

A revision of *Cyanella* (Tecophilaeaceae) excluding *C. amboensis*

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A taxonomic revision of the southern African genus *Cyanella* Royen ex L. (Tecophilaeaceae) is presented. Seven species are recognized; *C. cygnea* G. Scott and *C. aquatica* Obermeyer ex G. Scott are newly described, and *C. amboensis* Schinz is excluded from *Cyanella* as defined here.

'n Taksonomiese hersiening van die Suider-Afrikaanse genus *Cyanella* Royen ex L. is onderneem. Sewe spesies word herken; *C. cygnea* G. Scott en *C. aquatica* Obermeyer ex G. Scott word beskryf en *C. amboensis* Schinz word uitgesluit uit *Cyanella* soos hier omskrywe.

Keywords: *Cyanella*, taxonomy, Tecophilaeaceae

Introduction

The genus *Cyanella* Royen ex L., last revised by Baker (1896), has been variously placed in Liliaceae, Amaryllidaceae, Haemodoraceae, Hypoxidaceae and Tecophilaeaceae. Tecophilaeaceae was proposed by Leybold (1862, 1863) as 'a new order of Monocotyledonae', separable from Iridaceae on the basis of number, direction and mode of dehiscence of the anthers and comprising only the type genus *Tecophilaea* Bertero ex Colla. Miers (1864) pointed out the similarity between *Tecophilaea* and the Conantherae, a grouping established by D. Don (1832) as a separate tribe of Liliaceae and distinguished from Asphodeleae by a semi-inferior ovary and inarticulated pedicels. Miers also allied *Cyanella* with the Conantherae, a Chilean group comprising *Zephyra* D. Don, *Conanthera* Ruiz & Pavón, *Cummingia* D. Don and *Pasithea* D. Don. He noted however, that 'should it be considered desirable to raise Conantherae to the rank of family, it would claim on the score of priority the title of Conantherae or Conantheraceae rather than that of Tecophilaeaceae'.

The association of *Cyanella* and *Tecophilaea* with Conantherae as proposed by Miers (1864) was taken up, with modifications, as a tribe within Amaryllidaceae by Pax (1888) and Pax & Hoffman (1930), within Haemodoraceae by Bentham & Hooker (1883), and within Liliaceae by Baker (1880, 1896) and Marloth (1915). Baker (1896) considered Conantherae to be a connecting link between Liliaceae and Amaryllidaceae. Geerinck (1969), in a survey of the taxonomic position of *Cyanella*, concluded that the genus belonged in neither Haemodoraceae nor Hypoxidaceae. Hutchinson (1973) expressed the opinion that Cyanastraceae (Engler 1901), Cyanelleae (Salisbury 1866) and Conantherae (Bentham & Hooker 1883) 'should be associated with *Tecophilaea* and allied genera for which the family name Tecophilaeaceae was used by Leybold'. He regarded this modified Tecophilaeaceae as a more or less homogeneous group of mainly austral distribution and constituting a connecting link between Liliaceae and Iridaceae.

Chant (1978), without explanation, placed *Cyanella* in 'Cyanastraceae (Tecophilaeaceae)'. Since Cyanastraceae was recognized by Engler (1901) for the sole purpose of

separating a single genus, *Cyanastrum* D. Oliver, from the Haemodoraceae and Pontederiaceae, the family name cannot be used as an equivalent of Tecophilaeaceae. However, the family as circumscribed by Chant is identical to Hutchinson's Tecophilaeaceae, but without *Walleria* Kirk. Within this family he recognized two groups of species: those with equal stamens (*Conanthera*, *Odontostomum* Torrey, *Cyanastrum*) and those with dissimilar stamens/staminodes (*Cyanella*, *Zephyra*, *Tecophilaea*). Tahktajan (1980) recognized a Tecophilaeaceae similar to Hutchinson's but gave *Walleria* separate status as the tribe Wallerieae and included *Eriospermum*, with reservation, as the tribe Eriospermae. Cronquist (1981) rejected Tecophilaeaceae and retained Conantherae (including *Cyanella*) in Liliaceae. Dahlgren & Clifford (1982) felt that *Cyanastrum* merited family status and that *Lanaria* should be included in Tecophilaeaceae on the basis of embryological evidence. *Walleria* was also included, with reservation. This arrangement was retained by Dahlgren *et al.* (1985), but modified by Dahlgren & van Wyk (1988) who placed *Lanaria* in a new family Lanariaceae and *Walleria* in a new subfamily Wallerioideae of Tecophilaeaceae. Therefore the most recent treatment of the family considers Tecophilaeaceae as comprising six genera in two subfamilies. Two genera are African (*Walleria*, *Cyanella*), three are Chilean (*Conanthera*, *Zephyra*, *Tecophilaea*) and one Californian (*Odontostomum*).

Historical aspects

The name *Cyanella*, accompanied by a description, was validly published in edn 5 (1754) of Linnaeus' *Genera Plantarum* (p. 149), citing van Royen as the author. In an addendum to this work, reference is made to *C. hyacinthoides* as follows: 'Roy. Habitat ad Caput b. spei'. Although this is not accompanied by any description, the publication is valid, since the genus was at that time monotypic and the generic description acceptable as a generico-specific description in the sense of Art. 42 of the I.C.B.N. (1988).

The two separate entries are thought to refer to the same specimen, possibly from material in the collection of either Adrian or David van Royen, professors of Botany at Leiden

University from 1730 to 1754 and 1754 to 1781 respectively. Gunn & Codd (1981) record that both men received regular consignments of botanical material from the Cape governor Ryk Tulbagh (1751–71), whose superintendent gardener Auge was probably responsible for most specimen collections.

The existence of the valid specific epithet *hyacinthoides* was noted by Bullock in 1953; prior to this the earliest specific epithet attached to *Cyanella* had been attributed to Linnaeus' *Systema Naturae* edn 10, 2: 985 (1759) or to his *Species Plantarum* edn 2: 443 (1762). In both places, and in edn 3 (1764) of the *Species Plantarum*, which is a reprint of the 2nd edition, *Cyanella capensis* was the only species cited, and has therefore been quoted as the type species by Phillips (1951) and by Dyer (1976). In Bullock's opinion the type of *C. capensis* is 'clearly the Van Royen Specimen in Linnaeus' herbarium', and must be the type also of *C. hyacinthoides*, since Linnaeus attributed the original description to van Royen.

A period of active collection of plants at the Cape was heralded by the simultaneous but independent arrival of Thunberg and Sparrman in 1772. Sparrman is credited with the collection of the type specimen of *Cyanella lutea*, described by the younger Linnaeus (1781) as differing from *C. capensis* in having 'foliis radicalibus lanceolatis, nec linearibus, pedunculis minus divaricatis, petalis majoribus, luteis'. *Cyanella alba* is also described by him (1781), but as having 'foliis lineari-filiformibus'. Collection of the type of this species was attributed to Thunberg. *C. orchidiformis* was described for the first time by Jacquin (1791); the type specimen here appears to be t. 447 of Jacquin's *Icones Plantarum Rariorum* (1786–93) based on material collected by Boos and Scholl (Gunn & Codd 1981).

Cyanella pulchella Salisbury (1796) appears to be an illegitimate superfluous name in that the type depicts *C. hyacinthoides* and *C. coerulea* Ecklon (1827), a manuscript name lacking a description. *C. lineata* was collected by William Burchell in 1812, from the 'great plains of Litakun' in the northern Cape Province, as one of the 'various eatable roots utilized by the Bachapin Tswana'. The underground parts of species of *Cyanella* appear to lack the toxic alkaloids and glycosides encountered in other geophytic genera e.g. *Moraea* Mill., *Bowiea* Harvey ex Hook f., *Homeria* Vent. and *Scilla* L., being recorded as an article of diet by both settlers and indigenous peoples. Thunberg (1795) noted 'the *Cyanella capensis* (*C. hyacinthoides*), a kind of onion, was roasted for the table of the farmers in the Piketberg district' and Archer (1982) records extensive use of this apparently highly nutritious species by the Nama people in the Kamiesberg at the present time.

Lindley (1827) described *C. odoratissima* from plants growing at 'Mr Tate's Nursery in Sloane Street'. Type material of this sweetly scented species does not appear to have been preserved and the plate accompanying his description is here designated as lectotype. Comparison of the lectotype with type material of *C. lineata* and the illustration of *C. lutea* var. *rosea* (Baker 1871), for which a type specimen seems also not to have been preserved, suggests that these pink-flowered forms should be united with *C. lutea*. The distribution of this subgroup extends from the eastern Cape Province in a north-westerly arc, with

sporadic appearance along the Orange River plain. This is essentially a summer rainfall area and contrasts with the distribution of the rest of the genus, which lies in the winter rainfall region. It is suspected that the apparently uneven distribution of the group is the result of under-collection, but all attempts by the author to find the plants in nature have been unsuccessful.

The turn of the century saw three more species of *Cyanella* added to the list, namely *C. racemosa* Schinz (1895), *C. pentheri* Zahlbruckner (1902), described from material collected by Arnold Penther and *C. amboensis* Schinz (1902). The latter was the first of three *Cyanella* species arising from the exploration and collection of botanical material in Namibia, the missionary Martin Rautanen being responsible for the addition of *C. amboensis*. *Cyanella ramosissima* (Engler & Krause) Engler & Krause (1921) was based upon material of Range, government geologist in S.W.A. from 1906–14 and *C. krauseana*, the most recently published species, on a Dinter collection.

Ecology

Rainfall

Cyanella is endemic to South Africa and Namibia and almost entirely confined to the winter rainfall region as defined by Goldblatt (1976). This includes the Cape Floral Kingdom, Namaqualand and the southern portion of Namibia (Figure 1) i.e. the entire area west of a line drawn from Port Elizabeth–Grahamstown in the east, to Laingsburg and north to Lüderitz Bay. This region receives at least 40% and up to 100% of its annual rainfall in the winter months, summer precipitation increasing in an easterly direction (Goldblatt 1976).

A single taxon, *C. lutea*, has an arc-like distribution with the extremities of the arc lying within the winter rainfall region and the rest in the summer rainfall area where precipitation may vary from 400 mm per annum in the east to less than 100 mm in the north-western Cape. In the area receiving mainly winter rain, annual precipitation varies with altitude, the extremes being 2 500 mm in some of the

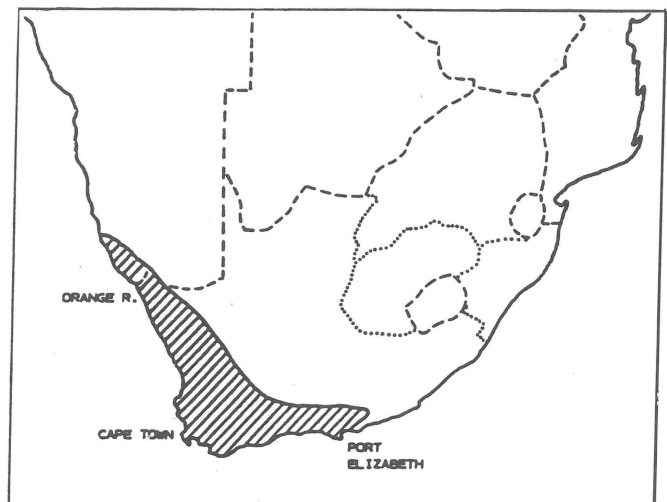


Figure 1 The winter rainfall area of southern Africa (after Goldblatt 1976).

south-western Cape mountains to less than 100 mm in southern Namibia (Venter *et al.* 1986; Fuggle & Ashton 1979).

Geology

Goldblatt (1976) noted the presence of three main soil types in the winter rainfall region: clay derived from shale (either Malmesbury or Bokkeveld), white sandy soils derived from Cape Supergroup sandstone and a granite-derived coarse gritty soil which is common in Namaqualand but local elsewhere, tending to become clayey in the high rainfall areas of the south. A preference for a particular soil type cannot be discerned for the two taxa with widest distribution, namely *C. hyacinthoides* and *C. lutea*. These species are recorded from a variety of substrates, at altitudes varying from sea level to 1 000 m, in different veld types.

Taxa with a restricted range appear to have more specific edaphic requirements e.g. *C. orchidiformis*, which shows a marked preference for clay soils on stream banks, in dry river beds or between rocks affording protection from desiccation, and *C. aquatica*, which occupies a restricted niche among large boulders in seasonally waterlogged clay. *C. alba* is found in clay soils only and *C. ramosissima* in loam with boulder cover. The newly described *C. cygnea* occurs, like *C. orchidiformis*, on stream banks in a clay substrate.

