

Clivia mirabilis (Amaryllidaceae: Haemantheae) a new species from Northern Cape, South Africa

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ABSTRACT

Clivia mirabilis Rourke is a new pendulous tubular-flowered species from Oorlogskloof Nature Reserve in Northern Cape. Its distribution area is some 800 km outside the previously accepted range of the genus *Clivia*. This sun-tolerant species is adapted to an arid Mediterranean climate, producing vegetative growth in winter and maturing its seeds rapidly in late summer/early autumn to synchronize with the arrival of winter rains.

INTRODUCTION

The genus *Clivia* Lindl., consisting of four currently recognized species, *C. nobilis* Lindl. (1828), *C. miniata* (Lindl.) Regel, *C. gardenii* Hook. (1856) and *C. caulescens* R.A.Dyer (1943), is presently considered to be endemic to southern Africa (Vorster & Smith 1994; Snijman 2000). These species occur in coastal and inland Afrotropical forest from Eastern Cape through KwaZulu-Natal, Swaziland and Mpumalanga to the Soutpansberg in Northern Province. Rumours of the occurrence of *Clivia* in Mozambique have not yet been confirmed by accurately localized herbarium collections.

Clivia is an evergreen, rhizomatous genus in the Amaryllidaceae, characterized by distichous strap-shaped leaves, umbellate solid scapes and red subglobose berries containing one to few cartilaginous, pearly-white seeds embedded in soft yellow pulp.

In February 2001 material of a further species was submitted to the Compton Herbarium for identification in a batch of herbarium specimens from the Oorlogskloof Nature Reserve near Nieuwoudtville, in Northern Cape, collected by the nature conservation officer in charge, Mr Wessel Pretorius. The author confirmed this astonishing discovery during a site visit to Oorlogskloof on 22 February 2001 when two fruiting populations were examined. The new species is here described as *Clivia mirabilis*. Rarely can such an extravagant epithet as *mirabilis* be confidently applied, yet in the case of this extraordinary *Clivia*, so unusual in its distribution and characters, its usage seems entirely appropriate.

Clivia mirabilis Rourke, sp. nov., a speciebus affinis, corollis actinomorpha rectis tubularibus bicoloribus (miniatis/luteis); pedicellis cernuis, 22–40 mm longis, miniatis per anthesin (demum viridibus post anthesin); foliis lineamentis medianis albis et apicibus acutis, distinguitur.

Rhizoma perenne solitarium, erectum; caespitibus foliorum 0.6–1.2 m alto. *Folia* disticha, rigida, erecta, 0.6–1.2 m longa, 30–50 mm lata, glabra, coriacea, lineamentis medianis albis; margines cartilagineae, plerumque laeves, interdum leviter scabra; apices acuti. *Scapus* 300–800 mm longus, carmineus, late ancipitius. *Inflorescentia* umbellata, 20–48 floribus; spathae 5–7, cymbiformi-acutae, papyraceae, 35–50 mm longae, 10–15 mm latae. *Pedicelli* cernui, graciles, 25–40 mm longi, miniati per anthesin, abrupte viridescentes post anthesin. *Perianthium* rectum, tubulosum, 35–50 mm longum, dilatatum versus orem; miniatum sed viride ad apicem per anthesin, tandem flavescens distale. *Antherae* 6, basifixae, leviter exsertae; filamenta 30 mm longa, trilobatus; apices subtiliter penicillati. *Ovarium* ovoideum, nitidum, miniatum per anthesin; viride post anthesin; loculi 3–4-ovulati. *Baccae* pendentes, irregulariter ovoideae, glebulosae; (1)2–5(–7) semina continentia, pericarpium maturum scarlatinum. *Semina* irregulariter ovoidea, ± 10 mm in diam., alba.

TYPE.—Northern Cape, 3119 (Calvinia): Nieuwoudtville, Oorlogskloof Nature Reserve, eastern margin of Oorlogskloof Canyon at Agterstevlei Farm, (–AC), ± 900 m, 18-10-2001, J.P. Rourke 2220 (NBG, holo.; BOL, K, MO, NSW, PRE, iso.).

