovate (14–) 21 (–30) mm long, (12–) 15 (–19) mm broad. *Short petioled leaves* 2–7 in number in axils of spines; petioles persisting as blunt stalks up to 6 mm long after abscission of the blade; blade rotund to broadly ovate (6–) 14 (–25) mm long, (6–) 12 (–15) mm broad. *Flowers* when open, up to 23 mm long (excluding

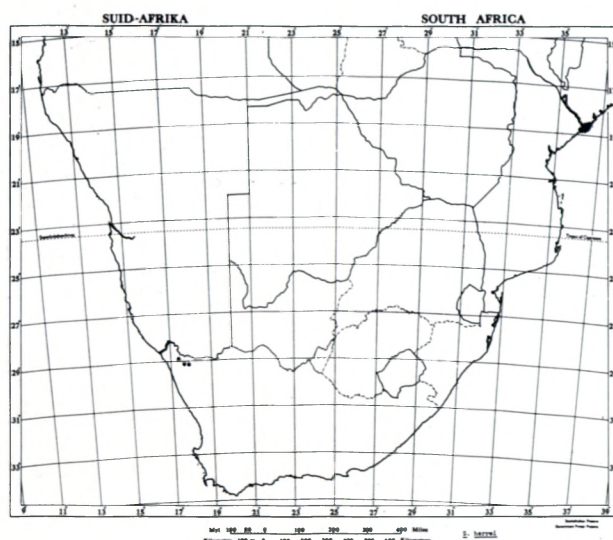


FIG. 30.—Geographic distribution of *Sarcocaulon herrei* in Southern Africa.

pedicel) and 28 mm broad; peduncle 3–9 mm long; pedicel pilose and tomentose, (11–) 20 (–28) mm long. *Sepals* villous and sericeous, 7–11 mm long, 3–4 mm broad; mucro 1–2 mm long. *Petals* with scattered hairs on adaxial surface, pale mimosa (R.H.S. No. 8D), (9–) 15 (–21) mm long, (9–) 13 (–15) mm broad. *Stamens* with long filaments 8–9 mm long, short filaments 5–6 mm long; basal 2 mm of filaments fused; anthers 2–3 mm long. *Ovary* sericeous; style sericeous to puberulous; stigmas 2 mm long. *Mericarps* 60–70 mm long; base 8–10 mm long, tail 50–60 mm long. *Seed* 2–3 mm long. PLATE 4b; FIG. 29.

#### Diagnostic features

Erect to semi-erect, spiny, rigid shrublet; branches thick; spines thick, straight, pubescent and rusty when young. *Leaf blade* segmented, bi-tripinnatisect, villous and sericeous, very broadly elliptical to broadly ovate. *Sepals* villous and sericeous. *Petals* longer than broad, with scattered hairs on adaxial surface, pale mimosa. *Mericarp*: base 8–10 mm long.

This species is confined to the south eastern Richtersveld (Fig. 30), occurring between Steinkopf in the south and Eksteenfontein in the north.

CAPE.—2817 (Vioolsdrif): Klipbokberg, Eksteenfontein (–CD), *Herre* 1025 (BOL; K); Kleinhelskloof (–CD), *Moffett* 631 (NBG; PRE; STE; WIND); between Kleinhelskloof and Eksteenfontein (–CD), *Moffett* 633 (PRE; STE); Klipbokberg, Eksteenfontein (–CD), *Moffett* 940 (STE); Prospectors trench E. of Klipbokberg (–CD), *Moffett* 944 (SUG); Kleinhelskloof (–CD), *Rauh* 11834 (M). 2917 (Springbok): 3 km N.W. of Steinkopf (–BA), *Thorne* s.n. (SAM); Eenriet, 11 km N. of Steinkopf (–BB), *Hall* 2000 (NBG); Kabinaskop, Steinkopf (–BB), *Moffett* 924 (PRE; STE); Kabinaskop, Steinkopf (–BB), *Moffett* 1121 (PRE; STE); Eenriet Mountain (–BB), *Wisura* 2015 (NBG). Without precise locality: Near Vioolsdrif, *Werger* 393 (PRE). Without locality: *Von Wettstein* s3; s.n. (M).

The plant occurs in rocky places, usually on quartz fragment slopes below quartz veins, and is found in Veld Type 33.