Floral phenology

Flowering in the strictly winter rainfall area occurs in late winter to spring. In the south and east, where significant summer precipitation is received, flowering time extends from late spring into summer.

Pollination biology

The variation in floral structure within *Cyanella* presumably reflects various pollination syndromes. The flowers lack nectar but are often delicately scented and some possess patterned tepals or variegated stamens. The androecium in all species consists of upper and lower groups of stamens, 3 + 3 in some, 5 + 1 in others. Anthers dehisce by pores or lateral slits and stamens may be joined at the base to form a short tube, connivent at the anthers, curved, reflexed or deflected in a direction opposite to that of the style (enantiomorphy).

True enantiomorphy (the presence of right- and left-handed flowers on the same plant) is seen only in *C. alba* and *C. lutea* but several of the floral characters mentioned above have been associated with enantiostyly (Steiner 1987). This phenomenon has been interpreted as an outbreeding mechanism, a means of reducing pollen wastage or of preventing injury to the gynoecium during pollinator visits. The presence of upper and lower stamen groups suggests feeding and pollinating anthers respectively, while poricidal anthers suggest heavy-bodied bees capable of providing the necessary vibration for dislodging pollen — so called 'buzz pollination' (Dulberger & Ornduff 1980).

Seed set data obtained by Dulberger & Ornduff (1980), following artificial pollination using *C. alba*, *C. lutea*, *C. orchidiformis* and *C. hyacinthoides*, indicated that there was no difference in fertility between pollen from upper and

lower anthers of these species and in addition, that physiological self-incompatibility was present in all four species examined.

Cytology

Chromosome numbers for four *Cyanella* species have been reported by Ornduff (1979). Seven collections of *C. hyacinthoides* had $n = 12$, five had $n = 24$ and one collection $n = 14$. A single collection of *C. orchidiformis*, two of *C. alba* and four of *C. lutea* all had $n = 12$, while three other collections of *C. lutea* had either $n = 8$ or $n = 24$. Other genera in Tecophilaeaceae have been recorded as having $n = 11$, 12 (*Cyanastrum*), 10 (*Odontostomum*) and 12 (*Tecophilaea*). Manning & Goldblatt (1989) report a chromosome number of 12, for *Walleria*, and it seems likely that the diploid base number $x = 12$ is characteristic of the family. The sequence $n = 11$, 10, 8 may represent a decreasing aneuploid series and $n = 14$ an aneuploid increase above the base number.

It might be expected that in the geographically widespread and morphologically variable *C. lutea* and *C. hyacinthoides*, some morphological or distributional trait would separate the diploid and tetraploid races, but this does not seem to be the case. Cytological support for the separation of the orange-flowered *C. aquatica* from *C. hyacinthoides* or of the pink-flowered *C. lutea* var. *rosea* from *C. lutea* is also absent. More extensive sampling of the widespread species may permit recognition of chromosomally distinct groups, but for the present cytological data appear to be more useful for clarifying relationships between *Cyanella* and other genera in Tecophilaeaceae than for infrageneric grouping.

Distribution and phylogeny

According to the most recent treatment of Tecophilaeaceae (Dahlgren & van Wyk 1988), *Cyanella* and *Walleria* are the only African genera in a family otherwise restricted to western America (California and Chile). This distribution may be the result of past migrations. Dahlgren *et al.* (1985) proposed a southern hemisphere origin for Tecophilaeaceae and other Asparagalean families on the grounds of rich representation of these groups in southern Africa today. It was postulated that their ancestors arose in West Gondwanaland from whence radiation took place to the northern hemisphere at the close of the Cretaceous period.

Cyanella species may be divided into two groups on the basis of distribution pattern and morphology:

Group A: *C. orchidiformis*, *C. cygnea* and *C. ramosissima*.

This group is largely confined to southern Namibia, the Richtersveld and Namaqualand. Its members have three upper and three lower stamens.

Group B: *C. hyacinthoides*, *C. aquatica*, *C. alba* and *C. lutea*. The distribution of this group extends from Namaqualand southwards to the Cape Peninsula and eastwards to Grahamstown, with outliers in the northern Cape. Members have five upper stamens and one lower stamen.

Within the genus a number of evolutionary trends can be traced, such as the reduction from raceme to single flower

(*C. alba*), free to fused androecium (*C. hyacinthoides*, *C. aquatica*) and operculate to non-operculate pollen (*C. alba*). The latter feature is considered by Zavada (1983) to be a sign of evolutionary advancement. Increasing adaptations to aridity are seen in heavily tunicated corms (*C. alba*, *C. lutea*) and narrow or hairy leaves (*C. alba*, *C. hyacinthoides*).

The coincidence of primitive features in species of Group A suggests that these are closest to the ancestral forms and that *Cyanella* has its origins in the Richtersveld and southern Namibia. A similar case is that of *Moraea*, of which palaeo-endemic species survive in this region as remnants of a former, wetter era (Goldblatt 1986). It seems possible that radiation of *Cyanella* has taken place in a southerly and easterly direction, accompanied by adaptation to the diverse habitats encountered. However the centre of greatest diversity for the genus is the Calvinia grid square (3119) where five of the seven species occur (Figure 2), specifically in the Nieuwoudtville area which is renowned for its extremely rich petaloid monocot. flora (Snijman & Perry 1987).

A clue to the origin of *Cyanella* and to the radiation of ancestors of Tecophilaeaceae from West Gondwanaland may be provided by *C. amboensis*, a strictly Namibian species which has been excluded from this revision pending further study of its precise relationship with other members of the genus. *Cyanella amboensis* differs markedly from the southern species (see Table 1). These dissimilarities may indicate either:

1. that *C. amboensis* is the most primitive member of the genus, on the basis of its pseudo-dichotomous branching and regular flowers, although the presence of a short corolla tube and connivent anthers may be regarded as advanced characters, or
2. that *C. amboensis* belongs elsewhere in Tecophilaeaceae. This species differs in several respects from *Walleria*, the other African genus in the family. The ovary is superior, the flowers are axillary and the rootstock is a tuber in *Walleria*, in which the seeds lack phytomelan. On the other hand, *C. amboensis* has some features in common with the Chilean genus *Conanthera* and may be closer to the American rather than African members of the family. Support for such a link is provided by Arroyo (1986) who noted that while leaf anatomy of *Cyanella*, *Walleria* and *Cyanastrum* was similar, *Cyanella* resembled the American rather than the African genera in Tecophilaeaceae in leaf surface pattern and might be more closely

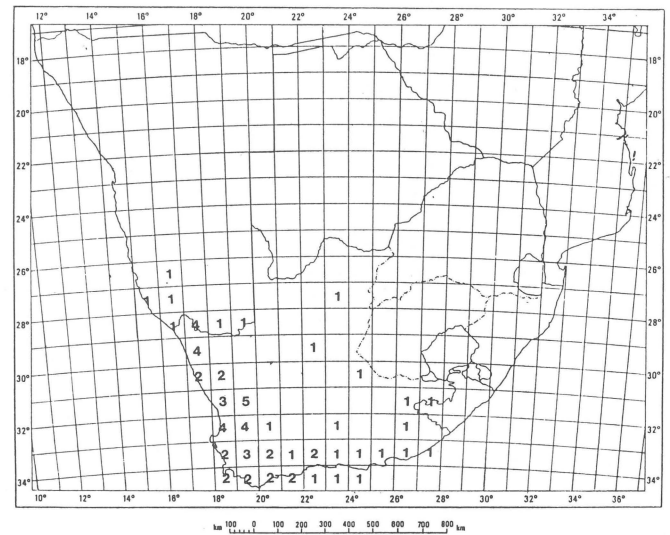


Figure 2 Concentration of species of *Cyanella* in geographical degree squares.

related to them. Further study may confirm the hypotheses presented above and permit correct placement of *C. amboensis* within Tecophilaeaceae. For the present this species is excluded from *Cyanella* as defined here.

Taxonomic treatment

Cyanella Royen ex L., In Genera Plantarum 5: 149 (1754); Baker 6: 6 (1896); Phillips (1951); Sölch (1966); Dyer (1976). Type: *C. hyacinthoides* Royen ex L.

Pharetrella Salisb.: 47 (1866). Type: *Cyanella alba* L.f.

Trigella Salisb.: 46–47 (1866). Type: *Cyanella orchidiformis* N.J. Jacq.

Herbaceous geophytes with aerial parts annual, 120–400 mm high. *Corms* deep-seated with a neck 25–100 mm long and a fibrous to hard outer tunic sometimes extending the length of the neck. *Leaves* numerous in a basal tuft or rosette, filiform, linear, linear-lanceolate or ovate-acuminate. Leaf margins entire, sinuate, finely dentate or occasionally crisped; texture soft to leathery and surface mostly glabrous, rarely pubescent. *Flowers* zygomorphic, bracteate, borne singly on unbranched peduncles or in racemes much exserted from the leaves. *Perianth* segments 6, in two whorls, free, 8–20 × 3–10 mm, white, blue, yellow, mauve or pink, often distinctly veined or patterned.

Table 1 Comparison of *Cyanella amboensis* with other *Cyanella* species

	<i>C. amboensis</i>	Other <i>Cyanella</i> spp.
Stamens	6, equal; anthers lanceolate and connivent	6 unequal: 3 upper & 3 lower or 5 upper & 1 lower; anthers generally not connivent
Leaves	2 basal	6 or more in basal tuft or rosette
Flowers	actinomorphic, pendulous	zygomorphic, never pendulous
Perianth	6 equal segments, fused at the base	in 2 whorls of 3, the segments of outer and inner whorls different, not fused
Inflorescence	branches cymose	branches racemose
Distribution	Namibia, summer rainfall	mainly Cape Floral Kingdom, winter rainfall

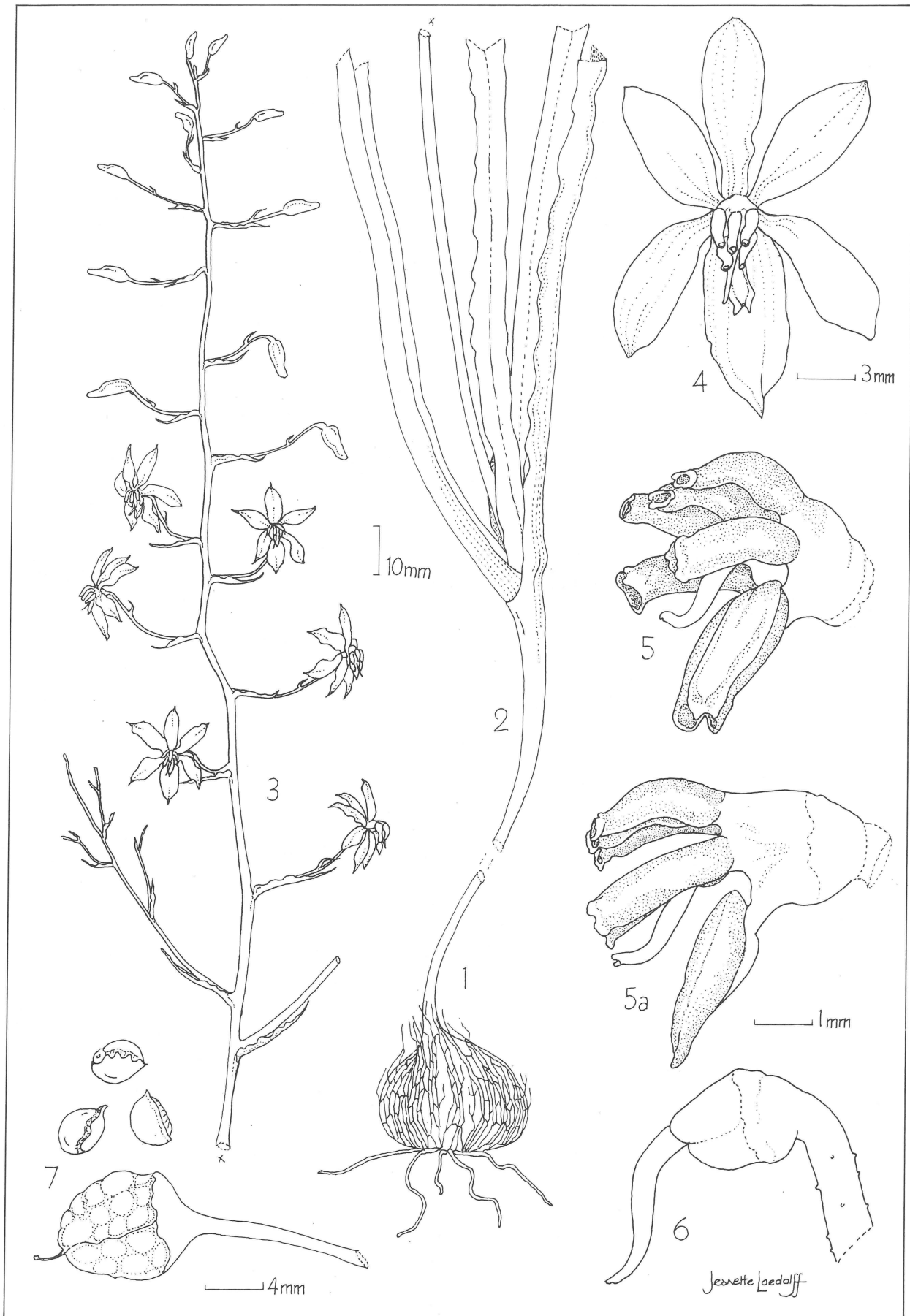


Figure 3 *Cyanella hyacinthoides*. 1. Corm with sheath. 2. Foliage. 3. Inflorescence. 4. Flower, front view. 5. Androecium, oblique view. 5a. Androecium, lateral view. 6. Gynoecium. 7. Fruit and seed. No's 1-3 and 7 from *G. Scott 87*; 4-6 from *G. Scott 17* (all live material).

