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STUDIES IN THE FLORA OF ARABIA XXIV:

The genus Ceropegia in Arabia

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ABSTRACT. The genus *Ceropegia* L. (Asclepiadaceae: Stapelieae) is revised for the Arabian Peninsula, with ten species being recognized. *C. foliosa*, *C. aristolochioides* subsp. *deflersiana* and *C. arabica* var. *abbreviata* are described as new, the new combination *C. arabica* var. *superba* (Field & Collenette) Bruyns is published, and extensive synonymy is recommended for *C. variegata*. *C. bulbosa* is shown to have a wide distribution from the Indian subcontinent to Africa.

INTRODUCTION

Much material of the Asclepiadaceae, both living and preserved, has come to Europe from the Arabian Peninsula over the last decade. From this it has been possible to obtain a better understanding of some species previously known from very scanty material and many new taxa have come to light. The very recent discovery in Arabia of *C. somalensis* indicates that previously unrecorded species will almost certainly continue to turn up even in such relatively well-collected parts as Saudi Arabia and North Yemen. South Yemen is botanically very little-known, with the only significant work having been done there last century, so that even a visit to the Jebel al 'Urays is certain to yield much new data on *Ceropegia*. Thus this paper does not provide the final word but summarizes the present knowledge of *Ceropegia* in this region.

HISTORY OF CEROPEGIA IN ARABIA

The first record of a *Ceropegia* from this area was made by Pehr Forsskål. He found what he called *Stapelia variegata* in the Wadi Surdud north of Manakhah early in 1763. Paul-Emile Botta collected the same species on the Jebel Ra's (near Hays) in 1837, but it was the expeditions in 1887 and 1890 of Albert Deflers which first gave an impression of the diversity achieved by the genus in this region. On 8 v 1887 he discovered *C. rupicola* on the mountain called Masar, west of Manakhah and five days later discovered *C. sepium* nearby. He also collected *C. variegata* and another unnamed species on this expedition, and later found *C. boerhaaviifolia* and *C. rupicola* in the Jebel al 'Urays, east of Aden in 1890. Schweinfurth collected a few Ceropegias during his excursions in the Yemeni mountains in 1889 but found little of interest. The next new species was collected in 1902 by the zoologist William R. Ogilvie-Grant but the specimen remained unidentified at Edinburgh (E) until unearthed by Huber during work for his revision (Huber, 1957). It is only recently, with the intensive collecting of J. R. I. Wood in North Yemen from 1974 to 1980 and I. S. Collenette in Saudi Arabia between 1980 and 1985 that a more detailed picture has emerged. In 1943 the first record of a *Ceropegia* in the Sultanate of Oman was made by D. F. Vesey-Fitzgerald which

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extended the distribution away from the mountains of south-west Arabia into the central southern portion of the peninsula.

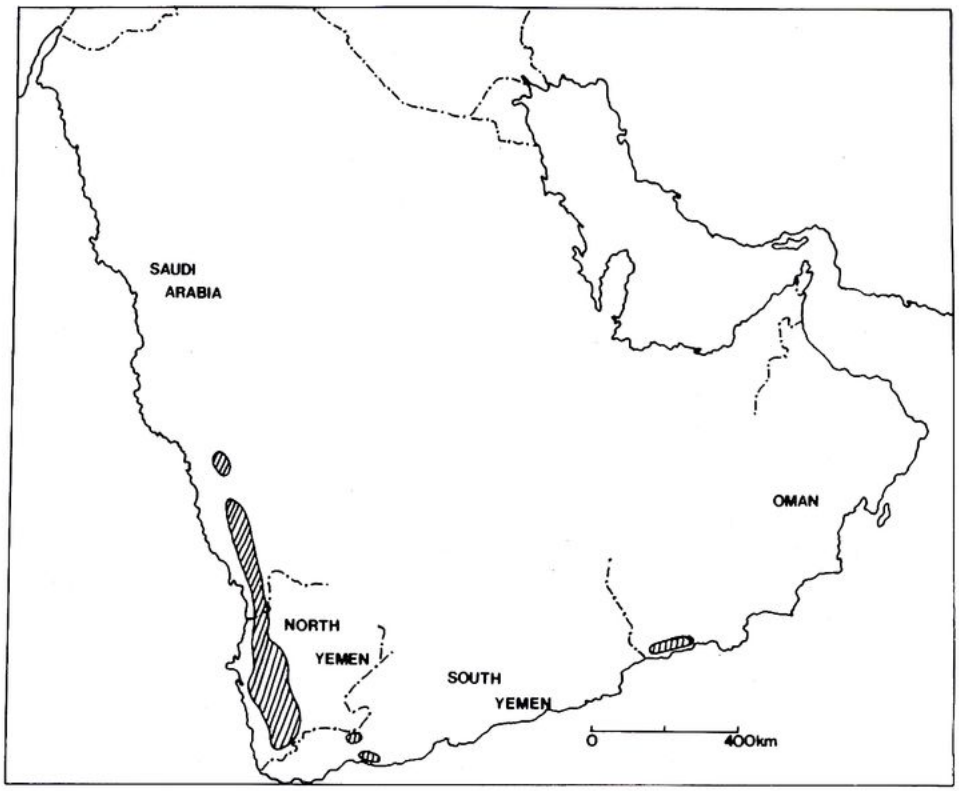
DISTRIBUTION

Of the 10 species recorded from Arabia, four (*C. rupicola*, *C. sepium*, *C. arabica*, *C. foliosa*) are endemic. Four others (*C. variegata*, *C. somalensis*, *C. botrys*, *C. tihamana*) are found to the south in north-east tropical Africa in the dry parts of Kenya, Somalia and eastern Ethiopia and are species of the so-called 'Mandeb Circle' (Newton, 1980). *C. aristolochioides* occurs in the Ethiopian highlands and in West Africa. *C. bulbosa* is found in the Indian subcontinent (Pakistan and India) as well as in the Ethiopian highlands.

Of the endemic species, only *C. foliosa* is related to an Indo-Chinese species, all the others having close relatives in north-east Africa. The only species recorded from the island of Socotra appears to be *C. racemosa* N.E. Br. (Kew records) and is not known in Arabia.

With 10 species, the Arabian peninsula is relatively poor in Ceropegias. This makes interesting comparison with 15 from Namibia (Bruyns, 1984), over 50 from South Africa (Dyer, 1980) and 44 from the Indian subcontinent (Ansari, 1984). The rarity of true forest, forest-margin vegetation and grassland clearly excludes any of the species associated with forest or grassland (a large proportion of the African and some of the Indian species) and seems, particularly, to have led to a lack of geophytic species (often associated with forest-margin vegetation) and the complete absence of *Brachystelma* R. Br., a genus widely sympatric with and very closely allied to *Ceropegia*. With the exceptions of *C. sepium* and *C. foliosa*, the Arabian species are all highly adapted, semi- to highly-succulent plants and represent most of the more drought-resistant forms found in the genus. The preponderance of species with an African affinity suggests that most of these highly adapted plants have migrated to Arabia from the south-west or west, not developing independently in the Arabian Peninsula. The differentiation of a number into distinct subspecies or species supports the theory that this migration is not recent (Al Hubaishi & Müller-Hohenstein, 1984).

That most of the peninsula is inhospitable to *Ceropegia* is seen in the small foothold of the genus in the southern part of the peninsula (Map 1). The main concentration of species is around the highest mountains of the south-west which are also the wettest parts of Arabia. However, Ceropegias are not found above 2700m, where frosts are regular (Hubaishi & Müller-Hohenstein, 1984). Only *C. variegata*, *C. botrys* and *C. tihamana* are found in the hot, sandy, dry (rainfall up to 200mm per annum) but very humid Tihama region forming the coastal belt of south-west Saudi Arabia and North Yemen. With few exceptions, the others are found above 1000m and many collections have been made in the range 1800–2400m where the rainfall is considerably higher (up to 800mm), the temperatures lower and the vegetation more lush. The single species from Oman, like those recorded by Deflers in the Jebel al 'Urays, occurs at relatively low altitudes. These taxa occur in mountain ranges which



MAP 1. Distribution of *Ceropegia* L. in Arabia (hatched area).

intercept the monsoon winds, bringing them an amount of rain equivalent to that received much higher up in western Arabia and hence supporting a vegetation otherwise found only at greater altitudes further west.

TAXONOMY

Study of the available material has, despite its relative paucity, brought to the fore the problem of achieving a practical but nevertheless representative species concept. A good example of this is provided by *C. aristolochioides* subsp. *deflersiana*, where the plants depicted could be divided into at least two species distinguished solely on the size of the corolla and corolla-lobes and the markings on them. However, in the first place this obscures the closeness of the relationship between these plants, which is far better indicated by considering them as one variable species. Secondly, it takes no account of the range of variation often present in a single, extensive population—some evidence for this already exists in that many of these variants have been collected at a single locality. Evidence from populations of similar species (for example *C. lugardae* N.E. Br. in Namibia; Bruyns, 1984) shows the extent of variation within populations as well as between them to be enormous. Further samplings will probably require more species to be described within Arabia as well as more 'splitting' of related taxa in other areas. It is particularly the difficulty which would arise in separating such a large selection of very similar

species so as to deal with the inevitable intermediate forms and in providing usable keys that makes 'splitting' unreasonable. This leads me to suggest the broad species concept espoused in this paper.

In grouping the species I have followed Huber (1957) as far as possible. *C. rupicola* is not a member of his section *Sarcodactylus* and, although florally not very specialized, is highly derived vegetatively so that it is placed at the end of the group from sect. *Phalaena*. Again this treatment diverges from Huber's in considering *C. bulbosa* a member of sect. *Ceropegiella*, where he placed *C. vignaldiana*, now regarded as synonymous with *C. bulbosa*. I have also removed the species related to *C. subaphylla* K. Schum. from sect. *Psilopegia*. Although there is some evidence that *C. botrys* and *C. tihamana* are not very closely related there is also an indication that they may be vegetatively reduced forms related to sect. *Phalaena* and so have been placed just after this section. There are, however, still so many inadequately known species that this grouping is tentative and a formal arrangement into sections is not attempted in the treatment below.

SYNFLORESCENCE STRUCTURE

The synflorescence of *C. dichotoma* Haw. was discussed in Bruyns (1986) where it was shown to be, along with many other parts of the plant, a very reduced structure.

In contrast to the situation on the Canary Islands a much wider selection of growth forms and responses to arid climatic conditions exists amongst Ceropegias of the Arabian Peninsula and these are reflected in the structures of synflorescences.

The basic organization of bracts and flowers within the synflorescences of all the species is as illustrated in one way for *C. rendallii* N.E. Br. (Bruyns, 1986) and in another way for various other species in Bruyns (1985); the Arabian species diverge from the basic organization only in how the flowers are spaced out on the synflorescence and how many arise during its lifetime.

The most unspecialized vegetative form in *Ceropegia* is assumed to be a non-succulent, leafy climber with fusiform roots. Representatives of this in Arabia are *C. foliosa* and *C. sepium*. Synflorescences in such plants usually have long, slender peduncles terminating in a pseudo-umbel of often nearly simultaneously opening flowers. *C. bulbosa* (Fig. 1A) illustrates this structure—although this species is slightly more specialized in having a basal tuber, the above-ground parts are as in the other leafy species. Figure 1B shows a further large synflorescence (one season's growth), this time of a leafy species (*C. aristolochioides*) with succulent stems. Here considerable elongation of the original peduncle occurs from axillary buds within the synflorescence. It may, in this taxon, be very much more complicated than illustrated in that 'branching' can take place after the first bract.

Further vegetative specialization takes various forms. The group to which *C. aristolochioides* belongs contains the highly succulent but still leafy *C. rupicola* whose synflorescence (Fig. 1C) is much reduced from that in Fig. 1B. Here the flowers open within a short time of one another

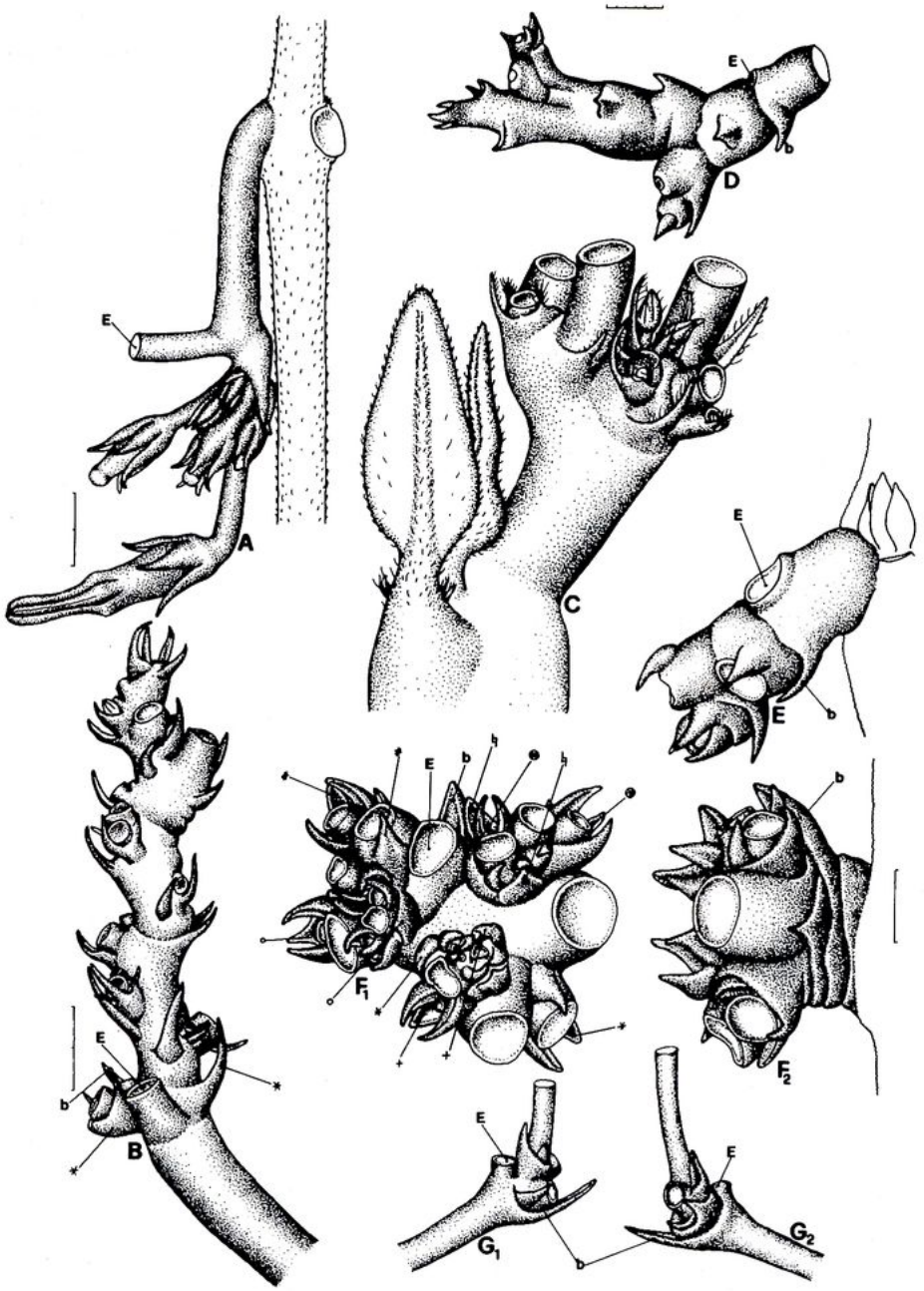


FIG. 1. Synflorescences. A, *Ceropegia bulbosa* (*Miller* 7218); B, *C. aristolochioides* subsp. *deflersiana* (*Collenette* 3524), paired bracts at base indicated with *; C, *C. rupicola* (*Noltee* 875), D, *C. variegata* (*Collenette* 3612); E, *C. arabica* var. *superba* (*Collenette* 3159); F, *C. arabica* var. *abbreviata* (*Collenette* 3281), F_2 view from r.h. side of F_1; G, *C. tihamana* (*Collenette* 3284), same synflorescence from opposite sides.

The terminal flower (when visible) is indicated by 'E' and the subtending bract by 'b'. In F_1 paired bracts are indicated by the same signs; note that the subsidiary (axillary) groups of flowers enclosed by these bract-pairs are organized in the same way as the synflorescence in A or G. Note too the different magnifications used. Scales: A, C, E (at A) = 2mm; B, G (at B) = 2mm; D = 6mm; F = 1mm.

and no elongation of the peduncle occurs after the first bract. Further development of succulence is found in *C. variegata*, which has greatly reduced leaves; here the highly succulent synflorescence may elongate up to a length of 10cm (note that Fig. 1D is drawn to less than one quarter of the magnification used in 1B), and the flowers develop in slow succession.

The somewhat anomalous *C. botrys* and *C. tihamana* have similar synflorescences (Fig. 1G). They are the smallest found in any of the species discussed here and do not seem to develop with age. It is not clear whether this size has been achieved by reduction from a structure as in Fig. 1B to coincide with the very reduced leaves and the partial development of a basal, tuberous, storage organ.