*S. herrei* flowers in spring and early summer from September to November. A record for March probably followed a February rainstorm. Such summer rainstorms are not infrequent in the Richtersveld.

Bolus (1932) described this species from a plant growing in the Botanical Garden at the University of Stellenbosch. Fragments of this plant, which Herre



FIG. 29.—*Sarcocaulon herrei*, Klipbokberg, north-western Cape (holotype: *Herre* 1025 in BOL).



had collected at Klipbokberg in the Richtersveld, remain in the Bolus Herbarium and serve as the holotype.

*S. herrei* cannot be confused with the other *Sarcocaulon* species, as it is the only one having segmented leaf blades as well as petioles persisting as long spines. Glass & Foster (1970) have recorded pale lavender flowers in cultivation.

The publication of *S. lorrei* Stiles may have resulted from the author misreading his informant's handwriting. The description and figure in Stiles (1972) is that of *S. herrei*.

13. *Sarcocaulon multifidum* E. Mey. ex Knuth in Pflanzenr. 4, 129:312 (1912); Engl., Pflanzenw. Afr. 3, 1:708 (1915); Dinter in Reprim nov. Spec. Regni veg. 28:106 (1930); Range in Reprim nov. Spec. Regni veg. 36:244 (1934); Merxm. & A. Schreib., Prod. Fl. S.W.Afr. 64:15 (1966) pro parte. Type: north-western Cape, Karoo flats at mouth of Orange River, Drège 3263 (P, lecto.; B†; HBG†; PRE, photo of P specimen!).

*Monsonia multifida* E. Mey. in Drège, Zwei Pfl. Doc. :203 (1843) nom. nud.; L. Bol. in Flower. Pl. S. Afr. 10:t.399 (1930).

*Sarcocaulon herrei* sensu Merxm. & A. Schreib., Prod. Fl. S.W.Afr. 64:15 (1966) non L. Bol.

Fleshy, dwarf, shrublet up to 0,2 m high and 0,25 m in diameter; stem branching 20–40 mm above ground; roots swollen; branches few, generally horizontal, 10–20 mm thick, greyed brown to greyed white with straight rows of leaves or dry stalks in two ranks on the upper surface. In erect branches, leaves are in the normal ranks of four. Leaves long petioled, usually erect, stipules minute, scale-like, broadly ovate, ciliate, persistent, hidden in leaf bases; petioles (6–) 14 (–24) mm long, pilose and tomentose, very broadly ovate to oblate, (8–) 16 (–24) mm long, (12–)

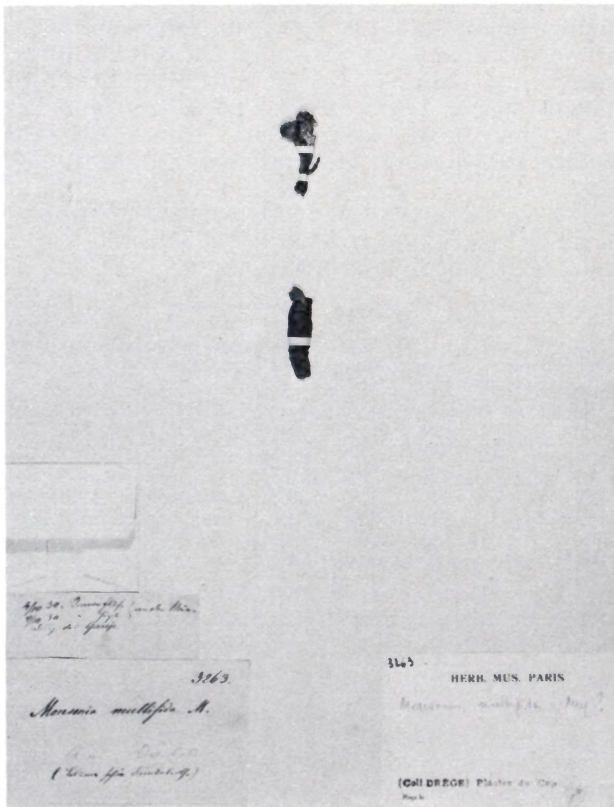


FIG. 31.—*Sarcocaulon multifidum*, Karoo flats at mouth of Orange River, north-western Cape (lectotype: Drège 3263 in P).