Stamens 6, in two groups, either 3 upper and 3 lower or 5 upper and 1 lower; filaments slender to spatulate, fused for part of their length or free; anthers basifixed, sagittate, spatulate or tubular, yellow or purple, sometimes maculate, dehiscent by apical pores or lateral slits. *Ovary* semi-inferior trilobular, globose, with numerous axile ovules. *Fruit* a 3-celled loculicidal capsule, globose to ovoid, developing mainly above the insertion of the perianth, containing numerous black, ovoid seeds with wrinkled surfaces, 2–4 mm long.

Salisbury (1866) raised *Cyanella* to the rank of order, Cyanelleae, in which he recognized three genera: *Cyanella* (*C. lutea*, *C. hyacinthoides*), *Pharetrella* (*C. alba*) and *Trigella* (*C. orchidiformis*). In his view the presence of an outer sheathing leaf in *C. alba* and two groups of three stamens in *C. orchidiformis* constituted grounds for the separation of these two species from the rest of the genus. Pax & Hoffman (1930) retained this arrangement as sections within *Cyanella*, but Pax (1888), Baker (1896), Phillips (1951) and Dyer (1976) found insufficient grounds for splitting the genus. The arrangement of the latter authors is followed here.

Key to the species

- 1 Flowers usually borne on unbranched peduncles more than 100 mm long 4. *C. alba*
- 1a Flowers borne in racemose inflorescences, on pedicels always less than 100 mm long 2
- 2 Flowers with 3 upper and 3 lower stamens 3
- 3 Plants usually more than 150 mm high when in flower; leaves more than 8 mm wide; perianth patterned; style not threadlike nor longer than the lower stamens 4
- 4 Perianth segments mauve with yellow centre; upper stamens having filaments reflexed and swollen at the base 7. *C. cygnea*
- 4a Perianth segments mauve with maroon centre; upper stamens having filaments neither reflexed nor swollen at the base 5. *C. orchidiformis*
- 3a Plants usually less than 150 mm high when in flower; leaves usually less than 8 mm wide; perianth not patterned; style threadlike and approximately twice the length of the lower stamens 6. *C. ramosissima*
- 2a Flowers with 5 upper stamens and 1 lower stamen 5
- 5 Stamens with filaments free to the base; perianth pink or yellow 3. *C. lutea*
- 5a Stamens with filaments fused at the base into a short tube; perianth blue or orange 6
- 6 Raceme sparsely branched, bearing few orange flowers on short (less than 20 mm) pedicels 2. *C. aquatica*
- 6a Raceme much branched, bearing numerous blue to lilac flowers on elongated pedicels (20 mm or more) ... 1. *C. hyacinthoides*

1. *Cyanella hyacinthoides* Royen ex L., *Genera plantarum* edn 5: addend; pag. ult., post ind., typus nominis generici (1754). Type: without locality; sheet 430/2 in herb. Linn. (LINN, holo; NBG, microfiche!)

Cyanella capensis L.: 985 (1759): 443 (1762); Baker: 7 (1896);

Barker: 205 (1950), *nom. superf.* Type: as for *C. hyacinthoides* Royen ex L.

Cyanella pulchella Salisb.: 249 (1796) *nom. superf.* Type: Jacquin Hortus Vindobonensis 3: 21, t. 35 (1776–7), (BOL, lecto! here designated).

Cyanella coerulea Eckl.: 4 (1827), *nom. nud.*

Cyanella pentheri Zahl.: 26 (1902). Type: Cape Province, Olifants River, *Penther* 400 (W, holo. +).

Plants 250–400 mm high. *Corms* deep-seated with a neck 50–90 mm long and a fibrous light brown tunic not extending the entire length of the neck. *Leaves* 6–8 in a basal tuft, linear, 2–15 mm × 60–200 mm, occasionally longer; stiff to pliable in texture with prominent ribs and finely dentate, somewhat undulate margins, glabrous to finely pubescent. *Flowers* borne in lax racemose inflorescences; pedicels borne at an angle approaching 90 degrees. *Perianth* segments obovate to lanceolate, 8–10 mm × 3–4 mm, with acute apices, pale to deep blue-mauve, often veined. *Stamens* 5 upper with filaments fused for part of their length, anthers tubular, 2 mm long, filaments 0.5 mm long, yellow; 1 lower with oblong anther 3 mm long and filament 1 mm long; yellow, purple or a combination of both, anthers dehiscent by terminal pores. *Fruit* a globose capsule to 6 mm in diameter; seeds numerous, black, 2 mm in diameter. (Figure 3).

Diagnostic characters

The unpatterned blue to blue-mauve flowers of *C. hyacinthoides* serve to distinguish this species from all others in the genus.

Distribution and habitat

Cyanella hyacinthoides has an extensive distribution range, centered in the SW Cape but reaching north as far as the Richtersveld and eastwards to Riversdale (Figure 4). An

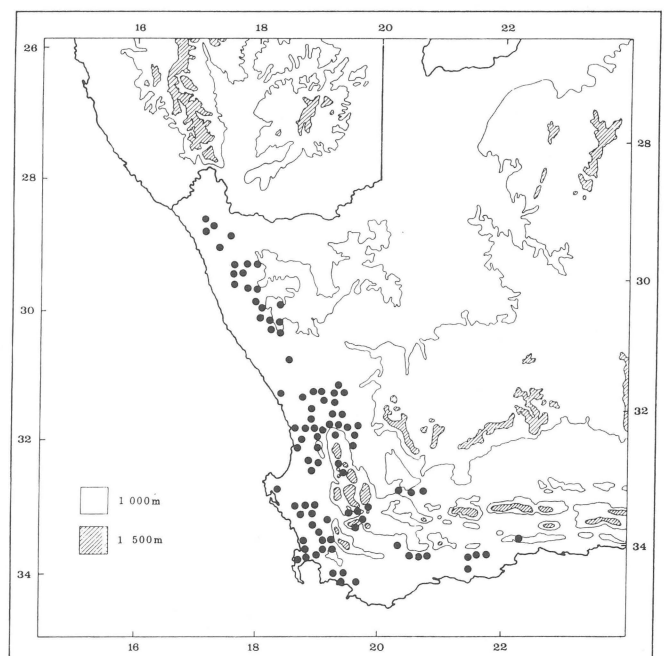


Figure 4 Distribution of *Cyanella hyacinthoides*.

outlying population has recently been recorded in the Outeniqua Mountains. The species is therefore confined to the winter rainfall region as defined by Goldblatt (1976). *C. hyacinthoides* does not appear to be confined to a particular veld type nor its edaphic requirements very specific. It is recorded as occurring in Renosterveld, Succulent Karoo and Mountain Fynbos i.e. veld types 46, 31 and 69 (Acocks 1975) in Table Mountain Sandstone, poorly drained clay, weathered granite soils and loam, over an altitudinal range of 0–900 m. Observations in the field supported the apparent lack of edaphic specificity of *C. hyacinthoides* suggested by herbarium records. It was frequently seen in disturbed areas such as old lands, beside farm roads and on sites cleared of aliens that this species tended to become almost weedy, springing up in dense stands. Seed trials carried out in the nursery (Scott 1989) showed germination to be equally good in sand, loam and clay.

Cyanella pentheri, described as a new species by Zahlbruckner (1902) is considered to be synonymous with *C. hyacinthoides*, in agreement with the view of Obermeyer (pers. comm. in Ornduff 1979). The type of *C. pentheri* was unfortunately lost during World War II, (pers. comm. Director, W) but the foliar characters outlined in Zahlbruckner's description, as the basis of his recognition of a separate taxon, are considered to fall within the normal range of variation for *C. hyacinthoides*. However the Nama people of the Kamiesberg distinguish the narrow-leaved form (klipraap) from the commoner broader-leaved form (raap, hotnotsraap).

Specimens examined

- 2817 (Violsdrif): Namaqualand, near Orange River (–CC), *Schlechter 11378* (BOL); Richtersveld (–CC), *Marloth 12483* (BOL).
- 2917 (Springbok): Komaggas, Van Reenen se water (–AD), *A.E. van Wyk 6502* (PRE); Sandhoogte, 16 km west of Springbok (–DA), *Thompson 1016* (PRE); Spektakel (–DA), *Barker 2026* (NBG); Top of Spektakel Pass (–DA), *Goldblatt 2797* (NBG); Komaggas (–DC), *Barker 74112* (NBG); Mesklip (–DD), *Maguire 309* (NBG).
- 3017 (Hondekliptaai): Kamieskroon (–BB), *Acocks 16477* (PRE); Kamieskroon (–BB), *Hutchinson 843* (PRE); Brakdam (–BD), *Barker 2027* (NBG).
- 3018 (Kamiesberg): Eselsfontein (–AC), *Barker 6656* (NBG); Near Garies (–CA), *Leipoldt 3993* (BOL).
- 3118 (Vanrhynsdorp): 7 km E. of Nuwerus (–AB), *Hugo 468* (STE); Sandkraal (–DB), *Barker 5648* (NBG); Klawer (–DC), *Roberts & Adendorff in TRV 17639* (PRE); Northern slopes of Nardouwsberg, de Hangen, (–DC), *Esterhuysen 32500* (BOL); Vanrhynshoek (–BD), *Schelppe 8175* (BOL).
- 3119 (Calvinia): Menzieskraal, Nieuwoudtville (–AC), *Markotter in STE 16568* (STE); Brandkop (–AC), *Barker 9485* (NBG); Lokenberg, 33.6 km south of Nieuwoudtville (–CA), *Story in PRE 4282* (PRE); Road to Middelpoort (–CC), *Barker 10768* (NBG).
- 3218 (Clanwilliam): Lamberts Bay, Nortier exp. farm (–AB), *Boucher 4282* (PRE); Kransvlei (–BB), *Barker 4760* (NBG); Clanwilliam, 8 km along Kransvlei Road (–BB), *Gillett 4039* (PRE); Clanwilliam, Langkraal (–BB), *Compton 4307* (BOL); Between Pakhuis and Nardouw (–BB), *Salter 3625* (BOL);

Olifants River dam (–BB), *Barker 4771* (NBG); Clanwilliam, Kanolvlei (–BB), *Barker 7448* (NBG); Piketberg (–DA), *Bond 532* (NBG).

—3219 (Wupperthal): Between Pakhuis and Wupperthal (–AA), *Bolus 22433* (BOL); Klipfonteinrand (–AA), *Barker 4861* (NBG); Brandywyn's River (–AA), *Lewis 22243* (BOL); 5 km north of Citrusdal (–CA), *Goldblatt 3032* (BOL); South of Citrusdal baths, Latjieskloof (–CC), *Emdon 96* (STE).

—3318 (Cape Town): Langebaan village (–AA), *Axelson 80* (NBG); Riebeeckskasteel (–BD), *Barker 2005* (NBG); Between Yzerfontein and Mamre (–BC), *L. Bolus in PRE 38316* (PRE); South of Skulpbaai, Buck Bay farm (–CB), *Boucher 4156* (STE); Robben Eiland (–CD), *Compton 652* (NBG); Lower Blinkwater, Camps Bay (–CD), *Cassidy 84* (NBG); Milnerton (–CD), *Letty in PRE 38300* (PRE); Pella, Burgers Post farm (–DA), *Boucher & Shepherd 4839* (STE); Paarl, Hercules' Pillar (–DC), *Barker 4853* (NBG); Kuilsrivier, Langverwacht (–DC), *Oliver 4806* (STE); Groot Drakenstein Mts (–DD), *Wasserfall 739* (NBG); Voeltjiesdorp, open erf. c/o Hamerkop and Patrys Streets (–DD), *Boucher 3387* (PRE).

