SYSTEMATIC STUDIES IN THE GENUS *BULBINELLA* KUNTH (ASPHODELACEAE)

by

P L PERRY

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ABSTRACT

Bulbinella Kunth is a comparatively small genus of the family Liliaceae *sensu lato*, with distributions in the Cape Province of South Africa and in the main islands comprising New Zealand. A revision is given of Baker's 1896 systematic treatment of the genus in *Flora capensis*. The data sources for the revision include a detailed morphological study based on living material, seedling development, pollen structure, leaf anatomy, geographical distributions and ecology. Previous work on breeding biology is reviewed.

A comparison of the systematics of *Bulbinella* in South Africa and New Zealand is followed by some discussion on this unique disjunct distribution. For the taxonomic treatment existing type material was viewed as well as herbarium material from the main collections in South Africa and Europe. Of the 21 names originally attached to the genus, as enumerated in Index Kewensis, seven had previously been transferred to other genera, six have been placed in synonomy, one has been rejected and seven upheld. Nine new species and two new varieties are described. One previously described variety is raised to specific rank.

CONTENTS

1. INTRODUCTION

Bulbinella Kunth is a small to moderate-sized genus of the family Asphodelaceae or Liliaceae *sensu lato*. The genus has two widely disjunct centres of distribution. One centre is in the winter rainfall region of the Cape Province of South Africa and the other is in New Zealand. Within its distribution range in the Cape the genus is widespread and several species are comparatively common, often being found in large stands in damp vleis or seepage areas. It also occurs in a variety of other habitats.

A revision of the New Zealand members of *Bulbinella* was undertaken by Moore (1964) when six species and one variety were described. Two of the species and the variety had not been previously described. A preliminary investigation into the history and nomenclature of the genus revealed that systematic studies on it in South Africa were somewhat incomplete. No new species had been described this century and all published work prior to that had been carried out on herbarium material or in the case of one new species the description was made from plants cultivated in Europe. Many of the early herbarium specimens lacked root systems and sheaths, both of which show important diagnostic characters. Descriptions were largely based on flower structure which shows very little variation between the different species. Identifications were therefore frequently unreliable.

Currently only four species of *Bulbinella* are recognised for South Africa (Gibbs Russell et al. 1985). However *Bulbinella* names for South African species, extracted from volumes of Index Kewensis up to 1900, total 21. Of these two have since been placed in *Ornithogalum*, four in *Trachyandra* and one has been identified as *Caesia contorta* (L.f.) Dur. & Schinz. With these taxa removed fourteen *Bulbinella* names remained. Various placings

were given to these remnant names by authors such as Kunth (1843), Baker (1872, 1876 and 1896), Durand & Schinz (1894). In the present work seven are shown to be synonyms, superfluous or illegitimate names and seven are retained. The latter together with one variety raised to specific rank, nine new species and two new varieties form the seventeen species and two varieties here recognised. This gives some indication of the state of past confusion of names for the genus.

The fact that no field work, other than occasional collecting of specimens, had been undertaken for the genus in South Africa was considered of prime importance in deciding on the present study. Living material from natural populations was studied. Collections were kept in cultivation to discover development of plants at different stages and times of the year. Many species were also grown from seed. It has thus been possible to make observations on ecology and details such as subtleties of flower colour, leaf texture and root development to give data which cannot be seen in herbarium specimens. Because of the importance of some of these characters in the identification of the species it was decided that colour plates would be of value in supplementing the data in the descriptions [Figure 1].

Systematic studies generally require data from other fields such as anatomy, cytology, biochemistry and palynology. Suitable leaf material has been supplied to Dr. H Baijnath of the University of Durban-Westville who is investigating the leaf anatomy along the same lines as he has already completed for Bulbine and Kniphofia. Ms L. Milicich recently commenced work for a Ph.D., at Victoria University, Wellington, on the genetics of Bulbinella. Plants or seed of 14 South African taxa have been sent to her.

The genus has little known economic value. However the fact that breeding research was initiated in the early 1960's (Horn, 1962) indicated that the genus was considered to have potential for the cut flower trade. In fact the common yellow Bulbinella is popularly referred to as the "Florist's Bulbinella". Unfortunately Horn's account is partly inaccurate, due to evidently unreliable naming of taxa (refer to p.39). Horn's results do not appear to have enhanced the commercial use of the genus. However the genus has undoubted horticultural value and it is to be hoped that more detailed and accurate information regarding the species will encourage their greater use in cultivation. Horn's paper gives some insights into breeding behaviour in the genus and more detailed research in this direction could be of considerable interest.

The anomaly of the extreme disjunct distribution between the Cape and New Zealand poses a fascinating problem. It is comparable to that of the related genus Bulbine Wolf which occurs in Africa and Australia. At this stage, knowledge of palaeogeography gives only broad indications as to how such a disjunction might have occurred (Good, 1953; Radford et al., 1983; Stace, 1980). A comparison of the species in the two areas made here confirms the similarities between the two groups. Studies of distributions of related genera and of others occurring in the two countries indicate that this limited disjunction pattern is unique (refer to p.57).

2. MATERIAL AND METHODS

Field studies for Bulbinella were carried out in the winter rainfall area of South Africa from 1977 and intensively between 1984 and 1986. In addition to the preparation of herbarium material in most cases live plants were brought back for cultivation at the Kirstenbosch and Karoo National Botanic Gardens. When seed was available this was collected both for examination of structure and for germination to study stages of development. For one species only, B. potbergensis, it has not yet been possible to obtain seed.

Herbarium material from the main herbaria in South Africa (BOL, NBG, SAM, STE) and also from Geneva (G) was borrowed and studied in detail. During a visit overseas it was possible to examine material at the chief British Herbaria (K, BM & LINN) and in Paris (P). Specimens from Berlin (B) were sent to Kew for study during this visit. It has also been possible to study high quality colour prints of the Thunberg specimens at Uppsala (UPS) and a monochrome print of Anthericum setosum from the Willdenow herbarium. Thus it has been possible to examine all existing Type material for the names of South African species of Bulbinella.

Portions of leaves from one or more collections of each possible taxon of Bulbinella were preserved in FAA. In a preliminary examination in the first year of study, sections were cut on a freezing microtome and temporary mounts were prepared using analine sulphate and iodine as stains. It was clear from the initial examination of the slides that many useful characters and interesting information could be obtained from a more detailed study. Arrangements were then made with Dr. H. Baijnath of the

University of Durban-Westville to undertake this as part of his anatomical study of Asphodelaceae.

An investigation of pollen size and surface structure was carried out using a scanning electron microscope. Anthers were taken from herbarium specimens of 18 South African and two New Zealand taxa. Pollen was scattered from the anthers directly onto mountant-covered stubs. After sputter-coating with gold/palladium the pollens were viewed on a Cambridge S200 SEM. Lengths and widths of several grains were measured for 16 taxa (Table 1) and photographs taken at approximately X 1 000 and in the range X 2 500 to 5 000.

For comparison purposes herbarium specimens of New Zealand species were examined at NBG and K. Living plants of three New Zealand species in cultivation at Kew were studied superficially. Seeds of two species were obtained from New Zealand. Unfortunately germination was not achieved, possibly because of loss of viability or lack of trials at sufficiently low temperatures. Most of the information on New Zealand species has come from the literature.

3. TAXONOMIC HISTORY

The genus Bulbinella was established by Kunth (1843) when he discarded the genus Anthericum L. and divided the taxa then known between the three genera Phalangium Mill., Trachyandra Kunth and Bulbinella Kunth. In addition to a detailed generic account of Bulbinella he named twelve species, with a thirteenth in the addenda. For six of these he gave new names and detailed descriptions. The remaining seven came under the heading "species decidedly dubious to me", and each had a question mark before the specific name. These were previously described species which possibly Kunth knew only from the brief descriptions hitherto given them. One of the seven B. ?ornithogaloides Kunth has been identified by Obermeyer (1968) as an Ornithogalum. Another, B. ?capillaris Kunth, originally named Phalangium capillare by Poiret is clearly a Bulbinella, judging from the Type specimen in the Lamarck Herbarium in Paris.

The remaining five species had previously been placed in Anthericum by Linnaeus' son and Thunberg. Of these three have been identified as species of Trachyandra by Obermeyer (1958 & 1968) and the other two clearly fall under Bulbinella. These are B. ?caudata (Thunb.)Kunth and B. ?triquetra (L.f.)Kunth.

Two years after Kunth had erected the genus Bulbinella, J.D. Hooker in his Flora Antarctica (1845) described plants he collected from islands to the south of New Zealand under a new genus Chrysobactron. In 1851 a second species of Chrysobactron from New Zealand was described. However in his handbook of New Zealand flora (1864) Hooker placed both species in Anthericum.

In 1876 Baker returned Kunth's *Phalangium*, *Bulbinella* and *Trachyandra* to *Anthericum*. Included amongst his subgenera of *Anthericum* were *Bulbinella*, with descriptions of nine South African species and *Chrysobactron*, with two South African Species (*A. carnosum* & *A. floribundum*) added to the two New Zealand species. Later, in his account for the Flora Capensis, Baker (1896) reinstated the genus *Bulbinella* with descriptions of eight species and three varieties.

Apart from the description of one new species, *B. punctulata* A. Zahlbr. near the end of the 19th century no further work has been published on the South Africa species of *Bulbinella*. In a revision of the New Zealand species Moore (1964) states that "no clear reasons have emerged for dissociating the New Zealand plants from *Bulbinella*".

4. FAMILY AND GENERIC RELATIONSHIPS OF BULBINELLA

Bulbinella has long been regarded as a member of the large and heterogeneous family Liliaceae of the order Liliales. Liliaceae sensu lato is one of the largest families of flowering plants with approximately 250 genera and 3 700 species world-wide (Willis, 1973). Recent research into affinities of the numerous genera in this unweildy family has resulted in several modern classifications. The most recent and detailed works, that of Dahlgren and Clifford (1982) and Dahlgren, Clifford and Yeo (1985), give an integrated and comparative account of the Monocotyledons. The classification presented in these works combines eleven Orders in a Super-Order Liliiflorae. Among the orders are Asparagales and Liliales. The division of the former Liliales into the two orders Asparagales and Liliales was first introduced by Huber (1969). This was based on a number of differences such as seed characters, endosperm formation, and nectaries (Dahlgren and Clifford, 1982). Families placed under Asparagales included Asphodelaceae with the three sub-families Astelioideae, Asphodeloideae and Anthericoideae (Dahlgren & Clifford, 1982). In a more recent publication (Dahlgren & Clifford, 1985), Asteliaceae and Anthericaceae are treated as Families whilst Asphodelaceae is divided into the Sub-families Asphodeloideae and Alooideae. During discussions by botanists employed at the Royal Botanic Gardens, Kew it was decided that Alooideae should also be raised to family level (J. Cowley, pers. comm.). This decision was based largely on anatomical studies carried out at the Jodrell Laboratory. Asphodelaceae is therefore left as a small homogeneous grouping consisting of the nine genera Asphodelus Rehb., Asphodeline L., Bulbine Wolf, Bulbinella Kunth, Eremurus M. Bieb., Jodrellia Baijnath, Kniphofia Moench, Simethis Kunth and Trachyandra Kunth. Of these Asphodelus, Asphodeline,

Eremurus and Simethis are northern hemisphere genera distributed in Europe and Asia, whilst Bulbine, Bulbinella, Kniphofia and Trachyandra are centred in South Africa. Kniphofia, Bulbine and Trachyandra each have a few representatives in tropical Africa and Bulbine has a second centre in Australia. Bulbinella has a second and smaller centre in New Zealand. Jodrellia is a recently described genus from Central Africa closely related to Bulbine.

5. GENERAL MORPHOLOGY

5.1 Habit

All species are deciduous geophytes ranging in height above ground from about 0,2 - 1,0 m. The underground stem is a compact corm-like structure with an apical shoot surrounded by membranous or fibrous sheaths extended to form a neck. Numerous swollen roots arise basally and laterally from the stem. A new stem and swollen roots are formed annually towards the end of the growing season. Plants remain largely dormant through the summer dry season.

5.2 Roots

A dense fascicle of some 20-100 roots emerges from the base of the condensed stem, in most cases penetrating through a thick mat of fibres surrounding the stem and leaf bases. As the roots perform the function of food storage and assist in perennation for the plant they become swollen or tuberous for part of their length. In some species such as Bulbinella chartacea and B. divaginata the roots are fusiform with a swollen region proximal to the stem, gradually tapering to a thinner absorptive portion at the ends. In other species for instance, B. cauda-felis and B. elegans, the tuberous part is frequently terminal and forms about one third of the length of the root with a thinnish wiry basal part. Sometimes as with B. triquetra swollen regions may be seen in both positions but the proximal ones may be only a preliminary growth phase. In a third group, including B. nutans, the roots are thickened more or less evenly for the whole length of 300 mm or more. These roots are orange coloured but are interspersed with many greyish brown dead remains of roots in which food stores have been used up.

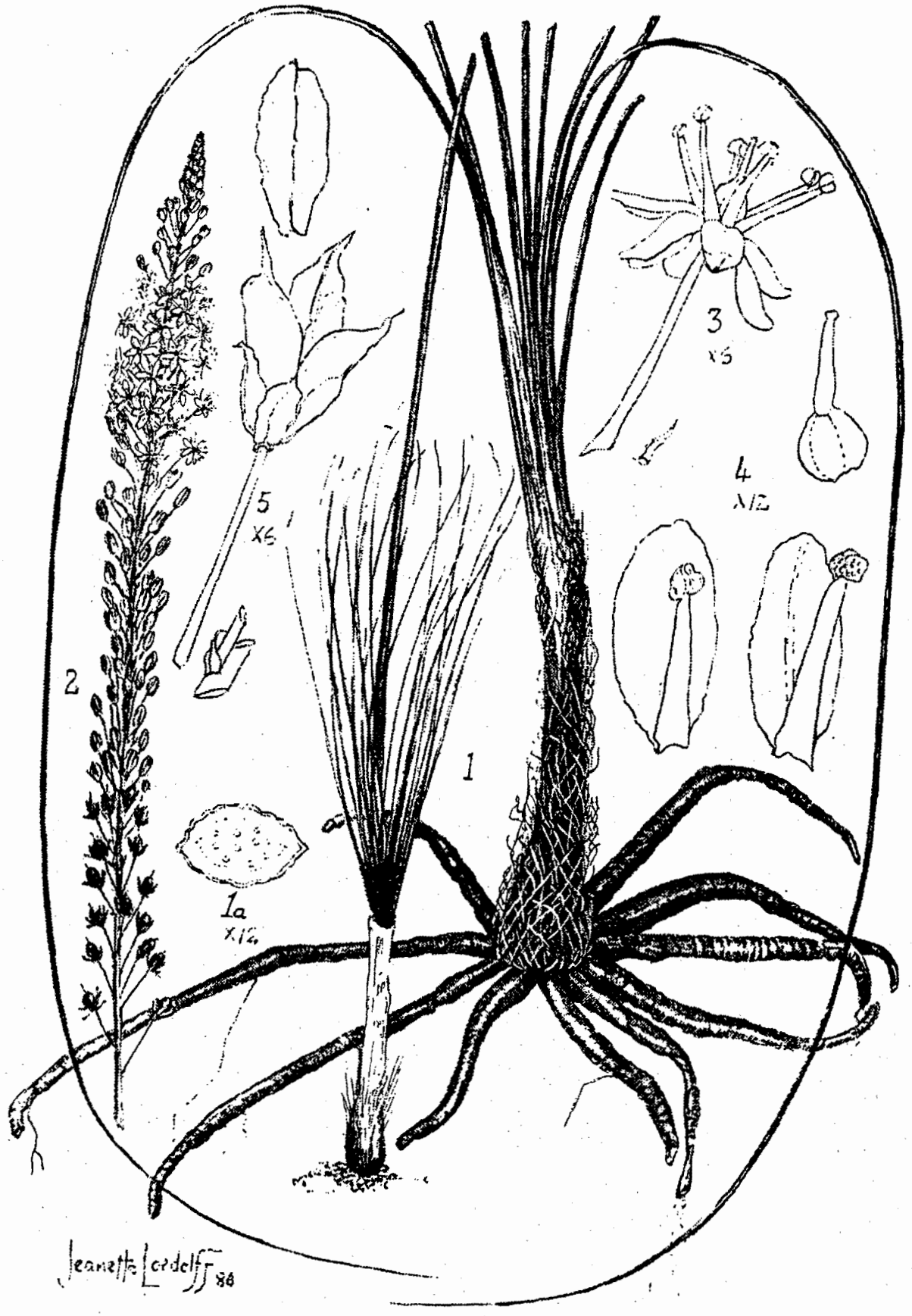


Figure 1. Bulbinella divaginata P.L. Perry. 1. Vegetative parts of the plant showing length of leaves at flowering and when fully grown; 1a. Transverse section through leaf. 2. Inflorescence. 3. Flower, side view. 4. Tepals, stamens and gynoecium separated. 5. Fruit and separate seed. (Perry 3103. Photocopy of colour plate prepared for future publication.)

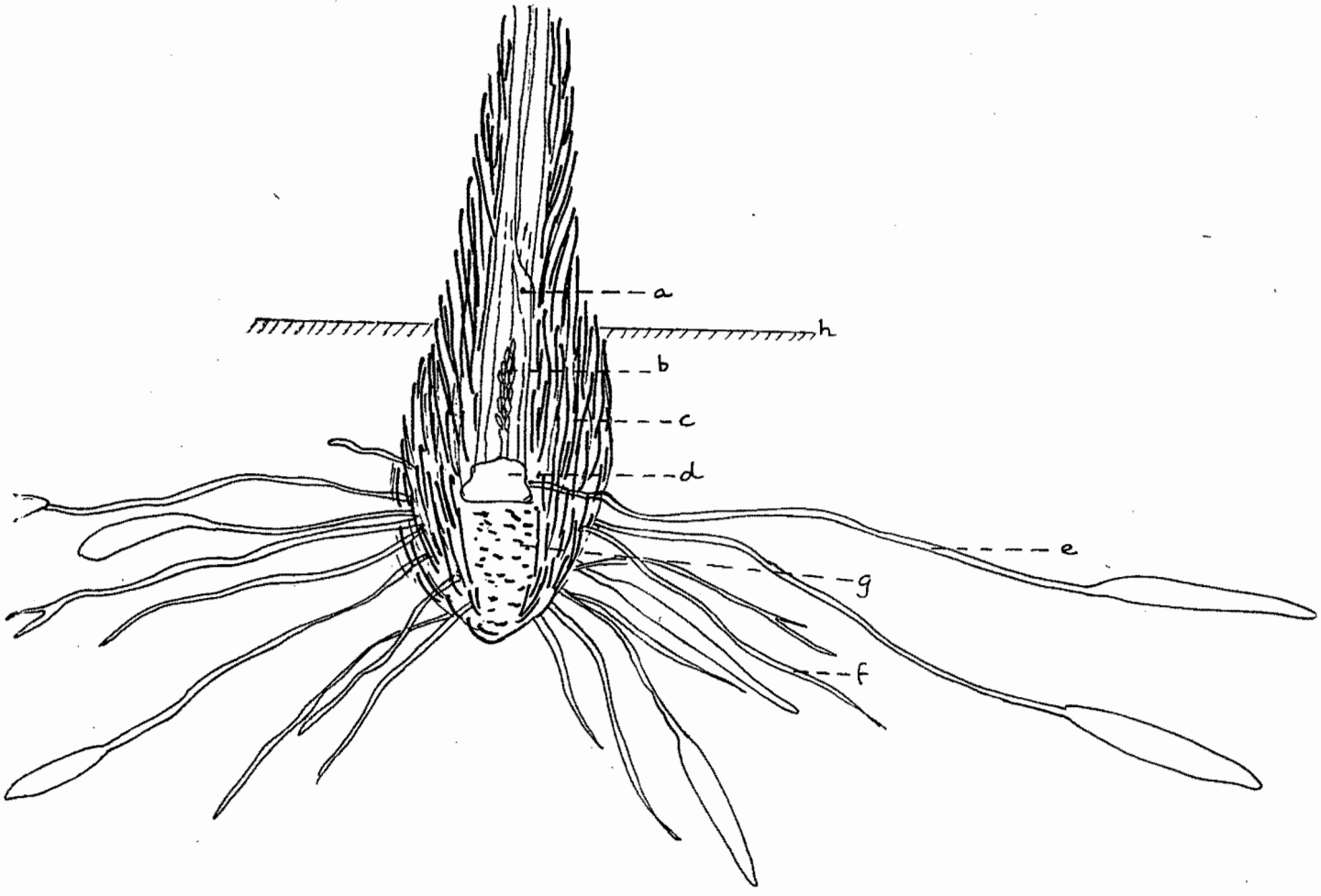


Figure 2. Section through the basal part of Bulbinella cauda-felis as seen in mid July. a = base of current season's foliage leaves, b = developing inflorescence, c = old sheathing fibres, d = stem disc or erect rhizome, e = current season's root with swollen apex, f = remains of root of previous year, g = spongy remains of stem discs of previous years, h = approximate position of ground level.

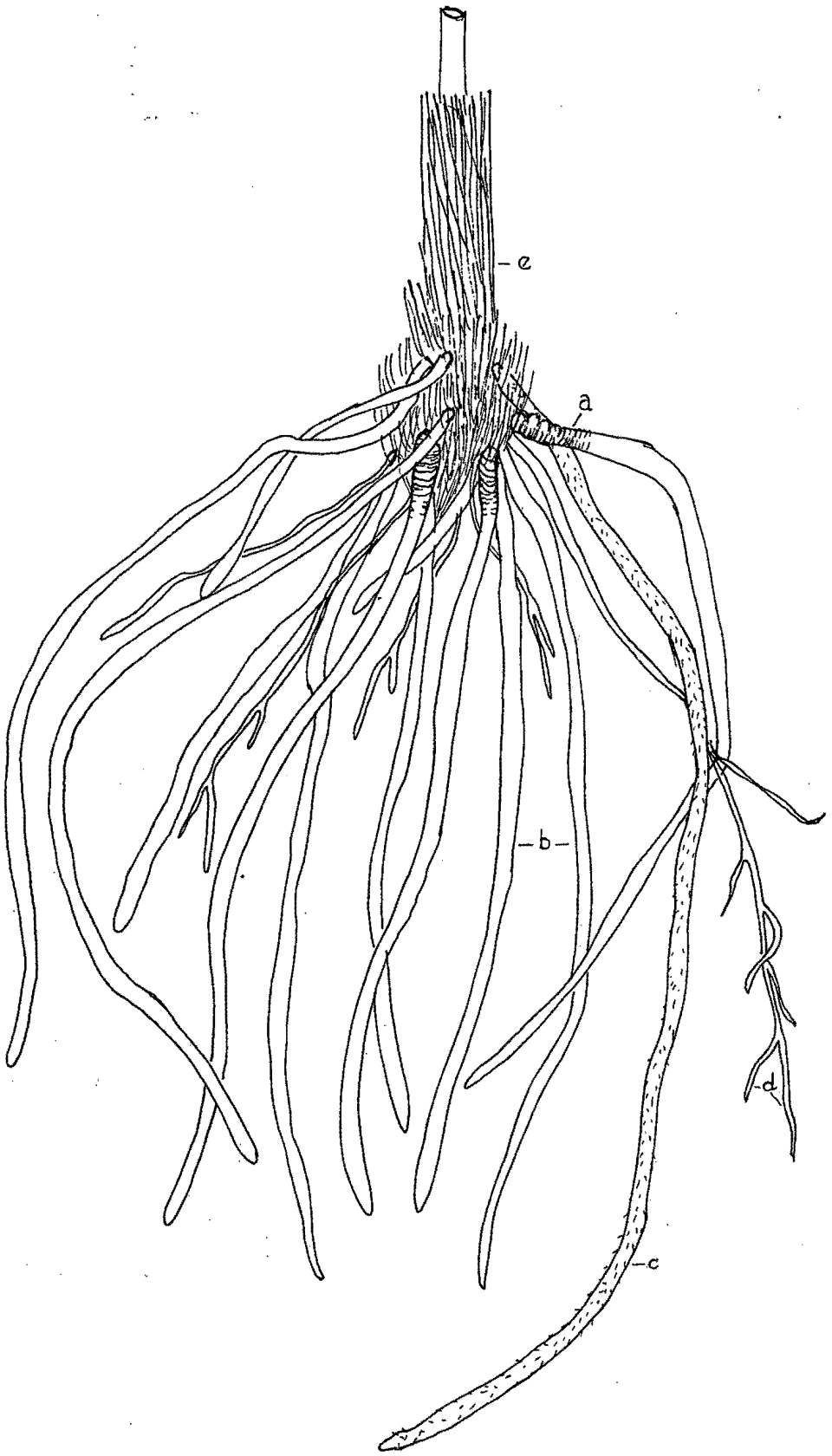


Figure 3. Root system of Bulbinella nutans from plant grown in cultivation. a = wrinkled contractile part of root, b = thickened roots, yellow-orange coloured, c = microscopic fine white root hairs, d = thin absorptive roots, e = basal sheathing fibres.

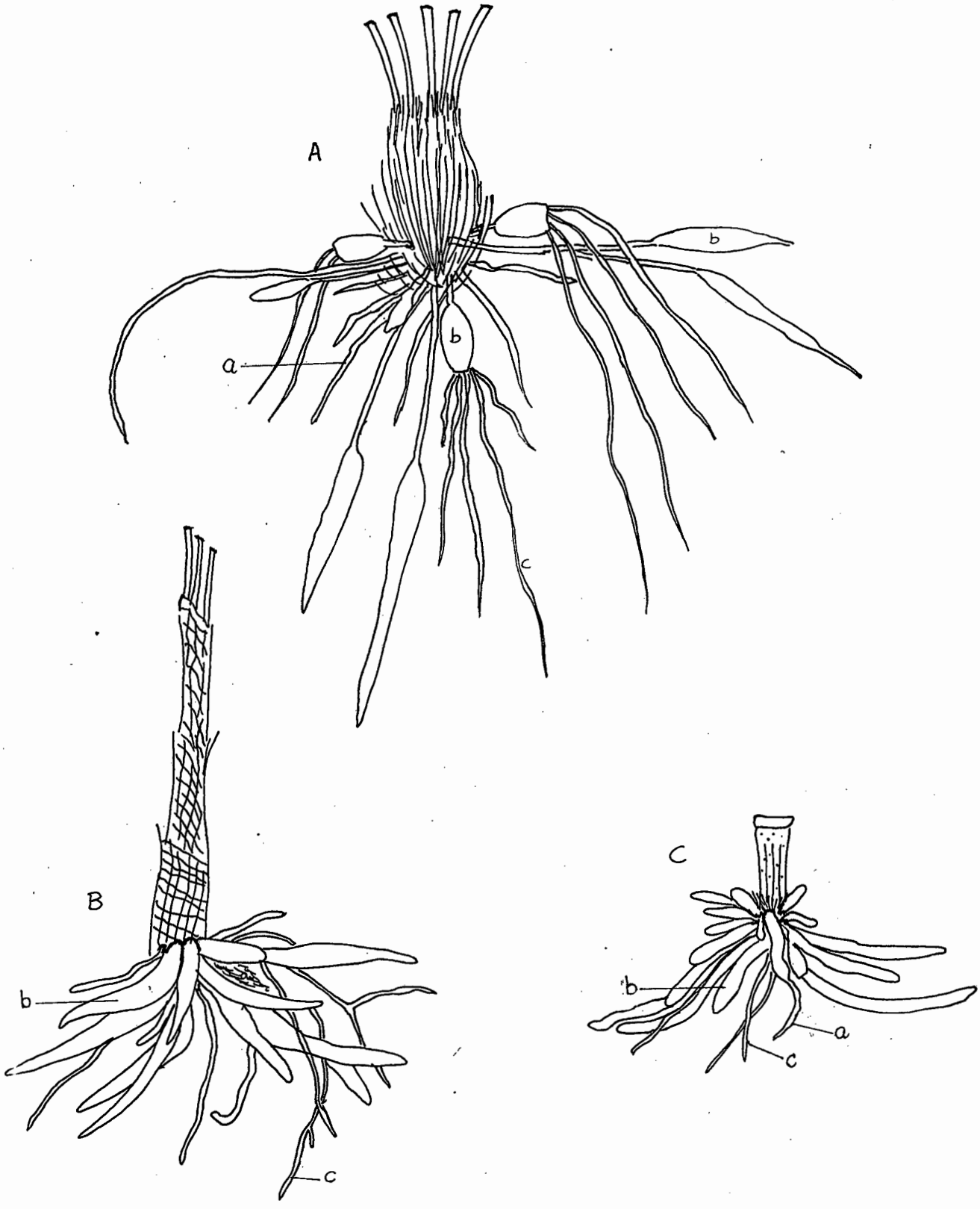


Figure 4. Root system of Bulbinella triquetra A, B. divaginata B, and B. gracilis C. All as seen in July from plants in cultuvation. a = shrivelled remains of old roots, b = swollen portions of roots, c = thin absorptive roots.

Three stages in root growth, covering three seasons can clearly be seen towards the end of the growth period. The newly forming swollen roots arise on the upper part of the sheath; they are light in colour and may appear woolly from a dense covering of root hairs. The previous season's swollen roots become darker skinned and numerous thin flexuose laterals arise from them. In between are the remaining empty skins of roots from the year before in which food stores have been used up. Rudimentary swollen roots may sometimes be seen growing erectly on the inside of the leaf base where they receive protection in the early stages of growth.

5.3 Stem

This is reduced to a small, solid subglobose structure resembling a miniature corm, at most 10 mm across. This appears to last for one year only and at the end of the growing season a new stem is formed on top of the old one. This leaves the old stem disintegrating and forming a spongy mass underneath. A bud on the upper part of the stem develops into the new aerial part of the plant. Sometimes a lateral bud may develop so that the plant gradually forms a clump.

5.4 Fibrous sheathing neck

When the foliage leaves die at the end of the growing season the basal vascular strands remain and gradually become hardened forming a brown, fibrous or bristle-like neck making a tough protective cover for young roots and shoots. These layers remain for a number of years and possibly protect the delicate primordia and stem from dessication during dormancy in the dry summer season and from being eaten by predators.

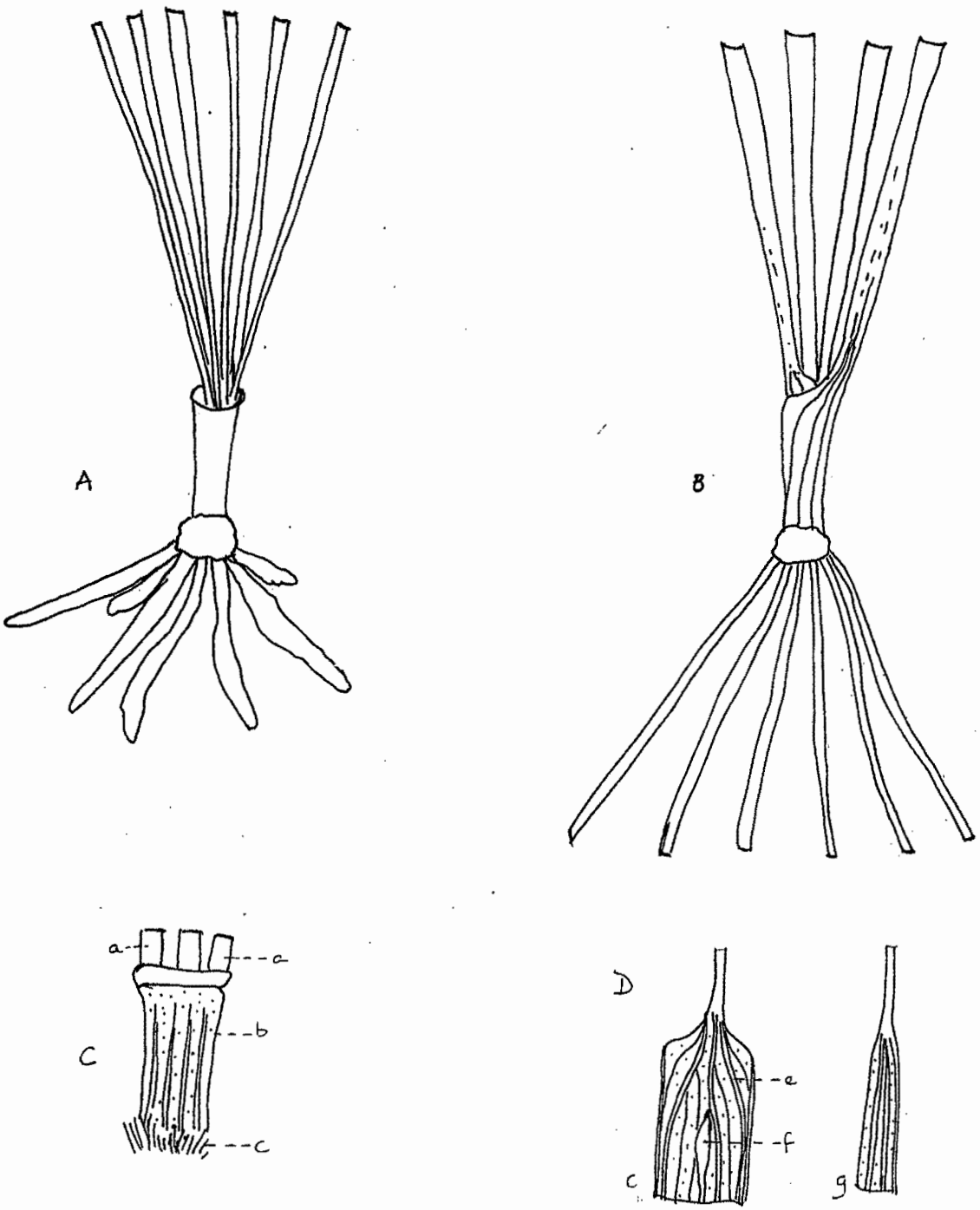


Figure 5. The structural difference between a cataphyll, A and sheathing leaf bases, B. Detail of cataphyll of Bulbinella gracilis C and sheathing leaf bases of B. triquetra D. a = base of foliage leaves, adaxial side, b = cataphyll, c = vestigial fibres, d = circular sheath from outer leaf cut and opened out, e = veins showing clearly on white sheath, f = young root forming, g = broadened base of inner leaf not completely sheathing.

These sheaths form a useful diagnostic character as their nature, such as tough, straight and bristle-like or fine, soft and reticulate, appears to be constant within a species. Most of this fibrous sheath is hidden below ground and is frequently missing, together with the roots, from herbarium specimens.

5.5 Leaves

The bases of the leaves and peduncle are held together by a hyaline sheath formed in one of two ways which is characteristic for the species. The leaf bases themselves may be expanded to form membranous wings which completely encircle the peduncle and other leaf bases. Sometimes all leaves of the plant are basally sheathing or only the outer bases are completely encircling and the inner leaves have gradually smaller wing extensions. In other species a completely separate tubular membrane is formed and the bases of foliage leaves are not sheathing. The terms squama and cataphyll have both been applied to such a sheath. Obermeyer in her account of Trachyandra (1962) uses the term "squamae" considering "basal rudimentary sheaths" to be too cumbersome and "prophylls" too vague. In this genus the sheaths are scale-like. The term cataphyll (lower leaf) is frequently used in Europe for such a structure as is clearly shown in Nordenstam's monograph on Ornithoglossum (1982) and so cataphyll will be used in this account where a completely separate sheath is formed.

Zahlbruchner, in his description of B. punctulata noted that the sheaths were "basally purple-violet dyed". A similar purple stain has been observed in other species, in particular B. cauda-felis and B. graminifolia. Although it is a characteristic seldom discernable on herbarium specimens, from a study of living collections it appears to be

confined to a few species and so could have some diagnostic significance.

Leaves are produced annually, dying down at the end of the growing season. Few to several erect, linear leaves arise directly from the upper side of the reduced stem. In the more narrow leaved species leaves tend to be of a similar length and width whereas with the broader leaved species there is a range in size usually with the outermost leaf being short the second and third leaves being the longest and broadest and the innermost being shorter and narrower. In the latter group the broader leaves are normally canaliculate with the inner leaves sometimes being more semi-terete.

Glabrous leaves are the most common but very occasionally leaves may be sparsely and irregularly covered with fine longish hairs. More frequently the margins of leaves produce irregularly spaced, tiny transparent teeth giving a rough feel to the sides of the leaf. This is found mainly with the more narrow semi-terete leaves, but the degree of denticulation does not always appear constant within a species. A degree of succulence is found in some species in particular in B. gracilis with its fleshy terete leaves, and in the B. nutans - B. latifolia complex.

5.6 Inflorescence

The simple unbranched and dense raceme is situated at the end of a comparatively long, erect peduncle. Some variations in size and shape due to the varying numbers of flowers and length of pedicels can be observed and these are of some value for identification purposes. The peduncle is always terete and naked. Normally only one scape appears to be produced per plant each season but in cultivation with plentiful watering two or

three inflorescences have been seen per plant in some species and this may be normal in the wild in good seasons.The 50--500 flowers are frequently tightly packed and mature progressively up the inflorescence. In a very floriferous raceme fruits, flowers and buds may be observed at the same time. Buds are held erect and close to the rachis but pedicels become spreading in the flower stage so that the open flowers face outwards. As the fruit develops in most species the pedicel returns to the more erect position so that the capsule is held upright. B. gracilis is an exception in which the pedicels remain patent.

5.7 Pedicels

Each bract supports only one pedicel and pedicels are articulated only with the tepals. These features distinguish Bulbinella from related genera such as Chlorophytum and Anthericum. If a flower is not fertilised it normally falls off completely at the apex of the pedicel. Pedicels vary in length from 5 mm to 25 mm. They are always very narrowly terete and in flower the colour is similar to that of the tepals, later turning green as the fruits develop.

5.8 Bracts

Some variation in size and shape of bracts occurs in different species giving a possible character for identification in the reproductive stage. The smallest bracts, about 1 mm long, occur in B. gracilis and the longest, up to 12 mm long, in B. nutans and B. cauda-felis where the attenuate apex is very conspicuous in the bud stage. In species such as B. trinervis the distinctive truncate-shaped bract appears to be quite consistent in all collections and is thus a useful character for identification purposes. In other species, such as B. triquetra, the length of the attenuate apex and

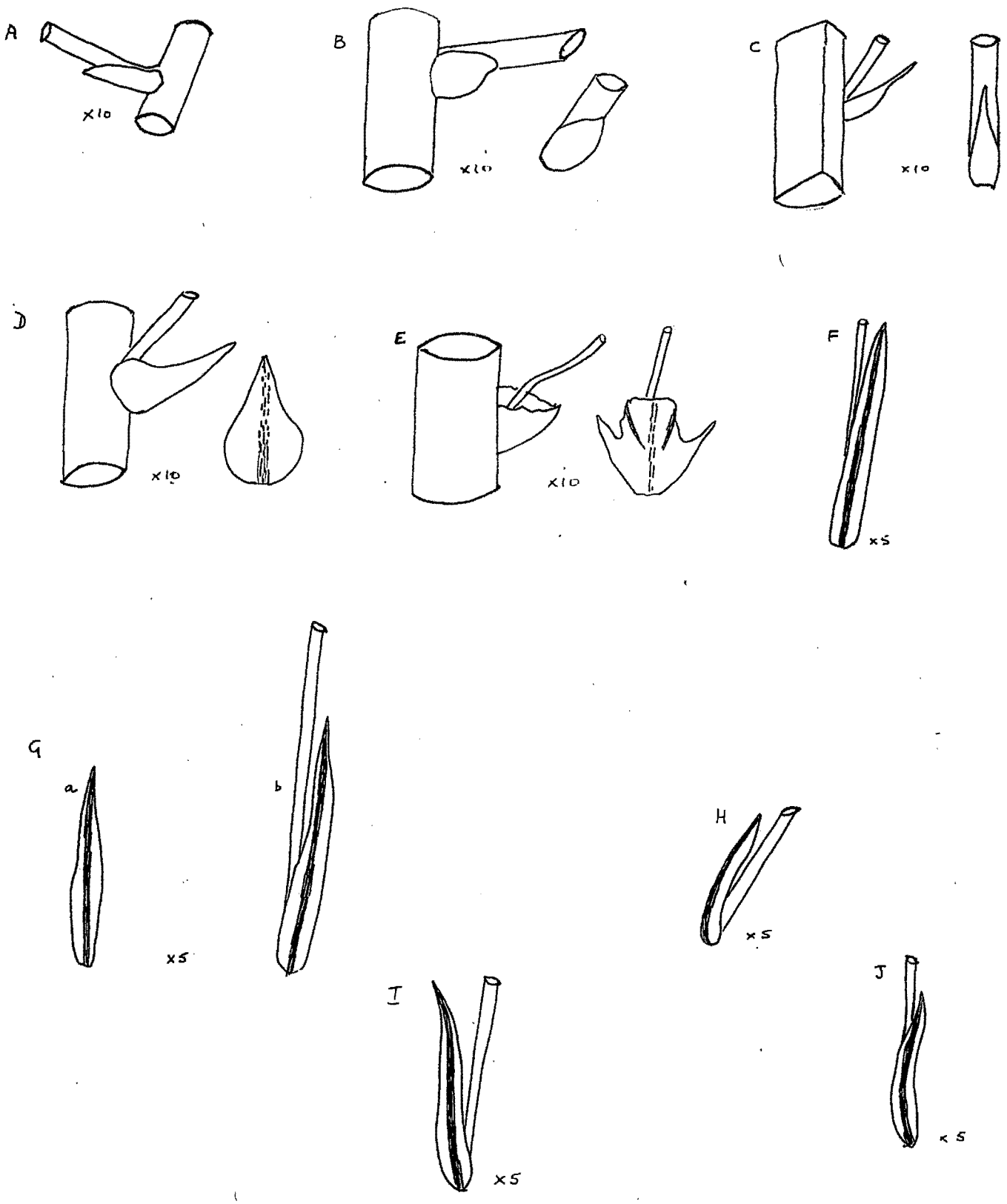


Figure 6. Bracts of Bulbinella gracilis A, B. confusa B, B. divaginata C, B. chartacea D, B. trinervis E, B. nutans var. turfosicola F, B. latifolia var. latifolia G. a = typical sized plant from Grootvlei, b = extra large plant from Kamiesberg. B. elata H, B. nutans var. nutans I, B. latifolia var. doleritica J.

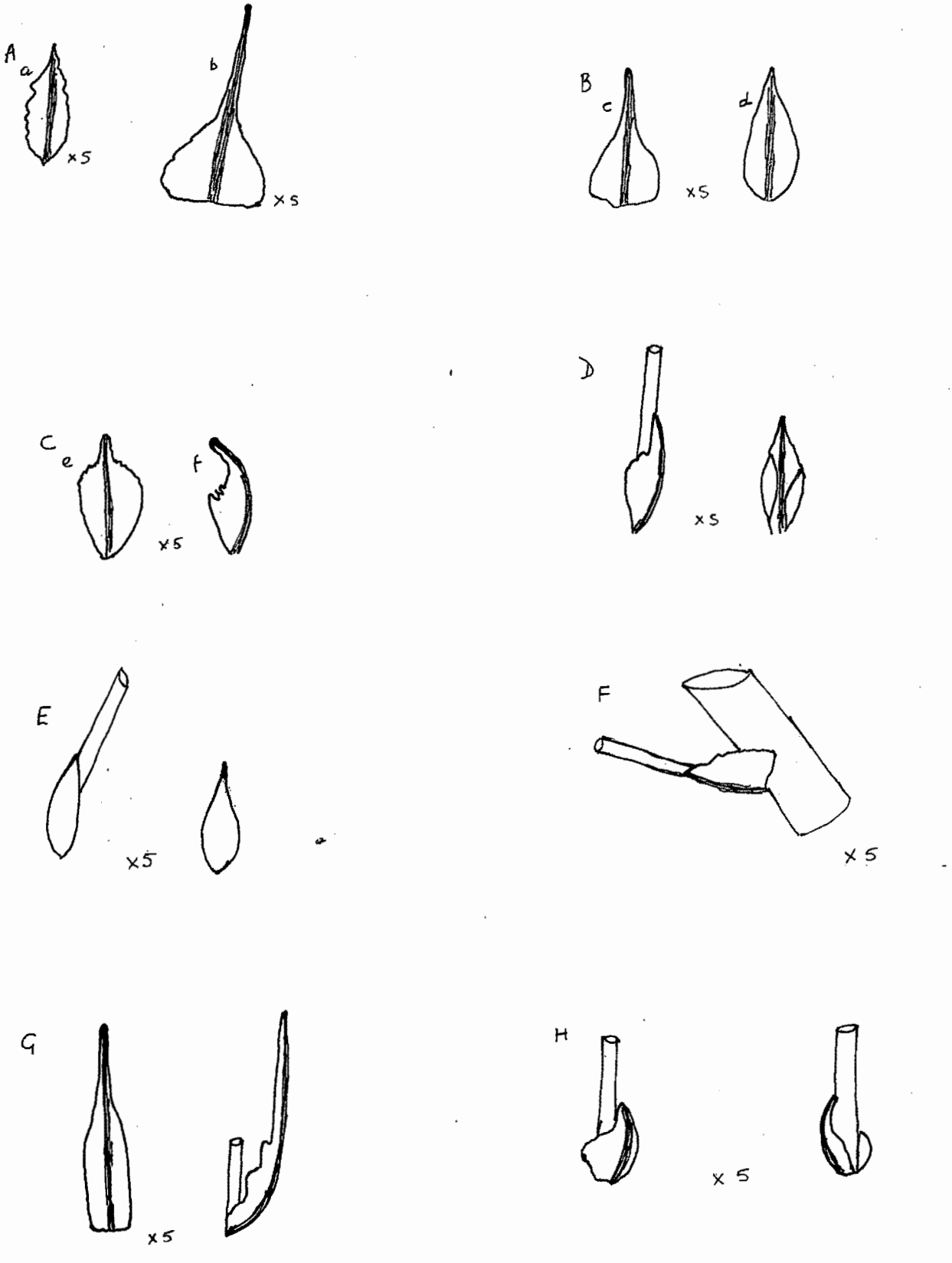


Figure 7. Bracts of Bulbinella triquetra A, a = from Biedouw Valley, b = from Darling, B. elegans B, c = lower, d = upper, B. eburniflora C, e = lower, f = upper, B. barkerae D, B. punctulata F, B. cauda-felis G, B. potbergensis H.

thus the length of the whole bract is very erratic and therefore it is a poor character for identification. No distributional clines have been observed in this variation. In several species such as B. gracilis, B. divaginata and B. nutans the margin of the bract is entire, but in other species it is variously and irregularly serrate.