Vegetatively, members of the *C. arabica* complex bear superficial resemblance to *C. botrys* and *C. tihamana* but their synflorescence organization is quite different: the peduncle is lacking and in var. *arabica* and var. *superba* synflorescences arise in the upper part of the stem with only one flower in each, as in *C. zeyheri* Schltr (Bruyns, 1985). If conditions are suitable a larger structure (as in Fig. 1E) may develop. In var. *abbreviata* (Fig. 1F) the synflorescence is usually much more complex right from the beginning with many flowers opening simultaneously (note that in Fig. 1 magnification for F is double that for E).

KEY TO SPECIES

1	Roots fibrous, not thickened/fusiform	2
+	Roots thickened, fusiform	8
2	Stems arising from a discoid tuber	**9. C. bulbosa**
+	Stems arising from thickened, irregularly-shaped, not discoid base or without thickened base	3
3	Leaves much reduced, rudimentary, more or less sessile	4
+	Leaves conspicuous (more than 2cm long), petiole more than 5mm long	6
4	Stems at least 5mm thick; leaves borne on conspicuous tubercles; flowers with double inflation at base	**8. C. variegata**
+	Stems less than 5mm thick; leaves not borne on conspicuous tubercles; flowers with single basal inflation	5
5	Corolla-lobes more than twice as long as breadth of mouth of tube; basal inflation with papillae inside	**6. C. botrys**
+	Corolla-lobes about as long as mouth of tube is broad; basal inflation with longitudinal stripes, epapillate	**7. C. tihamana**
6	Mature stems more than 6mm thick, often upright and not climbing; peduncle less than 10mm long; corolla-lobes not folded or narrowing around middle	**5. C. rupicola**
+	Mature stems 3–5mm thick, climbing vigorously and not self-supporting; peduncle more than 20mm long, corolla-lobes much folded along midrib and much narrowed above middle	7
7	Exterior of corolla pilose, corolla-lobes longer than tube, initially separated then connivent, afterwards diverging once more into secondary cage	**4. C. somalensis**

+	Exterior of corolla glabrous, corolla-lobes much shorter than tube, without secondary cage	**3. C. aristolochioides**
8	Stem succulent; leaves rudimentary, apetiolar, rapidly caducuous; new synflorescence without peduncle	**10. C. arabica**
+	Stem non-succulent; leaves large, petiolar, persistent; peduncle 10–30mm	9
9	Plant nearly glabrous, cage formed by corolla-lobes less than 1cm broad and tall, part of bud taken up by corolla-lobes narrower than tube	**2. C. sepium**
+	Plant densely pilose, cage formed by corolla-lobes more than 1cm broad and tall, part of bud taken up by corolla-lobes much broader than tube	**1. C. foliosa**

1. Ceropegia foliosa Bruyns, **spec. nov.** a ceteris speciebus arabicis caulibus gracilibus pilosis, foliis grandibus, pilosulis et floribus omnino dissimilibus discedit, a *Ceropegia longifolia* Wall. corolla extra pilosa et lobis corollae angustioribus in alabastro differt. Holotypus: North Yemen, on scrubby bank north of Ibb, 1800m, 21 viii 1977, *Wood* 1829 (K). **Fig. 2.**

FIG. 2. *C. foliosa.* A, stem with leaves; C, bud; D, side view of corolla; E, side view of corolla-lobe, showing hairs and markings; F, side view of base of dissected corolla; G, side view of staminal column. A_1, F, G from *Wood* 1829; A_2 from *Wood* 2899; D, E from *Müller-Hohenstein & Deil* 771. Scales: A = 10mm; C, D (at D) = 3mm; E = 2mm; F = 2mm; G = 1mm.

Rootstock a cluster of white, fusiform roots (comment on *Wood* 2899). *Stems* 1–2mm thick, climbing vigorously and often trailing over surrounding shrubs, pilose. *Leaves* borne on pilose petiole 10–30mm long, cordate to cordate-lanceolate, 15–50mm broad, 35–95mm long, often with attenuated apex, finely pilose, green. *Synflorescence* a falsely axillary cyme of successively opening flowers, peduncle 10–30mm long, pilose, pedicel 8–20mm long, pilose. *Sepals* lanceolate, pilose, 4–5mm long. *Corolla* 25–35mm long, exterior pilose, pale green, white at base of tube; *tube* 20–21mm long with slightly ovoid basal inflation up to 7mm diam. at maximum, with slightly thickened mouth then narrowing to 3mm after which gradually widening to funnel-shaped mouth up to 15mm diam., white with few green-black veins, hairs apparently only at mouth of basal inflation; *lobes* 10–12mm long, 5mm broad when fully folded in half, deep yellow-green at apex grading into narrow, black patch then becoming abruptly whitish with reticulation of pinkish veins becoming greenish black towards base, with few, long (up to 5mm) submarginal cilia near apex, long whitish hairs along midrib on inside and fine hairs on yellow-green apical portion. *Staminal corona*: *outer lobes* bifid into two suberect, linear lobes with rounded apex, 1·5mm long; *inner lobes* linear, incumbent on anthers then connivent and rising up above centre of column, 2·6–3mm long.

This new species is known only from over 1500m in the higher mountains of North Yemen. It has been collected several times around Al 'Udayn and Ibb in the southern portion of the territory but more recently has been found in the northern province of Hajjah. The species is named for its large, conspicuous leaves which appear to be produced in great quantity; it is often a vigorous plant, trailing over the surrounding vegetation.

I have searched in vain for relatives among the African species represented at Kew (K) and, although *C. cufodontii* Chiov. shows some similarities, it is not a close ally. However, among the collections placed under *C. longifolia* Wall. by Huber—particularly from the subsp. *sinensis* complex—there are a number of specimens from the Indian subcontinent which resemble *C. foliosa* quite closely. In these collections: the corolla-lobes are not as tightly folded in bud and have a depression near the base; the long cilia on the margin of the corolla-lobes are longer, more slender and found along most of the length of the lobe; the outer corona-lobes are shorter and more slender, as are the inner corona-lobes. Furthermore, the leaves are very much longer and narrower, and most parts of the plant and flower in *C. longifolia* are glabrous. This new species is not simply considered as a further form of *C. longifolia* as it is unclear whether all the specimens included by Huber under *C. longifolia* should really have been subsumed there. Ansari (1984) has questioned Huber's treatment of this complex and it would appear that the Indian specimens resembling *C. foliosa* are not at all typical of *C. longifolia* subsp. *sinensis*, under which they were placed, so that this complex needs re-assessment before the final status of *C. foliosa* can be decided.

2. Ceropegia sepium Deflers in Voy. Yemen, 167 (1889). Type: North Yemen, Wadi Mazeb, near Manakhah, 2200m, 13 v 1887, *Deflers* 382 (P). **Fig. 3.**

FIG. 3. *C. sepium*. A, plant; C, bud; D, side view of corolla; E, corolla-lobe; F, side view of dissected corolla; G, side view of staminal column; H, pollinarium. A_1, D, E, F, G_1, H from *Noltee* 17; A_2 from *Wood* 3300; C, G_2 from *Wood* 1831. All material preserved in alcohol. Scales: A = 10mm; C, D_2 (at D_2) = 2mm; D_1, F (at D_1) = 3mm; E = 2mm; G = 1mm; H = 0·25mm.

Rootstock a cluster of fusiform roots arising from small, thickened base. *Stems* sparsely villose, up to 2mm thick, climbing extensively. *Leaves* persistent, ovate to ovate-linear, 10–35mm broad, 40–80mm long, very sparsely villose, bright green. *Synflorescence* sub-umbellate, with slender peduncle 10–30mm long, bearing up to 10 successively developing flowers, pedicel 5–15mm long. *Sepals* filiform-subulate, usually recurved, pilose, up to 4·5mm long. *Corolla* exterior pilose, grey-green at base, whitish above; *tube* 10–15mm long with ovoid basal inflation 3·5–4mm diam. at maximum, then erect, narrowing above inflation to 2mm, widened abruptly at mouth to 4mm, interior dark purple, with hairs only around mouth of basal inflation; *lobes* yellow-green, tightly folded down middle, with rounded keel, nearly equally broad (1–1·3mm) for whole

length, 8–12mm long. *Staminal corona* about 2·5mm broad, 3mm tall, transparent white; *outer lobes* erect, bifid into deltoid, round-tipped teeth, with hairs on inner surface and margin; *inner lobes* connivent-erect over centre of column, round-tipped with fine setulae on apices, often slightly clavate.

C. sepium was one of the remarkable discoveries of Deflers who found it for the first time in 1887 high in the mountains near Manakhah. He made a large herbarium specimen from this place—the only one where he saw it—which contains only a few flowers and no rootstock. The species has now been collected in the same area a few times as well as somewhat further south but remains known only from six localities between 1900 and 2400m. From the most recent of these collections it has been ascertained that the rootstock consists of a cluster of fusiform roots.

The leaves of the 'hedge-growing' *Ceropegia* (a reference to the 'impenetrable hedge of bramble and rose' in which Deflers found it) are probably the most striking attribute of the plant since they are comparatively large, abundantly produced and bright green in colour. The small, pale green flowers are extremely insignificant.

The relationships of this species are obscure. The conspicuous, many-flowered, slender peduncle found on most species with fusiform roots and large, relatively glabrous leaves is present but the flowers and staminal corona are small, whereas in most such species they are large and highly ornamental—as in *C. macrantha* Wight, the closest relative (Huber, 1957). In addition, although the exterior of the corolla is pilose, hairs are restricted on the inside to around the mouth of the basal inflation and the inner faces of the outer corona-lobes.

3. Ceropegia aristolochioides Decne subsp. **deflersiana** Bruyns, **subsp. nov.** a subspecie typica lobis corollae brevioribus, pedunculo breviori et plerumque flore longiore, plus gracili differt; a subspecie *albertina* (S. Moore) Huber flore breviore et lobis corollae latioribus basim et brevioribus discedit. Holotypus: North Yemen, Ibb district, 35km north of Ta'izz around Dhi Sufal, 1800–2100m, 20 v 1975, *Wood & Hepper* 5887 (K). **Figs 4, 5.**

Rootstock a cluster of fibrous roots. *Stem* 3–5mm thick, glabrous, irregularly verrucose, climbing to 3m, glaucous-green. *Leaves* cleft at base, ovate to cordate with few scattered hairs on undersurface and margin, very slightly fleshy. *Synflorescence* sub-umbellate, flowers developing successively on slender, sometimes branched peduncle up to 40mm long, pedicels 10–15mm long, glabrous. *Sepals* 3–4mm long, subulate. *Corolla* exterior glabrous, with red-purple blotches on white or greenish background to uniformly yellow-green, lighter coloured forms exuding faintly sweetish odour; *tube* 18–35mm long, with ovoid basal inflation 4–7mm diam., thereafter constricted to 2·5–3·5mm in slender tube widening at mouth to 6–12mm, interior with many straight, white hairs except in basal inflation where walls ornamented with thick, purple-red, longitudinal stripes except at base which is whitish, lower half of tube purple; *lobes* 6–10mm long, mostly strongly folded down middle, with few marginal hairs near apex and along midrib, with broad keel just below

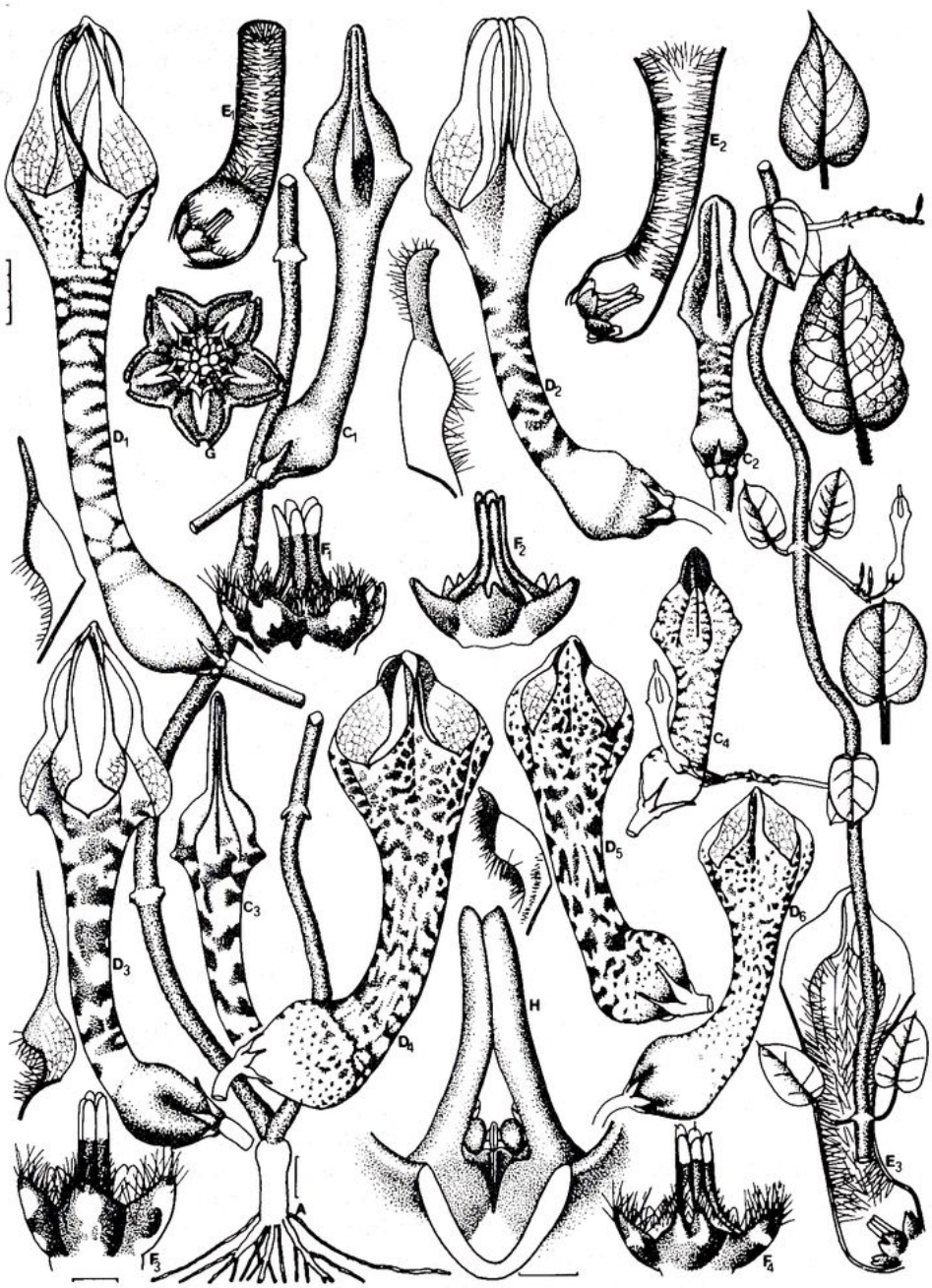


FIG. 4. *C. aristolochioides* subsp. *deflersiana*. A, plant, continued on r.h. side; C, bud; D, side view of corolla, in D_1–D_3 with single corolla-lobe on l.h. side (D_4 corolla-lobe on r.h. side) showing hairs; E, dissected side view of corolla; F, side view of staminal column, showing markings and hairs except in F_2 where same were present; G, face view of staminal column; H, detail of column with outer corona-lobe removed. A, C_1, D_1, E_1, F_1, G from *Collenette* 3524; C_2, D_2, E_2, F_2, H from *Collenette* 3326; C_3, D_3, F_3 from *Collenette* 3328; D_4 from *Collenette* 3603; C_4, D_6, E_3, F_4 from *Collenette* 3159. All drawn from live material in cultivation at ZSS. Scales: A = 10mm; C, D, E (at D_1) = 4mm; F, G (at F_3) = 1mm; H = 0·5mm.