—3319 (Worcester): Ceres, Lakenvlei (–AD), *Barker 2004* (NBG); Cold Bokkeveld, Ceres (–AD), *Compton 12497* (NBG); Ceres, Karroopoort (–BC), *Bolus 19586* (BOL).

—3320 (Montagu): Laingsburg, Tweedside (–AB), *Compton 4727* (NBG); Pienaarskloof (–AA), *Barker 6821* (NBG); Matjiesfontein (–BA), *Foley 120* (PRE).

—3322 (Oudtshoorn): Lower northern slopes of Outeniqua mountains near Zebrasfontein (–CC), *Vlok 1216* (NBG).

—3418 (Simonstown): Muizenberg (–AB), *Rogers 1089* (PRE); Noordhoek (–AB), *Wasserfall 674* (PRE); Cape Flats, Isoetesvlei (–AB), *Barker 10595* (NBG); Cape Peninsula, above Cannonball Bay (–AB), *Barker 3241* (NBG).

—3419 (Caledon): Kleinmond (–AC), *de Vos 287* (STE); Hermanus, Fernkloof Reserve (–AD), *Orchard 525* (PRE); Napier, Skurftekop (–BD), *Jordaan 66* (STE); Botrivier, Honingklip (–AC), *Taylor 4080* (STE).

—3420 (Bredasdorp): Swellendam (–AB), *Wurts 481* (NBG); Swellendam (–AB), *Liebenberg 6779* (STE); Uitvlugt Plantation, (–BA), *Hubbard 31* (STE).

—3421 (Riversdale): Riversdale (–AB), *Schlechter 1789* (GRA); 3 km west of Reisiesbaan siding (–AB), *Bohnen 7043* (PRE); Riversdale, Corente River (–AD), *Muir 530* (PRE); 2 km south of Aasvogelberg, Platbos farm (–BA), *Stirton 10261* (NBG).

2. *Cyanella aquatica* Obermeyer ex G. Scott sp. nov.

A *C. hyacinthoides* floribus aurantiacis, non lazulinus vel violaceis, inflorescentia valde deminuta fructibus grandioribus differt.

TYPUS.—Cape Province: Nieuwoudtville, Klipkoppies, *Scott 66* (NBG, holotypus; PRE, isotypus).

Plants to 400 mm high. *Corms* deep-seated, flattened, disc-shaped, with a light brown to cream fibrous tunic. *Leaves* numerous in a basal tuft, more or less erect, linear, up to 350 mm × 15 mm, soft, pliable, entire, glabrous. *Flowers* borne in a sparse raceme on pedicels not longer than 20 mm; pedicels borne at an angle approaching 90 degrees. *Perianth* segments obovate to lanceolate, 8–10 mm × 3–5 mm; mucronate, orange, with dorsal surface veined green. *Stamens* 5 upper with filaments fused for half their length

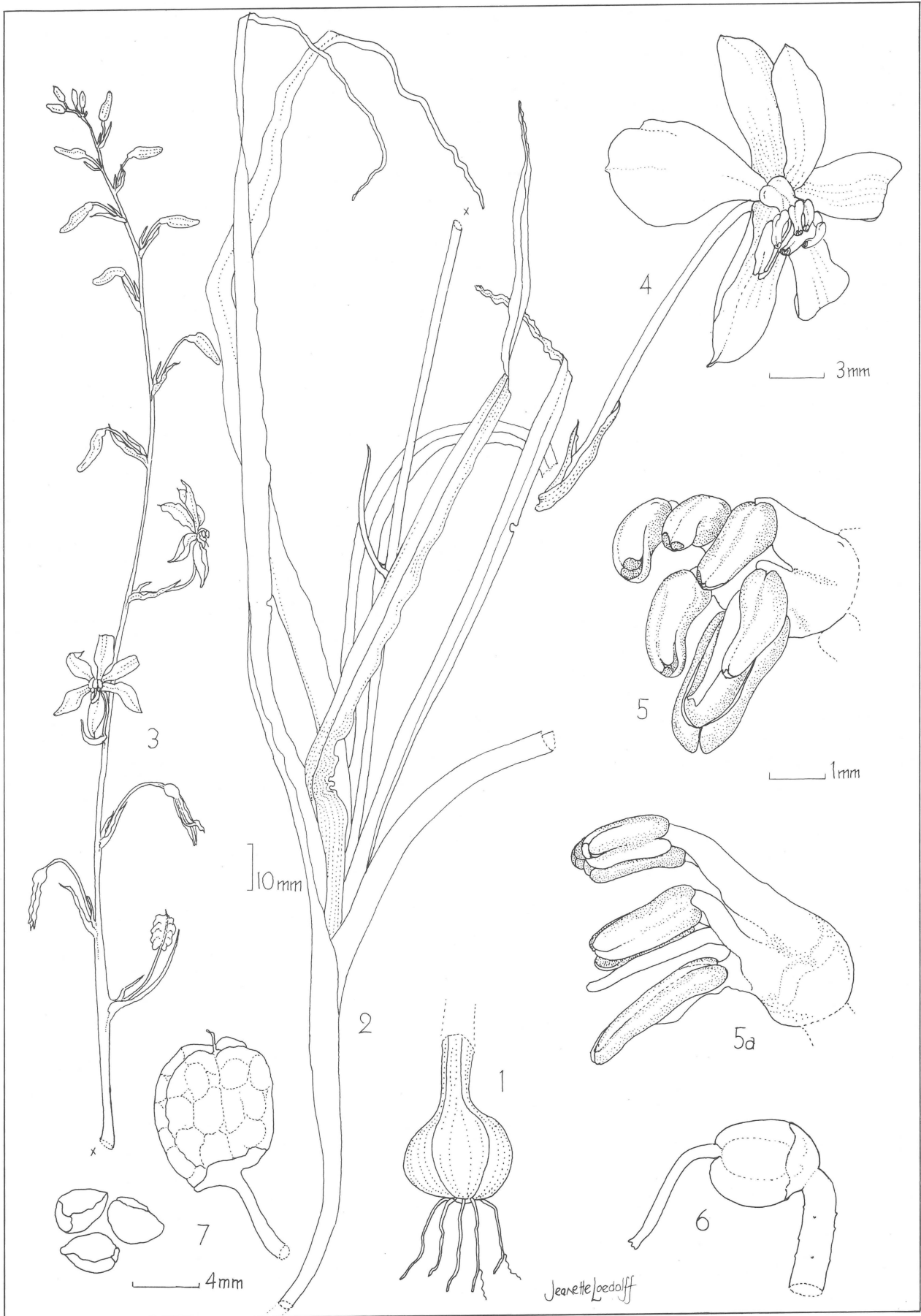


Figure 5 *Cyanella aquatica*. 1. Corm with sheath. 2. Leaves. 3. Inflorescence. 4. Flower, oblique view. 5. Androecium, oblique view. 5a. Androecium, lateral view. 6. Gynoecium. 7. Fruit and seed. No's 1-3 and 7 from G. Scott 66; 4-6 from G. Scott 129 (all live material).

into a short tube, anthers tubular, 2 mm long, with filaments 0.5 mm long, yellow; 1 lower with oblong anther 2 mm long and filament 1 mm long, yellow; anthers dehiscing by pore-like slits. *Fruit* a trilobular globose capsule, to 8 mm in diameter; seeds 3×2 mm, black, with rough exterior. (Figure 5).

Diagnostic characters

A.A. Mauve (Mrs A. Obermeyer) recognized the specimens in the Compton herbarium as an undescribed species, to which she gave the manuscript name *C. aquatica* in 1966. The description given here is based on type material collected from the same locality and her name is retained. It is thought that the specific epithet reflects the seasonal waterlogging of the habitat. *Cyanella aquatica* is considered to be most closely related to those of *C. hyacinthoides*, from which it differs in having orange flowers, a very sparse inflorescence and larger fruits.

Distribution and habitat

This species is known from a single locality, the dolerite hills west of Nieuwoudtville (Figure 6), where it grows wedged between large rocks, in seasonally waterlogged Dwyka tillite soil. Its edaphic requirements appear to be highly specialized in comparison with *C. hyacinthoides*, but further study of this aspect is necessary.

Specimens examined

—3119 (Calvinia): Nieuwoudtville, Klipkoppies (–AC), Barker 9531 & 9764 (NBG); Scott 66 (NBG, holo, PRE, iso).

3. *Cyanella lutea* L.f., Supplementum Plantarum: 201 (1781); Baker: 7 (1896). Type: Sparrman in LINN 430, 1, middle specimen. (LINN, holo; NBG, microfiche!).

Cyanella lineata Burch.: 589 (1812). Type: Bechuanaland, near Moshowa River, Burchell 2256–2 (K, holo.; NBG, photo!).

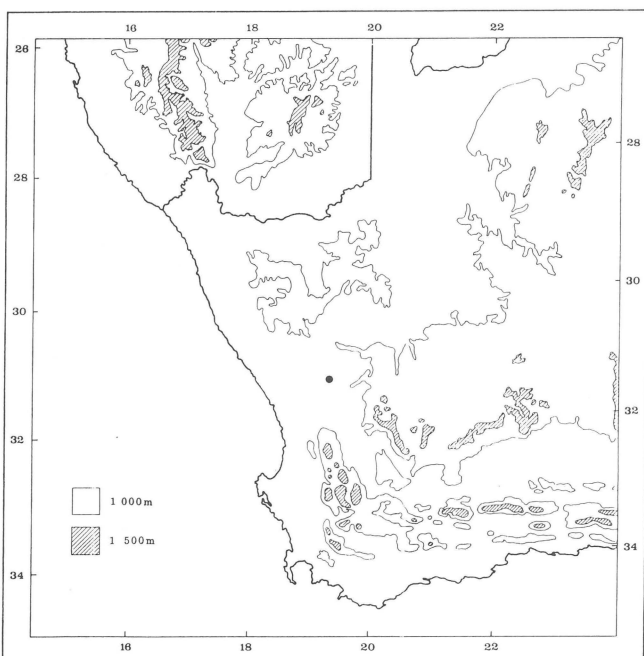


Figure 6 Distribution of *Cyanella aquatica*.

Cyanella odoratissima Lind: t. 1111 (1827). Type: Cape of Good Hope, a plant flowering in Tate's nursery, London, apparently not preserved; Edward's Botanical Register 13: t. 1111 (1827) here designated as lectotype.

Cyanella lutea L.f. var. *rosea* Baker: t. 259 (1871). Type: A native of Cape Colony, collected by Mr Thos. Cooper, flowering in Britain, apparently not preserved; Saunders Refugium Botanicum 4: t. 259 (1871) here designated as lectotype.

Cyanella racemosa Schinz: 394 (1895). Type: Cape Province 'propre Cape Town', 12 VI. 1892, Schlechter 839 (Z, holo!; NBG, iso!).

Cyanella lutea L.f. var. *angustifolia* Schinz: 48 (1896). Type: Namibia, Oas, Fleck 232 (Z, holo; NBG, photo!).

Cyanella lutea L.f. var. *angustior* A. Zahlbr: 27 (1902). Type: South Africa, Cape Province, Caledon, Penther 494 (W, holo, +).

Plants 150–350 mm high. *Corms* deep-seated with a neck 25–100 mm long and a wiry to fibrous light brown tunic occasionally extending the length of the corm neck. *Leaves* in a basal tuft, linear, 30–250 mm \times 2–18 mm, texture soft and pliable, margin entire, ribs not prominent, glabrous. *Flowers* often sweetly scented, borne in much-branched racemose inflorescences; pedicels branching from main axis at an angle of 40–60 degrees. *Perianth* segments oblong-lanceolate, 12–18 mm \times 2–4 mm, with acute to mucronate apices; yellow, pink, often with maroon veins, occasionally maculate. *Stamens* 5 upper with filaments free and anthers tubular, each 2.5 mm long, yellow; 1 lower with spatulate anther 4–5 mm long and filament 2.5 mm long, yellow; anthers frequently spotted maroon or black, dehiscing by pore-like slits. *Fruit* globose capsule 8 mm in diameter, seeds numerous, black, 2 mm long. (Figure 7).

Diagnostic characters

In *C. lutea* the inflorescence is racemose, the flowers are pink or yellow and the stamens arranged in two groups of one lower stamen and 5 upper stamens. This combination of characters serves to distinguish this species from all others in the genus.