5.9 Flowers

Species differences in flowers are largely limited to colour and a slight range in size. The perianth in all species has an open stellate shape with the six tepals joined at the extreme base. The six stamens are joined to the base of the tepals and regularly arranged, half spreading and central to each tepal. The superior ovary is centrally placed between tepals and stamens with the style extending erectly. Size of flowers ranges from 8mm to 11 mm in diameter, but this variation may be seen within one species depending on growth conditions and consequent size of plants. The tepals and other flower parts are most commonly yellow, but white segments with a pale pink keel and pink bud are also frequently met with. Creamy coloured flowers and brownish or greenish buds, and more rarely orange flowers are also found. Although most species have flowers of one colour only, in a few such as B. elegans and B. nutans, two or more different colour forms occur. The colour forms apparently have distinctive allopatric distribution ranges. Mixed populations of different colour forms have not been observed. Tepals are equal to sub-equal in size and shape and are commonly elliptic. The greatest length the tepals reach is 6 mm. Tepals frequently show a glittering appearance caused by large, turgid epidermal cells. Both sets of tepals are single nerved. The nerve usually shows up clearly either as a slight variation in colour, such as pale pink on white, or as a distinct thickened area.

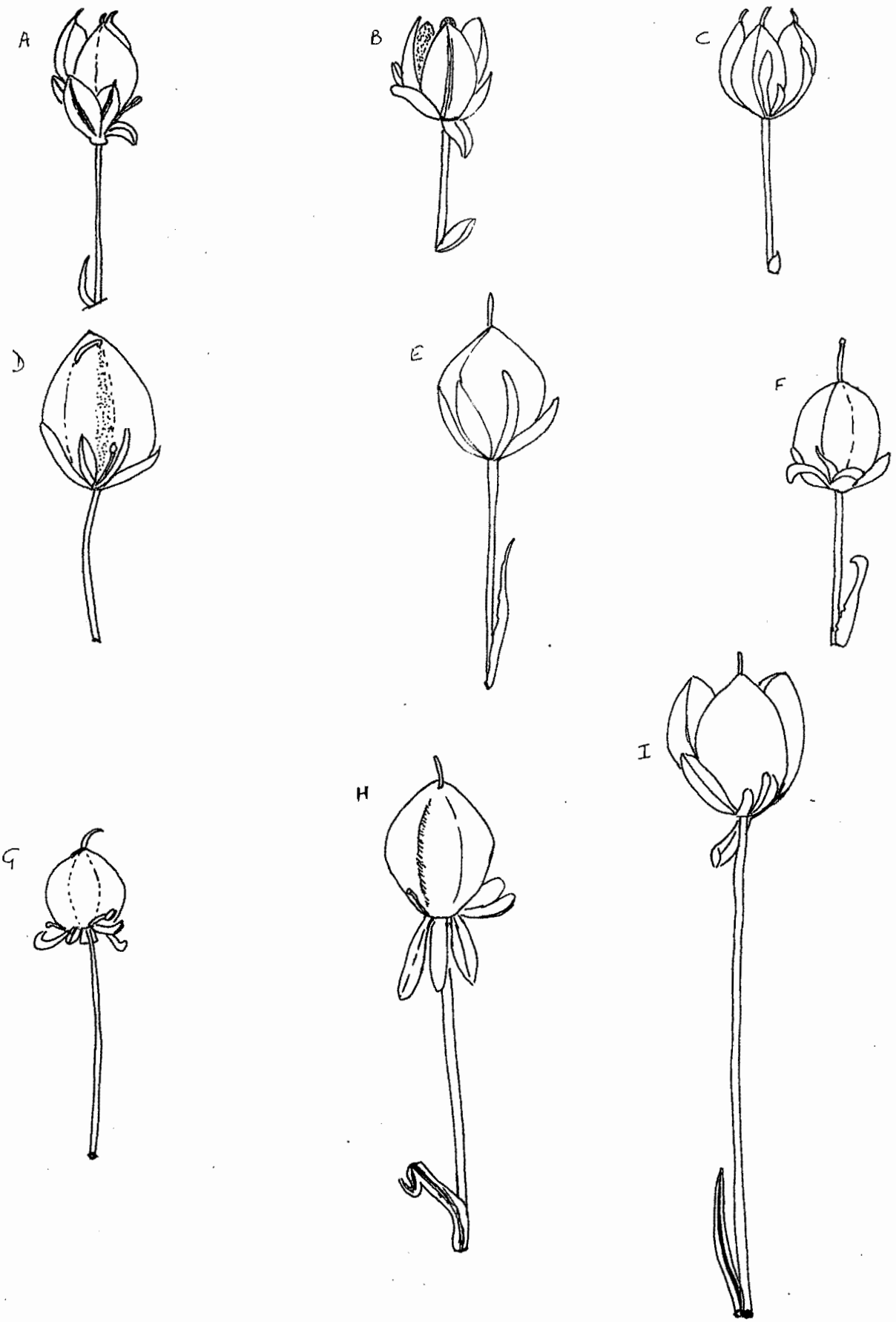


Figure 8. Fruits of Bulbinella divaginata A, B. chartacea B, B. trinervis C, B. punctulata D, B. cauda-felis E, B. barkerae F, B. elata G, B. nutans var. nutans H, B. nutans var. turfosicola I. All x 4.

5.10 Androecium

The six stamens show very little variation, always being adnate to the base of the segments and held in an equidistant erecto-patent position surrounding the ovary. Filaments are glabrous, narrowly subulate or filiform and two thirds or more the length of the segments. The colour of the filaments is usually the same as the tepals. The anthers are small, sub-rotund, dorsifixed and versatile.

5.11 Gynaecium

The tri-locular ovary is very characteristic for the genus, always containing two ovules lying side by side lengthways. The ovary wall is normally green, sometimes with a reddish brown tinge. The ovary is globose to ovoid but the small size of between 1 mm and 1,5 mm makes clear definition of shape difficult. The style is narrowly terete and erect and the stigma apical and minutely papillate, and of the dry type (Dahlgren & Clifford 1982) i.e. without copious fluid secretion.

5.12 Fruit

This is a dry sub-globose or ovoid capsule, brittle or more papery, loculicidally dehiscent. Size varies from around 4 mm long to 7 mm long in the different species and shape may be more or less globose or distinctly ovoid according to species. The texture and colour of outer walls may be of taxonomic significance. The outer walls may be chestnut brown, quite thick and brittle in some species such as *B. nutans*, and in other species such as *B. cauda-felis* a light fawn colour, more papery thin and not so

freely dehiscent. Tepals are persistent, usually fitting closely around the capsule but sometimes becoming more shrivelled and pendant. In all South African species the capsule is clearly sessile. After a few days unfertilized flowers wither and fall off completely from the apex of the pedicel.

5.13 Seed

The three to six seeds lie collaterally and are shaped to fit neatly into the capsule, the outer edge being rounded and the two inner edges straight. Seeds are thus three-angled. Each seed may form a one-sixth sector of a circle or a third, depending on whether both seeds in the locule develop or only one. The shape is very similar in the different species but size may vary from 1,5 mm to 7 mm long. The surface is slightly rugose and the colour may be a mat black or greyish black. A membranous extension formed from an extra covering layer which is easily removed, leaving the black testa, is obvious in some taxa and the width of the wing-like extension could be diagnostic. Although the covering usually has a dark brown to greyish black colour, in B. divaginata it is yellowish orange. According to Dahlgren and Clifford (1982) arillar structures are well developed in subfamily Asphodeloideae where they arise as an annular invagination at the distal part of the funicle enveloping the seed to a variable extent during its development as if it were a "third integument". In Bulbinella the integument is only 2 cell layers thick. The black pigment in the seed coat is phytomelan, an opaque, brittle, charcoal-like substance found only in the order Asparagales. It is restricted to the outer epidermis of the outer integument and is chemically very inert (Dahlgren & Clifford 1982).

6. PALYNOLOGY

According to Cranwell (1953) in her studies of New Zealand pollen, "the pollen of Chrysobactron (Hook. f.) is monocolpate, ellipsoidal, often assymetrical - wider at one end or flattened proximally. The furrow is very long, typical to one side of the grain. Forked furrows occur in Chrysobactron and in Bulbinella. In B. setosa for example the broad furrow is drawn out towards the angles of the grain. The exine is reticulate with very narrow luminae."

Not all of these characteristics have been observed in the present study. The long furrow appears consistent in all taxa viewed but a forked furrow has not been observed. The considerable variation in size is shown in table 1, and in shape, is shown in the photographs, [Figures 9 & 10]. Surface sculpturing is also quite variable. The two New Zealand species looked at [e.g. B. hookeri, Figure 9, A-B] show close affinity to some South African species such as B. ciliolata as regards shape and sculpturing.

It would appear from the pollen grains studied that this could be a useful diagnostic character. Further studies would be needed to show variation within each species to confirm this diagnostic value.

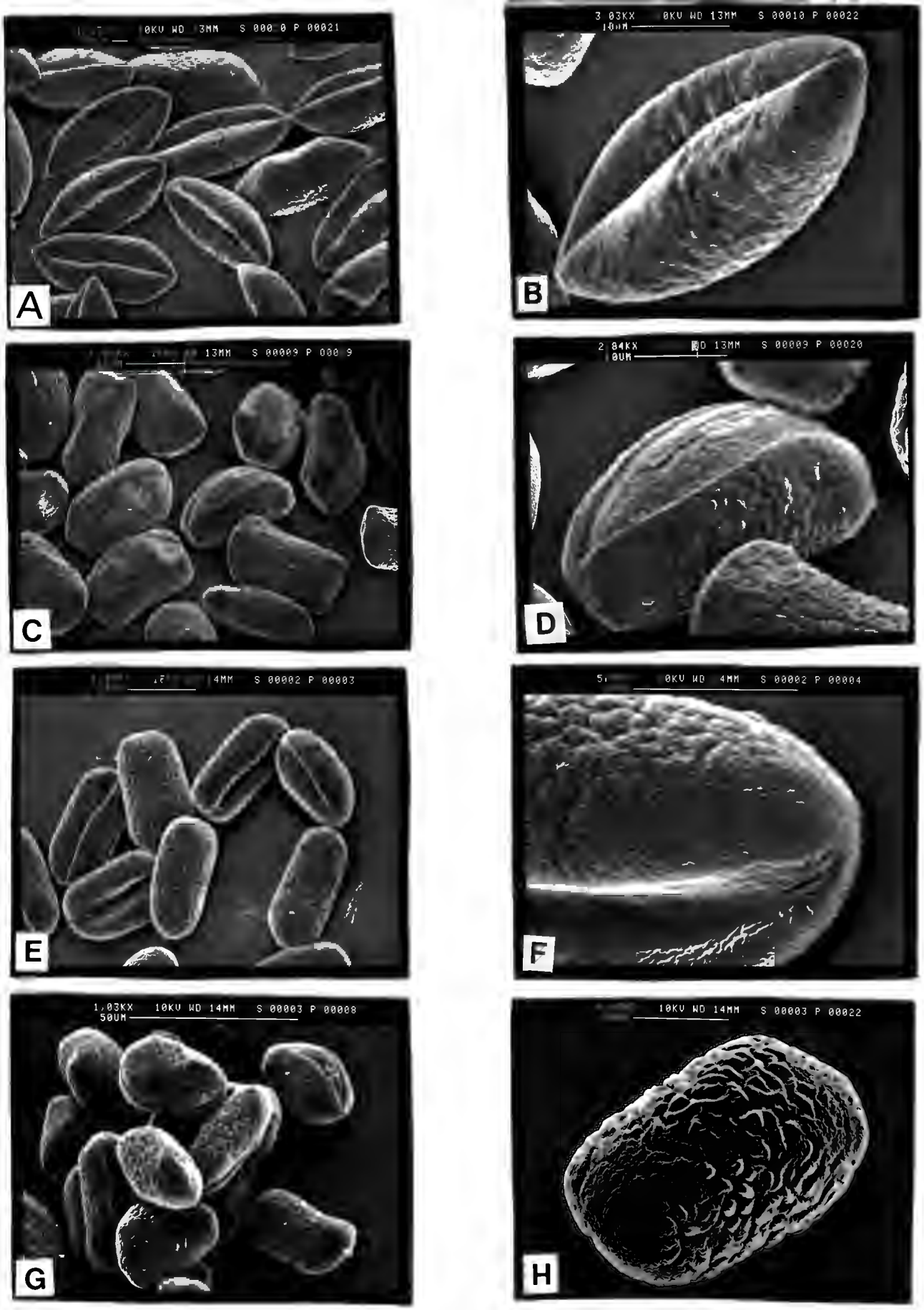


Figure 9. Pollen grains of *B. hookeri*, Sneddon s.n. (A-B), *B. latifolia* var. *doleritica*, Perry 3472 (C-D). *B. elata*, Perry 3132 (E-F), *B. nutans* var. *nutans*, Perry & Snijman 2146 (G-H); A, C, E, G, x 1000; B, D, H x 3000; F x 5000.

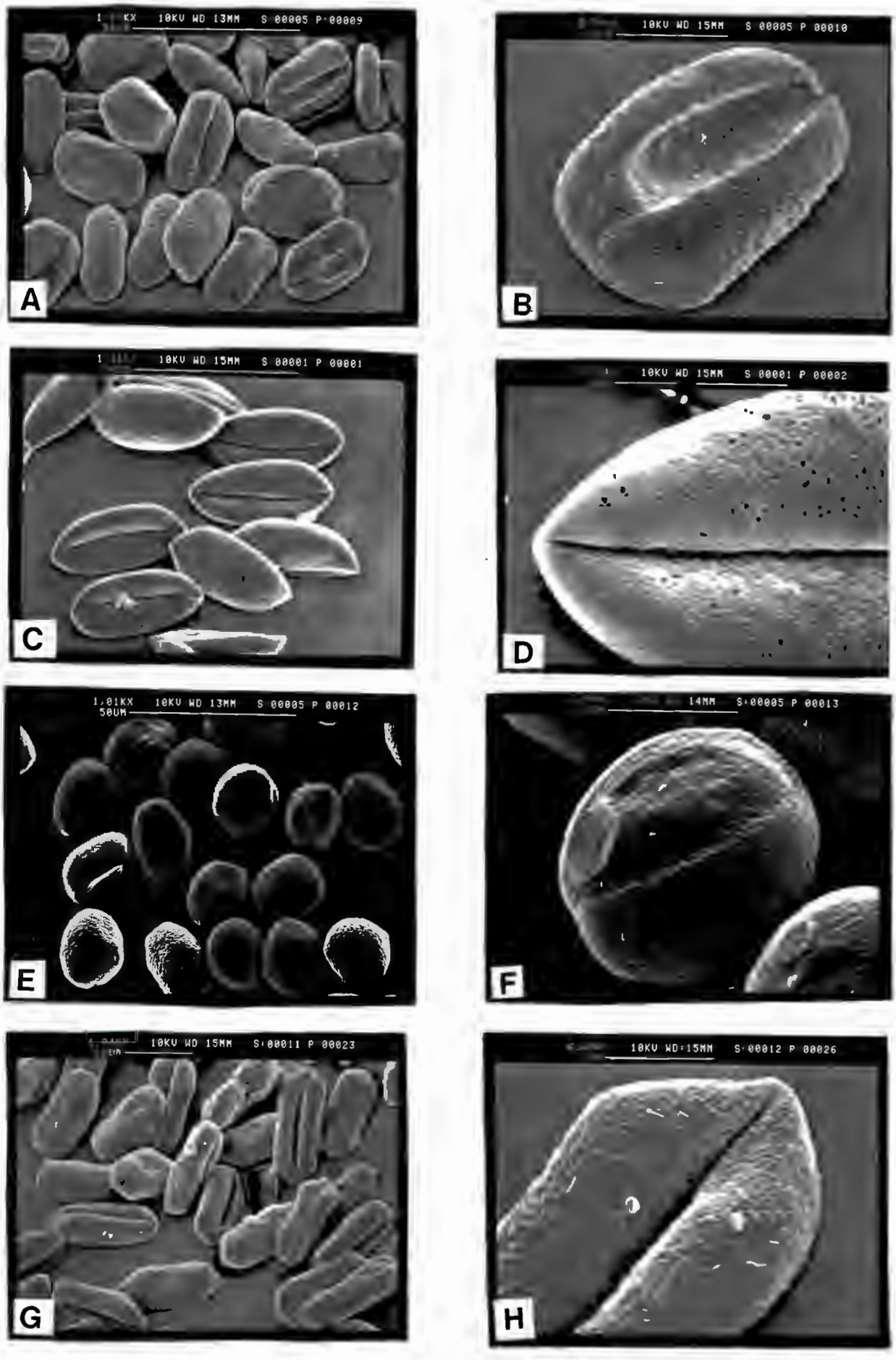


Figure 10. Pollen grains of *B. eburniflora*, Perry 3469 (A-B), *B. ciliolata*, Perry 1127 (C-D), *B. divaginata*, Perry 3265 (E-F), *B. gracilis*, Hall 186 (G-H); A, C, E, G x 1000; B, F x 3000; D, H x 5-6000.

Table 1: The average sizes of pollen grains of Bulbinella species.

Species	Collector & Number	Average size
Bulbinella cauda-felis	Perry 3196	33 X 21 um
B. chartacea	Perry 3260	33 X 19 um
B. ciliolata	Perry 1127	42 X 18 um
B. divaginata	Perry 3265	21 X 19 um
B. eburniflora	Perry 3469	28 X 20 um
B. elata	Perry 3132	32 X 18 um
B. elegans	Perry 3335	33 X 18 um
B. graminifolia	Perry 3139	26 X 17 um
B. hookeri	Sneddon s.n.	42 X 19 um
B. nana	Bayer 1637a	25 X 17 um
B. nutans var. nutans	Perry & Snijman 2146	33 x 20 um
B. nutans var. turfosicola	Perry 3075	28 X 18 um
B. potbergensis	Perry 3343	27 X 18 um
B. punctulata	Perry 3140	30 X 17 um
B. trinervis	Perry 3107	35 X 15 um
B. triquetra	Perry 3226b	31 X 21 um

7. PRELIMINARY ANATOMICAL STUDY

Portions were taken from the central region of the leaf when plants were well-developed in late winter or spring, and preserved in FAA for later sectioning. Transverse sections were made of 19 collections representing nearly all taxa. Sections were made using a freezing microtome and then placed in 70% alcohol before adding analine sulphate and iodine as a temporary stain. Sketches were made under low and high magnification of a light microscope to show the general outline and relative positions of the main tissues [Figures 11-13]. From this preliminary study it was clear that considerable variation existed in leaf shapes and arrangement of tissues.

At this stage Dr Baijnath requested material to carry out a detailed comparative anatomical study for his work on the family Asphodelaceae. His work will include SEM studies of the leaf surfaces as well as longitudinal and transverse sections. He will also be covering the New Zealand species of Bulbinella and also Trachyandra, having previously dealt with Bulbine in both Africa and Australia. It therefore seemed of greater value to collaborate with Dr Baijnath rather than continue with my own more limited study. His results are not likely to be published in time to review in this thesis.

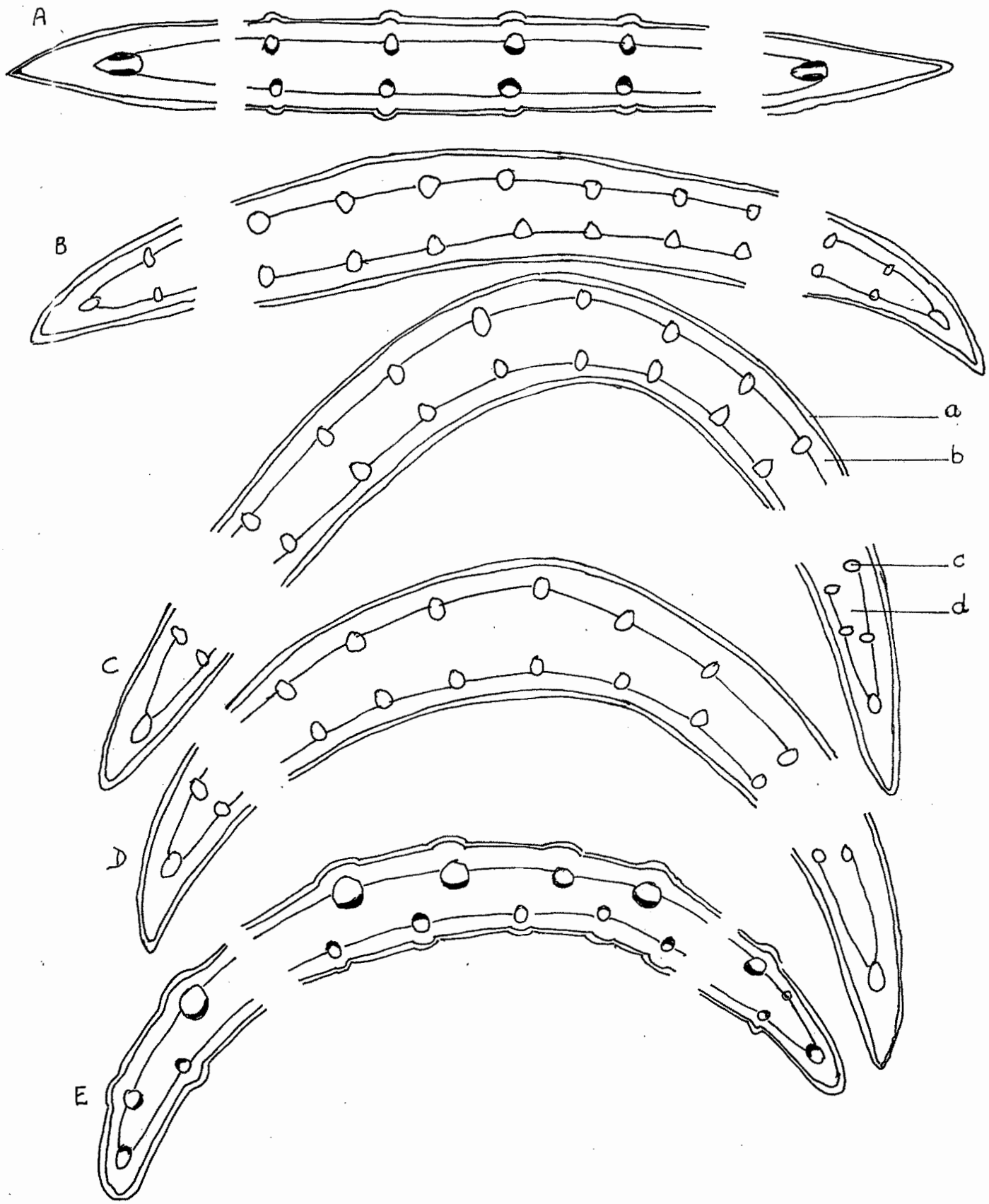


Figure 11. Outlines of transverse sections of leaves of Bulbinella elata A, (Perry 3132); B. latifolia var. latifolia B, (Perry 3169); B. latifolia var. doleritica C, (Buhr s.n. Karoo NBG 314/72); B. nutans var. turfosicola D, (Perry 3079); B. nutans var. nutans E, (Perry 3157). Schlerenchyma tissue shown black; a = epidermis, b = chlorenchyma, c = vascular bundle, d = parenchyma. (All approx. X 20).

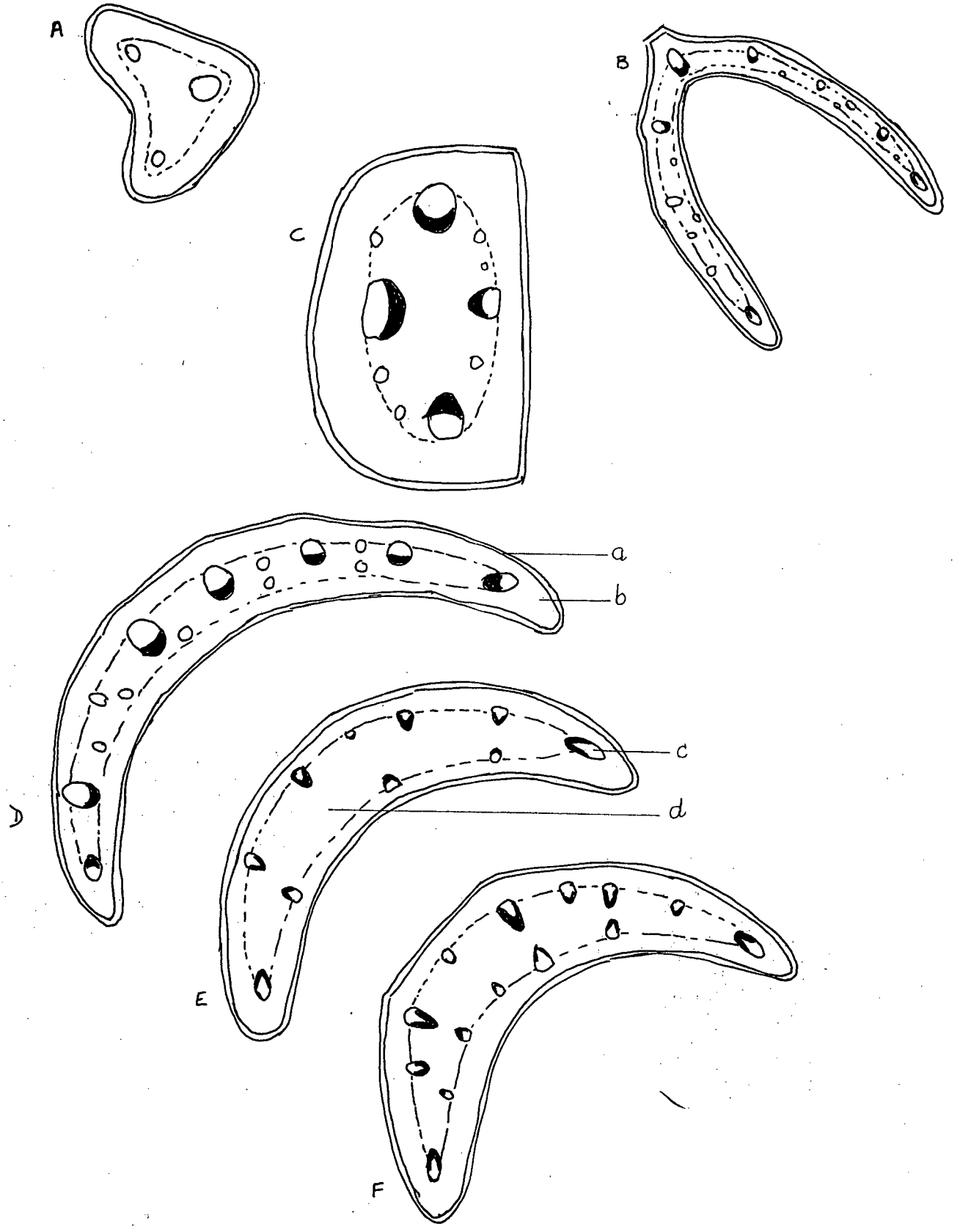


Figure 12. Outlines of transverse sections of leaves of Bulbinella triquetra A, (Perry 3144); Bulbinella graminifolia B, (Perry 3139); B. elegans C, (Perry & Snijman 2324); B. barkerae D, (Perry 3219); B. cauda-felis E, (Perry 3172); B. punctulata F, (Perry 3140). Schlerenchyma tissue shown black; a = epidermis, b = chlorenchyma, c = vascular bundle, d = parenchyma. (B, E & F X 20, D X 30, A & C X 20).

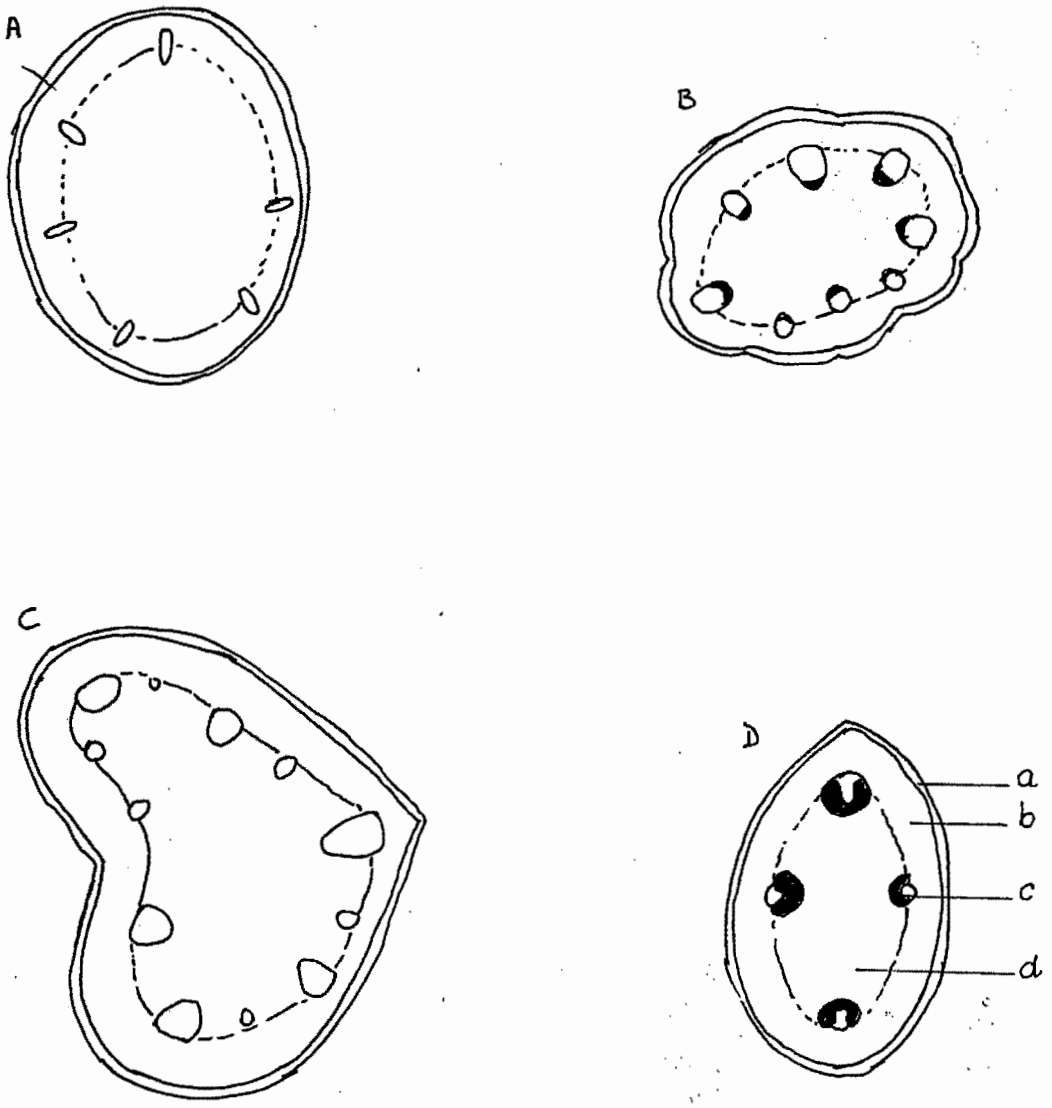


Figure 13. Outlines of transverse sections of leaves of Bulbinella gracilis A, (Perry 1077); B. divaginata B, (Perry 3105); B. chartacea C, (Perry 3260); B. trinervis D, (Perry 3107). Schlerenchyma tissue shown black; a = epidermis, b = chlorenchyma, c = vascular bundle, d = parenchyma. (A & C X 20, B & D X 40).

8. VEGETATIVE REPRODUCTION

This does not appear to be an important method of reproduction. In several species lateral buds develop so that older specimens may eventually consist of a cluster of up to seven loosely attached complete plants each with roots, leaves and inflorescence. It is not clear whether clumps will later form separate plants. Species where clump formation is most commonly found are B. nutans, B. cauda-felis and B. triquetra.

9. SEEDLING DEVELOPMENT

Germination is of the hypogeal type in which the cotyledon does not become green. It appears to fall into type C as described by Dahlgren and Clifford (1982). In this type the plumular leaves appear through a collar formed about the edge of the cotyledonary pore. This may be compared to the formation of the coleoptile in grasses. In some species of Bulbinella the collar appears to be very short, whereas in others it becomes elongated [Fig. 8 - A, B & C]. Collar length may be correlated with the formation of separate cataphylls compared to sheathing leaf bases, but this requires further detailed study.

After about three months 2-3 foliage leaves can be seen and the outer one may have a clearly developed sheathing base with adventitious roots arising from the base [Fig. 8 - D & E]. By the end of the first growing season swollen roots have developed and the first layer of sheathing fibres is clearly visible [Fig. 9 - B].

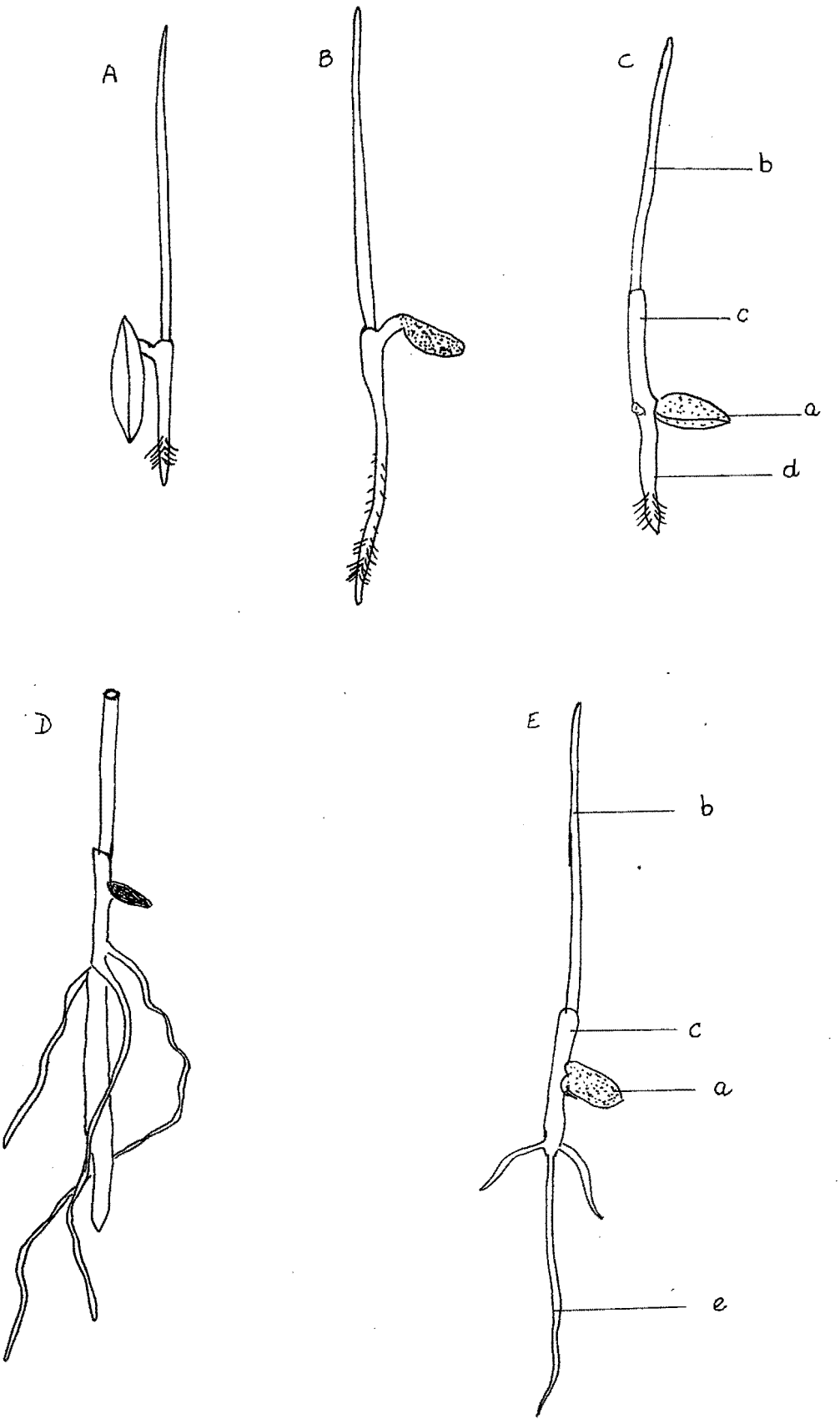


Figure 14. Stages in development of seedlings. Bulbinella divaginata A, B. trinervis B, and B. cauda-felis C at 3-4 weeks. B. elegans D and B. nutans var. nutans E at 2-3 months; a = seed, b = plumular leaf, c = collar formed about the edge of the cotyledonary pore; d = radicle, e = young adventitious roots. (All X 2).

Figure 15. Later stages in development of seedlings. Bulbinella nutans var. nutans A at about 4 months. Bulbinella cf cauda-felis at 6 months. B. cauda-felis at beginning of second season. a = storage roots forming at the end of the growing season, b = shrivelling storage roots at the beginning of the growing season. (All natural size).

10. POLLINATION BIOLOGY

Pollination has been observed on plants in cultivation, especially on the orange flowered B. latifolia var. doleritica, to be by honeybees who visit flowers on sunny days for pollen. No nectar has been found in any member of the genus. A variety of crawling insects which visit the inflorescences could also be responsible for pollination. Scent may be connected with pollination in some species which produce a distinctive, somewhat unpleasant, musty odour. This is particularly noticeable in B. eburniflora and B. barkerae. Although a similar somewhat musty odour has been noticed in some collections of some other species it was not possible to detect any odour in the majority of collections. The scent also appears somewhat ephermeral and may be connected with time of day or stage of development.

Blue scarab beetles and striped black and yellow beetles have been seen in considerable numbers on several occasions on B. eburniflora. Although they were observed to have been eating the flowers it is possible that they were also effective in pollination. Faegri & Van der Pijl (1979) describe beetle pollinated flowers as having few visual attractions, with no special shape, being generally large and flat or shallow bowl-shaped, and with dull colours, frequently greenish or off-white, a strong fruity or aminoid odour, easily accessible pollen and exposed sexual organs. These features are exhibited by many Bulbinella species but especially B. eburniflora with ivory coloured flowers and B. barkerae with off-white flowers.

11. BREEDING BIOLOGY

Limited breeding studies were carried out with a few species of *Bulbinella* by Horn (1962). The validity of the results is questionable as no voucher specimens were quoted and therefore the identities of the taxa concerned are uncertain. Identifications were carried out by "the Compton Herbarium at Kirstenbosch" and mention is made of a farm at Nieuwoudtville where "the Orange Bulbinella grows". As the only orange flowered *Bulbinella* has a very limited distribution it is fairly safe to assume that the farm in question was Glen Lyon and that *B. robusta var latifolia* (orange) refers to *B. latifolia* var. *doleritica* and that *B. robusta* is *B. nutans* subsp. *nutans*, the large yellow Bulbinella that is particularly common in the Nieuwoudtville area. Plants used for *B. robusta var. latifolia* (yellow) were apparently grown from seed from the National Botanic Garden at Kirstenbosch. As the only yellow flowered specimen in the Compton Herbarium that had been determined as *B. robusta var. latifolia* has the locality 'ex hort. Kirstenbosch' it is apparent that the original locality is unknown. From the broad leaves and other characteristics this specimen is now identified as *B. latifolia* var. *latifolia*, a species that grows frequently in marshy areas in the Kamiesberg district.

It was concluded that "cross pollination and most probably entomogamous cross pollination is the main and probably the only mode of pollination occuring naturally in *B. robusta* and in its variety *latifolia*. Plants from *B. triquetra* and *B. caudata* isolated from the population completely failed to set seed in the field, so that cross pollination seems to be the general mode of pollination in the field" (Horn 1962). It was not indicated in this particular case what isolation procedure was used but for other such experiments the racemes were covered with glassine bags.

No attempt has yet been made in the present study to carry out crossing experiments. However Horn's statements seem to be partially borne out by observations made on pot grown collections. When only one plant of a particular collection and species has produced an inflorescence no seed has set. Collections where more than one inflorescence, or another collection of the same species is in flower there have been varying amounts of seeds formed. On warm sunny days numbers of hive bees were observed flying indiscriminately between flowers of different plants for the collection of pollen.

Horn (1962) further states that "it is quite evident that an internal crossing barrier exists between B. robusta and its var. latifolia which should not exist between one and the same species." Although this species concept may be contentious in this case it is borne out by field observations at Nieuwoudtville Wild Flower Reserve where a stand of the orange variety of B. latifolia can be seen surrounded by the yellow form of B. nutans and yet no intermediates could be observed. The two taxa in question are clearly closely related. They do however show a number of clear differences that considering the limited variation within the genus as a whole, are deemed sufficient to place them in separate species.

Horn also mentions a mixed population of the yellow and orange forms of var. latifolia which was found to inter-cross freely and where a range of colours between the extremes of yellow and orange could be observed. He gives no indication of the locality of this population. However, Nieuwoudtville is the only area given where material of the orange coloured form was collected in their natural habitat. In 1983 the largest stand of

the orange Bulbinella on Glen Lyon farm, Nieuwoudtville was viewed. It was estimated that the population contained 250 000 plants. Yellow flowering plants amongst the orange were very rare and difficult to spot on this occasion. Although plants grown from seed collected from the orange Bulbinella showed variation in intensity of orange colour, they did not produce any yellow flowering plants. No crossing barrier was stated to exist between the yellow form of var. latifolia and its orange form but these occur naturally in habitats a long distance apart. In addition the type of habitat appears different: the yellow variety occurs along seasonal streams and damp seepage areas mainly in Table Mountain Group-derived soils, whereas the orange variety occurs only on flat areas on the interface between the red doleritic clays and lighter coloured dwyka tillite clays.

In his field observations Horn (1962) states "no hybrids could be observed" in any of the cases where populations of different species of Bulbinella grow in the same locality. While largely agreeing with this statement it must be pointed out that the names and colour forms he quotes reflect the considerable confusion in the taxonomy of the genus at the time his observations were made. In a number of instances more than one species of Bulbinella have been found growing together in a common habitat. On the slopes of Uitkyk Pass leading into Biedouw Valley for instance four distinctly different species occur. These have either been mutually isolated by very different flowering seasons e.g. B. divaginata flowering in April and B. caudafelis in September. Alternatively they are very obviously not closely related species because of size and other striking dissimilarities e.g. B. elata and B. triquetra. Although some species have

two colour forms, they are always in quite separate and often distinctively different habitats with different distribution ranges, e.g. B. elegans, and B. nutans var. nutans. No population has been observed by me with more than one colour form with the exception of the Orange Bulbinella B. latifolia var. doleritica and the rare yellow plant in its midst.

12. GEOGRAPHICAL DISTRIBUTION AND ECOLOGY

In South Africa Bulbinella is confined to the Winter rainfall area of the Cape Province where it is concentrated towards the west coast becoming less freqent northwards. The northern limits are in the drier areas of northern Namaqualand (latitude 28 degrees S). In the southern Cape one species occurs sporadically eastwards as far as Baviaans Kloof (longitude 23 degrees E). The genus is generally widespread within this distribution range occupying the main varieties of habitats with the exception of the afro-montane forest.

The greatest concentration of species occurs in the phytogeographical region that Goldblatt (1976) refers to as the Western Coastal Belt. This area extends from the Cape Peninsula north to Nieuwoudtville and includes the Cedarberg mountain range. The area receives over 60% of its rainfall in the winter months. This is the growing season for all South African species of Bulbinella. The average annual rainfall in the mountainous areas is 300-600 mm and in the lower lying areas it is mainly more than 250 mm per annum. Within this region the highest concentration of species is in the Nieuwoudtville area (31^{o}S, 19^{o}E) which has eight species with two neighbouring grid areas Wuppertal (32^{o}S 19^{o}E) and Clanwilliam (32^{o}S 19^{o}E) each having seven species. Those of Cape Town (33^{o}S 18^{o}E), Worcester (33^{o}S 19^{o}E) and Caledon (34^{o}S 19^{o}E) each have six species. The number of species tends to decrease eastwards and northwards towards areas of less winter rains.

The Springbok grid area (29^{o}S 17^{o}E) also has a comparatively high concentration of five species. This is an arid area of erratic rainfall seldom exceeding 100 mm per annum.