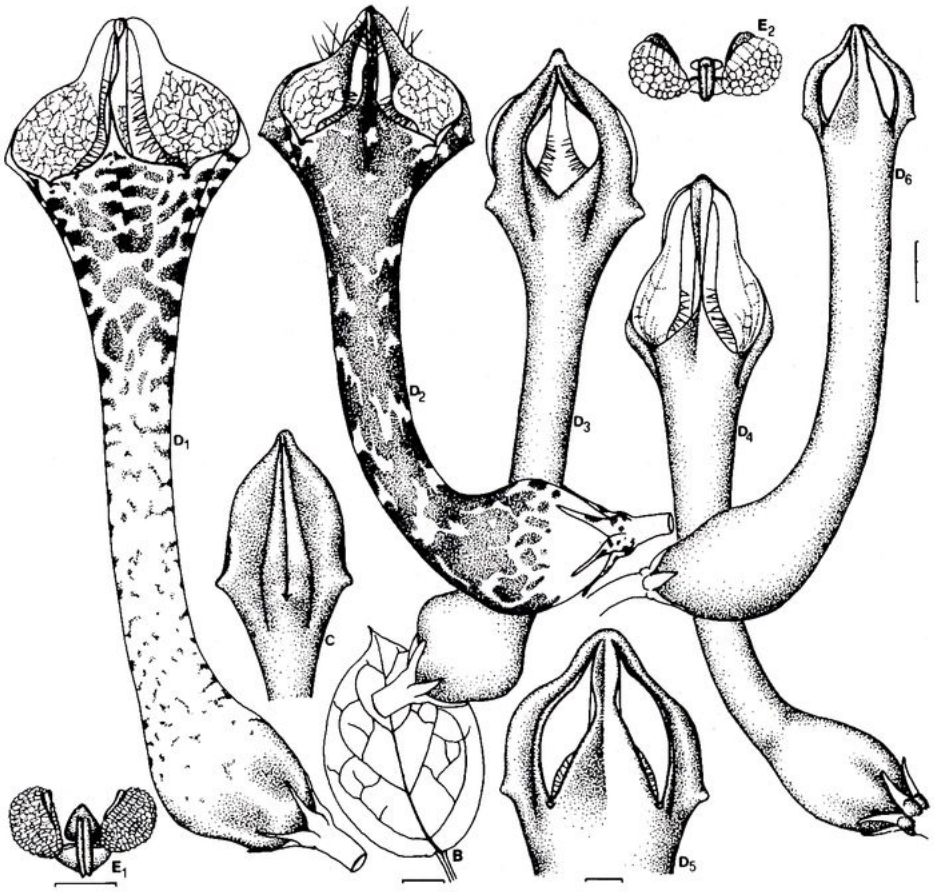


FIG. 5. *C. aristolochioides* subsp. *deflersiana*. B, leaf; C, bud apex; D, side view of corolla; E, pollinaria. B, from *Müller-Hohenstein & Deil* 1058; C, D_3 from *Wood* 1874; D_1, D_2 from two different clones of *Collenette* 4652, D_1 and E_1 from same plant; D_4, E_2 from *Noltee* 887; D_5, D_6 from *A. Butler* s.n. D_1, D_2, D_4 drawn from live material. Scales: B = 10mm; C, D_1–D_4, D_6 (at D_6) = 3mm; D_5 = 1mm; E = 0·25mm.

middle, area up to and including keel with brown to grey reticulation on yellow, white or yellow-green background, upper part darker (brownish, olive-green or dark purple). *Staminal corona*: *outer lobes* broadly bowl-shaped, bifid towards apex with long, transparent hairs on margin and inner surface, dark purple-black with yellow blotches; *inner lobes* linear, with rounded apices, incumbent on anthers, connivent and rising up above centre of column, pinkish in lower ⅔ with a few short hairs near base, translucent yellow above.

The type of *C. aristolochioides* is a collection from Senegal. Although plants exactly matching this—with very broad, relatively short corolla and thick, straight, obliquely descending peduncle—are not known from outside west Africa, similar plants are now known from Ethiopia, Kenya (where they are called *C. seticorona* Bruce—see Bally, 1970) and have recently been collected in many places in Arabia.

Plants of this complex are known from the high mountains of southern Saudi Arabia southwards into North Yemen as far south as Ta'izz near where they were first collected by J. R. I. Wood in 1975. They appear to occur mostly in scrubby vegetation with other succulents and climb to a height of 2–3m, depending on the support available.

I have tried, in Figs 4 and 5, to show the variability of the corolla of this Arabian taxon. Initially there appeared to be two distinctive colour forms: one with a uniform greenish or yellowish exterior to the corolla (often with longer corolla-lobes with narrower base) and another with purple-red exterior spotted with white (or vice-versa). However, an examination of sufficient material shows that these are impossible to separate reliably and as many intermediates exist there seems no option but to regard all as a single, variable taxon. The possibility that this taxon represents a slender-stemmed form of *C. rupicola* has been considered. Apart from the differences mentioned under that species the two taxa are sympatric in at least two known instances. Although they are readily separable the presence of *C. rupicola* var. *stictantha* (see p. 303) suggests that the barriers between the species may be breaking down.

C. aristolochioides, *C. rupicola* and *C. somalensis* are the easternmost members of a group in sect. *Phalaena* very widely represented in Africa from the Cape Province of South Africa to west and east Africa. They are characterized by the glaucous-green (when young), often rugulose stems bearing large, only slightly fleshy leaves persisting for only one season. The large, mostly elongated synflorescence bears many flowers over a long period. The invariably conspicuous flowers with funnel-shaped tube vary considerably in the shape of the corolla-lobes which are simplest in *C. rupicola* and *C. aristolochioides* but take on remarkable shapes in *C. somalensis* and *C. haygarthii* Schltr. The staminal corona is similar throughout, with slightly bifid, usually highly-coloured (purple-red and yellow blotched) outer corona-lobes forming a large, shallow basin beneath the usually long anther wings. Long anther wings are sometimes seen in other groups (notably in *C. affinis* Vatke) but the distinctive shape of the pollinarium with wings on the base and apex of the corpusculum seems to be unique.

4. Ceropegia somalensis Chiovenda, Result. Sci. Miss. Stefanini-Paoli Somalia Ital. 1:116 (1916). Type: Somalia, Fra El Bar e El Ellan, 8 x 1913, *Paoli* 889 (FI, n.v.). **Fig. 6.**

Rootstock a cluster of fusiform roots. *Stem* 3–4mm thick, glaucous-green, glabrous, climbing to 1m. *Leaves* acuminate, 10–20mm long, up to 15mm thick. *Synflorescence* few-flowered, with slender peduncle, pedicel up to 10mm long. *Sepals* filiform-subulate, 3mm long, pilose. *Corolla* entire exterior finely pilose, grey-green with faint purple-green patches becoming uniformly grey-green, paler right at base; *tube* 20mm long, with slightly inflated base up to 5mm broad, narrowing to long, erect cylinder 3mm broad widening gradually to mouth (12mm diam.), inside mouth pale purple-green on green-white background becoming dark maroon for lower ⅔ of tube and whitish at very base, with scattered hairs around mouth and in lower half of basal inflation; *lobes* 2·8–3mm long, folded

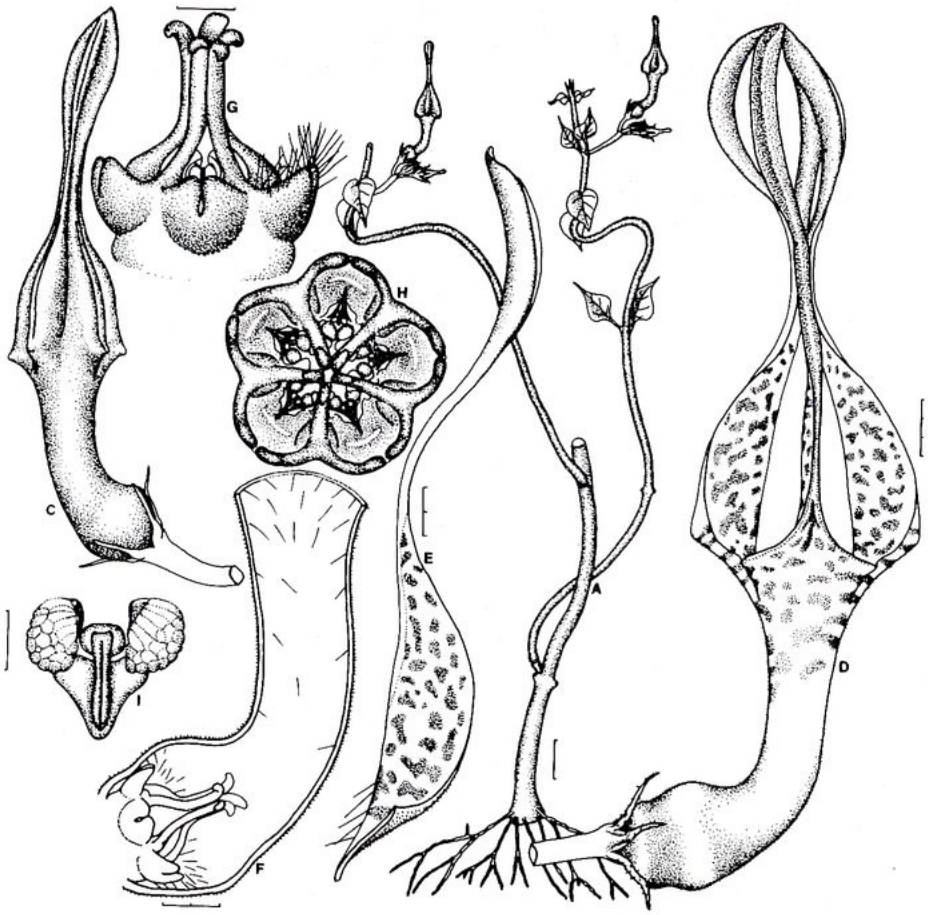


FIG. 6. *C. somalensis*. A, plant; C, bud; D, side view of corolla; E, corolla-lobe; F, side view of dissected corolla; G, side view of staminal column; H, face view of staminal column; I, pollinarium. All drawn from live material of *Noltee* 1514. Scales: A = 10mm; C, D (at D) = 3mm; E = 2mm; F = 2mm; G, H (at G) = 1mm; I = 0·25mm.

tightly for lower half (3mm broad), initially erect, then connivent, then diverging, finally connivent at apices, only slightly folded and about 1·5mm broad in upper part, few straight hairs on midrib near base, lower broad area pale purple-green spotted on green-white background, yellow-green in upper half. *Staminal corona* 4mm broad, 4·5mm tall, dark maroon; *outer lobes* bifid for half length into two connivent, deltoid teeth, forming broad, cupular area around column, straight transparent hairs along edges and inner face; *inner lobes* linear, incumbent on anthers, connivent, rising up above centre of column and diverging at apex.

The collections of J. B. Gillett of 1932 seem to be the only records of *C. somalensis* made in Somalia since the type collection but the species is well-known from the dry northern parts of Kenya. In March 1986 it was discovered near Manakhah by F. Noltee.

C. somalensis is distinguished from the other representatives of sect. *Phalaena* in Arabia by the finely hairy exterior to the corolla and the

different shape of the flower with its very long corolla-lobes. This shape is similar to that of *C. verruculosa* Field from southern Africa and seems to represent an intermediate between the simpler flowers of *C. lugardae* and *C. distincta* N.E. Br. and those of *C. haygarthii*, the most complex in the section.

The specimens collected by Noltee in Arabia show a few deviations from those in Africa. While the basic pale green background colour of the flower is similar throughout the range (occasionally tending to brownish in Kenya), the Arabian plants lack the small, dark purple osmophore near the upper end of the broad part of the corolla-lobe. The outer corona-lobes are also more compact and a darker maroon, lacking the yellow patching found in most members of the group.

5. Ceropegia rupicola Deflers in Voy. Yemen, 167 (1889). Type: North Yemen, near Manakhah, among rocks on the mountain Masar, 1800–2000m, 8 v 1887, *Deflers* 405 (P). **Fig. 7.**

Rootstock a cluster of fibrous roots. *Stems* without thickened base, slightly glaucous and quadrangular, 8–12mm thick, forming shrub to 1m tall, sometimes trailing and very much longer. *Leaves* ovate-lanceolate to cordate, 15–60mm long, 8–40mm broad, slightly fleshy, with scattered hairs on margins, petiole 3–10mm long. *Synflorescence* a dense, ovoid panicle arising between pair of leaves with thick, short peduncle 2–10mm long, pedicel 5–8mm long. *Sepals* linear-deltoid, greenish, spotted with maroon, 2–5mm long, sparsely hairy. *Corolla* 32–60mm long, exterior deep maroon except small whitish patch at base of basal inflation; *tube* with ovoid, nearly erect base, 7–9mm diam., merging gradually into narrower (4–4·5mm), cylindrical upper area gradually widening to mouth, inside with downward-pointing, white hairs except in basal inflation; *lobes* 13–21mm long, separating above base for 5–10mm, united for remainder, forming cage rounded-conical in outline, only slightly folded along midrib, inner face reddish with reticulated, darker veins, with few hairs on midrib at base. *Staminal corona* 5–5·5mm diam., 5–6mm tall; *outer lobes* broadly cupular, becoming erect towards bifid tips, dark purple-red with yellow near base, long, transparent hairs around margins and on inner surface; *inner lobes* cylindrical, incumbent on anthers, connivent, then erect above centre of column, with finely setulose, sometimes slightly reflexed apex, pale whitish-yellow, suffused with pink below middle, hairs on lower area.

C. rupicola is now known to occur quite widely in the highlands of North Yemen from Manakhah southwards but very little is known of its distribution elsewhere and Deflers (1894: 46) recorded it for the first and last time in South Yemen.

Plants are found growing on cliffs, or among rocks or even in dense *Euphorbia* thickets (Dyer & Lavranos, 1982). When growing on very steep slopes the stems assume a clambering habit (Deflers, 1889: 168; Wood, comment on specimens) but the species often forms a neat, shrub-like bush up to 1m tall. Although Taylor (1981) asserted that the young stems climb vigorously it seems that this is less vigorous than is typical of the genus. However, it is possible that the neat, shrub-like

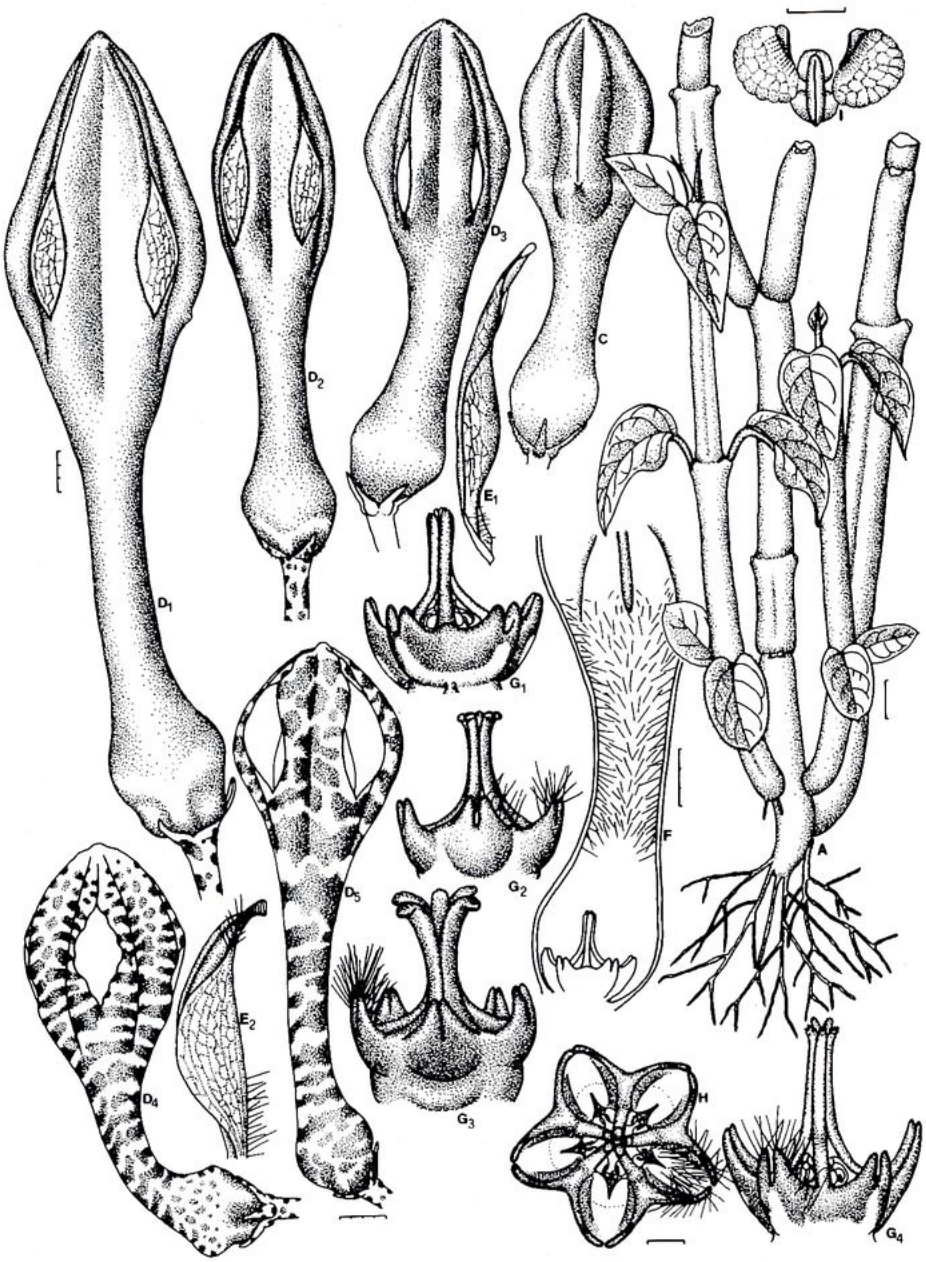


FIG. 7. *C. rupicola*. A, plant; C, bud; D, side view of corolla; E, corolla-lobe; F, side view of dissected corolla; G, side view of staminal column, all marked and hairy as in G_4; H, face view of staminal column; I, pollinarium. A, from *Noltee* 26 (Sumarah Pass); C, D_3, E_1, F, G_1 from *Radcliffe-Smith & Henchie* 4495; D_1, G_4, H from *Noltee* 875; D_2, I from *Noltee* 1124; G_2 from *Wood* 1874; D_4, E_2 from *Radcliffe-Smith & Henchie* 4437; D_5, G_3 from *Newton & Lavranos* 13109. D_4, E_2, D_5, G_3 are 'var. *stictantha*'; G_2 of *C. aristolochioides* subsp. *arabica* for comparison and the remainder are var. *rupicola*. D_5 intermediate between type of var. *stictantha* and var. *rupicola*. D_1, D_2, D_5 drawn from live material, D_4 from spirit material (hence closed-up corolla-lobes). Scales: A = 10mm; C, D_1–D_4 (at D_1) = 3mm; D_5 = 4mm; E, F (at F) = 3mm; G, H (at H) = 1mm; I = 0·25mm.

specimens are the result of grazing as it is reputed to be palatable to stock (Dyer & Lavranos, 1982).