Distribution and habitat

This species has the widest distribution of all in the genus, extending throughout the Cape Floral Kingdom into the summer rainfall region of the eastern and northern Cape Province, Lesotho and Botswana (Figure 8). It is not known whether the rather sporadic occurrence in the northern and north-eastern Cape is the result of under-collecting, fragmentation due to increasing aridity in the past, invasion into a new area, lack of suitable habitats or simply over-utilization as a foodstuff. *Cyanella lutea* has been recorded as occurring in a variety of veld types e.g. renosterveld, coastal fynbos, grassland and karroid scrub in several different soils e.g. sand, shale, calcrete and loam.

The locality for the type of *C. racemosa*, given as 'Camp Ground, propre Cape Town' may be the result of label switches, apparently common for Schlechter's early numbers (Rourke, pers. comm. and Jessop 1964). This would explain the rather unusual record of *C. lutea* from the Cape Peninsula.

Cyanella lutea is morphologically variable as regards

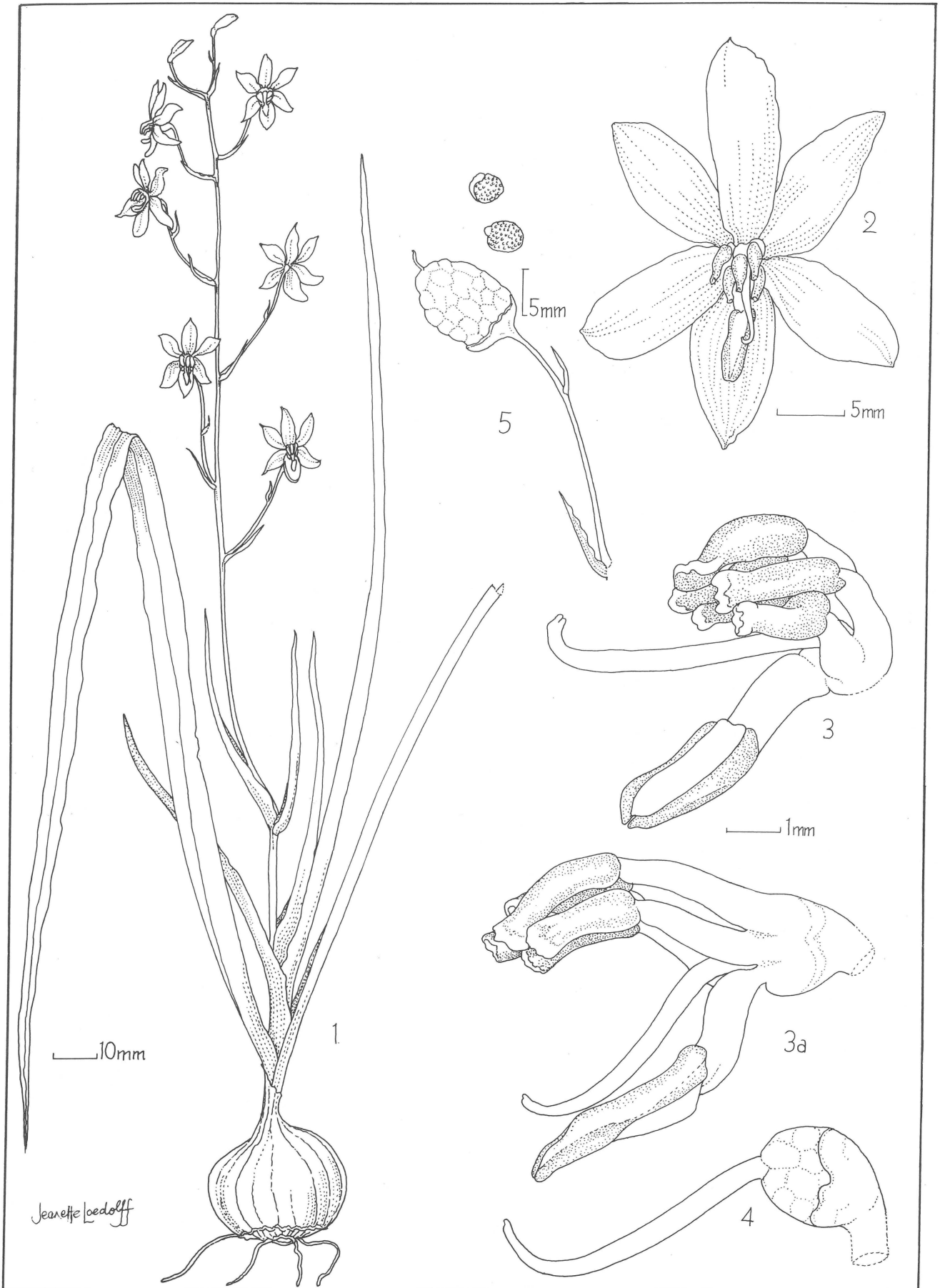


Figure 7 *Cyanella lutea*. 1. Whole plant. 2. Flower, front view. 3. Androecium, oblique view. 3a. Androecium, lateral view. 4. Gynoecium. 5. Fruit and seed. No's 1 and 5 from G. Scott 127; 2-4 from G. Scott 12 (all live material).

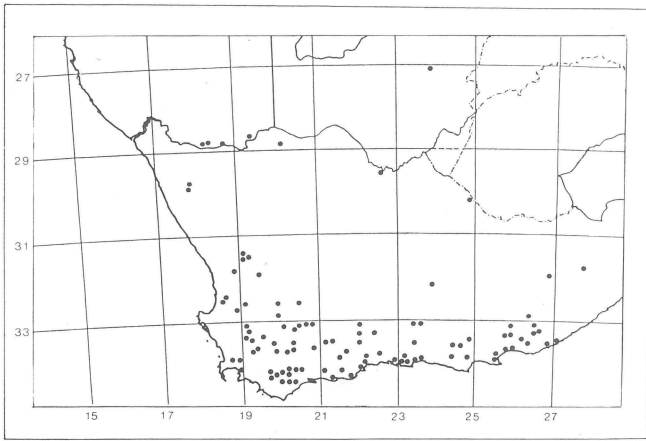


Figure 8 Distribution of *Cyanella lutea*.

flower colour and leaf shape. The pink flowers and linear leaves quoted as the basis for separation of *C. lineata*, *C. lutea* var. *rosea*, *C. odoratissima*, *C. racemosa*, *C. lutea* f. *angustior* and *C. lutea* var. *angustifolia* from *C. lutea* are considered to be acceptable variation within a single taxon.

The type of *C. lutea* f. *angustior*, a Penther specimen, has been lost, (pers. comm., Director, W) but from the description and locality it is possible to place this form into the synonymy of *C. lutea*.

Specimens examined

- 2723 (Kuruman): Bechuanaland, Moshowa River (–BB), Burchell 2256.2 (K).
- 2817 (Springbok): Kamieskroon, Droedap (–DD), Esterhuysen 5894 (PRE).
- 2818 (Warmbad): 3 km south of Goodhouse (–CC), Lewis 63739 (PRE).
- 2819 (Ariamsvlei): Turn-off on main road from Velloorsdrif to Numas (–CB), Muller & Leach 326 (PRE).
- 2820 (Kakamas): 19 km E. of Kakamas on Keimoes Road (–DC), Hardy & Rauh 1560 (PRE).
- 2922 (Prieska): Prieska golf course (–DA), Bryant 154J (PRE).
- 3024 (De Aar): Rolfontein Nature Reserve, Springbok Flats (–BB), Coetzee in PRE 657390 (PRE).
- 3118 (Vanrhynsdorp): Between Oorlogskloof and Papkuilsfontein (–DD), Leipoldt 3651 (BOL).
- 3119 (Calvinia): 11 km from Nieuwoudtville on Clanwilliam road (–AC), Hardy 795 (PRE); Nieuwoudtville, Klipkoppies (–AC), Barker 9765 (NBG); Botterkloof (–CD), Compton 20911 (NBG).
- 3126 (Queenstown): Lower slopes, Queenstown (–DD), Galpin 1568 (PRE); Queenstown, near Bowker's kop (–DD), Sim 11933 (GRA).
- 3127 (Lady Frere): Tembuland, Cala (–DA), Rogffe 25721 (PRE).
- 3218 (Clanwilliam): Piketberg, Rest-ho (–DA), Gillett 3706 (STE); Piketberg Road (–DA), Guthrie 2717 (NBG); Nurust farm, 9.6 km from Piketberg (–DD), Loubser 2107 (NBG).
- 3220 (Sutherland): Sutherland, Houthoek (–GA), Hanekom 1575 (STE); Koodoeberg, south-west of Sutherland (–CC), Oliver 4378 (STE); Verlatenkloof (–DA), Hall 3239 (NBG).
- 3223 (Rietbron): 20 km from farm Rietfontein, on Murraysburg road (–BA), Retief & Reid 521 (PRE).

—3226 (Fort Beaufort): Fort Beaufort, upper edge of new reservoir (–DC), Fort Beaufort convent 5 (GRA).

—3318 (Cape Town): Langverwacht, above Kuils River main kloof (–DC), Oliver 4704 (STE); Stellenbosch, Ida's Valley dam (–DD), Van Wyk in STE 31535 (STE); N. of Tygerberg, Bellville (–DC), Barker 4808 (NBG); Stellenbosch, Elsenerg (–DD), Penfold 153 (NBG).

—3319 (Worcester): Ceres, Lakenvlei (–AC), Compton 12087 (NBG); Artois (–AC), Compton 11682 (NBG); Tulbagh (–AC), Lewis 2458 (BOL); Tulbagh mountains (–AC), Marloth 5541 (STE); Worcester, E. of town (–CB), Taylor 4027 (STE); Ceres, Karroopoort (–BC), Hall 951 (NBG); Robertson, de Wet's farm (–DD), Grant 4935 (PRE).

—3320 (Montagu): Pienaar's Kloof (–AA), Acocks 23724 (PRE); Near Matjiesfontein (–BA), Marloth 9582 (STE); Laingsburg, Constable (–BB), Bond 664 (NBG); Whitehill, Karoo garden 5482 (–BB), Barker 11801 (NBG); 16 km E. of Montagu (–CC), Lewis (BOL); South of Ashton (–CC), Barker 2032 (NBG); Bonnievale (–CC), Marloth 11842 (PRE).

—3321 (Ladismith): North of Klein Swartberge, Vleiland (–AC), Thompson 3183 (STE); NW of Ladismith, Klein Swartberg, road to Waterkloof (–AD), Mauve, Reid & Wikner 105 (STE); Oudtshoorn district, Gamka Mt Reserve, Tierkloof (–CD), Cattell & Cattell 179 (PRE).

—3322 (Oudtshoorn): Prince Albert (–AA), Minnaar 2 (PRE); De Rust, P.M.K. le Roux farm, Doornkraal (–BC), Dahlstrand 1455 (STE); Oudtshoorn, Cango Caves (–CA), Gillett 1692 (STE); Knysna, Barrington (–DD), Barker 6068 (NBG).

—3323 (Willowmore): Volstruisleegte farm, at turn-off to Rietbron (–AB), Retief & Reid 394 (PRE); Vledermuis area between Fullarton and Heuningkop (–BA), Oliver 4582 (STE); Knysna, Portland (–CC), Duthie 1156 (STE); Bellevue, 5 km from Avontuur (–CC), Botha 2188 (PRE).

—3324 (Steytlerville): Near Slagboom, below Zuurburg (–BD), Rennie 462 (GRA); Steytlerville, Kruisrivier, Essenbos Road (–CD), Freer 161 (GRA); N. end of poort between Patensie and Cambria (–DA), Thompson 1885 (STE).

—3325 (Port Elizabeth): Addopark, Olifantkamp (–BC), Botha 5642 (GRA); Uitenhage, near Zwartkops River (–CD), Zeyher 255 (STE); Alexandria, Kinkelbos (–DB), Holland 4002 (BOL); Perseverance (–DC), Long 812 (GRA); Addo Nat. Park, Grootdraai (–BC), Archibald 5648 (PRE).

—3326 (Grahamstown): 'Rockdale', near Highlands (–AD), Dyer 2227 (PRE); Grahamstown, Brakkloof (–BA), White 1895 (GRA); Grahamstown, 9.6 km along Cradock road (–BC), Britten 572 (GRA); Alexandria, Bushman's River poort (–CB), Archibald 5326 (PRE).

—3327 (Peddie): Fish River mouth (–AC), Story 3214 (PRE).

—3418 (Simonstown): 0.6 km from Temperance village to Gordon's Bay (–BB), Mauve 4595 (PRE).

—3419 (Caledon): Between Lindeshof and Greyton (–BA), Lewis 5660 (NBG); Riviersonderend Mts (–BB), Stokoe 8117 (BOL); Slopes of Kleinberg, 3 km NW of Napier (–BD), Thompson 3206 (STE).

