Drawings of Scandinavian Plants 65–68

Juncus L.

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65. **Juncus trifidus** L. 1753

Perennial, densely caespitose to mat-forming, rhizome shortnoded; rhizome scales similar to the basal sheaths of the stems. Stems 5—40 cm, thin but usually rigid, with usually 4—6 basal sheaths, the uppermost of them with a usually short but rarely up to 10 cm long lamina. Upper leaves 2—4, usually all arranged as bracts of the inflorescence but rarely 1—2 leaves in a lower cauline position. Leaves usually 5—12 cm long, 0.3—1 mm broad, flat to slightly canaliculate, without or with very weakly developed sclerenchyma in their margins, finely serrulate (0.02—0.05 mm) especially in lower and middle parts; some dorsal epidermis cells with rounded papillae, only in the basal part of the leaf some of them slightly enlarged. Auricles up to 4 mm, ± finely lacerate. Inflorescence of 1—3(—4) usually densely crowded flowers. Involucral bracteoles often with a more or less lacerate upper margin. Tepals 2—3 mm, equally long or outer ones slightly longer, lanceolate to ovate, all acute to apiculate or outer ones aristate, light to dark brown, often with a herbaceous basal part, inner ones with a broad and outer ones with a narrow scarious margin. Stamens 6, 2/3—3/4 as long as the tepals; anthers 1.2—1.5 mm, c. twice as long as the filaments, shortly mucronate. Style 1—1.5 mm, stigmata 2—3 mm. Capsule exceeding the tepals, 2.2—3(—3.5) mm excl. rostrum, trigono-ovoidal, trilocular, with a 0.7—1.3 mm long mucro, brilliant dark brown but basally lighter. Seeds 0.9—1.3 mm, including the two unequal appendages 1.2—1.6 mm, irregular and variable in form, usually obliquely ovoidal and somewhat angular; reticulation very fine and obscured by the seedcoat. 2n = 30.

There are, especially in some low altitude localities of S. Norway, tall specimens of *J. trifidus* with large and often single flowers, cauline leaves and sometimes also one basal leaf. These forms also occur in limestone cliffs, and closely resemble the alpine forms called *J. monanthos* JACQUIN. This form series may no doubt be recognized as a subspecies, but we have seen no Scandinavian material that can be classified as more than transitional forms. Ssp. *monanthos* (JACQ.) ASCH. & GRAEBN. may have occurred in Norway, but merged into ssp. *trifidus* by frequent crossing and backcrossing. A

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detailed investigation of the variation and ecological diversity of *J. trifidus* would no doubt be of interest, especially in the Norwegian areas of Möre og Romsdal, Dovre, and Sogn og Fjordane. All the deviating forms in Fig. 65 have been collected in that part of S. Norway.

In the above description all measurements given refer to Scandinavian material only. Thus certain forms from the Alps, especially the typical ssp. *monanthos,* are not covered.

J. trifidus is a typical plant of the middle and low alpine heaths, where it is often dominant. It does, however, also grow on rocks and cliffs, and the typical ssp. *monanthos* is mainly a plant of limestone cliffs. *J. trifidus* has a circumarctic distribution, but occurs also in the mountains of Europe, W. and N. Asia and North America. In Scandinavia it is common in the arctic parts and in the entire mountain chain. Scattered localities exist in the lowlands, in Norway throughout the country, in Sweden down to about 61° N and in Finland to 65° N.

J. trifidus deviates a lot from the other species of subgenus *Pseudotenageia,* especially in the structure of its leaves. The serrulate leaf margin is quite unique for the genus and is reminiscent of related genera as *Prionium* and *Luzula.* The lacerate auricles and the occurrence of lacerate bracteoles are also features unusual in the genus *Juncus. J. trifidus* is here kept in subgen. *Pseudotenageia* partly as a concession to common usage, partly because of nomenclatural difficulties.

Subgen. **Septati** BUCHENAU 1875

Perennials or rarely annuals, rhizome well developed in most species. Leaves terete, though in some species with a flattened or furrowed dorsal side, uni- or pluritubulose, septate; tubes empty in mature leaves. Septation of pluritubulose leaves either perfect (septa of the individual tubes on the same level) or imperfect (septa of the individual tubes on different levels). Flowers in heads, lacking involucral bracteoles, adverse bracteole present only on lower inflorescence branches. Stamens shorter than tepals, filaments ± rigid. x = 20, polyploidy frequent.

The subgenus *Septati* has a worldwide distribution, though in the tropics it is mainly montane to alpine. It contains as many as about 100 species, with several critical complexes indicating rapid differentiation in widely different parts of the world. Hybridization is common, and several of the polyploids no doubt represent allopolyploids resulting from chromosome doubling of hybrids.

In Scandinavia, subgen. *Septati* is represented by seven species according to the taxonomic concepts accepted by us. Several of them are extremely variable and have been subject to different treatments in previous literature. Field studies in different areas have led us to the impression that most of the variation is haphazard and has not to any considerable extent led to the development of sterility barriers. Thus, some of the previous splitting has no doubt been too far-reaching. In this series, the species will be illustrated first. Then the hybrids which have been definitely identified in Scandinavia will be presented together.

66. **Juncus subnodulosus** SCHRANK 1789

(Syn. *J. obtusiflorus* EHRHART ex HOFFMANN 1971)

Perennial, matforming; rhizome thick, with usually c. 1 cm long internodes. Stems 40—130 cm high, 2—4 mm thick, terete or slightly compressed, with usually 3—4 basal sheaths and 1—2 cauline leaves. Rhizome also producing shortshoots with one long leaf. Leaves 20—100 cm long, 2—4 mm thick, pluritubulose with a wider central tube and a central vascular bundle, perfectly septate. Auricles short, broad, firm. Inflorescence of 10—50(—100) heads; branches patent;

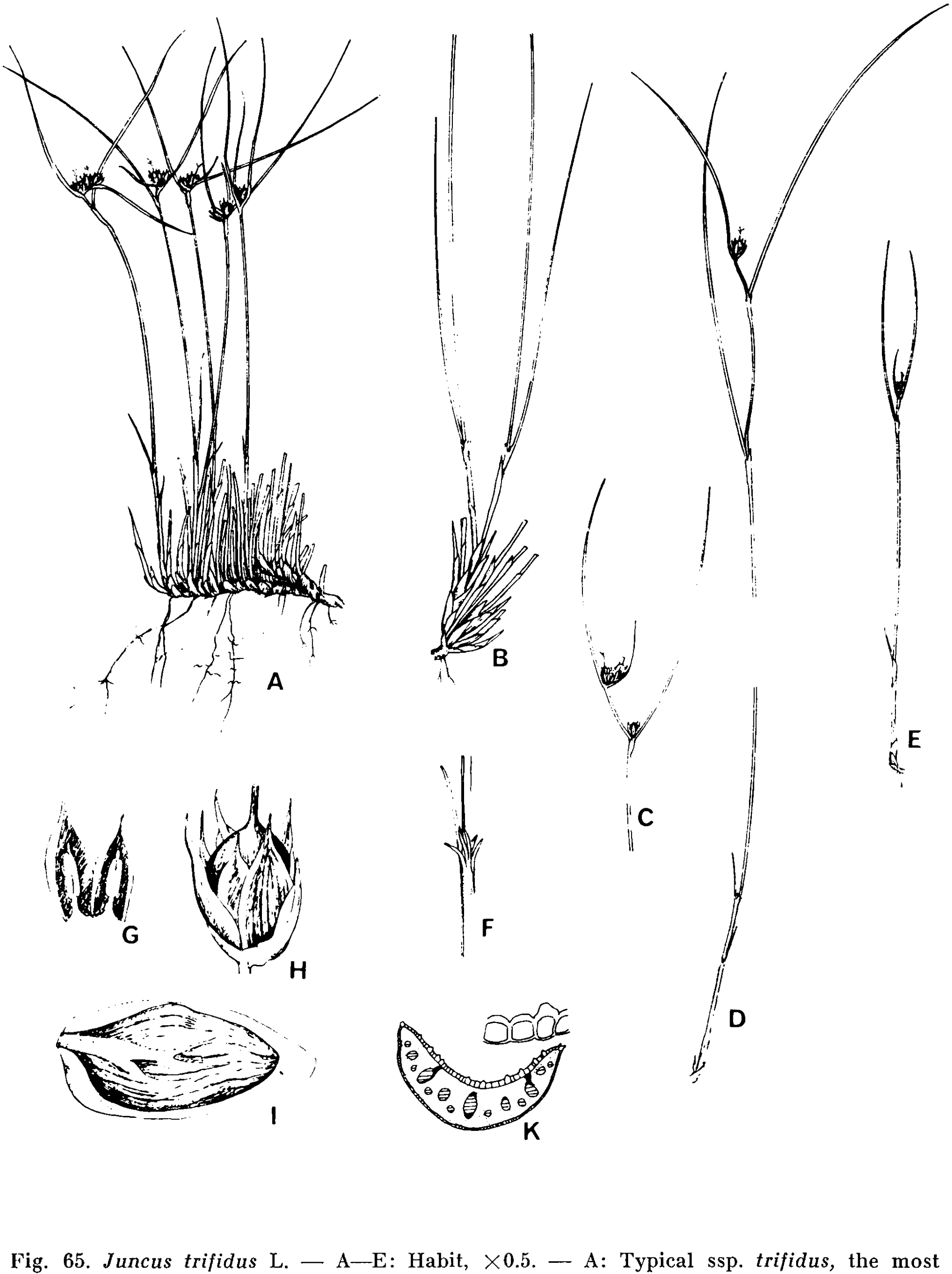

Fig. 65. *Juncus trifidus* L. — A—E: Habit, ×0.5. — A: Typical ssp. *trifidus,* the most common form in the area. — B, C, and D: long subbasal leaves, deviating inflorescence and large, single flowers of different cliff populations. — E: One-flowered form from subalpine heath. — F: Auricles of small subbasal leaf, ×2. — G: Tepals and stamens, ×6. — H: Flower with ripe capsule, ×6. — I: Seed, ×30. — K: Leaf transect, ×30, and detail of dorsal epidermis, ×100.

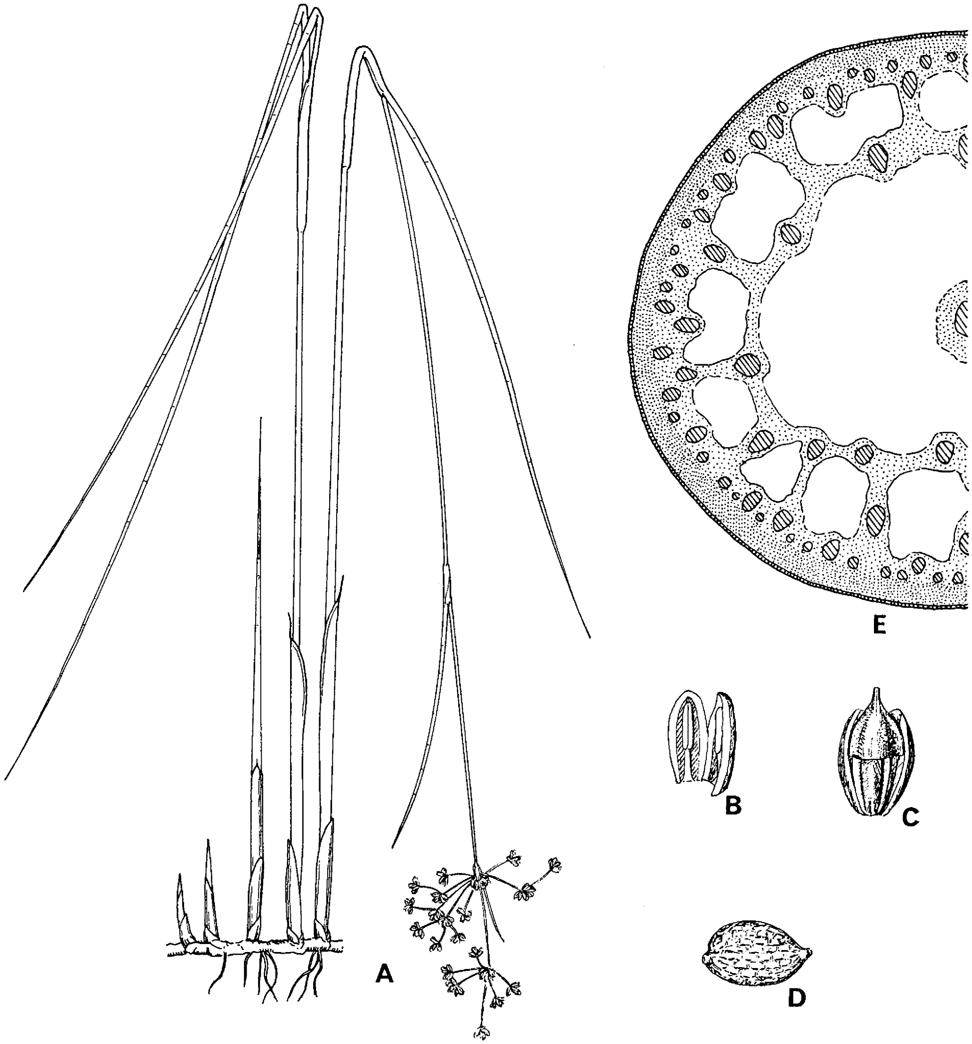

Fig. 66. *Juncus subnodulosus* SCHRANK — A: Habit, ×0.5. — B: Tepals and stamens, ×6. — C: Flower with ripe capsule, ×6. — D: Seed, ×30. — E: Half leaf transect, ×30. (The central vascular bundle is usually lost in hand-cut transects).

heads hemispheric or rarely almost spherical, 5—10(—30)-flowered. Tepals equally long, 2—2.5 mm, elliptic, obtuse, outer ones boatshaped, all greenish to light brown or dorsally partly reddish to chestnut-coloured. Stamens 6, 2/3—3/4 as long as or rarely almost equalling the tepals; anthers 0.8—1.1 mm, 1.5—2 times as long as the filaments. Style 0.7—1 mm, stigmata c. 1 mm. Capsule slightly exceeding the tepals, (2—)2.5—3 mm, trigono-ovoidal with somewhat depressed sides, attenuate, mucronate, trilocular. Seeds 0.5—0.6 mm, pyriform, markedly reticulate with c. 20 longitudinal ridges. 2n=40.

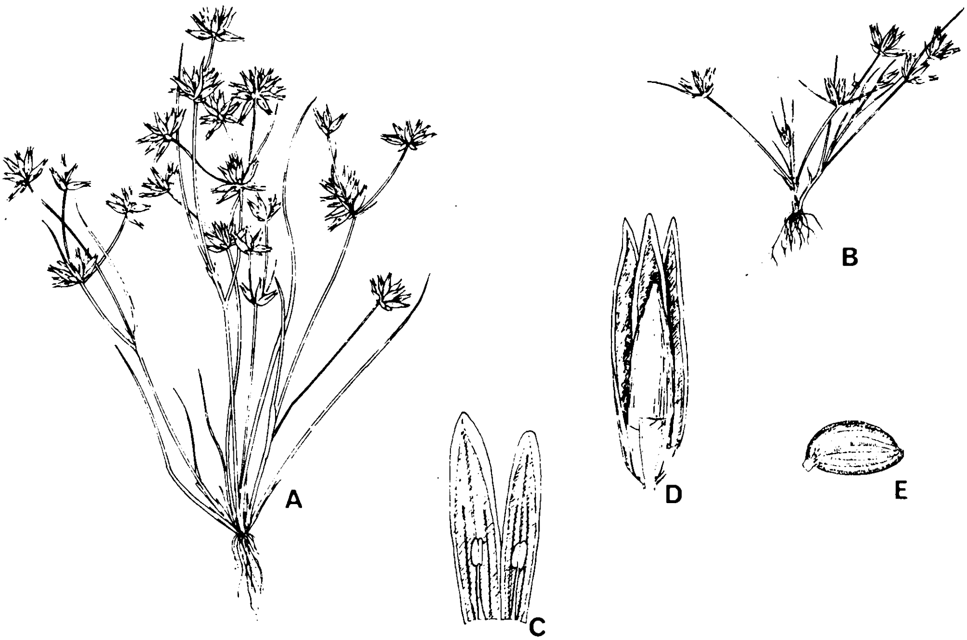

Fig. 67. *Juncus pygmaeus* RICH. — A and B: Habit, ×0.8. — C: Tepals and stamens, ×6. — D: Flower with ripe capsule, ×6. — E: Seed, ×30.

Juncus subnodulosus is a plant of fens, edges of ponds, and wet meadows, often occurring in localities with moving water. It is distributed throughout C., W. and S. Europe, and has a few localities in NW. Africa, Anatolia and Kurdistan.

In Scandinavia, *J. subnodulosus* is only known from a limited number of localities in Denmark, Skåne and the Baltic Islands. A single locality in Uppland was most probably due to an introduction. In our area this species is limited to rich fens, where it often forms dense stands by vegetative propagation by means of the branching rhizomes.

67. **Juncus pygmaeus** RICHARD in THUILLIER 1800

Annual, caespitose though often few-stemmed, branching intravaginal in basal sheaths. Stems 1—10 cm, erect or rarely ascending, with a few basal sheaths, usually one basal leaf, 0—1 cauline leaf, and 1—2 leaflike bracts at base of inflorescence branches. Leaves short, usually 0.5 mm thick or thinner, unitubulose, perfectly septate but septa externally visible only on exceptionally large leaves; auricles thin, very variable in size and form. Inflorescence of 1—5 heads; heads 2—15-flowered. Flowers usually cleistogamic. Tepals equal or almost equal, 4—7 mm long and 0.5—1 mm broad, obtuse to apiculate, outer ones sometimes with an up to 0.3 mm long seta, inner ones more sharply tapering than the outer ones, all green to light brown or sometimes reddish, with scarious margins. Stamens 3—6, variable and often unequal, outer ones usually 1/4—1/2 as long as the tepals, inner ones often smaller or lacking; anthers 0.3—1 mm, 1/2 as long as the filaments or usually shorter. Style 0.4 mm or shorter, stigmata 0.7—1 mm. Capsule shorter than the tepals, 2.5—3.5 (—4) mm,

Fig. 68. *Juncus bulbosus* L. — A—D: Habit, ×0.5. — A: The most common form in the area. — B: Part of submersed, non-flowering specimen. — C: Ecotype of open shores and similar habitats. — D: Form most common in drier habitats. — E and F: Tepals and stamens, ×6. — G, H, and I: Flowers with ripe capsules, showing part of the variation in capsule form, ×6. — K: seed, ×30. — L: Leaf transect, ×15.

narrowly pyramidal to narrowly ovoidal or rarely broader, without or with a very short mucro, unilocular, thinwalled, strawcoloured. Seeds 0.4—0.45 mm, turbinate to ellipsoidal, with a marked reticulation, longitudinal striae c. 20. 2n=40, chromosomes large for the subgenus.

Some recent authors, following DANDY (1958), have taken up for this species the name *J. mutabilis* LAMARCK (1789). Under that name LAMARCK included elements of *J. capitatus* WEIG. (1772) without variety mark, of the above species as var. β, and of *J. bulbosus* L. (1753) as var. γ. MEYER (1822) correctly interpreted the synonymy of *J. mutabilis* to the two older names, and chose to retain the name *J. pygmaeus* RICH. for the above species. This interpretation was followed e.g. by LA HARPE (1827) and BUCHENAU (1890, 1906). No formal typification has yet been published, but when effected, it ought to follow MEYER'S usage. Much of the confusion has probably been caused by the use of variety mark α never used in the original publication. MEYER (1822) as well as BUCHENAU (1890, 1906) cited α and β under the wrong species by reversion. LA HARPE (1827) cited α under both *J. capitatus* and *J. pygmaeus* and β and γ under *J. uliginosus* MEY. (syn. *J. bulbosus* L.). It should be noted that RICHARD in THUILLIER (1800) did not cite *J. mutabilis* LAM. as a synonym but mentioned it with a questionmark indicating his ignorance of its meaning.

Juncus pygmaeus is a plant of open and at least temporarily wet soils, usually occurring on maritime sand. It is also known to occur submersed in pools on such substrates.

The distribution area of *J. pygmaeus* includes W. and SW. Europe and NW. Africa. All previous reports from the E. Mediterranean were based on misdeterminations of *J. capitatus*. In Scandinavia, *J. pygmaeus* is only known from the dune slacks of the Danish west coast. Reports from Sweden referred to mislabelled material.

68. **Juncus bulbosus** L. 1753

(Syn. *J. Kochii* E. SCHULTZ 1855, *J. supinus* MOENCH 1777)

Perennial, though often flowering first year, caespitose; rhizome lacking, new shoots produced from the lower, short internodes of the stem. Stems 1—30 cm, usually slender, sometimes floating and then up to 1 m long, basally with a bulblike swelling, with several predominantly sub-basal leaves. Leaves terete with a slightly flattened to furrowed dorsal side, very variable in length, pluritubulose, imperfectly or in part perfectly septate. Inflorescence of 3—30 heads; heads 2—15-flowered; flowers often partly replaced by adventitious shoots in the axils of the bracts. Tepals equally long or inner ones slightly longer, 2—3 mm, ovate to lanceolate or inner ones oblong, outer ones ± boatshaped, all obtuse or outer ones acute, green, light to dark brown or reddish, with broad scarious margins. Stamens 3 or 6, 1/2—2/3 as long as the tepals; anthers 0.3—1 mm, from 1/3 as long as to equalling the filaments. Style 0.2—0.5 mm, stigmata (0.5—)1—1.5 mm. Capsule equalling or up to 1/3 exceeding the tepals, 2.2—3.5 mm, varying in form from prismatic or cylindrical to obovoidal or rarely more ellipsoidal, apically trigonous, obtuse or retuse, at the base usually tapering, unilocular, green to light or dark brown, usually lighter towards the base. Seeds 0.5—0.6 mm, turbinate, reticulation conspicuous with c. 25 longitudinal striae.