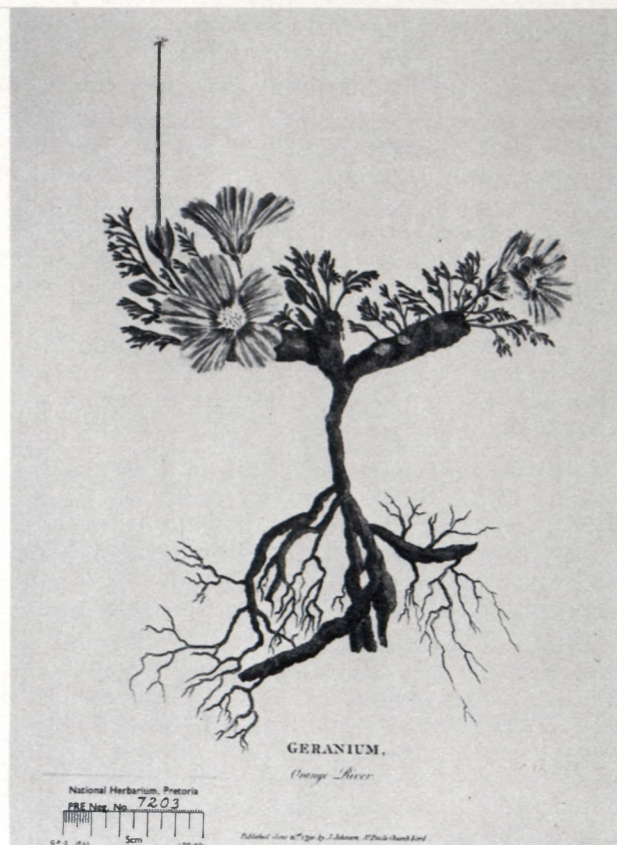


FIG. 32.—*Sarcocaulon multifidum* "Geranium, Orange River". Paters. itin. 2:113, t.12(1790).



FIG. 33.—*Sarcocaulon multifidum*. Copy of original painting from the Gordon collection at the Rijksmuseum, Amsterdam. Reproduced by kind permission of the Rijksmuseum.





FIG. 34.—*Sarcocaulon multifidum*, near Bloeddrif, Orange River, north-western Cape. (Moffett 954; scale provided by 2c coin).

22 (–34) mm broad; peduncle subsessile; pedicel pilose, 12–32 mm long. *Sepals* densely pilose and puberulous 9–12 mm long, 3–5 mm broad, mucro 1–2 mm long. *Petals* white, pale pink or magenta with crimson to dark red throat marking, rarely plain white (R.H.S. No. 158D, 55D or 57C), (15–) 19 (–25) mm long, (15–) 17 (–21) mm broad. *Stamens* with long filaments 7–9 mm long, short filaments 5–6 mm long; basal 2 mm of filaments fused; anthers 3 mm long. *Ovary* and style sericeous; stigmas 2–3 mm long. *Mericarps* 70–80 mm long; base 7–8 mm long, tail 65–70 mm long. *Seed* 3 mm long. PLATE 4c; FIGS. 31, 32, 33 & 34.

#### Diagnostic features

Semi-erect dwarf shrublet; branches few, fairly thick, horizontal; generally spineless with rows of leaves or short blunt petiole bases or with short blunt spines up to 6 mm long. *Leaf blade* segmented, bi-tripinnatisect, pilose and tomentose, very broadly ovate to obovate. *Sepals* densely pilose and puberulous. *Petals* white, pale pink or magenta with crimson to dark red throat marking, rarely plain white. *Meri-carp*: base 7–8 mm long. *Roots* swollen.

Limited to a small area on either side of the Orange River near its mouth. (Fig. 35). It is found within 10 km of the river and in an area roughly between 10–60 km from the sea.

S.W.A.—2816 (Oranjemund): Rooilepel, Schakalsberg (–BA), *De Winter & Giess* 6474 (WIND); Schakalsberg (–BA), *Merxmüller* 2302 (M); Schakalsberg (–BA), *Merxmüller* 2648; 2649 (M; PRE); 15 km W. of Schakalsberg (–BA), *Moffett* 1407 (STE); Sendelingsdrift (–BB), *Hall* 2005 (NBG); Sendelingsdrift (–BB), *Herre* s.n. (STE); Sendelingsdrift (–BB), *Merxmüller* 2566 (M); Sendelingsdrift (–BB), *Merxmüller & Giess* 3527 (M); Dreigratdrif (–BB), *Moffett* 1157 (STE); between Dreigratdrif and Lorelei (–BB), *Moffett* 1164 (STE); Dreigratdrif (–BB), *Moffett* 1348 (STE); WIND); 10 km N.E. of Hohenfels (–BC), *De Winter* 6533 (PRE); between Hohenfels and Daberas (–BC), *Moffett* 1402 (STE); Swartkop, Orange River (–CB), *Kneitsch* s.n. (B). Without precise locality: north side of mouth of Orange River, *Erni* in *BOL* 19222 (BOL).