—3420 (Bredasdorp): 11 km from Riviersonderend to Swellendam (–AA), Mauve 4586 (STE); Between Swellendam and Stormsvlei (–AB), Goldblatt 2924 (NBG); Bushman's River (–AB), Barker 2031 (NBG); De Hoop/Potberg reserve, opp. Windhoek residence (–AD), Burgers 1276 (STE); 30 km E. of Bredasdorp, Kathoek farm on road to De Hoop (–AD), Mauve & Hugo 140 (STE).

—3421 (Riversdale): Garcia's Pass, 457 m (–AA), Bolus s.n.

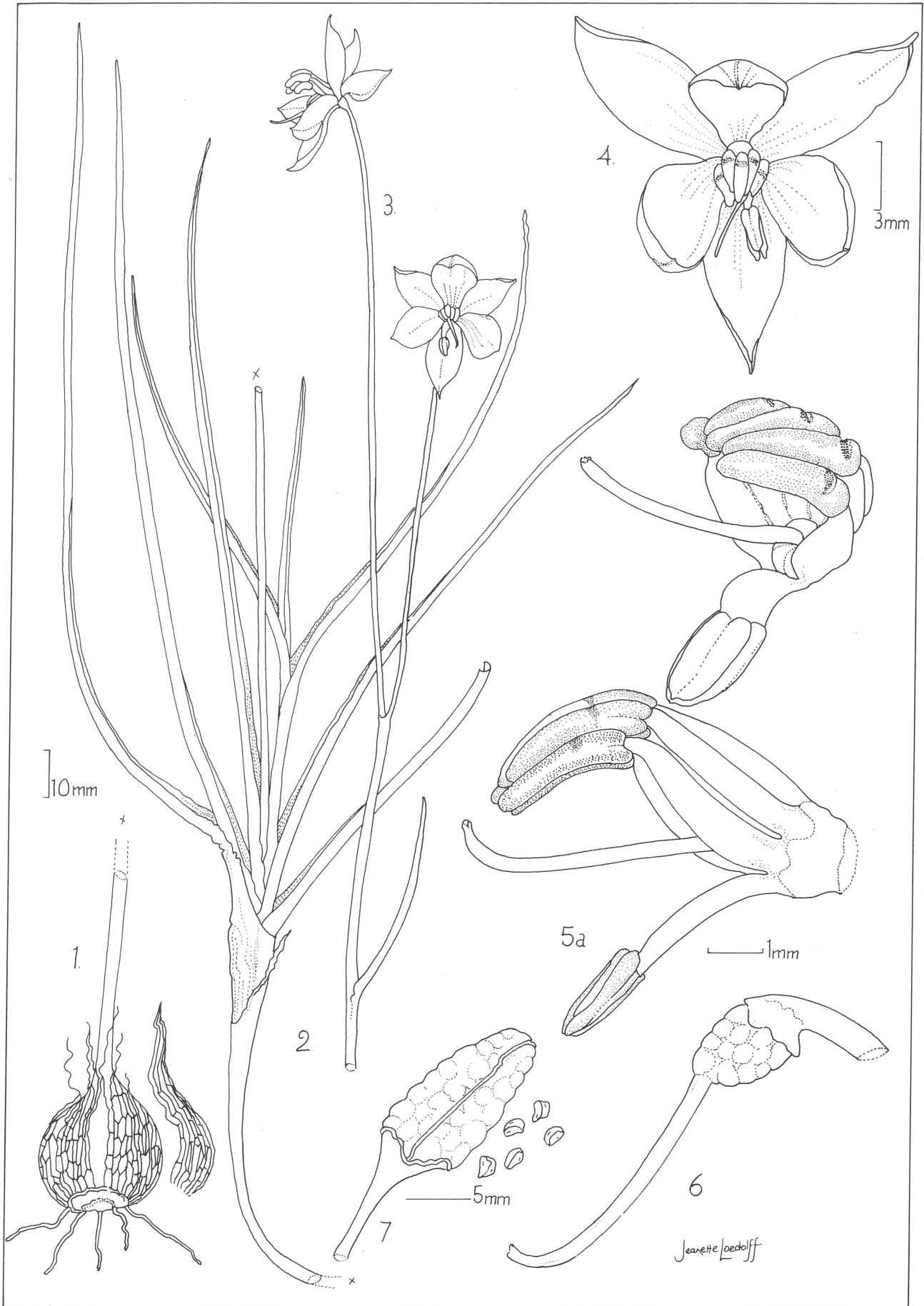


Figure 9 *Cyanella alba*. 1. Corm with sheath. 2. and 3. Above-ground parts. 4. Flower, front view. 5. Androecium, oblique view. 5a. Androecium, lateral view, 6. Gynoecium. 7. Fruit and seed. Drawn from G. Scott 127 (live material).

(BOL); Stillbay, in front of church hall (-AD), *Bohnen* 4463 (STE); Stillbay, Panorama Circle (-AD), *Bohnen* 7543 (STE).

—3422 (Mossel Bay): Great Brak River mouth (-AA), *Parsons* 361 (STE); 14.4 km west of Mossel Bay (-AA), *Barker* 8214 (NBG).

—3423 (Knysna): Paardekop (-AA), *Morris* 381 (NBG); Plettenberg Bay (-AB), *Britten s.n.* (PRE).

4. *Cyanella alba* L.f: Supplementum Plantarum: 201 (1781), Baker: 6 (1896). Type: Sheet 430/4, Thunberg collection in herb. Linn. (LINN, lecto!, here designated; NBG, microfiche!).

Plants 140–250 mm high. *Corms* deep-seated, globose, with a neck 50–90 mm long and a fibrous dun-coloured sheath often extending the length of the corm neck. *Leaves* numerous in a basal tuft, filiform to narrowly linear, erect, 75–100 mm × 1–3 mm, subtended by a single sheathing bract, glabrous. *Flowers* usually borne singly on peduncles up to 200 mm long. *Perianth* segments ovate to obovate, 12–20 mm × 6–10 mm, apex acute to mucronate, usually white or yellow, less commonly pale pink, sometimes veined on the dorsal surface. *Stamens* 5 upper with filaments free to the base and anthers tubular, connivent when in bud, separating later, yellow, sometimes maculate; filaments and anthers both 4 mm long; 1 lower with spatulate anther 4 mm long and filament 2 mm long, yellow; anthers dehiscing by lateral slits. *Fruit* a loculicidal capsule, 15 mm long at maturity; seeds numerous, black, 2 mm in diameter. (Figure 9).

Diagnostic characters

The description of *C. alba* by the younger Linnaeus refers only to the presence of linear-filiform leaves. Of the two specimens in the Linnaean herbarium (430/4 and 430/5), only 430/4 has a basal tuft of leaves, while the foliage of

430/5 is scanty and in poor condition. Sheet 430/4 is thus designated as lectotype.

C. alba is distinguished from other members of the genus by its large flowers, usually borne on unbranched peduncles and its usually filiform leaves. The corm sheath is often heavy, forming a protective structure extending the length of the corm neck. Minor morphological differences exist between the colour forms of the species but are considered at this stage to be an inadequate basis for the recognition of distinct taxa.

Distribution and habitat

The apparently disjunct distribution of this species, with centres in the Nieuwoudtville, Pakhuis/Wupperthal and Ceres areas (Figure 10) may be due to the aridity of the Doorn River Valley between Nieuwoudtville and Clanwilliam, and of the Tanqua Karoo, or possibly of fragmentation due to farming operations. Judging by the very large numbers of blooms appearing annually on local flower shows, there must be many populations of the various colour forms still in existence. Investigation of these populations would provide a clearer picture of the distribution, conservation status, and infraspecific variation of *C. alba*.

Specimens examined

—3119 (Calvinia): 17.4 km E. of Nieuwoudtville on Calvinia road (-AC), *Lewis* 6126 (NBG); 15 km south of Nieuwoudtville (-AC), *Goldblatt* 3092 (NBG); Van Wyk's farm, 17.4 km from Nieuwoudtville (-AC), *L. Bolus* 19587 (BOL); Nieuwoudtville, Meulsteenvlei farm (-AC), *McMurtry* 514 (PRE); Lokenberg (-CA), *Esterhuysen* 5751 (BOL).

—3218 (Clanwilliam): Clanwilliam (-BB), *Strassberger* in *STE* 11181 (STE); 12.8 km south of Clanwilliam on Citrusdal road (-BB), *Nordenstam* 994 (BOL).

—3219 (Wupperthal): Citadelkop (-AA), *Compton* 24237 (NBG); 2 km along Elizabethfontein road, off R364 from Clanwilliam to Calvinia (-AA), *Scott* 132 (NBG); 11.4 km from Clanwilliam/Calvinia turnoff to Wupperthal; South-western slopes of pass into Bidouw valley (-AA), *Hugo* 539 (STE); Koudeberg (-AC), *Bolus* 9095 (BOL); Welbedacht (-AA), *Martin* 1794137 (BOL).

5. *Cyanella orchidiformis* Jacquin Collectanea ad Botanicum: 211 (1791); Baker: 6 (1896). Type: Jacquin *Icones Plantarum Rariorum*: t. 447 (1786–1793), (BOL, lecto!, here designated).

Plants 300 mm high. *Corms* with a neck 30–70 mm long and a hard, dark red-brown, reticulately patterned tunic. *Leaves* 3–6 in a basal rosette, oblong-lanceolate, 75–250 × 10–25 mm, soft and pliable, margin entire to somewhat undulate, occasionally finely dentate, glabrous. *Flowers* borne in much-branched racemes on short pedicels branching from peduncle at an angle of 20 to 30 degrees. *Perianth* segments obovate, 8–10 mm × 2–5 mm, with rounded apices, mauve with maroon centre, often veined or patterned, those of the inner whorl are clawed. *Stamens* 3 upper with filaments free and anthers tubular to sagittate, yellow tipped with mauve; 3 lower with filaments free and anthers tubular, 4 mm long and filaments 1–2 mm long,

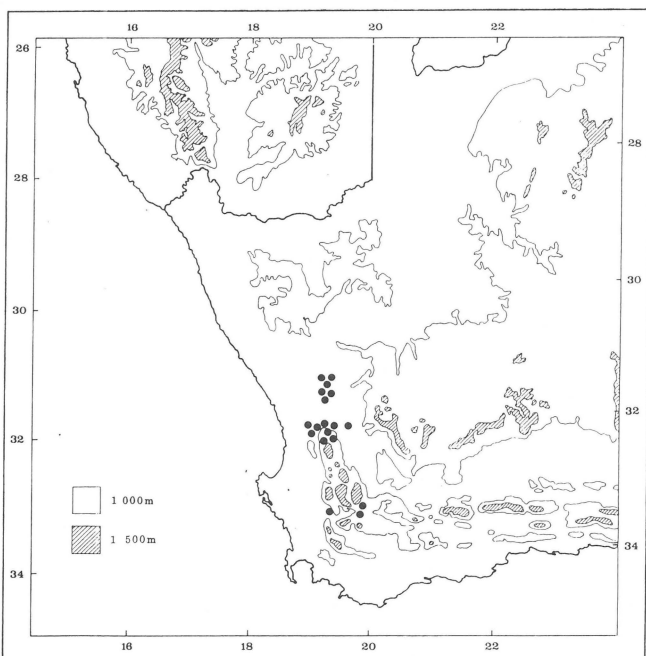


Figure 10 Distribution of *Cyanella alba*.