The relationship of this species to *C. aristolochioides* is close. Both Taylor (1981) and Walker (1980) were correct in questioning the placing of *C. rupicola* together with the Canarian species *C. dichotoma* and *C. fusca* Bolle in sect. *Sarcodactylus* Huber and the true relationship is particularly evident in the staminal coronas (Bruyns, 1986) and the complex pollinarium of *C. rupicola* which has the structure typical of most members of this section. It appears that the vegetative convergence of this species to the Canarian taxa is a response to the similar, often exposed, rocky volcanic habitats that all occur on.

C. rupicola and *C. aristolochioides* can be separated by the much thicker stems of the former (usually around 10mm thick, less than 5mm in the other), the short, thickly pedunculate or sessile synflorescence bearing flowers in a dense, nearly simultaneously opening cluster and the rather broad, pyramidal top to the corolla in *C. rupicola* with the lobes uniformly broad for most of their length and opening up for only a short distance. In *C. aristolochioides* the lobes are tightly folded down their middle (leaving wide openings to the tube) and they are differently shaped. The flowers of *C. rupicola* exude a sweetish smell of over-ripe or just beginning-to-rot mango or pawpaw which is readily detected when the corolla is newly opened.

Putative hybrid:

C. aristolochioides × C. rupicola.

C. rupicola var. *stictantha* N. P. Taylor in Cact. Succ. J. Gr. Brit. 42:111–112 (1980). Type: North Yemen, 3km north of Al Qa'idah on road to Dhi Sufal, 1700m, 4 viii 1977, *Radcliffe-Smith & Henchie* 4437 (K). **Fig. 7.**

Stems 6–10mm thick, more vigorously climbing than in *C. rupicola*. *Corolla* 30–40mm long, exterior deep maroon spotted with creamy-white; *tube* with nearly horizontal basal inflation, changing abruptly into erect cylinder, 3–4mm diam.; *lobes* strongly folded along midrib, greyish-yellow with reddish veins, with hairs along margins near apex and along midrib in lower third, joined together only near apex, forming cage more or less circular in outline.

This taxon was initially described as a variety of *C. rupicola* but evidence now suggests that it is the hybrid *C. rupicola* × *C. aristolochioides*. It was first collected 37km north of Ta'izz towards Sana'a in August 1973 by R. G. Potter (Potter, pers. comm., 1987) but is rarer than was previously thought as the collection *Wood* 1874, cited by Taylor (1981) is *C. aristolochioides*. Factors suggesting a hybrid origin are:

(1) stems are more slender and more inclined to climb than in *C. rupicola*;
(2) the corolla has a more horizontally-oriented basal inflation and more bent tube than in *C. rupicola*;
(3) where the flowers of *C. rupicola* are uniformly dark maroon, they are creamy white spotted with maroon in this taxon;
(4) the corolla-lobes in the probable hybrid are strongly folded down the middle.

In addition, both parent species were gathered in the same locality (32km north of Ta'izz) by Newton & Lavranos and by Noltee between Ibb and Al 'Udayn. The material *Newton & Lavranos* 13109, figured by Dyer & Lavranos (1982) has the corolla-tube straighter than in the type of 'var. *stictantha*', the lobes do not fold back as strongly as in the photograph in Walker (1980) but the corolla is spotted. In contrast to this, in specimens cultivated under this number in England (Fig. 7, D_5), the lobes fold back further and the tube is more bent. It would appear that this collection contains both 'var. *stictantha*' and possibly a back cross with *C. rupicola*.

6. Ceropegia botrys K. Schumann in Bot. Jahrb. 33:328 (1903). Type: Somalia, near Dadab, 30 i 1900, *Ellenbeck* 190a (K). **Fig. 8.**

Syn.: *C. mansouriana* Chaudhary & Lavranos in Notes RBG Edinb. 42:317 (1985). Type: Saudi Arabia, Abu Arish, near Jizan, 23 ii 1979, *Chaudhary* 900A (RIY, n.v.; E).

Rootstock a thickened, top-shaped to irregular lump bearing small finger-like projections with fibrous roots. *Stems* 2–3mm thick, faintly verrucose and glaucous, climbing to 2m, glabrous. *Leaves* 5–10mm long, 2–3mm broad, linear, with narrow base, margins finely ciliate, midrib slightly sunken, rapidly caducous. *Synflorescence* few-flowered, falsely axillary, with slender peduncle up to 4mm long, pedicel 8–12mm long. *Sepals* filiform-subulate, 5–6mm long. *Corolla* exterior glabrous, green at base becoming grey-purple blotched on whitish background, then greyish-white with darker veins; *tube* with ovoid basal inflation, 6–8mm long, 5mm broad, with scattered purple papillae on pale green background, then narrowing to 2mm, after further 5mm bent into erect direction and inflated to nearly 4mm diam., widening abruptly at mouth, tube just above basal inflation with dense ring of white hairs on dark purple patch, hairs occurring in decreasing numbers into whitish area above purple patch; *lobes* 26–30mm long, lower 15–18mm free, interior whitish with purple-grey veins and fine hairs all over up to and including margins, with purple-black patch towards apex, strongly folded along midrib, then connivent after which diverging once more into secondary cage, 8–11mm long, brownish on inside, glabrous, after which united at apices. *Staminal corona* 3mm broad, 4mm tall; *outer lobes* cupular, erect, bifid into deltoid-cylindric teeth, tips pale greenish-white, remainder very dark purple, with few purple hairs on inner face; *inner lobes* incumbent on anthers, connivent, erect above centre of column and then spreading at tips, cylindrical, dark purple at base, rest pale greenish-white.

Apart from the original collection from Somalia made in 1900, *C. botrys* has been collected near Abha and Jizan in Saudi Arabia and as far south as the At Tur region in the Hajjah Province of North Yemen. However, it is extremely inconspicuous and is probably more common and widespread than the records indicate.

The type at Kew consists of two parts: a piece of the flower and a tracing of the original specimen previously housed at Berlin. The flower in this tracing does not resemble the scrap of type material closely and seems to have been made from an immature bud. However, the scrap of flower (shown in Field, 1982, fig. 2, R–S), despite its small size, runs right

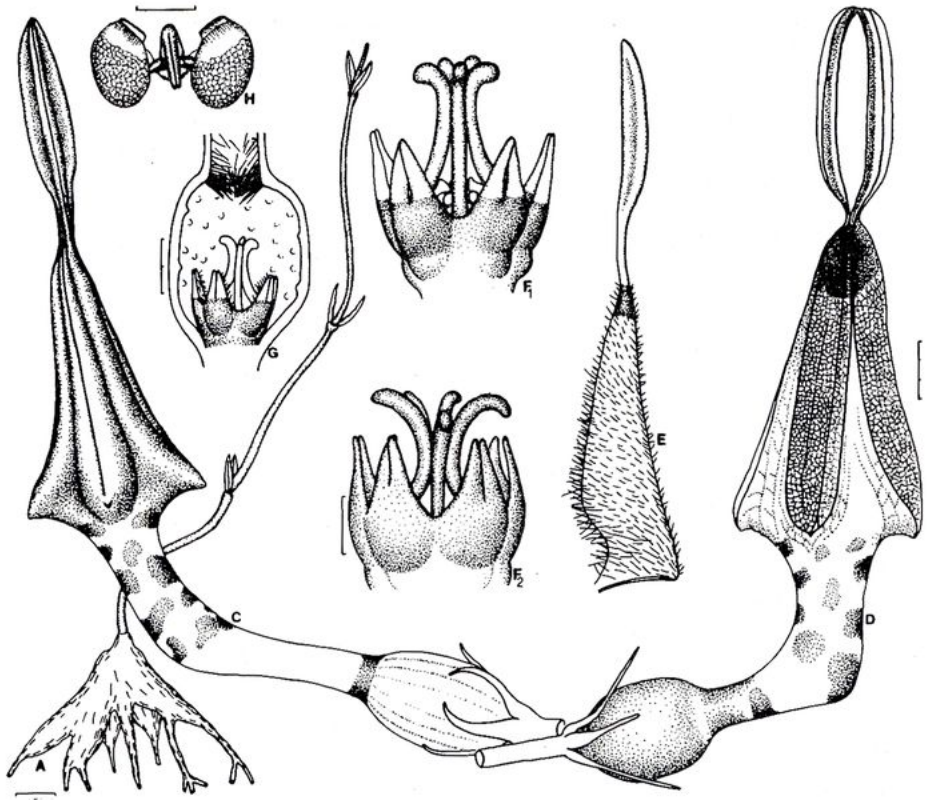


FIG. 8. *C. botrys*. A, plant; C, bud; D, side view of corolla; F, side view of staminal column, colouring shown only in F_1; G, side view of dissected corolla; H, pollinarium. A, D, F_1, G from *Collenette* 2977; C, E, F_2, H from material of unknown origin in cultivation at Huntington Botanic Garden. Scales: A = 10mm; C, D, E (at D) = 3mm; F = 1mm; G = 2mm; H = 0·25mm.

from the base of the flower to the tip of the corolla-lobe and is remarkably similar to *C. mansouriana*—the corolla-lobe is of the right length, the tube is bent and inflated in the right position and hairs are also present on the lobes in the same area. The sketch further confirms that the corona has the right structure. *C. mansouriana* is therefore reduced to synonymy.

In this species the resemblance to members of the *C. arabica* group is striking and reinforced by the scattered papillae in the basal inflation of the corolla-tube. The additional appendage formed at the apex of the lobes is very suggestive of that in *C. somalensis* and *C. haygarthii*. A rudimentary form of this structure is also seen in *C. tihamana*.

7. Ceropegia tihamana Chaudhary & Lavranos in Notes RBG Edinburgh. 42:316 (1985). Type: Saudi Arabia, Abu Arish, near Jizan, 23 ii 1979, *Chaudhary* 901A (RIY, n.v.; E). **Fig. 9.**

Rootstock a thickened, top-shaped to irregular lump bearing small finger-like projections with fibrous roots. *Stems* 2–3mm thick, faintly verrucose and glaucous, climbing to 2m, glabrous. *Leaves* 6–10mm long,

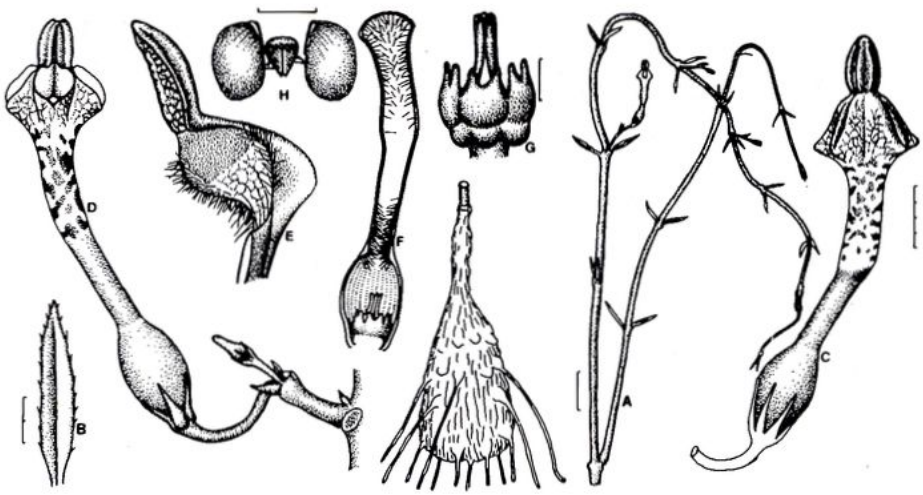


FIG. 9. *C. tihamana*. A, stem with rootstock just to left; B, face view of leaf; C, bud; D, side view of corolla; E, corolla-lobe enlarged, showing markings and hairs; F, side view of dissected corolla; G, side view of staminal column; H, pollinarium. C from *Collenette* 3324; H from *Chaudhary* 901A; remainder from *Collenette* 3284. Flowers and plant drawn from live material in cultivation at ZSS. Scales: A = 10mm; B = 2mm; C, D, F (at C) = 4mm; E, G (at G) = 1mm; H = 0·25mm.

2–3mm broad, linear, not always opposite, rapidly caducuous, with narrow base, margins finely ciliate, midrib slightly sunken. *Synflorescence* few-flowered, falsely axillary, with slender peduncle up to 4mm long, pedicel 8–12mm long. *Sepals* linear-subulate, 3–4mm long, glabrous. *Corolla* exterior glabrous; *tube* with ovoid basal inflation 5mm long, 3mm broad, thickened at mouth where densely hairy, each hair arising from purple-black papilla, hairs continuing up tube for short distance, narrowing to 1·5mm then widening after 5–6mm to 2mm (this area with hairs), after further 5mm widening into funnel-shaped mouth, exterior of upper end with dark purple veins on whitish background, below funnel becoming pale green-blotched then uniform grey-green, interior in upper widened area pale grey-green, then dark purple-red, basal inflation with many dark purple-red stripes falsely raised from surface; *lobes* 4–5mm long, lower 2mm folded down middle, nearly horizontal, with marginal hairs on and around midrib, dark purple reticulated veins on white background changing to black-green background around keel, upper 2–3mm erect, connivent, not folded, grey, with heavy, outstanding reticulation. *Staminal corona* 2mm broad, 2·5–3mm tall; *outer lobes* bifid into nearly cylindrical, erect teeth, cupular, with hairs on inner face; *inner lobes* connivent-erect, linear-clavate.

In Arabia, herbarium records indicate that *C. tihamana* is known only from Abu Arish near Jizan and the Wadi al Uss near Abha, further to the north. It also occurs in Kenya where it was found by Patricia and Gilfred Powys, whose plants scarcely differ from those in Saudi Arabia.

C. tihamana and *C. botrys* are remarkable in Arabia for the formation of a thickened base to the stem from which the fibrous roots emanate. In very large plants this structure may be inverted top-shaded but it may also be irregularly flattened (as illustrated here for *C. botrys*) with finger-like

projections on which the roots arise. The fleshy stems are not as thick as in *C. arabica* and are glaucous and only faintly verrucose. The small leaves show more differentiation into blade and petiole than in *C. arabica* where they are sessile. In addition they are not fleshy and have scattered, marginal hairs. In further contrast to *C. arabica* the flowers in these species are borne on a slender peduncle.

Figure 9 shows the small, peculiarly-shaped flowers with the bend and widening in the middle of the corolla-tube. Most *Ceropegia* flowers have a bend in the base of the narrow portion of the tube bringing the remainder of the flower into an erect position. Here the narrow portion is initially oriented in the same direction as the basal inflation and adjustment into vertical alignment takes place around the middle of the tube, accompanied by a slight inflation.

The staminal corona of this species and *C. botrys* is strongly suggestive of that of *C. arabica*. However, the teeth of the outer corona-lobes are much thicker than in the other, and are ornamented with straight, translucent hairs on the inner side.

This species and *C. botrys* have a similar rootstock to the Somalian *C. subaphylla* K. Schum. and *C. nuda* Hutch. & Bruce and the Indian *C. juncea* Roxb. These are all poorly documented species whose relationships to one another and other groups is unclear. There are wide differences in the pollinaria of *C. botrys* and *C. tihamana* so that it is also possible that these two are not particularly close.

8. Ceropegia variegata Decaisne in Ann. Sci. Nat. sér. 2, 9:262 (1838). Type: North Yemen, Jebel Ra's, 1837, *Botta* (P). **Figs 10, 11.**

Syn.: *Stapelia variegata* Forsskål, Fl. Aegypt. Arab.: 51 (1776), nom. illegit. Type: North Yemen, Wadi Surdud, *Forsskål* (no material preserved).

C. tubulifera Deflers in Bull. Soc. Bot. France 43:111 (1896). Type: South Yemen, near Serrya in a gorge in the Jebel al 'Urays, *Deflers* 799 (not located).

C. devecchii Chiovenda, Fl. Somala 2:301 (1932). Type: Somalia, Cisgiuba, Bur Acaba, 1929, *Senni* 459 (FI, n.v.).

C. devecchii var. *adelaidae* Bally in Candollea 17:79 (1959, description) et ibid. 29:390 (1974, validation). Type: Kenya, Kwale district, Maji-ya-Chumvi, 8 v 1956, *A. Bally* in *Bally* 10540 (G, n.v.)

