

A re-evaluation of the *Cotyledon orbiculata* Complex

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ABSTRACT

The *Cotyledon orbiculata* complex is reviewed and characters previously used are re-examined. A key is provided to the five varieties recognized. Var. *dactyloopsis* Toelken is described and the new combinations var. *flanaganii* (Schonl. & Bak. f.) Toelken and var. *spuria* (L.) Toelken are made.

RÉSUMÉ

RÉ-ÉVALUATION DU COMPLEXE COTYLEDON ORBICULATA

On revoit le complexe *Cotyledon orbiculata* et les caractères utilisés antérieurement sont ré-examinés. Une clé est fournie pour les 5 variétés reconnues. La variété *dactyloopsis* Toelken est décrite et deux combinaisons nouvelles sont opérées: var. *flanaganii* (Schonl. & Bak. f.) Toelken et var. *spuria* (L.) Toelken.

INTRODUCTION

Cotyledon orbiculata is one of the most complex species in the family, not only because of its seemingly endless range of variation, but also because many of its numerous forms have been formally described and subsequently often misinterpreted. Haworth alone described eleven species, all of which are now included in the synonymy of some of the varieties of *C. orbiculata*. Schonland (1902) distinguished a number of species and described some of them, but his detailed observations remained restricted to the eastern Cape Province. After a more comprehensive study of the genus, he (1915) reduced most of these species to the synonymy of known species. Lhotsky & Goddijn (1928) then produced proof of extensive hybridization among species of *Cotyledon*, but their paper was unheeded by most subsequent taxonomists. Von Pöhlitz (1937) could not add much to a better understanding of the complex as his work was based on herbarium specimens and individual cultivated plants. A re-evaluation based on several years of field observations in various parts of Southern Africa is thus attempted here. Although a few specimens from south-western Angola and southern Mozambique fall within the range of forms discussed here, *C. orbiculata* is essentially a South African species.

CHARACTERS

The characters used in the taxonomy of *C. orbiculata* are in greater need of re-evaluation than those of any other complex in the family, because firstly the species is the most widespread in South Africa and secondly it grows in many different habitats. The range of variation in each habitat should be determined before an overall decision on the delimitation of taxa can be made. It was mainly uncritical use of vegetative characteristics, some of which appear to be the result of parallel evolution, which marred previous taxonomic treatments.

1. Leaves

The specific epithets already point to the wide use that has been made of the shape and size of leaves in the delimitation of taxa. Two groups can usually be recognized: one comprising plants with a long corolla tube and usually with larger leaves, and a second one with a shorter corolla tube and smaller leaves. If the full range of variation is taken into account, however, it is obvious that the groups may overlap considerably. Although the relative size of a plant is a useful

distinguishing character in the field where the growth of the whole plant can be judged, it is of no use in the herbarium where only parts are preserved. However, in extreme cases it may be a useful guide to the identification of the taxon concerned.

The contrast between linear and oblanceolate or obovate leaves should not be used uncritically, for example in plants of var. *orbiculata* from Namaqualand. Here plants with finger-like leaves and others with oblanceolate to obovate leaves are found next to each other. However, these two forms cannot be separated ecologically, or by any other character; neither do they produce mixed populations with a full range of intermediates which would suggest a hybrid swarm, nor are such populations restricted to areas in which different phyto-geographic regions appear to overlap. In this connection, it seems futile to search for an explanation in a simple dominant and recessive genetic relation. In the Little Karoo similar forms are found, but here the broad-leaved form is restricted to the northern parts, while plants with finger-like leaves are common throughout the region.

Three different forms with narrow, oblong leaves can be distinguished in the var. *oblonga*, but in each case transitional forms are found between the extremes thus indicating a clinal development. These clines are so far apart geographically (see Fig. 1) that they are regarded as a result of parallel evolution. This assumption is strengthened by the fact that the unusual hairy form on the Natal coast also develops narrow leaves. The two forms from the north-eastern and south-eastern Cape and the narrow-leaved form of var. *orbiculata* were traditionally included in the completely artificial species *C. decussata*. The character of narrow finger-like leaves is even less diagnostic when compared with the remarkably similar var. *oblonga* from south-east of Aliwal North and var. *dactyloopsis* to the north of the Orange River. Young plants of these two varieties are indistinguishable when without flowers. Yet var. *dactyloopsis* may vary somewhat, particularly in the western parts of its distribution area, where plants with dorsiventrally compressed leaves have occasionally been recorded (e.g. Leistner 1980, near Barkley West). Narrow-leaved plants of the var. *spuria* are also known (Thunberg s.n. in Herb. Thunberg No. 11012), while plants of var. *flanaganii* always have terete leaves.

Similarly, the pubescence of leaves varies within or between populations. The leaves of juvenile plants of all species of *Cotyledon* are hairy to tomentose, and in shaded localities, in particular, this juvenile character is often retained. In the case of *C. zuluensis*, which