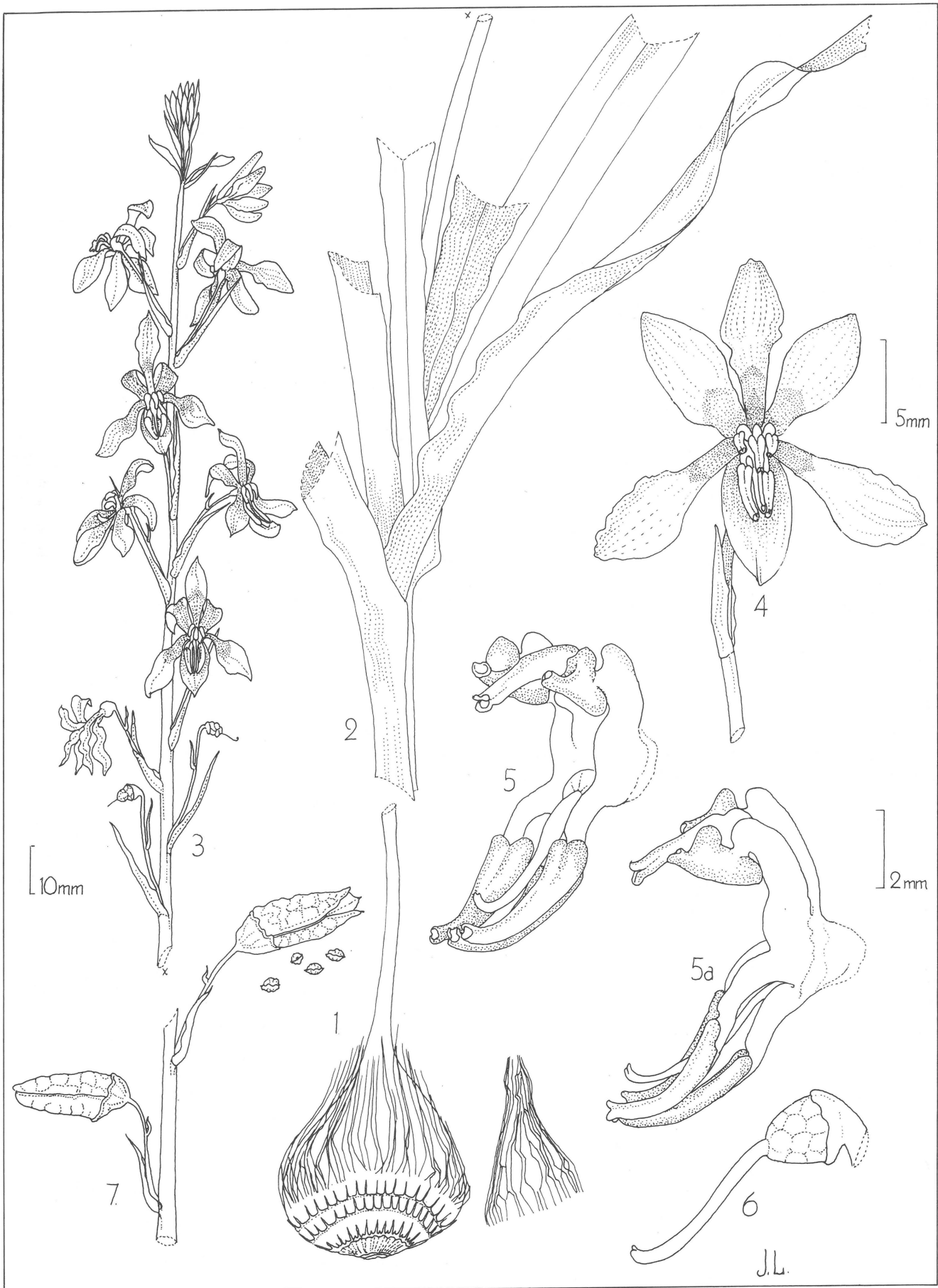


Figure 11 *Cyanella orchidiformis*. 1. Corm with sheath. 2. Foliage. 3. Inflorescence. 4. Flower, front view. 5. Androecium, oblique view. 5a. Androecium, lateral view. 6. Gynoecium. 7. Fruits. No's 1-3 and 7 from *G. Scott 10*; 5-6 from *G. Scott 88*; 4 from *G. Scott 131* (all live material).

mauve, anthers dehiscing by terminal pores. *Fruit* an ovoid capsule, to 15 mm × 10 mm, with numerous black somewhat wrinkled seeds. (Figure 11).

Diagnostic characters

C. orchidiformis is most closely related to *C. ramosissima* and *C. cygnea*. *C. ramosissima* generally has narrower leaves (8 mm or less) and a shorter more compact inflorescence (not more than 15 mm high) than *C. orchidiformis*. Further features separating these two species are the unpatterned perianth of *C. ramosissima* and its long filiform style (approximately twice the length of the lower stamens). *C. cygnea*, while resembling *C. orchidiformis* in having a patterned perianth, has a highly distinctive group of three upper stamens, with slender, strongly reflexed filaments, swollen at the base. The corms of *C. orchidiformis* are eaten by the indigenous peoples of the Richtersveld who know it as 'waterraap'.

Distribution and habitat

The species is confined to the Richtersveld and Namaqualand, where rocky sites or dry river beds are preferred (Figure 12).

Specimens examined

—2816 (Oranjemund): Richtersveld, mountains south west of Kuboos (-BD), *Lavrano* 10834 (PRE).

—2817 (Violsdrif): Lelieshoek, in kloof (-AC), *Oliver, Tölken & Venter* 315 (PRE); Koufontein (-BC), *Le Roux* 2688 (BOL); Richtersveld, Stinkfontein, south-west of Vanzylsrus (-CA), *Oliver, Tölken & Venter* 626 (PRE).

—2917 (Springbok): 2 km east of Anenaus Pass (-BA), *Botha* 3175 (PRE); Steinkopf (-BC), *Venter* 8203 (PRE); 12.8 km from Bulletrap to Nigramoep (-BC), *Van Wyk* 6367 (PRE); 9.6 km west of Springbok (-DB), *Barker* 6662 (NBG); Top of Wildepaardehoek Pass (-DC), *Goldblatt* 2821 (NBG).

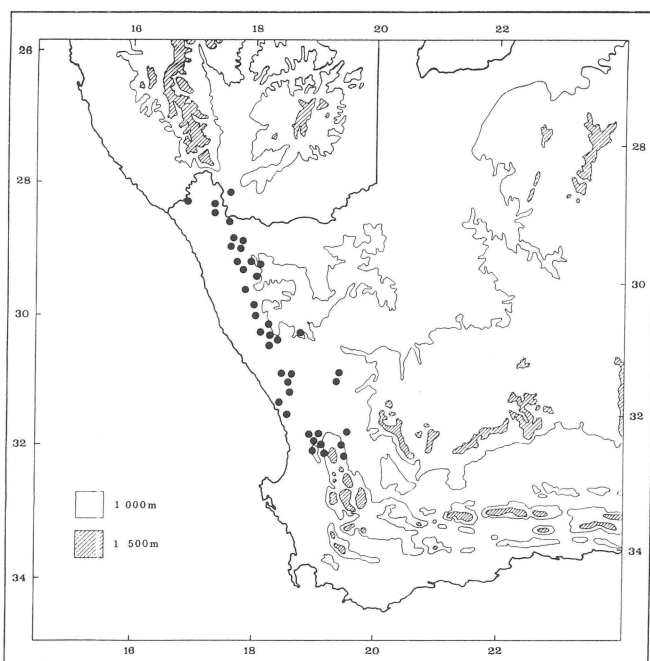


Figure 12 Distribution of *Cyanella orchidiformis*.

—3017 (Hondeklipbaai): 20 km from Kamieskroon to Garies (-BD), *Stirton* 5981 (PRE); East of Klawer, Vleikraal (-DB), *Walters* 17 (STE).

—3018 (Kamiesberg): 3.2 km north-west of Garies (-CA), *Acocks* 16461 (PRE).

—3118 (Vanrhynsdorp): Quaggakop, 6 km west of Nuwerus (-AB), *Le Roux* 2282 (STE); 24 km north-west of Koekenaap (-CB), *Hall* 3766 (NBG); Nardouw Road (-DD), *Compton* 17153 (NBG).

—3119 (Calvinia): Nieuwoudtville (-AC), *Leipoldt* 7-89 (BOL); Brandkop (-AC), *Stokoe* 8692 (BOL).

—3218 (Clanwilliam): Olifantsdam (-BB), *Barker* 4768 (NBG); Between Citrusdal and Klawer (-BB), *Van Niekerk* 833 (BOL); Pakhuis Pass (-BB), *Salter* 3623 (BOL); Rondegat River valley, 16 km north-west of Algeria (-BC), *Thompson* 2812 (STE).

—3219 (Wupperthal): Bidouw Valley (-AB), *Middlemost* 1748 (NBG); Cedarberg Wilderness, Langrug (-AC), *Viviers* 496 (STE); Near Citrusdal (-CA), *Steyn* 390 (NBG).

6. *Cyanella ramosissima* (Engler & Krause) Engler & Krause in *Botanische Jahrbücher für systematik* 57: 239 (1921). Type: Namibia, 'bei Kubub', *Range* 139 (Z, holo; NBG, iso!).

Iphigenia ramosissima Engler & Krause: 124 (1910).

Cyanella krauseana Dinter & Schulze: 525 (1941). Type: Namibia, 'Klinghardtgebirge', *Dinter* 3955 (B+; NBG, iso!).

Plants 150 mm high. *Corms* deep-seated, pear-shaped, 20 mm in diameter, with a neck 30-40 mm long and a light brown fibrous sheath. *Leaves* in a basal tuft, 70-120 mm × 3-8 mm, stiff to pliable with distinct venation, margin entire to finely dentate, glabrous. *Flowers* borne on a short, much-branched raceme with pedicels branching from main axis at an angle of 30 to 50 degrees, each subtended by a lanceolate bract. *Perianth* segments lanceolate, up to 18 × 5 mm, apices acute to mucronate, pink/mauve with darker veins. *Stamens* 3 upper with filaments free and anthers tubular to sagittate, yellow; 3 lower with filaments free and anthers tubular, 3 mm long and filaments 1.5 mm long, yellow; dehiscing by terminal pores. Style threadlike, at least twice the length of the lower anthers. *Fruit* a globose capsule containing numerous black seeds. (Figure 13).

Distribution and habitat

Cyanella ramosissima has a distribution restricted to the southern part of Namibia and the Richtersveld (Figure 14).

Diagnostic characters

Characters which serve to distinguish this species from its nearest relative, *C. orchidiformis*, are described under *C. orchidiformis*. *Cyanella cygnea* differs from *C. ramosissima* in having a patterned perianth, much-reflexed upper stamens with swollen bases and a more luxuriant growth form.

Specimens examined

—2616 (Aus): Farm Klein-Aus, west of Aus (-CA), *Giess & Van Vuuren* 756 (WIND); Farm Kubub (-CB), *Giess* 13083 (WIND);

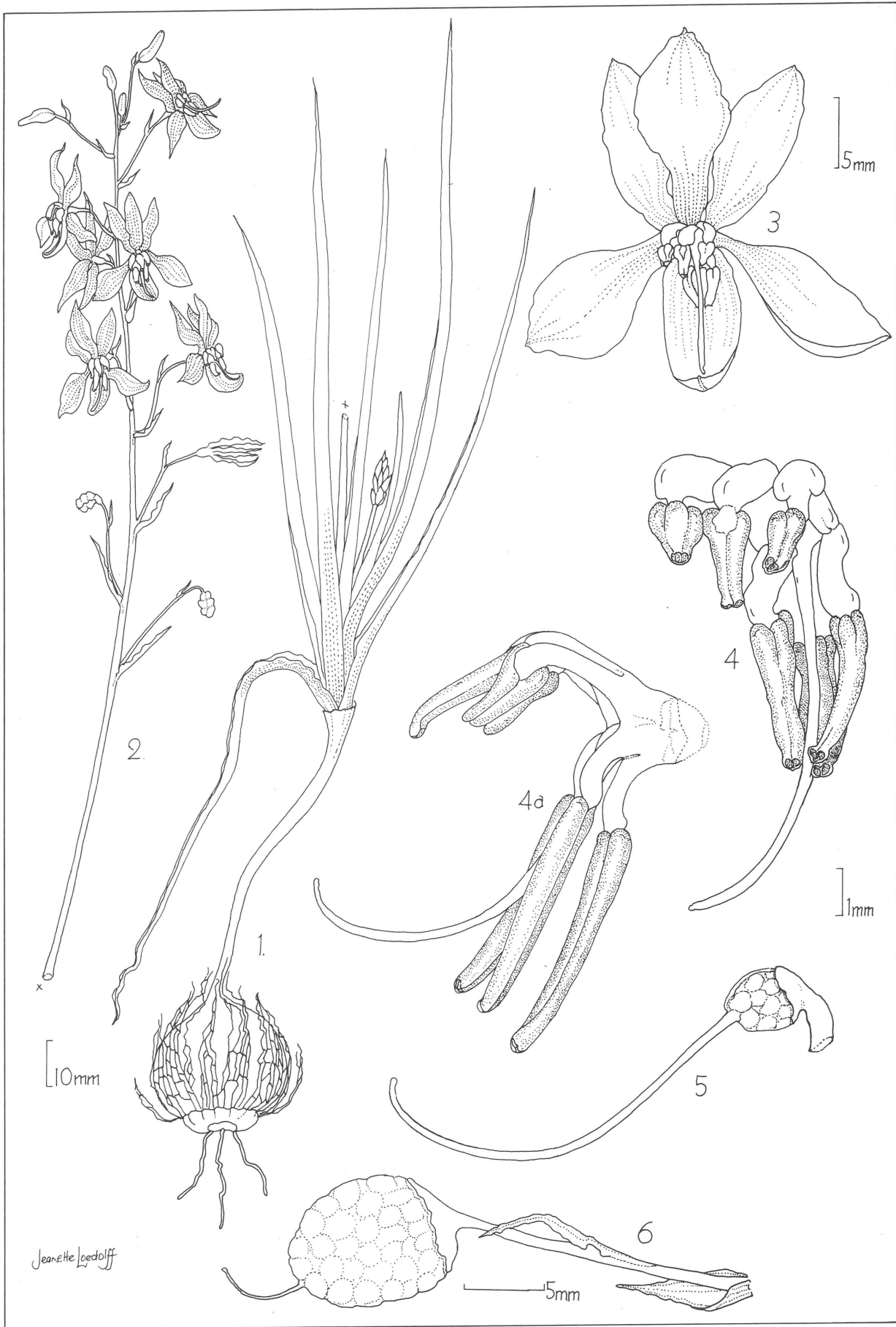


Figure 13 *Cyanella ramosissima*. 1. Entire plant, showing corm and foliage. 2. Inflorescence. 3. Flower, front view. 4. Androecium, oblique view. 4a. Androecium, lateral view. 5. Gynoecium. 6. Fruit. No's 1, 2 and 6 from *D. Kotze 860*; 3-5 from *van Berkel 558* (all live material).