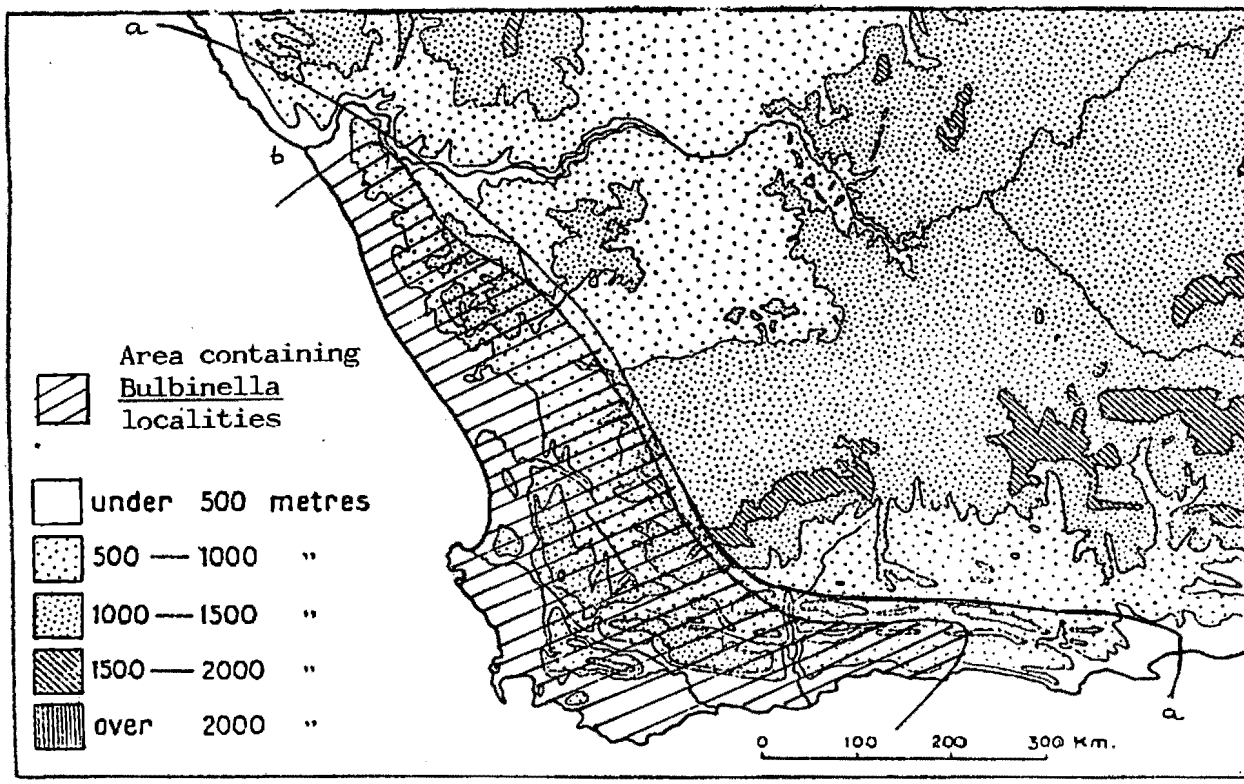


Figure 17. Map showing the limits of Bulbinella distribution in South Africa.

aa = limits of winter rainfall
b = Orange River Mouth

In the more arid regions the genus tends to appear in the moister local habitats and so is to be found either beside seasonal streams or in seepage areas or on south facing shaded slopes of clayey soil which retain moisture from the more limited rains. In seasons where moisture is extra low, growth is restricted so that plants may be stunted and in extreme cases there may be very limited flower production.

A few species such as B. cauda-felis, B. divaginata and B. triquetra are widespread over a large part of the distribution range. They may be found in a variety of habitats with different soils and vegetation types. B. triquetra for instance is found in damp depressions on sandy flats sometimes at altitudes only a little above sea level, and also on upper slopes of mountains of the Table Mountain group to an altitude of around 1,500 metres. It also occurs on shaded slopes of clayey soils derived from Malmesbury shale, amongst Karroid shrubs. B. divaginata may also be found on both clayey soils amongst karroid vegetation as well as on TMG derived sandy soils amongst fynbos vegetation. B. cauda-felis is mainly found on clayey soils often on shady slopes amongst Karroid vegetation or renosterveld. Because of the greater water holding capacity of these soils this species is able to grow in areas of low rainfall. Several good populations occur in the West coast Strandveld amongst broad-leaved shrubs both on granite soil sand on the coastal calcareous sands where they are enriched by quantities of humus.

Some other species are much more particular in their requirements and may have very limited distributions on a specific soil type. This is the case with B. eburniflora, found only amongst renosterveld vegetation on fine loamy soils, and B. latifolia var. doleritica growing only on the red doleritic soils of the Nieuwoudtville area.

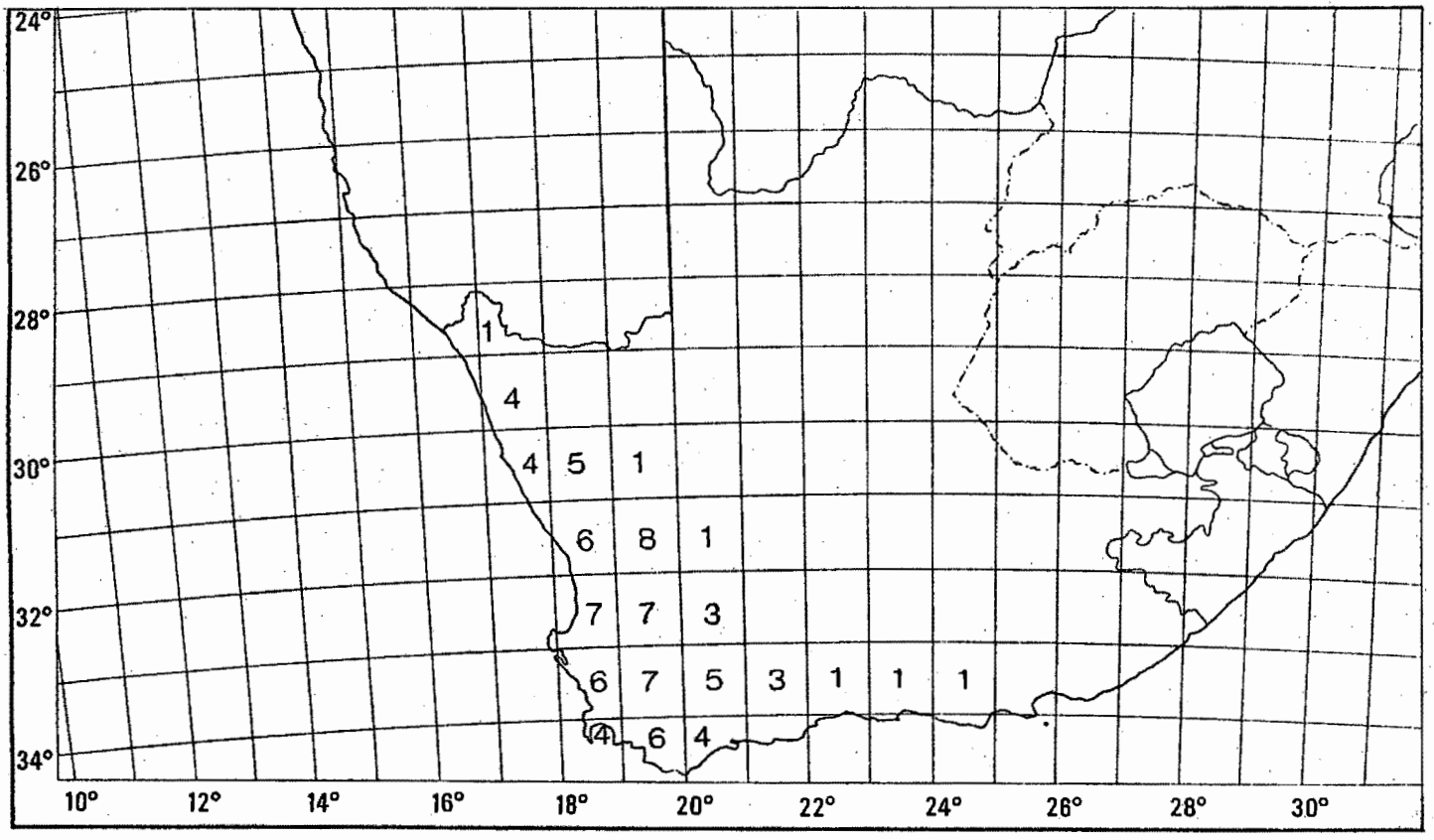


Figure 18. Concentration of species of Bulbinella by Geographical degree areas.

13. *BULBINELLA* IN NEW ZEALAND - A BRIEF ACCOUNT OF THE SPECIES AND THEIR DISTRIBUTIONS

In the most recent revision of *Bulbinella* in New Zealand (Moore, 1964) six species and two varieties were recognised. *B. rossii* (Hook.f.) Cheeseman was the first to be described in 1845 as *Chrysobactron rossii* Hook.f. J.D. Hooker (1845) had first seen this species growing on Campbell Island "covering the swampy sides of the hills in such profusion as to be distinctly visible at a distance of a full mile from shore". This species is endemic to Auckland and Campbell Islands where it apparently still forms dense stands probably protected against sheep grazing by its bitter taste (Moore, 1964). This species becomes a large plant up to one metre high. From herbarium material this species appears close to *B. latifolia* from South Africa, but is clearly distinct from it due to the lack of a fibrous sheathing neck.

B. gibbsii Ckn. var. *gibbsii* and var. *balanifera* L.B. Moore together cover a comparatively wide distribution in parts of the three main islands of New Zealand where the species is common in alpine and subalpine meadows or on open wet ground at lower altitudes. This species is similar to *B. angustifolia* (Ckn. & Laing) L.B. Moore which is confined to the less mountainous parts to the south and east of South Island. It is also found in wet areas or slopes of tussock grassland away from the sun. These two species are smaller than *B. rossii* and more similar to *B. nutans* among South African species.

B. hookeri (Hook.) Cheeseman occurs mostly in mountainous areas in the North Island and in the northern parts of South Island, again being found in seepage and other wet places or tussock grassland on sunless slopes.

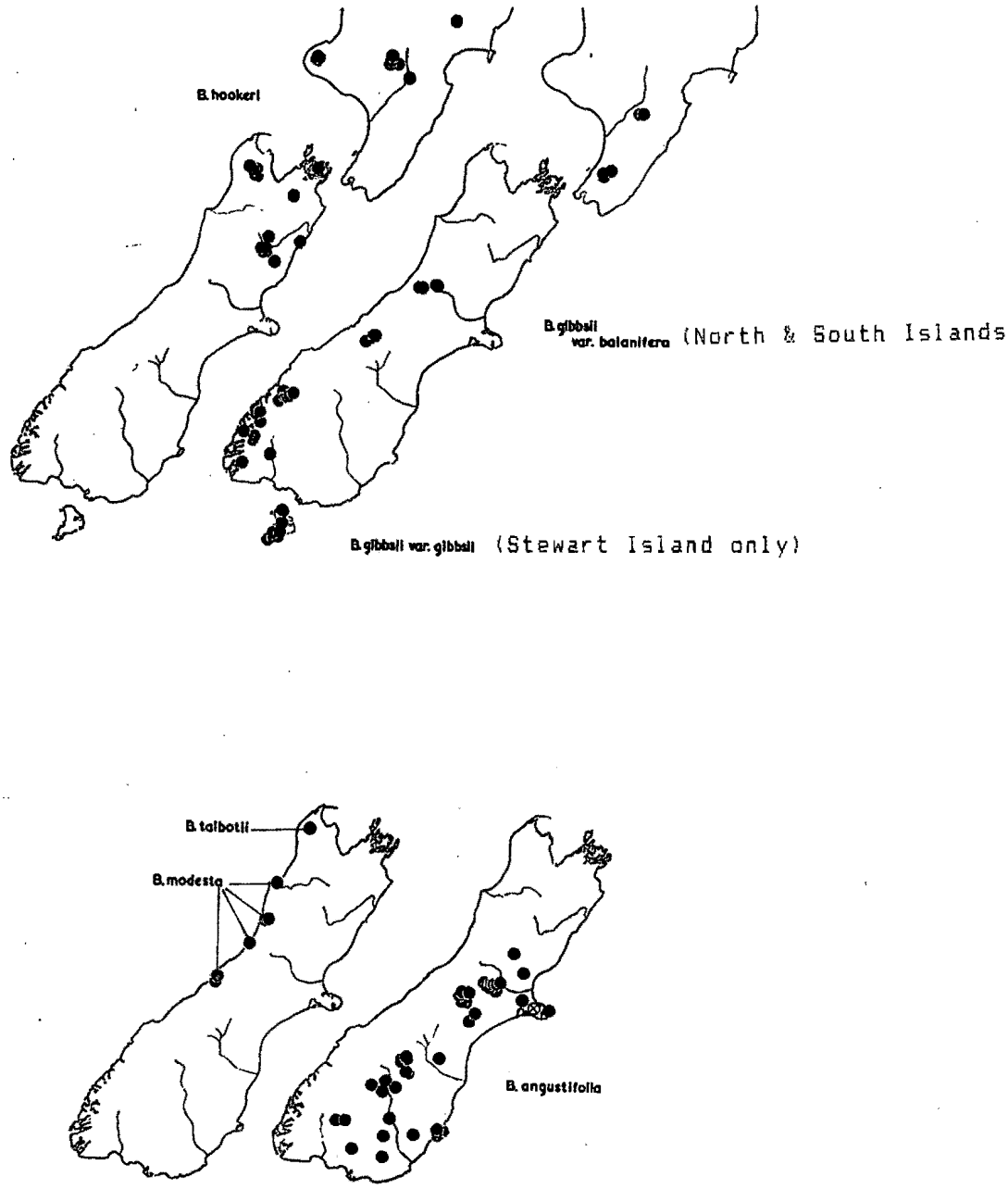


Figure 19. Distributions of the New Zealand Bulbinellas (from Moore, 1964). Each spot represents at least one specimen examined by Moore, cross in circle represents published record of A. Wall.

Figure 20. Photocopy of plate from Curtis's Botanical Magazine t4602 (1851) showing the structure of a typical New Zealand Bulbinella.

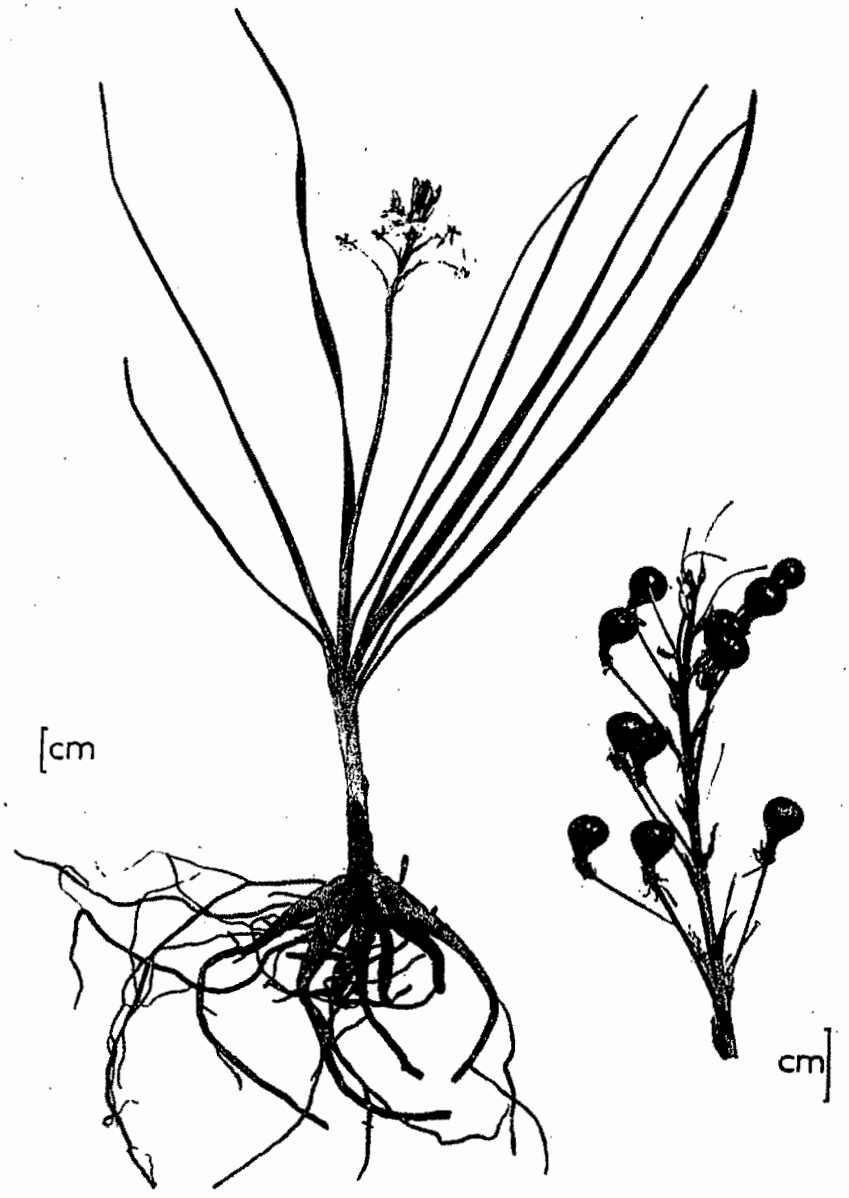


Figure 21. Photocopy showing the structure of Bulbinella modesta (from Moore 1964).

Although vegetatively this species also appears close to B. nutans the capsule is very distinctly stipitate and the tepals shrivelled round the base.

The remaining two species B. modesta L.B. Moore and B. talbotii L.B. Moore also have stipitate capsules and show greater divergence from South African species. B. modesta has a short lax raceme with few flowers. It is restricted to the west coast lowlands of South Island where it grows in damp areas. B. talbotii is a dwarf species endemic to the Gouland Downs N.W. of Nelson where it grows in open boggy places.

In general New Zealand distribution of Bulbinella is concentrated to the south of the country. Only one species and one variety occur in the North Island whereas five species occur in the South Island. All species apparently favour damp habitats and frequently grow in large populations. Growth and flowering times are consistent in all species with vegetative growth beginning in spring (September - October). Flowers appear from November to January, followed by fruiting, with a winter dormancy in the adverse cold conditions.

14. COMPARISON OF BULBINELLA IN SOUTH AFRICA AND NEW ZEALAND. ARE THE TWO GROUPS CONGENERIC?

14.1 Distinctive features of the genus

Several characters common to Bulbinella in both countries separate the genus quite clearly from related genera such as Bulbine and Trachyandra. The most distinctive feature is the ovary consisting of three locules each containing two erect, collateral ovules. Both or only one of the ovules in each locule may develop and the resulting seeds have a characteristic angular shape, with narrow wing-like extensions developed at the angles.

The terminal, simple, usually densely crowded raceme found in Bulbinella helps to distinguish it at a glance from related genera such as Trachyandra. The actinomorphic, stellate flowers having stamens with smooth filaments gives a clear separation from the two most closely related genera Trachyandra and Bulbine. Bulbinella may be separated from Anthericum, the genus with which it was originally associated, by the presence in the latter of more than one flower subtended by a single bract, articulated pedicels and non-tubular leaf-bases.

14.2 Differences between the groups in the two areas

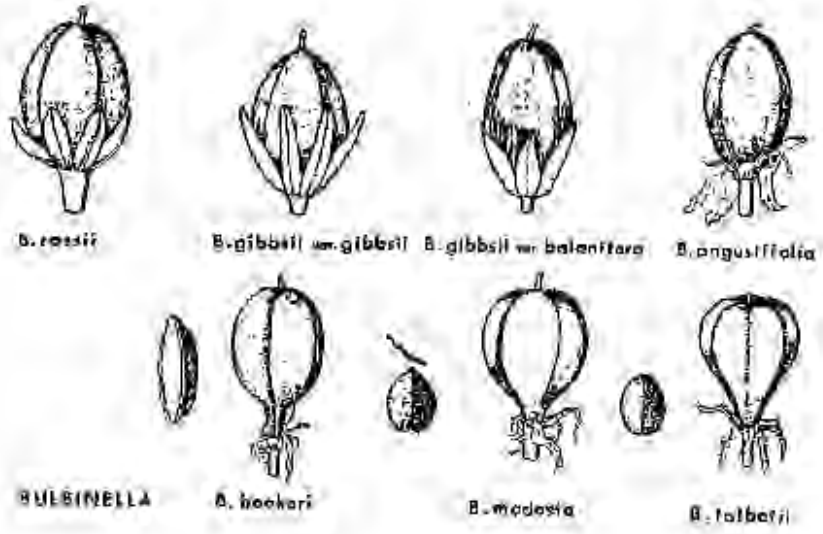
Differences between New Zealand and South African species appear slight in comparison to the major distinctive similarities separating them clearly from other genera. Possibly the most significant difference is the development of the protective fibrous sheaths surrounding the leaf bases. Although a few herbarium specimens of New Zealand species show some fibrous remains this is apparently not a normal feature whereas it is characteristic and diagnostic in South African species except for one

species, B. gracilis, where it is only vestigial. These tough fibrous sheaths may have evolved in South African species as a protection against gnawing or ground dwelling mammals, animals that would have been absent during the development of Bulbinella in New Zealand (Darlington 1966).

Roots of New Zealand species may be one of two types. They are either equally thickened for the whole length or they are fusiform being widest near the stem and gradually tapering. In South Africa, in addition to these two root types, several species have roots with a spindle-shaped terminal swollen region on a narrow basal region.

The leaves of New Zealand species are apparently all somewhat broad and either flat or canaliculate. There is a range of sizes with the longest and broadest towards the outside and the inner leaves gradually getting smaller. Although leaves of several South African species have similar leaf arrangement in other species the leaves may be numerous, equal to sub-equal and terete or semi-terete. Marginal denticulations more rarely hairs are found in some South African species, but not in New Zealand species. All leaves in New Zealand species have sheathing bases in which the veins appear to have poorly developed thickening. In addition the bases may be surrounded by squamae. A number of South African species also have leaf bases and possibly squamae but in other species the leaf bases are replaced by separate cataphylls. Cataphylls are not apparent in any New Zealand species.

A development in some New Zealand species which is not found in South African species is in the shape of the capsule. In all South African



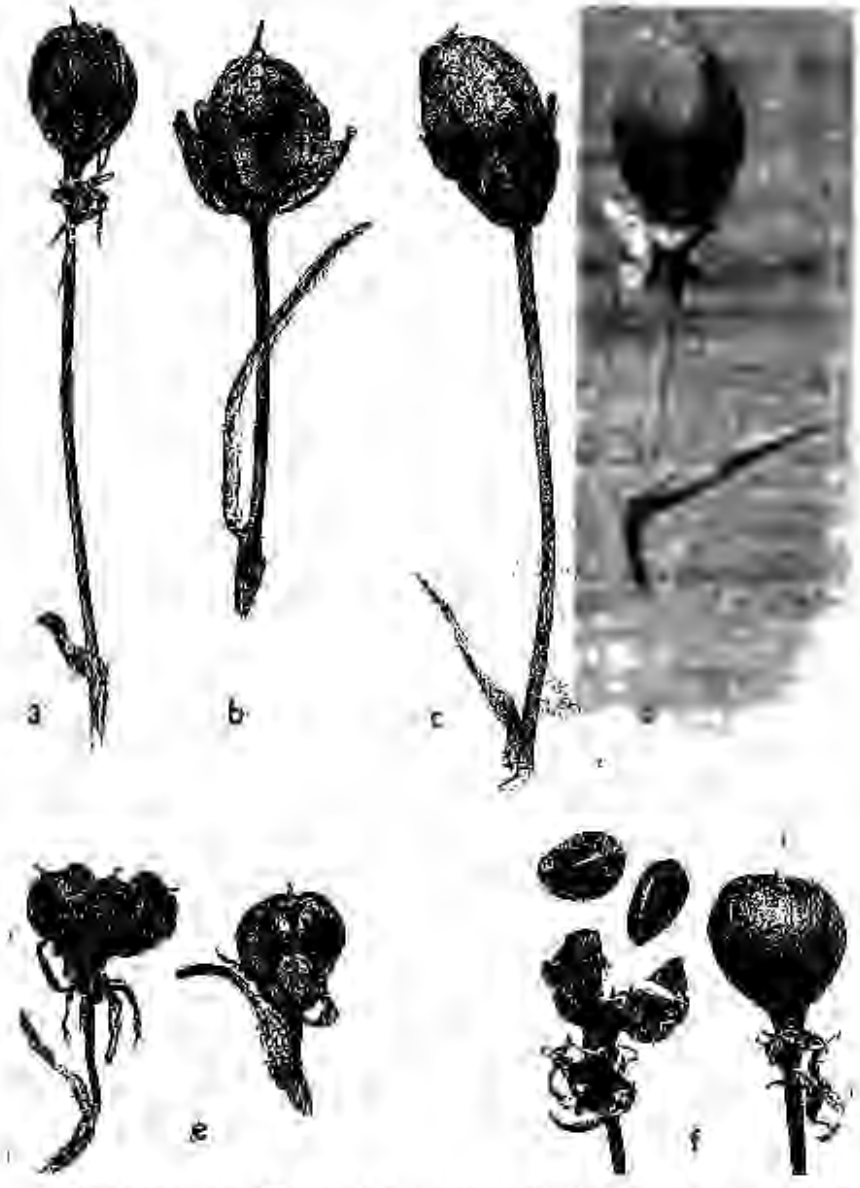


Figure 22. Photocopies of fruits of New Zealand species of Bulbinella to show persistence of tepals and shapes of fruits. a) B. hookeri, b) B. gibbsii var. gibbsii, c) B. gibbsia var. balanifera, d) B. angustifolia, e) B. talbotii (from Moore 1964, & Moore & Edgar 1970).

species the capsule is broad based and sessile with a more or less smooth surface. This is also the case in half the New Zealand species but in B. hookeri, B. modesta and B. talbotii the fruit becomes distinctly stipitate, more or less pear shaped and somewhat furrowed. [See Figure 22.]

Seeds of the South African species such as B. nutans and B. latifolia are more similar, regarding size, colour and shape, to New Zealand species such as B. hookeri and B. rossii than to some South African species such as B. divaginata and B. gracilis.

B. rossii has dioecious flowers, as observed by Hooker (1845) and others. Dioecy is also thought to occur in B. hookeri and B. gibbsii. (Moore, 1964.) This is a feature that requires careful observation of a large number of plants. There are no reports of its occurrence in South African species.

Although in South Africa some species have become adapted to drier habitats the species forming larger plants in particular tend to grow in marshy areas where they often form dense stands. This is also apparent in New Zealand. In both countries there appears to be a tendency to move to drier habitats such as tussock grassland in New Zealand and karoid environments of South Africa.

It is apparent that the groups in the two countries have developed from a common ancestor. The greatest similarity found in species from each of the countries is in the largest species forming large stands in damp areas, such as B. nutans and B. latifolia in South Africa and B. rossii and B. gibbsii in New Zealand. These species may therefore have been nearest to

the common ancestor. Speciation in each country would then have taken place along slightly different lines. In New Zealand species the most noticeable development has been in the shape of the fruit. In South African species development has been in specialised vegetative characters such as roots storage structures, fibrous sheaths, cataphylls and variations in leaf structure.

A further stage of study would be to make more accurate assessments by means of cladistic or phenetic analysis.

14.3 Historical views on their relationship

The first New Zealand species of Bulbinella to be described, B. rossii, was initially placed in a new genus Chrysobactron by J.D. Hooker (1845). At this time he stated: "I am unable to refer this to any described genus of Asphodeleae and have adopted the name in allusion to the magnificent racemes of golden-yellow flowers which it bears. It will rank near Anthericum L. from which it differs in having only one or at most two ovules and in the erect style. It is also very nearly allied to Bulbinella Kunth, (En. Plant. vol.iv.p569) especially in general appearance; but in that genus the perianth is persistent, a character probably of more importance than the number of ovules or bearded filaments, which have hitherto been considered sufficient to distinguish genera too nearly allied in other respects".

The character choice of the persistent perianth for separating the two genera would appear to be an unreliable one. In fact sketches of fruits of all New Zealand species (figure 22) show all species including B. rossii to have persistent tepals, although in some cases they remain firm and erect

around the capsule and in others they are pendent and shrivelled.

Indecision as to the placing of Chrysobactron and Bulbinella continued for many years. Baker (1876) for instance placed both groups as subgenera of Anthericum with two South African species, A. carnosum and A. floribundum, as well as two New Zealand species, A. rossii and A. hookeri under Chrysobactron on the basis of broad leaves, very dense inflorescences and non-setose rootstocks. Such decisions were largely based on false suppositions due to lack of detailed knowledge of the living plants.

In the most recent account of the New Zealand species - Moore (1964) stated: "no clear reasons have emerged for dissociating the New Zealand plants from Bulbinella. It remains an anomaly in plant geography that two so closely related groups of plants should occur only in South Africa and New Zealand". These findings are supported by the evidence in the present study.

14.4 The Bulbinella disjunction - some distributional comparisons with other genera

The extremely disjunct distribution of Bulbinella in South Africa and New Zealand raises interesting problems. Although more than 50 genera of Angiosperms have representatives in both countries none of them apart from Bulbinella is confined to these regions and many have a wide or cosmopolitan distribution (Table 2).

Table 2. Genera common to both South Africa and New Zealand with comparison of species numbers and other areas of distribution. (Ref. Moore & Irwin, 1978 and Bond & Goldblatt, 1984).

Genus	Approx. Genus total	Number of species in N. Zealand	Number of species in S.W.Cape	Other distribution
Cassytha	16	1	2	Old world
Anemone	150	1	1	Worldwide, mainly temperate
Clematis	250	10	1	Pan temperate
Lepidium	140	9	6	Cosmopolitan
Drosera	130	6	12	Cosmopolitan
Tetragonia	60	2	29	Africa, S. America, Australia
Stellaria	100	6	1	Cosmopolitan
Atriplex	200	2	2	Temperate & subtropical
Pelargonium	300	1	135	Africa to Mediterranean, W.Asia, Australia
Oxalis	500	3?(weeds)	ca 120	Cosmopolitan, chiefly S.Afr. & S.America
Gunnera	50	10	1	Africa, Malaysia, Australia, S. America
Metrosideros	60	11	1	Malay Archipelago, Australia.
Hibiscus	300	2	6	Cosmopolitan
Euphorbia	2000	1	ca 50	Cosmopolitan
Rubus	250	5 ? weeds	3	Cosmopolitan mainly N hemispher
Centella	40	1 weed	36	Southern Africa, 1 sp. pantropical
Galium	400	3	9	Cosmopolitan
Cotula	100	24	22	Nearly Cosmopolitan
Helichrysum	500	9	76	Africa, Madagascar, S.Eur., India, Ceylon, Australia
Senecio	2000	40	ca 100	Cosmopolitan
Sebaea	60	1	20	Mainly Africa, also Australia
Wahlenbergia	200	10	39	Chiefly S. temperate
Lobelia	300	3	42	Cosmopolitan
Myosotis	50	34	3	Cosmopolitan in temperate regions
Solanum	2000	3	16	Cosmopolitan
Utricularia	120	9	4	Cosmopolitan
Triglochin	14	2	2	Cosmopolitan
Potamogeton	100	4	4	Cosmopolitan
Hypoxis	80	1	6	Pantropical, subtropical, mainl Africa
Disphyma	3	1	2	Australia

New Zealand, positioned between latitudes 34°S and 48°S, consists of a number of islands isolated for some 80 million years from other land masses. It has a typical island flora of some 2000 species with many endemic to it (Moore & Irwin, 1978). At least 12% of the genera and 80% of the species of vascular plants are found nowhere else (Mildenhall, 1980). The comparatively low number of indigenous species and high endemism may be accounted for by long isolation and the periods of inhospitable climatic regimes, especially during the Pleistocene when many plants became extinct (Mildenhall, 1980). An example of this is the Amaryllid Monosulcites gemmatus of which fossil pollen has been found in the Oligocene to Pleistocene but which is now extinct (Mildenhall 1980). Amaryllidaceae, a family well represented in South Africa has no New Zealand species to-day.

The distributional area of Bulbinella in the winter rainfall area of the Cape, is situated between latitudes 28°S and 34°S and is also an area of high endemism. This area of the Cape is however a very species rich one with more than 10 000 species of Angiosperms (Bond & Goldblatt, 1984). The areas of the two distributions are roughly similar. The Cape area therefore has a considerably greater species density.

A comparison of genera in the distribution areas emphasises the uniqueness of the Bulbinella disjunction. Table 2 shows a representative selection of genera common to both areas with their distributions for the rest of the world. Information for the New Zealand Species was obtained from Moore and Irwin (1978) and for South Africa and other countries from Bond and Goldblatt (1984).

From the table it is clear that the majority of genera found in both areas are either cosmopolitan or have a widespread distribution. Less widespread genera mostly have representatives also in Australia and often include Southern Asia.

The two genera most closely related to Bulbinella are Bulbine and Trachyandra. Both these genera have their centres of distribution in the winter rainfall region of the Cape but extend into sub-tropical Africa. Bulbine also occurs in Australia where it is widely distributed (Bentham, 1878). Publication of a revision of the genus in Australia by E.M. Watson is due shortly (H. Baijnath pers.comm.)

Distributions of other genera of Asphodelaceae are Kniphofia also centred in southern Africa and extending into central Africa; Asphodelus in the Mediterranean and West Asia; and Eremurus in Asia.

Although now placed in a separate family Anthericaceae (Dahlgren, Clifford and Yeo 1985), Anthericum and Chlorophytum may also be regarded as close to Bulbinella. Both occur in South Africa, Anthericum having its centre in Africa but extending into the mediterranean, America and Asia, and Chlorophytum also with a wider tropical distribution. New Zealand has no other member of either Asphodelaceae or Anthericaceae. The only other member of Liliaceae sensu lato to occur in both South Africa and New Zealand is Ipheion. This genus of about 15 species occurs in Africa, Madagascar, India, Australia and New Zealand. Only one species extends into the northern sub-tropical parts of South Africa.

The closest relative of Bulbinella in New Zealand must be Astelia belonging to Asteliaceae. Members of this family are distributed mainly in the southern hemisphere but are absent from south Africa. Astelia has a widely disjunct distribution including Chile, Hawaii, Tahiti, Fiji, New Zealand, New Guinea, Australia and Reunion. Distribution is therefore largely on islands. The fruit in this case is a berry so that long range dispersal could have taken place by birds more easily than in Bulbinella. Pollen records for Astelia in New Zealand indicate its presence in upper Eocene (Mildenhall 1980). This is considerably earlier than the upper miocene record for Bulbinella (Mildenhall 1980).

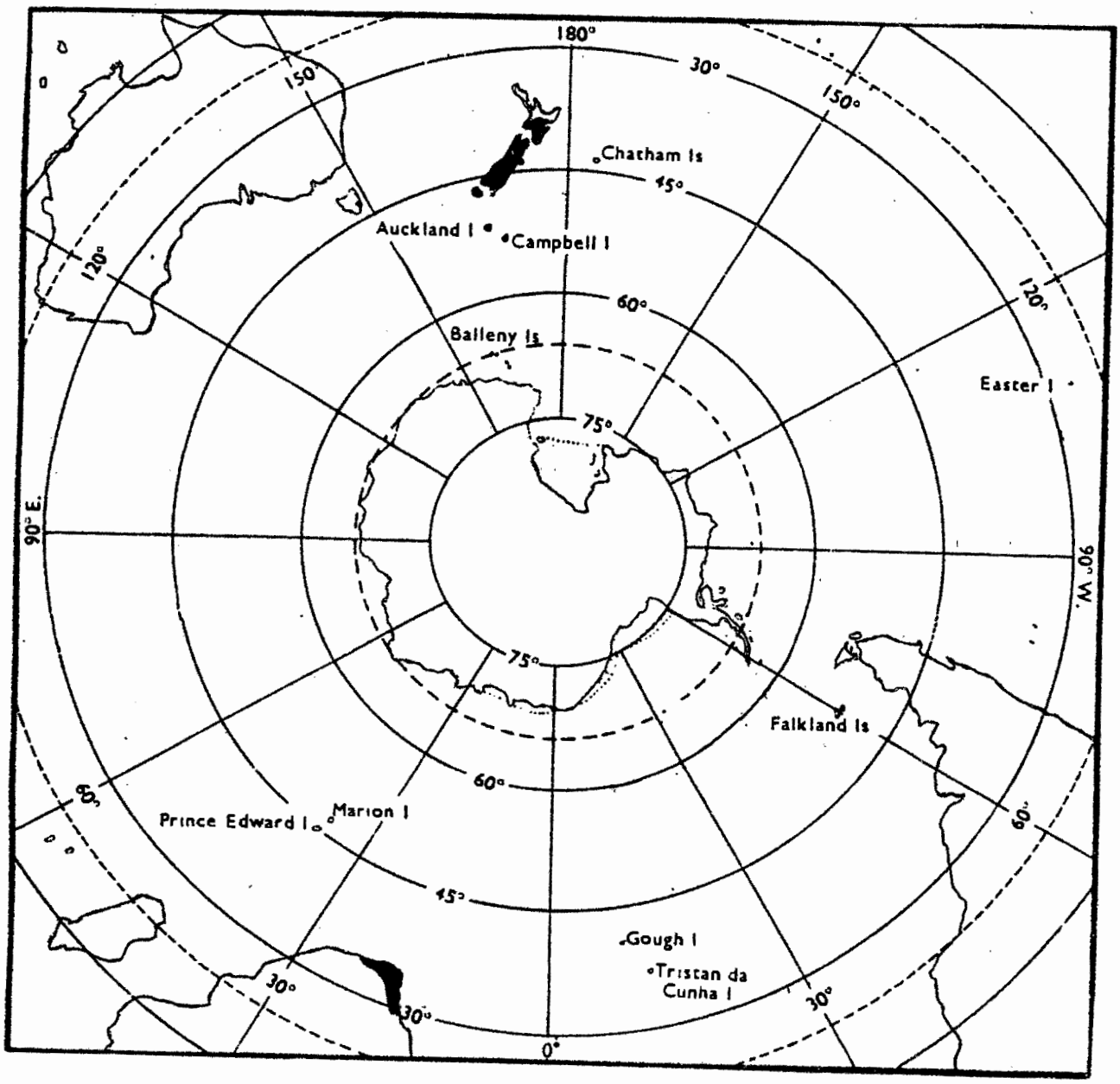


Figure 23. Relative positions of the distribution areas of Bulbinella in South Africa and New Zealand.

15. BIOGEOGRAPHY, ISOLATION AND SPECIATION WITH PARTICULAR REFERENCE TO *BULBINELLA*

15.1 Introduction

The apparently unique disjunct distribution of *Bulbinella* Kunth in South Africa and New Zealand poses many interesting questions of origin, speciation and biogeography.

Biogeography is the study of the world wide distribution of plants and animals. Several workers have divided the world into a number of biogeographic regions. These mostly comprise the larger more or less continuous land masses which are separated by major geological or ecological barriers to migration between the adjacent regions. Polunin (1960) proposes seven regions. Those covering the range of *Bulbinella* are the Ethiopian region comprising Africa south of the Sahara and the Australian region including Australia, New Zealand and the South Pacific Islands.

15.2 Palaeoenvironmental interpretations of the *Bulbinella* disjunction

Interpretations of major distribution patterns of taxa rest on palaeoenvironmental studies. Data sources are plate tectonics together with fossil records, evidence on palaeoclimates and evolutionary histories. The considerable global changes that have taken place in the past 150 million years (m.y.) or so since the early Cretaceous inception of the Angiosperms are complex and offer little other than hypotheses to explain *Bulbinella* distribution. The theory of global plate tectonics and sea floor spreading involves not only the rafting of continents but formation of mid-oceanic ridges and inland arcs, and the raising and lowering of sea

level at different times (Stott 1981). The climatic changes induced by these earth movements also greatly affected the distribution of plants.

The large southern land mass of Gondwanaland is generally considered to have begun breaking up by early to mid Cretaceous, roughly 130 million years ago (Hendey, 1983). Paleobotanical and stratigraphic analyses during the last 30 years have documented a major radiation of flowering plants during the mid-Cretaceous (Crane et al. 1986).

The move of Africa away from the rest of Gondwanaland began at an early stage of the break up 120-100 million years ago, although the two areas remained biogeographically effectively linked by numerous islands along a mid Atlantic ridge for another 10 million years or more. The palaeolatitude of the Cape at this time has been given as 50-55 degrees south, after which the continent moved gradually northwards. By the beginning of the Cenozoic it was only 10 degrees south of the present position (Axelrod & Raven 1978).

New Zealand became separated from Antarctica and Australia about 80 million years ago (Raven & Axelrod, 1974). At this time New Zealand was positioned at a palaeolatitude 60-70 degrees south. Australia broke away from Antarctica and began its northward movement considerably later, about 45 million years ago.

The possibility exists that the Bulbinella progenitor was an element of the

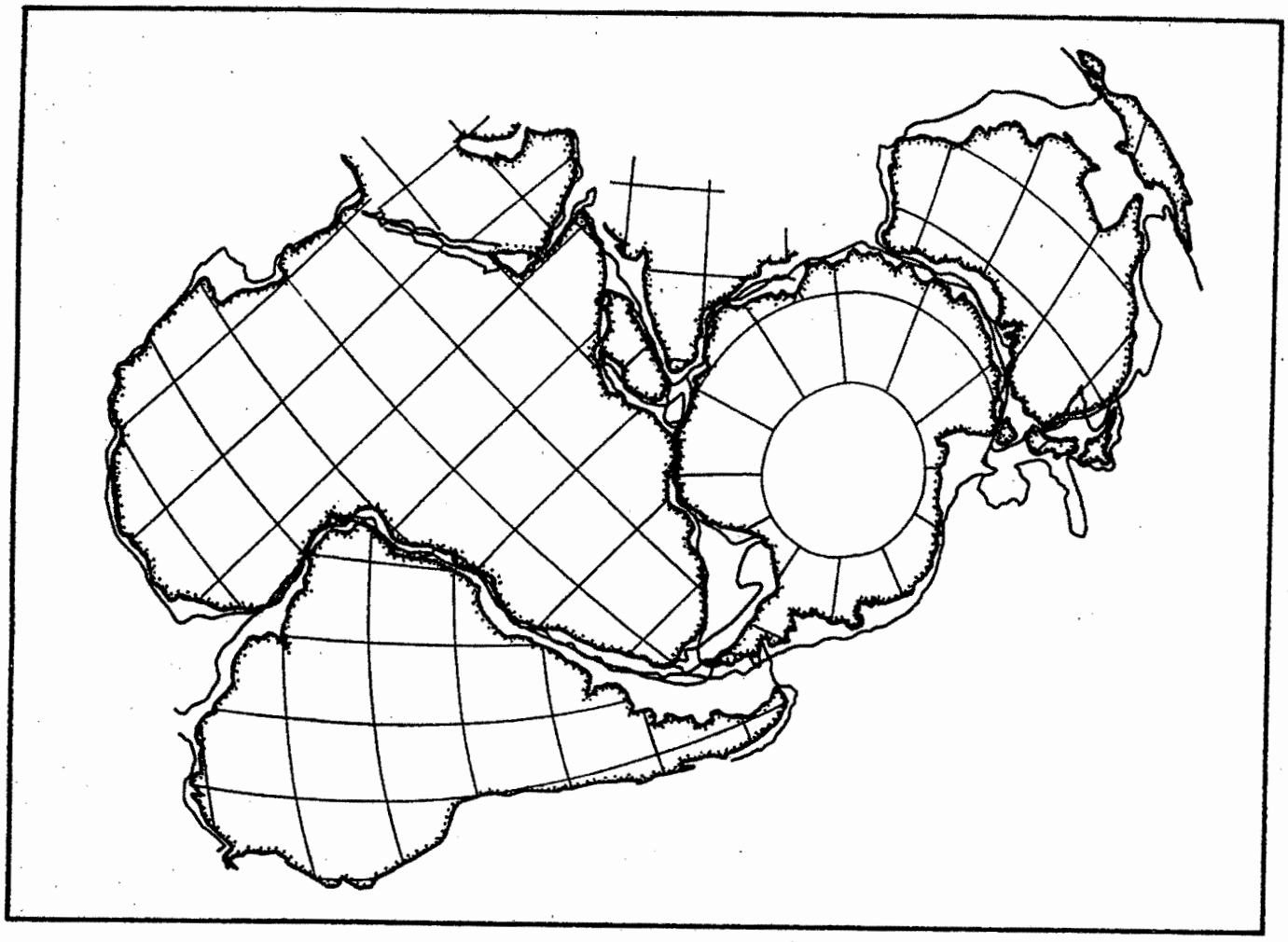


Figure 24. The Gondwana continents prior to breakup in mid Cretaceous showing the positioning of Southern Africa and New Zealand in relation to Antarctica (from Raven & Axelrod 1974).

Gondwanaland flora together with members of families such as Winteraceae, Proteaceae and Restionaceae. It would have been present also in Australia and Antarctica and possibly South America. Extinction from Australia could be considered on the grounds of the increased aridity of that country from the Oligocene onwards and the marked change in vegetation with Acacia and Eucalypts becoming dominant (Barlow, 1981). It is interesting to note that Bulbine is found in Australia as well as Africa but this genus shows considerably greater adaptations to arid conditions than Bulbinella. The absence of Bulbinella from South America is not so easily explained. However no members of Asphodelaceae are known to occur in South America (Dahlgren et al., 1985). Madagascar was connected with Africa into the mid-Cretaceous when it was situated about 15^{0}N of its present position, against Tanzania-Kenya. At this time Madagascar was also joined to India. Separation of Madagascar-India from Africa could have occurred between mid and late Cretaceous (Axelrod & Raven, 1978). This more northerly positioning of Madagascar-India could account for the absence of Bulbinella from those countries (Figure 24).

Possible angiospermous forms have been found in Early Cretaceous deposits of New Zealand along with typical southern ferns and several conifers (Takhatajan, 1969). The Late Cretaceous flora of New Zealand was very similar to that of Australia and of Antarctica (Cranwell, 1959) and the southern tip of South Africa (Axelrod & Raven, 1978). Pollen records for Late Cretaceous in New Zealand include Liliacidites peroreticulatis, a member of Liliaceae (Mildenhall, 1980). Fossil pollen evidence for Bulbinella is limited to the presence of the genus in late Miocene in New Zealand (Mildenhall 1980). The small number of Liliaceae, sensu lato, genera endemic to New Zealand (6) compared with the considerably larger

number (45) in the Cape flora would facilitate the identification of monocotyledon fossil pollen in New Zealand and possibly account for a lack of information for southern Africa.