J. bulbosus is very variable in most morphological characteristics, and part of the variation found in Scandinavia is illustrated in Fig. 68. The different forms found in nature are only to a minor extent due to modification; many of them have kept rather constant in experimental cultivation. The development and conservation of local forms and ecotypes is much favoured by the high frequency of vegetative propagation in this species.

J. Kochii F. SCHULTZ has often been regarded as a separate species, e.g. by LID (1963). It is said to be characterized by 6 small stamens, a retuse capsule and acute outer tepals. The characters mentioned are, however, only occasionally correlated, and all kinds of intermediates are found. The occurrence of the "*Kochii*" types is not geographically limited, and often single populations appear to contain representatives of both "species". Thus we find it impossible to keep them separate, especially as there are other equally characteristic forms in the northern as well as the southern part of the distribution area. Even the rather wide description given above will not cover all S European and African forms.

J. bulbosus occurs in different types of wet habitats, as fens, shores, heaths, and open wet soil. It also grows submersed preferably in oligotrophic waters, running as well as standing. Its distribution covers the whole of Europe except the alpine and arctic parts, the easternmost part, and the S. Balkans. It has also been found in NW. Africa and Newfoundland. In Scandinavia, it is very common in Denmark, in the coastal areas of S. Norway and in Sweden up to about 62° N. With scattered localities it reaches as far north as the Lofoten area and the Kola Peninsula.

The nomenclature of this species is still insufficiently understood, and no formal typification has been made. There is, however, one specimen in LINN which would make possible the stabilisation of the name of this species. This matter will be further commented in a separate paper.

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The Genus Osmitopsis (Compositae)

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CONTENTS

ABSTRACT

BREMER, K. 1972. The Genus Osmitopsis (Compositae). — Bot. Notiser 125: 9—48.

This monograph of the genus *Osmitopsis* (Compositae) is founded on studies of herbarium material. The two genera *Osmites* and *Osmitopsis* are united into one, named *Osmitopsis* CASS. emend. BREMER. It is placed in the tribe Anthemideae on morphological and palynological grounds.

One new species is described, viz. *O. tenuis* BREMER. Five new combinations are made. Nine taxa are recognized, viz. *O. pinnatifida* (DC.) BREMER ssp. *pinnatifida*, *O. pinnatifida* (DC.) BREMER ssp. *angustifolia* (DC.) BREMER, *O. osmitoides* (LESS.) BREMER, *O. afra* (L.) BREMER, *O. dentata* (THUNB.) BREMER, *O. nana* SCHLTR, *O. tenuis* BREMER, *O. asteriscoides* (BERG.) LESS. and *O. parvifolia* (DC.) HOFM.

Synflorescence types and reduction series in pappus and styles of ray-florets are discussed. The pollen grains are described.

The genus is endemic to the Cape Region. Its centre is in the southwestern districts.

ACKNOWLEDGEMENTS

In 1968 when I sought Dr. T. NORLINDH's advice in starting a taxonomic study, he directed my interest to *Osmitopsis*. The study has been carried out at the Section for Botany of the Museum of Natural History in Stockholm, the director of which is Professor NORLINDH. For providing me with all necessary working facilities and for much valuable and indispensable help I owe Professor NORLINDH sincere thanks.

I am specially indebted to Dr. B. NORDENSTAM. During the innumerable times that I have consulted him, intruding in order to seek his advice, his kindness and keen interest in my work have never failed. Moreover, Dr. NORDENSTAM has read the manuscript, and his constructive criticism has been of great help.

Among friends and colleagues, who have contributed with valuable advice, I wish to mention Mr. L. E. KERS and Mr. J. LUNDGREN. Dr. R. DAHLGREN has supplied me with base maps.

Mrs. D. BREMER, my mother, has kindly advised me in translation questions. The Latin description was kindly revised by Miss A. STORK and the English text by Mrs. A. SCOTLAND.

I am also indebted to the directors and curators of the herbaria listed under Material, where I have been working or wherefrom I have obtained herbarium material on loan. Pollen slides were prepared by the Palynological Laboratory in Stockholm.

INTRODUCTION

Aim and Scope

The genus treated in this monograph belongs to Compositae and is endemic to the Cape Region. These plants are hitherto known under the generic names *Osmites* and *Osmitopsis*. The latest revision of these genera was done by HARVEY (1865 p. 303) in the "Flora Capensis". I have united the genera into one, named *Osmitopsis* CASS. emend. BREMER, and my aim has been to revise this genus taxonomically. Beside the taxonomic treatment the present study includes brief discussions of morphology and phytogeography.

Material

This study is founded on herbarium material only. Unfortunately I have not been able to get hold of living material. However, the rich herbarium material has provided a sufficient base for solution of the taxonomic problems, at least on the species level. I have studied material from the following herbaria, abbreviated as in the "Index Herbariorum" (LANJOUW & STAFLEU 1964): B, BM, BOL, BR, G, G-DC (only microfiches), GRA, K, L, LD, LINN, LY, NBG, P, PRE, S, SAM, UPS, W and Z. Beside these there are three herbaria with no special abbreviation in the "Index Herbariorum". I have abbreviated them as follows: LD-RETZ=Lund, Sweden, Botanical Museum, Herbarium RETZIUS; SBT-BERG=Stockholm, Sweden, Hortus Botanicus Bergianus, Herbarium BERGIUS; UPS-THUNB=Uppsala, Sweden, Institute of Systematic Botany, Herbarium THUNBERG.

I have obtained most of the material on loan. However, beside the Museum of Natural History in Stockholm (S), where I am working, I have had the opportunity to visit the following herbaria: BM, K, LINN, SBT-BERG, UPS and UPS-THUNB.

Methods

The material has been studied in a stereo-microscope. Floral parts were dissected and studied after boiling in water.

The descriptions attempt to cover the total variation range. However, since it is impossible to study all parts in all collections, there may be rare extreme values and characters uncovered by the descriptions. Single collections with extreme values, which differ from the mass of collections through a considerable gap in the variation, are given in brackets as e. g. "style (1—)1.5—3(—4) mm long". In Fig. 1 it is indicated how length and width of some parts are measured in this treatise. Measurements in cm are given with an accuracy of 1 mm and those in mm with an accuracy of 0.1 mm.

After the descriptions the months are listed, from which flowering specimens have been seen. These may give a hint at the real flowering period. In the discussion of each species there are a few notes on ecology. Since they mostly come from herbarium labels, they are necessarily very fragmentary.

I have made the drawings myself. Vegetative parts are from dry material and floral parts from boiled material. In order to facilitate comparison, the same portion of the plant is magnified equally in all taxa. The magnifications are as follows: habit ×1/2; leaves ×2; involucral bracts, paleae and florets ×7; styles, stamens and achenes ×14.

All specimens seen are listed under Collections. The collections are assigned to Divisions following the magisterial district system. Locality statements in other languages are translated into English. Otherwise the spelling of names has been changed only in cases of apparent misspellings. Localities of DRÈGE's and ECKLON and ZEYHER's collections, which often lack such statements, are published by DRÈGE (1843 and 1847, respectively). On some specimens collected by ECKLON and ZEYHER there are locality statements in their own handwritings. These localities have been cited instead of those found in DRÈGE's publication.

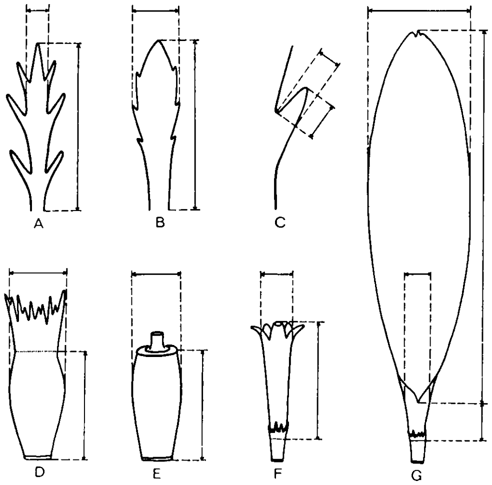


Fig. 1. Measurement of length and width. — A: Pinnatifid leaf of *O. pinnatifida*. — B: Leaf. — C: Leaf-lobe or tooth. — D: Achene with pappus. — E: Achene without pappus. — F: Corolla of disc-floret. — G: Lamina and tube of ray-floret.

The nomenclature is in accordance with the "International Code of Botanical Nomenclature" (1966).

Pollen slides were prepared at the Palynological Laboratory in Stockholm, where the slides are kept. The preparation method is found in ERDTMAN (1952 pp. 7—9).

Descriptive Terminology

The descriptive terminology is in accordance with modern usage. Glossaries such as FEATHERLY (1954), JACKSON (1928) and STEARN (1966) are recommended. However, a few terms will be commented upon below.

OUTLINES AND PLANE SHAPES. The terminology is adopted from the Systematics Association Committee for Descriptive Biological Terminology (Taxon 11, 1962 pp. 145—156, 245—247; also STEARN 1966 pp. 318—319). In some descriptions of solid forms, e.g. achenes, terms relating to plane shapes have been used, then indicating the outline of the body.

INCISION AND MARGINAL DIVISION. *Entire* is used to indicate absence of marginal division. On the contrary *lobed* means some kind of marginal division.

Most species of the genus have leaves, as well as similar organs, such as involucral bracts and paleae, with undivided margin or a margin not divided halfway to the midrib. If not entire, the margin is described as *serrate* (sawed), *serrulate* (minutely sawed), *dentate* (toothed) or *denticulate* (minutely toothed). Sometimes the teeth are prolonged, so as to give the margin a *fimbriate* appearance.

In *O. pinnatifida* the leaves are mostly divided more than halfway to the midrib and then described as *pinnatifid*. In this species the leaf-lobes are trated as separate from the leaf rachis in measurements (Fig. 1 A, p. 11) and descriptions of all leaves, whether pinnatifid or not. Thus the rachis and lobes are measured and described separately.

APEX. The terms used to describe the apex of various organs are discussed by RICKETT (1956). The definitions of the terms used here follow STEARN (1966 pp. 328—329).

INDUMENTUM. The meaning of indumentum terms is often arbitrary. I shall therefore explain the terms used in this study.

Pubescent refers to any kind of hair-covering and is the opposite of *glabrous*. The resin grains occurring on all parts of the plants are not regarded as hairs. *Puberulous* is used for a ± lax covering of very short, soft hairs. *Tomentose* applies to a ± dense covering of matted, ± appressed, soft hairs (a definition different from STEARN's, 1966 p. 338). *Villose* is used for a dense, but not matted covering of long, soft hairs. *Lanate* refers to a dense woolly covering of matted, long, soft hairs.

STYLOPODIUM. In most species the ovary is furnished with a *stylopodium*. This is a ± terete body between the ovary and the style-base. It is mostly persistent on the achenes and easily observed. The function is unknown. Perhaps it acts as a nectary or an elaiosome (cf. NORDENSTAM 1968 a p. 25).

Taxonomic Concepts

Since I have studied herbarium material only, the taxonomic concepts applied in this work necessarily have to be founded on morphology. They follow those adopted in modern taxonomic revisions based on herbarium material.

The *species* is based on a combination of marked discontinuities in several morphological characters. All species of *Osmitopsis* are reasonably easily defined. The infraspecific variation may be considerable, but the distinguished species all differ markedly from each other.

The *subspecies* rank is used in one case. *O. pinnatifida* is split into two populations, occupying different areas. The populations show differences in leaf-shape and pappus morphology. These differences are mainly quantitative, and the discontinuity is regarded as insufficiently developed for the distinction of species. Thus the populations are ranked as subspecies.

Other infraspecific taxa such as *variety* and *form* are not used in this study.

HISTORICAL OUTLINE

THE PRE-LINNAEAN PERIOD. One species of this genus, *Osmitopsis asteriscoides,* was early described and introduced in European gardens. It is a strongly camphor-scented shrub with showy inflorescences, commonly growing at the Cape.

Probably this plant was first described and illustrated at the end of the seventeenth century in the "Icones plantarum et animalium" in the Africana Museum, Johannesburg. An account of this volume is given by MACNAE & DAVIDSON (1969). I have not seen it, but according to BURMAN (1738 p. 161), in whose possession it was, *Osmitopsis asteriscoides* is here named *"Bellis Camphorifera, aquatica, Africana, flore albo odorato"*. BURMAN also cites CASPAR COMMELIN, who should have named the species *"Leucanthemum Africanum, aquaticum, camphoriferum"* in the "Manuscript Catalogue" (see MACNAE & DAVIDSON 1969 p. 68) at the same time. PLUKENET (1696 p. 65) and HERMANN (1698 p. 5) briefly mentioned *Osmitopsis asteriscoides* as *"Bellis major Africana, Camphoram redolens, aùt potiùs Zedoariam"* and *"Bellis Africana umbellata frutescens, odore Camphorae"*, respectively. RAY (1704 p. 221) described it under the name *"Bellis frutescens Africana camphorata"*. Simultaneously PETIVER (in RAY 1704 p. 242) named it *"Bellis Capensis Camphorifera foliis Lini incanis"*. VAILLANT (1722 p. 316) established the genus *Bellidiastrum,* based on the single species *Osmitopsis asteriscoides,* which he named *"Bellidiastrum subhirsutum, Linifolium"*. SEBA (1734 pp. 24, 143) described and illustrated two species, *"Bellis, Capitis B. Sp. Aquatica, Camphorata, umbellata, frutescens, foliis longis, crassis, acutis"* and *"Bellis, Camphorifera, Africana, aquatica, flore albo"*. I consider them both as belonging to *Osmitopsis asteriscoides.* BURMAN (1737 p. 5) mentions the species as *"Bellis frutescens, Camphorata, foliis angustis crassis, acutis"*. Later BURMAN (1738 p. 161) gave a detailed description of the plant and then named it *"Leucanthemum fruticosum Camphoratum, foliis crassis, angustis, acutis"*. As already mentioned, BURMAN was in possession of the "Icones plantarum et animalium", the illustrations of which he used as models for his own. Thus BURMAN's illustration of *Osmitopsis asteriscoides* is made after one in the "Icones plantarum et animalium".

THE LINNAEAN PERIOD. Besides *Osmitopsis asteriscoides* two more species of *Osmitopsis,* viz. *Osmitopsis afra* and *Osmitopsis dentata* were introduced during this period. The species described as *Osmites calycina* by LINNÉ f. (1781 p. 380) is no *Osmitopsis,* but *Relhania calycina* (L. f.) POIR. (see COMPTON 1935 p. 71). For a detailed discussion of the history of the species the reader should consult the nomenclatural notes under each species. This part will primarily consider important aspects of the history of the genus as a whole.

A species of *Relhania,* at present known as *Relhania ericoides* (BERG.) CASS., was mixed up with the *Osmitopsis* species. LINNAEUS (1756 p. 31) described a species, which he named *Anthemis fruticosa.* In the description he registered a BURMAN specimen, but there is no specimen with the epithet *fruticosa,* neither in the BURMAN herbarium in Geneva (G), nor in the Linnaean herbarium (LINN) in London. However, the leaves are stated to be linear and triquetrous (*"foliis linearibus triquetris; Folia subulato-linearia, triquetra"*), which clearly indicates that the description is based on the *Relhania* species, although the ray-florets erroneously are said to be white instead of yellow (*"Radius albus"*), indicating that LINNAEUS might have mixed up the *Relhania* species with *Osmitopsis asteriscoides.* Accordingly, *Anthemis fruticosa* must be referred to *Relhania.* Later LINNAEUS (1759 p. 1223) changed the name to *Anthemis Bellidiastrum,* thus adopting the generic name of VAILLANT (1722 p. 316) as a specific epithet. Since LINNAEUS did not change the previous description, this species still is to be interpreted as a *Relhania*. There is also a *Relhania* specimen with the note "*Anth. Bellidiastrum*" in LINNAEUS' handwriting in the Linnaean herbarium (LINN, specimen 1029: 1). The generic name *Osmites* was introduced in the Linnaean dissertation "Plantae rariores africanae" (LINNAEUS 1760 p. 24). Besides two species, both representing *Osmitopsis asteriscoides,* this genus included the species *Osmites Bellidiastrum,* discussed here. The previous description is not changed, and the species is still to be interpreted as a *Relhania*. However, there are three BURMAN specimens of *Osmitopsis asteriscoides,* one of which bears the note "*Osmites Bellidiastrum*" in LINNAEUS' handwriting, thus revealing that LINNAEUS confused the *Relhania* species with *Osmitopsis asteriscoides*. The genus was not described in the dissertation and it remained undescribed in the essentially unchanged section of *Osmites* in the "Species plantarum" (LINNAEUS 1763 a p. 1285). In "Genera plantarum" (LINNAEUS 1764 p. 441) he described the genus on the basis of his *Osmites Bellidiastrum,* which must be interpreted as a *Relhania*. There is nothing in the description of the genus to contradict this. Moreover, many characters point to the *Relhania* species. The ray-florets are described as provided with a style ("*Femineis: Stylus filiformis, longitudine corollulae*"), which is the case in the *Relhania* species, but not in *Osmitopsis asteriscoides*. Consequently, the name *Osmites* cannot be applied to the genus treated in this monograph.

NOTE ON RELHANIA. It is evident that the nomenclature of this genus needs a complete analysis. The generic name *Osmites* L. is prior to L'HÉRITIER's (1788 p. 22) name *Relhania*. Thus, *Osmites* should be the name of the genus at present known as *Relhania*. On the other hand the possibility of conserving the latter name could be taken into consideration. In this connection it should be noted that LINNAEUS' (1756 p. 31) epithet *fruticosa* is prior to BERGIUS' (1767 p. 294) epithet *ericoides*. Thus the epithet of the species in question must be changed. The making of this and other new combinations should naturally be preceded by the settlement of the generic name to be used.

THE POST-LINNAEAN PERIOD. L'HÉRITIER (1788 p. 22) introduced the genus *Relhania,* to which he transferred LINNAEUS' species *Osmites Bellidiastrum*. GAERTNER (1791 p. 442) then only recognized two species within *Osmitopsis,* both representing *Osmitopsis asteriscoides*. However, the three subsequent writers on the genus, viz. SAVIGNY (in LAMARCK 1798 p. 647), THUNBERG (1823 p. 700) and CASSINI (1825 p. 3) did not realize the mistake of LINNAEUS and kept his species *Osmites Bellidiastrum* within the genus.

CASSINI (1817 p. 154) described the genus *Osmitopsis* with *O. asteriscoides* as a generic type. *Osmitopsis* is then the name which must be used for the genus in this treatise. The first author to use this name when describing the species was LESSING (1832 p. 383), who besides *Osmites* and *Osmitopsis* also distinguished a third genus, *Bellidiastrum,* including the new species *Osmitopsis osmitoides,* which originally was introduced by THUNBERG (1800 p. 163). DE CANDOLLE (1837 p. 290) only recognized the two genera *Osmites* and *Osmitopsis,* but divided the former into three sections, *Euosmites, Bellidiopsis* and *Spanotrichum*. The last name was adopted from MEYER, who used it when naming specimens collected by DRÈGE. DE CANDOLLE contributed two new species, viz. *Osmitopsis parvifolia* and *Osmitopsis pinnatifida*. The latest treatment of the whole genus was made by HARVEY (1865 p. 303). His revision has hitherto been operative in distinguishing the species. He included one species in *Osmitopsis* and six, two of which are now united, in *Osmites*.

KUNTZE (1891 p. 351) reestablished BURMAN's (1738 p. 161) generic name *Leucanthemum,* replacing *Osmitopsis*. Appearing before 1754, the name *Leucanthemum* is too old to be adopted under the present rules of nomenclature.

Two more species of *Osmitopsis* are yet to be mentioned. These are SCHLECHTER's (1900 p. 206) *Osmitopsis nana* and *Osmitopsis tenuis,* described in this treatise.

DELIMITATION AND SYSTEMATIC POSITION OF THE GENUS

Osmitopsis is a quite distinct genus with no close relatives. Thus there has been no problems when delimitating it towards other genera. It is easily characterized through many features, such as distinct camphor-scent (the generic name derives from the greek word οσμη=smell), pluriseriate involucral bracts with somewhat scarious margins, presence of paleae and white ray-florets. With its semiterete, linear—oblong, apically penicillate and truncate style-branches, the style is fairly uniform through the genus. The same applies to the tailed anthers.

Indeed, *Osmitopsis* is so isolated that there has existed different views on its position within the family Compositae. CASSINI (1817 p. 154) correctly (cf. below) referred it to his tribe Anthemideae. Later authors transferred it to other positions in the family. Until recently it has been placed in the subtribe Buphthalminae of the tribe Inuleae (BENTHAM & HOOKER 1873 p. 189; HOFFMANN 1890 p. 210). STIX (1960 pp. 97—99) points out that for pollen-morphological reasons the genus would be better placed in the tribe Anthemideae. The odour, the pluriseriate involucral bracts with somewhat scarious margins, the shape of the style and the reduced pappus are other characters that agree with the Anthemideae. However, in this tribe the anthers are regularly untailed, and only in some cases they are shortly eared basally. The anthers in *Osmitopsis* have long, subulate, sterile tails. Despite this discordance with other genera of the tribe, I believe that *Osmitopsis* should be placed in Anthemideae.