Stout, rhizomatous, solitary, evergreen perennial, 0.6–1.2 m tall; stem reduced to a vertical rhizome, up to 250 mm long terminating in a tuft of leaves. *Root system* massive, up to 0.7 m diam., horizontally spreading; roots perennial, very stout, fleshy, up to 20 mm diam., outer surface covered in a corky, velamen-like layer. *Leaf sheath* prominent, flushed deep carmine (RHS 183A greyed-purple). *Leaves* long-lived, stiffly erect, distichous, strap-shaped, 0.6–1.2 m long, 30–50 mm wide, flattened to slightly V-shaped with a distinct pale whitish grey striation in the midrib area on upper surface, striation becoming less distinct in older leaves, coriaceous, glabrous, deep dull green, flushed carmine-maroon at base, apex obtuse-acute; margins entire, cartilaginous, usually smooth, occasionally irregularly scabrous, becoming slightly revolute in old, mature leaves. *Scape*

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300–800 mm long, broadly ancipitous, longitudinally ridged, 10–14 mm wide, glabrous, carmine-flushed. *Inflorescence* umbel-like, 20–48-flowered, subtended by 5–7 brownish/carmine, papyraceous spathe valves, narrowly cymbiform-acute, 35–50 × 10–15 mm; pedicels drooping, slender, 25–40 × 1.2 mm, orange-red, abruptly turning green in post-pollination phase. *Perianth* straight to imperceptibly curved, tubular, becoming progressively flared towards apex, 35–50 × 5 mm below ovary, 10–12 mm diam. at mouth, orange-red (RHS 32B) proximally, green-tipped (RHS 145A) distally on opening, the green changing to yellow (RHS 22B) distally, entire perianth becoming deep orange-red (RHS 33A) after anthesis; tepals fused distally to form a tube 10–15 mm long, outer tepals narrowly oblong, apices acute, inner tepals slightly wider, apices obtuse, outwardly flared. *Stamens* 6, dorsifixed, 2 mm long, very slightly exerted at anthesis; filaments 30 mm long, attached to tepals 10 mm above ovary; inwardly bowed proximally, adpressed around style at point of attachment forming a 10 mm long nectar well above ovary. *Ovary* ovoid, shiny, greenish yellow in bud, becoming orange-red at anthesis, changing to bright green in post-pollination phase; ovules 3 or 4 in each locule; style 40–45 mm long, terete, glabrous, tapering distally, included at anthesis, later elongating and becoming exerted 5–8 mm in post-pollination phase; stigma trilobed, lobes 0.4–1.0 mm long, penicillate at apex. *Fruiting heads* with 25–35 pendent berries. *Berries* irregularly oblong to ovoid, 10–30 × 10–15 mm, glebulous to submoniliform, often narrowed to a distinct neck above pedicel, apex often tapering to an eccentrically angled beak, containing (1)2–4(–7) gongyloid seeds projecting prominently and irregularly through thin pericarp; pericarp glossy, pale apple green, maturing through yellow, orange to pinkish red; mature berries red (RHS 40B eventually becoming RHS 45B). *Seeds* somewhat ovoid, slightly faceted, ± 10 mm diam., pearly white; embryo green. (Colour references according to Royal Horticultural Society colour chart.) Figure 1; Plates 1 & 2.

Diagnostic characters

Clivia mirabilis is distinguished by its straight, actinomorphic, bicolored (orange/yellow) tubular corolla, long drooping pedicels, 25–40 mm long, that are orange-red at anthesis and green when fruiting; the distinctive single median white striation on the upper surface of the leaves with smooth cartilaginous margins; and irregularly shaped glebulous-gongyloid berries. The basal part of the leaves forming the leaf sheath is flushed a deep carmine maroon, unlike any other *Clivia* except *C. nobilis*, which occasionally produces similarly coloured leaf bases. The orange-red coloration of the pedicels in this species during anthesis is a unique character in the genus *Clivia*.

Distribution and habitat

Apparently confined to the Oorlogskloof Nature Reserve in Northern Cape (Figure 2), *Clivia mirabilis* is restricted to a small area on the eastern margin of the Oorlogskloof Canyon. Populations are known to occur just north of Eland se Kliphuis adjacent to Agterstevlei Farm and a little further south around the Driefontein Waterfall. The distance between these sites is ± 5 km. The species also occurs at a few sites between these two localities.

The margins of the Oorlogskloof Canyon are capped with 30 m cliffs of Peninsula Formation Sandstone. This has eroded to form coarse sandstone talus screes below the cliffs that are partly covered in a light woodland of relictual Afromontane evergreen forest elements, principally *Olea europaea* subsp. *africana*, *Maytenus acuminata*, *M. oleoides*, *Cassine schinoides*, *Halleria lucida* and *Podocarpus elongatus* with additional shade provided by outside, (4 m tall) specimens of *Phyllica oleaefolia*. Small groups of *C. mirabilis* grow rooted in humus between cracks in the sandstone talus of the rock scree, either as solitary individuals or in small groups. Occasionally some clumps occur in full sun but these tend to have shorter leaves and often show signs of water stress (dried leaf tips). However, the remaining leaves show no signs of sunburn, despite the intense insolation experienced for several months each year. The main population extends over several hectares and probably consists of well over 1 000 individuals. Due to the position of these two sites under the eastern cliffs of Oorlogskloof Canyon, most plants experience shade until about mid-morning after which they are in direct sun.