New Zealand in Miocene times consisted of large shallow swamps surrounded by dense subtropical forests (Mildenhall, 1980). Restionaceae and Proteaceae were then relatively abundant. Bulbinella could have existed in the swamps. By the end of the Pleistocene glaciation Proteaceae was reduced to two species and Restionaceae to 3 species (Moore & Irwin 1978). However glaciation did not affect the lower lying parts of the country and Bulbinella apparently survived in these parts. The presence of B. rossii in the southerly Auckland and Campbell Islands is an indicator that members of the genus can withstand considerable cold, in fact B. rossii requires a temperature as low as 5 degrees Celsius for germination. (Botany Division, DSIR, New Zealand pers. comm.)

15.3 Disjunctions

A number of attempts have been made to classify the major disjunctions in the geographic range of seed plants. That of Thorne (1972) gives a list of major disjunctions with examples but no African-Australasian disjunctions. A more comprehensive list of disjunct distributions in Radford et al (1974) indicates that distributions restricted to mainland Africa and Australasia are rare. Only 18 genera are listed (Bulbine omitted) but the number is increased to 29 genera by including intervening islands such as Madagascar and Seychelles. Even so it is considerably smaller, for instance, than the 555 genera given as ranging from mainland Africa to Eurasia and beyond.

There are three main ways by which disjunctions may be considered to have occurred. These are long range dispersal, relics of former more continuous distribution patterns with intervening areas becoming depopulated, and taxa having arisen independently in the separate areas of distribution thus exhibiting evolutionary parallalism or convergence. The latter is frequently discounted and the possibility of relict populations for Bulbinella has already been mentioned.

Radford et al (1974) consider long-range dispersal the best logical explanation for the African-Australian disjuncts but they offer no examples. Convincing evidence has been produced by Sykes and Godley (1968) for the trans-oceanic dispersal of Sophora microphylla from New Zealand to South Chile and Gough island. However Legumes are noted for having seeds with tough coats and considerable longevity. Some experimental proof would be necessary to show the likelihood of a transoceanic transport for Bulbinella. It should be possible to discount this by soaking seeds in sea water for several months and comparing germination before and after. No information is available on the length of viability of Bulbinella seed or conditions required for storage and such a project is beyond the scope of the present work. Such long range dispersal could have occurred by means of the circum-antarctic current formed after the separation of Australia from Antarctica. It appears though that Africa would have been positioned rather far north to have been affected by this current.

A second means of long range dispersal would be by means of animal vectors, the most likely being sea birds. As Bulbinella has dry fruits transportation might of necessity be mainly on the plumage of the birds, rather than internally as with baccate fruits. Because of the habitat of

Bulbinella in wet places, seeds could have become stuck in the mud on the feet of migratory birds such as Gannets which occur round the coasts of both countries involved. Although some sea birds are known to travel vast distances in an east to west direction, or vice versa, following currents and fish movements, it is difficult to envisage this means as a real possibility for Bulbinella migration.

15.4 Speciation in Bulbinella

Speciation is an evolutionary process of change resulting in new discrete groupings of organisms referred to as species. As the process is a dynamic one with taxa sometimes in a state of flux the distinctiveness and recognition of some species may be a problem for systematists.

Two concepts for a definition of a species exist, the biological species and the taxonomic or morphological (phenetic) species. The biological species may be regarded in two ways. One approach is to define it as the unit of organisation of biparental organisms and as a reproductively isolated system of populations. The other approach is to define a species as a set of populations maintaining inclusive gene pools available to all their component individuals (Grant 1981).

The taxonomic species is the basic unit of formal classification based on morphological likeness and difference. Species may be separated by barriers to hybridisation between their respective populations. This may be brought about by various isolating mechanisms. These include geographical separation preventing different populations coming in contact. In South Africa geographical separation does not appear to be an important

isolating mechanism for Bulbinella as distributions of different species frequently overlap and no single taxon has a widely disjunct distribution. The geographical distribution of distinct colour forms of one species, such as in B. elegans and B. nutans is of interest and hybridisation experiments between these forms should prove worthwhile. In New Zealand all species apparently have distinct distributions with no two species occurring together so geographical isolation may be a factor (Milicich pers. comm.).

Ecological isolation in which the two groups have different habitat requirements is another isolating mechanism. The two groups may be growing sympatrically but require different environmental conditions such as amount of moisture, amount of shade, or different soil conditions. Bulbinella nutans var. turfosicola may be regarded as an example of ecological differentiation. Although morphologically difficult to separate from some populations of the cream form of B. nutans var. nutans, habitat requirements are very different. Variety turfosicola is found only at high altitudes in peaty seepage areas whereas the cream form of variety nutans is found on damp slopes or flats at low altitudes on clay soils. The difficulty in bringing variety turfosicola into cultivation has so far precluded experimental crossing between the two varieties to test for fertility.

Sometimes species occurring in the same locality have different flowering seasons. Several areas are known where two to four species of Bulbinella grow sympatrically but flowering times of the different species do not overlap. One example of this would be the Uitkyk Pass leading into Biedouw Valley. On the slopes here Bulbinella elata, B. divaginata, B. triquetra and B. cauda-felis can all be found. Flowering starts with B. divaginata

in April followed by B. elata in June, then B. cauda-felis in August and B. triquetra in September - October. Cross breeding may also be prevented in two sympatric species if each is pollinated by different vectors. No pollinators have been observed on Bulbinella other than the common honey bee, which has been seen in large numbers on cultivated plants of B. trinervis, B. divaginata, B. latifolia and B. nutans. It is possible that the less common species with strongish smelling flowers such as B. eburniflora and B. barkerae are pollinated by crawling beetles that have been seen amongst flowers of B. eburniflora. Although similarity of flower structure would seem to preclude variation in pollinators between species this requires more careful field observation.

Mechanisms such as differently structured flowers obviously do not concern Bulbinella but breeding behavioural isolation could do so, as most species of Bulbinella are apparently self-incompatible, (Horn, 1962) Several possible barriers may exist. It has been recorded in other taxa that frequently after cross-pollination has taken place the pollen tube will fail to germinate. In more closely related taxa the pollen tube may germinate but fail to enter the embryo sac, or if it does and releases the gametes fusion does not take place. If the process has gone as far as fertilisation the zygote or immature embryo may cease development so that viable seed is not formed (Stace, 1980).

Hybridisation if followed by stabilisation of the hybrid is one of the major evolutionary mechanisms in plants. It is likely that 20%-50% of all vascular plant species arose this way. However, in Bulbinella a hybrid origin is only indicated in the case of B. nana, which shows structural

features which are unusual and confined to it and two putative parental species, B. gracilis and B. divaginata (see account of B. nana). Unfortunately the only presently known population of B. nana occurs in a very arid and poorly collected area of Northern Namaqualand. Although the present distributions of B. gracilis and B. divaginata do overlap neither species has been collected in the vicinity of the B. nana population. Chromosomes of the putative parents have not so far been studied nor were they included in past breeding research.

The variability observed in Bulbinella cauda-felis may be an example of an early stage in speciation. Isolation may lead to a sequence of groups being formed over a period of time; these are local race, geographical race, allopatric race and finally biological species. In B. cauda-felis there is considerable variation in inflorescence size, flowering time, leaf structure and in particular the fibrous sheathing neck. Many of the forms can be clearly related to localised geographical areas. The early stages of separation into different races represented by this may not be recognised taxonomically or they may be given some level of infra-specific rank.

Although experiments with some other taxa have shown that some differentiation may take place in only a few generations, in other cases race formation may take place with an evolutionary slowness beyond most experimental time-scales (Löve, 1967). It is important to determine the beginning of such an isolation if we are to be able to understand the speed and effectiveness with which races and species are being created (Löve, 1967.) Löve (1967) states that "Although the problem of discontinuity is not rare and may be connected with geological, climatic

and historical events of various kinds and magnitudes, some of the events seem to be reasonably well understood and geologically timed whereas others remain without even the simplest explanation". The extreme case of disjunction in Bulbinella would appear to fall into this latter category.

16. SECTIONS IN BULBINELLA

The small size of the genus hardly warrants separation of species into named sections. However three distinct types of roots can be observed and these being the main perennating organs in the genus a division on these features is worth considering and may be of some help in distinguishing between species. The distributions of other characters also tend to agree with this sectioning.

A. Plants with many roots of more or less uniform thickness for the whole length with a yellow to orange coloured skin and flesh. Many of these roots are formed each year and these are intermingled with dried remains of roots of previous years in which the stored food has been used, making a dense fasicle of 50 or so roots. Leaves are more or less fleshy, of varied sizes, canaliculate or flat and mostly without marginal denticulations. Flowers are shades of yellow, orange-red or cream with green to bronze buds. Plants in this group are the largest for the genus, although in dry seasons considerably undersized specimens may be found. South African species are B. nutans, B. latifolia, B. elata. New Zealand species that appear to fall in this section would be B. rossii, B. hookeri, B. angustifolia, B. gibbsii.

B. Plants with roots of varying lengths and swollen with the thickest part near the reduced stem and gradually tapering to the apex, or in one species, B. gracilis with rounded ends. The skin is brown and the flesh white or yellow. Leaves are all sub-equal in size and terete to semi-terete with smooth margins. Flower colour is yellow. Leaf bases are not sheathing but surrounded by separate cataphylls. The species

17. TAXONOMY

Bulbinella Kunth, Enum. Pl. **4**: 569 (1843); Bentham & Hooker Genera Plantarum **3**: 784 (1883); Baker, Fl.Cap. **6**: 355 (1896); Phillips, Gen. S. Afr. Fl. Pl. **2**: 182-3 (19510; Moore & Edgar, Flora of N.Z. **2**: 21-22 (1970); Dyer, Gen. S. Afr. Fl. Pl. **2**: 924 (1976). Type: *B. latifolia* Kunth (lectotype here designated; G!, holotype!; K; P!; isotypes).

Chrysobactron J.D. Hooker, Flora Antarctica **1**: 72 (1845); Baker, Linn. Soc. **15**: 293 (1876). Type: *C. rossii* Hook f. (K!, lectotype).

17.1 Type for genus Bulbinella

According to *Index Nominum Genicorum* of Farr, Leusink and Staffleu (1979) the type for *Bulbinella* was not designated. The only previous reference to a type for the genus is given by Phillips, (1951) where *B. triquetra* (L. f.) Kunth is cited. However this appears to have been chosen arbitrarily and is inadmissable as in Kunth's description of the genus it comes under the heading "Species mihi valde dubiae" with a ? inserted before the epithet *triquetra* (ICBN Article 10.1.; Guide 4(a) and (c).) It has therefore been necessary to select a type for the genus from amongst the six new species Kunth describes under *Bulbinella*. Of these *B. latifolia* Kunth is a suitable representative of the genus and is retained as distinct species with type specimen clearly stated and located as duplicates (here isotypes) in several herbaria.

17.2 Description of genus

Medium sized, deciduous perennial geophytes. Rhizome a compact subterranean annually replaced stem surrounded by membranous cataphylls or basal leaf sheaths and frequently annually replaced by their fibrous

remains. Roots many, fascicled, swollen evenly the whole length, fusiform, or with tuberous swellings at the apices. Leaves few to many, inserted on the upper part of the stem and crowded over a short distance, filiform to linear and tapering to an acuminate tip; somewhat fleshy, triquetrous to subterete or canaliculate, parallel veins prominent or masked. Margin smooth, finely denticulate or ciliate. Peduncle erect, unbranched, naked, terete. Inflorescence a simple, many-flowered, cylindrical, conical or subcorymbose raceme, dense to somewhat lax. Bracts solitary, basal, subtending a single flower. Pedicels wiry, articulated at the apex. Flowers actinomorphic. Perianth stellate, yellow, orange, white or cream, 6--12 mm diameter. Tepals 6, equal to sub-equal, free or connate at extreme base only, oblong, uni-nerved, persistent. Stamens 6, hypogynous, adnate to base of segments; filaments subulate or filiform apiculate, glabrous; anthers small, subglobose, dorsifixed, versatile. Ovary superior subglobose to ovoid, 3-locular, ovules 2 in each locule, collateral; style terete; stigma small, apical. Capsule subglobose to ovoid, becoming dry, sessile or stipitate, dehiscent, topped with persistent style, loculicidally 3-valved. Seeds 1--2 per locule, narrowly or broadly triangular with sharp inner angle and curved outer angle, black sometimes with silvery to yellowish outer integument, narrowly or distinctly winged. Basic chromosome number x = 7; diploid number 2n = 14.

Number of species: 17 in South Africa, 6 in New Zealand.

17.3 Distribution

Western and southern Cape Province in South Africa and three main islands of New Zealand and Auckland and Campbell islands.

18. PROBLEMS IN THE CONSTRUCTION OF A KEY FOR THE SOUTH AFRICAN SPECIES OF BULBINELLA

The construction of a satisfactory and infallible key to the South African species of *Bulbinella* is handicapped by the lack of clear diagnostic characters separating the different species. In particular there is the similarity of floral structure in all species yet with subtle differences in properties such as proportions, colour, and scents that are not easily definable. Vegetative differences are often dependent on growing conditions which may vary according to habitat or to rainfall which is often erratic over much of the *Bulbinella* distribution range. Differences in the structure of tuberous roots are frequently not easily seen because of the difficulty in extracting the complete system from hard ground or entanglement with root systems of surrounding plants. The structure of the fibrous sheath has proved useful in most cases but is variable in the widespread *B. cauda-felis* species complex.

The cultivation of collections has proved difficult with a number of species, especially some of the rare ones for which material has been barely adequate to produce a conclusive description. There is also the problem as to what extent certain characters such as size of complete plants and of parts of plants change in cultivation.

19. CRITERIA FOR SEPARATING SPECIES AND LOWER TAXA

In general differences between the various species are not great, and yet merging together of any of the presently described taxa would also be unsatisfactory and pose a problem of where to draw the line between species complexes.

Criteria for species delimitation here rest on a classical concept of clear discontinuities. They are based on morphological likeness and difference in several independent characters such as structure of roots, leaves, sheathing bases and seeds and also on ecological properties such as edaphics and climate.

20. KEY TO THE SOUTH AFRICAN SPECIES

1a Leaves of different sizes, largest towards the outside, smallest inside; plants mostly more than 0,5 m high, flowers yellow, orange, cream or white.

2a Roots orange-yellow, thickened the whole length; leaves broad, up to 65 mm wide, bright green, somewhat fleshy; flowers yellow, cream or orange

3a Leaf blade flat, not canaliculate; raceme long and slender; flowers cream; fruits globose ..... **3 B. elata**

3b Leaf blade canaliculate; raceme broadly conical; flowers yellow, orange or cream

4a Largest leaves from 10 to 30 mm wide; raceme up to 55 mm wide; flowers bright yellow or cream ..... **1 B. nutans**

4b Largest leaves from 20 to 65 mm wide; raceme up to 40 mm wide; flowers orange yellow or reddish orange ..... **2 B. latifolia**

2b Roots white, distally swollen, basally wiry; leaves narrow, up to 9 mm wide, dark green to glaucous, somewhat coriaceous; flowers yellow or white

5a Leaves few (1 to 4), leaf bases not sheathing; flowers yellow

6a Leaves 2 to 3, rarely 4; distribution Cedarberg mountains ..... **4 B. punctulata**

6b Leaf 1, distribution Potberg range only ..... **5 B. potbergenis**

5b Leaves 5 to 14, leaf bases sheathing; flowers not yellow

7a Leaf margins ciliate or hispido-ciliate

8a Leaf margins distinctly ciliate, raceme narrowly cylindrical about 20 mm wide, with pointed apex, flowers off white ..... **9 B. barkerae**

8b Leaf margins hispido-ciliate, raceme broadly cylindrical about 30 mm wide, with rounded apex; flowers pale straw coloured ..... **6 B. eburniflora**

7b Leaf margins not ciliate, lacking small teeth, rarely with long wispy hairs

9a Raceme narrowly conical, in bud and flower, up to 30 mm wide; flowers white with pink mid nerve; capsule 5 mm long, seeds about 5 mm long ..... 7 **B. cauda-fel**

9b Raceme narrowly cylindrical up to 15 mm wide; flowers white not pink nerved; capsule small up to 3,5 mm long, seeds up to 2,5 mm long ..... 8 **B. graminifoli**

1b Leaves all equal to subequal; plants mostly less than 0,5 m high; flowers yellow or white.

10a Membranous cataphylls only with fibrous sheath absent or poorly developed, with few short fibres; pedicels remaining patent in fruit

11a Fibrous sheath absent or vestigial, leaves 4-8, up to 4 mm wide, succulent ..... 16 **B. gracilis**

11b Fibrous sheath poorly developed, fibres up to 10 mm long, leaves 10-20, up to 0,5 mm wide, filiform ... 17 **B. nana**

10b Membranous cataphylls or sheathing leaf bases surrounded by well-developed fibrous sheath, with tough, protective fibres; pedicels becoming erect in fruit

12a Sheathing fibres 1--2 mm wide, chartaceous, shiny brown to silvery shades ..... 15 **B. chartacea**

12b Sheathing fibres less than 0,5 mm wide, not chartaceous, dull brown or grey

13a Vagina two-layered, inner white membranous cataphyll showing above outer brown fibres; flowers yellow in autumn with young developing leaves ..... 14 **B. divaginata**

13b Vagina showing only outer brown fibres, inner cataphyll not showing above outer fibres, flowers yellow or white

14a Leaves terete, up to 7, margin seldom toothed; flowers white in autumn with young developing leaves ..... 13 **B. trinervis**

14b Leaves triquetrous or semi-terete, more than 7, margin toothed; flowers yellow or white in spring

15a Sheathing fibres coarse, straight, bristle-like; flowers white ..... 11 **B. ciliolata**

15b Sheathing fibres not course and straight; yellow or white

16a Sheathing fibres soft, fine straight to somewhat reticulate, leaves less than 1,5 mm wide ..... 10 **B. triquetra**

16b Sheathing fibres regularly, compactly reticulate, leaves 2--3 mm wide ..... 12 **B. elegans**

21. SPECIES DESCRIPTIONS

1. **Bulbinella nutans** (Thunb.) Durand & Schinz in Consp.Fl.Afr. 5 335 (1894).

Plants medium to large, 0,3--0,8 m high, solitary or in clumps of 2 to several plants joined together. Roots numerous in a dense fascicle, young roots yellow, up to 300 mm long and thickened throughout up to 4 mm diameter by the end of the season; skin becoming dark orange and flesh lighter orange with lateral roots developing in the second season; many dead and withered greyish brown remains of old roots. Stem disc up to 12 mm high and 15 mm diameter, internally orange coloured. Fibrous sheathing neck up to 100 mm long, 70 mm wide at the base; fibres fine to medium, partly reticulate to straight. Leaves rosette forming, erect, 5--13; base of all leaves expanded to form a sheath up to 90 mm high, whitish with green longitudinal veins prominent; lamina narrowly subulate, sizes varying, largest towards outside up to 700 mm long, 25 mm wide, inner becoming gradually shorter and narrower, bright green, fleshy, glabrous, canaliculate, margin smooth or sometimes finely irregularly denticulate. Peduncle up to 650 mm long, 8 mm diameter, terete, bright green. Raceme broadly conical in flower and bud, up to 170 mm long, 55 mm wide, becoming more cylindrical and up to 300 mm long in flower and fruit, 100--250 flowers. Bracts narrowly triangular 6--12 mm long, 1,5--2 mm wide at the base, membranous, becoming brown with age, brown keeled. Pedicels up to 25 mm long, wiry. Perianth stellate, up to 12 mm diameter, yellow or cream. Tepals connate at extreme base only, equal to sub-equal, 4,25 mm long, 2,5 mm wide, elliptic; raised nerve showing well in pressed material, green or

pale yellow. Filaments adnate to base of tepals, filiform apiculate, 3--4 mm long, 1,5 mm wide, yellow or cream. Ovary sub globose to ovoid up to 1,5 mm long, 1,5 mm wide. Style cylindrical 2,5 mm long. Capsule ovoid up to 6,5 mm long, 3,5 mm wide, chestnut brown becoming darker with age, hard, seeds freely released. Seeds up to 7 mm long, 3,25 mm wide, silvery black with lighter wings or wings not obvious.

Flowering time: Late July to December.

Distribution & habitat: This species is found from the Nieuwoudtville/Calvinia plateau to the Cape Peninsula and eastwards to the Caledon district, at near sea level to 1200 metres altitude. It is often seen in large stands, inhabiting damp areas on clayey or peaty soils, but also amongst Karoo vegetation or Renosterveld on clayey flats or hillsides.

Diagnostic features: This species is not always readily distinguished from B. latifolia from which it is separated largely on size. Apart from the leaves of B. latifolia being considerably broader than those of B. nutans in living plants they are arched and spreading whilst those of B. nutans are erect. The inflorescence is broader and shorter in B. nutans.

Key to the varieties

Widest leaves 8-16 mm wide, margin smooth, more rarely minutely denticulate; flowers yellow or cream; seeds silvery black up to 5 mm long; on clay soils in Renosterveld or Karroid Shrublands ..... var. nutans

Widest leaves from 10-25 mm wide, margins not denticulate; flowers cream, seeds black, up to 7 mm long; on dark peaty soils of seepage areas in mountains of the Table Mountain Group; amongst fynbos vegetation

..... var. turfosicola

(1a) **Bulbinella nutans** (Thunb.) Durand & Schinz var. **nutans**

Anthericum nutans Thunb., Prodr. Pl. Cap. 63 (1794); ed Schultes Fl. Capens. 319 (1823); Baker, Journ. Linn. Soc. **15** 294 (1876); non Jacq. Collect.Suppl. 86 (1796). Type:- Cap. Bon. Spei, Thunberg (UPS, lectotype here designated, photo!).

Anthericum setosum Willd. ex Roemer & Schultes, f. Syst. **7:1** 473 (1829); Baker, Journ. Linn. Soc. **15** 295 (1876). Type:- In promont. b. spei, Willdenow Herb. no. 6656 (B-W, photo!)

Bulbinella setosa (Willd.) Durand & Schinz, Consp. Fl. Afr. **5** 335 (1894); Baker, Fl. Cap. **6** 358 (1896); Verdoorn, T930(1944).

B. robusta Kunth, Enum. Pl. **4** 571 (1843); Baker, Fl.Cap. **6** 538 (1896). Nom superfl. Type:- As for Anthericum setosum Willd. ex Roemer & Schultes viz. Willdenow 6656 (B-W).

Flowering time: Late July - October.

Distribution & habitat: This variety is mainly found on clayey soils which become seasonally wet with winter rains. A vivid yellow flowered form is common in the Western Mountain Karoo shrublands of the

Nieuwoudtville/Calvinia plateau and Sutherland districts at altitudes of 600--1200 metres where it is often seen in large stands especially in wet seepage areas. Another yellow form having leaves with distinctly denticulate margins is found further south in the Ceres to Touws River districts at an altitude of around 800 metres. Plants are usually found scattered in localised patches of Renosterveld or Karoo shrublands. The cream flowered form occurs at lower altitudes in the karoid broken veld of the Worcester/Robertson karoo stretching to the remains of the Coastal Rhenosterveld of the Caledon district, and on clay flats or low hills in the vicinity of Cape Town where it may be only a little above sea level.

Diagnostic features: Herbarium specimens of this variety may be confused with B. cauda-felis as the leaves when pressed may be approximately the same size. They are easily separated when roots and fibrous sheaths are present being quite distinct in the two species. Also the inflorescence shape is long and narrow in B. cauda-felis compared with the more broadly conical one of B. nutans. In living material the white tepals with pink mid nerve of B. cauda-felis are clearly different in colour from the more creamy tepals of that colour form of B. nutans.

Nomenclatural notes: The epithet nutans for a species of Bulbinella has been largely ignored in the naming of specimens in South African and some overseas herbaria, possibly because Kunth did not include it in his treatise of the genus and also due to confusion with Anthericum nutans sensu Jacquin which, from the plate illustrating his concept of the species (Ic. rar. 2t 407) is clearly a Bulbine. Jacquin's Collectaneorum Supplementum, with his description of A. nutans on page 86, was published

in 1796 two years after Thunberg's Prodromus Plantarum Capensium and so the latter takes precedence.

Although Thunberg's specimen 8396 is smaller than normal for this taxon it agrees well with a specimen in the Bolus Herbarium collected by Pillans from the lower Southern slopes of the Tygerberg where the cream flowered form still occurs. This seems a very likely locality for Thunberg's specimen as according to his travels he could have been in that vicinity at flowering time. Specimens of the yellow flowered form collected in a dry season in the Nieuwoudtville area also look similar, but dates given for Thunberg's visit to that area, 4th November 1773, are too late for flowering of this taxon. Although flowers on the Uppsala specimen appear to be yellow this is also the case with the Pillans specimen from Tygerberg.

The type specimen for Willdenow's Anthericum setosum, no. 6656, matches well with Thunberg's A. nutans. As this was one of the specimens quoted by Kunth in his description of B. robusta the latter must be regarded as a nomenclaturally superfluous name. The additional inclusion of Drége 8763 (B. nutans var. turfosicola) in Kunth's circumscription of B. robusta indicates that he had a taxonomically confused concept of the species. Although stating that the Drége specimen differed in being larger and with longer pedicels he lacked the detailed information of flower colour, seed structure and habitat to create a separate taxon.

Baker gave A. nutans Thunb. as a synonym for B. gracilis Kunth, possibly because of the lack of fibrous sheath in Thunberg's specimen. However fibres together with roots had clearly been removed prior to pressing. Baker's misconception emphasises the considerable difficulty in making correct identifications from pressed material, in a genus where flower structure is of no significance and important distinguishing

characters are in the underground parts so frequently missing from herbarium sheets.

SPECIMENS EXAMINED

3019 (Loeriesfontein):Loeriesfontein(-CD),Sept.1964,C.M.Lombard 6(PRE, STE.).

3119 (Calvinia): Glenridge farm near Nieuwoudtville(-AC), 23/08/1966, G.J.Pamphlett 111 (NBG,PRE.); South of Nieuwoudtville(-AC),23/08/1966, G.J.Pamphlett 113(NBG); Oorlogs Kloof(-AC), 28/09/1941, W.F.Barker 1898 (BOL, NBG); Glen Lyon, Nieuwoudtville.(-AC),09/08/1984, P.L.Perry 3131 (NBG); Nieuwoudtville Wild Flower Reserve (-AC), 25/07/1983, P.L.Perry & D.Snijman 2146 (NBG); Glen Lyon farm, hills N.E. of Nieuwoudtville(-AC),11/09/1974, A.Mauve & I.Oliver 32 (K,PRE,STE); Glen Lyon farm(-AC),04/09/1976, P.Goldblatt 4037 (PRE); Nieuwoudtville(-AC),28/08/1941, E.Esterhuysen 5688 (BOL); Van Rhynspas(-AC),20/07/1967, H.P.van de Schijff 7041 (PRE); Nieuwoudtville(-AC),Sept. 1928, H.Buhr s.n. (BOL 035217); Grasberg Nieuwoudtville(-AC),18/08/1937, H.Herre s.n. (BOL 035230); near Nieuwoudtville(-AC),Sept. 1930, L.Bolus s.n. (BOL 035214); Nieuwoudtville(-AC),16/08/1951, H.Herre s.n. (BOL 035218); Along road between Nieuwoudtville & Calvinia(-AD),08/09/1966, M.F.Thompson 223 (K,PRE,STE); Nieuwoudtville Wild Flower Reserve (-AC), 15/09/1983, P.L.Perry 3013 (NBG); Farm Papkuilsfontein (-AC); 04/09/1985, P.L.Perry 3319 (NBG); Akkerdam, low slopes of Hantam mountains(-BC), 22/07/1961, W.F.Barker 9309 (NBG); Hantamsberg(-BC),24/08/1979,

D.C.H.Plowes s.n. (NBG 120390); 5 miles S.W. of Calvinia(-BD), 28/07/1948, D.K.Davis s.n. (PRE, SAM 64565); Botterkloof(-CD), 17/08/1897,R.Schlechter 10887 (BM,BOL,G,K,P,PRE); Ripjoeni mountains(-DA),Aug.1921, R.Marloth 10294 (PRE); 26 miles W.by S.of Calvinia(-DA),02/08/1953, J.P.H.Acocks 16888 (K, PRE); Kareeboomfontein, Calvinia(-DA),06/09/1974, W.J.Hanekom 2416 (PRE); Roggeveld, Farm Uitkijk(-DA),Oct. 1920, R.Marloth 9719(PRE); Karigaboschfontein,south of Calvinia(-DD),25/08/1975, M.F.Thompson 2477 (PRE, STE).

3120 (Williston):24,5 miles N.W. of Middelpos(-CC),16/09/1955, O.A.Leistner 306 (K, NBG, PRE); 21,1km Farm Bloemfontein towards Calvinia(-CC), P.L.Perry 3326 (NBG); Farm Bloemfontein/De Hoop, Middelpos - Calvinia(-CC),28/09/1984, K.E.Steiner 825 (NBG); 6,2 km Farm Bloemfontein towards Calvinia (-CC) 05/09/1985, P.L.Perry 3329 (NBG).

3219 (Wuppertal):Olifants River Valley,(-CA),Aug.1925, Ven. S.W.Lavis s.n. (BOL 018384); 0,6 Km South of Op die Berg turnoff on Gydo Pass to Citrusdal road (-CA), 26/09/1986, P.L.Perry 3521 (NBG); Koelfontein, Bo-Bokfontein, Ceres(-CC),07/10/1969, W.J.Hanekom 1303 (K,PRE,STE); turn off to Zuurvlakte, 13,3 miles beyond excelsior(-CD),17/09/1964, H.C.Taylor 5894 (PRE, STE); Zoo ridge on the Zuurvlakte(-CD),29/08/1976,C.H.Stirton 6199A(K,PRE).

3220 (Sutherland):Top of Gannaga Pass.(-AA),19/08/1975, W.Wisura 3477 (NBG); Ganagas Pass(-AA),20/09/1968, F.Stayner s.n.(NBG 87573); Between Kruis Rivier Plaats and Sutherland(-AB),11/09/1926, M.R.Levyns 1660 (BOL); 35 miles N.W. of Sutherland(-AB),22/08/1968, H.Hall 3241 (NBG); Between the two turn-offs to Botrivier from Middelpos to Sutherland road (-AB), 06/09/1985, P.L.Perry 3337 (NBG); Driefontein, west of Sutherland(-AD),01/09/1973, M.F.Thompson 1779 (K,STE); Farm

Voëlfontein (-AD), 06/09/1985, P.L.Perry 3333 (NBG); 13 miles north of Sutherland(-BC), 25/08/52, G.C.Theron 1258 (BM,K,PRE); Geelhoek (Vyffontein)(-BC), 21/09/1953, J.P.H.Acocks 17182 (K, PRE.).

3318 (Cape Town):8 miles S.E. of Langebaan Road(-AA),24/08/1956, G.C.Theron 2018 (BOL, K, PRE.); Lucasfontein, near Oupos Hotel, Malmesbury(-BA),24/08/1970, J.P.H.Acocks 24310 (PRE); Btn Paarlberg and Paardeberg(-DB),August, Drege 486 (G,K,P); Tigerberg(-DC),Aug.1838, P.B.S.Krauss 1431 (G); Tygerberg(-DC),Aug.1924, N.S.Pillans 18307 (BOL); Tygerberg Nature Reserve(-DC), 03/08/1975,J.W.Loubser 3069(PRE).

3319 (Worcester):Farm Het Kruis, Ceres(-AB),Oct.1921, R. Marloth 10622 (PRE); Theronsberg Pass, Ceres side(-AD),26/09/1984,P.L.Perry 3207 (NBG); Titus River Valley east of Eselfontein(-AD),10/10/1974, E.G.H.Oliver 5094 (STE); prope Ceres(-AD),Oct. 1889, H.Bolus s.n. (BOL 035155); Leeuwfontein, Ceres(-BC),26/09/1944, R.H.Compton 16051 (NBG); Hottentots Kloof, Ceres(-BC),27/09/1944, R.H.Compton 16132 (BOL, NBG); Hex River Valley(-BC),August, K.L.Davidson 85 (SAM); Bokkerivier Farms, Ridge on top of Roodeberg(-BC),10/11/1963, D.Woods s.n. (NBG 71873); Hex River Pass (-BC), 16/09/1974, A.Mauve & I.Oliver 161 (PRE, STE); 4 km S.W. Kleinstraat towards Hex River Pass(-BD),26/09/1984, P.L.Perry 3199 (NBG); Worcester Veld Reserve(-CB),July 1961, M.C.Olivier 1 (PRE, STE.); Karoo Garden(-CB), 26/07/1945, E.M.Leighton 1037A (BOL, NBG.); Veld Reserve, Worcester.(-CB),July 1937, N.G.van Breda 17 (PRE); Langerug Koppie(-CB),23/08/1977, I.B.Walters 1835 (NBG); Near site of drive-in cinema Worcester(-CB),31/07/1982, I.B.Walters 2568 (NBG); Langerug, Worcester(-CB),25/07/1984, P.L.Perry 3118 (NBG); near Worcester West township(-CB),27/08/1975, I.B.Walters

319(NBG); N1 just NE of Worcester West housing(-CB),21/08/1985, P.L.Perry 3300 (NBG); Worcester commonage(-CB),04/08/1959,P.A.B.van Breda 579 (K,PRE); Farm Reiersrus, Aan de Doorns(-CB),09/08/1962, I.B.Walters 598 (NBG); Karoo Botanic Garden(-CB),Sept.1974, M.B.Bayer 89 (NBG); Worcester commonage(-CB),August 1984, M.B.Bayer s.n. (NBG 130576); Worcester commonage(-CB),12/08/1968, F.Stayner s.n. (NBG 87517); 14,2 km from top Rooihoogte Pass towards N1(-DB),25/09/1984, P.L.Perry 3204 (NBG); Koo(-DB),12/09/1962, G.J.Lewis 6038 (NBG); Vrolikheid Nature Reserve, Robertson(-DD),July 1976, C.V.van de Merwe 2974 (PRE).

3320 (Montagu):Cobita, near Laingsburg(-AB),20/09/1931, R.H.Compton 3760 (BOL); Bonnievale(-CC),Aug. 1924, R.Marloth (Hurling & Neil) 11947 (PRE).

3418 (Simonstown):Cape Flats(-BA),07/11/1888, Comte de Vasseldt. s.n.(SAM 22729); Harmony flats, Gordon's Bay(-BB),19/08/1984, P.L.Perry 3151 (NBG); Flats between Strand and Gordon's Bay(-BB),26/08/1977, E.Esterhuysen 34611 (BOL); S.W. of Somerset West(-BB),09/09/1974, C.Boucher & A.A.Mauve 4961 (PRE).

3419 (Caledon):Pot River, Langehoogde(-AA),Aug. 1830, Ecklon & Zeyher 132 (G,K,PRE,SAM); Intersection of Caledon-Cape Town-Worcester roads(-AB),06/09/1976, I.B.Walters 1491 (NBG); Dumghye Park(-AB),Sept., P.G.Jordaan 202a (STE); Caledon, hillside above road(-AB), 16/10/1984, P.L.Perry 3224 (NBG); 1 km south of Caledon towards Shaws Pass(-AB), P.L.Perry 3225 (NBG); Shaw's Pass near Caledon(-AB), 01/09/1962, I.B.Walters 396 (NBG); Commonage S of Caledon(-AB), 13/09/1976, P.Goldblatt 4092 (PRE); Caledon road at intersection with Villiersdorp rd.(-AB),17/09/1968, A.A.Mauve 4699 (PRE); Caledon commonage(-AB),Sept. 1931, W.F.Barker 52 (BOL, K.); Caledon, near the Baths(-

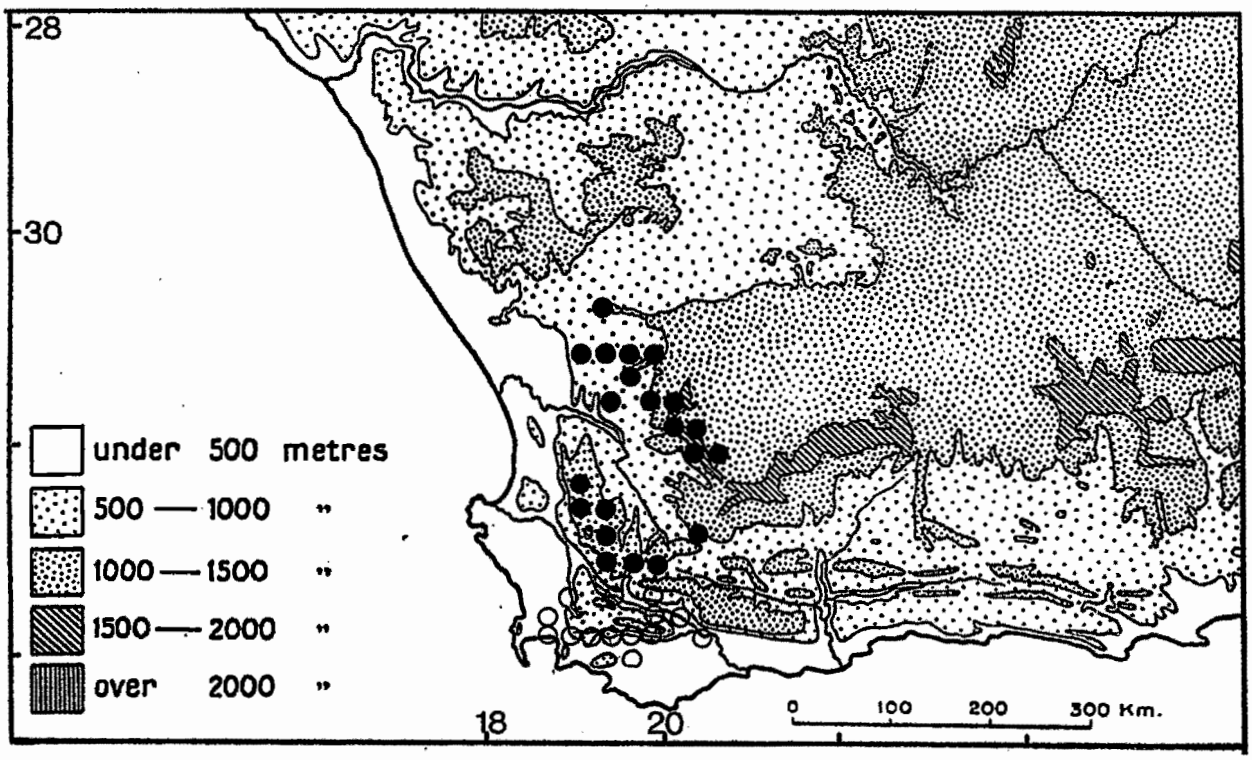


Figure 25. Distribution of Bulbinella nutans var. nutans yellow flowers ●, cream flowers ○.

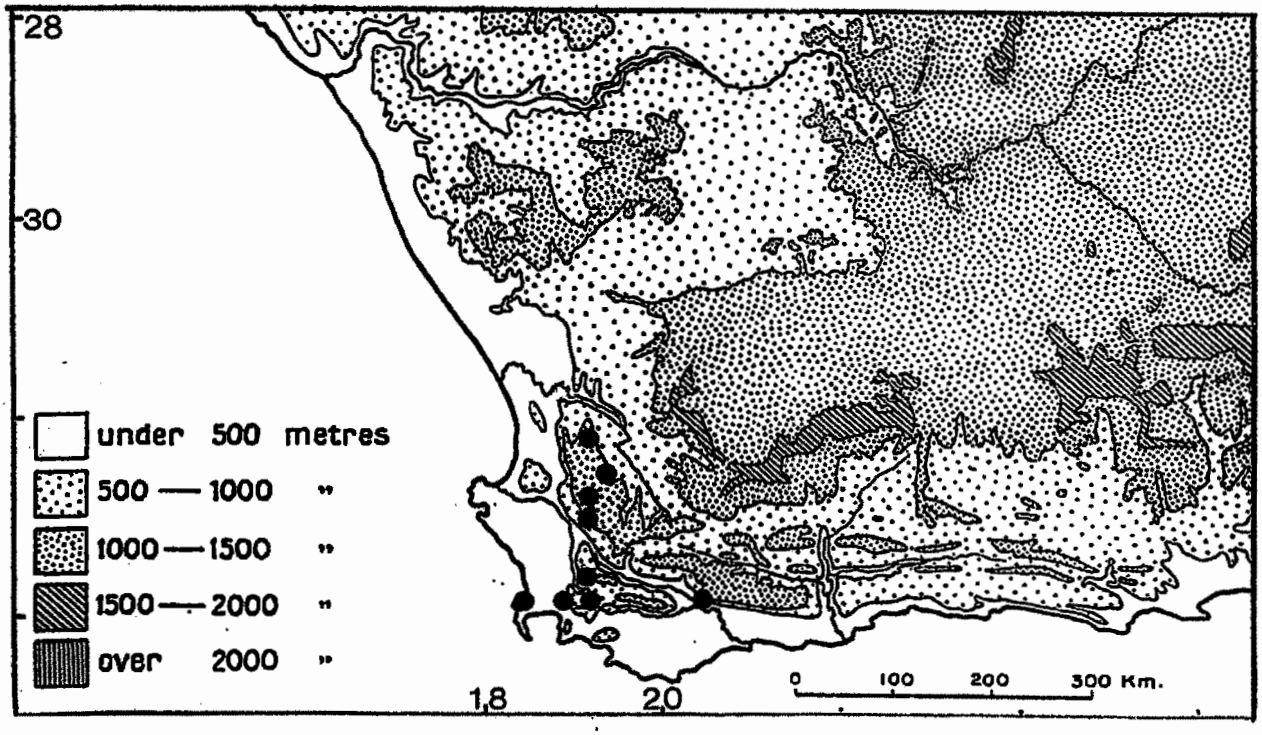


Figure 26 Distribution of Bulbinella nutans var. turfosicola.

AB),Sept. 1919, R. Marloth 9220 (PRE); Caledon(-AB),Oct.1934, A.Berg s.n. (STE, STEU 19622); Zwartberg, mountain ridges on S.E. side(-BA),Sept. 1830, Zeyher 4211 (G,K,P,PRE,SAM.); 6 miles W. of Rietpoel river flats(-BB),22/08/1962, H.C.Taylor 3749 (K,NBG,PRE,STE); Springerskuil(-BC),21/08/1984, P.L.Perry 3157 (NBG).

3420 (Bredasdorp):Bontebok Park, Swellendam(-AB),23/08/1965, P.J.Grobler 422 (PRE, STE.); Boesmanspad, Swellendam(-AB),Oct. 1921, C.J.Joubert s.n. (STE, STEU 10190).

(1b) **Bulbinella nutans** (Thunb.) Durand & Schinz var. **turfosicola** P.L. Perry var. nov. a varietate nutante foliis latoribus, seminibus atris magnioribus et habitatione montana in locis udis turfosis differt. TYPUS.-- Cape Province: Zuurvlakte, Du Toit'skloof, November 1983, Perry 3075 (NBG, holotypus; K, MO, PRE, isotypi).

Flowering time: October - December.

Distribution and habitat: This variety usually forms dense stands in flat seepage areas in mountainous regions from the Cedarberg to Table Mountain at an altitude of 500-1000 m. It grows in black peaty soil amongst Restionaceous species such as Hypolaena crinalis and Elegia intermedia or Erica species such as E. parvifolia and E. mollis.

Diagnostic features: This variety is most easily separated from the variety nutans by its locality and habitat, and its late spring to summer flowering time. Plants tend to be more robust than the variety nutans with generally wider leaves. When growing in good conditions the inflorescence of

the cream flowered form of variety nutans is almost indistinguishable from that of variety turfosicola. Seeds of the two varieties are distinctive, those of var. turfosicola being larger (up to 7 mm long) and black not grey as in var. nutans.

Attempts to cultivate this variety have so far met with little success. When given growing conditions similar to other species of Bulbinella only two seedlings were germinated and these did not survive beyond the first season. Complete plants taken from the veld also failed to settle in pots. Although one collection survived into a third season it did not produce flowers and the vegetative growth gradually diminished in size. As other plants of B. nutans and B. latifolia given similar conditions have grown satisfactorily it may reasonably be assumed that variety turfosicola requires a very distinctive set of growing conditions such as is provided by the wet peaty soil in which it is found.

SPECIMENS EXAMINED

3219 (Wuppertal):Flats near Moutons Klip vlei(-AC),01-10-1972, R.H.Andrag 169 (STE); Vlei E of top of Uitkyk Pass(-AC), P.L.Perry 3250 (NBG); Vlei 2 miles from top of Uitkyk Pass in Cedarberg (-AC), 09-09-1938, M.C. Gillet 4111 (K); Eikerboom, top of Uitkyk Pass(-AC),26-09-1934, E.M.Leighton s.n. (BOL 032682); Uitkyk Pass(-AC),Sept. 1942, T.P.Stokoe s.n. (SAM 55733); Kromme River(-CB),Aug. 1949,T.P.Stokoe s.n. (PRE, SAM 64566); Twenty-Four River Mountains above Porterville(-CC),23-10-1949, E. Esterhuysen 16202 (BOL); Koue-Bokkeveld(-CC),22-09-73, W.J.Hanekom 2174 (PRE); Twenty-Four Rivers Mtns near Porterville(-CC),10-10-1953, E. Esterhuysen 21883 (BOL).