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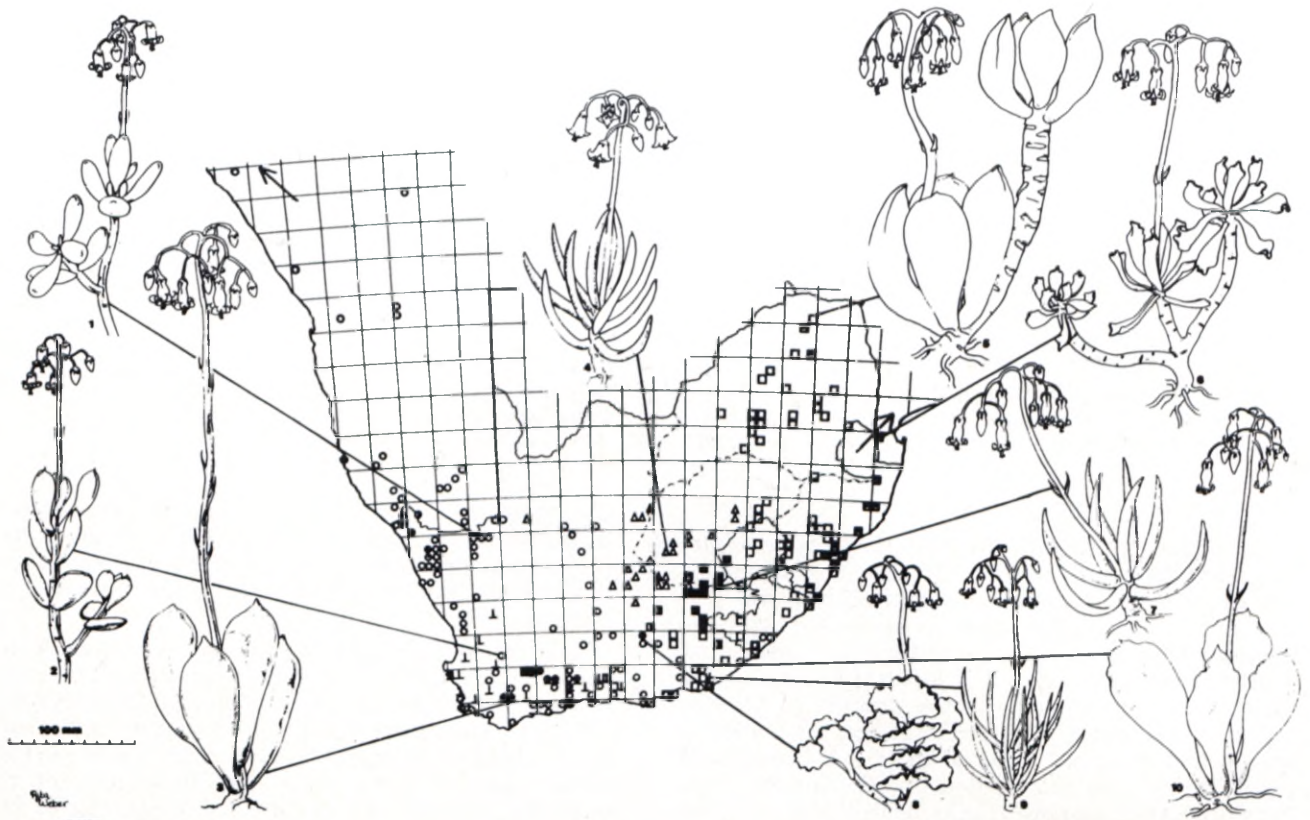


FIG. 1.—Extreme forms in the range of variation of *Cotyledon orbiculata*.—var. *orbiculata* (○ typical form with dorsiventrally flattened leaves; ⊙ form with few hairs; ⊕ form densely hairy; ⊗ form with undulate leaf margins): 1, Schlieben 21; 2, Stirton & Boucher 6136; 8, Tölken 5414.—var. *spuria* (1): 3, Tölken 5501.—var. *dactyloopsis* (△): 4, C. A. Smith 4612.—var. *oblonga* (□ typical form; ⊠ form with few hairs; ⊡ form densely hairy; ⊣ form densely hairy and with narrow leaves; ⊞ form with terete leaves): 5, Galpin 10309; 6, Tölken 5576; 7, Gerstner in PRE 32695; 10, Tölken 5521.—var. *flanaganii* (+): 9, Flanagan 1317.

is now placed into var. *oblonga*, a gradual change from glabrous to distinctly hairy leaves was found between Port Edward and Port Shepstone. These plants are not considered to be hybrids, as the glabrous form occurs only in central Natal. The hairy form is restricted to the coastal hills of Natal and extends into the interior only as far as the Lebombo mountains in northern Natal and southern Swaziland.

Within var. *oblonga* another hairy local form has been recorded from the western Soutpansberg (e.g. Tölken 5600A).

A similar local hairy form has also been recorded for var. *orbiculata* in the eastern Richtersveld, but the first hairs on the inflorescence can already be detected on plants near Komaggas (Tölken 1926). It is remarkable that this form apparently never penetrates into the western parts of the Richtersveld.

C. leucophylla was described from the central Transvaal on the basis of the thick bloom on its leaves. Plants which are similar, but have green leaves, are often found on rocky outcrops in the eastern Transvaal, but when they are grown under dry and hot conditions in the glass house they also develop glaucous leaves. Var. *oblonga*, into the synonymy of which *C. leucophylla* is now placed, shows considerable variation in the amount of bloom developed on the leaves; this appears to show no correlation with ecological conditions.

2. Habit

The stout, sparsely branched stems of var. *oblonga* are decumbent in the Cape, while they are often suberect in the remaining distribution area. The

decumbent habit may also be observed in some plants of the hairy form on the Natal coast. The stems are considerably narrower, a characteristic typical of the narrow-leaved form, which is found in northern Natal and eastern Swaziland. All the other varieties have erect, spreading branches, but under adverse conditions the stems are so short that the plants cannot be distinguished on the basis of their habit.