CAPE.—2816 (Oranjemund): 4 km S. of Oetha Gate near Sendelingsdrift, (–BB), *Thompson & Le Roux* 278 (STE); Bloeddrif (–BD), *Moffett* 954 (PRE; STE); hills N. of Annisfontein (–BD), *Pillans* 5484 (BOL); Grootderm (–DA), *Compton* 20724 (NBG); Grootderm (–DA), *Erni* s.n. (ERNI); Grootderm, 70 m (–DA), *Marloth* 12382 (PRE); Beauvalon (–DA), *Moffett* 643 (PRE; STE); Beauvalon (–DA), *Moffett* 969 (SUG); 6 km S.W. of Grootderm (–DA), *Nordenstam* 1669 (M); between Dunvlei and Grootderm (–DA), *Pillans* 5262 (BOL; K); between Grootdoorn and Grootderm (–DA), *Pillans* 5341 (BOL). Grid ref. unknown: Orange River, Hellenberg, *Herre* 2977 (STE). Without precise locality: Orange River Mouth, *Drège* 3263 (P).

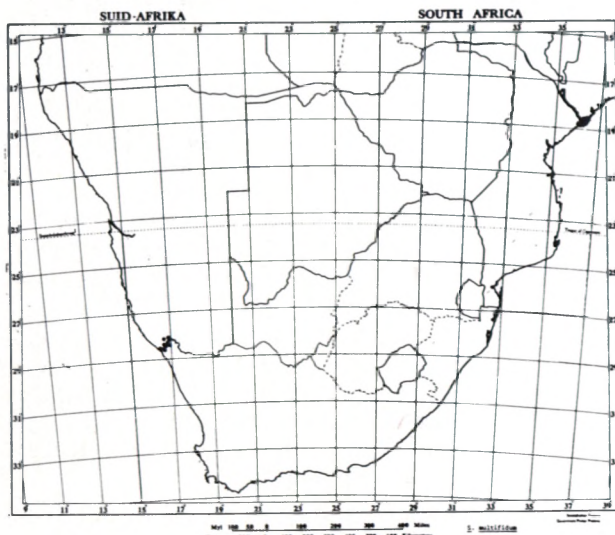


FIG. 35.—Geographic distribution of *Sarcocaulon multifidum* in Southern Africa.

Usually found growing in exposed, rocky places among dunes. In contrast to the closely allied *S. peniculinum*, which grows in sandy depressions among rocks, *S. multifidum* is generally found in cracks in almost pure rock.

It occurs in Veld Types 31 and 34 in South Africa and in Vegetation Type 3a in South West Africa.

The dwarf nature of this species reflects the harsh conditions of its environment. Although leafless for most of the year, the hairy, segmented leaf blade with its greatly reduced leaf area is also adapted to withstand excessive water loss. It has been recorded as flowering in all months of the year except January, February, May and June.

The earliest record of this species is the engraving entitled "Geranium, Orange River", which appears opposite p. 113 in the second edition of Paterson's *Travels* (Paterson, 1790). Fig. 34. This figure highlights the normally hidden, but important diagnostic character of the swollen roots. A virtually identical painting is in the Gordon collection at the Rijksmuseum in Amsterdam. A black and white copy obtained from the Director of the Botanical Research Institute, Pretoria, shows that the Gordon painting, while almost identical in all other features, has leaves foreign to this genus.

There is no further record of this species until Drège collected it when he visited the mouth of the Orange River in October 1830. Meyer, when cataloguing Drège's collection, named it *Monsonia multifida*, but failed to provide a description (Drège, 1843). According to Article 32 of the Code it was thus not validly published. Knuth (1912) was responsible for the type description, naming it *S. multifidum* (E. Mey.) R. Knuth.