3318 (Cape Town):Table mountain(-CD),05-11-1942, R.H.Compton 14050 (NBG);

Lower plateau near Kasteel Poort(-CD),05-08-1896, A.H.Wolley Dod 1470 (PRE); Summit of Table mountain(-CD),Nov. 1883, MacOwan 1558 (BOL,G,K,PRE,SAM,ST.); Summit of Table Mountain(-CD),Oct. 1891, MacOwan 2515 (G.); Table Mountain(-CD),29-11-1985, P.L.Perry 3079 (NBG); Table Mountain(-CD),Oct. 1879, H.Bolus 4588 (BM, BOL, K, NBG); Table Mountain, above Skeleton Gorge(-CD),18-11-1897, E.E.Galpin 4743 (PRE); Table Mountain, swamp at Fir tree(-CD),Jan.1921, H.Andreae 547 (PRE, STE); Table Mountain(-CD),Sept. 1884, R.Marloth 596 (PRE); Swamp on lower plateau, Table Mountain(-CD),26-09-1943, E. Esterhuysen 9011 (BOL); Table Mountain(-CD),Oct. 1919, R.Marloth 9406 (PRE); Table Mountain(-CD),27-09-1908, E.P.Phillips s.n. (BM, SAM 44614); Kasteelberg, summit of Table mountain(-CD),August, Pappe s.n. (SAM 22727); Kasteelberg(-CD),August, Zeyher s.n. (SAM 22726); Jonkershoek, Stellenbosch(-DD),Dec. 1965, Q.Kerfoot 5555(STE).

3319 (Worcester):Porterville Mountains; S.W. end of Zuurvlakte(-AA), 28-10-1972, E.G.H.Oliver 4093 (PRE); Winterhoek near Tulbagh (-AA), Nov. 1879, H.Bolus 5269 (BOL); Cold Bokkeveld, 5 km north of turnoff to Agterwitzenberg (-AB), 28-10-1986, P. Goldblatt 8032 (NBG); Witsenberg, Tulbagh(-AC),October, Pappe s.n. (SAM 22715); Zuurvlakte, du ToitsKloof(-CA),18-11-1983, P.L.Perry 3075 (NBG); Zuurvlakte, du Toitskloof.(-CA),13-11-1977, P.L.Perry 526 (NBG); Zuur Vlakte,Wellington(-CA),Nov.1922, C.Thorne s.n. (SAM 46519); Drakensteinbergen (-CC),Oct.,Drege 8763 (B,BM,G,K,P.).

3320 (Montagu) Eleven o'clock mountain, Swellendam(-CD),21-11-1952, T.M.Wurts 491 (NBG).

3418 (Simonstown): Vlakte next to Grootkop, Table Mountain (-AB),

03-10-1985, W.P.U.Jackson 43 (NBG); Hottentot Holland mtns near Somerset Sneeurkop(-BB),Sept. 1948, T.P.Stokoe s.n. (SAM 64550).

2. **Bulbinella latifolia** Kunth in Enum 4 572 (1843). Type:- Cape Province: Little Namaqualand, between Uitkomst. & Geelbeks Kraal, Drège 2667a (G! lectotype here designated; K! P! isolectotypes).

Plants tall, up to 1 metre high. Roots fascicled, numerous, all thickened the whole length up to 150 mm long, 6 mm diameter, orange with many dead membranous remains interspersed. Fibrous sheathing neck up to 150 mm long, 70 mm wide, fibres fine to medium thick, partially reticulate. Leaves 5--10, bases expanded to form a sheath encircling peduncle and inner leaves; lamina spreading to arched, ensiform to subulate, varying sizes, largest up to 550 mm long, 65 mm wide, bright green, fleshy, shallowly canaliculate, margin smooth. Peduncle up to 700 mm long, 12 mm diameter at the base, erect, terete, green to reddish. Raceme dense, conical in bud and flower up to 250 mm long, 40 mm wide becoming cylindrical in flower and fruit up to 400 mm long, 30 mm wide; up to 500 flowers. Bracts narrowly triangular up to 12 mm long, 3 mm wide at the base, attenuate, membranous with reddish brown keel. Pedicels up to 20 mm long, yellow in flower, green in fruit. Perianth stellate, 9--10 mm diameter yellow or reddish orange. Filaments filiform, apiculate, 2,5--3 mm long, yellow. Ovary ovoid, 1,5 mm long and 1 mm wide, yellow. Style cylindrical, 2,75 mm long. Capsule ovoid 7 mm long, 3 mm diameter, light chestnut brown. Seeds silvery to shiny black, membranous, wings not obvious, up to 6,5 mm long,

3,75 mm wide.

Flowering time: August to October.

Distribution and habitat: This spesies is found in seasonally damp areas such as annual streams or near dams on granitic soils in the Kamieskroon area and Table Mountain Group soils of the Cedarberg, at altitudes of 500--1,000 m. It is often seen in large stands. It also occurs on flats of red doleritic soils in the Nieuwoudtville area.

Diagnostic features: This species is closely related to B. nutans and frequently difficult to separate from that species especially with pressed material. It is separated from it largely on the grounds of size, B. latifolia being larger in all its parts. The fact that varieties of the two species namely the yellow form of B. nutans var. nutans and B. latifolia var. doleritica grow sympatrically at Nieuwoudtville and flower at the same time without showing any signs of hybridisation is regarded as further grounds for separating the species. Living plants of these two taxa growing side by side show marked differences in habit and young cultivated plants of the two show consistent differences in length and width of roots.

Nomenclatural notes: Kunth's description of Bulbinella latifolia was based on Drége, herb. Cap. no. 2667a which was collected in August in Little Namaqualand between Uitkomst & Geelbeks Kraal (Drege, 1843). Specimens of this collection seen in material from Kew, Geneva and Paris show clearly a broad-leaved taxon of Bulbinella. These specimens show leaves and inflorescence only with leaves up to 400 mm long and 28 mm broad

and inflorescence mostly in bud 100 mm long, 18 mm wide with 100--200 flowers. Pedicels and bracts are shorter than typical in this taxon. Although these specimens and Kunth's description could possibly apply to the taxon described here as *B. elata* he states that flowers are yellow whereas *B. elata* has cream coloured flowers.

B. latifolia is here separated into two varieties on the grounds of flower colour and the very distinctive habitat preference.

Key to the varieties

Flowers vivid yellow; sandy soils derived from granite or sandstone of the Table Mountain Group, mainly in damp seepage areas ..... *latifolia*

Flowers reddish orange; restricted to sticky red doleritic clay soil on flats in the Nieuwoudtville area ..... *doleritica*

(2a) **Bulbinella latifolia** *Kunth* var. **latifolia.**

B. robusta Kunth var. *latifolia* (Kunth) Baker, Fl.Cap. **6**: 358 (1896).

This variety often forms large stands in seasonally damp areas where in dry seasons flowering may be limited. Flowers are a vivid to orangy yellow.

Flowering time: August to October.

SPECIMENS EXAMINED

2917 (Springbok):Spektakel Pass(-DA),04-09-1951, W.F.Barker 7428 (NBG); O'Okiep(-DB),Sept. 1925, R.Marloth 12736 (PRE); 20 miles S. of Springbok(-DD),18-07-1948, R.H.Compton 20578 (NBG).

3017 (Hondeklipbaai):Grootvlei(-BB),07-09-1945, F.M.Leighton 1371 (BOL); 23 km N.of Garies then 11 Km west,farm Grootvlei.(-BB),24-08-1976, E.J.van Jaarsveld 1410 (NBG); Grootvlei(-BB),Sept.1945, G.J.Lewis 1455 (SAM); Grootvlei(-BB),07-09-1945, W.F.Barker 3722 (BOL, NBG.); 15 miles S. of Kamieskroon(-BB),20-09-1933, I.M.Salter 3822 (BOL); near Grootvlei from Kamieskroon(-BB),26-08-1954, W.F.Barker 8408 (NBG).

3018 (Kamiesberg):opposite Gamoep turnoff approx.12 km kamieskroon(-AA),27-08-1984, P.L.Perry 3169 (NBG); Leliefontein, Garies(-AB), 23-09-1978, A.Scheffler 262 (PRE, STE); Leliefontein(-AC), 01-10-1947, R.J.Rodin 1459 (BOL,K,PRE); S. of Leliefontein(-AC), 03-09-1971, W.Wisura 2214 (NBG); near Leliefontein,(-AC),18-08-1961, H.G.Schweicheedr 2545 (PRE); Eselkop, kamiesberg(-AC),07-09-66, B.Downing 317 (PRE, STE); near Leliefontein(-AC),27-09-1932, M.R.Levyns 4028 (BOL); Wet places in Naras Ravine, Khamiesberg(-AC),15-09-1911, H.H.W.Pearson 6652 (BOL, K).

3118 (Van Rhynsdorp): Gifberg near Ronderug Hoogte (-DD), 13-08-1968, J.P.Rourke 1068 (NBG).

3219 (Wuppertal):Algeria Forest Station, Cedarberg, Gatdeurkop(-AC), 20-10-1982, M.Viviers 622 (STE); Matjiesrivier, Cedarberg(-AD), 08-09-1943, G.E.H.Wagener 152 (BOL, NBG).

(2b) **Bulbinella latifolia** Kunth var. **doleritica** P.L. Perry var. nov. a varietate latifolia floribus aurantiacis intense et habitatione restricta solis rubris doleriticis argillaceis discedit.

TYPUS:- Cape Province: Glen Lyon Farm, Nieuwoudtville, August 1986, Perry 3472 (NBG, holotypus; K, MO, PRE, isotypi).

This variety can be seen in large stands in the vicinity of Nieuwoudtville where it is restricted to the flat areas near the dolerite koppies where the hard red doleritic clay begins to merge into the greyish dwyka tillite clay. According to the farmer in this area (pers. comm.) careful grazing management in these areas has greatly increased the size of the stands. Flowers are a dark reddish-orange with yellow stamens, ovary and style.

Flowering time: August to September.

SPECIMENS EXAMINED

3119 (Calvinia):Hill on Loeriesfontein road 4 miles N.W.Nieuwoudtville (-AC),Sept. 1930, L.Bolus 19600 (BOL); Glen Lyon farm, N.E. of Nieuwoudtville(-AC), 11/09/1974, I.Oliver & A. Mauve 43 (PRE, STE); McGregor's farm, Nieuwoudtville(-AC), 02/09/1959, D.S.Hardy 70 (PRE); Glen Lyon, Nieuwoudtville (-AC), 12/08/1983, P.L.Perry 3011 (NBG); Klip Koppies, Nieuwoudtville(-AC),09/08/1961, W.F.Barker 9367 (NBG); Glen Lyon Farm, Nieuwoudtville (-AC), 22/08/1986, P.L.Perry 3472 (K, MO, NBG, PRE); Oorlogskloof, Onder-Bokkeveld (-AC), 21/08/1897, R.Schlechter 10970 (BM, BOL, K, P, PRE).

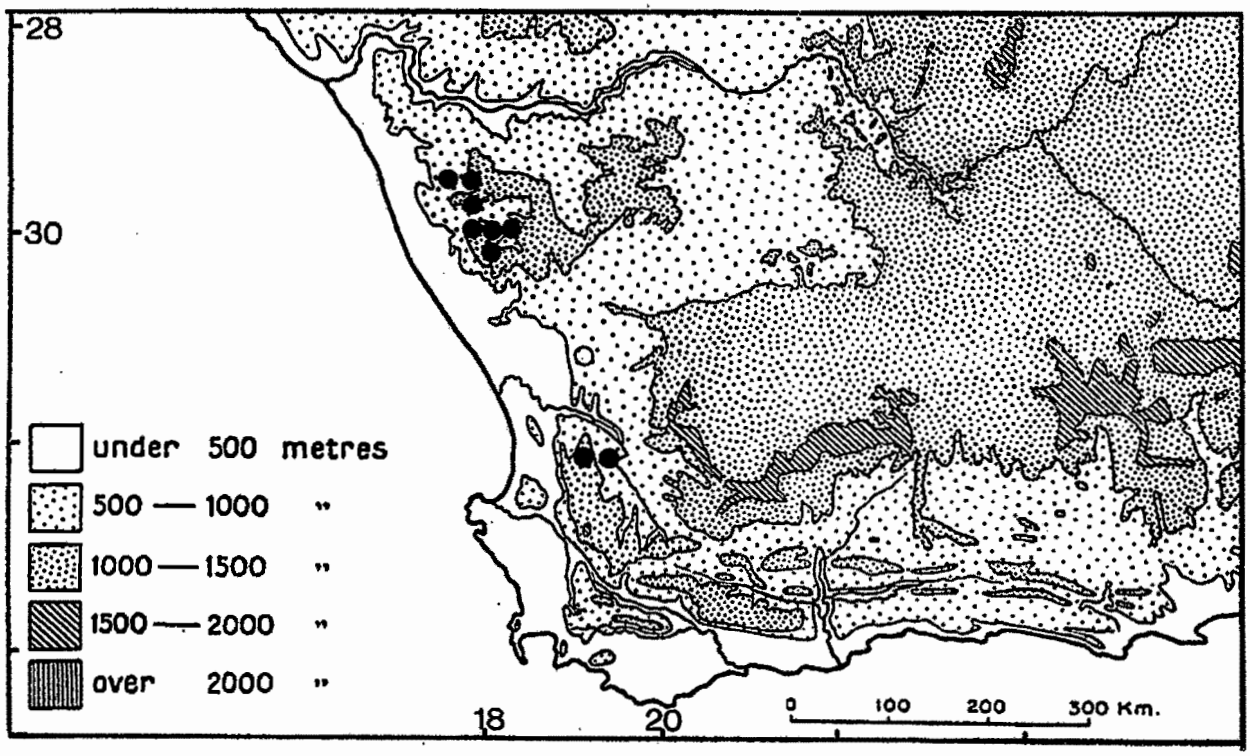


Figure 27. Distribution of Bulbinella latifolia var. latifolia ● , and var. doleritica O.

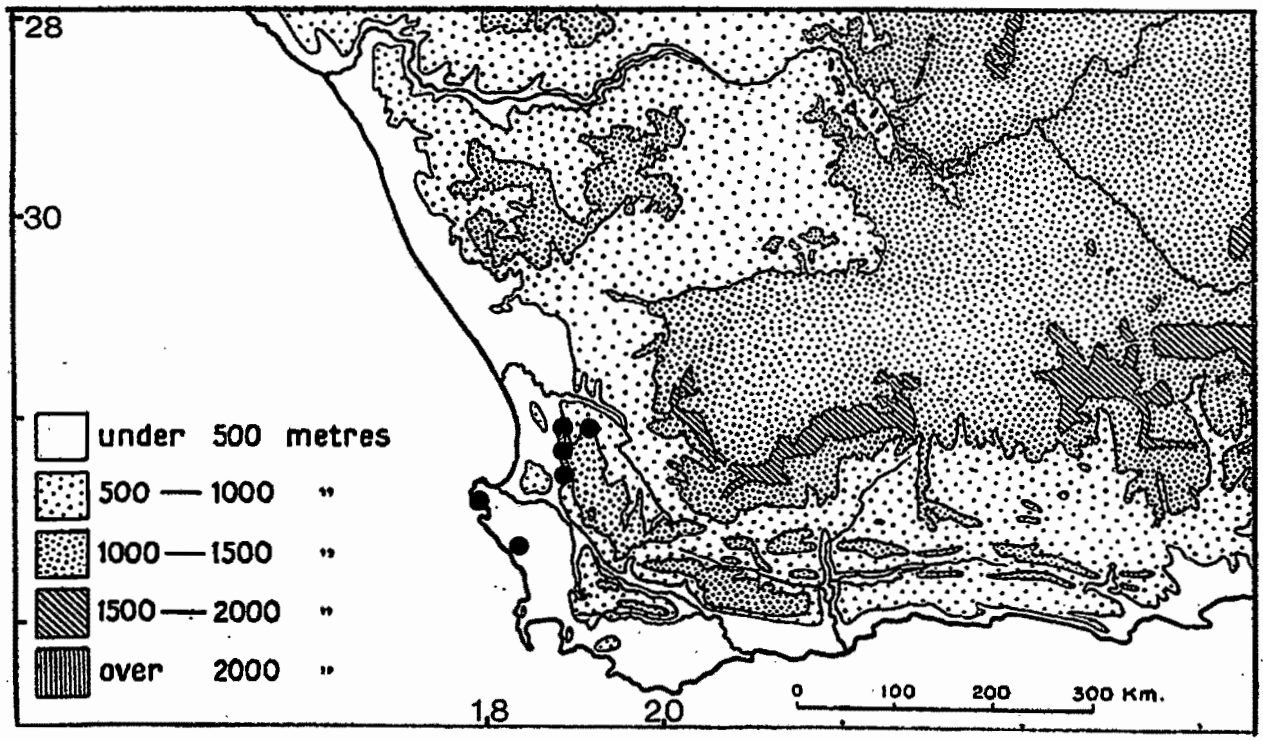


Figure 28. Distribution of Bulbinella elata.

3. **Bulbinella elata** P.L. Perry sp. nov. B. nutente (Thunb.) Durand & Schinz et B. latifoliae Kunth affinis sed foliis herbaceis prominenter nervatis racemo anguste cylindrico capsula globosa valde differens. TYPUS.-- Cape Province: Near top of hill into Biedouw Valley from Pakhuis, August 1984, Perry 3132 (NBG, holotypus).

Plants up to 1 metre tall. Roots fascicled with several thickened up to 180 mm long and 2,5--3 mm diameter, slightly more thickened near the stem, orange coloured, some old shrivelled remains and separate thin absorptive roots. Stem disc solid, 10 mm diameter, orange. Fibrous sheathing neck up to 80 mm long, usually nearer 40 mm; fibres thin, loose, straight becoming somewhat reticulate towards the inside. Leaves 6--8, erect to spreading, bases expanded to form a sheath, up to 80 mm long; lamina ensiform up to 450 mm long, 65 mm wide, gradually tapering, inner leaves shorter and narrower, not canaliculate, thinly coriaceous with parallel veins prominent and close together, bright yellowish green, glabrous, margin entire. Peduncle up to 800 mm long, 7 mm diameter, terete. Raceme cylindrical up to 400 mm long in flower and fruit, 30 mm wide, 200-500 flowers. Bracts 6 mm long lanceolate attenuate, colourless, faintly brown keeled. Pedicels up to 15 mm long, usually less, whitish in flower, reddish in fruit. Perianth stellate, 10 mm diameter, cream coloured, faintly scented. Tepals sub-equal, outer somewhat recurved, inner patent, oblong 4,5 mm long, 2 mm wide. Filaments filiform apiculate, inner 4 mm long, outer 3 mm long. Ovary globose, 1,25 mm long and wide, pale green to yellow. Style cylindrical, 1,75--2 mm long, off white. Capsule sub-globose up to 4,5 mm long, 4 mm wide, chestnut brown. Seed up to 4,5 mm long, 3 mm wide; greyish-black, wings not obvious.

Flowering time: July to August.

Distribution and habitat: Collections of this species are restricted to the Clanwilliam area where it has been found on shady south facing slopes on clayey soil amongst karroid vegetation and the Vredenburg area where it occurs in granitic sandy soil at the base of the large Witteklip granite boulders.

Diagnostic features: Although closely related to B. latifolia and B. nutans and not always easy to separate on herbarium sheets from some larger specimens of the former there are sufficiently good characters in living plants to make a distinct species. Among these are the flat coriaceous non-canaliculate blade, which is thinner and more delicate when pressed than those of B. latifolia. The long narrow inflorescence and the small globose capsule are clearly different from the more conical inflorescence and larger ovoid capsules of B. nutans and B. latifolia. B. elata flowers earlier in the season than all forms of B. latifolia and B. nutans.

SPECIMENS EXAMINED

3217 (Vredenburg):Witteklip, near Vredenburg(-DD),Sept. 1944, G.J.Lewis 1456 (SAM); Witteklip, south side of Vredenburg(-DD), P.L.Perry 3195 (NBG); Witteklip near Saldanha Bay(-DD),01-09-1944, F.M.Leighton 598 (BOL).

3218 (Clanwilliam):4 miles south of Clanwilliam on old road(-BB), 15-07-1965, Kellerman 6 (STE); 19 Km S Clanwilliam on old road(-

BD), P.L.Perry 3311 (NBG); Olifantrivier(-DB),02-07-1896, R.Schlechter 7997 (BM,BOL,G,K,P).

3219 (Wuppertal):Hill to Biedouw Valley, 47 Km from Clanwilliam(-AA), 19-08-1983, P.L.Perry 3019 (NBG); near top of hill into Biedouw Valley(-AA),09-08-1984, P.L.Perry 3132 (NBG); Pakhuis(-AA), 23-08-1941, E.Esterhuysen 5925 (BOL); Road to Wuppertal, from Pakhuis(-AA),Sept. 1933, F.M.Leighton s.n. (BOL 032639).

3318 (Cape Town):Summit of Contreberg, Malmesbury(-AD),22-09-1933, N.S.Pillans 6905 (BOL).

4. **Bulbinella punctulata** A. Zahlbr. in Ann.Hofmus. **15:1**; 16-17 (1900). Type:- Pikeniersbergen; Twentyfour River Mountains, Penther 422, 517 (W, holotype lost in war action in second world war). Cape Province; Top of Dasklip Pass, September 1985 Perry 3350 (NBG, neotype here designated; K, MO, PRE, W, iso-neotypes).

Plants tall and slender, 0,5--1 m in height, solitary. Roots densely fascicled up to 120 mm long with swollen regions proximal to the stem disc, up to 28 mm long, 8 mm diameter, also some roots with swollen ends about 28 mm long, 4 mm diameter. Fibrous sheathing neck forming a thick layer at the base up to 20 mm wide and 40 mm long becoming progressively fewer layered above, outer fibres greyish, very fine, distinctly reticulate, inner cataphylls up to 150 mm long, lacy, light goldeny fawn coloured; basally internally violet-purple dyed. Leaves 2, rarely 3 or 4 on older plants, base not expanded to form a sheath, sub equal or inner considerably smaller, up to 600 mm long, 6 mm wide, subulate with apex very gradually

narrowing to a point, dark green, canaliculate, fleshy to coriaceous, glabrous, margin not denticulate. Peduncle up to 700 mm long, 3 mm diameter, lightish green. Raceme narrowly cylindrical, up to 120 mm long, 20 mm wide, moderately dense, approximately 75-150 flowers. Bracts triangular, cuspidate, 3 mm long, base partly surrounding pedicel, colourless, membranous with light brown keel. Pedicels 4--8 mm long, green. Perianth stellate, spreading to somewhat recurved, ± 9 mm across. Tepals yellow with narrow green keel, oblong obtuse, sub equal, outer more recurved and slightly longer and narrower 5 mm long, 2 mm wide, inner narrowly lanceolate 4 mm long, 2,5 mm wide. Filaments filiform apiculate 3 mm long, yellow, anthers sub-globose. Ovary ovoid, shiny yellow, 1,5 mm diameter. Style cylindrical, 2 mm long. Capsule 6 mm long, 4 mm wide, light fawn, sections somewhat cymbiform, 3-veined. Seed 4,5--5,5 mm long, 3,5 mm wide, shiny black with dark brown wing about 0,5 mm wide all round.

Flowering time: August to October.

Distribution and habitat: This species is confined to the Cedarberg mountain range where it grows in Table Mountain Group derived sandy soils in rocky areas amongst mountain fynbos or in large stands in damp flats of Restio veld.

Diagnostic-features: This is a very distinctive species due to the small number of leaves, normally only two, which are comparatively long and narrow. The loose net-like part of the sheath with the inner cataphyll extending for some distance up the leaves also clearly separates B. punctulata from other species. It may also be easily recognised by the long narrow inflorescence of yellow flowers.

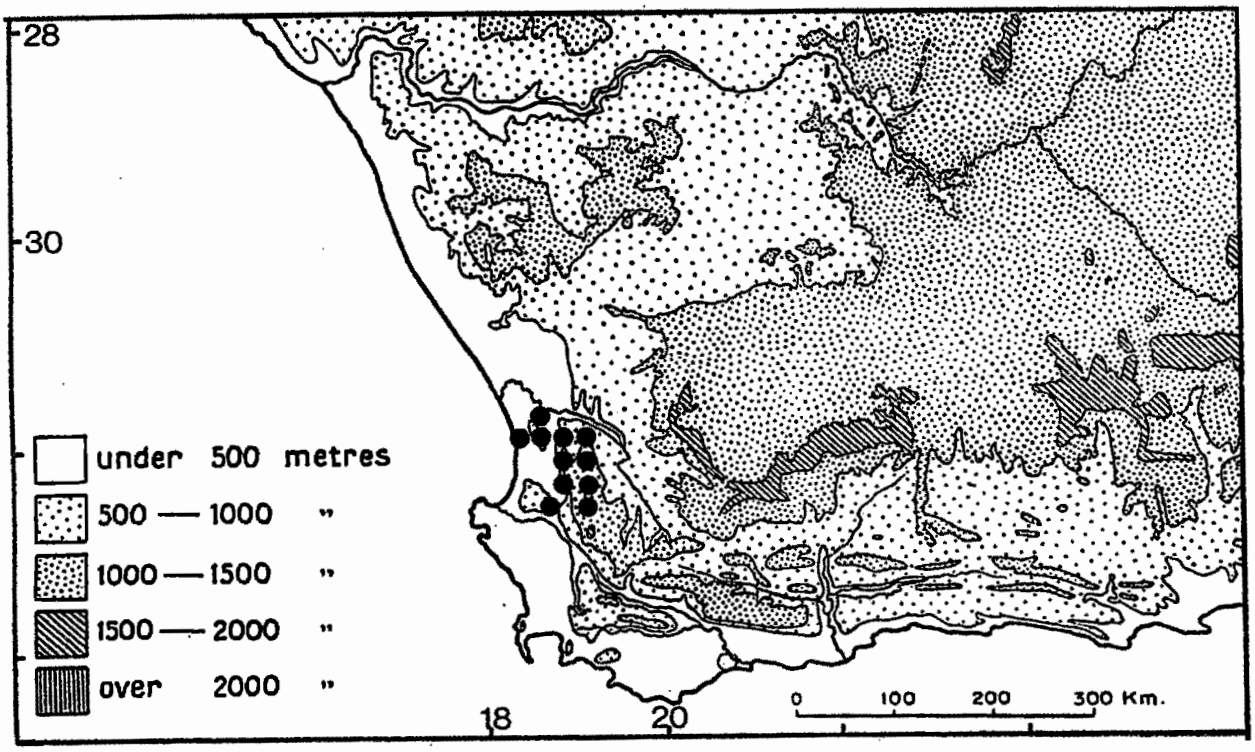


Figure 29. Distribution of *Bulbinella punctulata* ●, and *B. potbergensis* O.

Nomenclature Note: Although Penther's original type specimen for this species is no longer in existence Dr. Zahlbruckner's detailed description together with flowering time and locality, leave little doubt as to the identity of this species. The finely reticulate sheath and the small number of leaves are distinctive in the genus and are easily recognized on herbarium sheets. The epithet punctulata apparently refers to the minute whitish pelucid dots mentioned in Dr. Zahlbruckner's description. This is however a characteristic which is seen in the majority of species. On a number of herbarium specimens this species has been identified as B. peronata. However Kunth's description for that species gives "leaves about 13", whereas all collections of B. punctulata studied show at most 4 leaves.

The neotype for this name has been collected from as near as possible to the locality of Penther's original collection in the southern Cedarberg range above Porterville known as Twentyfour River Mountains.

SPECIMENS EXAMINED

3118 (Van Rhynsdorp):Matsikammaberg, N of farm Die Vlei, (-DB), 11/11/1985 D.Snijman 961 (NBG); Giftberg, slopes just below top plateau(-DC), 09-09-1962, B. Nordenstam 1374 (NBG); Giftberg(-DC),02-09-1948, R.H.Compton 20803 (NBG); Gifberg Pass(-DC),03-09-1985, P.L.Perry 3312 (NBG); Gifberg, top near second stream(-DC),03-09-1985, P.L.Perry 3316 (NBG); Giftberg(-DC),12-09-1911, E.P.Phillips 7550 (NBG,PRE).

3218 (Clanwilliam):1 mile down Die Berg rd. from Lamberts Bay turnoff(-AB),18-08-1966, J Pamphlett 102 (NBG); 8 miles from turn off to Die Berg from Graafwater(-AB),18-08-1966, J.Pamphlett 104 (NBG); Graafwater(-BA),07-09-1953, R.H.Compton 24219 (NBG); Graaf Water(-BA),18-08-1896, R Schlechter 2445 (BOL,PRE); W side of Pakhuis

Pass(-BB),02-08-1970, R.Ornduff 7176 (PRE); Lamberts Hoek Berg(-BD), B.Maguire 416 (NBG); Alpha west slope(-BD),28-07-1963, W.F.Barker 9906 (NBG); Piekeniers Pass(-DB),22-08-1966, J Pamphlett 103 (NBG, PRE.); Piekeniers Pass, Citrusdal side(-DB),10-08-1984, P.L.Perry 3140 (NBG); Piketberg Mountain Plateau.(-DC),12-09-1954, E Esterhuysen 23112 (BOL); Kapteinskloof.(-DC),05-09-1955,G van Niekerk 630(BOL, PRE).

3219 (Wuppertal):Pakhuis Pass, 2 miles from river picnic spot(-AA), 27-09-1970, W.F.Barker 10721 (NBG, PRE); Pakhuis (halfway)(-AA), 23-08-1966, G J Pamphlett 115 (NBG); Path between Heuningvlei and Koupoort(-AA),19-10-1945, E. Esterhuysen 12112 (BOL); Heuningvlei track(-AA),13-10-1984, Bean,Vlok,Viviers. 1537 (NBG); Pakhuis Pass, 28 Km from Clanwilliam(-AA),19-08-1983, P.L.Perry 3017 (NBG); Top of Pakhuis Pass. 10.4 mls from Clanwilliam.(-AA),24-08-1967, M F Thompson 308 (K,PRE,STE); Pakhuis(-AA),29-09-1940, E. Esterhuysen 3169 (BOL); Pakhuis Pass, 20 Km from Clanwilliam(-AA),29-08-1984, P.L.Perry 3173 (NBG); Pakhuis Pass(-AA),07-09-1949, W Steyn 402 (NBG); Pakhuis (-AA),23-08-1941, E.Esterhuysen 5913 (PRE, BOL); Pakhuis Pass (-AA),Sept 1942, I P Stokoe s.n. (SAM 55732); Cedarberg. In kloof above Algeria forest station (-AC),Sept 1925, P E Barnes 19290 (BOL); Eikeboom(-AC),26-09-1934, F M Leighton 21613 (BOL); Cedarberg Forest Reserve, Grootberg (-AC),16-08-1982, M Viviers 481 (STE); Middelberg, Cedarberg(-AC),Sept 1967, O Kerfoot 5967 (NBG, PRE); Cedarberg, Nieuwoudt Pass (-AC),10 Oct 1923, M A Pococks 812 (STE); Niewehoud Pass(-AC),02-08-1937, E. Esterhuysen s.n. (NBG 69871); Cedarberg, Duiwelskloof (-CA),Sept 1950, I P Stokoe s.n. (SAM 64561, PRE 38701); Elandskloof, Clanwilliam Disttrict (-CA), 20-08-1955,

I P Stokoe s.n. (PRE, SAM 68265); Top of Dasklip Pass (-CC), 09-09-1965, W.F.Barker 10301 (NBG,PRE); Porterville Mountains. Berghof, near Ratelrivier.(-CC),27-09-1972, M F Thompson 1461 (PRE, STE.); Cardouw Pass(-CC),16-09-1953, A. Middlemost 1857 (NBG); Top of Dasklip Pass(-CC),23-09-1985, P.L.Perry 3350 (K, MO, NBG, PRE, W).

5. **Bulbinella potbergensis** P.L. Perry sp. nov., species rarior, B. punctulata A. Zahlbr. tangit, folio unico et vagina compactiore fibrillosa ab ea removenda.

TYPUS.-- Cape Province: Diepkloof, north side of Potberg, September 1985 Perry 3343 (NBG, holotypus, MO, isotypus.)

Plants medium sized, solitary. Roots many, fascicled with slight proximal swellings and possibly also distal with wiry basal part, skin silvery brown. Fibrous sheathing neck formed from cataphylls; inner layer up to 150 mm long, compactly reticulate, light brown, basal 30 mm purple stained; outer older layers about 30 mm long, 12 mm wide, reticulate, dark greyish brown. Leaves 1 only in all specimens examined, 500--800 mm long, 2 mm wide, semi-terete, base slightly winged to clasp peduncle but not sheathing, bright yellow immediately above the stem disc; blade shallowly canaliculate towards the base, blueish green, somewhat coriaceous, stiffly erect with tip dying back at anthesis, margin smooth. Peduncle terete, 340--500 mm long, 1,5 mm diameter, light green becoming reddish brown towards the inflorescence. Raceme narrowly conical, 35--55 mm long in flower and bud, 9--15 mm wide, 40--50 flowers. Bracts broad based, cymbiform extending to inward curving attenuate apex, 1,75--2 mm long

membranous, hyaline with reddish brown keel, margin irregularly dentate. Pedicels 5 mm long, pale green. Perianth stellate 6,5--7 mm diameter, yellow with faint green nerve, pale orange in bud. Tepals equal to sub equal, 4 mm long, 1,5 mm wide. Filaments erecto-patent, filiform apiculate, yellow. Ovary yellow. Style yellow. Capsule and seeds not known.

Flowering time: September

Distribution and habitat: Apparently a very rare species so far found only on the north side of the Potberg range. The few plants seen were at an altitude of about 150 m growing amongst clumps of Chondropetalum microcarpum on low koppies near the base of the Potberg. Soil was a clayey silcrete with stones.

Diagnostic features: Although so little material of this species has been seen the single long leaf and neatly reticulate sheath make it a distinctive taxon, but closely related to B. punctulata.

This species was recognised as distinctive from the specimen of Acocks 22834 at PRE. According to Acocks' label it was found growing occasionally in fynbos on the north side of the Potberg at 400 feet. A search in 1985 in one possible area on the north side of the Potberg was unsuccessful, however a few scattered plants were found growing in a hilly area 0,5--1 km from the base of the mountain range.

SPECIMENS EXAMINED

3420 (Bredasdorp): N side of Potberg (-BC), 27-09-1962, J.P.H.Acocks 22834 (K, PRE); Diepkloof, N side of Potberg (-BC), 15-09-1985 P.L.Perry 3343 (NBG).

6. **Bulbinella eburniflora** P.L. Perry sp. nov. a omnibus ceteris speciebus floribus eburneis et paucis foliis canaliculatis statura variabili et marginibus hispidulis differens.

TYPUS.-- Cape Province: Farm Biekos near Nieuwoudtville, September 1985 Perry 3325 (NBG, holotypus; K, MO, PRE, isotypi).

Plants up to 0,75 m above ground. Roots numerous fascicled white, mainly with distal swollen regions 20-50 mm long, 3--4 mm diameter, on narrow bases 20-30 mm long, a few near the stem about 50 mm long, swollen for the whole length, gradually tapering. Fibrous sheathing neck up to 70 mm long, 20 mm wide; fibres very fine, somewhat reticulate, light fawn; base of sheaths purple stained on the adaxial side; inner membranous cataphyll becoming lacy above and extending up leaves about 30 mm beyond top of sheath. Leaves 3--7, erect; bases expanded, outer completely and inner partially sheathing; lamina linear, canaliculate, sizes varying, with largest up to 880 mm long and up to 8 mm wide, very gradually tapering to a point, dark green, coriaceous, parallel veins prominent, margins irregularly and finely toothed. Peduncle up to 450 mm long, 4 mm wide, terete. Raceme broadly cylindrical with rounded apex in flower, 40--100 mm long, up to 35 mm wide, 50--200 flowers; in fruit up to 150 mm long, 18 mm wide. Bracts 4 mm long, broad-based, attenuate, acuminate, membranous,

white with light green or brown keel. Pedicels 8--10 mm long, whitish in flower, becoming darker as fruit forms. Perianth stellate, 9-10 mm diameter, first green in bud becoming pale yellowish, then ivory white when open, sometimes with a strong musty odour. Tepals sub-equal, spreading. Filaments filiform apiculate, 3,5 mm long, whitish. Ovary ovoid, 1 - 1,5 mm long, green. Capsule valves up to 5 mm long, 2,75 mm wide, light fawn. Seeds up to 3,5 mm long, 2,5 mm wide, shiny black, surface finely granular, with wing about 0,5 mm wide all round.

Flowering time: August to September.

Distribution and habitat: Apparently confined to the Nieuwoudtville district where it has been found in a number of localities on flats of soft fine silty loam soils mainly in Renosterveld, but less often on a more sandy soil amongst Restionaceae.

Diagnostic features: This species is separated from similar species by its unequal sized hispido-ciliate, canaliculate leaves. In B. elegans and B. ciliolata the leaves are narrow, equal to sub equal and semi-terete. The fibrous sheath in B. eburniflora is fine, soft and somewhat reticulate whereas in B. ciliolata it is straight and loose and in B. elegans intricately reticulate. Flowers in B. eburniflora are an ivory white colour and frequently have a strong musty odour which makes them distinctive from the other two species. Blue scarab beetles of the genus Anisonyx, striped black and yellow beetles of the family Chrysomelidae and a syphid fly were collected from the flowers and possibly aided pollination. The striped beetles were also observed to be eating the

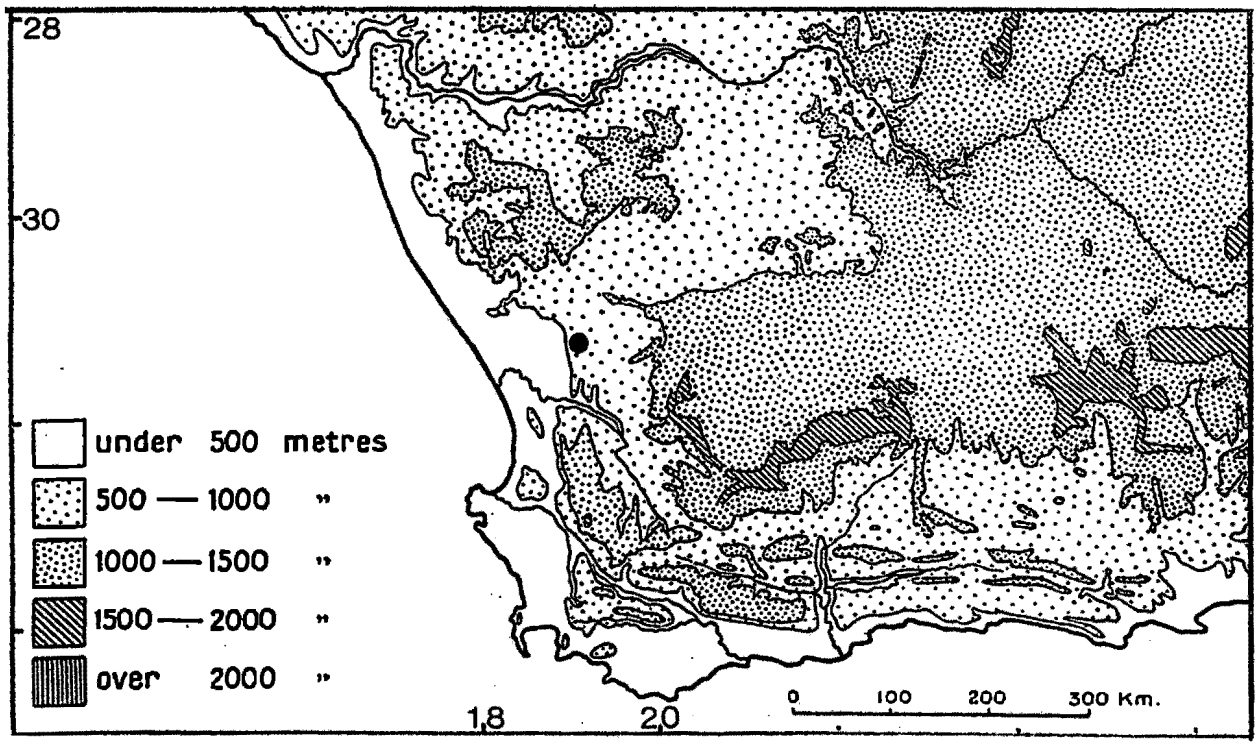


Figure 30. Distribution of Bulbinella eburniflora.

flowers.

SPECIMENS EXAMINED

3119 (Calvinia):Glen Lyon, Nieuwoudtville(-AC),04-09-1985, P.L.Perry 3318 (NBG); Roadside between farms Glen Lyon & Oorlogskloof(-AC), 04-09-1985, P.L.Perry 3324 (NBG); 4,4 miles from Nieuwoudtville to Clanwilliam(-AC),25-08-1967, M.F.Thompson 368 (PRE, STE); Halfway between Nieuwoudtville & Oorlogs Kloof (-AC),12-09-1974, A Mauve & I Oliver 59 (K,PRE,STE); 3 miles from Nieuwoudtville on road to Van Rhyns Pass (-AC), 23-08-1950, W.F.Barker 6470 (NBG); Near Grasberg, N. of Nieuwoudtville(-AC),08-08-1961, W F Barker 9353 (NBG); 3 Miles W. of Nieuwoudtville (-AC),23-08-1950, G J Lewis s.n. (SAM 64560); Farm Biekos, near Nieuwoudtville (-AC), 05/09/1985, P.L.Perry 3325 (K, MO, NBG, PRE); 5,6 km along Grasberg turn-off, towards Farm Biekos (-AC), 21/08/1986, P.L.Perry 3463 (NBG); 2 km north of Grasberg towards Perdekraal (-AC), 21/08/1986, P.L.Perry 3469 (NBG).

7. **Bulbinella cauda-felis** (L.f.) Durand & Schinz in Consp. Fl. Afr. **5:** 334 (1894).

Anthericum cauda felis L.f. Suppl. 202 (1781); Willd., Spec. **2:** 146 (1799); Baker, Trim. Journ. Bot. **10:** 137 (1872); Baker, Journ. Linn. Soc. **15:** 295 (1876). Type:- Cap. Bon. Spei. Thunberg (LINN!, lectotype here designated).

Bulbine cauda felis Roemer & Schultes, Syst. **7:1** 450 (1829).

Anthericum caudatum Thunb., Podr. Pl. Cap. 63 (1794); edit. Schultes,

Fl. Capens. 321 (1823). Type:- Cap. Bon. Spei, Thunberg (UPS, lectotype here designated, photo!).

Bulbinella ? caudata (Thunb.) Kunth, Enum. Pl. 4 572 (1843); Baker, Fl. Cap. 6 357 (1896).

Plants medium sized, varying from 0,4 m to 0,8 m high. Roots numerous, fascicled, up to 140 mm long, swollen up to 6 mm diameter the whole length or with a basal wiry part terminating in a thickened region approximately 30 mm long, 4 mm diameter, skin light fawn, flesh whitish. Stem disc approximately 8 mm diameter and 5 mm high, white to yellowish. Fibrous sheathing neck with fibres compactly reticulate or coarse, straight, loose, bristle-like. Leaves erect 5--11, with dilated bases up to 60 mm long, membranous, cream coloured, sometimes reddish above, outer completely sheathing, inner partly sheathing; laminae narrowly subulate, very gradually tapering to a point, sizes varying, largest towards the outside up to 750 mm long, 9 mm at widest, innermost much shorter, barely 2 mm wide, sometimes all leaves approximately 2 mm wide but lengths varying; canaliculate, dark to glaucous green, glabrous or rarely sparsely covered with long hairs, margin entire, or finely irregularly denticulate. Peduncle terete, up to 500 mm long, 4 mm wide, bright green. Raceme narrowly conical in flower and bud up to 200 mm long, 30 mm wide; in fruit 280 mm long, 10 mm wide, approximately 50--150 flowers. Bracts very conspicuous in bud, triangular with broad base surrounding pedicel, acuminate, 4--6 mm long, margin irregularly serrate. Pedicels 7--10 mm long, reddish pink, wiry. Perianth stellate, up to 13 mm diameter, pink in bud, opening to pure white with pink nerve. Tepals equal, elliptic, 5,5 mm long, 2,75 mm wide. Filaments filiform apiculate, 6 mm long, white. Ovary

flowers.

SPECIMENS EXAMINED

3119 (Calvinia):Glen Lyon, Nieuwoudtville(-AC),04-09-1985, P.L.Perry 3318 (NBG); Roadside between farms Glen Lyon & Oorlogskloof(-AC), 04-09-1985, P.L.Perry 3324 (NBG); 4,4 miles from Nieuwoudtville to Clanwilliam(-AC),25-08-1967, M.F.Thompson 368 (PRE, STE); Halfway between Nieuwoudtville & Oorlogs Kloof (-AC),12-09-1974, A Mauve & I Oliver 59 (K,PRE,STE); 3 miles from Nieuwoudtville on road to Van Rhyns Pass (-AC), 23-08-1950, W.F.Barker 6470 (NBG); Near Grasberg, N. of Nieuwoudtville(-AC),08-08-1961, W F Barker 9353 (NBG); 3 Miles W. of Nieuwoudtville (-AC),23-08-1950, G J Lewis s.n. (SAM 64560); Farm Biekos, near Nieuwoudtville (-AC), 05/09/1985, P.L.Perry 3325 (K, MO, NBG, PRE); 5,6 km along Grasberg turn-off, towards Farm Biekos (-AC), 21/08/1986, P.L.Perry 3463 (NBG); 2 km north of Grasberg towards Perdekraal (-AC), 21/08/1986, P.L.Perry 3469 (NBG).

7. **Bulbinella cauda-felis** (L.f.) Durand & Schinz in Consp. Fl. Afr. **5:** 334 (1894).

Anthericum cauda felis L.f. Suppl. 202 (1781); Willd., Spec. **2:** 146 (1799); Baker, Trim. Journ. Bot. **10:** 137 (1872); Baker, Journ. Linn. Soc. **15:** 295 (1876). Type:- Cap. Bon. Spei. Thunberg (LINN!, lectotype here designated).

Bulbine cauda felis Roemer & Schultes, Syst. **7:1** 450 (1829).