C. variegata var. *cornigera* Huber in Mem. Soc. Brot. 12:141 (1957). Type: *Senni* 459.

Rootstock consisting of fibrous roots arising from lower part of stem. *Stem* terete, 8–10mm thick, climbing in bushes to 3m, glabrous. *Leaves* sessile, lanceolate, arising on prominent tubercles, with flattened stipules and few scattered hairs on either side at base, very few scattered hairs also on margin and ventral surface, rapidly caducuous. *Synflorescence* glabrous, borne on stout, initially short but later elongating peduncle, flowers developing successively, pedicel 3–5mm long, stout. *Sepals* subulate, 3–4mm long, apices spreading, glabrous. *Corolla* exterior glabrous, shiny, rarely pale white-green all over, usually lower basal inflation greyish-white, rest variously blotched with purple on whitish background,

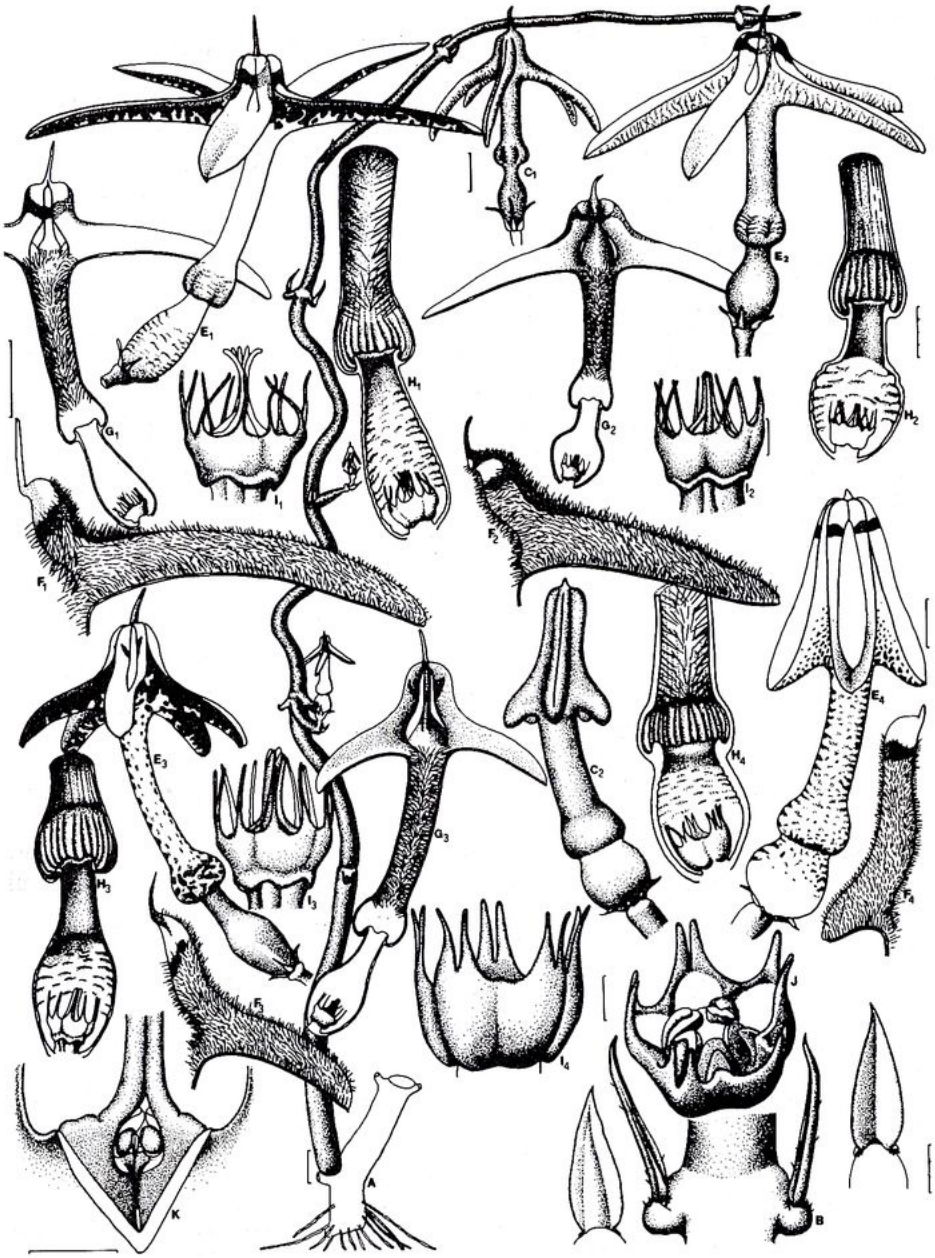


FIG. 10. *C. variegata*. A, plant, much reduced in length; B, detail of leaves, leftermost viewed from rear, centre showing node with tubercles and two leaves from side, rightermost from above; C, bud; E, side view of corolla; F, corolla-lobe, showing markings and hairs; G, view of dissected corolla; H, view of base of dissected corolla, all with hairs as in H_1 and H_4; I, side view of staminal column; J, oblique view of staminal column; K, detail of column with outer corona-lobe removed. A, B, C_1, E_2, F_2, G_2, H_2, I_2 from *Collenette* 3612; E_1, F_1, H_1, I_1 from *Collenette* 3599; E_3, F_3, G_3, H_3, I_3, K from *Collenette* 3285; C_2, E_4, F_4, H_4, I_4, J from *G. Claussen* s.n. (NE Africa, sine loc., cult. Holly Gate Nursery). All drawn from live material. Flower E_2 represents typical '*C. devecchii*', E_1 '*C. devecchii* var. *adelaidae*' and E_4 typical '*C. variegata*'. Scales: A = 10mm; B = 3mm; C_1 = 5mm; C_2, E_4 (at E_4) = 5mm; E_1–E_3, G (at G_1) = 10mm; F, H (at H_2) = 4mm; I_1–I_3 (at I_2) = 1mm; I_4, J = 1mm; K = 1mm.

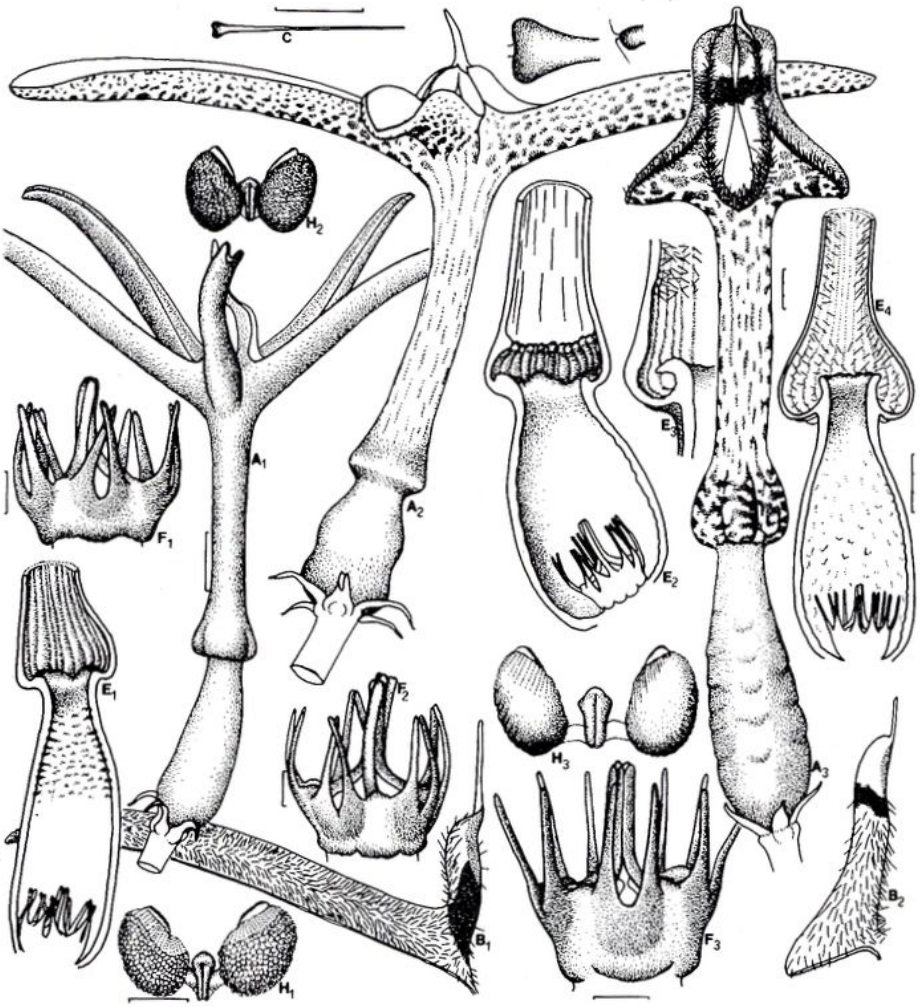


FIG. 11. *C. variegata*—some extreme forms. A, side view of corolla; B, corolla-lobe; C, hair on corolla-lobe, much magnified (sketches further to right indicate much thickened base with narrow join to lobe (leftermost) and side view (lower side is facing away from centre of flower) showing how hair movement is restricted by this base); E, view of base of dissected corolla; F, side view of staminal column; H, pollinaria. A_1, B_1, E_1, F_1, H_1 from *Noltee* 361A; A_2, E_2, F_2, H_2 from *Collenette* s.n. (Saudi Arabia); A_3, E_3, H_3 from *Noltee* 1499D; B_2, E_4, F_3 from *Lavranos* 4367 (this is the only collection seen from South Yemen). *Noltee* 1499D resembles '*C. tubulifera*' and the Saudi Arabian flower had the largest projections on the lobes seen. All except *Lavranos* 4367 drawn from live material. Scales: $A_1 = 5$mm; A_2, A_3 (at A_3) = 3mm; B, E (at E_4) = 3mm; C = 0·5mm; F = 1mm; H (at H_1) = 0·25mm.

40–60mm long; *tube* with double inflation at base, lower one 5-angled, ovoid, inside transversely wrinkled, dark red-brown becoming pink-brown above, glabrous, very variable in length (6–21mm long), 5–7mm broad near base, narrowing to 2–3mm at mouth which projects into next inflation, this one ovoid, 5–7mm diam., 4–5mm long, with swollen, longitudinal, dark purple-black ridges on yellow- to reddish-brown background, merging gradually into narrow, ascending cylinder with purple-

black to red stripes on white background and numerous, white hairs (with thickened bases) which stop at beginning of ridges in upper inflation, abruptly opening into wide mouth; *lobes* 7–17mm long, erect, connivent near apex, erect portion first white or pale green, often grey-brown along margin, then with horizontal purple-black band, yellowish to greenish band and finally purple-brown to grey-green before uniting into linear projection 1–5mm long, bases of adjacent lobes united into channeled, spreading to slightly ascending projection, 5–35mm long, inner surface of which is white (pale green) covered with white (purple) hairs with thickened bases, hairs otherwise along margins and midrib of lobe and on limb below dark patch. *Staminal corona* 4–5mm diam., 4–5mm tall, pale to bright yellow; *outer lobes* cupular around column, ascending, divided nearly to base into narrow, linear, parallel teeth; *inner lobes* incumbent on anthers, sometimes rounded and not exceeding them in length, mostly connivent to apices, erect above centre of column.

Section *Loligo* Chiov. was discussed by Bally (1959) who decided that the available facts did not justify Huber's sinking of *C. devecchii*. He based his argument for re-instating *C. devecchii* on two criteria: (1) the differentiation in *C. devecchii* of the secondary basal inflation of the corolla-tube from the rest by the lack of hairs on its inner surface and by the thicker, slightly ribbed walls, dark red inside; and (2) the projections in the sinuses between the lobes 2–3 times longer in *C. devecchii* than in *C. variegata*.

Bally's evidence for (1) lay entirely in Deflers' plate of *C. tubulifera* (Deflers, 1896). I have been unable to locate the material on which this was based but a number of collections corresponding to typical *C. variegata* indicate that the indumentum is not correlated with the length of the projections. It follows that the only difference between them is (2).

Figure 10—in which *Collenette* 3612 is a reasonable match for the type of *C. devecchii*, and *Collenette* 3599 for var. *adelaidae*—shows that these two and *C. variegata* are merely variants in a broad range. We find that the projections between the lobes may be as much as twice as long as in Bally's material but may also be only half as long. They may be reflexed, horizontal or even ascending as in *Noltee* 361A (Fig. 11). The basal pair of inflations in the tube also varies greatly—in the lower one from more or less spherical to more than twice as long as broad. However, Figs 10 and 11 show that there is constancy in colour patterns and distribution of ridges on the inner surface of the corolla throughout this complex. The raised ring projecting from the top of the lower inflation into the upper is also a constant feature.

The specimens *Collenette* 3285 and *Newton & Lavranos* 15899 are clearly intermediates between typical *C. devecchii* and *C. variegata*. Providing separate names for these would necessitate the same treatment for *Noltee* 361A and *Collenette* s.n. (Fig. 11) which also differ quantitatively from *C. devecchii*. There appear to be no correlating factors of habitat or distribution to support any further names and I have reverted to Huber's one species with no varieties, while recognizing that this is a complex situation which may have to be re-interpreted in the light of further material or elucidation of the pollination mechanism.

We have, thus, a single, variable species of wide distribution from South Yemen to Saudi Arabia and in Africa from Ethiopia and Somalia to Tanzania. I have not been able to detect any floral differences between Arabian and African plants but in some east African specimens the stipules are stout and spine-like rather than flattened and adpressed to the tubercle.

The close relationship of *C. variegata* to *C. stapeliiformis* Haw. and *C. cimiciodora* Oberm. from southern Africa should be noted (the position of the vegetatively similar *C. armandii* Rauh, *C. bosseri* Rauh and *C. dimorpha* Humbert is still not clear). These two were placed in sect. *Coreosma* Huber but a number of factors indicate that all could reside in sect. *Loligo*: (1) all have fibrous roots and unusually thick, often slightly 4-angled stems; (2) small, rapidly caducous, sessile leaves with conspicuous stipules are borne with each leaf atop a prominent tubercle; (3) flowers are borne consecutively on synflorescences closely resembling and only slightly thinner than the stem, and the flowers are much spaced out and interspersed with pairs of bracts resembling the leaves; (4) the pollinaria are similar.

In both *C. cimiciodora* and *C. variegata* the projections between the corolla-lobes are mostly much larger than the corolla-lobes. Their function is considered to lie in guiding visiting insects to the mouth of the tube (Bally, 1959). Hairs found on these projections and inside the corolla-tube are exactly as described by Vogel (1961: 202–204).

9. Ceropegia bulbosa Roxburgh, Pl. Corom. 1:11, t.7 (1795). Type: India, Coromandel Coast, *Roxburgh* (no preserved material, the above illustration selected by Huber (1957: 61) as lectotype). **Figs 12, 13.**

Syn.: *C. vignaldiana* A. Richard in Tent. Fl. Abyss. 2:48 (1851). Type: Ethiopia, Wojerat Prov. ('Ouodgerate', southern Tigray) Sensata, *Quartin Dillon & Pettit* (P, n.v.).

Rootstock a discoid tuber bearing fibrous roots on undersurface. *Stems* 1·5–2mm thick, sparsely and very finely pilose, climbing or pendulous to 1m or more. *Leaves* elliptic to ovate to lanceolate or filiform, as small as 3mm broad and 20mm long, few scattered hairs on midrib and ventral surface. *Synflorescence* with up to 8 flowers developing successively on slender, usually dependent peduncle about 1mm thick, up to 10mm long, pedicel up to 10mm long. *Sepals* filiform-subulate, 2·5–3mm long. *Corolla* exterior glabrous, pale green at base becoming greyish-white towards mouth of tube, sometimes faintly blotched with purple, 20–28mm long; *tube* with squat, globose, basal inflation with longitudinal ridges on inner surface, 4–5mm diam., 3–4mm long, merging gradually into narrower (1·5–2mm), cylindrical, ascending portion with conical mouth, inside very pale purple except in basal inflation which is greenish tending to white at base (Omani material), with hairs just above basal inflation; *lobes* with hairs along margins and inner surface, folded along midrib for most of length, 3–6mm broad at base narrowing immediately to 0·5mm, inside white near base, rest pale purple with black area along midrib, erect, joined at tips. *Staminal corona* 2–3mm diam., 2–3mm tall, translucent white, glabrous; *outer lobes* initially horizontal, forming broad, square

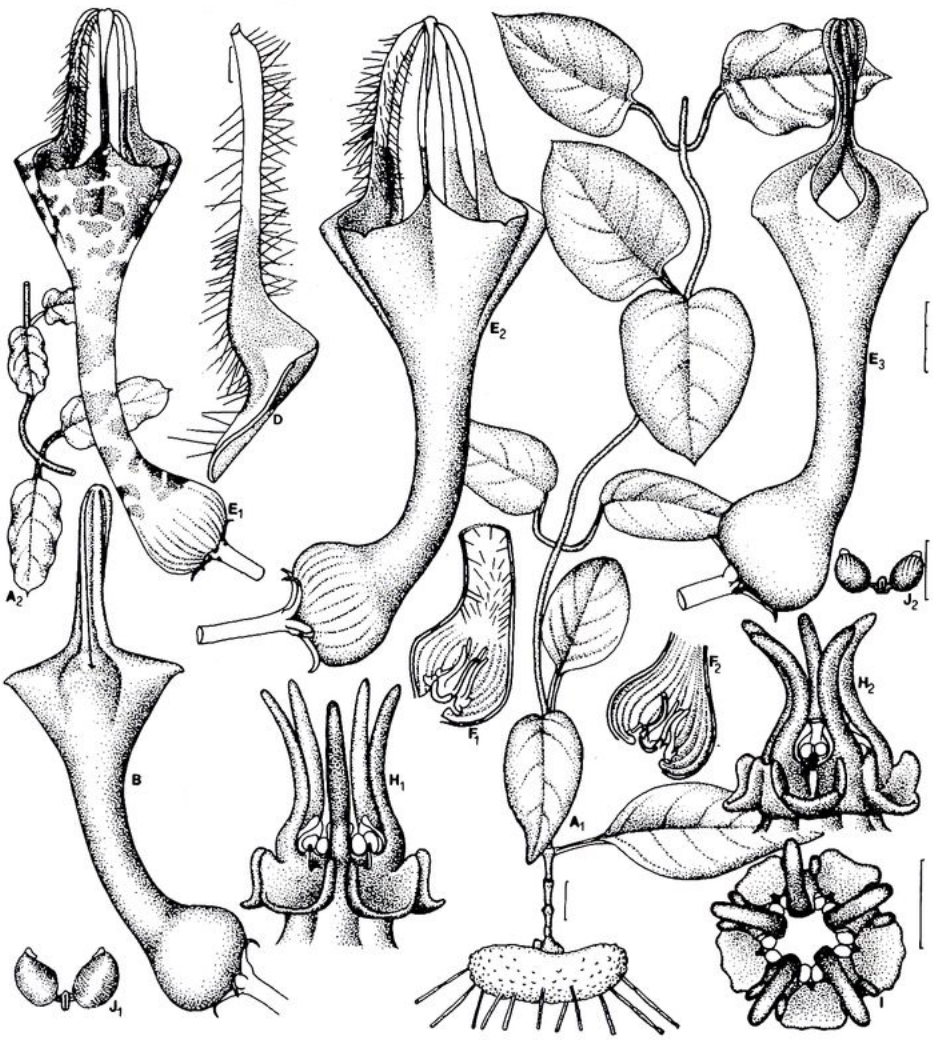


FIG. 12. *C. bulbosa*—Oman material. A, plant; B, bud; D, detail of corolla-lobe; E, side view of corolla; F, view of base of dissected corolla; H, side view of staminal column; I, face view of staminal column; J, pollinaria. A, B, D, E_1, E_2, F_1, H_1, J_1 from *Miller* 6270; remainder from *Miller* 7218. E_1 and E_2 drawn from live material, but different plants: in E_2 exterior uniform greyish white, in E_1 with faint reddish brown mottling on corolla. E_3 drawn from spirit material, hence the odd position of corolla-lobes. Scales: A (at A_1) = 10mm; B, E, F (at E_3) = 3mm; D = 1mm; H, I (at I) = 1mm; J (at J_2) = 0·25mm.

channel with raised sides and front, with truncate apex usually ascending to near level of base of anthers; *inner lobes* cylindrical, incumbent on anthers for at least short distance, sometimes connivent-erect over centre of column with apices recurved, sometimes with incurved apices and sometimes erect and not connivent.