The holotype has not been traced and could have been in the Berlin (B) or Hamburg (HBG) herbaria, both of which were destroyed in the second World War. Knuth (1912) stated that the type was in the Drège herbarium and in a footnote added that it was a single specimen 6 cm long. A photograph of an isotype in the Paris Herbarium (P) reveals two branch fragments, each about 4 cm long. The upper fragment



has thin branches and a short persistent petiole stump, and closely resembles plants growing at Dreigratdrif on the north bank of the Orange River. The lower fragment has an unopened flower bud and a small leaf attached to it. Although Walther (1965) contended that Drège never crossed the Orange River, Bolus (1873), quoted Meyer, who stated: "...after following the river upward and downward, by dint of great exertion, (Drège) crossed by a ford". There are two fords in the vicinity: Sendelingsdrif and Dreigratdrif. The possibility therefore exists that Drège might have collected his specimen near Dreigratdrif.

Bolus (1930) reassigned this species to *Monsonia*. She regarded it as a *Monsonia*, because of the arrangement of the stamens: "which are arranged in bundles of three, with the filaments united at the base, as in typical *Monsonia*" and also because: "the leafless petioles never become spinous".

The gaps between the filament triplet bundles in *Monsonia* are more deeply cleft than in *Sarcocaulon*. However, none of the material of *S. multifidum* dissected in this study, was as deeply cleft as shown in Fig. 4, t.399 in Bolus (1930). The more normal form of the androecium is shown in Fig. 3 of the latter figure. Bolus was probably unaware that *S. multifidum* occasionally has short, blunt spines. Merxmüller and Schreiber (1966) even named one such specimen *S. herrei*.

Rehm (1935) did not cite any specimens in his treatment of this species, but his description and two plates indicate that he was referring to the species now proposed as *S. peniculinum*. Of the collections cited by Merxmüller (1966), *Dinter* 8162 is also *S. peniculinum*.

*Dinter* (1930a) described how he treated three dormant specimens of *S. multifidum* collected by Knetsch from the Orange River. He mentions that after treating them with luke-warm water ("hand-warmen Wasser") for two days, he was fortunate to rouse them from their feigned death ("Scheintod") before planting them. Within three weeks under glass, all eight horizontal branches of the three specimens had produced leaves up to 8–10 mm long. One of the few specimens from the Berlin Herbarium to have survived the war is a Knetsch specimen from Swartkopp, on the northern bank of the Orange River.

The *Compton* 20724 specimen in the Compton Herbarium at Kirstenbosch is accompanied by a watercolour painting of the specimen by G. D. Morris.

Slightly different forms of this species may be distinguished. In the Dreigratdrif area, a thin-branched, blunt-stalked form with white petals and less well developed red throat marking occurs. In the foothills of the Schakalsberg, the plants are generally large, with thicker branches well off the ground, with few leaf base protuberances, and have white, pink or red petals with marked throat marking. The plants on the south side of the river have similar flowers to the Schakalsberg form, but the stems and branches are usually much smaller. Plain white petals are rare, but have been found in a recent collection 4 km south of Octha Diamond Mine near Sendelingsdrif.

14. *Sarcocaulon peniculinum* Moffett, sp. nov., *S. multifido* E. Mey ex Knuth affinis, sed ramis prostratoribus, latioribus, palidioribus, petalis sine macula atranti faucis et radicibus non tumidis.

*S. multifidum* sensu Rehm in Bot. Jb. 67:265 (1935); sensu Merxm. & A. Schreib., Prod. Fl. S.W.Afr. 64:15 (1966) pro parte; non E. Mey. ex Knuth.