3. Inflorescence

In contrast to *C. woodii* (= *C. salmiana* V. Poelln.) the flowers of *C. orbiculata* are often borne well above the leaves. The peduncle may attain a length of more than 1 m, particularly in var. *spuria*, and herbarium specimens of this variety are thus usually incomplete. Consequently the typical bracts on the peduncle, 2–5 pairs in the case of var. *spuria*, are often not preserved and specimens can only be distinguished from those of var. *oblonga* on the basis of their geographic distribution.

4. Corolla tube

The shape and size of the corolla tube distinguishes *C. orbiculata* from most species in the genus. Firstly, the tube [10–25 mm longer or (0,7–) 1–1,5 times the length of the lobes], is much longer than in *C. cuneata* Thunb. (= *C. pillansii* Schönl.), *C. campanulata* Marl. and *C. papillaris* L.f. Secondly, the corolla tube has prominent bulges between the lobes of the sepals in *C. barbeyi* Bak. and *C. velutina* Hook f., while the tube is usually cylindrical or slightly broadened towards the middle in var. *oblonga* and var. *spuria*.

Within *C. orbiculata* two groups of species are distinguished, one with a corolla tube 10–15 (–17) mm long, and the other with a tube (18–) 20–25 mm long. However, even this character must be used with discretion because, in the preparation of herbarium specimens, buds which have not attained their full length, often burst open and may be mistaken for mature flowers.

TAXONOMY

C. orbiculata L., Sp. Pl. ed. 1, 429 (1753); DC., Prodr. 3: 396 (1828); Harv. in Fl. Cap. 2: 371 (1862); Schonl. in Rec. Albany Mus. 3: 136 (1915). Type: Caput Bonae Spei, sine leg. in LINN 594.1 (holo.!).

C. orbiculata is widespread, but usually restricted to mountainous areas of Southern Africa. The species has thus not been recorded from large parts of the central Karoo, the sandy Kalahari basin or the coastal sandveld along the west coast and the Makatini Flats in north-eastern Natal. In addition, there are many

gaps on the map, which are probably due to inadequate collecting, as is so often the case with common plants.

Var. *dactyloopsis* is the only one of the five varieties usually associated with a particular habitat, namely dolerite hills of the north-eastern Karoo.

Plants of different varieties often grow close to one another and hybrids are found in many localities. Hybrids between species and/or varieties are fully fertile and herbarium material of hybrids cannot be readily identified, because the varieties show so much variation. Hybrids can only be identified with certainty in the field, where the range of variation of the parent populations can be evaluated. Similarly, it is impossible to establish whether any of the described species and varieties are based on hybrids. This is especially true of species described by earlier workers, who did not indicate the exact type locality: the true identity of these plants can only be guessed at. Such names are included under the synonymy of the variety which they resemble most closely.

KEY TO THE VARIETIES

- Corolla tube 8–15 (–17) mm long, usually cylindrical or funnel-shaped:
 Leaves in whorls of three.....2. var. *flanaganii*
 Leaves in pairs:
 Corolla tube ± cylindrical, 10–15 (–17) mm long, South West Africa. Cape except NE Cape.....
 1. var. *orbiculata*
 Corolla tube funnel-shaped, 8–10 mm long; NE Cape and Orange Free State.....3. var. *dactyloopsis*
 Corolla tube (18–) 20–25 mm long and usually bulging about the middle:
 Peduncle with (2) 3–5 pairs of bracts which are often not opposite; stems erect or spreading and 6–10 mm in diam. when bearing leaves.....4. var. *spuria*
 Peduncle with 1 (2) pairs of bracts; stems decumbent or suberect and 12–25 mm in diameter when bearing leaves (rarely less when from Natal and Swaziland).....5. var. *oblonga*

1. var. *orbiculata*.

C. orbiculata L., Sp. Pl. ed. 1: 429 (1753); Mill., Gard. Dict. ed. 8 (1768); Ait., Hort. Kew. ed. 1, 2: 106 (1789); Curtis's Bot. Mag. ser. 1, 9, t. 321 (1795); Haw., Syn. Pl. Succ. 105 (1812); DC., Hist. Pl. Succ. 2, pl. 76 (1801); Prodr. 3: 396 (1828); Harv. in Fl. Cap. 2: 371 (1862); Schonl. in Rec. Albany Mus. 3: 136 (1915); V. Poelln. in Reprum nov. Spec. Regni veg. 42: 33 (1937); Adamson in Fl. Cape Penins. 438 (1950); Kidd, Wild. Flow. Cape Penins. pl. 2, 1 (1950); Rice & Compton, Wild Flow. Cape Good Hope 51 (1950).

C. ramosissima Mill., Gard. Dict. ed. 8 (1768). Type: unknown.

C. unguata Lam., Encycl. 2: 139 (1786); DC., Prodr. 3: 396 (1828); Guill. in Hist. Pl. Succ. 2, t. 168 (1832). Iconotype: Burm., Rar. Afr. Pl. 54, t. 22, fig. 1.

C. mucronata Lam., Encycl. 2: 142 (1786); Schonl. & Bak. f. in J. Bot., Lond. 40: 15 (1902); Schonl. in Rec. Albany Mus. 3: 137 (1915). *Adromischus mucronatus* (Lam.) Lem., Jard. Fleur. 2, Misc. 60 (1852). *C. undulata* var. *mucronata* (Lam.) V. Poelln. in Reprum nov. Spec. Regni veg. 42: 36 (1937). Type: Burm., Rar. Afr. Pl. t. 19, fig. 2.

C. ovata Haw., Syn. Pl. Succ. 105 (1812), nom. illeg., non Mill.

C. elata Haw., Suppl. Pl. Succ. 20 (1819); in Phil. Mag. 1825: 32 (1825). *C. orbiculata* var. *elata* (Haw.) DC., Prodr. 3: 396 (1828). Type: unknown.