Anthericum caudatum Thunb., Podr. Pl. Cap. 63 (1794); edit. Schultes,

ovoid to globose, 1 mm long, 1 mm wide, green sometimes reddish tinged. Style 3 mm long, white. Capsule ovoid, 5--6 mm long, 2,5 mm wide, light fawn somewhat soft, not brittle when dry. Seed 5 mm long, 2--3 mm wide, black, wing extension not obvious, ripe seeds remaining in capsule for some time before dispersal.

Flowering time: August to December.

Distribution and habitat: This is a widespread species covering a large part of the distribution range for the genus and penetrating into the drier habitats on the northern and eastern margins. In the Saldanha/Vredendal area plants are found in sandy soils derived from granite or the coastal calcareous sands rich in humus. The surrounding mixed shrubby vegetation is of the coastal fynbos type. More frequently the species is found on shady hill slopes or flats on clayey soils amongst renosterveld or Karoo type vegetation.

Diagnostic features: B. cauda-felis is a very variable species complex in which it is difficult to find clear cut distinguishing characters, yet it is not easy to find reliable characters for separation into more than one distinctive taxon. The narrow inflorescence of white flowers with a pink tinge is one of the main characters on which it may be recognised in flower. The leaves always have a dilated sheath and somewhat glaucous appearance but in some cases they are so narrow that they could be confused with B. triquetra. In fact with a number of herbarium collections, particularly from mountainous areas it is difficult to decide if their affinities are most strongly with B. triquetra or B. cauda-felis.

Sheath fibres also vary from straight and coarsely bristle-like to finer and somewhat reticulate. This may be a result of habitat conditions as the coarse, straight fibres are found in specimens from eastern areas of lesser rainfall and clay soils. Many of these populations flower in November and December which is later in the season than is normal. The somewhat thin walled, pale fawn capsule and the large, dull black seeds are regarded as an important diagnostic character for the species.

Nomenclatural note: The type specimen of Linn.f. is housed in the herbarium of the Linnean society in London and clearly annotated 'cauda felis'. There is no information regarding the collector of the specimen which consists of an inflorescence surrounded by 5 leaves and one separate leaf but roots and fibrous sheath have been removed. There is a specimen of a similar plant in Thunberg's herbarium in Uppsala but this specimen, no. 8357, has been annotated Anthericum caudatum and was published as such in Prodromus and Flora Capensis ed.Schultes. This has no doubt led to the confusion between the epithets cauda-felis and caudatum in the naming of this species. Thunberg's no. 8358 is annotated Anthericum cauda felis with the "felis" crossed out and "tum" written in place of it and underneath "nov.spec." written apparently in different writing from the original. In any case this specimen is not the same as that of Linnaeus' son but has the broader leaf and inflorescence shape of the B. nutans group. The brief descriptions of A. cauda felis Linn. f. and A. caudatum Thunb. are almost identical.

Willdenow (1799) correctly used the name A. cauda felis but quoted A. caudatum Thunb. Schultes (1829) used Bulbine cauda felis, whereas Kunth used the epithet caudata quoting A. cauda felis of Linn. and Willd. and A. caudatum of Roem. & Schultes. Baker in the Journal of the Linnaean Society (1876) seems to have been undecided using A. cauda felis but Bulbinella

caudata in the Flora Capensis (1896). The specific epithet cauda felis consists of two words in the original description but according to Article 23.1. of the Code these must be united or hyphened. Durand and Schinz inserted the hyphen.

SPECIMENS EXAMINED

2917 (Springbok): 6,5 km West of Steinkopf towards Port Nolloth (-BA), 29-9-1986, P.L.Perry 3472 (NBG).

3118 (Van Rhynsdorp):Vleikraal, East of Klawer(-DA),Sept. 1981, I.S.Walters 182 (STE); Aties Farm, Vredendal (-DA), 9-10-1973, R.D.A. Bayliss 6121 (K).

3119 (Calvinia):Lokenburg(-CA),16-09-1956, J.P.H.Acocks 19031 (K,PRE); Plaatberg, S.W. of Calvinia(-DA),11-11-1955, J.P.H.Acocks 18614 (K, PRE).

3120 (Williston):Middelpos towards farm Bloemfontein (-CC), P.Goldblatt s.n. (NBG 128824); 17 km west of Middelpos towards farm Bloemfontein, (-CC), P.L.Perry 3371 (NBG).

3217 (Vredenburg):Witteklip, south of Vredenburg(-DD),19-09-1984, P.L.Perry 3194 (NBG); W. of Saldanha housing development, rocky ridge(-DD),19-09-1984, P.L.Perry 3196 (NBG).

3218 (Clanwilliam):Webedacht, Clanwilliam(-AC),20-09-1937, W.F.Barker 300 (NBG); Niewehoud Pass(-AC),02-08-1937, E. Esterhuysen s.n. (NBG

83576); Clanwilliam(-BB),1895, Leipoldt s.n. (SAM 22734); Sandveld between Greys Pass & Graafwater(-BC),Sept. 1940, C.L.Leipoldt 3136 (BOL); Between Citrusdal and Piquetberg(-CB),12-10-1952, S.Elioyson 168 (BOL); Greys Pass(-CB),06-09-1949, M.Steyn 374 (NBG,PRE); Dassieklip, western foothills of Piketberg(-DA),03-10-1984, P.L.Perry 3215 (NBG); Piekeniers Pass,south side(-DB),03-09-1985, P.L.Perry 3306 (NBG); Het Kruis near Piquetberg(-DB),17-09-1912, E.L.Stevens & R. Glover 8627 (BM, NBG); De Hoek, Piquetberg(-DC),28-09-1943, W.F.Barker 2569 (NBG); Piquetberg(-DC),15-09-1953, L.E.Taylor 3905 (STE); Slopes of Piketberg near the Town(-DD),02-09-1938, Hafstrom & Acocks 200 (PRE); Piquetberg(-DD),Oct. 1892, F. Guthrie 2713 (NBG); Between Citrusdal and Algeria turnoff on N7(-DD),03-09-1985, P.L.Perry 3307 (NBG); near Piquetberg(-DD),Oct. 1892, H.Bolus s.n. (BOL 012860); Between Piquetberg and Berg River Bridge(-DD),26-09-1930, D.Weintroub s.n. (BOL 032636).

3219 (Wuppertal):Foot of hill into Biedouw Valley(-AA),19-08-1983, P.L.Perry 3020 (NBG); Bidouw Valley(-AA),15-08-1967, D. McMurtry 309 (PRE); flats on top of hill down to Biedouw Valley(-AA),29-08-1984, P.L.Perry 3174 (NBG); Near bottom of pass into Biedouw Valley(-AA),24-08-1967, M.F.Thompson 354 (K,STE); Bidouw(-AA),04-09-1974, Van Breda 4278 (PRE); Middelberg, Cedarberg(-AA),Sept. 1967, O.Kerfoot 5963 (NBG); Top of Biedouw Pass(-AA),12-09-1974, A.Mauve & I.Oliver 79 (K,PRE,STE); 4 km beyond Biedouw Valley turn-off towards

Botterkloof (-AA) 22-08-1986, P.L.Perry 3493 (NBG); Matjiesrivier, Cedarberg(-AC),Sept. 1943, G.E.H.Wagener 207 (NBG); Katbakkies(-BC),Oct. 1984, Bean and Viviers 1464 (NBG); Middelberg Pass (Citrusdal)(-CA),01-10-1972,M.F.Thompson 1534(STE); 5 miles N. of Citrusdal(-CA),01-09-1945, R.H.Compton 17121 (NBG); 5 miles N. of Citrusdal(-CA),01-09-1948, R.H.Compton 20770 (NBG); Gydo Pass to Citrusdal road, 1 km south of Tandfontein turn-off (-CA) 26-09-1986, P.L.Perry 3522 (NBG); Kromme River(-CB),Sept. 1934, E.M.Leighton 21614 (BOL, PRE); Short way down hill to Kromrivier(-CB),14-08-1984, P.L.Perry 3093 (NBG); Kromrivier, short way down hill(-CB), 10-08-1984, P.L.Perry 3136 (NBG); De Keur, Cold Bokkeveld(-CD), 05-10-1946, E. Esterhuysen 13009 (BOL); Zoo ridge,Groot River road from Koue Bokkeveld(-CD), 18-09-1964, H.C.Taylor 5914 (PRE).

3220 (Sutherland): Roadside by Quaggasfontein turn-off (-AB), 26-11-1985, P.L.Perry 3377 (NBG); Farm Voelfontein (-AD), 26-11-1985, P.L.Perry 3364 (NBG).

3317 (Saldanha):Stony Head, on Donkergat road(-BB),09-09-1966, G.J.Pamphlett 118 (NBG, STE); Near Hoetjies Bay, Saldanha Bay(-BB), Sept. 1905, H.Bolus 12860 (BOL); Granite koppie just outside Saldanha(-BB),06-10-1981, L.Hugo 2937 (PRE, STE); Promontory on west side of Saldanha Bay(-BB),11-10-1933, T.M.Salter 3926 (BOL); Peninsula west of Langebaan(-BB),11-10-1933, N.S.Pillans 6958 (BOL).

3318 (Cape Town):near Langebaan(-AA),Sept.1932, Lewis s.n. (BOL 38839); Olifants Kop, near Langebaan(-CA),18-09-1974, P.Goldblatt 2707 (PRE); Groenekloof(-CB),Sept. 1883, MacOwan 2500 (SAM).

3319 (Worcester):N. Sneeurgat Peaks(-AA),01-01-1952, E. Esterhuysen 19802 (BOL, PRE); Road from Citrusdal to Cold Bokkeveld(-AB), 08-09-1945, E.M.Leighton 1258 (BOL); Hansies Berg, Ceres(-AB), 17-12-1944, R.H.Compton 16698 (NBG); Waendrift, 30 miles N. of Ceres(-AB), 20-09-1952, S.M.Johnson 508 (NBG); Klipkopjes; north ridge of Gydoberg(-AB),11-10-1974, E.G.H.Oliver 5140a (STE); Slagboom farm Witzenberg(-AB),07-12-1977, P.L.Perry 558 (NBG); Boboskloof, Cold Bokkeveld(-AB),26-10-1966, J.P.Rourke 681 (NBG,PRE); Gydouw Pass (-AB),07-12-1940, P.Bond 687 (NBG); Tulbagh(-AC), Ecklon & Zeyher 139 (SAM); Tulbagh to Wolseley, turnoff to Boontjiesrivier (-AC), 26-09-1984, P.L.Perry 3206 (NBG); Montpelier, near Tulbagh(-AC), 22-09-1985, P.L.Perry 3352 (NBG); Witsenberg(-AC),December, Zeyher 4213 (SAM); Hex River Valley(-AC),Oct. 1881, W.Tyson 656 (BOL, SAM.); Witsenberg, east slope(-AC),26-11-1941, N.S.Pillans 9711 (BOL); Mostert's hoek Twins(-AC),08-01-1944, E. Esterhuysen 9888 (BOL); Plains near Tulbagh(-AC),Oct. 1920, B.Marloth 9933 (PRE); Tulbagh(-AC),Sept. 1931,I. Brink s.n. (STE, STEU 11478); Jackals Rest(-AD),27-09-1944, R.H.Compton 16082 (NBG); Flats N.W.of Prince Alfred's Hamlet(-AD),12-10-1974, E.G.H.Oliver 5131 (STE); Mostert's Hoek Twins(-AD),01-12-1944, E.Wasserfall 793 (NBG); Prospect Peak, Hex River Mountains(-BC),02-10-1949, E.Esterhuysen 15920 (BOL, NBG); Hex River Valley(-BC),Oct. 1893, MacOwan 1662/3 (BM,G,K,P,SAM.); Theronsberg Pass, Karoopoort side(-BC), 28-10-1983,P.L.Perry 3058 (NBG); Hex River Valley(-BC),14-08-1897, A.H.Wolley Dod 4016 (BOL);

Stettynsberg(-CB),16-12-1944, E. Esterhuysen 11166 (PRE); McGregor, Vrolikheid(-CB),1971, J.F.Jooste 159 (STE); Veld reserve, Worcester(-CB),Sept. 1963, M.C.Olivier 230 (STE); Karoo Garden Worcester(-CB), 01-10-1976, M.B.Bayer 248 (NBG); Pokkraal roadside, Worcester(-CB), 28-09-1975, I.B.Walters 902 (NBG); Worcester(-CB),Sept. 1929, J.R.Theron s.n. (STEU 10012); Roadside Bossiesveld, main road to Worcester(-CD), 28-09-1980, I.B.Walters 2306 (NBG); N.W. Lemoenpoort(-CD),Sept.1983, M.B.Bayer 2935(NBG); Villiersdorp(-CD),Oct. 1941, E. Esterhuysen 2944 (BOL); Villiersdorp(-CD),12-10-1940, E. Esterhuysen 3859 (BOL); Rooihoogte Pass, N of Villiersdorp(-CD),03-10-1984, M.B.Bayer s.n. (NBG 130608); Montagu to Matroosberg, Rooihoogte Pass(-DB), 28-10-1981, Mauve,Reid & Wikner 201 (STE); Matroosberg to Montagu road near top of Burger's Pass (-DB) 6-11-1985, P.L.Perry 3357 (NBG); Matroosberg to Montagu road, 1 km NW of farm Soutrivier (-DB) 6-11-85, P.L.Perry 3356 (NBG); 14 Km from top Rooihoogte Pass toward Matroosberg (-DB), 25-9-84 P.L.Perry 3208 (NBG).

3320 (Montagu):2 km along track to Cabidu from N1(-AB),25-09-1984, P.L.Perry 3200 (NBG); Track to Cabidu just beyond gate(-AB), 25-09-1984, P.L.Perry 3201 (NBG); Turnoff N1 at Konstabel towards Elandsfontein(-AB),25-09-1984, P.L.Perry 3202 (NBG); Witteberg, near Tweedside(-AB),27-09-1951, W.F.Barker 7555 (NBG); 5 miles N. of Touws River(-AC),27-09-1949, J.L.Sidey 1890 (PRE); 6 km E. of Elandsfontein(-AD),25-09-1984, P.L.Perry 3203 (NBG); Elandsfontein, Witteberg(-AD),21-09-1931, R.H.Compton 3808 (NBG, BOL); Matjiesfontein, near station(-BA),21-10-1921, R.Marloth 10758 (PRE); Cabidu, Laingsburg(-BA),20-10-1941, R.H.Compton 12092 (NBG); Bantams Karoo(-BA),27-10-1941, R.H.Compton 12169 (NBG); Whitehill Ridge (-

BA),22-10-1942, R.H.Compton 13922 (NBG); Whitehill Ridge, south side(-BA),25-10-1943, R.H.Compton 15184 (NBG); Matjiesfontein(-BA),Nov. 1915, E.&L.Bolus 2108 (BOL); Whitehill Ridge(-BA), 25-10-1943, E.M.Leighton 256 (BOL); Witteberg, Laingsburg(-BA), 31-10-1924, R.H.Compton 2736 (BOL); Whitehill Ridge, south side (-BA),30-10-1929, R.H.Compton 3618 (BOL); Whitehill Karroo(-BA), 10-11-1935, R.H.Compton 5903 (BOL); Keurkloof(-BC),22-09-1935, G.J.Lewis s.n. (BOL 035232); Montagu Baths(-CC),Aug. 1920, M.M.Page s.n. (BOL 035131).

3321 (Ladismith):Waterkloof road in KleinSwartberg mtns NW Ladismit(-AD), 23-10-1980, Mauve, Reid & Wikner 111 (STE); Seven Weeks Poort (-AD), 30-12-1928, H.Andreae 1300 (PRE); Garcias Pass(-CC),Sept. 1908, E.P.Phillips 378 (SAM); Between farms Bonniedale and Woeska(-DD), 14-09-1985, J.H.J.Vlok 1143 (NBG).

3322 (Oudtshoorn):Swartberg, neck in summit ridge S. of Blouberg(-AC), 04-01-75, M.F.Thompson 2218 (STE); Zwartberg Pass in dit. Prince Albert(-BC),Dec. 1904, H.Bolus 11651 (BOL); Laudina(-DB),Nov. 1941, H.G.Fourcade 5452 (BOL, STE); Laudina(-DB),04-11-1941, E.Esterhuysen 6516 (BOL); near Ganskraal, 29 km E of Herold towards Avontuur(-DC),25-11-1984, P.L.Perry 3255 (NBG).

3323 (Willowmore):Poort between Uniondale and Avontuur(-CA),Dec. 1944, J.R.James s.n. (BOL 334044); Uniondale (-CA), November, H. Bolus 2494 (K); Uniondale Pass N. of Avontuur (-CA), 9-12-1950, G.C.Theron 957 (PRE); 9 km E of Avontuur towards Haarlem(-CB),25-11-1984, P.L.Perry 3253 (NBG); Btn Haarlem drift & 2,3 miles nearer Avontuur(-CB), 23-11-1943, H.G.Fourcade 6248 (STE).

3419 (Caledon):Bushman's River, Robertson Division(-BB),29-09-1935, G.J.Lewis s.n. (BOL 135176); Danger Point Caledon(-CB),1940, I.P.Stokoe s.n. (PRE 38798); Geelrug, burnt area(-DB),15-10-1983, J.Albertyn 802 (NBG).

3420 (Bredasdorp):Swellendam(-AB),25-09-1930,Fries, Norlindh & Weimarck 1395 (PRE); Potberg, De Hoop Nature Reserve(-BC),17-10-1978, Burgers 1391 (PRE); Struys Bay(-CA),Oct. 1940, C.L.Leipoldt 3247 (BOL).

3421 (Riversdale):S.E. Riversdale(-AB),11-09-1985, M.B.Bayer 4870 (NBG).

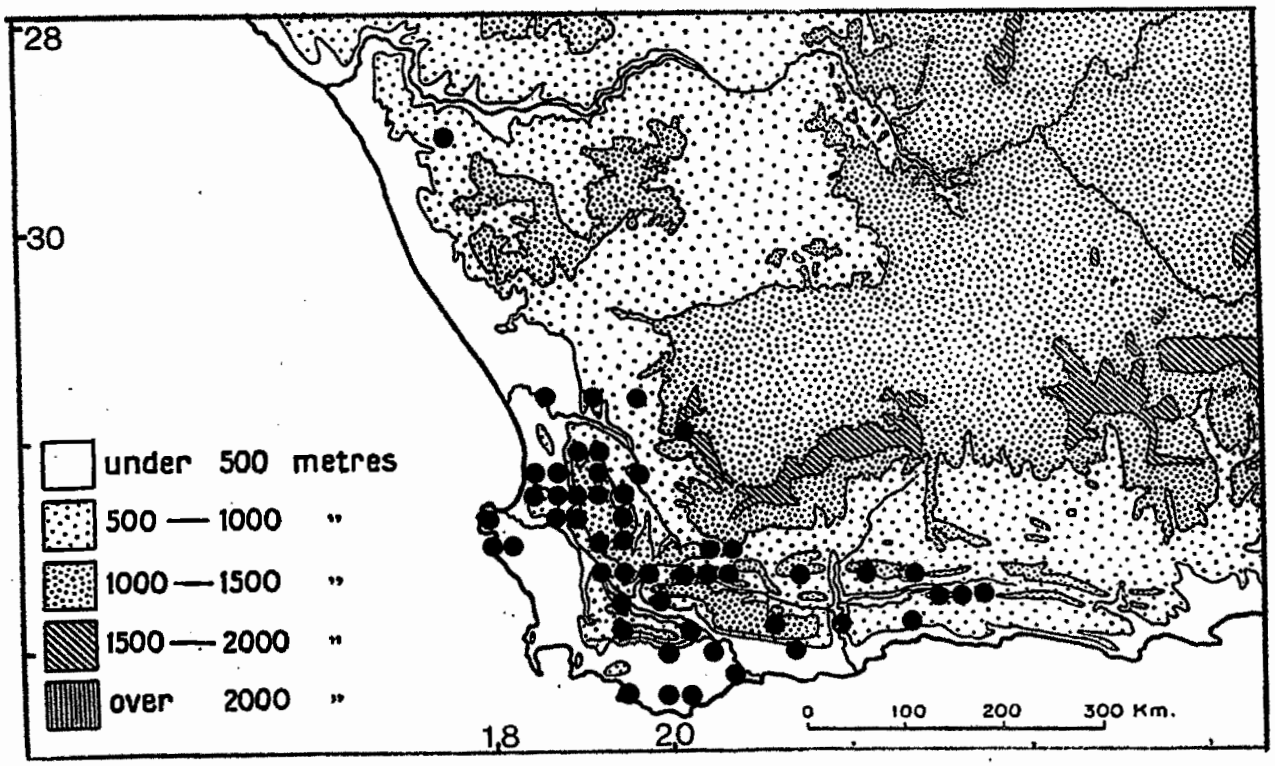


Figure 31. Distribution of Bulbinella cauda-felis.

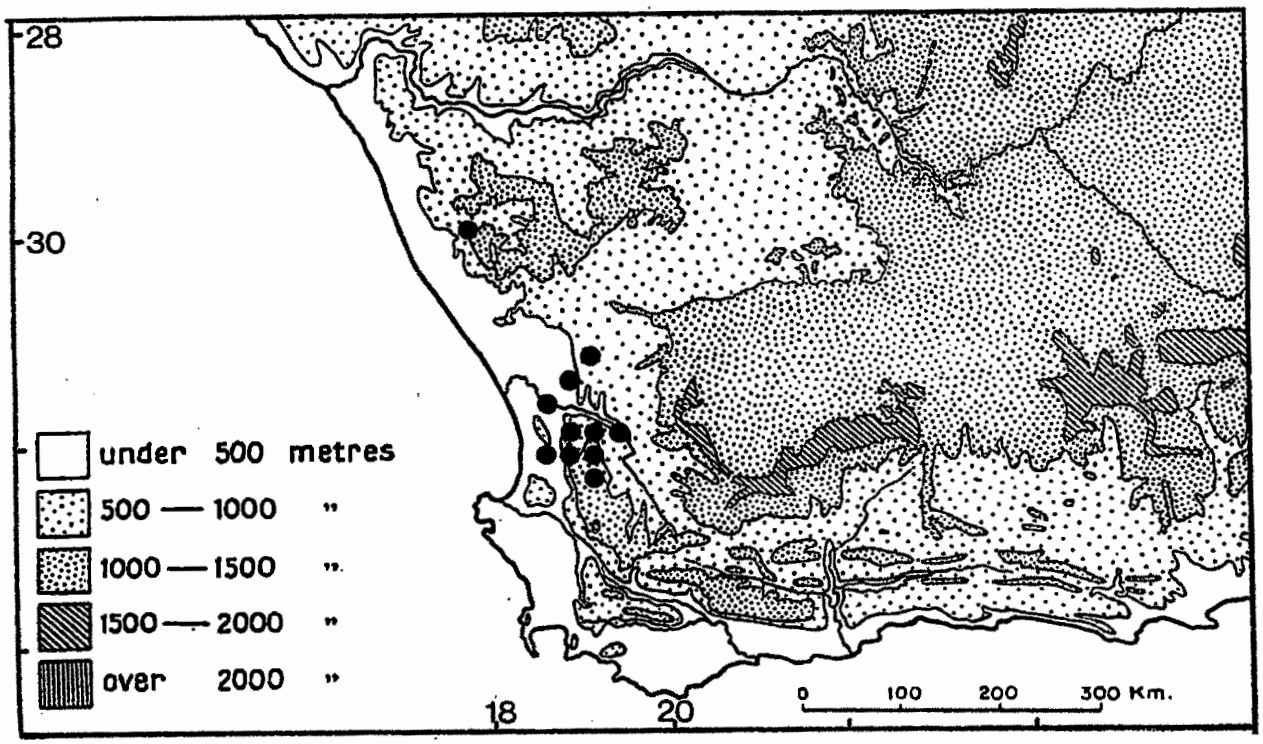


Figure 32. Distribution of Bulbinella graminifolia.

8. **Bulbinella graminifolia** P.L. Perry sp. nov., propria certe ad B. cauda-felis (Linn.f.) Durand & Schinz accedenti sed inflorescentia anguste cylindrica; vagina fibrillosa fibris subtiliter reticulatis; et semine angulis angustissime alatis alis hyalinis distincta.

TYPUS.-- Cape Province: Near Clanwilliam, opposite farm Remhoogte on road from N7 to Algeria, August 1954, Perry 3139 (NBG, holotypus; K, PRE, isotypi).

Plants medium sized, up to 0,65 m above ground. Roots fascicled with swellings proximal and distal; distal up to 35 mm long, 3 mm diameter, on wiry basal part 30 mm long, proximal approximately 10 mm long, 5 mm wide, close together at the base of stem with thinner laterals from the swollen part and with thin absorptive roots intertwined; skin light fawn, white internally. Fibrous sheathing neck up to 70 mm long, 18 mm wide at the base, fibres soft, fine, somewhat reticulate, light fawn coloured. Stem disc 5 mm across, approx 3 mm high, pale yellowish. Leaves erect, 4--9; outer broadening at the base to form a complete sheath up to 65 mm long, innermost non-sheathing, membranous; lamina subulate very gradually tapering, canaliculate to carinate, sizes varying, from outermost about 370 mm long, 6 mm wide, to innermost about 290 mm long, 1,5 mm wide; light to glaucous green; margin with irregular minute transparent crenulations. Peduncle up to 350 mm long, 1,5 mm diameter, light green, terete. Raceme narrowly cylindrical, up to 180 mm long, 15 mm wide, 70--100 flowers. Bracts ovate attenuate, 3--5 mm, membranous, colourless, faintly green keeled, or keel lacking. Pedicels 5--6 mm long, wiry, whitish. Perianth stellate up to 8 mm wide, white, pale salmon pink in bud. Tepals equal to sub-equal, 3,5 -- 4 mm long, 1,75 mm wide, elliptic, inner somewhat

cymbiform, connate at extreme base only. Filaments filiform apiculate, adnate to base of segments, 3 mm long, white. Ovary broadly ovoid to globose approximately 1 mm long, 1 mm wide, dark green to reddish brown. Style cylindrical, nearly 2 mm long, white. Capsule valves 3,5 mm long, 2,5 mm wide, light fawn coloured. Seeds, 2 -2,5 mm long, black, narrow hyaline extension all round.

Flowering time: July - August.

Distribution and habitat: This species is confined to the Clanwilliam area where it occurs on stony, clayey or loamy, damp south facing hill slopes, in Renosterveld or amongst Karroid bushes such as Eriocephalus africanus.

Diagnostic features: Closely related to B. cauda-felis but separated from that species by its considerably finer, reticulate, fibrous sheath, and its smaller more narrowly cylindrical inflorescence with flowers more pure white and faintly salmon coloured in bud but tepals not pink nerved. The fruit and the seeds of B. graminifolia are not much more than half the size of those of B. cauda-felis.

SPECIMENS EXAMINED

3017 (Hondeklipbaai):Khamieskroon(-BB),17-08-1952, H Hall 547 (NBG); Khamieskroon(-BB),17-08-1952, H Hall 548 (NBG).

3118 (Van Rhynsdorp):Mountain Pass to Kobee(-DB),08-10-1973, H.Hall 4463 (NBG, PRE, STE); Gifberg(-DC),Sept. 1911, E.P.Phillips 7538 (SAM).

3119 (Calvinia):Willemsrivier(-AC),Sept.1895, C.L.Leipoldt 808 (SAM).

3218 (Clanwilliam):Clanwilliam, near the Dam(-BB),July 1948, G.J.Lewis 3259 (SAM, PRE); 7 km S. of Clanwilliam(-BB),19-07-1984, P.Goldblatt 7131 (NBG); Beyond Paleisheuwel.(-BC),05-09-1954, M.R.Levyns 10157 (BOL); 2,5 miles S.E. of Redelinghuys(-BC),11-09-1935, N.S.Pillans 7683 (BOL); 20 km S. of Clanwilliam on National road(-BD),19-08-1983, P.L.Perry 3025 (NBG); Opposite farm Remhoogte on road from N7 to Algeria(-BD),10-08-1984, P.L.Perry 3139 (K, NBG, PRE); Dpposite Farm Remhoogte from N7 to Algeria(-BD), P.L.Perry 3308(NBG); Rondegat, 15 miles S. of Clanwilliam(-BD),04-08-1974, H.Hall 4532 (NBG, PRE, STE); 5-9 miles W of Clanwilliam, Lambert's Bay road(-BD), July 1948, I.P.Stokoe s.n. (SAM 64564); Grey's Pass (-CB), 06-09-1949, M.Steyn 374 (PRE) Piekeniers Pass (-DB) 04-09-1986 P.L.Perry 3306 (NBG).

3219 (Wuppertal):Biedouw to Wuppertal road(-AA),13-10-1984, Bean,Vlok & Viviers 1538 (NBG); near Brandewyns Rivier(-AA),Sept. 1947, G.J.Lewis 2610 (SAM); Bidouwberg(-AB),26-08-1896, R.Schlechter 8693 (BM,BOL,P,PRE.); Koudeberg, near Wupperthal(-AC),06-10-1897, H.Bolus s.n. (BOL 032606); Citrusdal rocks(-CA),08-09-1945, W.F.Barker 3767 (NBG).

9. **Bulbinella barkerae** P.L. Perry sp. nov. ad B. cauda-felis (Linn.f.) Durand & Schinz sed foliis ciliatis fructibus minoribus griseo-viridis; testa in alam crustacean semen cingens expansa differt.

TYPUS.-- Cape Province: Farm Klipfontein, N.W. end of Potberg, September 1985, Perry 3344 (NBG, holotypus; PRE, isotypus).

Plants medium sized up to 0,6 m high, solitary. Roots numerous, fascicled, those immediately below stem disc swollen near base, with contractile rings, growing more or less vertically downwards; more lateral roots spreading with distal swellings on wiry bases. Fibrous sheathing neck up to 50 mm high and 28 mm wide at the base, fibres fine to medium coarse, more or less straight, loose, untidy. Leaves 6--13, sub-erect to spreading, base dilated to form a complete sheath, cream coloured with brownish veins; lamina subulate, canaliculate; sizes varying from outer up to 300 mm long, 6 mm wide to innermost up to 120 mm long, 1 mm wide; margin with dense short cilia. Peduncle up to 400 mm long, 3 mm diameter. Raceme narrowly cylindrical, dense, in flower up to 110 mm long, 20 mm wide; 60--100 flowers; compact in fruit, up to 95 mm long, 18 mm wide. Bracts 3--5 mm long, base broad cymbiform, apex narrow attenuate, membranous white with brownish keel, margin somewhat irregularly serrate. Pedicels 5--6 mm long. Perianth stellate, up to 9 mm diameter, with a strong, rather unpleasant, musty odour. Tepals whitish with very faint pink nerve, sometimes pinkish in bud. Filaments filiform apiculate, 2,5 mm long, white. Ovary ovoid, 1 mm long, less than 1 mm wide, yellowish. Style 2 mm long, white. Capsule ovoid, 4--5 mm long, 3 mm wide, light greenish-grey. Seed grey-black, 3,5--4 mm long, 1,75--3 mm wide, with amber coloured membranous wing extension up to 1 mm wide all round.

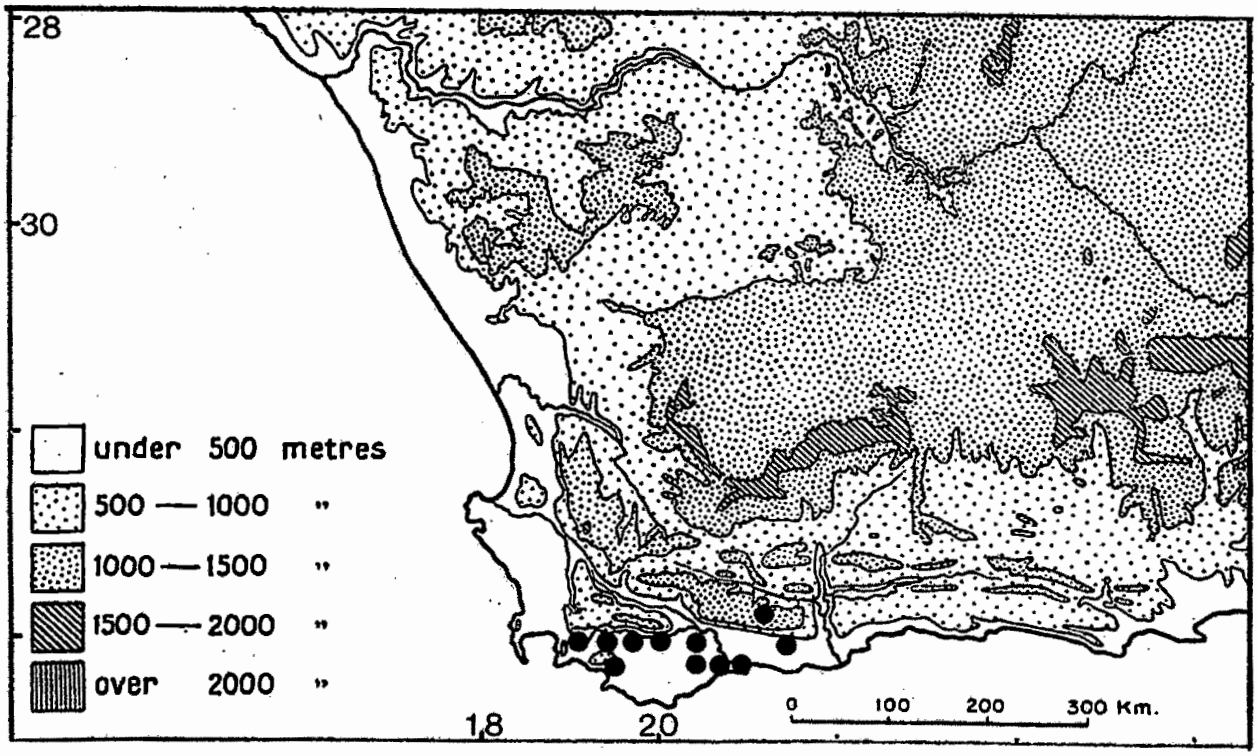


Figure 33. Distribution of Bulbinella barkerae.

Flowering time: September to October.

Distribution and habitat: Confined to the Caledon, Bredasdorp and Riversdale districts where it is found on shale flats or slight slopes mainly in Renosterveld, or on stony sandy ground at the foot of the Riviersonderend mountain range. Possibly much more common before the Renosterveld was cleared for agriculture.

Diagnostic features: Most easily confused with B. cauda-felis but separated from that species by a number of features especially the spreading leaves with regularly ciliate margins, the smaller greyish-green coloured fruits and the seeds with a broadish wing extension, also the strong smelling flowers. B. barkerae is easily separated from the other species with ciliate margins, B. ciliolata on locality and also on the broader and fewer leaves.

It is fitting that a Bulbinella should be named after Miss Barker, former Curator of Compton Herbarium because of her past interest in the genus. A specimen of this taxon in the Herbarium was tentatively identified by her as sp.nov.

SPECIMENS EXAMINED

3321 (Ladismith):Mountains Garcia's Pass(-CC),03-10-1897, E.E.Galpin 4742 (PRE).

3419 (Caledon):Bot River(-AA),19-09-1949, A.M.Wilman 799 (BOL); Hillside on outskirts of Caledon(-AB),29-09-1952, G.van Niekerk 262 (BOL); Caledon(-AB),01-09-1943, L.van Niekerk 312 (NBG); Caledon(-AB),

01-10-1846, A.Prior s.n. (K,PRE 38802); Caledon(-AB),Sept.1884, Templeman s.n. (SAM 22735); Valley S. of Shaw's mountain(-AD), 26-09-1938, M.C.Gillett 4432 (BOL, PRE); Drayton siding(-BA), P.L.Perry 3219 (NBG); near Zandfontein, Caledon district(-BA),20-10-1897, E.E.Galpin 4741(PRE); Riviersonderend(-BB),20-09-1961, J.Matthie 5 (STEU); 5 miles N.W.Riviersonderend(-BB),18-09-1949, M.Heginbotham 93 (NBG); Riviersonderend mountains(-BB),Oct. 1950,T.P.Stokoe s.n.(SAM 64563, PRE).

3420 (Bredasdorp):Bontebok Park, Swellendam(-AB),14-10-1981, Mauve & Hugo 261 (STE); National Bontebok Park, Swellendam(-AB),Sept. 1962, L.C.C.Liebenberg 6460a (PRE, STE); Farm Spitzkop, N of de Hoop(-AD),15-09-1985, P.L.Perry 3342 (NBG); Farm Klipfontein, N.W.end of Potberg(-BC),15-09-1985, P.L.Perry 3344 (NBG, PRE); Koppies E of farmhouse, S. Swellendam, N.E.Malgas.(-BD),12-09-1985, M.B.Bayer 4900 (NBG).

3421 (Riversdale):Flats and hills near Riversdale(-AB),08-09-1923, J.Muir 2685 (BOL, PRE).

10. **Bulbinella triquetra** (L.f.) Kunth in Enum. Pl. **4:** 573 (1843). Baker in Thiselton-Dyer, Fl. Cap. **6:** 356 (1896).

Anthericum triquetrum L. f., Suppl. 202 (1781); Thunb. Prodr. 62 (1794); Willd., Spec. **2:** 146 (1799); ed Schultes Fl. Cap. 317 (1823); Baker, Journ.Linn.Soc. **15:** 293 (1876). Type:- Cap. bonae Spei, Sparrman s.n. (Linn!)

Bulbine triquetra Roemer et Schultes f. Syst. **7:1** 451 (1829).

Phalangium capillare Poir. Encycl. **5:** 247 (1804). Type: without collector or locality. (P! Lamarck Herb.)

Anthericum capillare (Poir.) Roem. et Schult., f. Syst. **7:** 457 (1829). Bulbinella ? capillaris (Poir.) Kunth, Enum. Pl. **4:** 572 (1843) Bulbinella setifolia Kunth, Enum. Pl. **4:** 569 (1843); Durand & Schinz, Consp. Fl. Afr. **5:** 335 (1894). Type:- Cap. Bon. Spei, Bergius, Lichtenstein (? B, lost in war).

Bulbinella peronata Kunth Enum. Pl. **4:** 570 (1843). Type:- Cap.b.spei. Roodezand between Nieuwekloof & Slangheuwel, Drége 955 (G!).

Plants small up to 350 mm high, solitary or in small clumps. Roots fascicled, either entirely thickened more or less evenly, up to 100 mm long, 2--3 mm diameter or with wiry basal region and swollen spindle-shaped end, 20--30 mm long, 4 mm diameter, pale yellow. Stem disc 4 mm high, 4mm wide, pale yellow. Fibrous sheathing neck up to 65 mm high, 20 mm wide, fibres fine to medium coarse, straight, not reticulate, loose, untidy, bristle-like. Leaves 10--40, usually many, erect sub-equal; basal part expanded to form a sheath; outer completely encircling inner leaves and scape, expanded part becoming progressively narrower on inner leaves, whitish, membranous, veins reddish; lamina filiform, trigonous, up to 180 mm long, 1--1,5 mm wide, light green, margin very finely, irregularly toothed. Peduncle 300 mm long, 2 mm diameter, reddish to green. Raceme sub-corymbose to cylindrical with rounded apex, or narrowly conical, 20--80 mm long, 20--24 mm wide, becoming up to 150 mm in bud and fruit together; about 50--80 flowers. Bracts triangular 2-4 mm long, broad based with acuminate apex variable in length, membranous, colourless with brown keel.

Pedicels up to 8 mm long, yellowish green. Perianth stellate, 8--9 mm diameter. Tepals 3 mm long, 2 mm wide, broadly elliptic, connate at extreme base, bright yellow. Filaments filiform apiculate, 3,5--4 mm long, yellow, adnate to base of tepals. Ovary globose, about 1 mm long, yellow. Style 2,5 mm long, yellow. Capsule globose to ovoid 4 mm long, 3,5--4 mm diameter, bright green becoming fawn on drying. Seeds greyish black, 2--3,5 mm long, 1,75 mm diameter with indistinct wing extensions.

Flowering time: August to December, mainly September and October.

Distribution and habitat: A common species which appears to favour damp depressions on flats of organic rich sandy soils from the Cedarberg to the Cape Town area and east to the Caledon area, but also extends to damper shaded slopes on clayey soils in Karroid vegetation. It has been collected from a little above sea level on the Cape flats to higher mountain plateaus at up to 1500 metres altitude.

Diagnostic features: Two other species, B. divaginata and B. trinervis are of similar size and have similar narrow leaves to B. triquetra but their leaves are almost terete and without denticulations not trigonous and with finely denticulate margins as in B. triquetra. They are also both autumn flowering species with leaves in an early stage of development at anthesis whereas B. triquetra is spring flowering with leaves having completed development at flowering. B. trinervis has white flowers whereas B. divaginata and B. triquetra have yellow flowers, but the

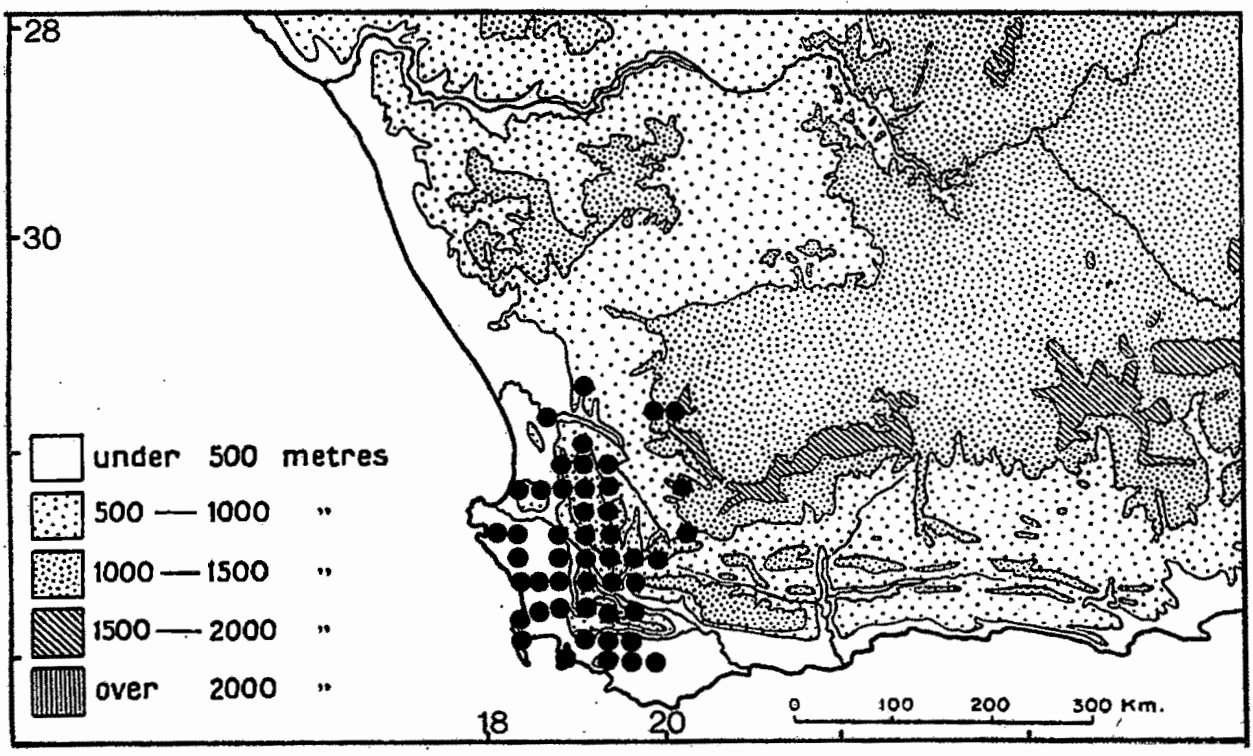


Figure 34. Distribution of Bulbinella triquetra.

latter two are clearly separated by the sheathing leaf bases in B. triquetra whereas in B. divaginata the fibrous sheath is formed from separate cataphylls.

Nomenclatural notes: In the Linnean Herbarium in London amongst the specimens of Anthericum is one annotated triquetrum by the younger Linnaeus. This specimen, apparently collected by Sparrman, shows a single complete plant with small swollen roots, fibrous sheath, several narrowly terete or triquetrous leaves with scattered small teeth along the margins and a small almost corymbose inflorescence. All features leading to a clear identification of this species. This may be regarded as the specimen used by Linnaeus'son for his description of A. triquetrum in page 202 of his Supplement. Another specimen in the Linnaean herbarium is named A. annuum although aggreeing with the specimen of triquetrum. The name was however not published in the Supplement.

In the herbarium of Thunberg at the Botanical Museum in Uppsala there are four specimens that have been annotated Anthericum triquetrum. These do not include roots and shoots and appear to belong to different taxa Nos. 8415 & 8417 agree with the type for A. triquetrum. No. 8416 is more similar to the autumn flowering species B. divaginata and the fourth specimen appears quite different having much shorter and broader leaves and is difficult to relate to any known species.

The type specimen of Phalangium capillare examined in the Lamarck herbarium in Paris clearly belonged to the same taxon as B. triquetra and so must be placed in synonomy with that species.

Kunth's description of another species, B. setifolia seems to agree well with the type for B. triquetra. Unfortunately the plants from which Kunth drew up his description have not been traced. He mentions specimens of

Bergius and Lichtenstein from Cap. b. spei. It seems likely that the Bergius in question was the German Carl Heinrich Bergius who under the patronage of Lichtenstein of the Berlin Museum obtained employment in Cape Town and in his spare time collected material for the Berlin museum. Lichtenstein had himself in his early twenties spent several years travelling extensively in the Cape. Although both Baker and Durand and Schinz included B. setifolia under B. triquetra they cited no specimens as having been seen by them.