The tribe Anthemideae has been artificially divided into two subtribes, Anthemidinae and Chrysanthemidinae, with paleate and epaleate receptacle, respectively (HOFFMANN 1891 p. 268). When Anthemideae is divided in this manner, which, however, is unsatisfactory, *Osmitopsis* should be placed in Anthemidinae.

Hitherto *Osmitopsis* has been regarded as two genera, known as *Osmites* and *Osmitopsis.* The reasons for now uniting these are given under the discussion of pappus morphology and fertility and sterility conditions in the capitulum, characters which were used for separation of these genera.

MORPHOLOGICAL ASPECTS

The generic description on p. 23 is a condensed account of the important common features and their total variation range in the genus. The descriptions of the species merely deal with characters differing between the species.

Some aspects of the morphology will be discussed more in detail in the following paragraphs.

Organization of Stems, Branches and Synflorescence

This heading covers only a small part of the subject of growth-forms. The growth-form is the complex of characters forming the general appearance (habit) of the plant, including the change of the habit in time. MEUSEL (1951, 1952, 1970) has discussed the concept of growth-form and given many examples. But growth-form studies have rarely been carried out in connection with taxonomic revisions and the terminology of the subject is not sufficiently developed. Another difficulty is the need for living material in a comprehensive growth-form study. Since I have only been able to study herbarium material of *Osmitopsis,* I must limit the discussion of growth-forms to characters and organization of stems and branches and organization of the synflorescence. The different types are shown in Fig. 2.

The primitive, unbranched type (Fig. 2 A) is found in three species, but often capitulous branches of first and second order are developed (Fig. 2 B, C). A more extreme type is found in another species. This plant is a much-branched shrublet, where the ramification is equivalent and one cannot distinguish a main axis and branches of different order (Fig. 2 D).

Two species have a pedunculoid main axis, unbranched (Fig. 2 E) or sometimes with capitulous branches of first order (Fig. 2 F).

The types described above all have complete synflorescences. But two species of *Osmitopsis* have developed a "trunk synflorescence" (NORDENSTAM 1968 b p. 211). In this type the main axis is not terminated by a capitulum, but continues vegetative growth. Lateral branches of first and sometimes second order bear the capitula terminally (Fig. 2 G, H). The branches generally appear in clusters, observable in Figs. 11 A and 12 A, (pp. 39 and 41, respectively). Sometimes there are more than one cluster of branches on the main stem, indicating previous flowering occasions.

The term "Rumpfsynfloreszenz" was introduced by TROLL (1964 p. 157) and translated to "trunk synflorescence" by NORDENSTAM (loc. cit.), who also discussed it and pointed out that the condition is probably uncommon in the family.

Pappus Morphology

The upper parts of achenes and ovaries with the different pappus types in the genus are outlined in Fig. 3. When present the pappus consists of glabrous, scarious, basally connate scales. Three of the species regularly have a crown-like pappus with subequal scales (Fig. 3 C, D, E). *O. pinnatifida* has 2—15 distinctly longer, subulate scales (Fig. 3 A), which may have some adaptive value in dispersal. In ray-florets of *O. pinnatifida* ssp. *angustifolia* these long scales are mostly absent and the pappus is reduced to very short scales (Fig. 3 B). Sometimes this is also the case in *O. dentata* (Fig. 3 F). The remaining four species generally lack pappus completely. Apically the achene is white-yellow and annulus-shaped, the annulus surrounding the stylopodium (if present) (Fig. 3 G, H, J, K). Occasionally, as in one collection of *O. tenuis,* pappus scales may develop on some achenes (Fig. 3 I).

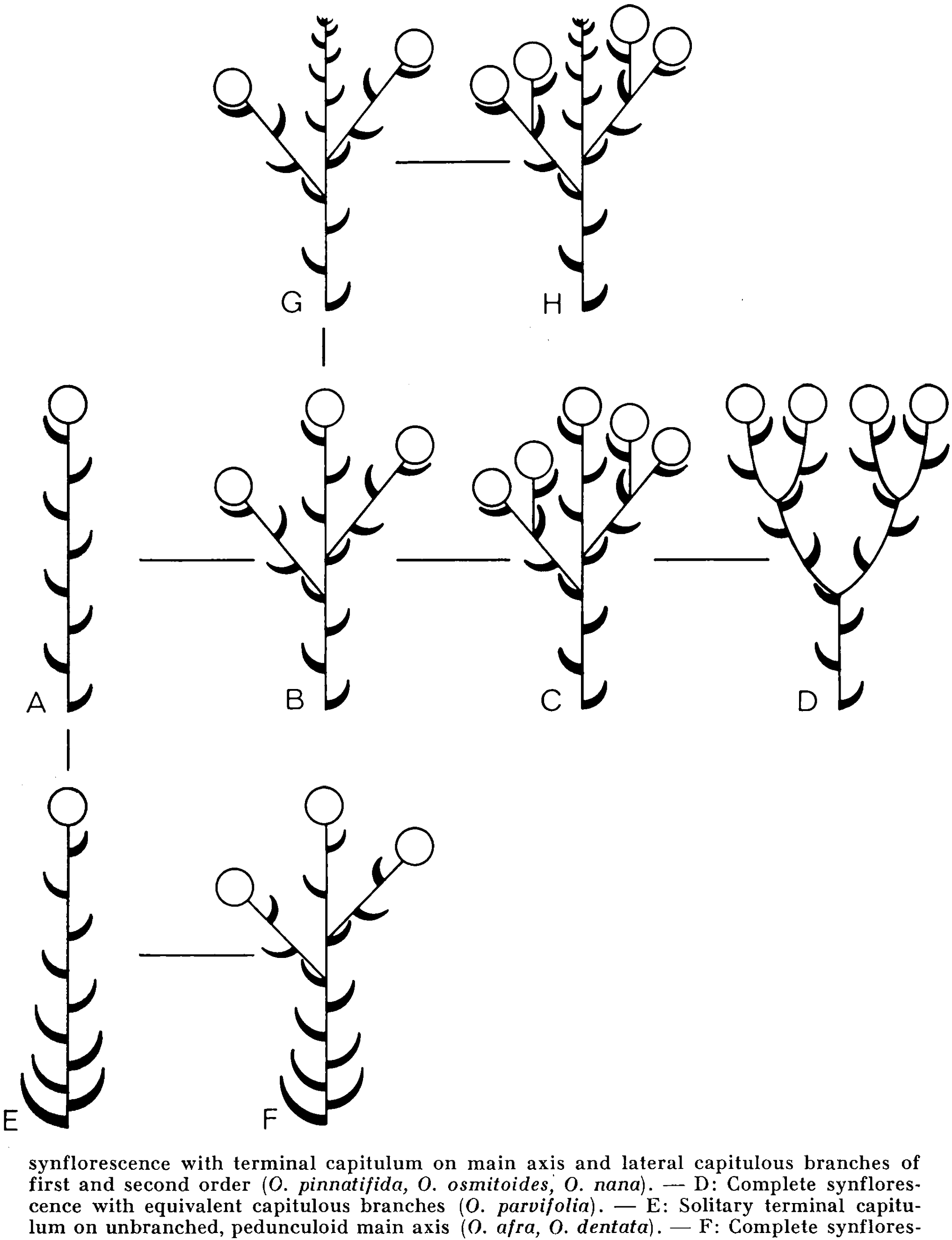
When CASSINI (1817 p. 154) established *Osmitopsis* he distinguished it from *Osmites* through the absence of pappus. The reduced character of the pappus, the pappus reduction on some achenes in the pappus-furnished species and the occasional achenes with developed pappus-scales in the pappus-lacking species make this character useless for generic delimitation. I have therefore united the two genera into one, *Osmitopsis* CASS. emend. BREMER.

The fertility versus sterility of the ray-floret has also been used in delimitation of the genera now united under *Osmitopsis.* This character will be discussed in the following paragraph.

Fertility and Sterility Conditions in the Capitulum

The primitive condition in *Osmitopsis* is a capitulum with perfect disc-florets and female, fertile ray-florets. From this type are derived species with ♀-sterile disc-florets and sterile or even neuter ray-florets. The different types of styles of the ray-floret are outlined in Fig. 4.

Fig. 2. Diagrams of stems and branches with synflorescence types in *Osmitopsis.* — A: Solitary terminal capitulum on unbranched main axis (*O. pinnatifida, O. osmitoides, O. nana*). — B: Complete synflorescence with terminal capitulum on main axis and lateral capitulous branches of first order (*O. pinnatifida, O. osmitoides, O. nana*). — C: Complete



synflorescence with terminal capitulum on main axis and lateral capitulous branches of first and second order (*O. pinnatifida, O. osmitoides, O. nana*). — D: Complete synflorescence with equivalent capitulous branches (*O. parvifolia*). — E: Solitary terminal capitulum on unbranched, pedunculoid main axis (*O. afra, O. dentata*). — F: Complete synflorescence with terminal capitulum on pedunculoid main axis and lateral capitulous branches of first order (*O. afra, O. dentata*). — G: Trunk synflorescence without terminal capitulum on main axis and lateral capitulous branches of first order (*O. tenuis, O. asteriscoides*). — H: Trunk synflorescence without terminal capitulum on main axis and lateral capitulous branches of first and second order (*O. tenuis, O. asteriscoides*).

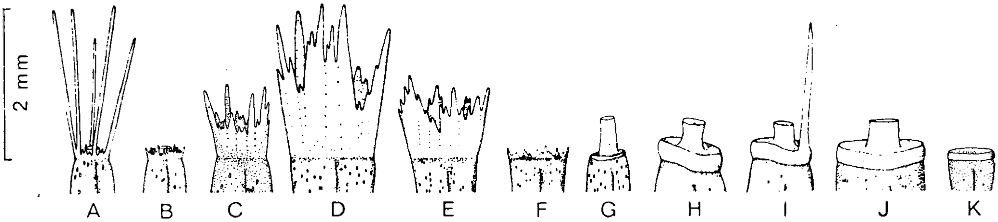


Fig. 3. Achenes and ovaries showing reduction of pappus. — A: *O. pinnatifida.* — B: *O. pinnatifida* ssp. *angustifolia* (from ray-floret). — C: *O. osmitoides.* — D: *O. afra.* — E: *O. dentata.* — F: *O. dentata* (from ray-floret). — G: *O. nana.* — H: *O. tenuis* (from disc-floret). — I: *O. tenuis* (from disc-floret). — J: *O. asteriscoides* (from disc-floret). — K: *O. parvifolia* (from ray-floret).

A: Wicht 427 (BOL). — B: Esterhuysen 1377 (BOL). — C: Martin 81 (NBG). — D: Stokoe, Rooi Els River (SAM). — E: Zeyher, shady, grassy places at the waterfall (SAM). — F: Wall Nov. 1938 (S). — G: Schlechter 9854 (S). — H: Esterhuysen 17793 (BOL). — I: Stokoe Nov. 1949 (SAM). — J: Wall Dec. 1938, Table Mtn., at the water reservoir (S). — K: Schlechter 5387 (BOL).

Of the eight species no less than seven have perfect disc-florets. Within this group a gradual reduction of the style of the ray-floret has taken place. *O. pinnatifida* and *O. osmitoides* mostly have fertile ray-florets (Fig. 4 A, C). They are seldom sterile with a simple style (Fig. 4 B). The ray-florets of *O. afra* and *O. nana* are mostly fertile, too (Fig. 4 D, G), but often they are sterile with coherent style-branches or a simple style (Fig. 4 E, H). *O. dentata* always has sterile ray-florets. The style is bifid, but the style-branches are coherent (Fig. 4 F). *O. tenuis* and *O. asteriscoides* regularly have neuter ray-florets. In one collection of the latter species rudimentary styles in some ray-florets have been observed (Fig. 4 I).

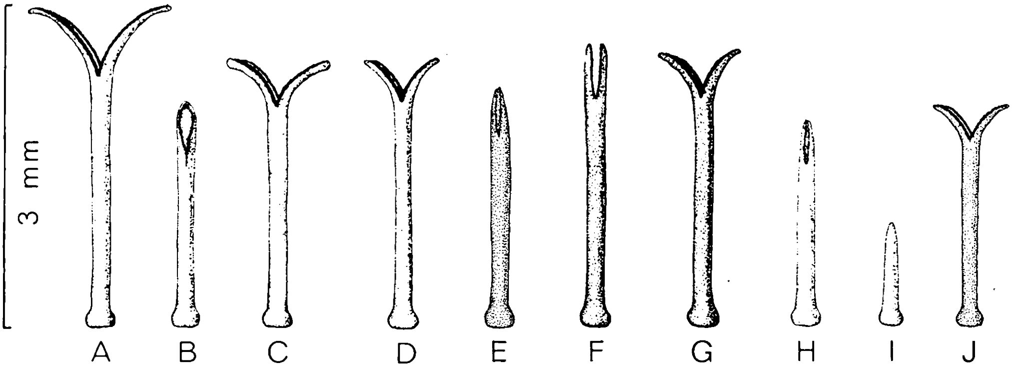


Fig. 4. Styles of ray-florets. — A, B: *O. pinnatifida.* — C: *O. osmitoides.* — D, E: *O. afra.* — F: *O. dentata.* — G, H: *O. nana.* — I: *O. asteriscoides.* — J: *O. parvifolia.*

A: Esterhuysen 13537 (BOL). — B: Esterhuysen 9703 (BOL). — C: Wall Dec. 1938, Tradouw Pass (S). — D: Stokoe, Rooi Els River (SAM). — E: Barker 7163 (NBG). — F: Wall Nov. 1938 (S). — G: Stokoe 17576 (BOL). — H: Schlechter 9854 (S). — I: Phillips 1179 (SAM). — J: Penther 2395 (S).

In *O. parvifolia* the evolution has taken another path. The disc-florets are ♀-sterile and the ray-florets are fully fertile (Fig. 4 J). The style of the disc-floret has short coherent style-branches (Fig. 13 E, p. 45).

The fertility versus sterility of the ray-floret has been used previously as a generic character. In the preceding paragraph it was pointed out that the presence or absence of pappus was the basic character for separation of the two genera *Osmites* and *Osmitopsis* (CASSINI 1817 p. 154 and later authors). Beside this the ray-florets in *Osmites* were said to be female and those in *Osmitopsis* neuter (DE CANDOLLE 1837 pp. 290—292). After the discovery of *O. nana* and the transfer of *O. parvifolia* to *Osmitopsis* from *Osmites* because of the absence of pappus (HOFMEYR 1925 p. 364), this does not hold true, however, since these species have female ray-florets, but lack pappus. This strengthens the motivation for uniting the two genera into one, *Osmitopsis* CASS. emend. BREMER.

Pollen Morphology

STIX (1960 p. 77) has given a description of the pollen grains of *Osmitopsis,* based on examination of material from five species. I have studied material from most species of *Osmitopsis,* including the three species not examined by STIX. I find only slight quantitative differences between the species and the morphology of the examined pollen material well matches the description given by STIX. I therefore reproduce her description translated into English with a few amendments.

Pollen grains zonocolporate (3), oblate-spheroidal, c. 28—33 μ×30—35 μ incl. sexine, c. 13—18 μ×15—20 μ excl. sexine. Colpi c. 18 μ×6 μ, tenuimarginate, with acuminate ends, membrane smooth. Ora c. 5 μ×10 μ, irregularly singly delimitated, tenuimarginate, lalongate with obtuse or acute ends. Apocolpia c. 10 μ in diam. Mesocolpia in equatorial plane with c. 12 spines.

Exine c. 10 μ thick incl. spines, at the poles somewhat thinner, crassisexinous. Sexine tegillate, with spines and infrategillar bacula. Tegillum c. 1.5 μ thick, where it forms the base of the spines up to 3.5 μ thick, of fine pila with capita mostly confluent and a thin support layer. Spines c. 3.5 μ high with a median distance of c. 6 μ, finely and sharply pointed (acute —acuminate), with a small cavity in the solid tip. Infrategillar bacula 3.5 μ high, at the poles somewhat lower, up to 2 μ wide, branched in the outer third. Nexine 1 c. 1.5 μ thick, nexine 2 developed only near the apertures.

STIX distinguished many pollen types in Compositae, one of which was the “Osmites type”. The “Osmites type” is insignificantly different from the “Anthemis type” (STIX 1960 p. 75). The description of the latter is based on examination of material from five important genera in the tribe Anthemideae, viz. *Achillea, Anthemis, Chrysanthemum, Cotula* and *Matricaria.* This is a strong support for the suggested position of *Osmitopsis* in the Anthemideae (discussed on p. 15).

Evolutionary Trends

To sum up the discussion of some morphological characters in the previous paragraphs, evolutionary trends in some of these characters are listed in Table 1. Most of these, viz. those concerning the fertility and sterility conditions in the capitulum, are quite obvious, while the others may be open to discussion.

Synopsis of the Species

The synopsis or general view of the species is outlined below in order to demonstrate a natural grouping of the species. It is based on the diagnostic characters discussed previously with one addition, the indumentum on the tube of the ray-florets. This character is used to separate *O. tenuis* and *O. asteriscoides.* The latter species is the only one in the genus with

Table 1. Evolutionary Trends in *Osmitopsis.*

Primitive	Advanced
Stems not pedunculoid	Stems pedunculoid
Complete synflorescence	Trunk synflorescence
Pappus present	Pappus 0
Disc-florets perfect	Disc-florets ♀-sterile
Ray-florets fertile	Ray-florets sterile
Style of ray-florets present	Style of ray-florets 0
Style of ray-florets bifid	Style of ray-florets simple

pubescent tube of the ray-florets. The other species have glabrous tubes.

This synopsis is not constructed for determining the species. For this purpose the reader should consult the artificial key on p. 23.

Pappus present; disc-florets perfect.
  Pappus of many short (seldom 0) and few long scales; ray-florets fertile .... 1. *O. pinnatifida*
  Pappus of subequal scales.
    Main axis not pedunculoid; ray-florets fertile .... 2. *O. osmitoides*
    Main axis pedunculoid.
      Ray-florets mostly fertile; style present .... 3. *O. afra*
      Ray-florets always sterile; style present .... 4. *O. dentata*

Pappus 0.
  Disc-florets perfect.
    Ray-florets fertile or sterile; style present .... 5. *O. nana*
    Ray-florets sterile; style 0; trunk synflorescence.
      Tube of ray-florets glabrous .... 6. *O. tenuis*
      Tube of ray-florets pubescent .... 7. *O. asteriscoides*
Disc-florets ♀-sterile; ray-florets fertile .... 8. *O. parvifolia*

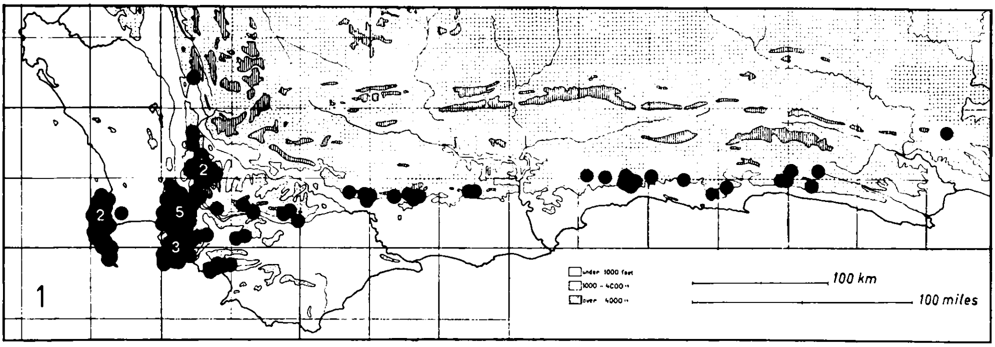
PHYTOGEOGRAPHY

DISTRIBUTION AND CENTRE OF THE GENUS. The total range of *Osmitopsis* is seen on Map 1. The genus is restricted to the Cape Region and the distribution pattern is typical for a representative of the "Cape Element" (WEIMARCK 1941 p. 4). Comparisons with typical Cape genera, e. g. *Elegia* (Restionaceae) (WEIMARCK 1941 pp. 9, 11, 16, 17, 20, 21, 31, 32, 41, 45, 48, 107), *Paranomus* (Proteaceae) (LEVYNS 1970 pp. 40—42) and *Aspalathus* (Leguminosae) (DAHLGREN 1963 p. 434), demonstrate the similarity in distribution, although the range of *Osmitopsis* is considerably smaller. The genus has a somewhat southern distribution, not reaching the Cedarberg Mts. in the north.

A more detailed examination reveals that *Osmitopsis* is almost exclusively confined to montane regions. It is also evident that the genus is distributed within the area with a mean annual rainfall of 10—20 inches (DAHLGREN 1963 p. 434). There is a well known relation between the presence of the Cape Element and a marked winter rainfall. In the south-western parts of the Cape Region, where *Osmitopsis* occurs, the winter rainfall is marked, i. e. > 50 % of the annual rainfall.