On the Arabian Peninsula this species occurs in two areas. One is at altitudes of over 1000m in the highlands of North Yemen between Ta'izz and Ibb and north of Manakhah. It was first collected in these parts by J. R. I. Wood in August 1977 and grows in dry scrubland, with succulent

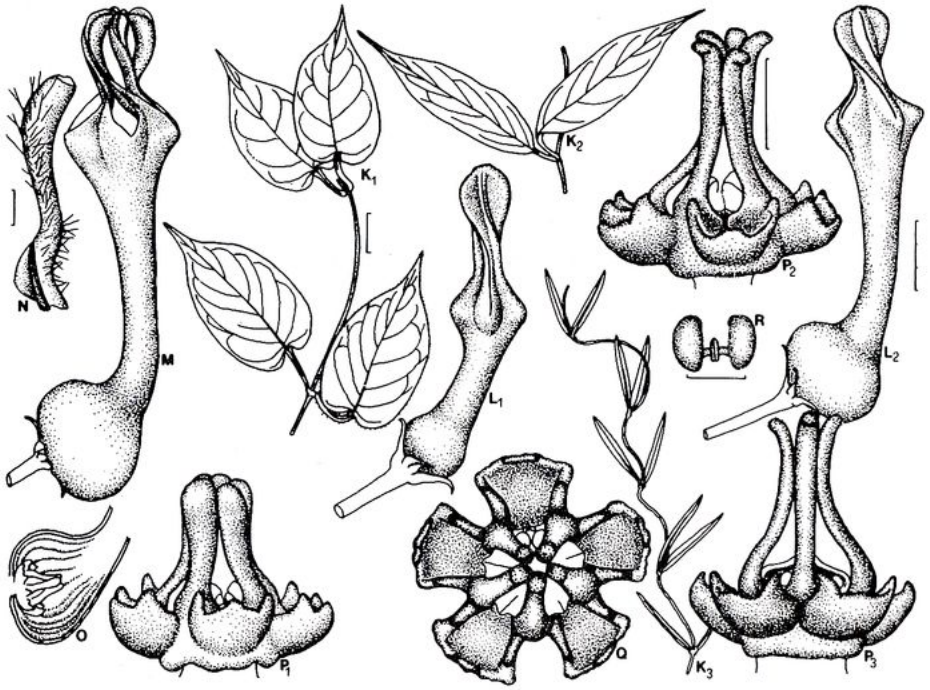


FIG. 13. *C. bulbosa*—N Yemen material. K, parts of plant (tuberous as in Fig. 11); L, bud; M, side view of corolla; N, corolla-lobe; O, view of base of dissected corolla; P, side view of staminal column; Q, face view of staminal column; R, pollinarium. K_1, L_2, M, N, O, P_1 from *Wood* 2013; K_2, L_1, P_2, Q from *Wood* 1827; K_3 from *Wood* 1873; P_3, R from *Noltee* 1383. All drawn from spirit material, hence odd shape of corolla in M. Scales: K (at K_1) = 10mm; L, M, O (at L_2) = 3mm; N = 1mm; P, Q (at P_2) = 1mm; R = 0·25mm.

Euphorbias and *Carissa* bushes providing the most usual protection. The other area is around the sea-facing cliffs of the Jebel Qara and Jebel Qamar in the Dhofar Province of Oman (at altitudes ranging from sea level to 700m) where it was discovered by Vesey-Fitzgerald in 1943. Here it occurs on shaded cliffs or as a climber in dense thickets. The country between these two areas is, however, botanically very little-known so that this species is probably more widespread.

Material from Oman is very similar indeed to forms of *C. bulbosa* from western India (Bhandari, 1978; Hooker, 1834; Wight, 1844–45). The corolla is rather variable in shape (Fig. 12) but generally seems to have shorter corolla-lobes and a longer corolla-tube than Indian plants. The basal inflation is also usually more widely inflated in Indian material. The staminal columns are more or less identical.

Specimens from North Yemen are rather different. The corolla is usually shorter and narrower, with smaller corolla-lobes while the staminal column shows wide variability. The outer corona-lobes are far more cupular than in plants from Oman (though this, too, is variable) although they always have the two upright teeth on either side of the base of each inner lobe, a characteristic of *C. bulbosa*. The inner corona-lobes are sometimes spathulate and incurved apically but are more usually linear-erect with recurved tips. These specimens are more or less identical

to material examined of *C. vignaldiana* (*Gilbert* 2200 (K); *Gilbert & Egziabher* 756 (K)). There seems little basis for maintaining these two as distinct species (they would have to be separated on the more cupular outer corona in western Arabian and north-east African specimens) and *C. vignaldiana* is reduced to synonymy.

The synonymy of this species with the Arabian material and hence with *C. vignaldiana* gives it a very wide distribution from India and Pakistan through Arabia to Ethiopia and Somalia. A similar distribution is otherwise known in the Stapelieae only in the cases of *Caralluma edulis* (Edgew.) Benth. and *C. subulata* (Forsskål) N.E. Br. (unpublished data) and is not found in any other species of *Ceropegia*. However, the tubers of Arabian plants of *C. bulbosa* are much sought after as food (also the case for *Caralluma edulis*) and it is possible that man bears responsibility for its present distribution.

With its discoid tuber, slender, seasonal growth, fine pedunculate synflorescences bearing small, insignificantly-coloured flowers with low, cupular outer corona on a staminal corona situated atop a short stipe, this species is another member of the widely distributed complex containing *C. rendallii*, *C. africana* R. Br. and *C. linearis* E. Meyer (among others) in southern Africa, a number of undescribed, succulent-leaved species in east Africa, *C. linophyllum* Huber in west Africa, and the pan-tropical African *C. purpurascens* K. Schum. *C. bulbosa* shares with *C. linophyllum* and *C. purpurascens* the characteristic of non-succulent leaves and it is probably closest to *C. linophyllum*, which differs in having no widening of the corolla-tube at its mouth and a reduced staminal column, lacking a platform formed by each outer corona-lobe under the anther wings.

10. Ceropegia arabica

Here we are dealing with three very closely-related taxa which seem to be manifestations of a single variable species. The flowers are some of the most remarkable in the genus in Arabia. Those of var. *superba* seem to be especially highly evolved and are regarded here as a specialized pollination syndrome.

C. arabica is the easternmost representative of a widespread group of species including *C. galeata* Huber and *C. powysii* Field from east Africa and *C. fimbriata* E. Meyer, *C. zeyheri* and *C. ampliata* E. Meyer from further south. Others in this group from Kenya, Somalia and Ethiopia remain to be described and further species may appear as these plants are extremely insignificant and easily overlooked. At present it appears that *C. arabica* is endemic to Arabia but collections very similar to var. *superba* exist from Africa (Kenya, Ngong Hills, 1960, *Bally* B12366 (K):– slightly shorter corolla-lobes, basal inflation with rather small roughness on wall, large quantities of dark, vibratile cilia on upper margins of corolla-lobes; Somalia, Al Madu Range, 15 x 1956, *Bally* 11111 (K):– corolla much larger, lobes with rounded apex and small, round keel rather high up, staminal corona very small (more like that in *C. galeata*)) and it is possible that further collecting will reveal the species to be more widely distributed.

Three varieties are recognized, distinguished as follows:

1 Corolla-lobes usually much more than 2·5 times as long as max. width of corolla, usually twisted together for upper ⅔, keel rounded, scarcely projecting, hairless . . . . . **10a** var. **arabica**

\+ Corolla-lobes usually less than 2·5 times as long as max. width of corolla, not twisted together, keel conspicuous, projecting, with hairs 2

2 Corolla-lobes usually 2–2·5 times as long as max. width of corolla, with conspicuous purple-black band on keel, above keel pea green . . . . . **10b** var. **superba**

\+ Corolla-lobes much less than 2 times as long as max. width of corolla without purple band on keel, lobes above keel yellow to light brownish . . . . . **10c** var. **abbreviata**

Rootstock a cluster of fleshy, fusiform roots. *Stems* 3–4mm diam., sprawling to climbing to 3m, with fine, longitudinal ridges making surface rough to touch, dark green to purple-green. *Leaves* rapidly caducous, sessile, fleshy, lanceolate, with few small hairs, slightly concave above. *Synflorescence* sessile, eventually developing into considerable patch without peduncle, flowers in groups of 1–15, pedicels 4–8mm long, glabrous. *Sepals* linear-subulate, 1·5–4·5mm long, glabrous. *Corolla* exterior glabrous, 30–75mm long; *tube* with rectangular, inflated, glabrous base up to 10mm diam., 20mm long, exterior of basal inflation with sunken lines, interior with raised, longitudinal ridges of greenish papillae, narrowing after base into slender, erect cylinder widening gradually towards mouth, hairs only around mouth and on extension of midribs of lobes; *lobes* variously shaped, margins replicate, with hairs on inside, around margins and on midrib, mostly erect, connivent and fused at apices but sometimes free, reflexed. *Staminal corona* translucent white with purple-pink patch on inside of outer lobes, glabrous, 3–3·5mm broad, 3·5–4mm tall; *outer lobes* erect to diverging, bifid for at least half of length into linear teeth, with cupular base; *inner corona* terete, slender, incumbent on anthers, connivent and rising above centre of column, apices often finely setulose.

10a. var. **arabica Fig. 14.**

Syn.: *Ceropegia arabica* Huber in Mems. Soc. Brot. 12:138 (1957). Type: Arabia, 1902, *Ogilvie-Grant* 75a (E).

Sepals 2·5–4mm long, lanceolate-subulate. *Corolla* 35–75mm long; *tube* with basal inflation more or less square to nearly spherical in vertical outline (7–9mm broad), often shallowly depressed on top, exterior with purple-brown to greyish blotches or veins on whitish background near top, rest uniform greyish-green to yellowish, tube above basal inflation slender, only rarely projecting into basal inflation, 2–2·5mm broad, gradually widening to funnel-shaped mouth; *lobes* slender, up to 35mm long, 3–5mm broad at base, 2–3mm broad at rounded, grey-black to yellowish-green, scarcely projecting keel, tapering to less than 1mm above keel, connivent for upper ⅔, usually not separating at all in this part and often spiralling.

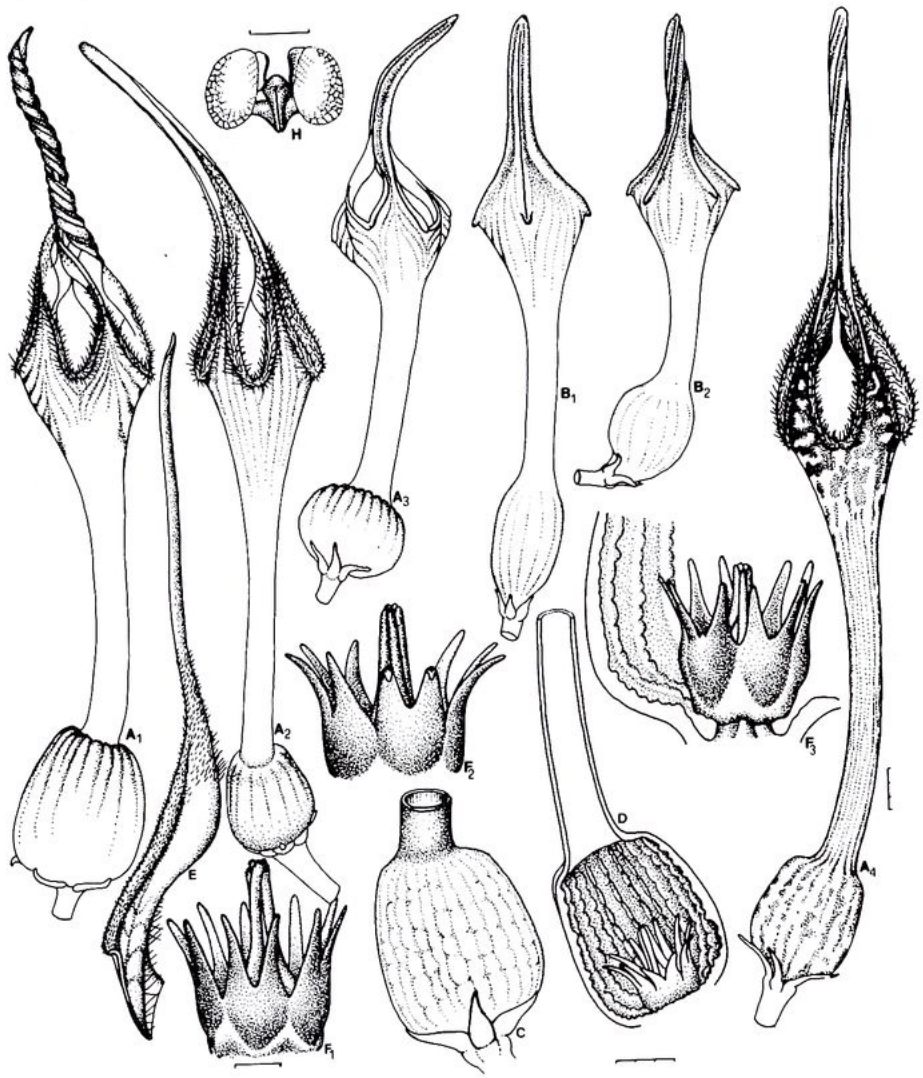


FIG. 14. *C. arabica* var. *arabica*. A, side view of corolla; B, buds; C, slightly enlarged view of base of corolla; D, view of base of dissected corolla; E, side view of corolla-lobe; F, side view of staminal column; H, pollinarium. Plant as in other two varieties. A_1 from *Wood* 2391; A_2, C, D, F_1, F_2, H from plant cultivated by A. Kroesen, Netherlands; A_3, B_2 from *Collenette* 4646; B_1 from *Collenette* 4650; A_4, F_3 from *Noltee* 974. Of the flowers only A_2 and A_4 drawn from live material. Scales: A, B (at A_4) = 3mm; C, D, E (at D) = 3mm; F (at F_1) = 1mm; H = 0·25mm.

This taxon was discussed at length by Field & Collenette (1984) in their account of *C. superba* and was also mentioned in the context of *C. powysii* (Field, 1982). It is known to occur from near Abu Arish in Saudi Arabia to Ta'izz in North Yemen. Var. *arabica* differs from var. *superba* in having generally longer, more slender corolla-lobes which lack both the dark colour pattern and prominent keel. In general flowers of var. *arabica* are a pallid whitish to greyish- or yellowish-green colour but in *Noltee* 974 the exterior has a striking purple-brown mottling on white background

and a much darker interior, with grey-black keel and purple-brown marginal area of the lobes, suggestive of var. *superba*. However, the distinctive white, purple-black, white, brownish and then green arrangement of colour on the inside of the lobes of var. *superba* is not met with in the other varieties and *Noltee* 974 fits clearly under var. *arabica*. The flowers of var. *arabica* have not been observed to give off a scent.

10b. var. **superba** (Field & Collenette) Bruyns stat. nov. **Fig. 15.**
Syn.: *Ceropegia superba* Field & Collenette in Kew Bull. 39:639 (1984). Type: Saudi Arabia, Jebel Fayfa, north-east of Abu Arish, 20 xi 1981, *Collenette* 3159 (K, E).