Suffrutex succulentus usque ad 0,08 m altus et 0,18 m in diametro; caulis ramificans circiter solo; radices non tumidae; rami rare excedentes 2, griseo-albi, prostrati, generatim excedentes 20 mm lati, saepe ferentes surculos breves bifarios supra. *Folia* longe petiolata, plerumque erecta, stipulae minutae, squamiformes, late ovatae, ciliatae, persistentes, occultae in basis foliorum; petioli (5–) 12 (–24) mm longi, pilosi et tomentosi, latissime ovati vel oblatis, (5–) 16 (–26) mm longi, (9–) 18 (–30) mm lati, segmentis semiteretibus. *Flores* ubi apertae, usque ad 20 mm longae (pedicello excluso), 36 mm latae; pedunculus subsessilis; pedicellus pilosus, 11–15 mm longus. *Sepala* dense pilosa et puberulosa, 8–12 mm longa, 3–5 mm lata, mucrone 1–2 mm longo. *Petala* erubescens vel palide rosea et sine maculae faucis (R.H.S. No. 55C & 55D), (16–) 20 (–24) mm longa, (11–) 14 (–16) mm lata. *Stamina* filamentis longis 8–10 mm longis, filamentis brevibus 5–6 mm longis, filamentis connatis 2 mm ad basim; antherae 3 mm longae. *Ovarium* sericeum et stylus sericeus, stigmatibus 2–3 mm longis. *Merispermia* 65–80 mm longa, basibus 8–9 mm longis, caudis 55–75 mm longis.

TYPE.—South West Africa, between Rosh Pinah and Dreigratdrif, *Moffett* 1353 (STE, holo.!: K!: PRE!).

Fleshy, dwarf prostrate shrublet up to 0,08 m high and 0,18 m in diameter; stem branching at or just below ground level; roots not swollen; branches seldom more than 2, greyed white, resting on the

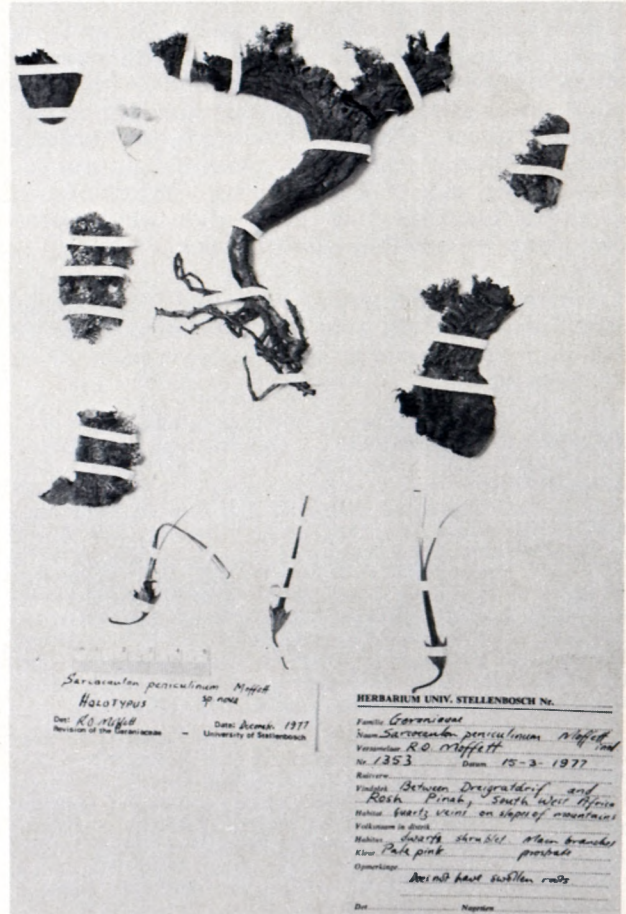


FIG. 36.—*Sarcocaulon peniculinum*, between Rosh Pinah and Dreigratdrif, South West Africa (holotype: *Moffett* 1353 in STE).



ground, generally exceeding 20 mm thick, often bearing fleshy short shoots in 2 ranks on upper surface. *Leaves* long petioled, usually erect; stipules minute, scale-like, broadly ovate, ciliate, persistent, hidden in leaf bases; petioles (5-) 12 (-24) mm long, pilose and tomentose, very broadly ovate to oblate, (5-) 16 (-26) mm long, (9-) 18 (-30) mm broad, segments semi-terete. *Flowers* when open, up to 20 mm long (excluding pedicel), 36 mm broad; peduncle sub-sessile; pedicel pilose, 11-15 mm long. *Sepals* densely pilose and puberulous, 8-12 mm long, 3-5 mm broad, mucro 1-2 mm long. *Petals* rose to pale pink without throat marking, (R.H.S. No. 55C & 55D), (16-) 20 (-24) mm long, (11-) 14 (-16) mm broad. *Stamens* with long filaments 8-10 mm long, short filaments 5-6 mm long; basal 2 mm of filaments fused; anthers 3 mm long. *Ovary* and style sericeous; stigmas 2-3 mm long. *Mericarps* 65-80 mm long; base 8-9 mm long, tail 55-75 mm long. *Seed* 3 mm long. PLATE 4d; FIG. 36.