Another probably important factor in the distribution is the soil conditions. A

Maps 1—9. — 1: The total range of *Osmitopsis.* — 2: *O. dentata* (○=inexact locality). — 3: *O. osmitoides.* — 4: *O. pinnatifida* (○=inexact locality). — 5: *O. afra* (○=deviating collections, see p. 33). — 6: *O. nana.* — 7: *O. tenius.* — 8: *O. asteriscoides* (○=inexact locality). — 9: *O. parvifolia.*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5
3
2
under 1000 feet
1000 - 4000 ft
over 4000 ft
100 km
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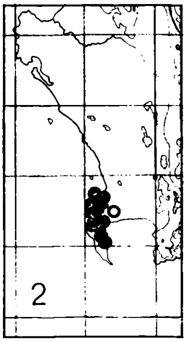
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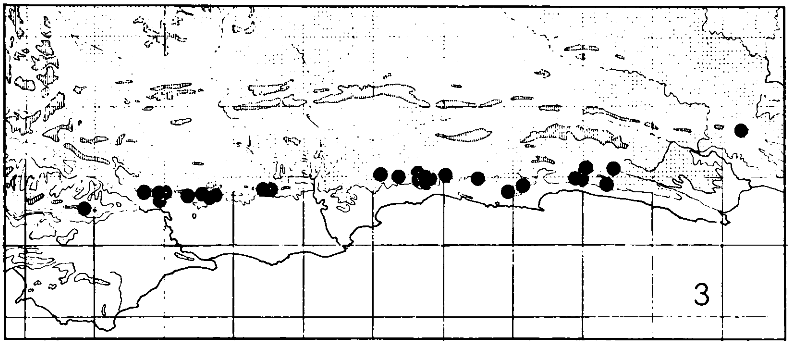
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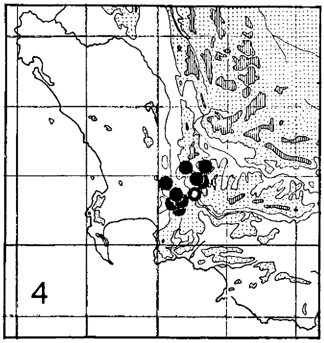
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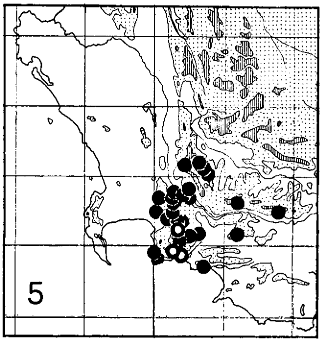
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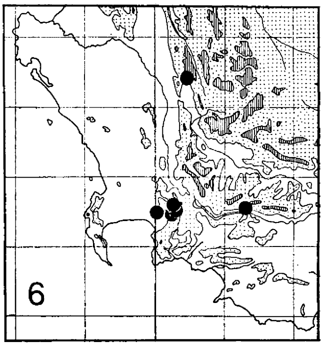
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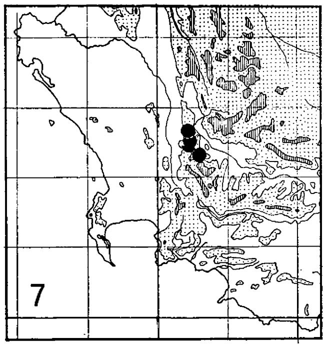
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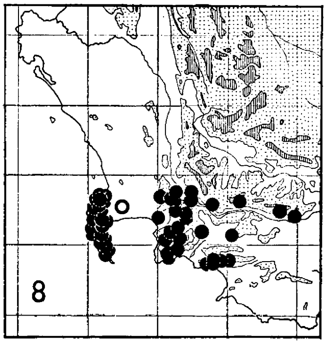
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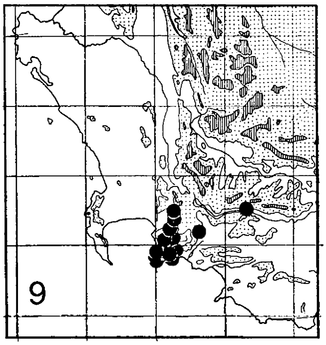
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comparison of the distribution of the genus with the distribution of the soils of the Table Mountain Series of the Cape System (DAHLGREN 1969 pp. 525—526) shows that, with only a few exceptions, the *Osmitopsis* species grow on this substratum. The Table Mountain Series consist mainly of sandstones and quartzites and the soils are sandy and mainly acid (DAHLGREN loc. cit.).

Map 1 also attempts to give an idea of the centre of the genus. Four white figures indicate the number of species in the corresponding areas. It is evident that the main bulk of the species, as expected from a typical Cape genus, is concentrated to the southwestern districts. As a phytogeographical centre this region is named "the Caledon Centre" (CROIZAT 1965 p. 668; NORDENSTAM 1969 p. 62) or "the South-Western Centre" (WEIMARCK 1941 p. 58). In the Drakenstein Mts. and northern Hottentots Holland Mts. five of the eight species occur. From these mountains the number of species decreases gradually in all directions. The centre of the genus thus appears to be in this area.

DISTRIBUTION OF THE SPECIES. The species of *Osmitopsis* can be referred to two of the phytogeographical groups within the Cape Flora as distinguished by WEIMARCK (1941 pp. 14, 31). These are "the South-Western Endemics" and "the Southern Group", both belonging to the main group "Species endemic in the Cape proper".

To the former group seven of the eight species belong. Of these, *O. afra* (Map 5) and *O. asteriscoides* (Map 8) have a relatively wide distribution. The others are more or less restricted to smaller areas, sometimes with distant outliers, e. g. *O. nana* (Map 6) and *O. parvifolia* (Map 9). Following the present knowledge of distribution, *O. dentata* (Map 2) and *O. tenuis* (Map 7) might be termed locally endemic on the Peninsula and in the Slanghoek Mts., respectively.

There is one good example of vicarism in the genus. This is on the subspecies level in *O. pinnatifida* (Map 4; Fig. 5, p. 25). Ssp. *pinnatifida* is confined to the Wemmershoek and Dutoits Mts. while ssp. *angustifolia* is confined to the Simonsberg, Hottentots Holland and Drakenstein Mts. A less obvious example is furnished by the mutually allied species *O. dentata* and *O. afra* (Map 2 and 5, respectively).

"The Southern Group" of WEIMARCK's phytogeographical groups comprises one *Osmitopsis* species. This is *O. osmitoides* (Map 3), separated from the main bulk of the species in the southwestern district and with a wide distribution from the Rivier Zonder Einde Mts. through the Langeberg and Outeniqua Mts. to the Great Winterhoek Mts.

Taxonomy

OSMITOPSIS Cass. emend. Bremer, emend. nov.

CASSINI 1817 p. 154; CASSINI 1823 p. 186; 1825 p. 5; 1826 pp. 31, 40; LESSING 1832 p. 386; CASSINI 1834 p. 63; DE CANDOLLE 1837 p. 292; HARVEY 1838 p. 181; SPACH 1841 p. 25; HARVEY 1865 p. 305; 1868 p. 196; BENTHAM & HOOKER 1873 p. 341; HOFFMANN 1890 p. 210; PHILLIPS 1926 p. 653; LEVYNS 1929 p. 260; MARLOTH 1932 p. 237; LEVYNS 1950 p. 798; PHILLIPS 1951 p. 811; THONNER 1962 p. 555. — Typus generis: *O. asteriscoides* (BERG.) LESS.

Osmites L. p. p. max., excl. typus (non L. 1764, descr. orig.; LINNAEUS 1764 p. 441; REICHARD 1778 p. 437; SCHREBER 1791 p. 575); [LINNAEUS 1760 p. 24; 1763 a p. 1285; 1763 b p. 105; sine descr.]; LINNAEUS 1767 p. 571; BURMAN f. 1768 p. 27; LINNAEUS 1771 p. 477; MURRAY 1774 p. 651; CHRISTMANN & PANZER 1779 p. 406; REICHARD 1780 p. 892; MURRAY 1784 p. 783; GAERTNER 1791 p. 442; GMELIN 1792 p. 1261; PERSOON 1797 p. 824; SAVIGNY in LAMARCK 1798 p. 647; THUNBERG 1800 p. 163; WILLDENOW 1803 p. 2258; DIETRICH 1806 p. 564; SMITH in REES 1813; CASSINI 1823 p. 186; THUNBERG 1823 p. 700; CASSINI 1825 p. 3; 1826 pp. 31, 40; SPRENGEL 1831 p. 639; LESSING 1832 p. 384; CASSINI 1834 p. 63; RICHTER 1835 p. 855; DE CANDOLLE 1837 p. 290; HARVEY 1838 p. 181; SPACH 1841 p. 25; HARVEY 1865 p. 303; 1868 p. 196; BENTHAM & HOOKER 1873 p. 341; HOFFMANN

1890 p. 210; PHILLIPS 1926 p. 653; LEVYNS 1929 p. 260; MARLOTH 1932 p. 237; LEVYNS 1950 p. 797; PHILLIPS 1951 p. 812; THONNER 1962 p. 555. — Typus generis: *O. Bellidiastrum* L. (=*Relhania* sp.).

Bellidiastrum LESS., nom. illeg. (non CASS. 1816 p. 199); LESSING 1832 p. 383; HARVEY 1838 p. 181. — Typus generis: *B. osmitoides* LESS. (=*Osmitopsis osmitoides* (LESS.) BREMER).

Spanotrichum E. MEY. ex DC., pro syn.; DE CANDOLLE 1837 p. 291; SPACH 1841 p. 25. — Typus generis: *S. pinnatifidum* E. MEY. ex DC. (=*Osmitopsis pinnatifida* (DC.) BREMER).

Bellidiopsis (DC.) SPACH, nom. superfl., typus ut in *Bellidiastrum* LESS.; SPACH 1841 p. 25.

Leucanthemum [BURMAN 1738 p. 161] OK., nom. illeg.; KUNTZE 1891 p. 351. — Typus generis: *L. asteriscoides* (L.) OK. (=*Osmitopsis asteriscoides* (BERG.) LESS.).

Suffrutices—frutices, resiniferous, dotted all over with resin grains, camphor-scented, glabrous or pubescent. Stems ramifying or simple, sometimes somewhat pedunculoid, mostly with terminal capitula.

Leaves densely—laxly set, mostly alternate, sometimes approaching rosulate, occasionally opposite, sessile, flat, midribbed, entire or mostly lobed—serrate—dentate.

Capitula heterogamous or homogamous, ± sessile.

Involucre campanulate. Involucral bracts 2—4-seriate, imbricated, subequal, firm, mid-ribbed, canaliculate, often with plane, scarious margins, laterally and apically ± purplish, entire or mostly fimbriate—serrate—dentate.

Receptacle alveolate, flat—convex—conical, paleate. Paleae equalling the number of disc-florets, equal, ± scarious, midribbed, longitudinally curved, canaliculate and thus half-embracing, fimbriate—serrate—dentate.

Ray-florets neuter or female, fertile or sterile, with a ± cylindrical, widening tube and an elliptic—oblong—lorate, white lamina. Style terete, bifid or simple, with a swollen base; style-branches semiterete, linear—oblong, coherent—erect—spreading, glabrous or minutely penicillate at the apex, acute—obtuse; stylopodium present or 0. Staminodes occasionally present.

Disc-florets bisexual, perfect or ♀-sterile. Corolla yellow, tubular, gradually widening upwards, 5-lobed; corolla lobes ovate-triangular, thickened at the apex. Style terete, bifid, with a swollen base; style-branches semiterete, linear—oblong, coherent—erect—spreading—revolute, apically penicillate, truncate; stylopodium present or 0. Stamens 5; anthers linear, with sterile, flat, ovate—oblong, rounded—truncate apical appendage and sterile, flat, subulate tails, ± connate in pairs; filaments filiform.

Achenes glabrous, dotted all over with resin grains, brown, oblong—elliptic—obovate, somewhat three—four-edged, basally annulus-shaped and white-yellow; stylopodium sometimes persistent; pappus 0 or present, crown-like, light brown, of scarious, subulate—triangular scales.

KEY TO THE SPECIES

1. Pappus present at least in disc-florets 2
   Pappus 0 5
2. Pappus of many short, subulate-triangular, ± connate scales (seldom 0) and 2—15 long scales (at least in disc-florets), up to 2.5 mm long, subulate, hair-like .... 1. *O. pinnatifida*
   Pappus of many, subequal, up to 2 mm long, subulate-triangular—subulate, basally connate scales 3
3. Leaves always < 2 cm long .... 3. *O. afra*
   Most leaves > 2 cm long 4

4. Leaves subequal in shape, narrowly elliptic or oblanceolate, cuneate, acute—acuminate; ray-florets fertile .... 2. *O. osmitoides*
   Lower leaves obovate and cuneate or spatulate, obtuse—rounded, upper leaves elliptic, acute; ray-florets sterile .... 4. *O. dentata*
5. Involucral bracts glabrous; ray-florets female 6
   Involucral bracts dorsally pubescent; ray-florets neuter 7
6. Disc-florets fertile; stylopodium on achenes terete, 0.4—0.5 mm long .. 5. *O. nana*
   Disc-florets sterile; stylopodium on achenes 0 .... 8. *O. parvifolia*
7. Leaves always < 1.5 cm long .... 6. *O. tenuis*
   Most leaves > 1.5 cm long .... 7. *O. asteriscoides*

1. Osmitopsis pinnatifida (DC.) Bremer, comb. nov.

Basionym: *Osmites pinnatifida* DC.; DE CANDOLLE 1837 p. 291; HARVEY 1865 p. 305. — *Spanotrichum pinnatifidum* E. MEY. ex DC., pro syn.; DE CANDOLLE 1837 p. 291. — Orig. coll.: DRÈGE, Drakenstensberg (G-DC holotype).

Osmites angustifolia DC.; DE CANDOLLE 1837 p. 291; HARVEY 1865 p. 305. — Orig. coll.: DRÈGE, Drakenstein, Waaterval (G-DC holotype).

ILLUSTR.: Fig. 3 A, B, p. 18; 4 A, B, p. 18; 6, p. 27.

MAPS: 4, p. 21; Fig. 5, p. 25.

NOMENCLATURAL NOTE

When naming specimens of this species, collected by DRÈGE, MEYER used the name *Spanotrichum pinnatifidum*. DE CANDOLLE (1837 p. 291) adopted *Spanotrichum* as a section of the genus *Osmites*, and described the two species *Osmites pinnatifida* and *Osmites angustifolia*. I have reduced them to subspecies. Since the epithet *pinnatifida* seems to be most widely used, it has been adopted for this species.

A 30—50 cm high, glabrous suffrutex. Stems simple or ramifying, ascending or erect, somewhat striate, densely leafy, gradually more sparsely upwards, finally clothed with dry leaves and leaf-bases or nude and marked with leaf-scars, terminally bearing a capitulum. Cortex light brown.

Leaves spreading or reflexed, herbaceous, narrowly elliptic-oblong—linear or narrowly obovate-oblong, 0.5—4 cm long, 1—4 mm wide, acute—acuminate, entire or mostly serrate—pinnatifid; leaf-lobes up to 18, erecto-patent, triangular—subulate, 0.5—8 mm long, 0.1—1.5 mm wide, acute—acuminate. Upper leaves smaller with fewer lobes.

Involucre campanulate, 0.5—2 cm wide. Involucral bracts 15—30, 2—3-seriate, obovate-oblong or elliptic-oblong, outer lanceolate or oblong, 3.5—8.5 mm long, 1—3 mm wide, laterally ± scarious, apically irregularly and ± minutely denticulate-serrulate and sometimes purplish, obtuse or mucronate—acuminate.

Receptacle convex. Paleae glabrous, ± scarious, oblong or narrowly elliptic-oblong, 3—5 mm long, 0.5—1.4 mm wide, apically irregularly serrate, ± acute—acuminate.

Ray-florets 10—30, female, mostly fertile, glabrous. Tube cylindrical—funnel-shaped, gradually widening, 0.5—2 mm long, 0.5—0.9 mm wide. Lamina lorate or ± narrowly elliptic-oblong, 6—18 mm long, 2—4 mm wide, ± distinctly 6—10-veined, apically entire or ± irregularly and deeply 2—3-lobed. Style 1.8—3.2 mm long, bifid or sometimes simple; style-branches 0.3—1 mm long, spreading—revolute, acute; stylopodium terete, up to 0.2 mm long.

Disc-florets numerous, > 50, perfect. Corolla cylindrical, ± widening upwards, 2.5—4 mm long, 0.6—1 mm wide; corolla lobes ± narrowly ovate-triangular, 0.3—0.8 mm long, spreading—revolute. Style 2.5—4 mm long; style-branches 0.3—0.8

mm long, spreading; stylopodium terete, up to 0.3 mm long. Anthers 1.5—2 mm long; apical appendage ovate, truncate-rounded.

Achenes obovate-oblong, 1—2 mm long, 0.5—1 mm wide, somewhat three—four-edged; pappus of many, short, subulate-triangular, ± connate scales (seldom 0) and 2—15 long scales (seldom 0), up to 2.5 mm long, subulate, hair-like.

Sometimes *O. pinnatifida* is similar in habit to *O. nana* and small specimens of *O. osmitoides*. It differs from these species in the character of the pappus.

VARIATION. This species expresses a considerable variation in leaf-shape, shown in Fig. 6 J—R. At first sight it might seem continuous and of no taxonomic value, but there is a connection between leaf-shape and distribution (see Fig. 5). Two different populations appear to have developed, one with few leaf-lobes in the Jonkershoek, Simonsberg and Drakenstein Mts. and one with many leaf-lobes in the Wemmershoek and Dutoits Mts. In the former population 10 of the 12 collections known to me have ray-florets with a reduced pappus consisting of short scales only. The remaining two (Esterhuysen 8692 and Esterhuysen 19906) and all collections in the latter population have ray-florets with a pappus consisting both of short and long scales.

Since no distinct differences between the two populations exist, but the variations show a geographical distribution, I have chosen to rank the populations as subspecies, ssp. *pinnatifida* with many leaf-lobes and ssp. *angustifolia* with few leaf-lobes.

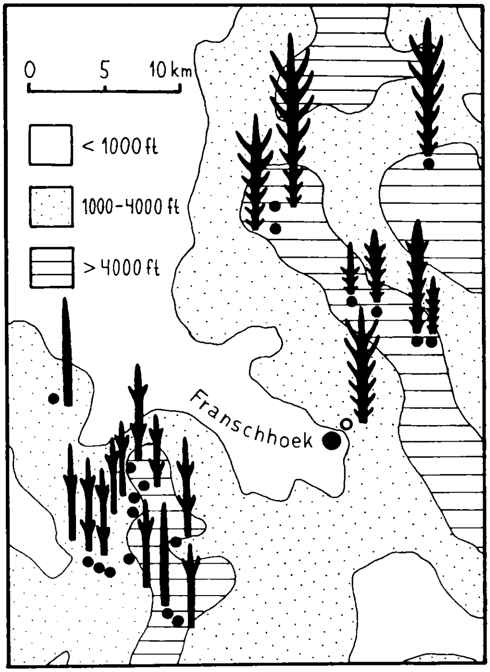

Fig. 5. Distribution and leaf-shape of *O. pinnatifida* (○ = inexact locality).

The 20 collections of this species that I have examined are insufficient for a definite taxonomical treatment and further study is desirable.

DISTRIBUTION. *O. pinnatifida* occurs in the mountains stated under Variation above. It grows among rocks and in rock crevices (fide coll.).

KEY TO THE SUBSPECIES

Most leaves with 6—18 leaf-lobes; if fewer, distributed below the middle of the leaf .... ssp. *pinnatifida*
All leaves with 6 or less leaf-lobes, apically or evenly distributed .... ssp. *angustifolia*

Osmitopsis pinnatifida (DC.) Bremer ssp. pinnatifida

Basionym: *Osmites pinnatifida* DC.; De Candolle 1837 p. 291; Harvey 1865 p. 305. — *Spanotrichum pinnatifidum* E. Mey. ex DC., pro syn.; De Candolle 1837 p. 291. — Orig. coll.: Drège, Drakenstensberg (G-DC holotype).

ILLUSTR.: Fig. 6 A, F, M—R. p. 27.

MAP: Fig. 5, p. 25.

Leaves serrate—pinnatifid ± basally (a few upper leaves seldom entire); leaf-lobes basally gradually smaller, up to 18, erecto-patent, triangular—subulate, 0.5—8 mm long, 0.1—1.5 mm wide, acute—acuminate.

Pappus of many, short, subulate-triangular, ± connate scales (seldom 0) and 2—15 long scales (seldom 0), up to 2.5 mm long, subulate, hair-like.

FLOWERING SPECIMENS seen from Nov.—Jan.

COLLECTIONS

Paarl Div.: Drakenstensberg, DRÈGE (G-DC) — Dutoitskloof, 2000—4000 ft., DRÈGE (BM, K, L, LD, P, S, W) — April Peak, Wemmershoek Mts., summit, S side in rock crevices, 5000 ft., 1940, ESTERHUYSEN 4026 (BOL, K, NBG, PRE) — Tierkloof, Wemmershoek Mts., SE slopes, rocks, 2500—3000 ft., 1940, ESTERHUYSEN 4079 (BOL, K) — Wemmershoek Peak, 3000 ft., 1944, LEWIS (SAM) — Wemmershoek Peak, gully on W side, 4000—5000 ft., 1944, ESTERHUYSEN 11335 (BOL) — French Hoek, 1946, DICKSON (NBG) — Slopes of Haalhoek Spitzkop, growing on wet rocks on a waterfall, 3500 ft., 1947, ESTERHUYSEN 13537 (BOL) — Haalhoek Sneeuwkop, cliffs on S side, 4000 ft., 1952, ESTERHUYSEN 20872 (BOL)

Osmitopsis pinnatifida (DC.) Bremer ssp. angustifolia (DC.) Bremer, comb. et stat. nov.