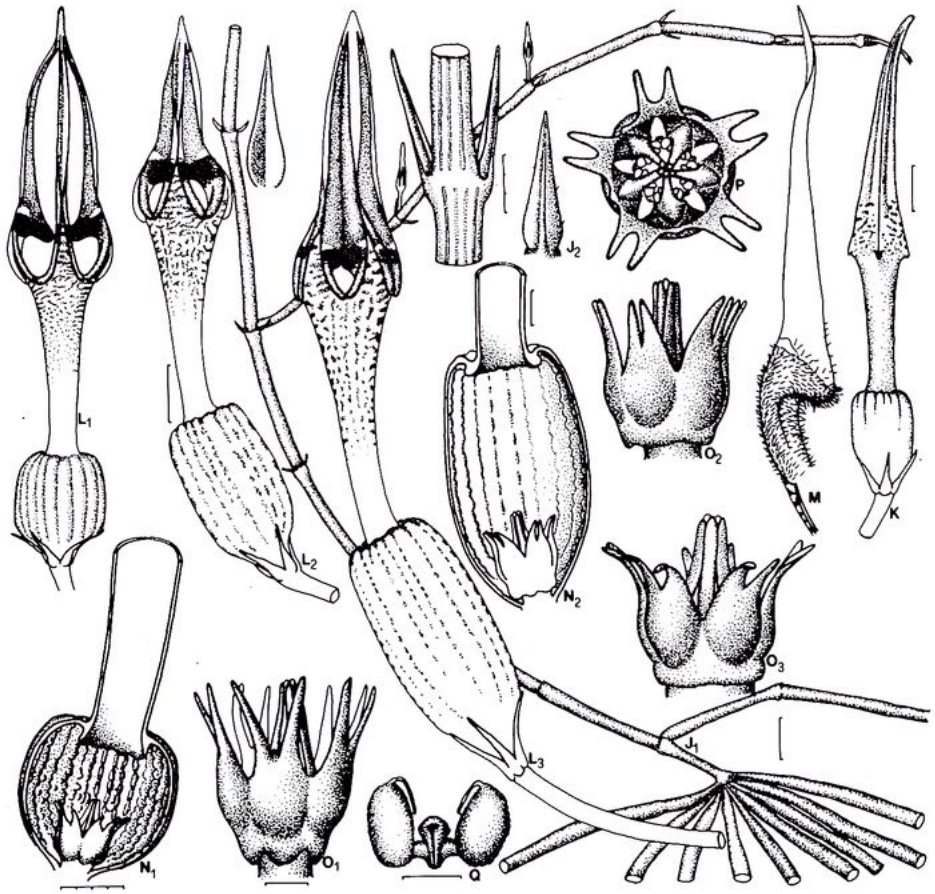


FIG. 15. *C. arabica* var. *superba*. J_1, plant; J_2, detail of leaves (rightermost, view from rear; middle, node showing two leaves from side; leftermost (left of L_3), face view); K, bud; L, side view of corolla; M, side view of corolla-lobe, showing hairs; N, view of dissected basal inflation; O, side view of staminal column; P, face view of staminal column; Q, pollinarium. J_1, J_2, K, L_1, M, N_1, O_3, P from *Collenette* 3159; L_2, N_2, O_2 from *Wood* 2154; L_3 from *Wood* 2536; O_1 from *Collenette* 3282; Q from *Noltee* 1353. All drawn from live material; outer corona in O_3 somewhat older than others, reflection being part of shrivelling process. Scales: J_1 = 10mm; J_3 = 3mm; K, L_1 (at K) = 5mm; L_2, L_3 (at L_2) = 5mm; M, N_1 (at N_1) = 4mm; N_2 = 3mm; O, P (at O_1) = 1mm; Q = 0·25mm.

Sepals 2·5–4mm long, lanceolate-subulate. *Corolla* 45–80mm long, exterior purple-mottled on grey to white; *tube* with rectangular to globose basal inflation 7–22mm long and 7–9mm diam., shallowly depressed on top, upper, cylindric, narrow part of tube (2·5–3mm diam.) projecting some way into basal inflation (projection finely setulose), interior green to greenish-brown lined with purple-brown; *lobes* 17–31mm long, 4mm wide at base, about 3mm broad at strongly projecting keel, tapering off to apex, inner face below keel white, on keel purple-black, then small white patch after which grading through brown to pea green as ascend lobe, few purple, marginal cilia sometimes present, often connivent from keel upwards but sometimes diverging more and connivent only near apex.

Var. *superba* is still not represented by many collections but is known from the type locality in Saudi Arabia southwards to near Ta'izz in North Yemen.

The most striking feature of this taxon is undoubtedly the colour of the flowers and the large, inward-pointing, thickened keel on the inside of the lobes. The combination of purple-black, green and white is often found in *Ceropegia* and occurs in species from India (*C. oculata* Hook.) to the southern tip of Africa (*C. radicans* Schltr and *C. fimbriata* subsp. *geniculata* (Dyer) Bruyns). In *C. superba* (as in *C. radicans*) the flowers produce an unpleasant formic-acid scent and this is probably combined with the colour pattern as an attractant to a specific pollinator.

Field & Collenette (1984) commented on the distinctive shape of the basal inflation of the flower. However, among a batch of seedlings grown at the Städtische Sukkulentensammlung, Zürich from seed collected at the Jebel Fayfa (*Collenette* 3159, 3282), this varied from oblong-cylindrical to globose. It is even more cylindrical than any of these in *Wood* 2536 from North Yemen so that this shape is not taxonomically significant. Figures 14 & 15 show that there is no difference between the staminal coronas of this variety and var. *arabica* (c.f. Field & Collenette, 1984:640–641).

10c. var. **abbreviata** Bruyns, **var. nov.** a aliis varietatibus brevioribus lobis corollae; brevibus sepalis; angusta base conica tubi et forma projecturae lobi differens, flores a varietate *superba* colore discedent. Holotypus: North Yemen, above Hadia in Jebel Raymah, 900m, 13 vi 1980, *Wood* 3295 (K). **Fig. 16.**

Sepals 1·5–2mm long, subulate-acute. *Corolla* giving off slightly musty odour, 30–45mm long; *tube* with cylindrical basal inflation 5–9mm diam., 9–11mm long, with conical, elongated base, running gradually into narrowed upper tube (1·5–3mm broad) which does not project into basal inflation, exterior greenish-white to white with green lines and pale pinkish blotches near broad, funnel-shaped mouth; *lobes* 10–13mm long, well separated and connivent only at apex but sometimes free there too, 3–7mm broad at base, 4–5mm broad at truncated to strongly-projecting keel, then narrowing abruptly to less than 2mm and tapering gradually to top, front of keel usually bright yellow or slightly brownish, rear of keel and upper part of lobe pale yellow to pale yellow-brown becoming darker towards apex, lobe below keel white.

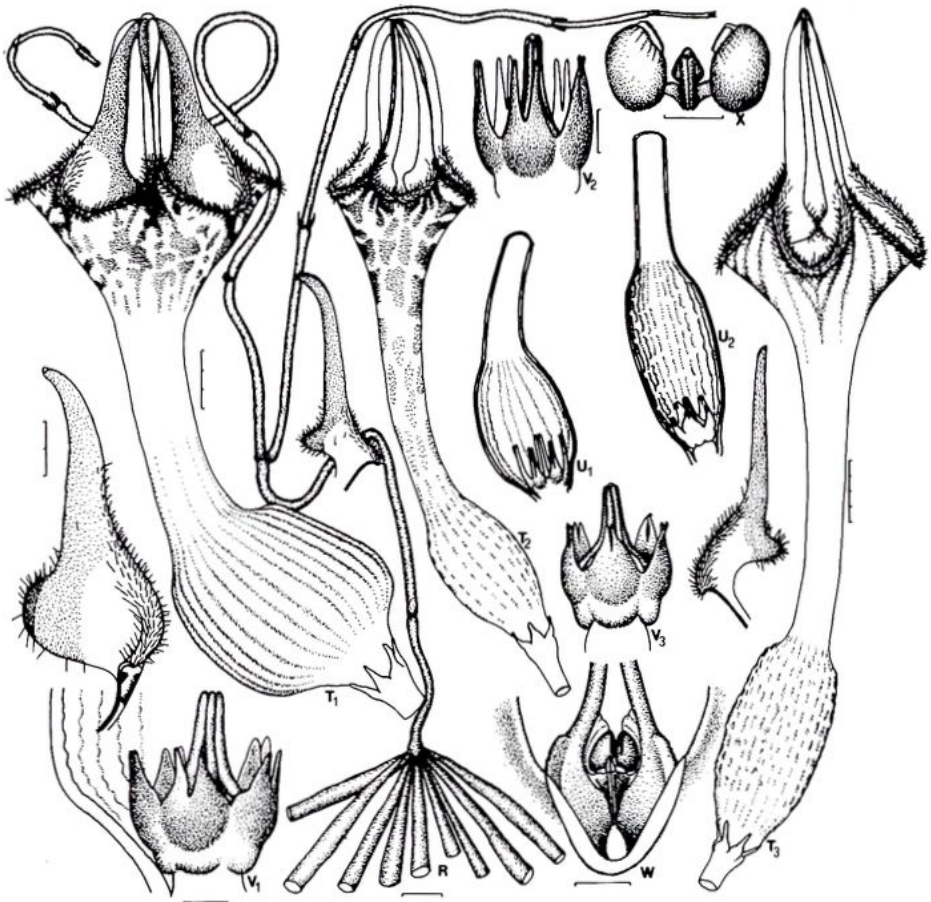


FIG. 16. *C. arabica* var. *abbreviata*. R, plant; T, side view of corolla: in each case to left of flower is one of its corolla-lobes; U, side view of dissected corolla; V, side view of staminal column; W, detail of column with outer corona-lobe removed; X, pollinarium. R, T_3, U_2, V_3, W from *Collenette* 3281; T_1, V_1, X from *Collenette* 3521; T_2, U_1, V_2 from *Collenette* 3283. All drawn from live material. Scales: R = 10mm; T_1 = 3mm (but separate corolla-lobe = 2mm); T_2, T_3 (including separate corolla-lobes), U (at T_3) = 4mm; V_1 = 1mm; V_2, V_3 (at V_2) = 1mm; W = 0·5mm; X = 0·25mm.

This third taxon was not considered by Field & Collenette (1984) and it is in many respects intermediate between '*arabica*' and '*superba*'. Although the flower is never as dark as in var. *superba*, it is darker than var. *arabica* and has a much larger keel on the inside of the lobes—in *Collenette* 3281 this is as large as in var. *superba*. The corolla-lobes are shorter than in either of the other two but are variable and in *Collenette* 3281 and 4646 they are nearly as long as in var. *superba*. The distinctive characteristic of these collections relating them closer to var. *abbreviata* than the others is the narrow portion at the base of the basal inflation (which corresponds to a longer stipe on the base of the staminal corona) with short sepals.

Collenette (1985: 61–63, showing *Collenette* 3160, 3281, 3324A, 3603) has illustrated this variety extensively, showing much of the variation that

occurs. Very occasionally the corolla-lobes are free at the apex (as in *Collenette* 3160 on p. 61) and they then fold back, giving the upper part of the corolla a curious spoked appearance.

In this variety it will often be found that the flowers develop in clusters of up to 15 on a single synflorescence (Fig. 1F) and that many of these open at once. From this the synflorescence develops into a flattened 'peduncular patch' rather than a small, projecting, scar-covered structure as in the other varieties. The difference between these clusters of flowers and the solitary flowers (developing slowly in succession—the second flower takes some time to mature) of a stem flowering for the first time is quite striking. It is possible that further taxonomic attention ought to be paid to this phenomenon but it is sufficiently unreliable that I decided against describing this element as a new species.

INSUFFICIENTLY KNOWN AND EXCLUDED SPECIES

1. *C. boerhaaviifolia* Deflers in Bull. Soc. Bot. France 43:112 (1896), in Mems Inst. Egypt. 3:264 (1896) et in Esq. Geogr. Bot., 48 (1894). Type: South Yemen, Fadhli region, near Serrya in wooded gorge south of the Jebel al 'Urays, 300–400m, March 1890, *Deflers* 412 (no specimen located).

The description of this taxon is incomplete. It is likely that the type would enable identification with one of the species discussed here but Huber was unable to find it and it has not materialized since.

2. *C. deflersii* Schwartz nom. nud. in Fl. Trop. Arab., 192 (1939).

Schwartz attributed this name to Schweinfurth who possibly had written it on his specimen *Schweinfurth* 1264, collected at 1400m at Usil near Manakhah. This specimen was probably destroyed in the Second World War and its identity is unknown.

3. *C. squamulata* Decaisne in Ann. Sci. Nat. sér. 2, 9:263, t.9B (1838) = *Echidnopsis squamulata* (Decne) Bally.

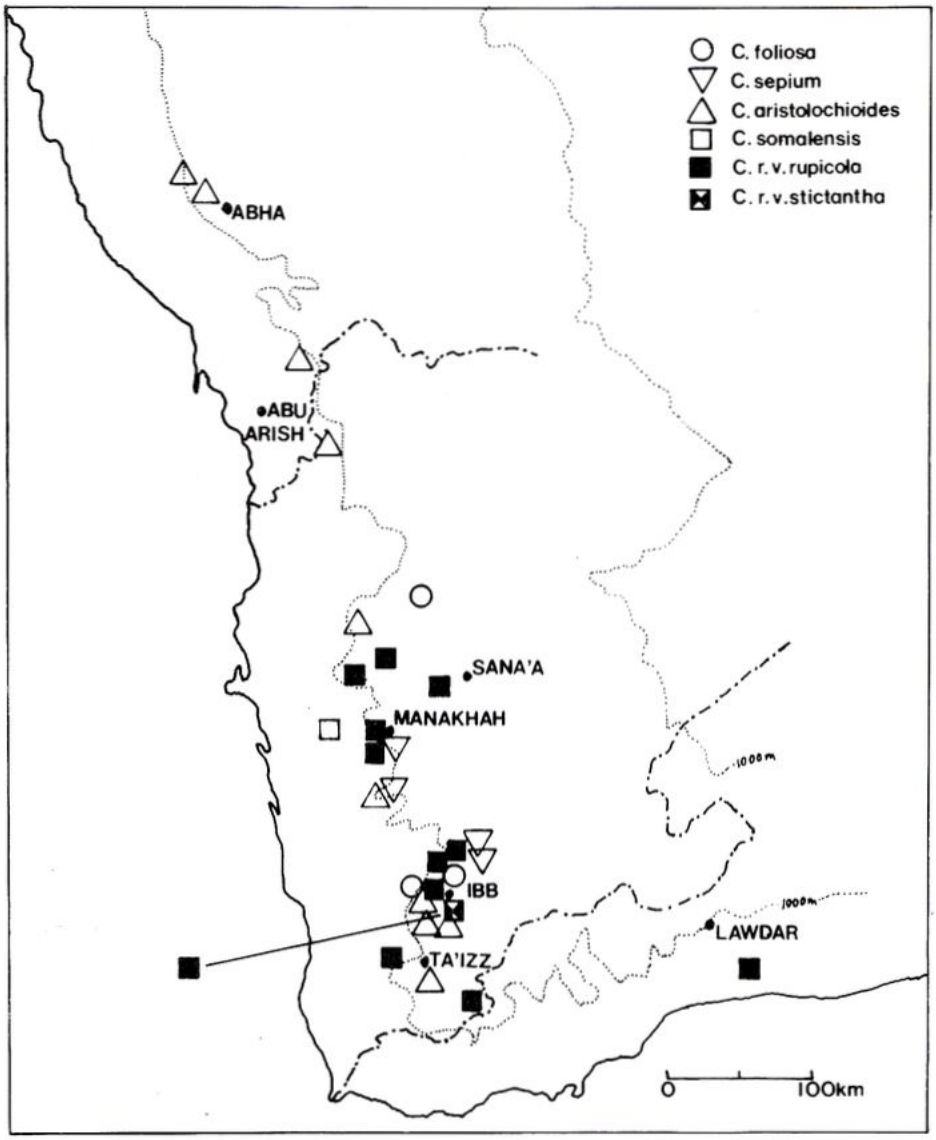
Deflers collected a further insufficiently-known *Ceropegia* (Deflers, 1889, 168: North Yemen, Wadi Schaba, near Hodjeilah, 500–600m, *Deflers* 142 but again the specimen is missing and its identity remains unknown.

MATERIAL EXAMINED

This is located at The Herbarium, Kew unless otherwise stated. Specimens are listed from north to south and west to east. These data were used to draw up distribution maps 1–4.

1. C. foliosa. Map 2.

NORTH YEMEN. Prov. Hajjah, west slopes of Jebel Mabyan, 1700m, 9 Oct. 1982, *Müller-Hohenstein & Deil* 771 (BAYR); North of Ibb, 1800m, 21 Aug. 1977, *Wood* 1829; In valley north of Ibb, 1900m, trailing over shrubs, 5 Sept. 1977, *Radcliffe-Smith & Henchie* 4958; Wadi Dur, Al 'Udayn, 1500m, frequent in scrub, 14 Sept. 1979, *Wood* 2899 (K, BM); North of the Suq, Al 'Udayn, 1500m, 7 June 1975, *Wood* 75/287.



MAP 2. Distribution of *C. foliosa*, *C. sepium*, *C. aristolochioides*, *C. somalensis* and *C. rupicola* in Arabia.