C. ramosa Haw., Suppl. Pl. Succ. 24 (1819), nom. illeg. *C. orbiculata* var. *ramosa* (Haw.) DC., Prodr. 3: 396 (1828), nom. illeg. Type: same as for *C. ramosissima* Mill.

C. papillaris sensu Haw., Suppl. Pl. Succ. 21 (1819), non L.f.

C. decussata Sims in Curtis's Bot. Mag. 51, t. 2518 (1924); Lindley in Bot. Register 11, t. 915 (1825); Harv., Fl. Cap. 2: 372 (1862); Schonl. & Bak. f. in J. Bot., Lond. 40: 19 (1902); Schonl. in Rec. Albany Mus. 3: 138 (1915), pro parte; V. Poelln. in Reprum nov. Spec. Regni veg. 42: 30 (1937), pro parte; Friedr. in Prodr. Fl. S.W. Afr. 52: 8 (1968). Type: Sims in Curtis's Bot. Mag. 51, t. 2518.

C. tricuspidata Haw. in Phil. Mag. 1825: 32 (1825). *C. papillaris* var. *tricuspidata* (Haw.) DC., Prodr. 3: 397 (1828). Type: Caput Bonae Spei, *Haworth* s.n. (OXF, holo.!).

C. orbiculata var. *rotundifolia* DC., Prodr. 3: 396 (1828). Type: unknown.—var. *obovata* DC., Prodr. 3: 396 (1828). Type: DC., Hist. Pl. Succ. 2, t. 76.

C. flanaganii var. *karroensis* Schonl. & Bak. f. in J. Bot., Lond. 40: 22 (1902). Type: Cape, near Beaufort West, *Becker* s.n. (GRA, holo.!).

C. engleri Berger & Dinter in Bot. Jb. 50, Suppl. 590 (1914). *C. orbiculata* var. *engleri* (Dinter & Berger) Dinter in Reprum nov. Spec. Regni veg. (Beih.) 53: 92 (1928). *C. orbiculata* var. *viridis* Dinter ex Range in Reprum nov. Spec. Regni veg. 36: 102 (1934), nom. superfl.: nom. nov. for *C. engleri*. Type: South West Africa, Aus, *Dinter* 1103 (B, holo.!).

C. ausana Dinter in Reprum nov. Spec. Regni veg. 30: 195 (1932). *C. orbiculata* var. *ausana* (Dinter) Jacobsen in Handb. Sukk. Pfl. 1: 365 (1954), nom. inval., sine publ. orig. Type: South West Africa, Aus, *Dinter* 5219 (B, holo.!).

C. orbiculata var. *oophylla* Dinter in Reprum nov. Spec. Regni veg. 30: 195 (1932); Jacobsen, Handb. Succ. Pl. 287, fig. 233 (1960); Sukk. Lex. 134, fig. 3, 6 (1970). Type: South West Africa, Buchu Mountains, *Dinter* 6601 (B, lecto.!).

C. decussata var. *dielsii* Schltr ex V. Poelln. in Reprum nov. Spec. Regni veg. 42: 31 (1937). Type: Cape, along Doring River, *Diels* 404 (B, holo.!).

C. orbiculata var. *dinteri* Jacobsen, Handb. Sukk. Pfl. 1: 365, fig. 246 (1954), nom. illeg.; Handb. Succ. pl. 287, fig. 281 (1960), nom. illeg.; Sukk. Lex. 134, fig. 39, 5 (1970), nom. illeg., sine descript. lat.

C. undulata sensu Jacobsen, Handb. Succ. Pl. 293, fig. 289, 290 (1960); Sukk. Lex. 136, fig. 41, 2 (1970), non Lam.

C. orbiculata var. *higginsiae* Jacobsen, Handb. Sukk. Pfl. 1: 365, fig. 247 (1954), nom. illeg.; Handb. Succ. Pl. 1: 287 (1960), nom. illeg.; Sukk. Lex. 134, fig. 39, 4 (1970), nom. illeg., sine descript. lat.

C. decussata var. *hinrichseniana* Jacobsen in Kakteen 7: 51, fig. (1956); Handb. Succ. Pl. 281, fig. 275 (1960); Sukk. Lex. 133, fig. 38, 3 (1970). Type: unknown.

Shrubs with spreading branches, usually much branched, up to 1 m high when flowering or when without 0, 2–0, 3 m high, branches with (4–) 6–12 mm in diameter when bearing leaves, rigid and woody (not shrivelling when dried) with pale bark. *Leaves* opposite, oblanceolate, orbicular to obovate or sometimes oblong 35–60 (–80) mm long, 10–35 (–45) mm broad, usually mucronate to cuspidate, green or grey-green to greyish-brown and with a deep red, rarely pale yellow horny margin. *Inflorescence* a thyse with a peduncle (0, 2–) 0, 25–0, 35 (–0, 45) m long, with 1 (2) pairs of bracts. *Corolla* deep red or

sometimes orange or pinkish-red due to a thick bloom on the outside; tube usually more or less cylindrical, (8–) 10–14 (–16) mm long; lobes 6–10 (–13) mm long, recoiling. *Anthers* 2–2,5 mm long. FIG. 1.1, 1.2, 1.8.

Growing usually in exposed positions on rocky slopes, rarely on more sheltered rock outcrops on forest margins. Flowering period: November–January.