Basionym: *Osmites angustifolia* DC.; DE CANDOLLE 1837 p. 291; HARVEY 1865 p. 305. — Orig. coll.: DRÈGE, Drakenstein, Waaterval (G-DC holotype).

ILLUSTR.: Fig. 3 B, p. 18; 6 B, J—L, p. 27.

MAP: Fig. 5, p. 25.

Leaves entire or pinnatifid ± apically; leaf-lobes subequal, up to 6, erecto-patent, subulate-triangular, 0.5—5 mm long, 0.3—1 mm wide, acute—acuminate.

Pappus of ray-florets of many, short, subulate-triangular, ± connate scales (seldom 0); seldom also of a few, up to 2.5 mm long, subulate, hair-like scales.

FLOWERING SPECIMENS seen from Oct.—Febr.

COLLECTIONS

Stellenbosch Div.: Bullers Kop, wet rocks, in shady gully, facing W, 1939, ESTERHUYSEN 1377 (BOL) — Jonkershoek, in moss on precipice at first waterfall, 1940, WICHT 427 (BOL) — Jonkershoek Valley, waterfall at head, on rocks, 1944, ESTERHUYSEN 9703 (BOL) — Jonkershoek Valley, Forest Reserve, on moist cliff near stream, 1948, RODIN 3238 (BOL, K, PRE) — Banhoek Kloof, ledges and crevices in rock faces at head of kloof, S aspect, 3500 ft., 1952, ESTERHUYSEN 19906 (BOL) — Jonkershoek Forest Reserve, Dwarsberg, rock faces, S aspect, 3600 ft., 1953, RYCROFT 1467 (NBG) — Jonkershoek, kloof above second waterfall, under moist overhanging rocks in moss, 2500—3000 ft., 1967, MARSH 637 (PRE) — Jonkershoek, second waterfall, 1959, VAN DER MERWE 2054 (PRE)

Paarl Div.: Drakenstein, Waaterval, DRÈGE (G-DC); Simonsberg, in the krantzes by the waterfall, 2000 ft., DRÈGE (K, L, P, S, W) — Drakenstein, on damp banks, 3000 ft., 1939, STOKOE (SAM) — Devil's Tooth, Groot Drakenstein Mts., shady ledge, 3000 ft., 1943, ESTERHUYSEN 8692 (BOL) — Devil's Tooth, cliffs on S side, 3200 ft., 1954, ESTERHUYSEN 24018 (BOL)

2. Osmitopsis osmitoides (Less.) Bremer, comb. nov.

Basionym: *Bellidiastrum osmitoides* LESS.; LESSING 1832 p. 384. — *Osmites Bellidiastrum* sensu THUNB. (non L. 1760 p. 24 = *Relhania* sp.); THUNBERG 1800 p. 163; THUNBERG 1823 p. 701; DE CANDOLLE 1837 p. 291; HARVEY 1865 p. 304. — *Osmites lancea* THUNB. ex HARV., pro syn.; HARVEY 1865 p. 304. — Orig. coll.: THUNBERG, "Cap. b. Spei" (UPS-THUNB lectotype).

Osmites anthemoides DC.; DE CANDOLLE 1837 p. 291. — Orig. coll.: BURCHELL 6965, about the waterfall at Garcias Pass, 1814 (G-DC lectotype, K, P).

ILLUSTR.: Fig. 3 C, p. 18; 4 C, p. 18; 7, p. 29.

MAP: 3, p. 21.

NOMENCLATURAL NOTE

This species was first described by THUNBERG (1800 p. 163). However, THUNBERG did not distinguish it from LINNAEUS' (1760 p. 24) *Osmites Bellidiastrum,* which is a species of *Relhania,* and adopted LINNAEUS' name, which has been used hitherto. Hence THUNBERG's description of the Linnaean species is no publication of a new species and should be cited *Osmites Bellidiastrum* sensu THUNB. Accordingly, the epithet *Bellidiastrum* must be rejected for this species. LESSING (1832 p. 384) realized the difference between *Osmites Bel-*

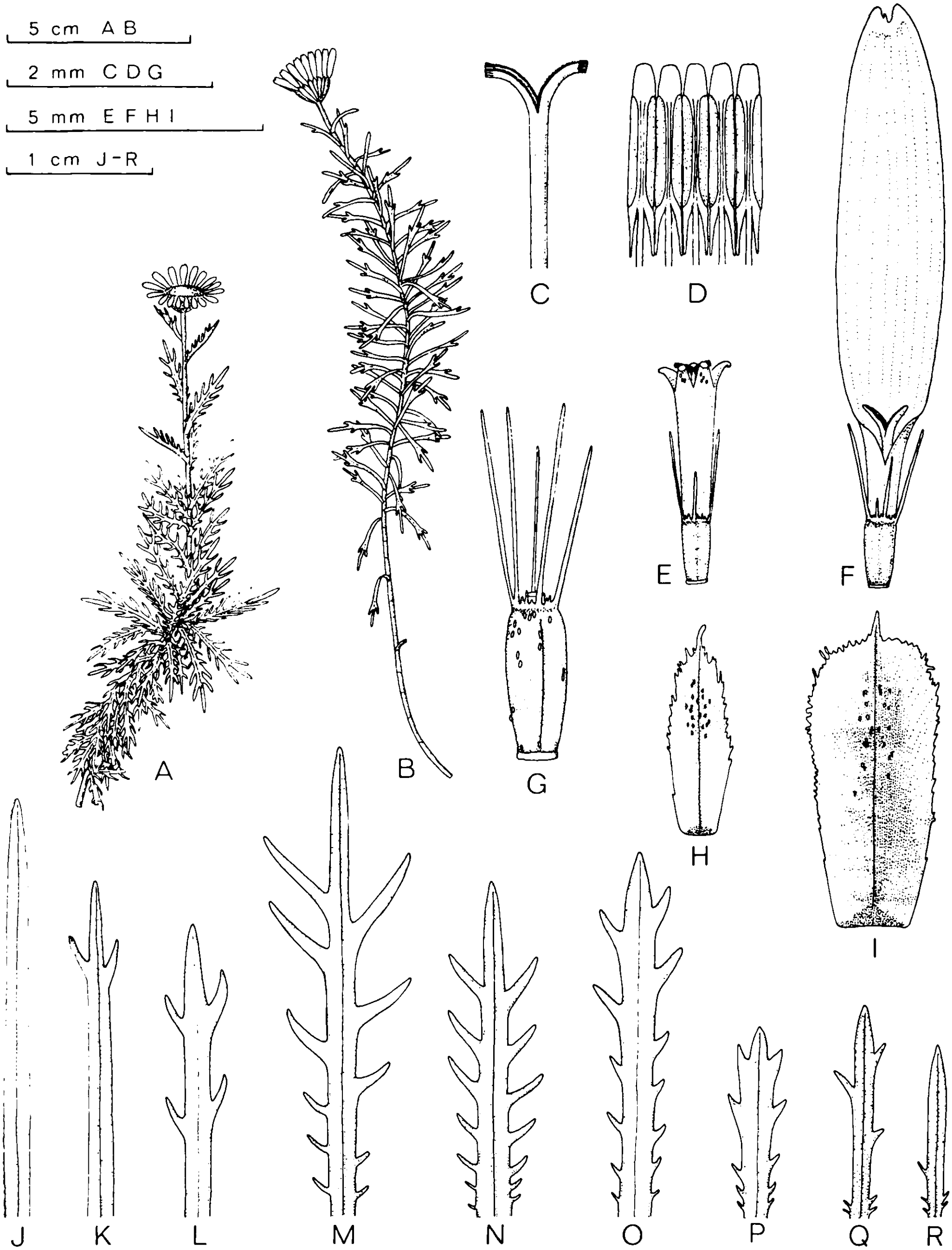

Fig. 6. *O. pinnatifida* (C—E, G—I) ssp. *pinnatifida* (A, F, M—R) and ssp. *angustifolia* (B, J—L). — A, B: Habit. — C: Part of style of disc-floret. — D: Stamens. — E: Disc-floret. — F: Ray-floret. — G: Achene. — H: Palea. — I: Involucral bract. — J—R: Leaves. A, M: Esterhuysen 20872 (BOL). — B: Rodin 3238 (BOL). — C, D, N: Esterhuysen 13537 (BOL). — E, J, K: Esterhuysen 9703 (BOL). — F, H, I: Esterhuysen 4026 (NBG). — G: Wicht 427 (BOL). — L: Stokoe Dec. 1939 (SAM). — O: Esterhuysen 4026 (BOL). — P: Esterhuysen 11335 (BOL). — Q, R: Esterhuysen 4079 (BOL).

lidiastrum L. and *Osmites Bellidiastrum* sensu Thunb. Thus he excluded the former and included the latter in the synonymy, when describing his *Bellidiastrum osmitoides,* the epithet of which has to be used for this species.

A 15—60 cm high, branched suffrutex. Stems erect or ascending, somewhat striate, puberulous or glabrous, leafy, gradually more sparsely upwards, terminally bearing a capitulum. Cortex light brown.

Leaves spreading, herbaceous, glabrous, narrowly elliptic or oblanceolate, cuneate, 1.5—8 cm long, 2—10 mm wide, acute, serrate ± apically; teeth up to 16, subulate-triangular, 0.5—4 mm long, 0.1—2 mm wide, acute—acuminate. Upper leaves smaller with fewer teeth.

Involucre campanulate, 0.5—2 cm wide. Involucral bracts 15—40, 2—3-seriate, obovate-oblong, outer lanceolate, 3.5—8 mm long, 1—2.5 mm wide, dorsally puberulous or glabrous, laterally ± scarious, apically minutely and irregularly serrulate-denticulate and sometimes purplish, obtuse or somewhat mucronate—acuminate.

Receptacle convex. Paleae glabrous, scarious, oblong, 3—5 mm long, 0.8—1.5 mm wide, apically irregularly serrate, ± acute—acuminate.

Ray-florets 7—25, female, fertile, glabrous. Tube cylindrical—funnel-shaped and gradually widening, 1—1.3 mm long, 0.6—1 mm wide. Lamina lorate or ± narrowly elliptic-oblong, 8—15 mm long, 2.5—4 mm wide, ± indistinctly 6—10-veined, apically minutely and irregularly 3-lobed. Style 1.5—3 mm long; style-branches 0.4—0.8 mm long, spreading, obtuse; stylopodium terete, up to 0.2 mm long.

Disc-florets numerous, > 50, perfect. Corolla gradually widening upwards, 2.5—3.5 mm long, 0.7—1 mm wide; corolla lobes ovate-triangular, 0.3—0.6 mm long, spreading or revolute. Style 2—3.2 mm long; style-branches 0.5—0.8 mm long, spreading; stylopodium terete, up to 0.3 mm long. Anthers 1.4—1.8 mm long; apical appendage ovate, truncate-rounded.

Achenes obovate—oblong, 1.5—2.5 mm long, 0.5—1.2 mm wide, flattened or somewhat three—four-edged; pappus of many, up to 1.2 mm long, subulate, basally connate scales.

FLOWERING SPECIMENS seen from Aug.—Jan.

VERNACULAR NAME: "Basterbelskruie" (Smith 1966 p. 615).

Together with *O. pinnatifida* this species exhibits most primitive features, e. g. fertile disc- and ray-florets, in the genus. Small specimens of *O. osmitoides* are sometimes determined as *O. pinnatifida* or other small species of the genus, i. e. *O. afra* and *O. nana.* It is distinguished from these in the character of the pappus and the shape and size of the leaves.

DISTRIBUTION. *O. osmitoides* has a wide distribution in the southern districts and is separated from the other species of the genus. It occurs mainly in the Langeberg and Outeniqua Mts.

COLLECTIONS

Caledon Div.: Rivier Zonder Einde Mts., 1940, Stokoe 8079 (BOL) — Foot of Zonder Einde Mts., 1943, Stokoe (SAM)

Swellendam Div.: Between Sparrbosch and Trado, 2000—3000 ft., Ecklon & Zeyher (S) — Moist places at the mts. above Voormansbosch, Zeyher 2935 (G-DC, K, L, S, SAM, P, UPS, W) — Swellendam, at the mtn., Drège (G-DC) — In the forest Grootvadersbosch, Pappe (Zeyher?) (Z) — Near Swellendam, 1890, Bolus 8091 (BOL) — Swellendam Mtn., 1925, Barnard (SAM) — Tradouw Pass, 1936, Salter 6307 (BM, K) — Tradouw Pass, 1937, Wall (S) — Tradouw Pass, 1938, Hafström & Acock 2269 (PRE, S) — Summit of Tradouw Pass, 1500 ft., 1938, Wall (S) — Swellendam, 1939, Thorns (NBG) — Langebergen, near Swellendam, 1943, Stafford (BOL) — Grootvadersbosch, 1947, Walgate 894 (NBG) — One o'clock Mtn., S side, 1000—1600 ft., 1952, Wurts 386 (BOL, NBG) — Langeberg, Strawberry Hill, 1954, Stokoe (SAM) — Grootvadersbosch, 1958, Barker 8817 (NBG) — Mts. above Swellendam, 2000 ft., 1962, Taylor 4231 (PRE)

Riversdale Div.: Lower part of Langebergen at Garcias Pass, 1814, Burchell 6930 (K) — About the waterfall at Garcias Pass, 1814, Burchell 6965 (G-DC, K, P) — Langebergen, near Riversdale, 2000 ft., 1892,

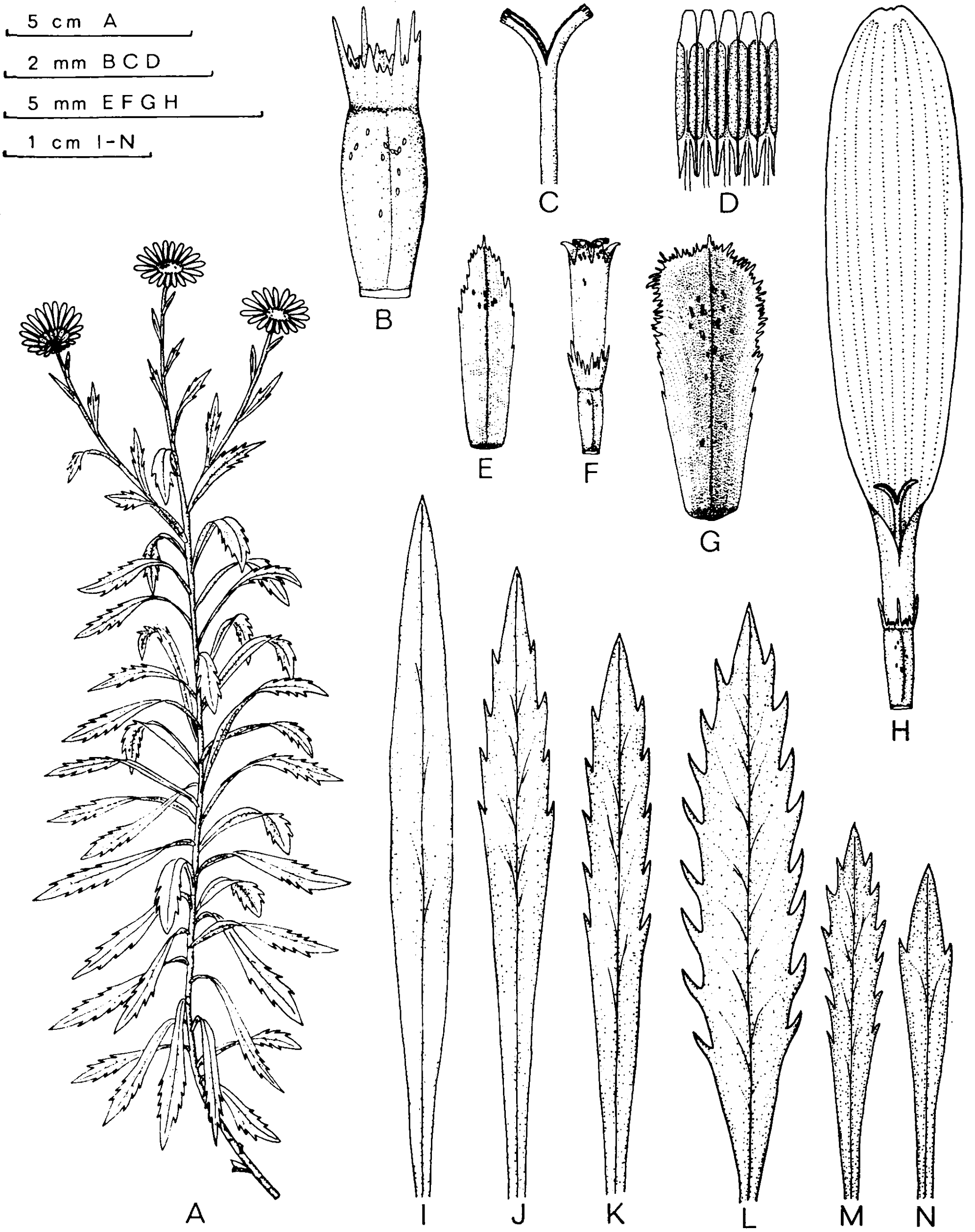

Fig. 7. *O. osmitoides.* — A: Habit. — B: Achene. — C: Part of style of disc-floret. — D: Stamens. — E: Palea. — F: Disc-floret. — G: Involucral bract. — H: Ray-floret. — I—N: Leaves.

A, K: WALL Dec. 1938, summit of Tradouw Pass (S). — B—D, H: MARTIN 81 (NBG). — E—G: COMPTON 21708 (NBG). — I: TAYLOR 3604 (NBG). — J: ZEYHER 2935 (SAM). — L: HAFSTRÖM & ACOCK 2269 (S). — M: WALL Dec. 1938, Tradouw Pass (S). — N: STOKOE 8079 (BOL).

Schlechter 1922 (BOL, P, Z) — Garcias Pass, 1200 ft., 1897, Galpin 4170 (GRA) — Langeberg, 1908, Muir 232 (SAM) — Garcias Pass, 2000—3000 ft., 1926, Thorne (SAM) — Garcias Pass, 2000 ft., 1937, Wall (LD, S)

Mossel Bay Div.: S slopes of Outeniqua Mts., 2500 ft., Bolus 12002 (BOL, BR, K, P, SAM)

George Div.: On Cradock Berg, near George, 1814, Burchell 5935 (K) — Between Touw River and Kaymans River, 1814, Burchell 5782 (K) — In wet places in the ravines of the Georgetown Mtn., 1847, Alexander Prior (BM, K) — Montagu Pass, 1875—1880, Rehmann 315 (BR, Z) — Montagu Pass, 1875—1880, Rehmann 339 (Z) — Montagu Pass, 1894, Penther 1344 (S, W) — Cradock Berg, near George, 300 ft., 1897, Galpin 4169 (GRA) — George, 1916, Paterson 1264 (GRA) — S side of Montagu Pass, above George, hanging from cliffs, 1928, Hutchinson 1204 (BM, BOL, K, PRE) — Montagu Pass, 1929, Marloth 14080 (PRE) — Montagu Pass, 1000 ft., 1938, Compton 7909 (NBG) — Montagu Pass, roadside on S slopes, 2100 ft., 1938, Lam & Meeuse 4659 (L, W) — Montagu Pass, macchia on steep slopes, 3000 ft., 1948, Story 3564 (GRA, PRE) — Jonkersberg, 1500 ft., 1949, Compton 21798 (NBG) — Old Montagu Pass, 1949, Martin 81 (NBG) — George Forest, 1950, Maguire 472 (NBG) — Outeniqua Pass, S side, wet bank at forest margin, 2300 ft., 1960, Acock 21322 (PRE) — Montagu Pass, 1961, van Breda 1113 (K, PRE) — Outeniqua Pass, occasional in stream bank, 4000 ft., 1962, Killick 3488 (K, PRE) — Steep N slope from top of Outeniqua Pass to summit of peak to S of pass, 2626—4517 ft., 1962, Taylor 4465 (PRE) — 1 mile beyond viewpoint on Outeniqua Pass, roadside bank, 2500 ft., 1964, Wells 2820 (GRA, K, PRE)

Uniondale Div.: Joubertina, 1941, Esterhuysen 7068 (BOL, PRE)

Knysna Div.: Karatara among rocks, 1000 ft., 1923, Keet 1074 (GRA) — Formosa, Lauterwater, 1940, Stokoe (SAM) — Groot River, 1951, Taylor 3604 (BOL, NBG) — Gouna Forest Reserve, 1953, Taylor 1057 (NBG) — Deepwalls Forest Reserve, wet valley of tributary to Gouna River, 1963, Bos 978 (PRE)

Humansdorp Div.: Ratels Bosch, along watercourses Klein Bosch River, 700 ft., 1908, Fourcade 373 (BOL, GRA) — Hawthorn River, in bed of river, 300 ft., 1921, Keet 938 (GRA) — Blaauwkrantz, 1949, Compton 21708 (BOL, NBG) — Blaauwkrantz Forest Reserve, 1952, Middlemost 1801 (SAM); Middlemost 1802 (NBG)

Uitenhage Div.: Foot of Winterhoek Mtn., 1839, Krauss (P)

SINE LOCO: "C. B. S.", 1847, Alexander Prior (K) — "Prom. b. spei", Auge (BM) — "Africa Australis", Masson (BM) — "Cap. B. Spei", Sparrman (S) — "Cap. b. Spei", Thunberg (SBT-BERG, UPS-THUNB) — "Rég. au Cap. de B. Esper.", 1911, Wood 3725 (L)

EX HERB.: "Cape of Good Hope", Forsyth (K) — "C. B. S.", Schultz Bipontinus (P)

EX HORT.: Kew 1792 (BM)

3. Osmitopsis afra (L.) Bremer, comb. nov.

Basionym: *Anthemis afra* L. (non Burm. f. 1768 p. 27 = *Osmitopsis dentata* (Thunb.) Bremer); Linnaeus 1759 p. 1223. — *Anthemis leucantha* L.; Linnaeus 1760 p. 23; Linnaeus 1763 a p. 1261; 1763 b p. 104; 1767 p. 565; Burman f. 1768 p. 27. — *Osmites camphorina* L. 1771 var. β. *leucantha* (L.) L.; Linnaeus 1771 p. 477; Murray 1774 p. 651; Christmann & Panzer 1779 p. 407; Reichard 1780 p. 892; Murray 1784 p. 783; Gmelin 1792 p. 1261; Persoon 1797 p. 824; Savigny in Lamarck 1798 p. 648; Willdenow 1803 p. 2259; Richter 1835 p. 856. — *Osmites leucantha* (L.) Druce; Druce 1914 p. 422. — Orig. coll.: Herb. Linnaeus 1029: 3 (LINN lectotype).