Kunth's description of B. peronata and the locality and date given for the Drége specimen 955 as quoted are confusing as the description fits reasonably well the autumn flowering species now described as B. divaginata however the flowering time given for 955 is September (Drége, 1843). The only specimen traced containing this number is at Geneva and a clue to the confusion becomes evident as this specimen is clearly a mixed collection of B. triquetra and B. divaginata. Drége's original number has been cut out and pasted onto another piece of paper, so at some stage a specimen of B. divaginata from a different locality must have been added. Locality and flowering date clearly referred to the B. triquetra specimen. Also the epithet peronata is more easily related to the B. triquetra specimen.

SPECIMENS EXAMINED

2817 (Vioolsdrif):SW side of mountain, 3 miles NE of Stinkfontein(-CD), 06-12-1910, Percy Sladen Memorial Expedition 5638 (BOL).

3118 (Van Rhynsdorp):Koudeberg(-DC),28-08-1896, R.Schlechter 8730 (BOL,G,K,P, PRE).

3119 (Calvinia): Nieuwoudtville Wild Flower Reserve (-AC), 08-09-1983, P.L.Perry & D.Snijman 2363 (NBG); Uitkomst Farm, Nieuwoudtville(-AC),27-09-1970, W.F.Barker 10738 (NBG); about 10 miles from Nieuwoudtville on Calvinia road(-AC),Sept. 1930, L.Bolus 19604 (BOL); 10 Km along turnoff to Toren from Calvinia to Loeriesfontein road (-BC), 21-09-1986, P.L. Perry 3507 (NBG); 14 miles along old Middelpos to Calvinia road(-DD), 12-11-1974, D.Snijman 22 (NBG).

3120 (Williston):23 Km Middelpos to farm Bloemfontein(-CC),25-10-83, P.L.Perry 3053 (NBG).

3218 (Clanwilliam):23 miles N. of Citrusdal(-BD),05-09-1950, H.Hall 122 (NBG); Elandskloof Pass, upper W. slopes(-BD),03-09-1938, Hafstrom & Acocks 202 (PRE); Eland's kloof(-BD),26-09-1936, G.J.Lewis 22084 (BOL); Opposite farm Remhoogte, Algeria to Citrusdal(-BD),10-08-1984, P.L.Perry 3138 (NBG); Papkuils Vlei (Valley)(-CB),30-09-43, W.F.Barker 2637 (BOL, NBG); Farm Het Kruis, Ceres, Cold Bokkeveld (-DA),Oct. 1921, R.Marloth 10623 (PRE).

3219 (Wuppertal):Pakhuis Pass(-AA),03-11-30, E.E.Galpin 11121 (K, PRE); Boontjieskloof, N. Cedarberg(-AA),24-10-1945, E.Esterhuysen 12201 (BOL,NBG,PRE); Middelberg(-AA),14-12-41, R.H.Compton 12700 (NBG); Heuningvlei, Groot koupoort(-AA),11-10-1975, E.J.Kruger 1704(STE); Biedouw Hill(-AA),13-08-1985, P.L.Perry 3018 (NBG); near top of hill into Biedouw Valley(-AA),09-08-1984, P.L.Perry 3144 (NBG); Krakadouwsberg, Cedarberg(-AA),30-12-1941, E. Esterhuysen 7512 (BOL); Wuppertal(-AC),04-10-1985, A.Bean 1539 (NBG); Middelberg, Cedarberg(-AC),12-10-1923, M.A.Pocock 156 (STE); Farm Driehoek(-AC),07-11-1984, P.L.Perry 3248 (NBG); 2 km E of top of Uitkyk Pass(-AC),07-11-1984, P.L.Perry 3251 (NBG); Heuningvlei Forest Station, Grootkoupoort area(-AC),09-12-1981, M.Viviers 6 (STE); Middelberg plateau,

AD),04-10-56, G.J.Lewis 5071 (NBG); Darling Flora Reserve(-AD), 04-10-56, W.F.Barker 8647 (NBG); Darling(-AD),Sept. 1932, M.Lotter s.n. (STE, STEU 17093); Darling(-AD),Oct. 1932, J. Nieuwoudt s.n. (STE, STEU 16933); Darling Wild Flower Reserve(-AD),27-08-1985, P.L.Perry 33040 (NBG 132630); Lower slopes of Heuningberg, Piketberg Div.(-BB),28-10-1971, M.L.Thomas s.n. (NBG93795); Riebeck Kasteel(-BD),Oct. 1927, E. Markotter s.n. (STE, STEU 8539); Riebeck Kasteel(-BD),Sept. 1955, J.J.B.van Niekerk s.n. (STE 31517); Mamre Hills(-CB),26-09-41, R.H.Compton 11776 (NBG); Mamre Hills(-CB),22-09-42, W.F.Barker 1823 (BOL, NBG); Mamre Hills(-CB),22-09-43, E. Wasserfall 454 (NBG); Second Gate to Gansekraal(-CB),15-09-40, R.H.Compton 9447 (NBG); Camp Ground, Claremont.(-CD),Oct. 1883, H.Bolus 3763 (BOL, K); Field by Camp Ground(-CD),15-09-1895, A.H.Wolley Dod 532 (BM, BOL, K); Beyond Milnerton(-CD),28-09-28, J.Hutchinson 556 (BOL, K, PRE); Camp Ground, Cape Peninsula(-CD), 26-09-1955, T.M.Salter 9636 (BM,BOL); Rondebosch Common(-CD),19-09-50, H.A.Baker s.n. (NBG69572); Rondebosch Common - Camp Ground Road(-CD),1982-09-07, M.R.A. Edwards s.n. (NBG 124695); Kalbaskraal(-DA),29-09-58, Werdermann & Oberdieck 317 (K, PRE); Paarl(-DB), J.G.Smith s.n. (STE 31552); Zoutfontein Beacon hill on farm Domania(-DC), 23-11-70, J.P.H.Acocks 24501 (K, PRE); Killarney(-DC),08-09-1984, P.L.Perry 3191 (NBG); Sewefontein above Kuils River(-DC),02-10-73, E.G.H.Oliver 4735 (PRE); Near Joostenberg between Durbanville & Paarl(-DD),11-10-49, E.Esterhuysen 16048 (BOL, NBG, PRE.); On hill between Klapmuts & Simondium(-DD),Oct. 1930, H. Morrison s.n. (STE, STEU 11112).

3319 (Worcester):Sneeuwgat, Great Winterhoek, Tulbagh(-AA),Nov. 1916, E.P.Phillips 1882 (SAM); Great Winterhoek(-AA),31-12-1951,

E.Esterhuysen 19797 (BOL); near base of Sneeuwkop(-AA),29-09-1934, F.M.Leighton 21612 (BOL); Visgat, between Schurfteberg & Great Winterhoek(-AA),Oct. 1953, T.P.Stokoe s.n. (SAM 63174); road to Witsenberg Vlakte, Tulbagh(-AA),17-11-1941, F.M.Leighton s.n. (BOL 035222); Houtenberg Rivier, Cold Bokkeveld(-AB),Dec. 1944, G.J.Lewis 1451 (SAM); Hansiesberg, lower slopes(-AB),Dec. 1944, G.J.Lewis 1452 (SAM); Gydo Pass, swamp(-AB),18-12-44, R.H.Compton 16747 (NBG); Gydouw, Ceres division(-AB),Sept. 1941, C.L.Leipoldt 3891 (BOL); Boboskloof farm, Cold Bokkeveld(-AB),25-10-1966, J.P.Rourke 674 (NBG, PRE); Romans River(-AC),14-09-41, R.H.Compton 11662 (NBG); Witsenberg vlakte Nek, Ceres(-AC),17-11-1941, R.H.Compton 12464 (NBG); near Tulbagh(-AC),29-09-1945,F.M.Leighton 1311(BOL); Elandskloof, Ceres(-AC),25-09-1936, M.R.Levyns 5795 (BOL); Between Darling Bridge and Artois(-AC),14-09-1941, E.Esterhuysen 6089 (BOL); Darling Bridge(-AC),14-09-1941, E.Esterhuysen 6097 (BOL); Tulbagh Road(-AC), H.Herre s.n. (BOL 035171); Baboon Peak, Hex River Mountains(-AD),11-11-1973, E. Esterhuysen 33335 (BOL); Ceres(-AD),02-10-1933, M.R.Levyns 4693 (BOL); Bokkerivier Farms,S.E.of camping site, Ceres(-AD),09-11-1963, L.I.Boovsen 76 (NBG); Waaihoek mountain(-AD),16-12-1942, E.Esterhuysen 8281 (BOL); Milner Ridge Peak(-AD),10-11-1943, E.Esterhuysen 9343 (BOL); Ceres, road between Rosendalfontein & Visgat(-AD),25-11-1941, N.S.Pillans 9677 (BOL); Ceres(-AD),Sept. 1938, H.C.vand de Merwe s.n. (STE 31516); Roodeberg(-BC),Jan.1940, E. Esterhuysen 1519 (BOL); Hottentots Kloof(-BC),27-09-44, R.H.Compton 16080 (NBG); near Laaken Vlei, Matroosberg(-BC),26-11-1917, E.P.Phillips 2089 (SAM); near Laakenvlei, Matroosberg(-BC),02-12-1917, E.P.Phillips 2090 (SAM);

Hottentots kloof, Ceres(-BC),19-10-1941, D.L.Olivier s.n. (NBG 69582); Horseshoe Ridge Peak, Hex River Mountains(-BD),01-11-1953, E. Esterhuysen 22215 (BOL); Buffelshoek Peak, Hex River Mountains(-BD),02-01-1955, E.Esterhuysen 24052 (BOL); Botha's Halt(-CA), 14-09-1928, J.B.Gillett 281 (STE); Veld opposite Gevonden farm stall, Rawsonville(-CA),09-09-1962, I.B.Walters 393 (NBG); Langerug koppie, south side(-CB),02-10-1974, I.B.Walters 1246 (NBG); Worcester(-CB),18-08-1963, R.D.A.Bayliss 1645 (PRE); Farm Groenrivier, Botha,(-CB),08-09-1979, I.B.Walters 1902 (NBG); Groenvlei area on Divisional Council property(-CB),27-08-1980, I.B.Walters 2112 (NBG); Skoonuitsig farm, Botha, Worcester(-CB),02-09-1980, I.B.Walters 2146 (NBG); Veld reserve Worcester(-CB),Aug. 1963, M.C.Olivier 269 (PRE, STE); Sentinel Peak, Hex River mountains(-CB),15-12-1957,E. Esterhuysen 27429(BOL); Karoo Garden Veld, Worcester(-CB),30-08-1977, P.L.Perry 436 (NBG); Goudini Road(-CB),Oct. 1921, M.R.Levyns 4424 (BOL); Breede River flats(-CB),26-09-1983, D.Snijman 754 (NBG); 17 miles from Villiersdorp to Worcester(-CB),16-09-1968, J.A.Marsh 890 (PRE, STE); Worcester(-CB), W. Naude s.n. (STE 31555); near Worcester(-CB),Aug. 1926, C.L.Leipoldt s.n. (STEU 252195); Wemmershoek Peak(-CC), 31-12-1944, E. Esterhuysen 11283 (BOL); Du Toit's Peak(-CC), 27-12-1949,E.Esterhuysen 16639(BOL); April Peak, Wemmershoek mountains(-CC),15-12-1940, E.Esterhuysen 4130 (BOL); Farm Meerlust, Doornrivier, Worcester(-CD),20-09-1976,I.B.Walters 1523 (NBG); Doornrivier(-CD),29-08-1980, I.B.Walters 2212 (NBG); Rabiesberg slope(-DA), 26-09-1935, G.J.Lewis s.n. (BOL 032669); Wansbek, Robertson.(-DC), 26-08-65, Van Breda & Joubert 2004 (PRE); Sewefontein above Kuils River(-DC),02-10-1973, E.G.H.Oliver 4735 (STE).

3320 (Montagu):Tweedside,on mountain(-AB),Oct.1921, R.Marloth 10824 (PRE); Cabidu, Laingsburg(-AB),20-10-1941, W.F.Barker 1897 (NBG); Cabidu, Laingsburg(-AB),28-09-1951,R.H.Compton 22891(NBG).

3418 (Simonstown):Bergvliet Farm Constantia(-AB),14-09-1916, W.F.Purcell 10 (SAM); Near Wynberg(-AB),Oct.1892, R.Schlechter 1685 (K, PRE); Diep River(-AB),Oct.1915, R.Marloth 7141 (PRE); Near Bergvleit, Cape Peninsula(-AB),16-09-1938, I.M.Salter 7643 (BOL, K); De Klip, C. Peninsula(-AB),11-08-1940, I.M.Salter 8463 (BOL); Bergvleit, hill at Firgrove(-AB),24-09-1916, Purcell 984 (STE); Bergvliet, Cape Peninsula(-AB),18-09-1938, I.M.Salter s.n. (BOL 035206); Firgrove, Bergvleit, Cape Peninsula(-AB),24-09-1916, W.F.Purcell s.n. (BOL); Bettys Bay(-BD),Aug 1963, W. Topper 153 (NBG).

3419 (Caledon):Houw Hoek Pass(-AA),24-09-1958, E.Werdermann & H.Oberdieck 156 (K,PRE); Bot River(-AA),19-09-1949, A.M.Wilman 796 (BOL); Caledon(-AB),11-09-1917,F.Purcell 100(SAM); 12 m. E. of Caledon on road to Riversonderend(-AB),19-09-68, A.A.Mauve 1776 (PRE); Caledon commonage(-AB),12-09-31, W.F.Barker 2 (BOL, K, PRE); Dunghye Park, Caledon(-AB),Sept. P.G.Jordaan 202 (STE); Outskirts of Caledon(-AB),27-09-52, G.van Niekerk 261 (BOL, PRE); Field outside Caledon(-AB),03-09-71, M.L.Strauss 28 (NBG); near Caledon(-AB),06-10-55, G.van Niekerk s.n. (PRE 38803); Caledon(-AB),Oct. 1923, M.Radloff s.n. (STE, STEU 12744); 5,5miles from Caledon to Shaws Pass(-AD), 29-09-1969, J.A.Marsh 1434 (PRE, STE); Shaw's Pass, near top(-AD),16-10-1984, P.L.Perry 3226B (NBG); Valley S of Shaw's mountain(-AD),27-09-1938, M.C.Gillett 4436 (BOL, K, PRE); Drayton siding(-BA), P.L.Perry 3220 (NBG); Springerskuil(-BC),06-09-1984, P.L.Perry 3160 (NBG); Fairfield(-BD),27-08-62, J.P.H.Acocks 22642 (K, PRE); Napier(-BD), J.Wackock s.n. (STE 31554).

11. **Bulbinella ciliolata** Kunth in Enum. Pl. **4:** 570 (1843). Type:- Cape Province: Between Pedroskloof & Leliefontein. Drége s.n. (G!, lectotype here designated.)

Anthericum ciliolatum Baker in Trim. Journ. Bot. **10:** 137 (1872); Baker, Journ Linn. Soc. **15:** 294 (1876).

Bulbinella caudata var. ciliolata (Kunth) Baker in Thiselton-Dyer, Fl. Cap. **6:** 357 (1896).

Plants medium sized, less than 0,6 m high. Roots numerous, fascicled, thickened the whole length up to 120 mm long, 3 mm diameter, or with swollen ends. Fibrous sheathing neck 60--80 mm long, 30 mm at widest, fibres straight, coarse, loose to compact, bristly above. Leaves 12--40, erect to sub-erect, equal to sub-equal; base of outer leaves dilated to form a membranous, colourless sheath up to 50 mm long, inner not sheathing; lamina filiform, semi-terete, up to 700 mm long, 1,5 mm wide, dark green, margins irregularly, shortly ciliate. Peduncle up to 350 mm long, 2--3 mm diameter. Raceme dense, narrowly conical to sub-cylindrical up to 100 mm long, 30 mm wide in flower and bud, elongating as fruits form; about 125 flowers. Bracts narrowly triangular up to 7 mm long, white keeled green, membranous, margin irregularly serrate. Pedicels 7--15 mm long, very pale pink in flower becoming green in fruit. Perianth stellate, 8--9 mm diameter. Tepals equal to sub-equal elliptic 5 mm long, 2 mm wide, white, faintly pink in bud. Filaments filiform apiculate, 3,5--4 mm long, white.

Ovary ovoid, 1,25 mm long, 1 mm wide, greenish yellow. Style narrowly cylindrical, 2,5 mm long, white. Capsule valves 5,5--6 mm long, 3,75 mm wide, fawn with 3 wavy veins lengthwise, whole open capsule 5 mm across. Seeds 4,75 mm long, 2,75 mm or 1,85 mm wide, black with flat, brown, hyaline extensions at each end up to 0,5 mm wide.

Flowering time: July, August, September.

Distribution and habitat: This species appears to be restricted to northern Namaqualand in the vicinity of Springbok and Kamieskroon. It occurs in Namaqualand Broken Veld on sandy loams of the granite hills, especially in damper depressions or by streamlets but is never common.

Diagnostic features: Leaves of this species are similar to B. elegans although tending to be narrower and more numerous, however it is easily distinguished from that species by the fibrous sheath which is loose and straight in B. ciliolata but compactly reticulate in B. elegans.

The inflorescence is similar to B. cauda-felis and in flower may be confused with narrow leaved forms of that species. Although fruits and seeds should help to distinguish the two species further study of more living collections would help to clarify the situation.

Nomenclatural notes: Kunth quotes no number for the Drége specimen he cites for B. ciliolata but adds the name Bulbine caudata as Drége's identification. On Drége's label for the specimen in Geneva is written Bulbine caudata Spr.e. P.B. Spei Drége 1839. Drége Documente gives the locality between Pedroskloof & Leliefontein. The specimen in Geneva is a complete plant and compares well with Kunth's description of B. ciliolata.

Drége specimens in K and BM and named Bulbine caudata have the leaves separated out and show no sheaths and so are not easily identified, also Drége localities given for Bulbine caudata Spr. a, b, c and d conform more to Bulbinella cauda-felis than to B. ciliolata. The specimen in Geneva has therefore been chosen as the lectotype for B. ciliolata.

SPECIMENS EXAMINED

2917 (Sprinkbok):near O'kiep(-DB),Sept. 1883, H.Bolus 6586 (BOL); Nabapeep(-DB),05-09-1951, W.F.Barker 7432 (NBG); Top of Messelpad Pass.(-DC),24-07-1957, J P H Acocks 19363 (K, PRE.).

3017 (Hondeklipbaai):Grootvlei Pass. 4,7 km east of farm.(-BB), 15-08-1979, P L Perry 1127 (NBG); Khamieskroon(-BB),24-08-1941, R H Compton 11315 (NBG, BOL); Between Kamieskroon & Grootvlei Pass.(-BB),25-08-1976, Rosch & Le Roux 1445 (PRE); 1 mile S of Kamieskroon(-BB),Sept. 1945, G.J.Lewis 1454 (SAM); Grootvlei, W. of Kamieskroon.(-BB),28-08-1957, J P H Acocks 19462 (PRE); 8 Km E. of Khamieskroon(-BB),19-09-1972, H.Hall 4238 (NBG); Khamieskroon(-BB),24-08-1941, E Esterhuysen 5666 (BOL); 3,5 km east of Grootvlei Farmhouse (-BB), 13-08-1986, P.L.Perry 3168 (NBG).

3018 (Kamiesberg): 20,3 Km from Kamiesberg towards Leliefontein (-AA), 28-09-1986, P.L.Perry 3548 (NBG); De Kom 3 miles from Leliefontein(-AB),Oct 1940, C.L.Leipoldt 3138 (BOL); Welkom, Khamiesberg near Garies (-AC), 16-10-1954 E. Esterhuysen 23689a (BOL).

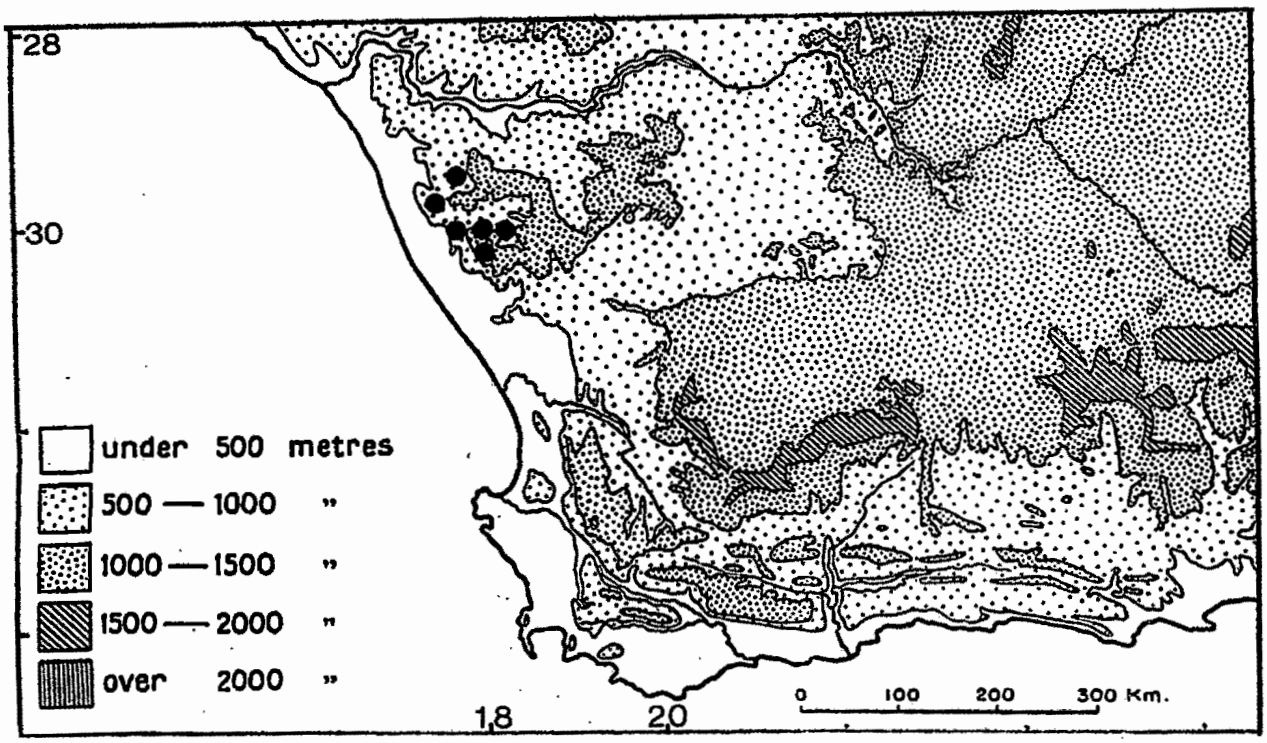


Figure 35. Distribution of Bulbinella ciliolata.

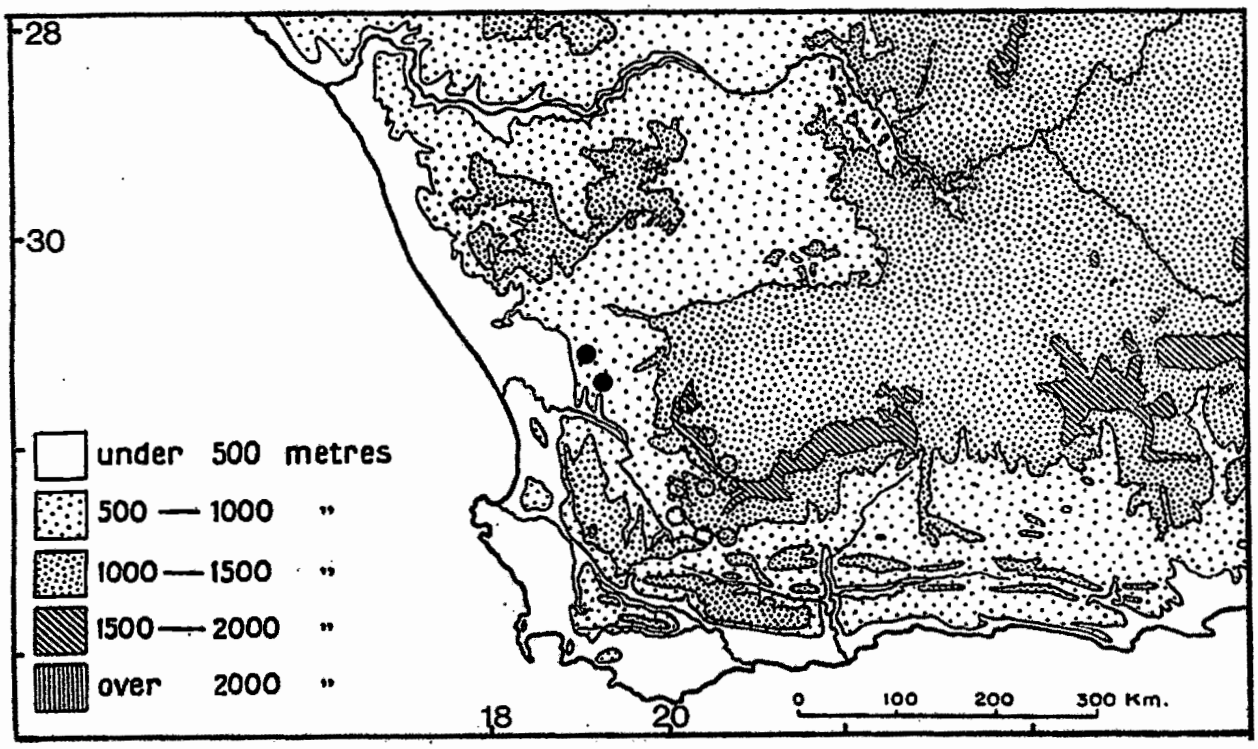


Figure 36. Distribution of Bulbinella elegans, yellow flowers ●, white flowers O.

12. **Bulbinella elegans** Schlechter ex P.L. Perry sp. nov. B. ciliolatae Kunth arcte affinis sed vaginae fibris dense arctissime reticulatis statim diagnoscenda.

TYPUS.-- Cape Province: Matjiesfontein, Onder Bokkeveld, 20 August 1897 Schlechter 10930, (K!, holotypus; BM!, BOL!, P!, PRE! isotypi).

Plants up to 0,6 m tall. Roots many, fascicled; those directly below the stem disc swollen proximally; those from the sides basally wiry with swollen ends up to 50 mm long, 5 mm diameter, and laterals arising from the swollen region. Fibrous sheathing neck up to 65 mm high, 17 mm diameter of several layers, fibres tough, reticulate sometimes becoming loose and untidy in the upper and outer parts especially in older plants, light to dark brown. Leaves 3--25, erect, sub- equal, basal 50-70 mm completely sheathing, white with green reticulate veins prominent when visible above the fibrous neck; laminae narrowly linear up to 300 mm long, 3 mm wide, innermost somewhat narrower and shorter, dark green both surfaces, somewhat fleshy to coriaceous, margin irregularly denticulate. Peduncle terete up to 400 mm long, 4 mm diameter, reddish green. Raceme compact cylindrical, about 90 mm long, 25 mm wide, flowers 70--100. Bracts prominent in bud, up to 5 mm long, broadly lanceolate attenuate, membranous, colourless with reddish brown keel. Pedicels 7--8 mm long, colour dependent on flower colour. Perianth stellate, 7--8 mm diameter. Tepals either lemon yellow or pure white with pinkish tinge, filament and ovary and style the same colour as the tepals. Filaments filiform apiculate, 3--3,5 mm long. Ovary ovoid, 1,5 mm long, 1 mm wide, Style cylindrical, about 2,75 mm long. Capsule ovoid, up to 5,5 mm high, 3,5 mm diameter, shiny green becoming light fawn on drying. Seeds up to 4,5 mm long, greyish black, shiny, with

light brown membranous extension widest at each end.

Flowering time: July to October, mainly August (lemon yellow-flowered form) and September (white-flowered form).

Distribution and habitat: This species is found from the flatter parts of the Nieuwoudtville/Calvinia plateau to the Sutherland and Laingsburg districts, at an altitude of 600-1000 metres. It inhabits a variety of vegetation and soil types but occurs mainly in the drier areas of the distribution range for the genus. There are two distinct flower colour forms - pure white with pink tinge and lemon yellow. The flower colour however does not vary within a population. The lemon yellow form appears to be confined to Western mountain Karoo vegetation of the doleritic and dwyka clays in the Nieuwoudtville/Calvinia area. The white form occurs in the Sutherland and Laingsburg districts mainly in Mountain Renosterveld on sandy or shale derived soils.

Diagnostic features: B. elegans appears to be most closely related to B. triquetra being a larger form of that species in which the broader leaf has developed a more intricate system of conducting tissues resulting in a basal sheath with more prominent reticulate veins and with the remaining dead fibres solidly compact and intertwined, whereas in B. triquetra the fibres are shorter, straighter and looser. The dense reticulate fibrous sheath is also the main distinction from B. ciliolata which has a loose straight fibrous sheath.

Nomenclatural notes: Schlechter left specimens at a number of herbaria which he had collected among hills on the farm Matjiesfontein,

south of Nieuwoudtville. On the specimen at Kew the inscription "elegans Schlechter sp. nov." occurs and so that name is adopted here.

SPECIMENS EXAMINED

3119 (Calvinia): 5,1 km along Theunisdrift road from turn-off near Grasberg (-AA), 21-08-1986, P.L.Perry 3470 (NBG); Matjiesfontein, Onder Bokkeveld(-AC),20-08-1897,R Schlechter 10930 (BOL, BM, G, K, P, PRE.); +- 10 Miles E.S.E. of Nieuwoudtville.(-AC),17-09-1957, J P H Acocks 19492 (PRE); 2-4 miles to Loeriesfontein near Nieuwoudtville(-AC), Sept. 1930, L Bolus 19601 (BOL); Nieuwoudtville Reserve (-AC), 08-09-1983, P.L.Perry & D.Snijman 2362 (NBG); Roadside nr farm Matjiesfontein SE Nieuwoudtville(-AC),04-09-1985, P.L.Perry 3323(NBG); Glen Lyon, Nieuwoudtville(-AC),05-09-1985, P.L.Perry 3336 (NBG); Glen Lyon farm, N.E. of Nieuwoudtville.(-AC),11-09-1974, I Oliver & A Mauve 36 (PRE); 4 km W of Nieuwoudtville(-AC),14-08-1972, H.Hall 4225 (PRE); Glen Lyon. South of Nieuwoudtville. (-AC), 11-09-1974, I Oliver & A Mauve 56 (PRE, STE); Mc Gregor's farm, Nieuwoudtville.(-AC),02-09-1959, D.S.Hardy 71 (K, PRE); 34 Km S Farm Oorlogskloof towards Botterkloof (-CA), 22-08-1986, P.L.Perry 3479 (NBG); Augustfontein Mountain(-CB),27-08-1956, J P H Acocks 18981 (K,PRE).

3120 (Williston):Bloemfontein Farm, E of Middelpos(-CC),29-09-1970, W.F. Barker 10780 (NBG); 16,8km N of farm Bloemfontein on Calvinia road(-CC),05-09-1985, P.L.Perry 3327 (NBG); 2,9 km E of Farm Bloemfontein on Middelpos road(-CC),05-09-1985, P.L.Perry 3330 (NBG); 14,2 miles on old rd. Middelpos to Calvinia(-CC),02-10-1974, K.Heimstra 592 (NBG).

3220 (Sutherland):between two Bo-Visrivier turnoffs, Middelpos rd.(-AB),06-09-1985, P.L.Perry 3331 (NBG); Geelhoek (Vyffontein).(-BC), 21-09-1953, J.P.H.Acocks 17181 (K, PRE); Bo-Visrivier area near farm Hottentotsfontein(-BC),06-09-1985,P.L.Perry 3334 (NBG); Farm Rooikloof, 4 km south of Sutherland (-BC), 12-08-1986, K. Steiner 799 (NBG); Houthoek, Sutherland(-CA),31-08-1971, W.J.Hanekom 1548 (K,PRE); 42 Km from Matjiesfontein on Sutherland road(-CB),06-09-1985, P.L.Perry 3335 (NBG); Koedoesberg. S.W. of Sutherland.(-CC),01-09-1973, M F Thompson 1772 (STE); Verlaten Kloof(-DA),07-09-1926, M R Levyns 1596 (BOL).

3319 (Worcester):Titus River Valley E. of Eselfontein(-AD),10-10-1974, E.G.H.Oliver 5095 (STE).

3320 (Montagu):Tweedside(-AB),24-09-1932, W F Barker 20640 (BOL); 4 Mls. S. of Matjiesfontein on Cape Town road.(-AB),01-09-1968, D.S.Hardy 2454 (K, PRE); Tweedside, Laingsburg(-AB),30-09-1926, R.H.Compton 3126 (BOL); Farm Geelhoek on way to Voëlfontein(-AB),06-09-1985, P.L.Perry 3332 (NBG); Tweedside, Voetpadsberg.(-AB),27-09-1951,W F Barker 7487(NBG); Witteberg(-BA),24-10-1943, R H Compton 15219 (NBG); Foot of Witteberg.(-BA),12-10-1929, R H Compton 3554 (BOL, NBG); Whitehill(-BA),20-08-1931, J Archer 381 (BOL); Matjiesfontein(-BA),Aug. 1915, F.& L.Bolus s.n. (BOL 035139).

13. **Bulbinella trinervis** (Baker) P.L. Perry Comb. nov., stat nov.

Anthericum triquetrum L.f. var. trinervis Baker in Journ.Linn.Soc. **15** 294 (1876). Type:- Cape Province, Houw Hoek Mountains, Burchell 8043, (K!, lectotype here designated).

Bulbinella triquetra (L.f.) Kunth var. trinervis Baker, Fl. Cap. **6**: 356 (1896).

Plants small, up to 0,4 m above ground. Roots about 16, thickened along the whole length, from 50 mm to 95 mm long, 4 mm wide, growing more or less vertically downwards; thin absorptive roots growing separately and as laterals from older swollen roots, skin very light fawn, inside white. Fibrous sheathing neck up to 120 mm long, 15 mm diameter; fibres fine, straight to somewhat reticulate, compact, basally purple stained. Stem disc 4 mm high and 4 mm diameter, internally whitish. Leaves 5--7, surrounded at the base by a cataphyll, about 25 mm high, pale cream coloured, thin membranous, supported by a few fine fibrous strands; new leaves scarcely developed at flowering, fully developed up to 400 mm long, 1 mm wide, semi-terete, bright green; minute sparsely scattered teeth along the two margins; old leaves turn brown and remain for more than a year becoming somewhat spiralled. Peduncle terete, up to 350 mm long, approximately 1 mm diameter, glabrous, bright green to reddish. Raceme narrowly conical in bud becoming narrowly cylindrical, up to 90 mm long, 17 mm diameter in fruit and bud, 30--60 flowers. Bracts 1--1,5 mm long, broad bracket-shaped surrounding pedicel at the base, membranous, transparent, pinkish keeled. Pedicels 5 mm long, whitish or pinkish in flower becoming green in fruit. Perianth stellate, 6--7 mm diameter, pale pink in bud.

Tepals sub-equal, inner slightly cymbiform, 3 mm long, 1,5 mm wide, white, nerve pale pink. Filaments adnate to base of tepals, filiform apiculate, 2,5--3 mm long, white. Ovary globose 1 mm long, 1 mm wide, yellow-green. Style cylindrical,1,25 mm long, white. Capsule 4 mm high, light brown. Seed 3,5 mm long, 2 mm wide, black with lighter, narrow, marginal wings.

Flowering time: December to May, mostly March, April.

Distribution and habitat: This species is found in the western part of the southern Cape excluding the peninsula, where it grows on rocky lower mountain slopes up to an altitude of about 500 metres. It has been collected most frequently on sandy soils amongst fynbos vegetation but also on shales with clayey soils. In the north western part of its range it grows sympatrically with another common autumn flowering species B. divaginata.

Although many of the collections come from S.W. corner of the Cape this may be a reflection of collecting pressures and the species may occur more commonly, than has been recorded, in the mountainous regions such as the Langeberg and Rooiberg. Time of flowering in the hotter months of summer and early autumn is another possible factor limiting accurate distribution records.

Diagnostic features: B. trinervis may be confused with B. triquetra because of the similar narrow leaves. However the two species differ in several ways. The white flowers of B. trinervis are produced in autumn after a period of rest with leaves just beginning into growth at anthesis,

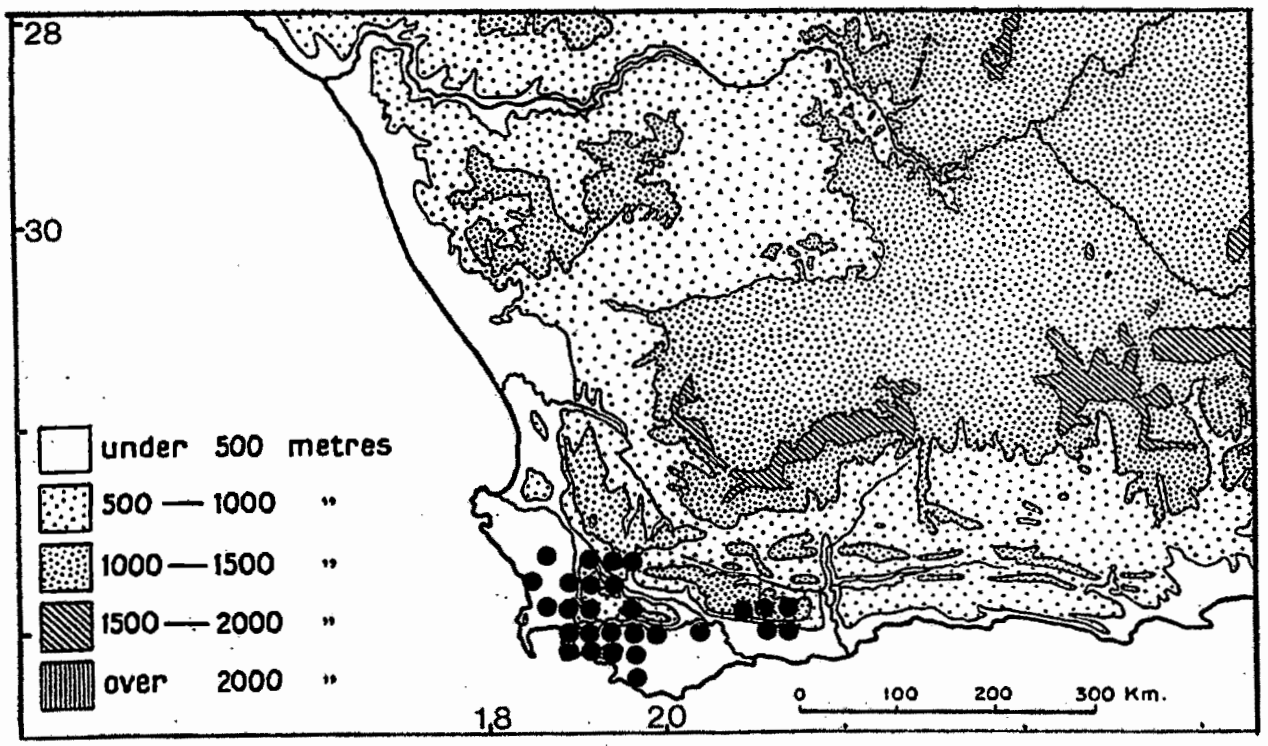


Figure 37. Distribution of Bulbinella trinervis.

but frequently with long loosely spiralled brown remains of the previous year's leaves. B. triquetra has yellow flowers produced when leaves are fully developed in spring. Bracts in B. trinervis are very distinctive in the genus being broad and truncate without the more typical attenuate apex. B. trinervis may also be confused with narrow leaved forms of B. caudafelis, especially those populations flowering later in the season in November and December. The non-sheathing leaf bases and small bracts, also the smaller seeds are characters that most surely separate B. trinervis in this case.

Nomenclatural note: Baker (1876, p.294) described briefly a variety trinervis under A. triquetrum. He cites two specimens. One is Burchell 8043 which is in the herbarium at Kew, and this specimen has the locality Houw Hoek mountains and the date March 1818. This information helps to make certain of the identity of this specimen, which shows clearly identifiable characters. The other specimen Baker quotes was collected by Thunberg but there is no number and the locality given - Cold Bokkeveld is vague. None of the four specimens of Thunberg annotated A. triquetrum in the herbarium at Uppsala is of the same taxon as Burchell 8043.

Although Baker described this as a variety of B. triquetra apart from the similarly very narrow filiform leaves the two taxa are not close and B. trinervis should be regarded as a separate species.

SPECIMENS EXAMINED

3318 (Cape Town):between Malmesbury and Morresburg(-BC),Ap-May 1947, G.J.Lewis 2611 (SAM); Mamre Road area(-BC),29-04-1976, E. Esterhuysen 34275 (BOL,K); Riverlands, Malmesbury(-BC),26-04-1978,

E. Esterhuysen 34924 (BOL,K); Malmesbury(-BC),28-04-1947, W.F.Barker 4493 (NBG); Melkbosch turning(-CB),25-04-1948, W.F.Barker 5346 (NBG); Paarl(-DB),26-04-1946, R.H.compton 17984 (NBG); Kanonberg (Tygerberg)(-DC),02-04-1944, R.H.Compton 15617 (NBG); Tygerberg Nature Reserve(-DC),03-05-1975, J.W.Loubser 3061 (PRE); Summit of Kanonberg(-DC),02-04-1944, F.M.Leighton 423 (BOL); Sewefontein above Kuils River,(-DC),05-04-74, E.G.H.Oliver 4840 (PRE,STE); Jonkershoek: contour path below 3rd Ridge Peak(-DD),01-03-1980, H.C.Taylor 10115 (STE); Jonkershoek State Forest. The Valley(-DD), 15-04-1976, E.Kruger 166 (PRE,STE); Jonkershoek, Stellenbosch(-DD),08-04-1951, E.Esterhuysen 18496 (NBG); Jonkershoek Twins(-DD), 08-04-1951, E.Esterhuysen 18497 (BOL); Jonkerhoek Forestry Reserve: Abdolskloof(-DD),07-04-1982, M.Viviers 222 (STE); Jonkershoek, Stellenbosch(-DD),15-04-1949, G.D.Morris 36 (NBG); Stellenbosch(-DD),April 1917, A.V.Duthie 449 (BOL); Jonkershoek,Jakkalsvlei.(-DD),04-04-1963, H.C.Taylor 4664 (K, PRE, STE); Jonkershoek(-DD), 17-03-1964, H.C.Taylor 5725 (PRE); Jonkershoek Mountain slopes,Stellenbosch(-DD),28-03-1943, E.Wasserfall 94 (NBG); Kleinplass, Jonkershoek(-DD),April 1967, D.Kerfoot K.5790 (STE).

3319 (Worcester):Slanghoek(-AC),23-03-1960, G.J.Lewis 5713 (NBG, PRE); Waboomsrivier, Wolsely(-AC),April 1946, I.P.Stokoe s.n. (SAM 60607); Tuesday's Peak, Waaihoek Mountains(-AD),01-04-1934, E.E.Galpin 12751 (K,PRE); Michell Peak,Ceres(-AD),27-03-1949, E.Esterhuysen 15199 (BOL, NBG); West foot of Waaihoek Peak(-AD),10-04-1955, E.Esterhuysen 24295 (BOL.); Ceres(-AD),10-05-1925, R.Marloth 6460 (STE); Mostert Hoek Twins(-AD),21-02-1985, S.Liede s.n. (NBG 132598); Hex River Valley near De Doorns(-BC),April 1907, H.Bolus 13204 (BOL); Summit Klein Drakenstein mountains near Salem farm(-CA),06-03-1931,

E.E.Galpin 10601 (PRE); Klein Drakenstein Mountains near farm Salem(-CA),13-04-1931, E.E.Galpin 11061 (K,PRE); Seven Sisters Mountains, Paarl(-CA),09-02-1947, E. Esterhuysen 13739 (BOL); Top of Bains Kloof(-CA),Feb. 1928, I.P.Stokoe 1613 (PRE); Hawequas mountains W. of Microwave Tower(-CA),24-02-1972, E.G.H.Oliver 3733 (PRE, STE); Limietberg, Paarl(-CA),March 1940, E.Esterhuysen s.n. (BOL 032673); Between Darling Bridge and Worcester(-CB), E.M.Leighton 1649 (BOL); Bothashalt(-CB),10-04-1959, P.A.B.van Breda 540 (PRE); Riverside (-CB) , 22-03-1985, M.B.Bayer 3617 (NBG); French Hook Pass, Villiersdorp end(-CC),April 1966, M.R.Levyns 11562B (BOL); Top of French Hoek Pass(-CC),03-05-1945, E.Esterhuysen 11612 (BOL, K); Zachariashoek exp. catchment, Kasteelkloof(-CC),08-03-1973, R.D.Smith 118 (STE); Slopes of Haalhoek,Sneeuwkop.(-CC), 13-03-1949, E.Esterhuysen 15183 (PRE); Berg River Hoek, Paarl(-CC), 07-04-1944, R.H.Compton 15633 (NBG); Wemmershoek, lower slopes(-CC),29-04-1951, E.Esterhuysen 18595 (BOL,PRE); Wemmershoek Valley, below April Peak(-CC),27-04-1952, E.Esterhuysen 20088 (NBG, PRE,BOL); Fransch Hoek(-CC),24-03-1926, C.A.Smith 2656 (PRE); French Hoek Pass(-CC),March 1934, Smuts & Gillett s.n. (STE 31553); Klein Drakenstein, Leliefontein Farm, Paarl(-CC),04-05-1966, M.Lawyer s.n. (NBG 84059); Ouklaarberg, 20 miles S. of Worcester(-DC),Dec. 1924, I.P.Stokoe 1072 (PRE).

3320 (Montagu):Kortfontein, Langeberg(-DD),01-03-1984, Liede & Kotze s.n. (NBG 128820).

3321 (Ladismith):Langebergen, Riversdale(-CC),14-02-1893, R.Schlechter 2200 (K, PRE); Southern slopes, Ladismith(-CD),08-08-1977,R.A.Haynes 1384(STE).