This is the only variety which sometimes has orbicular leaves. Those of the specimen in the Linnaean herbarium are not orbicular. Linnaeus (1753) included in his original description a reference to Commelin's illustration (Comm., Horti med. Amst. pl. rar. fig. 23), which he later transferred to *C. spuria*. As this plant is illustrated with narrow, oblanceolate leaves, it seems that Linnaeus initially had a very broad concept of the species. This is also apparent from his description of the leaves as "subrotundis", which applies to some of the leaves illustrated by Hermann (Herm., Hortus acad. Lugd. fig. 551 (1687)). The latter author used the polynomial "Sedum africanum frutescens incanum orbiculatis foliis", which might have been the source of the epithet chosen by Linnaeus. Judging by the annotations of his interleaved copy of the first edition of his Species Plantarum, Linnaeus must have had a specimen of this species at an early stage of his career. The specimen (LINN 95.1) has thus been accepted as the type. The petal tube of the flowers are about 15 mm long and the specimen agrees well with plants growing on the Cape Peninsula.

Two main forms may be distinguished within this variety. Firstly, plants with dorsiventrally flattened leaves with a sharp-edged horny margin and mucronate to cuspidate apex. These usually occur on rocky outcrops or slopes on forest margins, but also occur in dry scrub vegetation in the eastern Cape and in the coastal areas of the southern to south-western Cape. Secondly, plants with dorsiventrally compressed to almost terete leaves with a rounded margin, and obtuse, rounded or rarely mucronate apex. These occur in the Little Karoo, the mountainous areas of the Great Karoo, as well as Namaqualand, the south-western, central and north-western parts of South West Africa. A few specimens of this form were also seen from south-western Angola. Although these two forms seem quite distinct in some areas, a complete range of intermediates between the two is found in others, in particular to the north and south of the Little Karoo, yet there are no indications that the two forms hybridize in these areas.

The problem is further complicated by the fact that the narrow-leaved form of the arid area type was described as *C. unguolata*, *C. decussata* or *C. engleri*. In time, *C. decussata* became the specific epithet generally used for this form together with all other plants of the *C. orbiculata* complex with narrow leaves, which were placed into this "species". Von Poellnitz (1937), in contrast to Schonland (1915), recognized a number of varieties under *C. decussata*, which represent widely differing elements artificially grouped together because of their narrow leaves. It is surprising that he did not realize that each of these forms occurs in a different area and shows a greater overall similarity to other taxa than to the other elements of *C. decussata*. Only extensive field studies revealed the true connections of certain narrow-leaved forms as illustrated in Fig. 1.

Another variation is often found in var. *orbiculata*. It has undulate leaf apices and for that reason has been

referred to as *C. undulata*. Unfortunately the type specimen indicates that this name should be referred to the synonymy of var. *oblonga*. The above form has to date been only recorded from three widely separated areas (see map) and has a distribution pattern uncommon to any other South African plant.

Putative hybrids

(a) *C. cuneata* × *C. orbiculata* var. *orbiculata*.

C. deasii Schonl. in Rec. Albany Mus. 3: 140 (1915), pro species.

The decumbent habit and the relatively short corolla tube (up to 10 mm) together with the sharply pointed reflexed lobes and glandular inflorescence are reminiscent of *C. cuneata*. However, the glabrous, glaucous leaves which are narrow and oblanceolate, and the relatively long corolla tube indicate possible hybridization with *C. orbiculata* var. *orbiculata*, the only other species from the same area.

CAPE.—3322 (Oudtshoorn): Oudtshoorn district, *Deas* 13 (GRA).

(b) *C. orbiculata* var. *orbiculata* × *C. papillaris*

The leaves and flowers are similar in shape to those of var. *orbiculata*, but they are smaller. The leaves are densely clustered at the base, a condition which is characteristic of *C. papillaris*, which is similar to the glandular inflorescence which also is found in hybrids.

CAPE.—3118 (Vanrhynsdorp): Steenkampskop (–BD), *Bruyns* s.n. (PRE).

(c) *C. orbiculata* var. *orbiculata* × var. *spuria*

Plants are superficially similar to the narrow-leaved form of var. *orbiculata*, because of the terete leaves and cylindrical flowers. However, the shrubs are up to 1,2 m high and the peduncle has several pairs of bracts on it.

Plants of the putative parents were found in the vicinity of the hybrid population.

CAPE.—3320 (Montagu): Cogmanskloof (–CC), *Tölken* 5502 (PRE).

2. var. *flanagani* (Schonl. & Bak. f.) Toelken, stat. nov.

C. flanagani Schonl. & Bak. f. in J. Bot., Lond. 40: 22 (1902); Schonl. in Rec. Albany Mus. 3: 138 (1915). Type: Cape, near Komga, *Flanagan* 1317 (GRA, lecto.!, BOL.!, PRE.!, SAM.!).

Shrubs with spreading branches up to 1 m high including the inflorescence, sparsely branched; branches 6–10 mm in diameter when bearing leaves, rigid and somewhat woody (not shrivelling when dried), pale bark. *Leaves* in whorls of 3, linear (60–) 70–90 mm long, (3–) 4–8 mm in diameter, terete, scarcely widened in the middle, tapering to a sharp point, green to grey. *Inflorescence* a thyse with a peduncle 0,25–0,4 m long, with bracts in 1 or 2 whorls or often scattered along the peduncle. *Corolla* red often pinkish-red due to a thick bloom tube cylindrical and 12–15 mm long; lobes 10–14 mm long, narrowly oblong, acute, recoiled. *Anthers* 2–2,5 mm long. FIG. 1.9.