Osmites hirsuta Less.; Lessing 1832 p. 385; De Candolle 1837 p. 290; Harvey 1865 p. 304. — Orig. coll. not traced, destroyed?

ILLUSTR.: Fig. 3 D, p. 18; 4 D, E, p. 18; 8, p. 32.

MAP: 5, p. 21.

NOMENCLATURAL NOTE

This species was first described by Linnaeus (1759 p. 1223) as *Anthemis afra.* The fact that this short description represents *Osmitopsis afra* is verified by a specimen in the Linnaean herbarium (LINN, specimen 1029: 3), which bears the note *"Anth. capensis afra leucantha"* with lines drawn through the two former epithets. Probably Linnaeus intended to name the species *capensis,* but changed the epithet to *afra.* When Linnaeus (1760 p. 23) described the species *Anthemis leucantha,* he probably again changed the epithet on the specimen to *leucantha.* Thus the Linnaean species *Anthemis afra* and *Anthemis leucantha* both represent *Osmitopsis afra.* This interpretation is also supported by the close similarity of the descriptions.

Later Linnaeus (1771 p. 477) reduced his *Anthemis leucantha* to a variety under his *Osmites camphorina.* Lessing (1832 p. 385) did not notice Linnaeus' descriptions of this species, but described it as a new species under the name *Osmites hirsuta,* which name has hitherto been used. Druce (1914 p. 422), however, discovered LINNAEUS' *Anthemis leucantha* and made the combination *Osmites leucantha.*

A 10—40 cm high, tomentose or seldom glabrous suffrutex. Stems simple or ramifying, erect or ascending, somewhat striate, densely leafy, gradually more sparsely upwards and thus somewhat pedunculoid, terminally bearing a capitulum. Cortex light brown.

Lower leaves spreading, mostly reflexed at the base and often curved and ascending, herbaceous or somewhat coriaceous, ± narrowly oblong or sometimes ± narrowly obovate and cuneate, 0.5—2 cm long, 1—5 mm wide, acute, serrate ± apically; teeth 4—24, subulate-triangular, 0.3—1 mm long, 0.2—1 mm wide, acute—acuminate. Upper leaves different in being erecto-patent, straight, lanceolate or narrowly oblong, 0.5—1 cm long, 0.5—2 mm wide, acute, entire or serrate—serrulate-denticulate; teeth up to 14, subulate-triangular, 0.3—0.5 mm long, 0.2—0.5 mm wide, acute—acuminate.

Involucre widely campanulate, 0.8—2 cm wide. Involucral bracts 18—50, 2—3-seriate, oblong or narrowly elliptic-oblong, outer elliptic-lanceolate, 4—8 mm long, 1—3 mm wide, laterally ± plane and scarious, apically minutely and irregularly denticulate-serrulate and sometimes purplish, acute—acuminate.

Receptacle convex. Paleae glabrous, somewhat scarious, oblong, 4—6 mm long, 0.7—2 mm wide, apically irregularly serrate, ± acuminate, sometimes persistent.

Ray-florets 15—35, female, fertile or sterile, sometimes both conditions in the same capitulum, glabrous. Tube cylindrical—funnel-shaped and gradually widening, 0.8—2.2 mm long, 0.6—1.2 mm wide. Lamina lorate or ± narrowly elliptic-oblong, 8—16 mm long, 2—4.5 mm wide, indistinctly 8—15-veined, apically ± deeply 2-lobed. Style 1—2.8 mm long, simple or bifid; style-branches up to 0.6 mm long, coherent or spreading, somewhat acute; stylopodium 0 or present, conical, short.

Disc-florets numerous, > 100, perfect. Corolla gradually widening upwards, 3—4 mm long, 0.7—1.5 mm wide; corolla lobes ovate-triangular, 0.4—0.9 mm long, somewhat spreading. Style 2.5—4 mm long; style-branches 0.5—0.9 mm long, spreading; stylopodium terete, short. Anthers 1.8—3 mm long; apical appendage ovate, rounded.

Achenes oblong—obovate, 1—3 mm long, 0.5—1.5 mm wide, somewhat three—four-edged; pappus of many, up to 2 mm long, subulate, basally connate scales.

FLOWERING SPECIMENS seen from Nov.—Febr., April and July.

VERNACULAR NAMES: "Belskruie, Vandermerwes—" (SMITH 1966 p. 615).

This species is usually easily recognized. However, it may be confused with young and sparsely branched or unbranched specimens of *O. parvifolia.* It differs from this species by the presence of pappus.

VARIATION. *O. afra* is normally tomentose. However, I have seen four deviating collections (listed below) of quite glabrous specimens. Their leaves are slightly shorter and broader and have more teeth than the medium of normal *O. afra.* These collections are indicated on Map 5, p. 21.

Since the material is small and only the character of indumentum distinct, I have avoided establishing a new taxon. Further study of more material might very well lead to taxonomic recognition of these deviating collections.

DISTRIBUTION. This species is rather common in montane regions in Caledon, Stellenbosch and Paarl Divisions. According to various collectors *O. afra* often grows in burnt areas.

COLLECTIONS

Stellenbosch Div.: Drakensteinberg, DRÈGE (G-DC) — Stellenbosch, at the mtn., 2000—3000 ft., DRÈGE (BM, K, L, P, S, W) — Stellenbosch, mts. at Grietjesgat, between Lowryspas and Palmietrivier, 2000—4000 ft., ECKLON & ZEYHER (S, SAM) — Swartboskloof, VAN DER MERWE 770 (K) — Helderberg, 1923, STOKOE (BOL) — Jonkershoek,

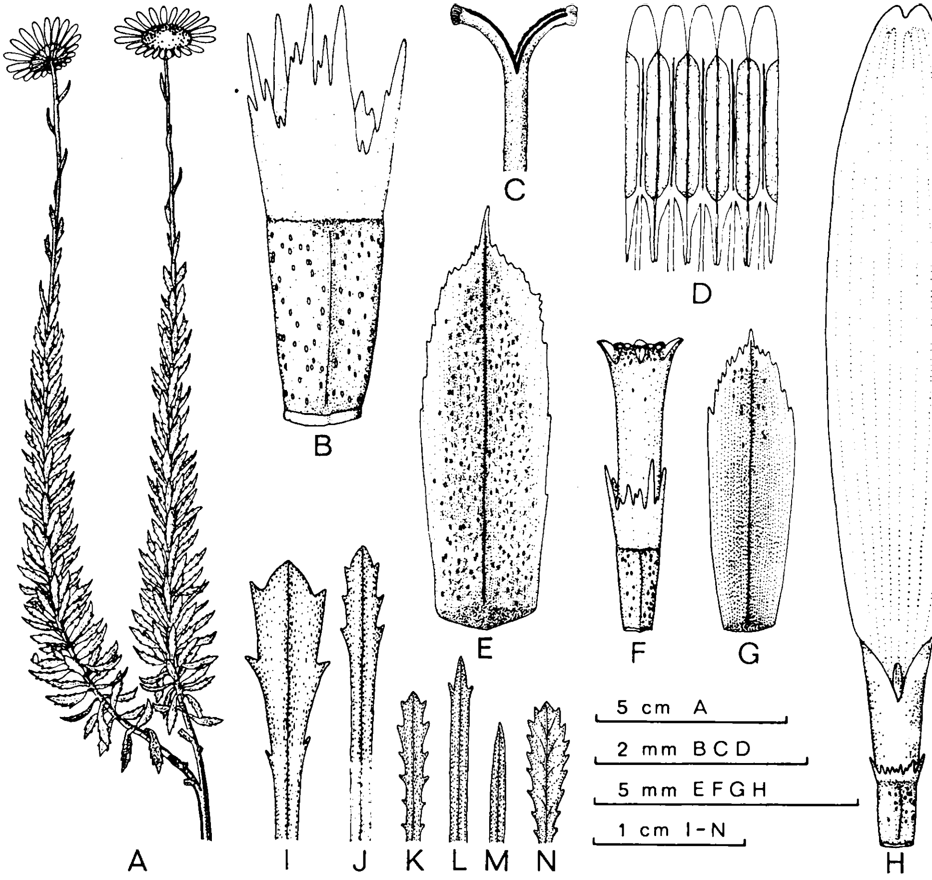

Fig. 8. *O. afra.* — A: Habit. — B: Achene. — C: Part of style of disc-floret. — D: Stamens. — E: Involucral bract. — F: Disc-floret. — G: Palea. — H: Ray-floret. — I—K: Leaves. — L, M: Upper leaves. — N: Leaf, deviating collection (see text).

A: Barker 7163 (NBG). — B—H: Stokoe, Rooi Els River (SAM). — I: Esterhuysen 22313 (BOL). — J, L, M: Compton 15302 (NBG). — K: Pillans 6739 (BOL). — N: Stokoe Dec. 1947, near Elgin, between Grabouw and the Paardeberg (BOL), deviating collection (see text).

1943, Compton 15302 (NBG) — Guardian Peak, SW side, slopes, 3000—4000 ft., 1955, Esterhuysen 24109 a (BOL) — Jonkershoek belt 13 E, the E segment of the large cut-off belt 13 at Jakkalsvlei, burnt 4-yearly, N side of valley, with steepish SW slope, 1300—2300 ft., 1962, Taylor 4514 (PRE) — Assegaaibosch, 2500 ft., 1963, van der Merwe 1628 (PRE)

Paarl Div.: Dutoitskloof, 3000—4000 ft., Drège (BM, G-DC, K, L, P, S, W) — Slopes above Dutoitskloof, 2500—3000 ft., 1882, Tyson 949 (BM, SAM, Z) — Dutoitskloof Mts., 2200 ft., Bolus (SAM) — French Hoek, 2600 ft., 1895, Bolus (LD, NBG) — Mts. N of French Hoek Pass, 1933, Pillans 6739 (BOL, K) — French Hoek Mts., 1934, Hafström (S) — Foot of French Hoek Pass, 1935, Compton 6006 (NBG) — French Hoek Pass, W side, 2500 ft., Compton 8169 (NBG) — Head of Dutoitskloof, 1937, Pillans 8412 (BOL, K) — Groot Drakenstein Mts., Duivelskloof, 1500 ft., 1943, Wasserfall 453 (NBG) — Haalsneeuwkop, 1944, Stokoe (SAM) — Dutoitskloof, 1950, Barker 7163 (NBG)

Worcester Div.: Louwshoek Mtn.,

1946, Stokoe (SAM) — Dutoitskloof, 1951, Stokoe (SAM) — Dutoitskloof, slopes below Witteberg, 1953, Esterhuysen 22313 (BOL, PRE)

Caledon Div.: Mtn. of Baviaans Kloof, near Genadendal, 1815, Burchell 7881 (G-DC, K) — Nieuw Kloof, Houw Hoek Mtn., 1815, Burchell 8044 (G-DC, K) — Moist, shady places on Rivier Zonder Einde Mts., not far from Appelskraal, Zeyher 2936 (SAM, W) — Baviaansberg, Genadendal, Pappe (SAM) — Hottentots Holland Mts. near Palmiet River, 1500 ft., 1877, Bolus 4157 (BOL, K) — Slopes of Zwartberg near Caledon, 1200 ft., 1899, Bolus (BOL) — Hottentots Holland, Rooi Els area, 1932, Stokoe 6631 (GRA) — Viljoen's Pass, 1933, Salter 4026 (BM, K) — Lower part of Buffels Kloof, near Rooi Els, 1936, Pillans 8290 (BOL) — Nieuwberg, 1936, Compton 6746 (NBG) — Hottentots Holland Mts., in ravine SE of Somerset Sneeuwkop, 1939, Esterhuysen 3535 (BOL) — Somerset Sneeuwkop, 1939, Stokoe (SAM) — Rooi Els River, Stokoe (SAM) — Hermanus, 1942, Compton 14235 (NBG) — Hermanus Mtn., 1943, Leighton 347 (BOL) — Aries Kraal, river cliffs, 1944, Compton 16826 (NBG) — Hottentots Holland Mts., "Boundary Kloof", 1948, Stokoe (SAM) — Palmiet River Mts., Oudebosch, 1952, Stokoe (SAM) — Nuberg, near top of Viljoen's Pass, 1954, Stokoe (SAM) — Lebanon, Grabouw, 2400 ft., 1966, Kruger 222 (PRE)

SINE LOCO: "Promont. b. Spei", Masson (BM)

EX HERB.: Linnaeus, 1029: 3 (LINN)

Dubious locality: Peninsula, "In summo mont. tabul.", 2500—3500 ft., Mundt (K) (wrong label?)

DEVIATING COLLECTIONS (CF. TEXT)

Caledon Div.: Honingklip, Bot River, Taylor 5121 (NBG) — Near Elgin, between Grabouw and the Paardeberg, 1947, Stokoe (SAM) — Palmiet River Mts., 1948, Stokoe (SAM) — Palmiet River Mts., Oudebosch, 1952, Stokoe (SAM)

4. Osmitopsis dentata (Thunb.) Bremer, comb. nov.

Basionym: *Osmites dentata* Thunb.; Thunberg 1800 p. 163; Willdenow 1803 p. 2259; Dietrich 1806 p. 564; Smith in Rees 1813; Thunberg 1823 p. 701; Lessing 1832 p. 385; De Candolle 1837 p. 291; Harvey 1865 p. 304; Levyns 1929 p. 260; 1950 p. 798. — Orig. coll.: Thunberg, summit of Table Mtn. (UPS-THUNB lectotype).

Osmites camphorina L. 1771 (excl. var. β. *leucantha* (L.) L. 1771 p. 477 = *Osmitopsis afra* (L.) Bremer), nom. illeg. (non L. 1767 p. 571 = *Osmitopsis asteriscoides* (Berg.) Less.); Linnaeus 1771 p. 477 (*"camphor."*); Murray 1774 p. 651; Christmann & Panzer 1779 p. 407; Reichard 1780 p. 892; Murray 1784 p. 783; Gaertner 1791 p. 442; Gmelin 1792 p. 1261 (*"camphorata"*, sphalm.); Persoon 1797 p. 824; Savigny in Lamarck 1798 p. 648; Willdenow 1803 p. 2259; Dietrich 1806 p. 564; Smith in Rees 1813; Cassini 1825 p. 4; Richter 1835 p. 855. — Orig. coll.: Herb. Linnaeus 1029: 2 (LINN lectotype).

Anthemis afra Burm. f., nom. illeg. (non L. 1759 p. 1223 = *Osmitopsis afra* (L.) Bremer); Burman f. 1768 p. 27. — Orig. coll. not traced, enquiries made to G. L.

ILLUSTR.: Fig. 3 E, F, p. 18; 4 F, p. 18; 9, p. 35; Gaertner 1791 Plate 174 Fig. 3; Lamarck 1823 Plate 704 Fig. 1.

MAP: 2, p. 21.

NOMENCLATURAL NOTE

This species was first described by Burman f. (1768 p. 27) as *Anthemis afra*. This name is a later homonym to Linnaeus' (1759 p. 1223) *Anthemis afra* and the epithet *afra* must be rejected for this species.

Then the species was again described by Linnaeus (1771 p. 477) in the "Mantissa plantarum", where it appears under the abbreviated name *Osmites camphor*. In the same work Linnaeus (1771 p. 474) reduced another of his own species, *Anthemis leucantha*, which, however, represents *Osmitopsis afra*, to a variety under the species discussed here with the words, *"Anthemis leucanth. Osmites camphoratae* varietas est.". I consider the spelling *camphorata* a mistake, replacing the correct spelling *camphorina*, which Linnaeus used earlier. Thus the abbreviated epithet *camphor.* should stand for *camphorina*. If Linnaeus really meant to change the epithet, he probably would not have abbreviated it under *Osmites* and merely mentioned it spelt out in full under *Anthemis*. Moreover, Linnaeus named a specimen (LINN, specimen 1029: 2) of *Osmitopsis dentata "Osmites camphorina"*. Thus the epithet of this species in the "Mantissa plantarum" (Linnaeus 1771 p. 477) should be interpreted as *camphorina*. However, from the descriptions it is clear that *Osmites camphorina* L. 1771 is different from *Osmites camphorina* L. 1767, which represents *Osmitopsis asteriscoides*. Since the epithet *camphorina* first was connected with *Osmitopsis asteriscoides*, it cannot be used for *Osmitopsis dentata*.

Unlike numerous other post-Linnaean authors, Gmelin (1792 p. 1261) used the epithet *camphorata* instead of *camphorina* in his edition of the "Systema vegetabilium".

This is merely a repetition of the wrong spelling in the "Mantissa plantarum" (LINNAEUS 1771 p. 474) and *camphorata* can only be treated as a mis-spelling of the epithet *camphorina*.

THUNBERG (1800 p. 163, 1823 p. 701) described his *Osmites dentata* as a new species, the epithet of which is used for the species here discussed.

A 15—50 cm high suffrutex. Stems simple or at the base ramifying, ascending—erect, striate, puberulous, densely leafy — almost rosulate at the base, gradually more sparsely leafy upwards and thus somewhat pedunculoid, terminally bearing a capitulum. Cortex light brown.

Lower leaves spreading, herbaceous or somewhat coriaceous, glabrous or puberulous, obovate and cuneate or spatulate, 1.5—4.5 cm long, 5—15 mm wide, obtuse—rounded, serrate, at the base ± dentate; teeth 14—34, subulate—triangular, 1—4 mm long, 0.5—3 mm wide, acute. Upper leaves different in being erecto-patent, elliptic, 0.5—2.5 cm long, 1—5 mm wide, entire (the uppermost) or serrate-dentate, often only towards the base; teeth up to 20, subulate—triangular, 0.5—3 mm long, 0.5—1.5 mm wide, acute.

Involucre widely campanulate, 1—2 cm wide. Involucral bracts 30—50, 3—4-seriate, ± narrowly elliptic-oblong, 6—10 mm long, 2—4 mm wide, dorsally puberulous, laterally plane and scarious and sometimes purplish, apically irregularly serrulate, acute—acuminate; outer bracts different in being lax, lanceolate and smaller.

Receptacle flat or convex. Paleae glabrous, firm but laterally scarious, oblong, 4—7 mm long, 1—2 mm wide, apically irregularly fimbriate-serrulate, acuminate.

Ray-florets 15—30, female, sterile, glabrous. Tube somewhat triquetrous, gradually widening, 1—3 mm long, 0.5—1 mm wide. Lamina lorate, 15—22 mm long, 3—5 mm wide, 6—10-veined, apically minutely and ± irregularly 3-lobed. Style 1.5—3 mm long, simple or bifid; style-branches up to 0.7 mm long, erect, somewhat acute, with indistinct stigmatic areas; stylopodium short. Ovarium nearly square, 1—1.5 mm long, somewhat three-edged; pappus 0 or present, of few, up to 1 mm long, subulate-triangular, ± connate scales.

Disc-florets > 200, perfect. Corolla very gradually widening upwards, 4—6 mm long, 0.5—1.5 mm wide; corolla lobes ovate-triangular, 0.5—1 mm long, somewhat spreading. Style 3.5—5.5 mm long; style-branches 0.8—1.3 mm long, spreading or revolute; stylopodium obconical or terete, up to 0.4 mm long, deciduous. Anthers 2—2.5 mm long; apical appendage ovate, rounded.

Achenes oblong-obovate, 2—4 mm long, 0.7—1 mm wide, slightly curved, somewhat four-edged; pappus of many, up to 1 mm long, triangular-subulate, basally connate scales.

FLOWERING SPECIMENS seen from Oct.—Febr. and July.

VERNACULAR NAME: "Basterbelskruie" (SMITH 1966 p. 615).

This easily recognized species has big flowerheads and characteristic obovate leaves. Although easily distinguished from *O. afra* in the leaves, it is probably allied to this species. They are similar in habit and most floral characters.

DISTRIBUTION. *O. dentata* grows among rocks in damp places on the mountains (LEVYNS 1950 p. 798) and is common on the Peninsula, where it is endemic.