2. C. sepium. Map 2.
NORTH YEMEN. Wadi Mazeb, near Manakhah, 2200m, 13 May 1887, *Deflers* 382 (P); West of Manakhah on road to Hajarah, 2400m, on rocks on north-facing slopes, 21 Aug. 1977, *Radcliffe-Smith & Henchie* 4678 (K, E); Haraz, west of Jebel Shibam, 2600m, in scrub amongst rocks, 5 June 1980, *Wood* 3283; Jebel Raymah, frequent in lush, scrubby vegetation above Hadia, 1900m, 13 June 1980, *Wood* 3300 (K, E, BM); South side of Sumarah Pass, north of Ibb, 2400m, 1985, *Noltee* 17; In scrub on north-west side of Jebel Ba'dan, north of Ibb, 1700m, 21 Aug. 1977, *Wood* 1831.

3. C. aristolochioides subsp. **deflersiana.** Map 2.
SAUDI ARABIA. Muhayl, 450m, *Collenette* 3524 (ZSS); Foot of Jebel Sawdah, Wadi al Uss, north of Abha, growing in *Grewia* and *Euphorbia*, 1500m, *Collenette* 2111; 3324–3328 (all of

them in part only), 3329 (K, E); 15 Mar. 1980, *Nasher* IH110, (E); Jebel Fayfa, 1600m, in *Abrus*, *Euphorbia cactus* etc., common, *Collenette* 3282 (E); 3199 (K, ZSS); 3603 (ZSS); 3159 in part (ZSS); *Chaudhary* 937 (E). Uncertain locality: *Collenette* 4652 (E).
NORTH YEMEN. Wadi Liyah, Khawlam as Sham, 900m, 1 Nov. 1979, *Haig-Thomas* in *Wood* 3064; Prov. Hajjah, At Tur, in wadi with *Acacia abyssinica*, 27 Oct. 1982, *Müller-Hohenstein & Deil* 1058 (BAYR); Jebel Raymah, 1000m, 27 Sept. 1975, *Wood* 849; 20km west of Ibb on road to Al 'Udayn, 1500m, *Noltee* 887; Dhi Sufal, 1800–2100m, twining up *Euphorbia ammak*, 20 Oct. 1975, *Wood & Hepper* 5887; *Wood* 75/896; 32km from Ta'izz towards Ibb, 6 Aug. 1977, *Newton & Lavranos* 15738 (E); 3km north of Al Qa'idah towards Dhi Sufal, 1700m, 4 Aug. 1977, *Wood* 1874; Jebel Sabir, Wadi Tha'bad, 1700m, 10 Oct. 1979, *Wood* 2979; Jebel Hawban, near Ta'izz, June 1982, *A. Butler* s.n.

4. C. somalensis. Map 2.
NORTH YEMEN. East of Bajil on road to Sana'a, 1050m, March 1986, *Noltee* 1514.

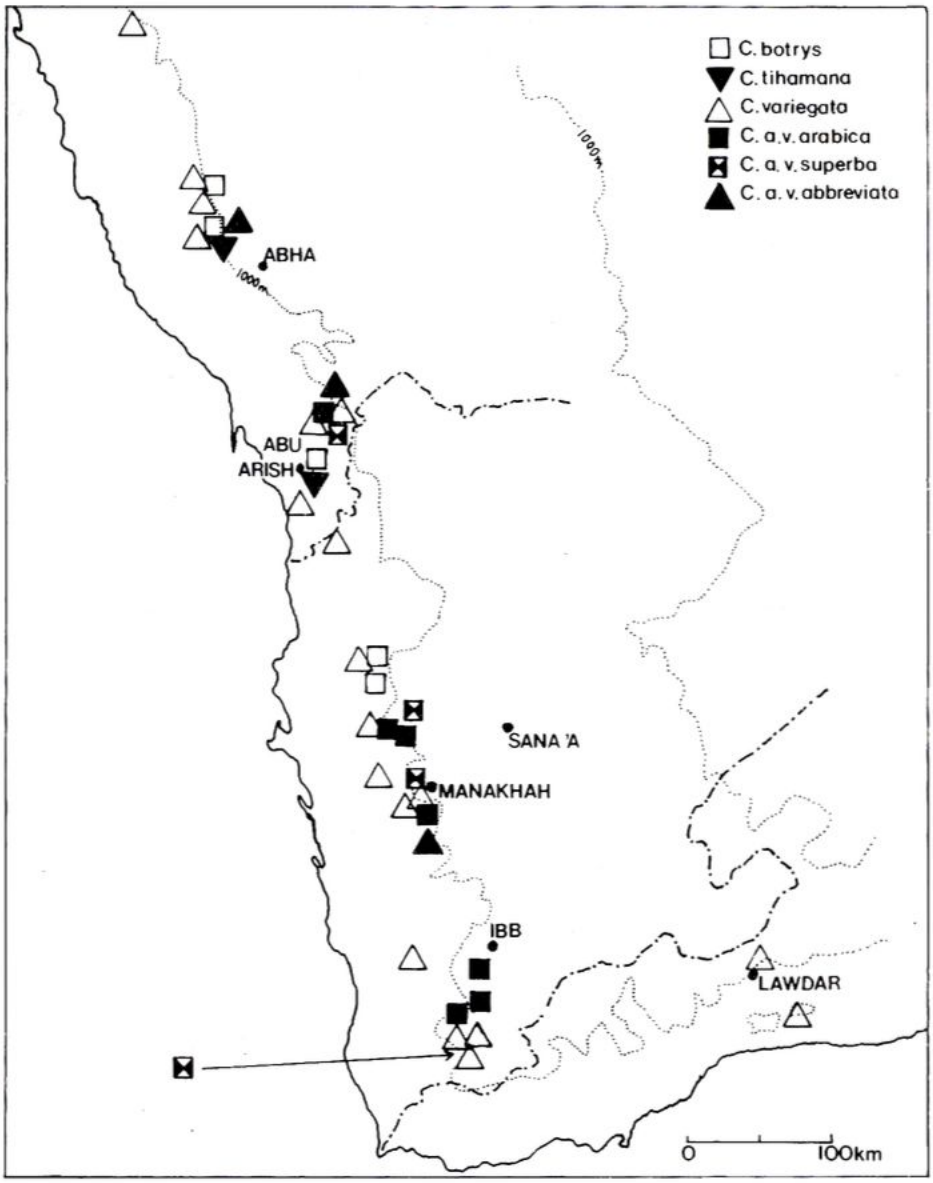
5. C. rupicola. Map 2.
NORTH YEMEN. 3km north-west of Al Mahwit, hanging down from rock face on limestone cliff, 21 May 1979, *D. Wood* Y1195 (E); On rock faces hanging down cliffs, Jebel Milhan, 14 June 1979, 1900m, *Wood* 2858; Wadi Ahjar, west of Sana'a, 14 Mar. 1977, *Chaudhary* s.n.; Near Manakhah, Wadi Hadud, south slopes, 2000m, 20 Mar. 1984, *Müller-Hohenstein & Deil* 1880 (BAYR); On rocks on Masar Mountain, west of Manakhah, 1800–2000m, 14 May 1887 (P); Near Zulmah, 2200m, growing in rock crevices, 5 Aug. 1977, *Radcliffe-Smith & Henchie* 4495; 20km west of Ibb towards Al 'Udayn, 1500m, *Noltee* 875 (E); 32km from Ta'izz towards Ibb, 6 Sept. 1977, *Newton & Lavranos* 15737 (E); In *Euphorbia* bushland just north of Al Qa'idah, c.1700m, 4 Aug. 1977, *Wood* 1767; About 8km west of Hajdah, west of Ta'izz, 700m, *Noltee* 1124; Between Beni Ai and Hayfan, Jebel Hisn, 21 Apr. 1974, *Wood* 75/93; Bilad Hodjerica, Jebel al Reyami, 17 Apr. 1890, *Deflers* 576 (P).
SOUTH YEMEN. Jebel al 'Urays, *Deflers* s.n. (in litt., no specimen located).

C. rupicola × C. aristolochioides.
NORTH YEMEN. 3km north of Al Qa'idah on road to Dhi Sufal, 1700m, 4 Aug. 1977, *Radcliffe-Smith & Henchie* 4437.
Possible back cross of hybrid with *C. rupicola*.
Collected 1976, *Newton & Lavranos* 13109, large straight flowers with narrow openings of typical form but with spots (K, PRE).

6. C. botrys. Map 3.
SAUDI ARABIA. Al Moraira, 44km north of Muhayl, 150m, climbing to 2m in *Acacia*, 2 May 1981, *Collenette* 2616 (K, E); 3km east of Muhayl towards Wadi al Uss, 350m, *Collenette* 2977 (ZSS); Abu Arish, 23 Feb. 1979, *Chaudhary* 900A (E); 7 Mar. 1981, *Chaudhary* s.n.
NORTH YEMEN. At Tur, in basal plains in granite, 350m, 18 Oct. 1982, *Müller-Hohenstein & Deil* 866 (BAYR).

7. C. tihamana. Map 3.
SAUDI ARABIA. Wadi al Uss, near Abha, *Collenette* 3324 (ZSS); Abu Arish, 23 Feb. 1979, *Chaudhary* 901A (E); 30m, 7 Mar. 1980, *Collenette* 1998; 150m, 1982, *Collenette* 3284 (ZSS).

8. C. variegata. Map 3.
SAUDI ARABIA. Grandi Lavori Road, 750m, Sept. 1982, twining in *Anisotes trisulcus*, *Collenette* 3909; Al Moraira, 44km north of Muhayl, 150m, 8 Mar. 1980, *Collenette* 2617; 40km north of Muhayl, 3 Apr. 1980, greenish corolla-lobes with red hairs, 450m, *Collenette* 2217; 10km north of Muhayl, 24 Feb. 1982, *Collenette* 3334; Between Sabya and Jebel Fayfa, 250m, 4 Mar. 1982, *Collenette* 3285 (K; ZSS); *Collenette* 3612 (K; ZSS); *Collenette* 3740; Jebel Fayfa, 1600m, *Collenette* 3599 (ZSS); 1km north of Ad Arda, between Jizan and Yemen border, 150m, 8 Mar. 1980, *Collenette* 1996.
NORTH YEMEN. Harad, in protection of *Salvadora persica* in Wadi Harad, 150m, 1 Nov. 1979, *Wood* 3059; At Tur, vegetation on edge of village in Wadi Labtah in sand, 300m, 14 Mar. 1982, *Müller-Hohenstein & Deil* 345 (E, BAYR); At Tur, on basal plain in granite, 350m, 18 Oct. 1982, *Müller-Hohenstein & Deil* 864 (BAYR); Walajah, hills of Haksaba, Jebel Milhan, 18 Jan. 1889, *Schweinfurth* 738 (P); 23km east of Bajil towards Sana'a, 200m,



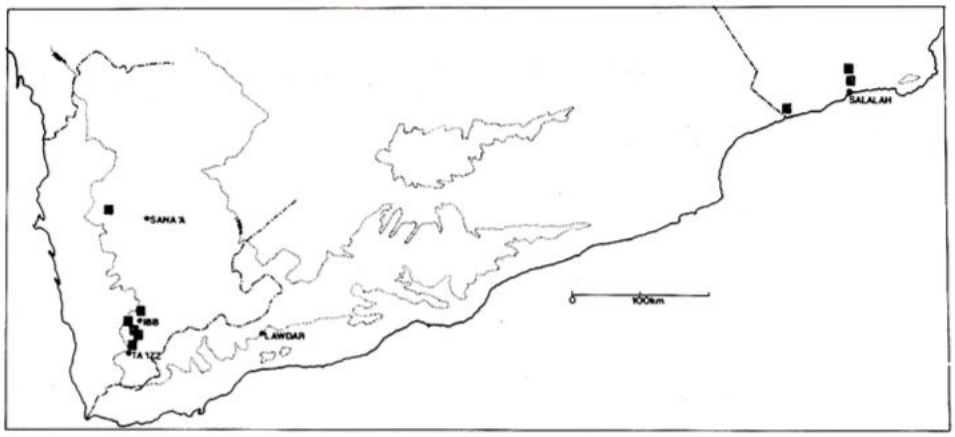
MAP 3. Distribution of *C. botrys*, *C. tihamana*, *C. variegata* and *C. arabica* in Arabia.

Noltee 1499D; Upper end of Wadi Shadb, 19 Sept. 1977, *Newton & Lavranos* 15899; Between Al Khalifa and Wadi Siham, 300m, in protection of *Cadaba glandulosa*, 27 Sept. 1977, *Wood* 2031; Jebel Ra's, 1837, *Botta* (P); Al Misrakh, south of Ta'izz, c.1500m, 9 Dec. 1977, *Wood* 2154; 30km towards At Turbah off Ta'izz, Al Mukha road, 1050m, *Noltee* 1048; hills south of Al Barh, *Noltee* 361A.

SOUTH YEMEN. Lawdar, *Lavranos* 4367; Jebel al 'Urays, 200–300m, *Deflers* 799 (in litt., no specimen located).

9. C. bulbosa. Map 4.

NORTH YEMEN. 15km from Al Mahwit towards At Tur, 1150m, 1986, *Noltee* 1383; North of Ibb, 2000m, 21 Aug. 1977, *Wood* 1827; North of the Suq, Al 'Udayn, 1500m, climbing over



MAP 4. Distribution of *C. bulbosa* in Arabia.

Carissa edulis, 18 Sept. 1977, *Wood* 2013; 32km from Ta'izz towards Ibb, 6 Sept. 1977, *Newton & Lavranos* 15739A (E); Between Dhi Sufal and Qa'idah, in *Euphorbia* scrub, plant with very narrow leaves, 28 Aug. 1977, *Wood* 1873 (K, BM); 10km from Ta'izz towards Ibb, low hills north of road, 7 Sept. 1977, *Newton & Lavranos* 15763 (E).
OMAN. DHOFAR PROVINCE. Jebel Qara, inside bush islands, tubers eaten, 2 Oct. 1943, *D. Vesey-Fitzgerald* 1244/2 (BM); Jebel Qara, Salalah to Thamrait road, 700m, hanging from shady cliffs, 5 Oct. 1979, *Miller* 2549 (E); *Miller* 6270 (E); *Miller* 7218 (E); Jebel Qamar, Khadrafi, Sarfait area, 650m, 26–27 Sept. 1976, *Mandeville* 6935 (BM); Kharfawt, lower Wadi Sayq, 9km east of Dhalqut, 40m, in dense mixed thicket, 27 Oct. 1977, *Radcliffe-Smith* 5285.

10. C. arabica var. **arabica.** Map. 3.
SAUDI ARABIA. Jebel Fayfa, 1500m, *Collenette* 3158A, 4650, 4646 in part.
NORTH YEMEN. Im Saum des Wadi La'ah, At Tur, 25 Oct. 1982, *Müller-Hohenstein & Deil* 1029 (BAYR); Jebel Milhan, between Walajah and Ukaybir, 700m, one plant climbing over bushes, flowers purple-tipped, 9 Sept. 1976, *Wood* 1197; Al Maghraba in Milhan-Hufash Pass, 1500m, 2 June 1975, *Wood* 2391; Wadi Hijan, 8km west of Manakhah, 1700m, 13 Oct. 1978, *Miller & Long* 503 (E); 3km north of Al Qa'idah towards Dhi Sufal, 1650m, *Noltee* 974; near Qa'idah, 1800m, 4 Aug. 1977, *Wood* 1766; 10km from Ta'izz towards Ibb, 1400m, Sept. 1977, *Newton & Lavranos* 15761 (E); Hoeban, near Ta'izz, 1500m, 19 Apr. 1975, *Wood* 75/83; Ta'izz, north side of town, 1300m, in *Euphorbia cactus*, 19 Oct. 1975, *Hepper & Wood* 5834. Without precise locality: SOUTH YEMEN (?) 1902, *Ogilvie-Grant* 75a (E).

var. **superba.** Map 3.
SAUDI ARABIA. Jebel Fayfa, 1600m, 20 Nov. 1981, *Collenette* 3159 (K, ZSS); 3282 (ZSS); 4647.
NORTH YEMEN. Below Rahbaan, near Al Mahwit, 1400m, on stony slope, 27 Sept. 1978, *Wood* 2536; west of Al Mahwit, 1600m, 1986, *Noltee* 1353; Manakhah, Oct. 1979, *Mueller-Hohenstein* 21/2 (BAYR); On rocky volcanic slope, Al Misrakh, c.1500m, 9 Dec. 1977, *Wood* 2154.

var. **abbreviata.** Map 3.
SAUDI ARABIA. Wadi al Uss, north of Abha, 975m, 16 Mar. 1980, *Collenette* 2111 (dark flowered form) (E); 3283 (ZSS); 3324 (E); 3326 (E); 3328. Jebel Fayfa, in *Abrus* shrubs, 950m, 20 Nov. 1981, *Collenette* 3160; 3281 (K; ZSS); 3283; 3521 (K; ZSS); 3603 (E); with diverging corolla-lobes, 20 Nov. 1981, *Chaudhary* 902 (E).
NORTH YEMEN. Jebel Raymah, above Hadia, 900m, 13 June 1980, *Wood* 3295 (K; BM); Jebel Raymah, on steep rocky slopes between Suq Ar Ribut and Beni Danan, 1900m, 5 Apr. 1980, *Wood* 3189.

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INDEX

Accepted names are in bold, synonyms are in italic, and names of species mentioned in the text are in roman.