Schonland & Baker fil. (1902) described *C. flanagani* on the basis of three narrow-leaved specimens. Of these *Sim* s.n. and *Galpin* 2531 bear their leaves clustered at the base of what seems to be a decumbent stem, which may be one reason why authors have compared it to *C. campanulata* (= *C. teretifolia* Thunb., non Lam.). The description is short and general so that the only specific indication that the authors referred to third specimen in particular are the pointed terete leaves and the specific epithet. It was therefore selected as lectotype.

The most important character of the whorled leaves Schonland and Baker seem to have overlooked, but the curious statement "folia alternata" may refer only to the bracts which are often spirally arranged in this taxon. Whorled leaves are occasionally found on a single branch in other varieties of *C. orbiculata*, but no case has been recorded where a whole plant or even an entire population shows this unique characteristic.

3. var. *dactyloopsis* Toelken, var. nov. a varietatibus aliis floribus campanulatis tubis brevibus corollae (ad 10 mm longis) et foliis teretibus acutis differt.

Fruticuli ramis brevibus patentibus, plus minusve fruticosi, ad 0,25 m alti; rami cortice atrofusca, 8–12 mm in diametro, rigidi et lignosi. Folia linearilanceolata, 50–80 (–100) mm longa, 6–12 mm plerumque contracta ad spicam acuta, viridia rare glauca, fascicularia ramis non visibilibus. Inflorescentia thyrsum pedunculo 0,2–0,3 (–0,4) m longo et 1 pare bractearum. Corolla flava et plus minusve cupreo-vel rubrotincta, tubo campanulato (6–) 8–10 mm longo, lobis 5–8 mm longis. Antherae 2–3 mm longae.

TYPE.—Orange Free State, Fauresmith, *C.A. Smith* 4612 (PRE!).

Shrublets with short spreading branches, more or less branched, up to 0,25 m high without inflorescence; branches 8–12 mm in diameter rigid and woody (not shrivelling when dried) with dark brown bark. Leaves linear-lanceolate, 50–80 (–100) mm long, 6–12 mm broad, usually tapering into a sharp point, green rarely grey-green, densely clustered with branches not visible between them. Inflorescence a thyrse with peduncle 0,2–0,3 (–0,4) m long and with 1 pair of bracts. Corolla yellow, more or less tinged orange or red; tube campanulate (6–) 8–10 mm long; lobes 5–8 mm long, recurved. Anthers 2–3 mm long. Fig. 1.4.

Growing on rock outcrops and often associated with dolerite boulders in the area between Kimberley, Bloemfontein, Hopetown and Smithfield. Flowering period: October–December.

4. var. *spuria* (L.) Toelken, stat. nov.

C. spuria L., Sp. Pl. ed. 2, 614 (1762); Dryand. in Ait., Hort. Kew. ed. 1, 2: 106 (1789); Ait. f., Hort. Kew. ed. 2, 3: 109 (1811); Haw., Syn. Pl. Succ. 107 (1812). Type: Commelin, Horti med. Amst. Pl. Rar. fig. 23 (lecto.!).

C. purpurea Thunb., Prodr. 83 (1794); Fl. Cap. ed. Schultes 396 (1823); Haw., Syn. Pl. Succ. 23 (1812); DC., Prodr. 3: 397 (1828); Harv., Fl. Cap. 2: 371 (1862); Schonl. & Bak. f. in J. Bot., Lond. 40: 18 (1902). Type: hills near Cape, Thunberg in Herb. Thunberg 11012 (UPS, holo.!).

C. unguilata sensu Guillaumin, Hist. Pl. Succ. 2, t. 168 (1832); sensu Schonl. & Bak. f. in J. Bot., Lond. 40: 19 (1902), non Lam.

Shrublets with spreading rarely decumbent branches, much branched, up to 1 m high excluding the inflorescence; branches 6–10 mm in diameter when bearing leaves, rigid and woody (not shrivelling when dried) with pale bark. Leaves oblanceolate, rarely oblong or obovate, 80–120 (–160) mm long, (20–) 35–70 (–85) mm broad, with mucro up to 2 mm long, rarely closely together, grey-green usually with a thick bloom and a dark red margin. Inflorescence a thyrse sometimes branched from the middle of the peduncle, with peduncle 0,5–0,8 (–1,2) m long and with (2–) 3–4 (–6) pairs of bracts which are often not exactly opposite to each other. Corolla orange to pale yellow, rarely deep red; tube (18–) 20–25 mm long, cylindrical but slightly bulging at the middle; 10–14 mm long, recurved. Anthers 2–2,5 (–3) mm long. FIG. 1.3.

Growing in karroid vegetation on plains, often along rivers or streams, rarely on lower slopes of hills

in the southern Little Karoo and south of this region from vicinity of Albertinia to Worcester, but also occasionally on the west coast near Cape Town, as well as along the eastern slopes of the western Cape mountains as far north as the Hantams Mountains. Flowering period: (October) November–January.

In spite of the uncertainty expressed in the original description and in the specific epithet, it is clear from the way in which Linnaeus treated the taxon in all subsequent publications that he regarded it as a full species. His species, as described, consists of several elements, but at the end of his first description Linnaeus stated that *C. spuria* differs from *C. orbiculata* by its finger-like alternate leaves. This indicates that his description was mainly based on Commelin's illustration as the plants figured by Burman (1738) have either spatulate leaves or in other cases the leaves are not alternate, apart from the fact that two of the plants illustrated (see below) are not at all closely related to *C. orbiculata*. The finger-like alternate leaves must refer to the bracts so clearly illustrated by Commelin and which are a characteristic feature of var. *spuria*. The illustration also shows that there are more than two bracts, and the long scape together with the yellow flowers mentioned in Commelin's description identify this taxon without any doubt. This illustration was thus selected as the type and Burman's illustrations are referred to *Tylecodon paniculatus* (L.f.) Toelken (Burman 1738, fig. 18), *C. papillaris* L.f. (Fig. 19.1) and *C. orbiculata* var. *orbiculata* (Fig. 22, 1) although several different interpretations have been offered in literature.