#### Diagnostic features

Prostrate, dwarf shrublet; branches pale, thick, mostly only two; on the surface of the ground; spineless, with two rows of leaves or blunt leaf bases or thick fleshy shoots along the upper surface. *Leaf blade* segmented, bi-tripinnatisect, pilose and tomentose, very broadly ovate to oblate. *Sepals* densely pilose and puberulous. *Petals* rose to pale pink without throat marking. *Mericarp*: base 8-9 mm long. *Roots* not swollen.

Restricted to South West Africa (Fig. 37), in a very small area between the Orange River and Rosh Pinah.

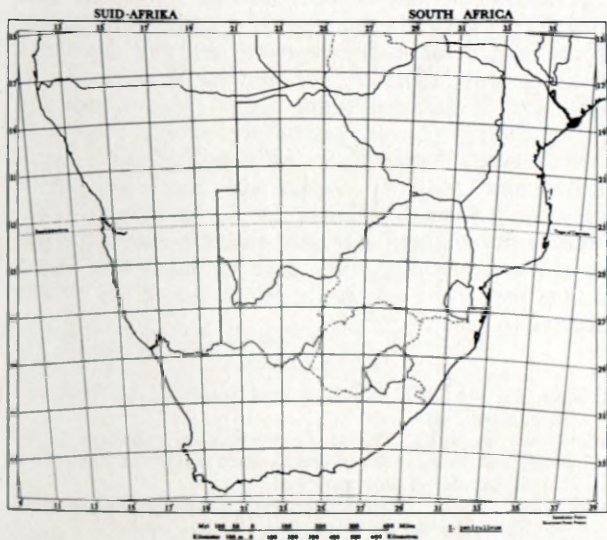


FIG. 37.—Geographic distribution of *Sarcocaulon peniculinum* in Southern Africa.

S.W.A.—2816 (Oranjemund): Kahanstal, Lorelei Copper Mine (-BB), *Dinter 8162* (B; BOL; G; K; M; PRE; WIND; Z); 10 km N. of Sendelingsdrift (-BB), *Hall 1888* (NBG); Lorelei Copper Mine (-BB), *Hall 2002* (NBG); half way between Rosh Pinah and Sendelingsdrift (-BB), *Moffett 1159* (SUG); 5 km N. of Dreigratdrif (-BB), *Moffett 1353* (K; PRE; STE). Without precise locality: Witpütz District, *Erni s.n.* (BOL); South West Africa, *Von Wettstein s.n.* (M).

Grows in shallow sand in and among white quartz fragments. It occurs in Vegetation Type 3a.

The few specimens of this species collected so far flowered in January, March, September and October. Because it is found at a higher elevation than the

previous closely related species, it is not subject to the early morning fog which often hangs over the Orange River. *S. peniculinum* is thus subject to an even harsher climate than *S. multifidum*.

This new species was portrayed for the first time by Rehm (1935) as *S. multifidum* in Plate 14, Fig. 1 and Plate 16, Fig. 6 of his revision. The plant or plants depicted in these photographs could have been collected by Von Wettstein in 1929. Dinter, who collected it near Lorelei in 1934, must have been intrigued by this strange species, for one finds specimens of *Dinter 8162* in at least eight different herbaria.

All the herbarium specimens seen of this species, refer to it as *S. multifidum*.

#### EXCLUDED SPECIES

##### Species published in error

*Sarcocaulon currali* Heckel in *Compt. Rend. Acad. Sc. Paris*, 147:906 (1908) sphalm. This species was based on a leafless and flowerless piece of *Kalanchoë grandidieri* from Madagascar. Heckel corrected the mistake in *Compt. Rend. Acad. Sc. Paris T.1.*,:1073 (1909), (Rehm, 1935).

*S. lorrei* Stiles in *Bull. Afr. Succ. Soc.* 7:36 (1972) sphalm. A mis-spelling of *S. herrei* L. Bol.