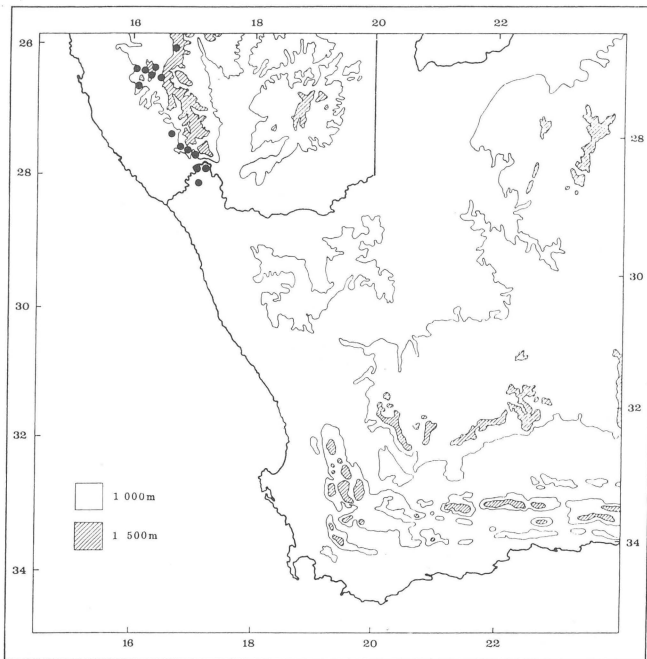


Figure 14 Distribution of *Cyanella ramosissima*.

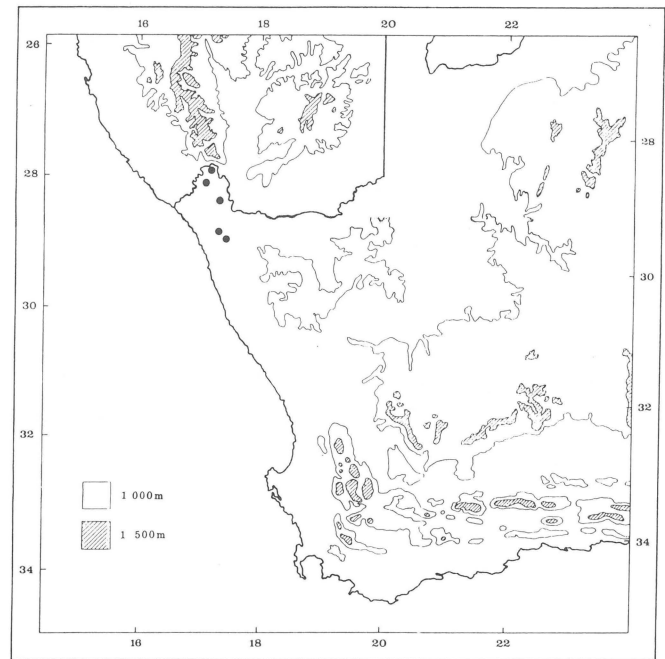


Figure 16 Distribution of *Cyanella cygnea*.

Lüderitz-Süd (-CB), *Karen Regius* 9 (WIND); Farm Klein-Aus (-CC), *Merxmüller & Giess* 2983 (PRE).

—2715 (Bogenfels): Mittagskuppe, W. Höchster Mt. 2 km NW of Höchster (-BD), *Van Berkel* 558 (NBG).

—2716 (Witputz): Farm Namuskluft (-DD), *Giess* 12894 (WIND); Farm Zebrafontein (-DD), *Merxmüller & Giess* 3319 (PRE); McMillan's Pass, near Rosh Pinah (-DD), *Lavranos & Pehlemann* 19023 (WIND); Namuskluft, near Rosh Pinah (-DD), *Lavranos & Pehlemann* 19935 (WIND).

—2817 (Violsdrif): Richtersveld (-AA), *Marloth* 12372 (BOL); Van der Sterberg (-AC), *Van der Westhuizen* 119180 (STE).

7. *Cyanella cygnea* G. Scott sp. nov.

A *C. orchidiforme* et *C. ramosissima* (Engler & Krause) Engler & Krause antheris valde reflexis, basibus filorum tumidis tepalisque flavinotatis differt.

TYPUS.— Cape Province: 51.4 km from Springbok along the road to Komaggas, fl. Karoo Botanic Garden, Worcester, 16 September 1988. *P.L. Perry* 1119 (NBG, holotypus; K, MO, PRE, isotypi).

Plants to 400 mm high. *Corms* deep-seated, 20 mm in diameter with a light brown fibrous sheath. *Leaves* 5–8 in a basal tuft, linear-lanceolate, up to 25–170 mm, pliable, entire to finely dentate, glabrous, with distinct venation. *Flowers* numerous, on short pedicels borne on a much-branched raceme. *Perianth* segments elliptical to obovate, those of the outer whorl clawed, 8–10 × 6–7 mm, apex obtuse to mucronate, mauve with yellow centre and maroon markings. *Stamens* three upper, with strongly reflexed threadlike filaments, swollen at the base, free, to 5 mm long and sagittate anthers 2 mm long, yellow; 3 lower with filaments free, to 1.5 mm long and tubular anthers to 3 mm long, yellow tinged with mauve; anthers dehiscing by terminal pores. Style slender, curved, similar in length to the

lower stamens. *Fruit* an ovoid capsule 15 × 10 mm. (Figures 15 & 17).

Diagnostic features

This species may be distinguished from *C. orchidiformis* and *C. ramosissima* by its distinctive upper group of stamens with strongly reflexed anthers and swollen filament bases, and by the yellow perianth markings.

Distribution and habitat

This species was seen growing at the Karoo Botanic Garden, Worcester, where it had been propagated by Miss Pauline Perry from material collected by her in the Richtersveld in 1979. It represents one of many new and interesting species discovered by Miss Perry in the course of her work on geophytes. The corms are edible and known to the inhabitants of the Richtersveld as 'wilde beet'. The specific epithet refers to the stamens, arched and reflexed in a manner resembling the neck of a swan. *C. cygnea* is known only from the Richtersveld and immediately adjacent area (Figure 16). Plants have not been seen growing in their natural habitat by the author but limited information on herbarium labels suggests a preference for sites offering some moisture, e.g. river banks.

Specimens examined

—2817 (Violsdrif): Kodaspiek, main valley south of beacon (-AA), *Oliver, Tölken & Venter* 492 (PRE); Near Khubus (-CA), *Archer* 391 (NBG, PRE); 10 km west of Eksteenfontein (-CD), *Williamson* 3548 (NBG).

—2917 (Springbok): Komaggas, vicinity of Van Reenen se water (-AD), *Van Wyk* 6501 (PRE); 51.4 km from Springbok, on the road to Komaggas (-AD), *Perry* 1119 (NBG, holo; K, MO, PRE, iso).



Figure 15 *Cyanella cygnea*. 1. Corm with sheath. 2. Foliage. 3. Inflorescence. 4. Flower, oblique view. 5. Androecium, oblique view. 5a. Androecium, lateral view. 6. Gynoecium. 7. Fruits. All from P.L. Perry 1119 (live material).

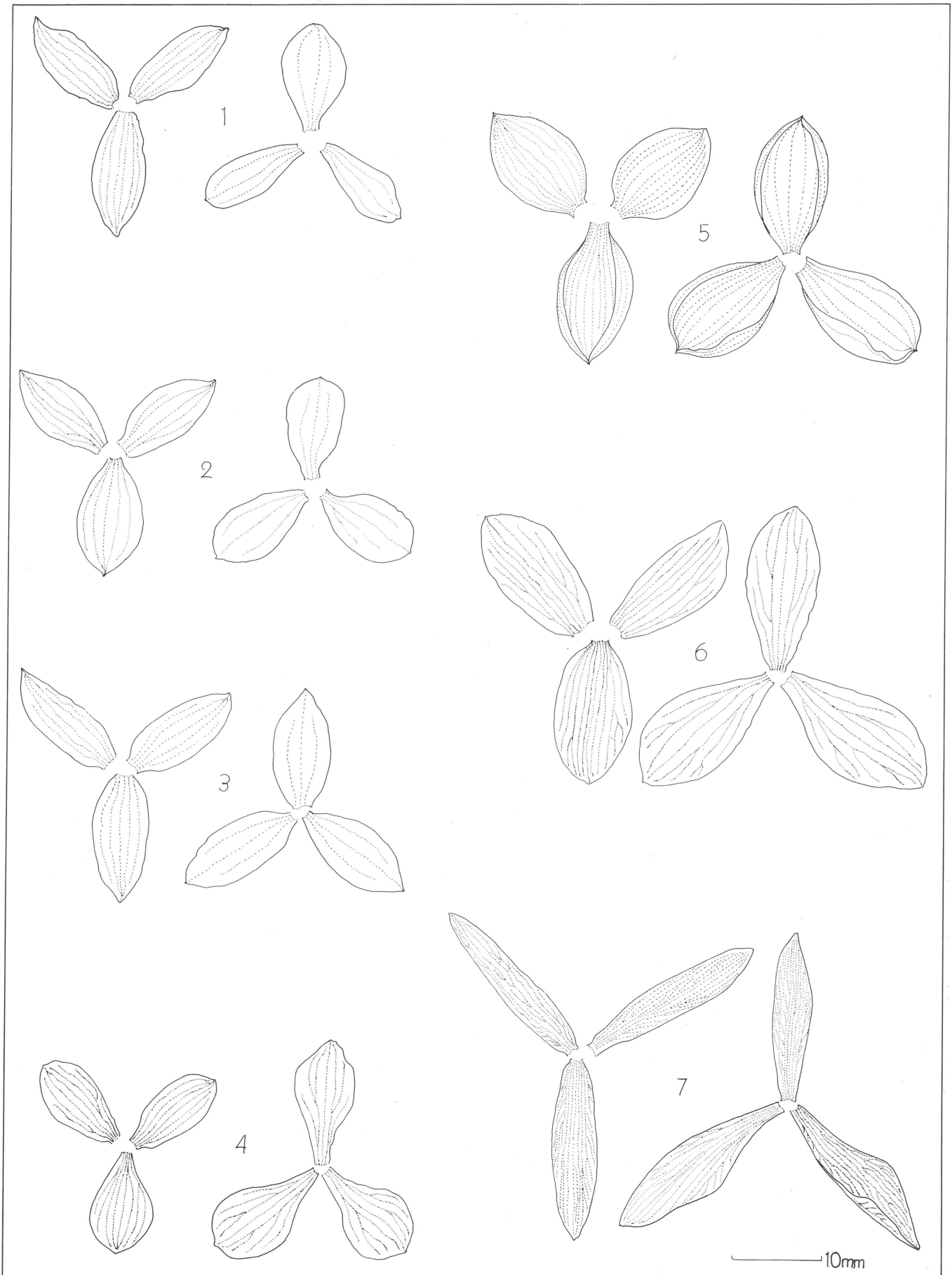


Figure 17 *Cyanella*: perianth segments (outer whorl on the left). 1. *C. hyacinthoides*. 2. *C. aquatica*. 3. *C. lutea*. 4. *C. cygnea*. 5. *C. alba*. 6. *C. orchidiformis*. 7. *C. ramosissima*.

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