Herbarium specimens of var. *spuria* can usually only be identified by the combination of the long corolla tube and the geographic distribution, because usually only part of the peduncle with the characteristic number of bracts is represented. Most researchers have failed to identify Thunberg's *C. purpurea*, but the "long narrow leaves grooved above", a reference probably applies to the lower bracts, and the long corolla tube of the type immediately identify the species as a synonym of var. *spuria*. The plant is rarely found west of Worcester, but "hills near Cape" may be correct as plants have even recently been recorded from Circle's Vlei (*Barker* 3948) near Cape Town.

5. var. *oblonga* (Haw.) DC., Prodr. 3: 396 (1828).

C. oblonga Haw., Syn. Pl. Succ. 106 (1812). Type: Plate 792 (K, lecto.!).

C. undulata Haw., Suppl. Pl. Succ. 20 (1819); DC., Prodr. 3: 396 (1828); Schonl. & Bak. f. in J. Bot., Lond. 40: 13 (1902); Hemsley in Curtis's bot. Mag. ser. 3, 59, t. 7931 (1903); V. Poelln. in Reprim nov. Spec. Regni veg. 42: 35 (1937). Type: Caput Bonae Spei, Haworth s.n. (OXF, holo.!).

C. coruscans Haw., Suppl. Pl. Succ. 21 (1819); in Phil. Mag. 1825: 32 (1825); Sims in Curtis's bot. Mag. t. 2601 (1825); Lodd., Bot. Cab. t. 1030 (1825); DC., Prodr. 3: 396 (1828); Harv., Fl. Cap. 2: 371 (1862); Schonl. & Bak. f. in J. Bot., Lond. 40: 17 (1902); Schonl. in Rec. Albany Mus. 3: 137 (1915); Burt Davy, Fl. Transv. 143, fig. 14C, D (19' 6") V. Poelln. in Reprim nov. Spec. Regni veg. 32: 29 (1937). T pe: unknown.

C. canaliculata Haw., Suppl. Pl. Succ. 22 (1819). Type: unknown.

C. canalifolia Haw. in Phil. Mag. 1825: 32 (1825), nom. ill. g. Type: Cape, Haworth s.n. (OXF, holo.!).

C. viridis Haw. in Phil. Mag. 1827: 273 (1827). Type: unknown.

C. crassifolia Haw. in Phil. Mag. 1827: 273 (1927). Type: Caput Bonae Spei, Haworth s.n. (OXF, holo.!).

C. cuneiformis Haw. in Phil. Mag. 1828: 185 (1828). Type: unknown.

C. virescens Schonl. & Bak. f. in J. Bot., Lond. 40: 14 (1902); Schonl. in Rec. Albany Mus. 3: 136 (1915). *C. macrantha* var. *virescens* (Schonl. & Bak. f.) V. Poelln. in Reprim nov. Spec. Regni veg. 42: 33 (1937). Type: Cape, near Port Alfred, Becker s.n. (GRA, holo.!).

C. whiteae Schonl. & Bak. f. in J. Bot., Lond. 40: 19 (1902), as 'whitei'. Type: Cape, near Grahamstown, *G. White* s.n. (GRA, holo.!).

C. galpinii Schonl. & Bak. f. in J. Bot., Lond. 40: 16 (1902). Type: Cape, Queenstown, *Galpin 2* (GRA, holo.!).

C. orbiculata sensu Burtt Davy in Flower. Pl. S. Afr. 5, pl. 161 (1926); Fl. Transv. 143, fig. 14 A, B (1926); sensu Jacot Guill., Fl. Lesotho 180 (1971), non L.

C. leucophylla C. A. Smith in Steyn, Toxicol. Pl. S. Afr. 224 (1934); Dyer in Flower. Pl. Afr. 17, t. 652 (1937). Type: Transvaal, Wonderboom, *C. A. Smith 6023* (PRE, holo.!).

C. flavida Fourcade in Trans. R. Soc. S. Afr. 21: 34 (1934) *C. decussata* var. *flavida* (Fourcade) V. Poelln. in Reprim nov. Spec. Regni Veg. 42: 31 (1937). Type: Cape, Dunes on Slang River, *Fourcade 1869* (GRA, holo.!).

C. decussata var. *rubra* V. Poelln. in Reprim nov. Spec. Regni veg. 42: 31 (1937). Type: Cape Andriesberg near Bailey, *Galpin 2242* (B, holo.!).

C. zuluensis Schonl. ex V. Poelln. in Reprim nov. Spec. Regni veg. 42: 41 (1937); Compton, Fl. Swaziland 218 (1976). Type: Natal, Zululand, *van der Bijl* s.n. (GRA, holo.!).

C. obermeyerana V. Poelln. in Reprim nov. Spec. Regni veg. 42: 41 (1937). Type: Cape, near Queenstown, *Galpin 2192* (B, holo.!).

C. rudatisii V. Poelln. in Reprim nov. Spec. Regni veg. 42: 42 (1937), nom. prov. Type: Natal, Farm Friedenau, *Rudatis 664* (B, holo.!).