COLLECTIONS

Peninsula: Summit of Table Mtn., THUNBERG (UPS-THUNB) — On Table Mtn., 1811, BURCHELL 646 (K) — Devil's Mtn., 1815, BURCHELL 8461 (K) — Devil's Peak, ECKLON (S) — Among shrubs near the summit of Devil's Peak, "Blockhaus", ECKLON (W) — Shady, grassy places at the waterfall, ZEYHER (SAM) — In large ditch towards the top of Table Mtn., ECKLON & ZEYHER (GRA) — Table Mtn., in the krantzes, 2000—3000 ft., DRÈGE (P) — Upper slopes of Devil's Peak, PAPPE (GRA, Z) — Table Mtn., PAPPE (K) — Summit of Table Mtn., PAPPE (SAM) — On the mtn. above Simon's Bay, 1846, ALEXANDER PRIOR (K) — Table Mtn., HARVEY (BOL) — Simon's Bay, 1865, WRIGHT (K) — Table Mtn., 1875—1880, REHMANN 737 (Z) — Devil's Peak, 1875—1880, REHMANN 1027

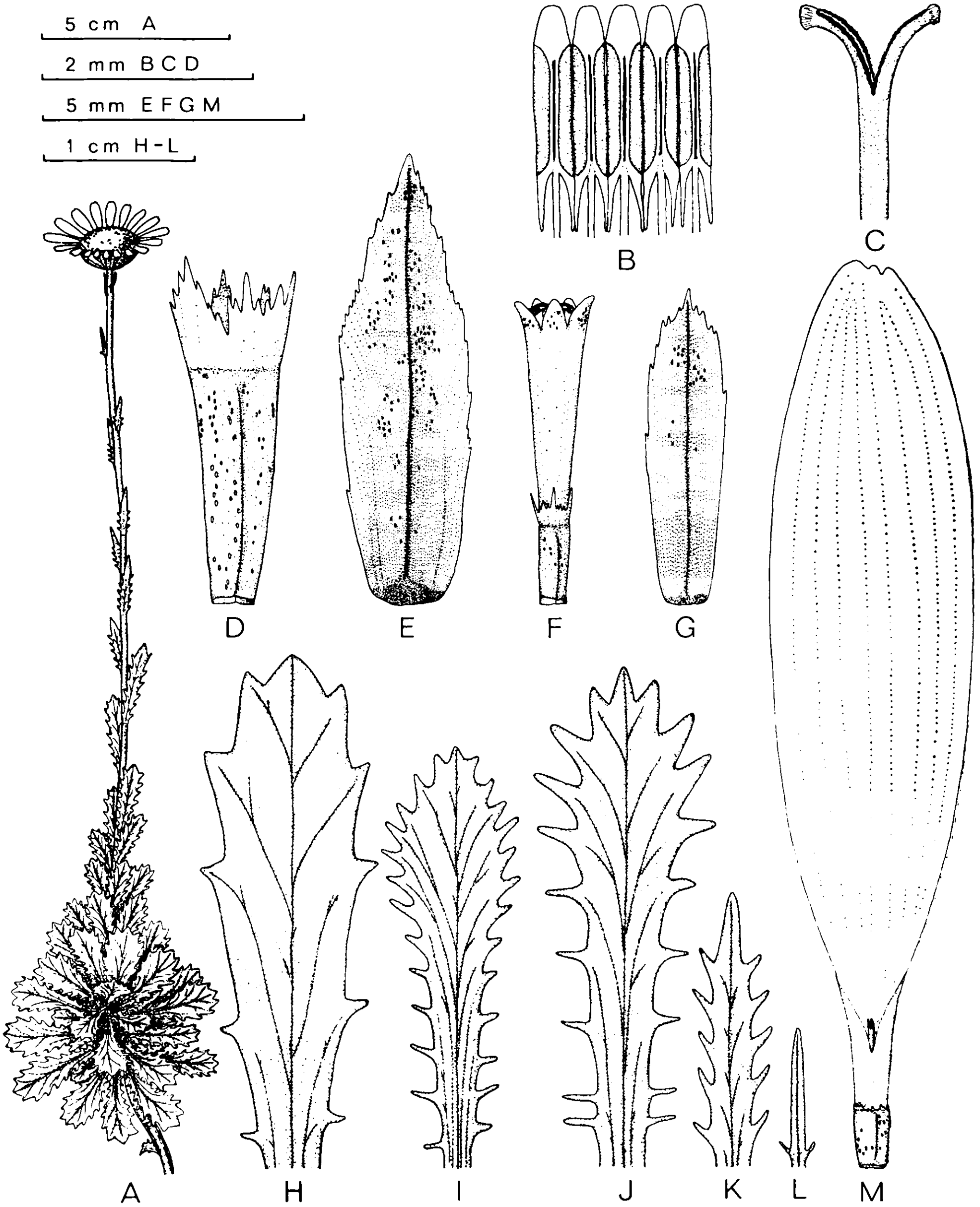

Fig. 9. *O. dentata.* — A: Habit. — B: Stamens. — C: Part of style of disc-floret. — D: Achene. — E: Involucral bract. — F: Disc-floret. — G: Palea. — H—J: Leaves. — K, L: Upper leaves. — M: Ray-floret.

A: Wall Nov. 1938 (S). — B, E, G, M: Ecklon, Devil's Peak (S). — C, F: Linley Dec. 1961 (NBG). — D: Zeyher, shady, grassy places at the waterfall (SAM). — H: Bolus 3377 (BOL). — I: Compton 12005 (NBG). — J—L: Esterhuysen 22401 (BOL).

(BM, Z) — Slopes of Muizenberg Mtn., 1000 ft., 1876, BOLUS 3377 (BOL, PRE) — Slopes of Table Mtn., 2800 ft., 1877, BOLUS (BOL) — Stony and grassy slopes at the side of Table Mtn., towards E, Klassenbosch, 500 ft., 1884, Herb. Norm. Austr. Afr. 136 leg. MACOWAN & BOLUS (BM, BOL, K, P, SAM, UPS, W) — Waai Vley, 1896, BOLUS 2240 (BM, BOL) — Mts. near Noordhoek, 1902, SICHEL (BOL) — Disa Gorge, Table Mtn., NW Cape Town, 1500 ft., 1923, MOSS 7241 (BM) — Table Mtn., top of Kasteels Poort, 650 m, 1924, MARLOTH 11986 (PRE) — Klaver Valley, 1927, SALTER 281/15 (BM, K) — Noordhoek, 1600 ft., 1929, GODMAN 802 (BM) — Charing, N of Window Stream, Kirstenbosch, 500 ft., 1935, ESTERHUYSEN 420 (NBG) — Slopes S of Trolley Track, Kirstenbosch, 1935, ESTERHUYSEN 571 (NBG) — Skoorsten Kop, Constantia Mts., 1200 ft., 1938, WALL (S) — Mts. above Muizenberg, 1500 ft., 1938, WALL (LD) — Kirstenbosch, top of Trolley Track, 2000 ft., 1939, COMPTON 7655 (NBG) — Contour Path, Kirstenbosch, 1941, COMPTON 12005 (NBG) — Table Mtn., steep S slopes above Skeleton Gorge, 2000—2500 ft., 1944, ESTERHUYSEN 11225 (BOL) — Kirstenbosch, between Nursery and Skeleton Gorges, 2500 ft., 1944, HENDERSON 2181 (NBG) — Table Mtn., E slopes above Kirstenbosch, ledges and steep rocky slopes, 1500 ft., 1953, ESTERHUYSEN 22401 (BOL, LD, PRE) — Orange Kloof, 1955, SALTER 9708 (BM) — Clovelly, mtn. slopes, 1961, LINLEY (NBG)

Cape Div.: Sandy plains, Cape Flats, 100 ft., 1888, TYSON 2960 (SAM)

SINE LOCO: "Cap.", ECKLON (G-DC) — "C. B. S.", ECKLON (UPS) — "e C. b. Sp.", GRUBB (SBT-BERG) — "Promont. b. Spei", MASSON (BM) — 1880, ROGERS (K) — "Cap.", SCHOLL (W) — "Cap. b. Spei", 1773, THUNBERG (S) — "C. B. S.", VILLETTE (K)

EX HERB.: "ex Capité B. S.", JAQUIN fil. (W) — LINNAEUS, 1029:2 (LINN) — "ad Cap. b. sp.", PORTENSCHLAG (W) — VAN ROYEN (L)

5. Osmitopsis nana Schltr

SCHLECHTER 1900 p. 206. — Orig. coll.: SCHLECHTER 9854, among rocks, mts. near Genadendal, 3000 ft., 1896 (Z lectotype, BM, BOL, BR, K, L, P, S, W).

ILLUSTR.: Fig. 3 G, p. 18; 4 G, H, p. 18; 10, p. 37.

MAP: 6, p. 21.

A 3—15 cm high, glabrous suffrutex. Stems simple or ramifying, ascending—erect, somewhat striate, densely leafy, gradually more sparsely upwards, finally nude and marked with leaf-scars, terminally bearing a capitulum. Cortex light brown.

Leaves spreading or reflexed, herbaceous, ± narrowly oblong or obovate-oblong, 0.5—2.5 cm long, 1—4.5 mm wide, acute, entire or serrate apically; teeth up to 8, ± triangular, 0.2—1.2 mm long, 0.1—1 mm wide, acute. Upper leaves smaller with fewer teeth.

Involucre campanulate, 0.5—1.5 cm wide. Involucral bracts 15—25, 2—3-seriate, oblong or obovate-oblong, outer lanceolate, 3.5—6.5 mm long, 1—2.5 mm wide, laterally ± scarious and sometimes purplish, apically irregularly serrate—denticulate-serrulate, obtuse or acute—acuminate.

Receptacle convex—conical. Paleae glabrous, scarious, oblong, 3—5 mm long, 0.8—1.5 mm wide, apically irregularly serrate, ± acuminate.

Ray-florets 10—20, female, fertile or sterile, sometimes both conditions in the same capitulum, glabrous. Tube cylindrical—funnel-shaped, 1—2.5 mm long, 0.5—1 mm wide. Lamina lorate or ± narrowly elliptic-oblong, 8—14 mm long, 3—4 mm wide, ± distinctly 6—9-veined, apically ± deeply 2—3-lobed. Style 1—3 mm long, simple or bifid; style-branches up to 0.7 mm long, spreading, somewhat acute; stylopodium terete, up to 0.5 mm long.

Disc-florets numerous, > 80, perfect. Corolla tubular, swollen at style base, gradually widening upwards, 3—4.2 mm long, 0.7—1 mm wide; corolla lobes ovate-triangular, 0.5—1 mm long, spreading or reflexed. Style 2.5—4 mm long; style-branches 0.4—0.6 mm long, spreading; stylopodium terete, 0.4—0.5 mm long. Anthers 1.6—2.5 mm long; apical appendage ovate, rounded.

Achenes obovate—oblong, 1—2 mm long, 0.5—1 mm wide, somewhat three—four-edged; stylopodium yellow-white; pappus 0.

FLOWERING SPECIMENS seen from Oct. and Dec.—Febr.

O. nana is sometimes confused with *O. pinnatifida* and small specimens of *O.*

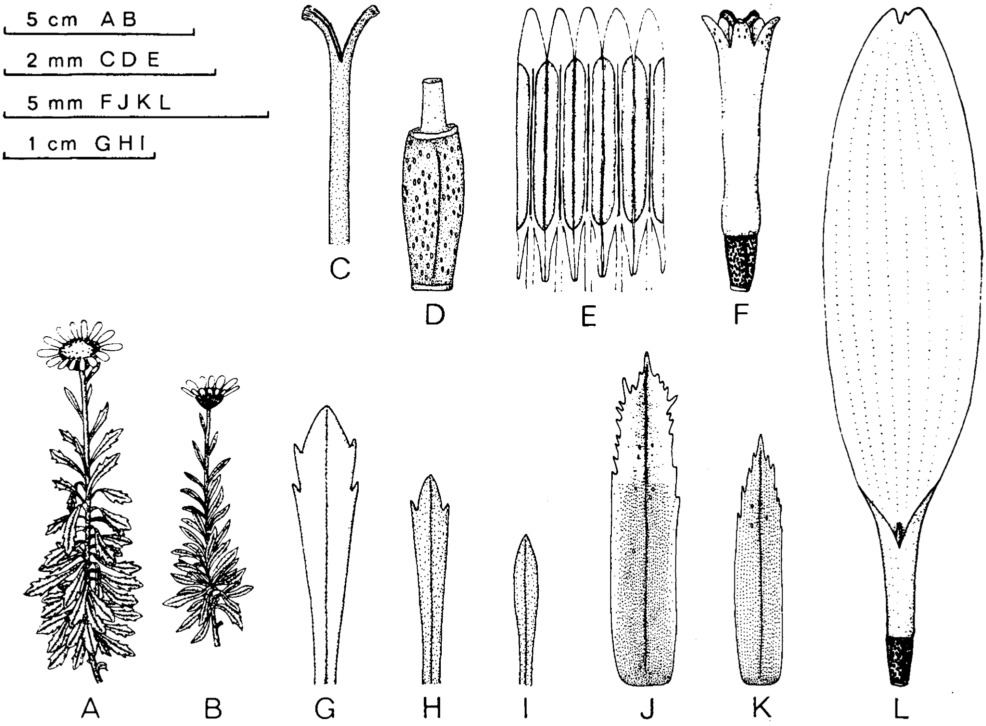

Fig. 10. *O. nana.* — A, B: Habit. — C: Part of style of disc-floret. — D: Achene. — E: Stamens. — F: Disc-floret. — G—I: Leaves. — J: Involucral bract. — K: Palea. — L: Ray-floret.

A: STOKOE 17576 (BOL). — B, G—I: STOKOE Jan. 1946 (SAM). — C—F, J—L: SCHLECHTER 9854 (S).

osmitoides, but it is easily recognized on its achenes, which lack pappus, but have a well developed stylopodium.

DISTRIBUTION. The distribution is somewhat discontinuous. Most collections are from the Helderberg and Hottentots Holland Mts., but there are outliers at Winterhoek Mtn. in Tulbagh Division and Genadendal in Caledon Division. According to SCHLECHTER (1900 p. 207) and various collectors the species grows in rock crevices.

COLLECTIONS

Tulbagh Div.: Winterhoek Mtn., near Tulbagh, 1896, BOLUS 6379 (BOL)

Stellenbosch Div.: Helderberg, 1923, STOKOE (BOL) — Helderberg, upper S slopes, on cliffs, 1941, ESTERHUYSEN 7661 (BOL) — Hottentots Holland, SE side of Guardian Peak, cliffs and rock crevices, 3000 ft., 1944, ESTERHUYSEN 9811 (BOL) — Guardian Peak, SW side, crevices in cliff faces, 3000—4000 ft., 1955, ESTERHUYSEN 24109 (BOL) — Swartboskloof, 1600 ft., 1961, VAN DER MERWE 826 (K, PRE)

Caledon Div.: Among rocks, mts. near Genadendal, 3000 ft., 1896, SCHLECHTER 9854 (BM, BOL, BR, K, L, P, S, W, Z) — Somerset Sneeuwkop, 1946, STOKOE (SAM)

6. Osmitopsis tenuis Bremer, sp. nov.

Orig. coll.: ESTERHUYSEN 17793, Slanghoek Needle, foot of cliffs on S slopes, 4500 ft., 1950 (BOL holotype, K, LD, NBG, PRE, UPS).

ILLUSTR.: Fig. 3 H, I, p. 18; 11 p. 39.

MAP: 7, p. 21.

Suffrutex tenuis, procumbens vel erectus, villosus—lanatus. Caulis ramifer, 10—50 cm, interdum usque ad 1 m longus, dense foliatus. Ramuli subcorymbosi, praesertim apicem versus sparse foliati, omnes capitulo terminali instructi.

Folia alterna vel raro opposita, erecto-patentia—patentia, vetustiora reflexa, elliptica vel subcuneata, usque 1.5 cm longa, 8 mm lata, integra vel 2—5-lobata; lobis foliorum dentibus similibus, ovatis vel triangulatis, ad 3 mm longis. Apices lobique foliorum atro-mucronati. Folia apices ramulorum versus anguste elliptica vel sublanceolata, minora, plerumque integra.

Involucrum campanulatum, 0.5—1.5 cm diametro. Bracteae involucri 10—25, 2—3-seriatae, anguste elliptico-oblongae vel subobovato-oblongae, exteriores anguste elliptico-lanceolatae, usque ad 6 mm longae, apice irregulariter denticulatae, purpureae, acutae —acuminatae.

Receptaculum convexum, paleaceum. Paleae anguste elliptico-oblongae vel subobovato-oblongae, ad 5 mm longae, apice dorsoque villosae pilis albis, erectis, apice irregulariter fimbriato-denticulatae, ± acuminatae.

Flores radii 6—20, neutri. Tubus cylindricus. Lamina elliptico-oblonga, 5—8 mm longa, alba, apice integra vel ± minute 3-lobata.

Flores disci c. 30—100, perfecti. Corolla gradatim sursum ampliata, 3—4.2 mm longa; lobi corollae ovato-triangulares, revoluti. Stylus corolla paulo brevior; rami styli patentes—revoluti; stylopodium teres, ad 0.4 mm longum. Antherae corolla duplo breviores, appendice apicali ovato-oblonga, rotundo-truncata.

Achaenia ± anguste elliptico-oblonga, 2—3.5 mm longa, 0.5—1 mm lata, paulo curvata, subtetragona, apice annulariformia alboflavida, stylopodio persistenti, alboflavido, annulo circumcincto; pappus nullus.

A slender, procumbent or sometimes erect, villose—lanate suffrutex. Main stem continuing vegetative growth, emitting branches in a ± distinct cluster near the apex, 10—50 cm, sometimes up to 1 m long, densely leafy, finally clothed with dry leaves and leaf-bases. Branches simple or sometimes ramifying, ascending, extending well past the apex of the main stem, sparsely leafy especially in the upper parts; branches and branchlets with terminal capitula. Cortex light brown.

Leaves except on the upper parts of the branches alternate, spreading, finally reflexed, herbaceous, elliptic or somewhat cuneate, 0.6—1.5 cm long, 3—8 mm wide, entire or mostly 2—5-lobed; leaf-lobes toothlike, ovate or triangular, erecto-patent, 1—3 mm long, 0.5—2 mm wide; leaf-lobes and leaf-tips mucronate with a black point. Leaves on the upper parts of the branches different in being alternate or seldom opposite, erecto-patent and spreading, narrowly elliptic or somewhat lanceolate, 0.4—0.8 cm long, 1—3 mm wide, mostly entire or seldom 2—3-lobed; leaf-lobes and leaf-tips as described above but c. 0.5 mm shorter and narrower.

Involucre campanulate, 0.5—1.5 cm wide. Involucral bracts 10—25, 2—3-seriate, narrowly elliptic-oblong or somewhat obovate-oblong, outer narrowly elliptic-lanceolate, 3.5—6 mm long, 1—2 mm wide, laterally plane and scarious, apically irregularly denticulate and purplish, acute—acuminate.

Receptacle convex. Paleae scarious, narrowly elliptic-oblong or somewhat obovate -oblong, 3—5 mm long, 1—1.5 mm wide, apically and dorsally villose with white, erect hairs, irregularly fimbriate-denticulate at the apex, ± acuminate.

Ray-florets 6—20, neuter, glabrous. Tube cylindrical, 1.2—2 mm long, 0.3—0.6 mm wide. Lamina elliptic-oblong, 5—8 mm long, 2.5—4 mm wide, ± distinctly 4—6-veined, apically entire or ± minutely 3-lobed. Ovarium rectangular, 1—1.8 mm long, somewhat three-edged; pappus 0.

Disc-florets c. 30—100, perfect. Corolla gradually widening upwards, 3—4.2 mm long, 0.5—1 mm wide; corolla lobes narrowly ovate-triangular, 0.7—1.2 mm long, revolute. Style 2.8—4 mm long; style-branches 0.5—0.8 mm long, spreading or revolute; stylopodium terete, up to 0.4 mm long. Anthers 1.5—2.1 mm long; apical appendage ovate-oblong, rounded-truncate.

Achenes ± narrowly elliptic-oblong, 2—3.5 mm long, 0.5—1 mm wide, slightly curved, somewhat four-edged, furnished

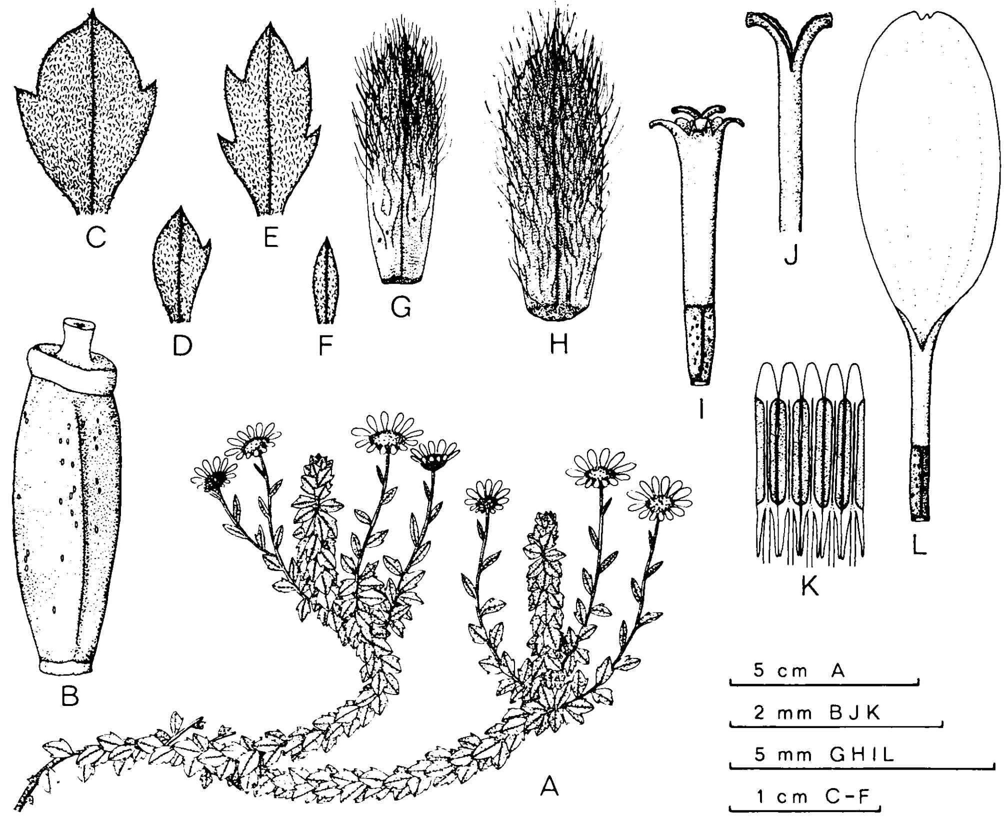

Fig. 11. *O. tenuis*. — A: Habit. — B: Achene. — C, E: Leaves. — D, F: Upper leaves on flowering branches. — G: Palea. — H: Involucral bract. — I: Disc-floret. — J: Part of style of disc-floret. — K: Stamens. — L: Ray-floret.