3324 (Steytlerville):Baviaans kloof, (CA),12-12-1976, R.D.A.Bayliss 7999 (PRE).

3418 (Simonstown):Steenbras DAm(-BB),03-04-1949, A.M.Wilman 191 (NBG,BOL); Wesselgat, near Elgin(-BB),27-03-1959, H.B.Rycroft 2173 (NBG, STE); Boland Trail, between Sir Lowrys Pass & Verkykers Kop(-BB),02-05-1982, C. Burman 772 (BOL); Palmiet river bank and mountain ridge(-BB),25-04-1948, M.P.deVos 890 (STE); Sir Lowry's Pass, Steenbras side(-BB),March 1948, T.P.Stokoe s.n. (SAM 64555); Kleinmond(-BD),19-03-1983, C. Burman 1117 (BOL); Kogelberg Forest Reserve(-BD),26-03-1970, C.Boucher 1204 (K, PRE, STE); Kogelberg STate Forest Research site(-BD),12-04-1978, R.A.Haynes 1441 (STE).

3419 (Caledon):Houw Hoek Mountains(-AA),April 1892, E. & E.A.Guthrie 2320 (NBG); Lower slopes west of Palmiet River near Elgin(-AA),24-04-1943, E.M.Leighton 492 (BOL); Lebanon 2c(-AA),17-03-1967, E.J.Kruger 701 (NBG); Nieuwekloof, Houw Hoek Mountains(-AA),16-03-1815, Burchell 8043 (K); Top of Viljoens Pass, Caledon(-AA),March 1951, T.P.Stokoe s.n. (SAM 64557); Sandfontein, Zwarteberg(-AB),06-04-1897?, R.Schlechter 10356 (BM, K, P, PRE); Happy Valley(-AB),12-04-1941, W.F.Barker 1896 (NBG); Shaws Pass, Caledon(-AB),April 1950, G.J.Lewis 3256 (SAM); Hills N of Baths Caledon(-AB),15-03-1916, E. Purcell 64 (SAM); Caledon(-AB),11-03-1916, E.Purcell s.n. (SAM 46237); Hermanus, flats near Klein River(-AD),29-04-1934, E.E.Galpin 12831 (PRE); Vogelgat Kloof,above Dragonfly Pool(-AD),01-04-1979, I.Williams 2761 (NBG, PRE); Fernkloof Nature Reserve, Hermanus(-AD),1980, C. Robertson 294 (K); Vogelgat, near Hermanus. Above Dragonfly Pool(-AD),02-04-1984, P.L.Perry 3107 (NBG); Vogelgat, east of Olinia Glade(-AD),14-03-1982,I.Williams 3211(NBG); Die Mond, Voelklip, Hermanus (-AD) 17-03-1981, S.L.Williams 648 (K); Kleinriviermond(-

AD),March 1933, P.G.Jordaan 789 (STE); Shaws Pass, Caledon(-AD),April 1950, G.J.Lewis s.n. (PRE, SAM 64552); Kanonkop, Behind Genadendal(-BA),04-03-1985, P.L.Perry 3259 (NBG); Genadendal, lower slopes of Kanonkop(-BA),21-02-1966, J.P.Rourke 328 (NBG); Greyton(-BA), 23-04-1973, R.D.A.Bayliss 5698 (NBG); Swartberg, near Drayton siding (-BA), 13-03-1986, J.H.J.Vlok 1438 (NBG); Riviersonderend mountains(-BB),30-04-1950, A.M.Wilman 1003 (BOL); Lower slopes of Riviersonderend mountains(-BB),Ap.-May1950,G.J.Lewis 3257(SAM); Paardeberg(-BC),March 1950, T.P.Stokoe s.n. (SAM 64554); Elim(-DA),April 1916, M.Frowein 15542 (PRE); Hills just north of Elim(-DA),29-03-1971, E.G.H.Oliver 3343 (K, PRE, STE).

3420 (Bredasdorp):Ten o'clock Mountain, Swellendam(-AB),05-04-1952, T.M.Wurts 15 (NBG); Swellendam(-AB),01-04-1926, C.A.Smith 2734 (PRE); Swellendam mountain, south slopes(-AB),04-02-1941, E. Esterhuysen 4833 (BOL); Ten o'clock mountain, Swellendam(-AB),14-01-1953, T.M.Wurts 549 (NBG); Road to Bontebok Park, Swellendam(-AB), 09-05-1978, P.L.Perry 717 (NBG); National Bontebok Park, Swellendam(-AB),March 1963, L.C.C.Liebenberg 7202 (PRE); Swellendam mountain(-AB),04-02-1941, P.Bond 946 (NBG); Swellendam(-AB),Jan-Mar1930, Thode A2400 (K,PRE).

3421 (Riversdale):Grootberg,south slopes of peak.Heidelberg.(-AA), 18-02-1981, H.P.Linder 2782 (BOL); Riversdale(-AB),25-01-1966, J.P.Rourke 311 (NBG).

14. **Bulbinella divaginata** P.L. Perry sp. nov. vaginae parte interiore basi fibrosa protrudenti conspicue albidus; B. triquetra (L.f.) Kunth frequenter confusa sed autumno florens foliis terentibus haud denticulatis subhysteranthus facile distinguenda.
TYPUS.-- Cape Province: Boontjieskloof, near Pakhuis, May 1985, Perry 3267 (NBG, holotypus; K, MO, PRE, G, isotypi).

Plants small to medium, up to 0,45 m above ground, solitary or up to 5 plants together. Roots fascicled 5--20 fusiform up to 150 mm long, 8 mm at the widest, a few thin absorptive laterals arising towards the apices; skin light to chestnut brown, yellow internally; many withered remains of old roots. Stem disc 7 mm long, 4 mm wide, orange. Fibrous sheathing neck showing two distinct regions, the outer consisting of old loose bristle-like fibres, up to 80 mm long, 14 mm wide, fine, straight or somewhat reticulate, light brown to greyish; inner region formed of several layers of membranous, white cataphylls up to 90 mm long and conspicuous beyond the outer old fibres; upper part showing fine reticulate strands as thin tissue between starts disintegrating; inner two cataphylls usually shorter than outer. Leaves usually numerous, up to 40, but may be as few as 4, only partly developed at anthesis; laminae fully developed some months after flowering, all approximately the same size, filiform, semi-terete, up to 500 mm long, 1--1,5 mm wide, dark green, glabrous, margins without denticulations. Peduncle terete, 100--150 mm long, 1--2 mm diameter. Raceme narrowly cylindrical 25--175 mm long and up to 20 mm wide, 20--150 flowers. Bracts somewhat variable either small, approximately 1 mm long and wide, ovate attenuate, membranous, transparent and inconspicuous especially in the bud stage, or becoming more attenuate and up to 3 mm

long. Pedicels up to 7 mm long, green. Perianth stellate, 7--9 mm diameter, bright yellow. Tepals sub-equal, oval to elliptic, shallowly cymbiform. Filaments filiform apiculate, about 3 mm long and 0,5 mm at widest near the base, yellow. Ovary ovoid to subglobose, a little more than 1 mm long, 1 mm wide, yellow. Style cylindrical, 1,5 mm long, yellow. Capsule 5 mm long, 3,5 mm wide, light brown. Seed 3,5--4 mm long, 1,75--2 mm wide, with yellow to orange thin flaky covering over the shiny black testa.

Flowering time: March to June.

Distribution and habitat: This species is common in the Western Cape from Northern Namaqualand to the Paarl/Malmesbury area in the south. It occurs mostly in the more hilly or mountainous areas and apparently not in the sandveld of the coastal flats. It is found on a variety of soil types from fine clay overlying shales where it is usually on south facing stony slopes amongst Karroid bushes such as Pteronia incana, Rhus undulata and R. incisa, to sandy Table Mountain Group derived soils amongst fynbos vegetation and associated with plants such as Protea nitida, Restio sp., Erica sp. and Metalasia muricata.

Plants collected in the Algeria area on Table Mountain Group derived soils tended to be more sparsely distributed with smaller inflorescences fewer flowers and fewer but thicker leaves, than plants from populations in the drier Karroid Biedouw area.

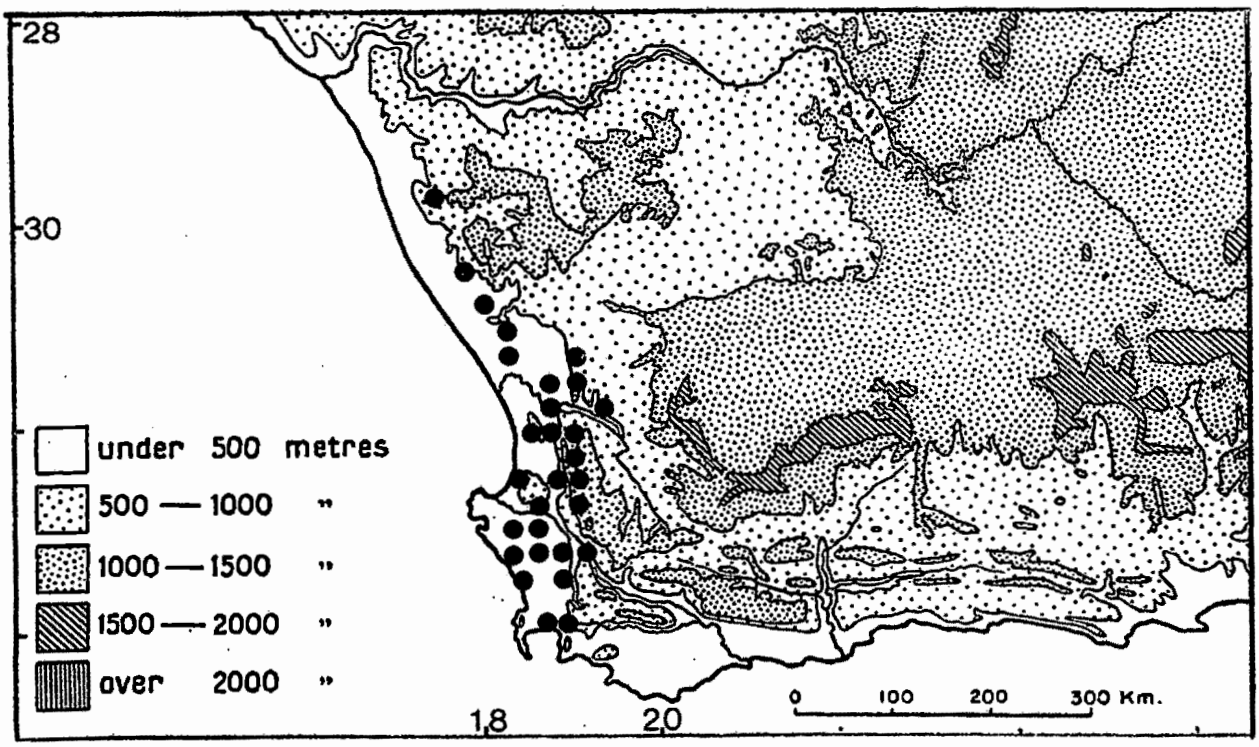


Figure 38. Distribution of Bulbinella divaginata.

Diagnostic features: Although this species shows some variation in certain characters such as size of plant and number of flowers and leaves it is an easily recognised and distinctive autumn flowering species. An important diagnostic feature is the membranous white cataphylls surrounding the base of the leaves which show beyond the fibrous remains.

The narrow filiform leaves have resulted in this species being frequently identified as B. triquetra but several features distinguish it from that species. In particular the structure of roots is quite different, the distal swollen regions typical of B. triquetra not being found in B. divaginata. B. divaginata is a distinctly autumn flowering species normally appearing a few weeks after the first good winter rains when the leaves are still only in an early stage of development. June is the latest time of flowering of any of the more than 50 specimens identified as B. divaginata.

B. divaginata appears most closely related to B. gracilis, differing from that species in the more elongated inflorescence, narrower more filiform and non-succulent leaves and the well developed fibrous sheath.

SPECIMENS EXAMINED

2917 (Springbok):4 Km from Sannagas farmhouse towards Kammagas(-DC), 04-06-1980, E.van Jaarsveld 5370 (NBG).

3017 (Honderklipbaai):N. bank of Groenrivier, 17 Km S.W. of Garies(-DB),04-06-1973, H.Hall 4276 (NBG, PRE).

3018 (Kamiesberg):Between Bitterfontein & Eenkooker(-CC), Zeyher 1691 (K,SAM).

3118 (Van Rhynsdorp): Meerhofkasteel (-AA), 01-04-1986 P.L.Perry 3143 (NBG); 2 Km north of Nuwerus(-AB), 27-04-71, H.Hall 3957

(NBG); Moedverloor(-AD),15-04-1971, H.Hall 3932 (NBG); Sandkraal(-DB),09-05-1947, G.G.Smith s.n. (NBG 83571) Gifberg; flats near top of pass(-DD),08-05-1971, M.F.Thompson 1178 (STE); Top of Gifberg, 13 Km from Sandkraal.(-DD),30-03-1982, P.L.Perry 1808 (NBG).

3119 (Calvinia):near Nieuwoudtville(-AC),18-04-1937, R.H.Compton 6620 (NBG); 9 miles S. of Nieuwoudtville(-AC),23-04-1971, E.A.Buhr s.n. (NBG 92537); Lokenburg(-CA),16-03-1957, J.P.H.Acocks 19195(K, PRE); Lokenburg(-CA),08-05-1971, H.Hall 3968 (NBG); Near Botterkloof(-CD),15-04-1958, B.Martin 1151 (NBG); Flats on top of Botterkloof Pass(-CD),06-05-1985, P.L.Perry 3287 (NBG), 6,2 km Doring River Bridge towards Botterkloof, (-CD), 09-04-1986, P.L.Perry 703 (NBG).

3218 (Clanwilliam):Die Berg road from Graafwater.(-BA),none, J.Pamphlett 106 (NBG); Ramskop , near Clanwilliam(-BB), Louis Leipoldt 145 (BOL); 4 miles S.E. of Clanwilliam on Algeria road.(-BB), 01-04-1970, W.Wisura 264 (NBG); Clanwilliam(-BB),Aug.1897, Leipoldt 430 (SAM, BOL); Near Clanwilliam Dam on Graafwater road(-BB), 03-05-1963, W.F.Barker 9863 (NBG); Clanwilliam(-BB),May 1915, Edwards s.n. (BOL 135167); Opposite Farm Remhoogte (-BD) P.L.Perry 3309 (NBG); Hills above Aurora(-CB), J.Pamphlett 105 (NBG); Top of Grey's Pass(-DB),02-05-1953, E.Esterhuysen 21361 (BOL); Eendekuil,(-DB), 04-05-1953, H.Herre 3160 (BOL); Grey's Pass(-DB), 04-05-1951, W.F.Barker 7297 (NBG); De Hoek mountain slopes, Piquetberg.(-DC),April 1947, G.J.Lewis 2613(SAM).

3219 (Wuppertal):Boontjieskloof(-AA),06-05-1971, M.F.Thompson 1162 (PRE, STE); Hillside near Brandywynriver, (-AA), 11-05-1934, E E Galpin 12950 (PRE); Between Brandewyn River & Doornbosch(-AA),April 1947, G.J.Lewis 2614 (SAM); Hill leading to Biedouw valley(-AA),29-03-1984, P.L.Perry 3103 (NBG); 5,5 km along Wuppertal road from Biedouw Valley

turn-off (-AA) 29-03-1984 P.L. Perry 3101 (NBG); Farm Kleinfontein between Pakhuis and Traveller's Rest(-AA),06-05-1985, P.L.Perry 3265 (NBG); Boontjieskloof, near Pakhuis(-AA),06-05-1985, P.L.Perry 3267 (NBG) Near Traveller's Rest P.O. (Brandywyns River)(-AA),11-05-1934, I.M.Salter 4439 (BOL); Vleikraal, east of Klawer(-AB),June, 1980, I.S.Walters 133 (STE); Cedarberg, NW of Algeria forest station(-AC),29-03-1984, P.L.Perry 3105 (NBG); Nieuwoudt Pass, Cedarberg (-AC), 11-04-1986, P.L.Perry 3434 (NBG); Matjiesrivier, Cedarberg(-AC),16-04-1943, M.G.E.Wagener 37 (NBG); Olifants River Valley, S. of Citrusdal.(-CA),17-04-1949, G van Niekerk 15274 (PRE, K); S. slopes along Thee River,S. of Citrusdal(-CA),17-04-1949, E.Esterhuysen 15274 (BOL, K, NBG); Thee Rivier Kloof, 15 miles S.of Citrusdal(-CA),April 1949, D.K.Davis 64558 (SAM); Near Wuppertal(-CA),01-04-1941, Compton & party s.n. (NBG 83567); Olifants R. Dome(-CC),12-05-1963, E. Esterhuysen 30177 (BOL,K).

3318 (Cape Town):Geelkuil, on road to Hopefield(-AB),22-04-1964, D.K.Fisher 29 (NBG); Kapokberg, S of Darling(-AD),26-04-1985, S. Liede s.n. (NBG 132622); Swartberg, Moorresburg(-BA),14-06-1946, P.G.Jordaan 547 (STE); Malmesbury(-BC),28-04-1947, W.F.Barker 4492 (NBG); North of Malmesbury.(-BC),May 1941, F Z Van der Merwe X9 (PRE); Riebecks Kasteel(-BD),14-05-1931, M.R.Levyns 3103 (BOL); Riebeeck Kasteel (-BD), 22-04-1986, J.P.Rourke 1852 (NBG); S. foot of the Paardeberg, Malmesbury(-CB),06-05-1955, G. van Niekerk 364 (BOL, PRE); Mountain slope Paarl(-DB),May 1929, M.W.Smuts s.n. (STE, STEU 10654).

3319 (Worcester):Elands kloof, Ceres(-AC),07-04-1947, W.F.Barker 4476 (NBG).

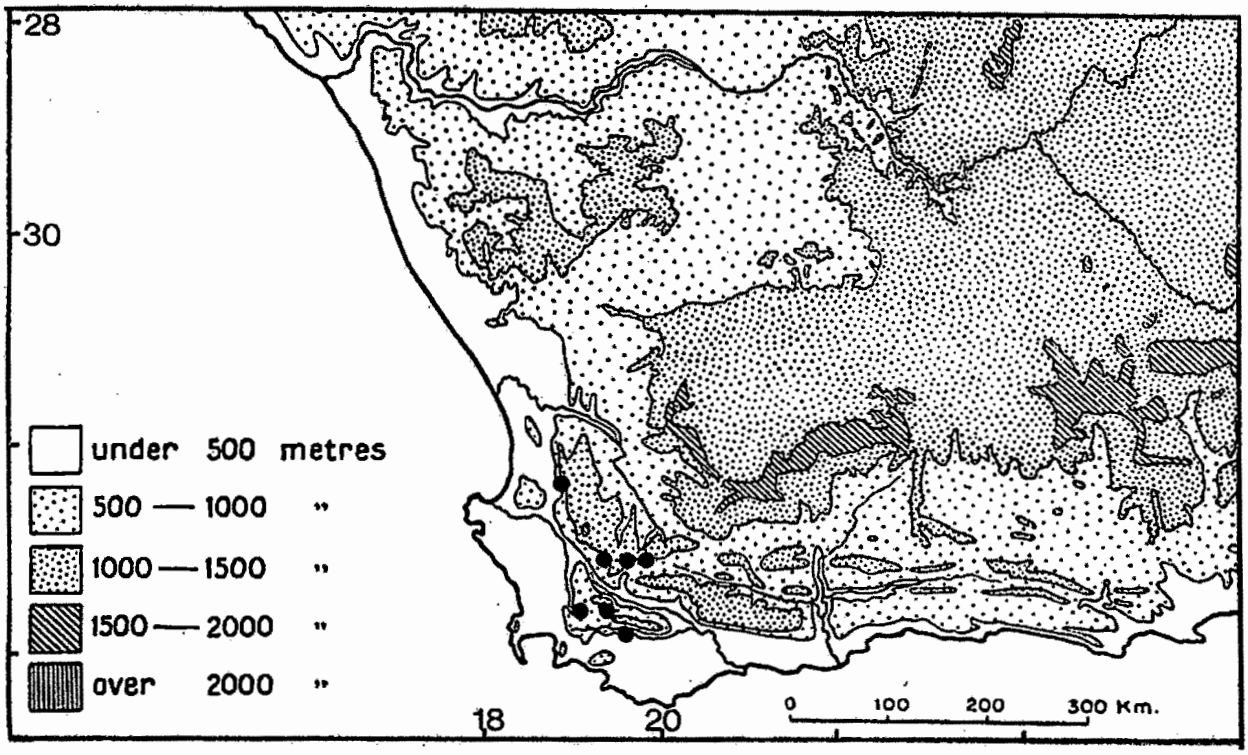


Figure 39. Distribution of Bulbinella chartacea.

3418 (Simonstown):Cape Flats.(-BA),May 1925, R Marloth 5663 (PRE);
Hottentotsholland, Stellenbosch(-BB),May, Ecklon & Zeyher 61.5 (G).

15. **Bulbinella chartacea** P.L. Perry sp. nov. a B. triquetra (Linn.f.) Kunth vagina recta incohaerens chartaceus basiliter fibrosa et foliis hysteranthis succulentis canaliculatis haud denticulatis valde differens. TYPUS.-- Cape Province: Kanonkop, Genadendal, March 1985 Perry 3260 (NBG, holotypus; K, MO, PRE, isotypi).

Plants small, up to 0,4 m above ground, solitary. Roots up to ten, fascicled, fusiform, up to 50 mm long, 5 mm diameter near the base of the stem gradually tapering to the apex; skin light fawn, white internally. In the growing season also numerous longer thin absorptive roots and the shrivelled remains of many food storing roots. New shoots have been noted growing from the ends of some of the previous year's storage roots consisting of a sheath and beginnings of a single leaf. Fibrous sheathing neck 30--50 mm high and up to 15 mm wide; fibres loose, straight, flat, papery, inner almost transparent, outer darker. Leaves 3-5, erect, scarcely developed at flowering time; surrounded at the base by a thin, membranous, transparent cataphyll up to 30 mm long, entirely sheathing except the top 5 mm, base of outer leaf dilated to form a sheath, remaining leaves not sheathing; laminae of differing lengths, longest up to 320 mm long, 4 mm wide at the base, inner shorter and narrower, dark green, fleshy to succulent canaliculate, glabrous. Peduncle terete, about 300 mm long, 1,5 mm diameter, light green to reddish. Raceme narrowly conical up to 85

mm long, 16 mm wide, 20--40 flowers. Bracts not conspicuous in bud, 2 mm long, broad at the base and surrounding the pedicel, attenuate, transparent with red keel. Pedicels wiry, about 5 mm long, yellow-green. Perianth stellate to recurved when fully open, about 9 mm diameter. Tepals equal to sub equal, elliptic, bright yellow with narrow green nerve. Filaments adnate to base of tepals, filiform apiculate, 2--2,5 mm long, yellow. Ovary ovoid, 1 mm long, less than 1 mm wide, yellow. Style cylindrical, 2 mm long, yellow. Capsule ovoid, up to 5,5 mm long, chestnut brown, shiny. Seed dullish black, up to 4,5 mm long, 3 mm diameter, wings not pronounced.

Flowering time: February to April.

Distribution and habitat. This species appears to have a comparatively limited distribution mainly in the Riviersonderend mountains and ranges to the North of Worcester, where it occurs in the middle slopes at an altitude of 700-1100 metres, in rocky areas in Table Mountain Group derived soils amongst fynbos vegetation.

Diagnostic features: The basal sheathing fibres clearly distinguish B. chartacea from all other species being very loose and straight and papery. Specimens of this species have previously been identified as B. triquetra but it is clearly separated from that species by the production of flowers at the beginning of the growing season and the wider, glabrous, canaliculate more fleshy leaves of different lengths together with the narrower inflorescence and shorter bracts. B. trinervis which flowers at the same time of year often in similar areas has white flowers and is found on lower slopes.

SPECIMENS EXAMINED

3218 (Clanwilliam):Olifants river mountains near Thee river(-DB), 16-04-1949, E.Esterhuysen 15353 (BOL); Old Elands Kloof(-DB), 24-03-1951, W.F.Barker 7272 (NBG).

3319 (Worcester):Milner Peak, Hex River Mountains(-AD),06-12-1947, E. Esterhuysen 14237 (BOL); Waaihoek Peak(-AD),25-05-1950, E.Esterhuysen 18333 (BOL); Waaihoek peak, south slopes(-AD),12-01-1954, E. Esterhuysen 22611 (BOL, K, PRE); Keeromsberg(-BC),22-11-1956, E. Esterhuysen 26592 (BOL); Buffels Hoek, Hex River mountains(-BD), 28-04-1942, R.H.Compton 13181 (NBG); Milner Ridge Peak, Hex River mountains(-BD),11-11-1943, E. Esterhuysen 9332 (BOL); Mountains S. of Wemmershoek(-CC),Jan. 1921, H.Andreae 766 (STE); Farm Jonas Plaats, 20 miles S of Worcester(-CD),April 1920, H.Andreae 317 (PRE, STE).

3320 (Montagu): Leeurivierberg 20 km NW Swellendam (-CD), 20-3-1987, Liede & Esterhuysen s.n. (NBG 135011).

3419 (Caledon):Kanonkop, behind Genadendal(-BA),04-03-1985, P.L.Perry 3260 (K, MO, NBG, PRE); Genadendal, S. slopes of Kanonkop(-BA),21-02-1966, J.P.Rourke 329 (NBG); Galgeberg, McGregor(-BA),05-03-1984, S.Liede s.n. (NBG 130610).

16. **Bulbinella gracilis** Kunth in Enum. P.. **4:** 571 (1843); Durand & Schinz in Conspec. Fl. Afr. **5:** 335 (1894). Type:- Cape Province: Mierenkasteel, Drege 2670b (G! lectotype here designated; BM! K! P!

isolectotypes).

Anthericum gracile Baker in Trim.Journ.Bot. **10:** 137(1872) and Journ.Linn.Soc. **15:** 295 (1876).

Plants small up to 0,3 m high, normally solitary. Roots a fascicle of 15-20 fleshy swollen finger-like roots of varying lengths from 5--50 mm and up to 3 mm wide, intermingled with fine sparsely branched absorptive roots. Sheathing neck consisting of 1 or 2 membranous cataphylls up to 22 mm long, more frequently around 10 mm long and up to 7 mm wide, whitish or fawn coloured with thin darker, longitudinal lines lower down; fibrous remains lacking or vestigial. Leaves 4--8 circling the scape, erect, sub-equal up to 240 mm long, 4 mm diameter, terete or slightly flattened on the inner side, tapering very gradually to an acute apex, bright green, glabrous, succulent, somewhat flaccid, drying flat. Peduncle terete, to 300 mm long, 2 mm diameter, glabrous, bright green. Raceme broadly conical in bud and flower becoming cylindrical with a rounded apex, up to 60 mm long, 25 mm wide, approximately 20--80 flowers. Bracts triangular, 1 mm long, partly surrounding the base of the pedicel. Pedicels up to 10 mm long in flower, yellow, wiry; remaining in the patent position after the flowers fade and fruits form. Perianth stellate up to 8 mm diameter. Tepals equal, elliptic, slightly cymbiform, 4 mm long, 1,75 mm wide, rich bright yellow. Filaments filiform apiculate, 2 mm long, bright yellow. Ovary ovoid to globose, little more than 1 mm long and wide, pale yellow. Style cylindrical, 1,5 mm long, yellow. Capsule shorter than surrounding remains of segments, valves 2,5 mm long, 1,75 mm wide, light fawn coloured.

Seeds 1,5--2 mm long, 1 mm wide, black with narrow, amber coloured, hyaline extension all round.

Flowering time: June to August.

Distribution and habitat: B. gracilis occurs in the north western Cape from the Richtersveld as far south as Newerus. Rainfall in the area is normally low and erratic with an average of 100-150 mm per annum but this species may be found in dampish areas either among the rocks of dried river beds and flood plain ravines or on shady south facing slopes mainly of shale or quartzitic rocks.

Diagnostic features: This species is easily identified by a number of distinctive features. In particular the absence of dead leaf remains forming a fibrous sheath around stem and leaf bases is not met with in any other Bulbinella species in South Africa. The patent pedicels in the fruiting stage are unique to B. gracilis and B. nana. The almost terete leaves are considerably more succulent than is found in other Bulbinella species and, as Kunth describes, dry flat. The small boat-shaped inconspicuous bracts are similar but smaller than those of the two autumn flowering species B. trinervis and B. divaginata.

Nomenclatural note: A search in August 1984 for this species at Mierenkasteel (Meerhofkasteel) one of the Drége localities quoted by Kunth was unproductive. It was however a very dry season and the possibility that the species has been grazed out from the locality should also be considered.

None of the type specimens of Drége seen at K, BM, G and P shows a

complete plant including roots and basal sheaths, two of the most distinctive characters in the identification of this species. But inflorescence and bract size and shape, together with size of leaves which have dried flat help to confirm the identity. The absence of a fibrous sheath is made clear in Kunth's description of the species when he says "scarcely sheathed; no remains of the old leaves".

SPECIMENS EXAMINED

2817 (Vioolsdrif):Cornellsberg in Stinkfontein mountains.(-CA),06-09-1977, Oliver, Tolken & Venter 709 (PRE); S.E. slope of Jenkins Kop.(-CB),21-07-1981, P L Perry 1077 (NBG); Jenkins Kop(-CB),18-08-1980, P M van der Westhuizen 149/80 (NBG); 6 mls West of Stinkfontein.(-CC),19-07-1970, W Wisura 1651 (NBG).

2917 (Springbok):Ezelsfontein, 14 mls. W. of Springbok.(-DA),30-06-1965, L I Hall 186 (NBG); 14 miles W by S of Springbok(-DA),08-06-1957, J.P.H.Acocks 19266 (K, PRE); Ezelsfontein, 14 mls. West of Springbok.(-DA),28-06-1965, H Hall 2910 (NBG); 15 mls from Springbok on Spektakel road.(-DA),16-07-1962, B Nordenstam 621 (NBG); Spektakelberg, Farm Naries between Kleinsee & Spri(-DA),26-08-1983, A.E. van Wyk 6456 (PRE); 14 mls. West of Springbok, Spektakel Pass Rd.(-DA),04-07-1965, H Hall s.n. (NBG 82318); Keurboskloof in Komaggas mountains(-DC),21-05-1940, H. Herre 3360 (BOL); Komaggas Mountains(-DC),July 1926, Marloth (G.Meyer) 6964 (PRE); Messelpad Pass, S.W. of Springbok.(-DC),28-06-1968, J P Rourke 802 (NBG).

3118 (Van Rhynsdorp):Karee Bergen(-AB),18-07-1896, R.Schlechter 969(BOL, K, PRE); Bitterfontein (-AB), 16-06-1931, I.M. Salter 953 (K).

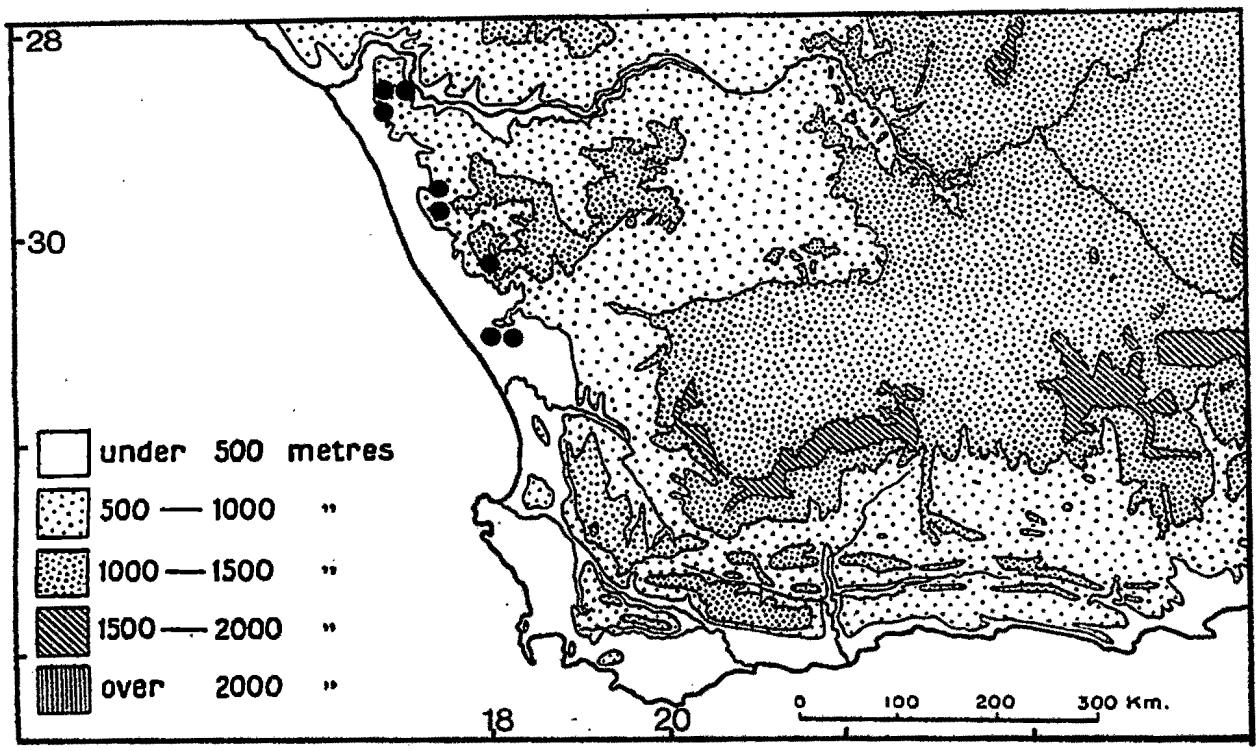


Figure 40. Distribution of Bulbinella gracilis.

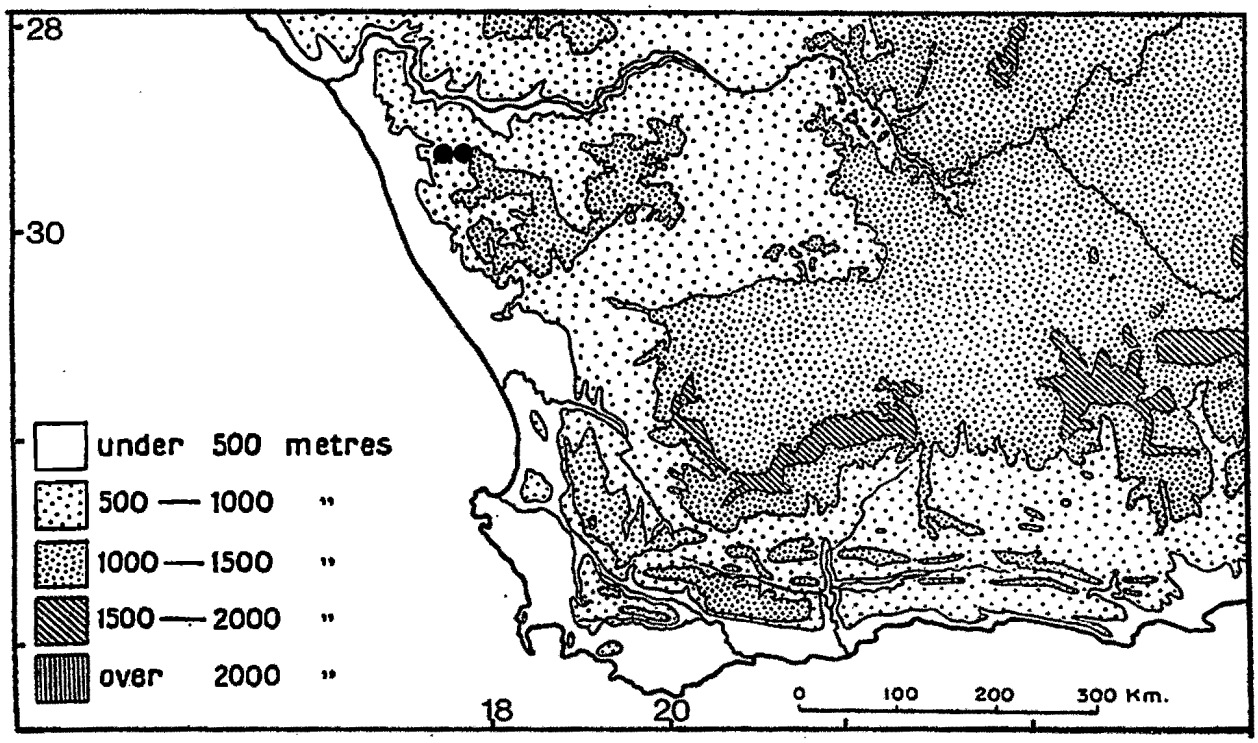


Figure 41. Distribution of Bulbinella nana.

17. **Bulbinella nana** P.L. Perry sp. nov. quam omnes congenri minores, B. gracili Kunth proxima sed foliis filiformibus numerosis et fibris brevibus basi confertis satis diversa.
TYPUS.-- Cape Province: Ratelpoort, April 1982 Bayer 1637a (NBG, Holotypus).

Plants small, up to 0,25 metre above ground, solitary. Roots fascicled, 10--30, swollen, up to 60 mm long, 4 mm at widest near base of stem, gradually tapering. Fibrous sheathing neck of numerous, short fibres up to 15 mm high, fine and straight. Leaves 10--20, equal, erect; base of leaves not sheathing but surrounded by two membranous, colourless cataphylls, longitudinaly dark veined; laminae narrowly filiform, about 40 mm long at anthesis later lengthening to 100 mm long, 0,5 mm wide, dark green. Peduncle terete, up to 160 mm long, 1 mm diameter, green. Raceme compact rounded to somewhat lax and broadly cylindrical up to 35 mm long, 16 mm wide, 15--30 flowers. Bracts closely adpressed to pedicel base and hard to distinguish, 1 mm long, ovate, almost colourless. Pedicels up to 7 mm long very wiry, green. Perianth stellate to somewhat recurved, 7 mm diameter, yellow. Tepals oval to elliptic, 3,5 mm long, 1,75 mm wide. Filaments filiform apiculate, up to 3 mm long, 0,5 mm at widest, yellow. Ovary ovoid to globose, barely 1 mm long, 1 mm wide. Style cylindrical 1,5 mm long. Capsule irregularly ovoid, valves 4 mm long, 1,75 mm at widest, pale fawn. Seeds 2,25 mm long, black, with pale orange outer covering forming a wing-like extension all round.

Flowering time: April to June.

Distribution and habitat: This species is known only from two collections from the Richtersveld area of the north western Cape. The habitat for one collection was a south facing rocky hill slope where rainfall is low and erratic, averaging 100 mm or less per annum.

Diagnostic features: This is the smallest of Bulbinella species forming dainty, delicate looking plants. It has close affinities with B. gracilis which occurs in a similar area, but is separated from that species by the more numerous and very fine filiform leaves compared with the more succulent ones of B. gracilis. It also has more prominent basal sheath fibres, and distinct veining in the cataphylls which is not so obvious in B. gracilis. The plants from Ratelpoort were at first thought to be a dwarfed form of B. divaginata as the fusiform roots and numerous filiform leaves are closer to that species. A few seeds formed in cultivation were markedly similar to the distinctive seeds of B. divaginata. However seeing collections of the three species in flower together it was noticed that B. nana had the patent pedicels of B. gracilis after the flowers faded.

A putative hybrid: B. divaginata X B. gracilis?

This marked similarity to two distinct species has not been observed in other Bulbinella species and leads to speculation as to whether B. nana could be a hybrid between B. divaginata and B. gracilis.

Although the two species are not known to occur together their distribution ranges do overlap in northern Namaqualand and it is possible they were more plentiful in a different climatic phase. Flowering time for B. divaginata is mainly in April whilst that of B. gracilis has more frequently been June. However flowering in the drier parts of Namaqualand

is very dependent on the time of rains and in cultivation the three species flowered at the same time. A specimen with Marloth's no. 6887 and collected by Rev. Meyer with the locality given as Steinkopf is clearly the same taxon and it is possible it could occur more widely in this arid, poorly collected area. According to the label Marloth's specimen flowered in June which is closer to the flowering time of B. gracilis.

SPECIMENS EXAMINED

2917 (Springbok) Steinkopf(-BC),24-6-1926, (G. Meyer) Marloth 6887 (PRE, STE); Ratelpoort(-BD),01-03-1979, M.B.Bayer 1637a (NBG).

22. SPECIES NON SATIS COGNITI

Bulbinella floribunda (Aiton) Durand & Schinz in Consp. Fl. Afr. **5:** 33 (1894). Anthericum floribundum Aiton, Hort. Kew **1:** 447; (1789) Baker, Journ. Linn. Soc. **15:** 296 (1876).
Trachyandra ? floribunda (Aiton) Kunth Enum. Pl. **4:** 583 (1843).

Anthericum floribundum was described by Aiton from material collected by Francis Masson in the Cape of Good Hope. It was stated to be introduced in 1774. The flowering time given as March and April would presumably indicate the months of flowering at Kew. No Masson type specimen for this name has been traced in the British Museum or elsewhere, also Baker quotes no Masson specimen in his account of Anthericum floribundum (1876). It seems likely that the original description was made from cultivated plants grown from seed collected by Masson and that no herbarium specimen was made at the time of collection nor from the cultivated plants. This assumption is made from a study of Masson's travels and other material preserved at the British Museum. One of the places visited at the end of September by Masson and Thunberg together was Witteklip, south of Vredenburg. Two species of Bulbinella still exist in this locality, one B. cauda-felis is in flower in September and both Masson and Thunberg made pressed material of this species but with no locality given. The other has finished flowering and is in seed by the end of September and neither Masson nor Thunberg appear to have made herbarium material from this population, but it is possible that Masson collected seed.

The name B. floribunda has recently been applied to the large Bulbinellas, in this account regarded as B. nutans and B. latifolia. Aiton's description is unfortunately brief and includes no account of the

underground parts of roots and sheaths which are important diagnostic features for the genus. Further the description "folius planis glabris lineari-lanceolatis acutis" & "racemo multifloro cylindrico compacto" do not accurately fit the plants erroneously identified as B. floribunda in which leaves are canaliculate and the raceme conical. Although it could be assumed that plants for Aiton's A. floribundum were collected by Masson at Witteklip and the brief original description could apply better to the species described as B. elata P.L. Perry, the lack of good diagnostic characters for the genus Bulbinella makes the upholding of the name B. floribunda very tenuous.

Further Durand & Schinz (1894) who validated the name Bulbinella floribunda gave no reason for doing so but merely listed citations for Anthericum floribundum and also included as a synonym B. latifolia Kunth quoting the latter's type for B. latifolia (namely Drége 2667a) as the type for B. floribunda. Baker (1896) in Flora Capensis dropped the epithet floribunda in favour of Kunth's B. latifolia which he placed as a variety of B. robusta Kunth.

Bulbinella peronata Kunth in Enum. Pl **4:** 570 (1843). Type: Cap.b.spei, Roodezand, September, Drége herb. Cap. no. 955 (G! right hand specimen, lectotype! here designated).

Kunth described this species from Drége herb. Cap. no. 955. No specimens with this number exist with other Drége Bulbinella material at Kew, British Museum, Paris or Berlin but a sheet at Geneva has the number clearly cut out from the original typical Drége annotated slip and glued to

another piece of paper with the name Drége printed and affixed to two Bulbinella specimens. These two specimens belong to different species which accounts for the discrepancy between Kunth's description which appears to fit an April flowering taxon, one of the specimens, and Drége's locality, Roodesand and flowering time, September (Drége, 1843), which fits the other specimen. The epithet "peronata" is not easily related to either specimen but could refer to the sheathed part of the latter specimen identifiable as B. triquetra (L.f.) Durand & Schinz. Because of Kunth's obvious confusion in his description of B. peronata the former specimen is now described as B. divaginata P.L.Perry.

EXCLUDED TAXA

Bulbinella aitonii (Baker) Durand & Schinz, Consp. Fl. Afr. **5:** 335 (1894) = Anthericum aitonii (Baker, Journ. Linn. Soc. **15:** 294 (1876) = **Trachyandra filiformis** (Aiton) Oberm., Bothalia **9:2** 344 (1967).

B. brevifolia (Thunb.) Kunth, Enum. Pl.**4:** 573 (1843) = Anthericum brevifolium Thunb., Prodr. 62 (1994) = **Caesia contorta** (L.f.) Durand & Schinz, Consp. Fl. Afr. **5:** 353 (1893).

B. burkei (Baker) Benth., Gen. Pl. **3:** 784 (1883) = Anthericum burkei Barker, Journ. Bot. Lond. **10:** 140 (1872) = **Trachyandra burkei** (Baker) Oberm., Bothalia **7:4** 721 (1962).

B. carnosum (Baker) Baker, Fl. Cap. **6** 358 (1896) = Anthericum carnosum Baker, Journ. Linn. Soc. **15:** 296 (1876) = **Ornithogalum paludosum** Baker, Journ. Bot. Lond. **12:** 366 (1874).

B. ? filiformis (Aiton) Kunth, Enum. Pl. **4:** 572 (1843) = Anthericum filiforme Aiton, Hort. Kew **1:** 451 (1789) = **Trachyandra filiformis** (Aiton) Oberm., Bothalia **9:2** 344 (1967).

B. ? ornithogaloides Kunth, Enum. Pl. **4:** 693 (1843) = **Ornithogalum ornithogaloides** (Kunth) Oberm., Bothalia **9:2** 344 (1967).

B. ? squamea (L.f.) Kunth, Enum. Pl. **4:** 573 (1843) = Anthericum squameum L.f., Suppl. 202 (1781) = **Trachyandra hispida** (L.) Kunth, Enum. Pl. **4:** 575 (1843).

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