C. simulans Schonl. ex V. Poelln. in Reprim nov. Spec. Regni veg. 48: 111 (1940), non rite publicatum quoad sine diagn. latin.

C. simulans var. *spathulata* Schonl. ex. Poelln. in Reprim nov. Spec. Regni veg. 48: 111 (1940), non rite publicatum quoad sine diagn. latin.

C. decussata sensu Jacot Guill., Fl. Lesotho 180 (1971), non Sims.

Robust shrublets with decumbent rarely suberect branches up to 0,8 m high excluding inflorescence branching mainly from the base; branches 10–18 mm in diameter when bearing leaves, stiffly fleshy (usually somewhat shrivelled when dried), with pale bark. *Leaves* obovate to oblanceolate, rarely narrowly oblong, (40–) 50–110 (–140) mm long, (10–) 35–65 (–80) mm broad, with mucro up to 2 mm long but usually absent or almost so, closely packed so that the stem is usually not visible between them, green to glaucous, sometimes with a thick bloom, usually with red margin at the apex. *Inflorescence* a thyrses with peduncle (0, 15–) 0,2–0,35 (–0,45) m long, each with 1 or 2 pairs of bracts. *Corolla* orange to red; tube (18–) 20–25 mm long, cylindrical but slightly bulging in the middle; lobes (8–) 10–13 (–15) mm long, usually recurved, rarely recoiled. *Anthers* 2,5–3,5 mm long. FIG. 1.5, 1.6, 1.7, 1.10.

Growing usually in exposed positions on rock outcrops or on gravelly slopes, usually associated with grassland or very low vegetation, rarely sheltered under trees or shrubs. Occurrence is widespread in the eastern Cape, except in Fish River scrub vegetation, extending its distribution in the west to about Prince Albert along the northern slopes of the Winterhoek and Swartberg ranges; to the east it is found in most parts of Natal, Lesotho, eastern Orange Free State, and is widespread in Transvaal and south-eastern Swaziland. Flowering period: (June) July–September (October).

The var. *oblonga* is widespread in areas in which summer rainfall predominates, but it is rarely common outside the eastern Cape. The distribution is often somewhat broken up into a number of populations which often vary from one another. The habit may vary from suberect to decumbent as discussed above. Although the leaves are usually green, plants may develop glaucous leaves under dry and hot conditions. In some cases the leaves will always be covered with a bloom. The three different developments of narrow

leaves have been mentioned in the evaluation of the variation of characters above. The two hairy forms recorded from Natal and Transvaal can not be given taxonomic rank (see Fig. 1).

C. undulata is included in the synonymy of this variety, because of the long corolla tube and a note by Haworth on the type sheet to the effect that the plant never exceeds one foot. The broad based bracts are, however, a typical and closely resemble those of *C. velutina*, a species which has undulate leaves. At present it is impossible to establish whether this plant was slightly abnormal or whether it was a putative hybrid between var. *oblonga* and *C. velutina*. Lotsy & Goddijn (1928) illustrated a number of hybrids with undulate leaves and the illustration of segregate No. 1 compares well with Haworth's specimen.

C. canalifolia is an illegitimate name, because Haworth considered his *C. coruscans* inappropriately named and thus changed it to the former name.

Putative hybrids

(a) *C. campanulata* × *C. orbiculata* var. *oblonga*

C. coruscans × *C. teretifolia* Lotsy & Goddijn in Genetica 10: 27–30, fig. 16–19, pl. 1 & 2 (1928).

Lotsy & Goddijn (1928) illustrated a whole range of plants with the leaves varying from narrow to broad and usually somewhat undulate. The inflorescence is usually glandular and the flowers vary from yellow to red, with short or long tube, and with recurved or reflexed corolla lobes. A complete range of intermediates was found in most localities when such populations were investigated.

CAPE.—3225 (Somerset East): near Somerset East (–DA), *MacOwan 173* (BOL). 3326 (Grahamstown): top of Ecce Pass (–BC), *Tölken 5402* (PRE).

(b) *C. orbiculata* var. *oblonga* × *C. papillaris*

C. coruscans × *C. gracilis* Lotsy & Goddijn in Genetica 10: 31, plate 3,9 (1928).

At first glance the plant illustrated by Lotsy and Goddijn resembles robust plants of *C. papillaris* var. *gracilis*. It has slender decumbent branches and only three flowers on the inflorescence. However, the flowers are orange-red, have a longer corolla tube (8–10 mm long) and corolla lobes which are in comparison much shorter. All represent characteristics of var. *oblonga*. The green leaves with a red horny margin are also typical of the variety.

(c) *C. orbiculata* var. *oblonga* × *C. velutina*

C. berkeri × *C. coruscans* in Lotsy & Goddijn in Genetica 10: 30, fig. 20, plate 3,2–4 (1928).

The plant illustrated by Lotsy & Goddijn (1928) looks like a depauperate specimen of *C. velutina* with woody erect stems. However, no depauperate plant would produce so many flowers and the corolla is red and not bulging at the base. Although it cannot be clearly seen on the illustration, the leaves do not seem to show the characteristic broadening of the leaf bases.

UITTREKSEL

Die Cotyledon orbiculata kompleks is hersien en kenmerke wat voorheen gebruik is, is herwaardeer. 'n Sleutel tot die vyf varieteite is voorsien. Var. *cactyloopsis* Toelken is beskryf en die nuwe kombinasies var. *flanaganii* (Schonl. & Bak.f.) Toelken en var. *spuria* (L.) Toelken is gemaak.