The area is characterized by a semi-arid Mediterranean climate with a strictly winter rainfall regime—exactly the opposite climatic conditions experienced by the other four species in this genus. The mean annual rainfall for Oorlogskloof is 414 mm, falling mainly between May and September. Vegetative growth is thus restricted to a brief winter growing period. Situated at 850–900 m, some 100 km inland from the coast, these populations are subject to brief but light frost in winter.

MORPHOLOGY AND BIOLOGY

Root system

On excavating several plants in the habitat for cultivation at Kirstenbosch, the enormous root system characteristic of this species was revealed. Large adult plants have a mass of fleshy, succulent roots radiating between $\frac{1}{2}$ – $\frac{3}{4}$ m from the base of the rhizome, each root ± 20 mm in diameter. This disproportionately large volume of sub-



FIGURE 1.—*Clivia mirabilis*: A, mature inflorescence; B, fruiting head with irregularly shaped berries; C, longitudinal section through flower; note filament bases adpressed to style forming nectar reservoir; D, detail of filament bases. Scale bars: 10 mm. Artist: John Manning.

terranean biomass gives mature plants an extensive water storage capacity, allowing them to survive the prolonged rainless summers of the Oorlogskloof environment.

Flower colour, development and pollination

The general impression of a fully open scape is of bicoloured perianths, orange-red at the base, yellow towards the mouth and with orange-red pedicels. During the development of the flower, both perianth and ovary progress through a series of well-marked colour changes. The unopened bud is yellowish, but prominently green-tipped, and the ovary is also pale green. At anthesis the green coloration slowly disappears from the tips of the tepals which take on the same yellow tones as the basal half of the perianth. The pedicels and upper half of the perianth are deep orange-red at this stage. After pollination the yellow coloration disappears and the whole perianth and ovary take on a uniform orange/red colour. As

the perianth begins to wither, the ovary swells and undergoes an abrupt colour change from orange to bright green, as do the pedicels. No other *Clivia* has pedicels the same colour as the perianth when the flower is fully open. The pedicels abruptly change to green as the perianth abscises and the ovary swells in the post-pollination phase.

The purpose of these colour changes is not yet understood, but is probably related to pollinator cues. Pollination appears to be by sunbirds. A single sighting of a malachite sunbird probing the perianths was made at Oorlogskloof on 18 October 2001 suggesting that sunbirds could be involved in pollen transfer. However, like the other three tubular-flowered species, *C. mirabilis* may also be a selfer as between 80 and 90% of the flowers in each umbel are pollinated and produce viable berries. *Flowering time*: \pm six weeks, from October to mid-November.

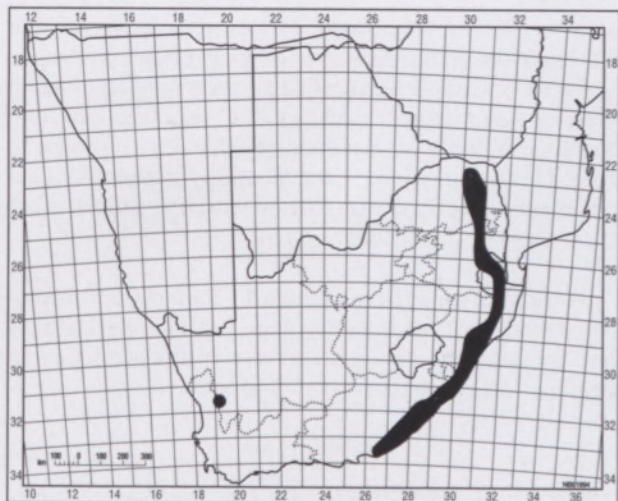


FIGURE 2.—Distribution of *C. mirabilis*, ●, in relation to the distribution of the remainder of the genus *Clivia* (black shaded area).

Fruiting

The berries mature more rapidly than in the other *Clivia* species. By the end of February, four months after flowering, the fully developed berries turn from yellow and orange to pinkish and later red by the end of March and are shed shortly thereafter prior to the onset of the first winter rains in April/May. This rapid autumn maturation of berries is in sharp contrast to the summer rainfall area clivias which mature slowly, usually 12 months for *C. miniata* and *C. gardenii*, about nine months for *C. caulescens* and *C. nobilis* (Duncan 1999) to coincide with the commencement of October/November summer rains.

Seed dispersal and germination

Berries commence falling from late February to early April. Germination appears to be rapid in response to the onset of autumn/early winter rains. At Kirstenbosch seeds sowed on 18 March 2001 had already developed a 10 mm radicle by 10 April 2001.