##### Species published without description

*S. ernii* Dinter ex Range in *Reprum nov. Spec. Regni. veg.* 36:244 (1934) nom. nud. Range published this name for a living Dinter specimen in the Botanic Garden at Berlin. The locality is given as "Südliches Namaland", which is southern South West Africa. No trace of this specimen or any herbarium material labelled *S. ernii* has been found and the cited specimen is presumed to have been destroyed during the second World War (Hiepkko, personal communication). H. Erni jnr. of Aus, considers that this taxon may be the species now designated as *S. peniculinum*.

##### Species incertae

*Sarcocaulon spinosum* (Burm. f.) Kuntze in *Rev. Gen.* 3, 2:33 (1893), Iconotype: Burm., *Pl. Afr. rar.*, :87, t.31 (1738). FIG. 38.

*Geranium spinosum* Burm. f., in *Spec. Bot. de Geran.*: 16 (1759); L., *Sp. Pl.* no. 66 (between 1763 & 1800) not seen; L., *Mant.*:98 (1767); Burm. f., *Prodr. Fl. Cap.*:20 (1768); Murr., *Syst. Veg. ed. 14*:618 (1784); Cav., *Diss.* 4, 22:195 (1787); Lam., *Encycl.* 2, 2:651 (1788); Pers., *Syst. Veg. ed. 15*:656 (1797); Willd., *Sp. Pl.* 3, 1:696 (1800); Thunb., *Fl. Cap. ed. 2*:509 (1823) pro parte.

*Sarcocaulon burmannii* (DC.) Sweet in *Hort. Brit.* ed. 1:73 (1826); G. Don, *Gen. Syst.* 1:715 (1831).

*Monsonia burmannii* DC., *Prodr.* 1:638 (1824); Spreng., *Syst. Veg. ed. 16*, 3:83 (1826), as "Burmanni"; Steud., *Nom. Bot. ed. 2*, 2:158 (1841).

Both *S. spinosum* and *S. burmannii* have as their type, Fig. 31 in Burman (1738). In this work, Burman stated, "From the collection of (my) Lord Van der Stell I have produced this unusual plant, (which has been) observed by no one else as far as I know". The figure could be the work of Claudius, who accompanied Simon van der Stel to the Copper Mountains in 1685 (MacNae & Davidson, 1969).

De Candolle (1824), took up *G. spinosum* in *Monsonia* and called it *M. burmannii*, as *M. spinosa* had already been described by L'Héritier (L'Hérit. 1792). Sweet (1826), erred, however, in taking up the specific epithet *burmannii* into *Sarcocaulon* and it was Kuntze (1893) who eventually made the correct combination.





FIG. 38.—Iconotype of *Sarcocaulon spinosum* and *Sarcocaulon burmannii*. Burm., Pl. Afr. rar. :87, t.31(1738).

The names *S. spinosum* and *S. burmannii* have subsequently been applied by all botanists to the taxon now known as *S. crassicaule*. N. E. Brown, however, noted in a footnote in Phillips (1921): "It is very doubtful if the *S. Burmannii* of the Flora Capensis and the specimens in Herbaria so named, really represent the plant figured by Burmann upon which that species was founded". Brown's doubt was well founded, as the plant as figured by Burman does not exist. No single taxon in *Sarcocaulon* has both small, entire leaves on thin branches, as well as large sinuous-crenate leaves on swollen, knobby branches. The iconotype thus comprises two discordant elements.

The type description is merely a description of the discordant figure and cannot thus be used as a type to retain the name *S. spinosum*. Attempts to trace a topotype were also unsuccessful.

Unfortunately, therefore, this earliest record of a *Sarcocaulon* cannot be typified and the names *S. spinosum* and *S. burmannii* must remain as *species incertae*.

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#### UITTREKSEL

'n Hersiening van *Sarcocaulon* (*Geraniaceae*) word aangebied waarin 14 soorte erken word. Beskrywings, afbeeldings, verspreidingsgewens en twee sleutels tot die soorte word voorsien. Die volgende nuwe name word publiseer: *S. salmoniflorum* Moffett (nom. nov. vir *S. l'heritieri* DC. var. *brevimucronatum* Schinz), *S. camdeboense* Moffett, *S. ciliatum* Moffett en *S. peniculinum* Moffett. Omdat die ikonotipe van *S. spinosum* (*Burm.f.*) Kuntze en *S. burmannii* (DC.) *Sweet onverenigbare elemente uitbeeld wat nie gelykgestel kan word met enige bekende taksa van Sarcocaulon nie, word hierdie soorte behandel as species incertae.*

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