On germinating, the primary root develops into a swollen, white, succulent cylinder up to $50 \times 5\text{--}6$ mm. During the moist winter months (May–September), it swells, accumulating water in its succulent tissue. By October, two short (5–10 mm long) leaves have been produced, whereafter further vegetative growth of the seedling slows or largely ceases with the onset of summer dormancy (November–April). During the rainless phase of \pm six months the seedling survives on water reserves stored in the greatly enlarged primary root. Vegetative growth commences again in autumn. Thus the biology of a *C. mirabilis* seedling in its first year is much akin to a winter rainfall area geophyte with the swollen primary root being functionally equivalent to a corm or bulb.

The phenology of the germinating seed described above is clearly an adaptation to a semi-arid Mediterranean climatic regime—exactly the reverse of the summer rainfall region *Clivia* species.

Within a few months of germinating, the plumular bud (cotyledon plus first true leaf) (Boyd 1932), becomes densely pigmented with anthocyanins (Plate 1F). This prominent development of anthocyanins at the base of the leaves is later evident in the leaf sheaths of adult plants which are heavily suffused with purple-carmine pigments. Why the seedlings of *C. mirabilis* are so densely pigmented with anthocyanins is not clear, but it may be a response to the intense levels of sunlight experienced in the natural habitat, thereby providing effective screening during the seedlings' critical establishment phase.

Relationships

The distribution ranges of all four previously known *Clivia* species are contiguous or overlap, while at many localities different pairs of species occur sympatrically, *C. nobilis* with *C. miniata*, *C. gardenii* with *C. miniata*, and *C. caulescens* with *C. miniata*. Geographically, populations of *C. nobilis* in Eastern Cape, though more than 800 km distant, are the closest spatially to *C. mirabilis*. *C. nobilis* also appears to be the closest relative to *C. mirabilis* on morphological grounds: tough stiffly erect coriaceous leaves with a median pale striation on the upper surface (some populations of *C. nobilis* occasionally have a faint median striation), and the small seeds.

Phytogeographic implications

Palynological evidence indicates that in Western Cape and southern Namaqualand, subtropical forests were present during Miocene and Pliocene times (\pm 5.3 million years BP) (Scott *et al.* 1997). Since then, apart from more recent cyclical changes in the Quaternary, there has been a progressive eastward retreat of these forest elements. Assuming that the genus *Clivia* has not changed its dependence on a forest environment significantly since pre-Quaternary times, it can be argued that the Nieuwoudtville species is relictual and that its survival in the Oorlogskloof Canyon is partly fortuitous and partly due to its adaptation to a different climate. The berry maturation period, seedling and germination biology are so perfectly in harmony with an arid Mediterranean climatic regime that *Clivia mirabilis* is able to survive environmental conditions inimical to all other *Clivia* species.

It is currently believed that the late Miocene also saw the development of a Mediterranean climate in the western part of the Cape (Axelrod & Raven 1978). This would have interrupted the further spread of an essentially summer rainfall genus like *Clivia* into the forests of the southern and western part of the Cape. It would also have left the precursors of *Clivia mirabilis* to adapt to increasing aridification and the onset of a pronounced Mediterranean type climate. Thus if *C. mirabilis* evolved from forms with an essentially summer rainfall phenology, the adaptation to an arid Mediterranean type climate is a derived condition dating from late Miocene times.

Long distance dispersal should also be considered as a possible explanation for this bizarre distribution pattern, but this seems highly unlikely as no living vectors

for the long-distance dispersal of *Clivia* seed have yet been identified nor has biotic dispersal been recorded for any other species of Amaryllidaceae (Meerow & Snijman 1998). Birds are probably the main seed dispersal vectors. *Clivia miniata*, *C. gardenii* and *C. caulescens* have all been observed by the author growing epiphytically in forest trees, five or more metres above ground level. It is probable that frugivorous birds deposited seeds in these positions, leading one to postulate that forest dwelling birds are responsible for the dispersal of large scarlet *Clivia* berries. While the dispersal of *Clivia* seed by birds between closely adjacent forest patches is a strong possibility, dispersal over distances of 800 km of arid country seems highly unlikely.

Conservation status

No populations are known outside the Oorlogskloof Nature Reserve where the species currently enjoys maximum protection. Yet there is no reason why *C. mirabilis* should not occur further down the Oorlogskloof Canyon, outside the reserve, as numerous suitable habitats occur there. If this proves to be the case, special efforts will have to be made to protect these populations as the species' horticultural potential will render it vulnerable to exploitation.

Other material examined

NORTHERN CAPE.—3119 (Calvinia): Oorlogskloof Nature Reserve, (–AC), 10-11-2000, W. Pretorius 651 (NBG).

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Auriol Batten's fine painting of *C. mirabilis* was prepared from the type material. I am especially grateful to her for loaning this plate to the National Botanical Institute for reproduction in this paper.

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