A—D, F—L: ESTERHUYSEN 17793 (BOL). — E: ESTERHUYSEN 22768 (BOL).

with a white-yellow collar surrounding the white-yellow stylopodium; pappus 0.

FLOWERING SPECIMENS seen from Sept., Nov. and Febr.

The slender habit and the characteristic leaves easily distinguish this new species from the other species of *Osmitopsis*. It is generally creeping, but dense vegetation might support it to erect growth (STOKOE 7272—7274).

Despite the difference in size and leaf-shape, *O. tenuis* shows many features in common with *O. asteriscoides*, viz. neuter ray-florets, tomentose—villose involucral bracts and paleae and "trunk synflorescence" (see p. 16).

DISTRIBUTION. *O. tenuis* is known only from a small area in and near the Slanghoek Mts., where it is said to grow in moist places and among rocks (fide coll.).

COLLECTIONS

Paarl Div.: Sebastian's Kloof, off Bain's Kloof, 1939, STOKOE 7272, 7273 (BOL); STOKOE 7274 (K) — San Sebastian's Kloof (Baviaan's Kloof), 1939, STOKOE (SAM) — Bain's Kloof, 1949, STOKOE (SAM) — San

Sebastian's Kloof, off Bain's Kloof, 1951, STOKOE (SAM) — Bailey's Peak, steep S slopes at head of kloof on E side, 3500—4000 ft., ESTERHUYSEN 22768 (BOL)

Worcester Div.: Slanghoek Needle, foot of cliffs on S slopes, 4500 ft., 1950, ESTERHUYSEN 17793 (BOL, K, LD, NBG, PRE, UPS)

7. Osmitopsis asteriscoides (Berg.) Less.

LESSING 1832 p. 386. — *Osmites asteriscoides* BERG.; BERGIUS 1767 p. 305. — Orig. coll.: GRUBB, "e Cap. b. Sp." (SBT-BERG lectotype).

Osmites asteriscoides L.; [LINNAEUS 1760 p. 24; 1763 a p. 1285; 1763 b p. 105; non rite publ.]; LINNAEUS 1767 p. 571; LINNAEUS 1771 p. 477 (*"asteroid."*, sphalm.); BURMAN f. 1768 p. 27; MURRAY 1774 p. 651; CHRISTMANN & PANZER 1779 p. 407; REICHARD 1780 p. 892; MURRAY 1784 p. 783; GAERTNER 1791 p. 442; GMELIN 1792 p. 1261; PERSOON 1797 p. 824; SAVIGNY in LAMARCK 1798 p. 648; THUNBERG 1800 p. 163; WILLDENOW 1803 p. 2259; DIETRICH 1806 p. 564; SMITH in REES 1813; THUNBERG 1823 p. 700; CASSINI 1825 p. 4; RICHTER 1835 p. 856. — *Osmitopsis asteriscoides* (L.) "CASS.", comb. non rite publ.; CASSINI 1817 p. 154; CASSINI 1825 p. 5; DE CANDOLLE 1837 p. 292; HARVEY 1865 p. 305; LEVYNS 1929 p. 260; 1950 p. 798. — *Leucanthemum asteriscoides* (L.) OK.; KUNTZE 1891 p. 351. — Orig. coll. not traced, see Nomenclatural Note.

Osmites camphorina L. 1767 (non L. 1771 p. 477 = *Osmitopsis dentata* (THUNB.) BREMER); [LINNAEUS 1760 p. 24; 1763 a p. 1285; 1763 b p. 105; non rite publ.]; LINNAEUS 1767 p. 571; BURMAN f. 1768 p. 27; THUNBERG 1800 p. 163 ("*camphorata*", sphalm.); 1823 p. 700 (*"camphorata"*, sphalm.). — *Osmitopsis camphorina* (L.) LESS.; LESSING 1832 p. 387. — Orig. coll. not traced, see Nomenclatural Note.

Osmitopsis calva GAND.; GANDOGER 1918 p. 46. — Orig. coll.: PENTHER 1449, Houhoek, 1894 (LY holotype, W).

ILLUSTR.: Fig. 3 J, p. 18; 4 I, p. 18; 12, p. 41; "Icones plantarum et animalium" (cf. MACNAE & DAVIDSON 1969); SEBA 1734 Plate 16 Fig. 3, Plate 90 Fig. 8; BURMAN 1738 Plate 58 Fig. 1; GAERTNER 1791 Plate 174 Fig. 3; LAMARCK 1823 Plate 704 Fig. 2; MARLOTH 1908 Fig. 50, 54, Plate 10; 1932 Fig. 59, 64.

MAP: 8, p. 21.

NOMENCLATURAL NOTE

The first names and descriptions of this plant after 1753 appear in the Linnaean dissertation "Plantae rariores africanae" (LINNAEUS 1760 p. 24). These are *Osmites camphorina* and *Osmites asteriscoides,* both representing *Osmitopsis asteriscoides.* However, these names are not validly published, neither here nor in the essentially unchanged section of *Osmites* in the "Species plantarum" (LINNAEUS 1763 a p. 1285), since the genus *Osmites* is not described until in the "Genera plantarum" (LINNAEUS 1764 p. 441). Then BERGIUS' (Sept. 1767 p. 305) description of *Osmitopsis asteriscoides,* there named *Osmites asteriscoides,* precedes the next Linnaean work containing a treatment of *Osmitopsis,* the "Systema naturae" (LINNAEUS Oct. 1767 p. 571). Consequently, the epithet *asteriscoides* must be ascribed to BERGIUS.

Suitable types of *Osmites asteriscoides* L. and *Osmites camphorina* L. 1767 have not been traced. None of the four Linnaean specimens of *Osmitopsis asteriscoides* known to me can be chosen as a type. Specimen 1029: 4 (LINN) was collected by SPARRMAN after LINNAEUS described the species. Specimen 1029: 5 (LINN) is marked *"Osmites Bellidiastrum asteriscoides"* in LINNAEUS' handwriting, with a line drawn through the former epithet. Thus LINNAEUS first referred this specimen to his *Osmites Bellidiastrum* (see the Historical Outline) and later correctly transferred it to *asteriscoides.* But there is no evidence that he used this specimen when describing the latter species. Specimen 1029: 6 (LINN) and a Linnaean specimen in Herb. MONTIN at Stockholm (S) bear no marks in LINNAEUS' handwriting and are thus unsatisfactory for typification.

CASSINI (1817 p. 154) described the genus *Osmitopsis.* He pointed out *Osmites asteriscoides* as a generic type, but never made the combination *Osmitopsis asteriscoides.* This was first done by LESSING (1832 p. 386), who also cited the description of BERGIUS (1767 p. 305). Consequently, the combination *Osmi-*

Fig. 12. *O. asteriscoides.* — A: Portion of plant. — B: Ray-floret. — C: Disc-floret. — D: Achene. — E: Upper leaf on flowering branch. — F—I: Leaves. — J: Part of style of disc-floret. — K: Stamens. — L: Palea. — M: Involucral bract.

A, H: NORLINDH Sept. 1963 (S). — B, C, J, K, M: PHILLIPS 1179 (SAM). — D: WALL Dec. 1938, Table Mtn., at the water reservoir (S). — E, F: BOND 1495 (NBG). — G: ROGERS 22219 (Z). — I: GILLETT 992 (BOL). — L: BODKIN Jan. 1896 (NBG).

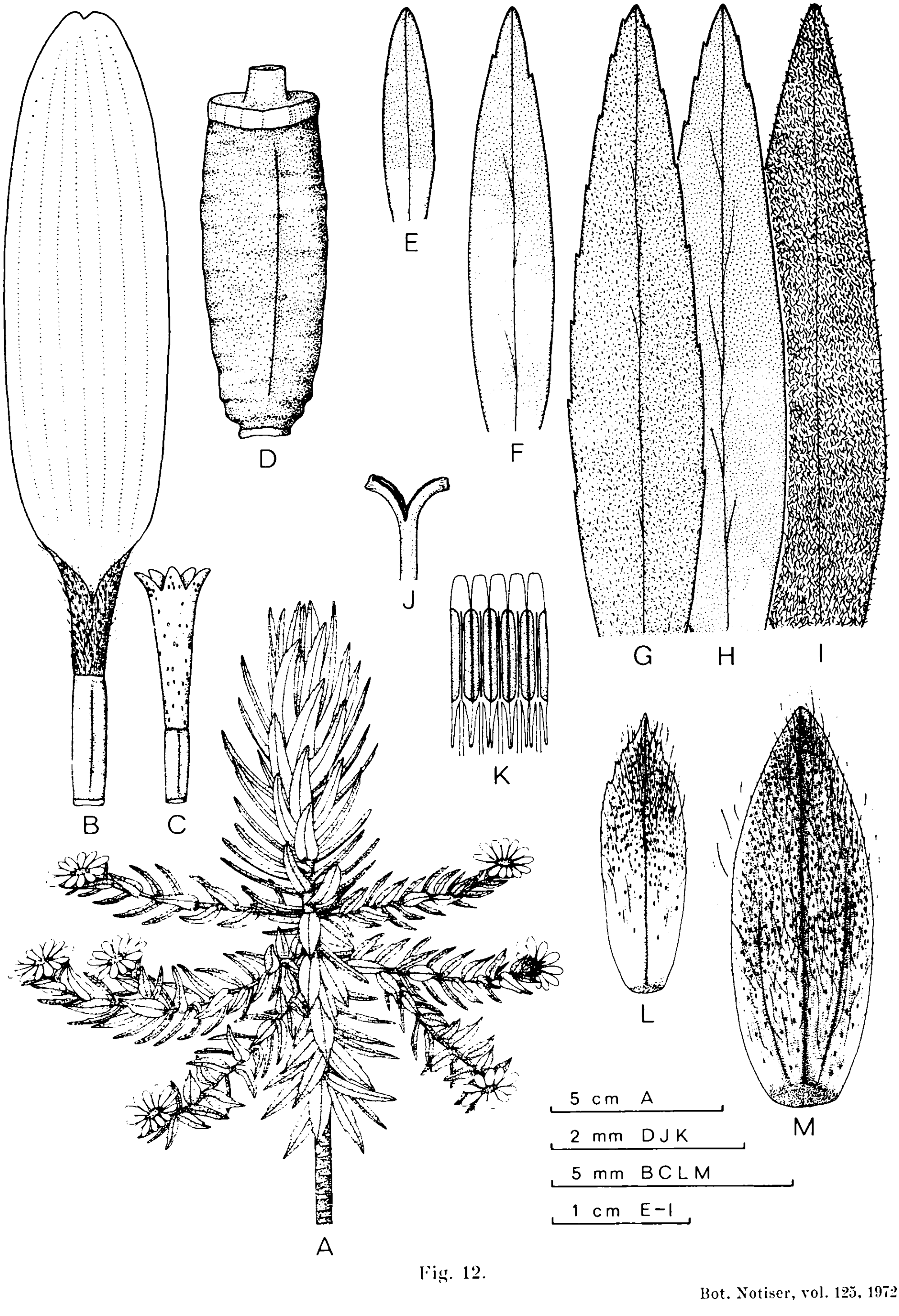

Fig. 12.

topsis asteriscoides must be ascribed to LESSING.

The name *Osmites camphorina* was used by LINNAEUS for two different species, viz. *Osmitopsis asteriscoides* and *Osmitopsis dentata.* Moreover, the epithet has been mis-spelt as *camphorata.* Some confusion has arisen out of this. Thus THUNBERG (1800 p. 163, 1823 p. 700) named a species *Osmites camphorata* representing *Osmitopsis asteriscoides.* See further the Nomenclatural Note under *Osmitopsis dentata.*

A vigorous, strongly camphor-scented, up to 2 m high (fide coll.), branched, glabrous—tomentose—lanate shrub. Main stems continuing vegetative growth, near the apex emitting branches with terminal capitula. Stems and branches erect or ascending, ± densely leafy, finally nude and marked with leaf-scars. Cortex light brown, becoming greyish brown.

Leaves spreading, coriaceous, lanceolate or narrowly oblong-elliptic, 1—6 (—8) cm long, 3—14 (—18) mm wide, acute, entire or serrate ± apically; teeth up to 24, triangular, up to 0.5 mm long and wide, acute.

Involucre campanulate, 0.5—1.5 cm wide. Involucral bracts 15—25, 2—3-seriate, ± narrowly elliptic or elliptic-obovate, outer lanceolate, 6—12 mm long, 3—4.5 mm wide, one—three-ribbed, laterally ± scarious, apically sometimes purplish, mostly entire or apically irregularly serrate-serrulate, acute.

Receptacle convex. Paleae ± scarious, ± narrowly oblong—elliptic, 4—6 mm long, 1.5—2 mm wide, apically and dorsally tomentose or villose with long erect hairs, apically irregularly serrate—serrulate, ± acuminate.

Ray-florets 10—20, neuter. Tube cylindrical—funnel-shaped, 1.5—2.5 mm long, 0.8—1.4 mm wide, tomentose—laxly villose. Lamina lorate or ± narrowly elliptic-oblong, 9—16 mm long, 3—4.5 mm wide, ± distinctly 6—8-veined, dorsally laxly villose or glabrous, apically entire or ± deeply 2—3-lobed. Ovarium obovate-rectangular, 2.5—3.2 mm long, somewhat three-edged; pappus 0.

Disc-florets numerous, > 100, perfect. Corolla gradually widening upwards, 3—3.8 mm long, 0.7—1.2 mm wide; corolla lobes ovate-triangular, 0.4—0.8 mm long, somewhat spreading. Style 2.5—3.5 mm long; style-branches 0.3—0.6 mm long, spreading; stylopodium terete, up to 0.4 mm long. Anthers 1.5—2 mm long; apical appendage ovate, truncate-rounded.

Achenes elliptic-oblong or obovate, 2.5—4 mm long, 0.5—1.5 mm wide, somewhat four-edged, furnished with a white-yellow collar surrounding the white-yellow stylopodium; pappus 0.

FLOWERING SPECIMENS seen from the whole year.

VERNACULAR NAMES: "Bellis, Bels(e), Belskruie; (Mountain) Daisy" (SMITH 1966 p. 615).

O. asteriscoides, the type of the genus, is well known to every student of the Cape Flora. It is often collected in the southwestern Cape, including the Peninsula.

O. asteriscoides has been used medicinally for various purposes. Already THUNBERG (1788 p. 323) gave an account of this subject.

VARIATION. The leaves of *O. asteriscoides* vary considerably from glabrous through tomentose to lanate and from entire to serrate. DE CANDOLLE (1837 p. 292) divided the species into three varieties, viz. var. α. *pubescens* DC., var. β. *subdentata* DC. and var. γ. *glabra* DC. These varieties were founded on differences in the indumentum and toothing of the leaves. I have found these characters to vary continuously and non-geographically and must thus reject the varieties.

DISTRIBUTION. *O. asteriscoides* is common on the Peninsula and in the Stellenbosch and Caledon Divisions. It does not thrive in the shadow of trees, but needs open and moist ground (MARLOTH 1908 p. 132), where it forms small "forests" (HUTCHINSON 1946 p. 44). Such a "forest" is found e.g. in a swampy place on the summit of Table Mtn.

COLLECTIONS

Peninsula: Table Mtn., Thunberg (UPS-THUNB) — Between Wynberg and Constantia, 1811, Burchell 798 (K) — On a slope among stones in a ravine, N side of Table Mtn., 1826, Ecklon (S) — Among shrubs on a slope in a ravine, N side of Table Mtn., 1827, Ecklon (K, S, W) — Somewhat moist place, summit of Table Mtn., Zeyher (Z) — Moist places at the plateau above Kasteelberg, Zeyher 4771 (BOL, NBG) — Table Mtn., in the krantzes, 2000—3000 ft., Drège (BM, K, L, P, W) — Slopes of Table Mtn., Pappe (SAM) — Summit of Table Mtn., Pappe (SAM) — Moist places, slopes of Devil's Peak, 2000 ft., 1838, Krauss (P, W, Z) — Muizenberg, 1838, Krauss (S) — Summit of Table Mtn., 2500—3500 ft., Mundt (K) — Table Mtn., Wahlberg (S) — Waterfall, 1841—1844, Jameson (K) — Wynberg, 1842, Wallich 400 (BOL) — On the mtn. above Simon's Bay, 1846, Alexander Prior (K, Z) — Simon's Bay, 1848, Boivin 600 (P, W) — Simon's Bay, 1852, Voyage of H. M. S. Herald Bot. No. 542 leg. Gillivray (K) — Table Mtn., 1852, Milne (K) — Simonstown, 1853, Andersson (S) — Simon's Bay, 1853—1856, Wright (P) — Table Mtn., 1862, Cooper 3514 (K) — Devil's Peak, 1875—1880, Rehmann 1011 (BM, BR, Z) — Houtbay, 1875—1880, Rehmann 1621 (BR, Z) — Plains of Constantia Mtn., near Table Mtn., 2500 ft., 1877, Bolus 3766 (BOL) — Moist places, Claremont near Cape Town, 300—1500 ft., 1879, Bolus 3766 (K, PRE) — On a bank of a streamlet at the plateau, summit of Table Mtn., 2500 ft., 1883, Herb. Norm. Austr. Afr. 198 leg. MacOwan (BM, K, P, SAM, UPS, W); MacOwan 2547 (GRA) — Table Mtn., 1885—1886, Purcell (Z) — Table Mtn., 1886, Thode A 17 (PRE) — Simonstown, 1887, Paulay (W) — Muizenberg Hill, 1890, Gamble 22139 (K) — Near streamlets at Constantiaberg, 2500 ft., 1892, Schlechter 1460 (BM, GRA, K, W, Z) — Table Mtn., 1894, Kuntze (K) — Slopes over Wynberg, 1895, Wolley Dod 224 (BM) — Noordhoek, 1897, Kensit (BOL) — Simonstown, mts., 1903, Pearson 148 (Z) — Table Mtn., on the slopes near the plateau, 1911, R. E. Fries (UPS) — Cape Town, 1912, Tobler (Z) — Table Mtn., 1913, Garside 417 (K) — Table Mtn., 1919, Rogers 17731 (Z) — Table Mtn., 1922, Moss 7252 (BM) — Clovelly, 1924, Rogers 29219 (Z) — Witsand, 1926, Lotsy & Goddijn 1543 (L) — In valley ground, Simonstown, 1926, Watt & Brandwijk 249 (PRE) — Smith's Farm, 1927, Lotsy & Goddijn 1412, 1758 (L) — Klaver Valley, 1927, Salter 281/16 (BM) — Table Mtn., Pipe Track Route, Constantia side, 1927, Young 395 (PRE) — Near Orange Kloof, 1928, Hutchinson & Bolus 49 (BM, BOL, K, PRE) — Noordhoek, 300 ft., 1929, Godman 302 (BM) — Top of Kalk Bay Mtn. near stream, 1932, Acock 1357 (S) — Swampy place above Victoria Road beyond Bakoven, 1933, Acock 1897 (S) — Table Mtn., 1075 m, 1933, Humbert 9625 (PRE) — At the road between Smitswinkel Bay and Slangkop Point, 1934, Hafström (S) — In the valley at Klaver Vlei above Simonstown, 1937, Wall (LD, S) — The saddle, Devil's Peak, 1938, Penfold 171 (NBG) — Table Mtn., at the water reservoir, 3000 ft., 1938, Wall (S) — Summit of Table Mtn., 3000 ft., 1938, Wall (S) — Kirstenbosch, 1939, Bond 83 (NBG) — Slangkop Vlei, 1942, Bond 1495 (NBG) — Table Mtn., 3000 ft., 1948, Rodin 3207 (BOL, K, PRE) — Rooihoogte Flats, 1949, Morris 95 (NBG) — Near Klaasjagers, 1949, Steyn 660 (NBG) — Patrys Vley, moist peat, 1949, van Zinderen Bakker 15 (NBG) — Orange Kloof, 1300 ft., 1953, Schelpe 3890 (BM) — Top of Table Mtn., 1953, Sidey 2232 (S) — Orange Kloof, 1955, Salter 9599 (BM) — Table Mtn., Weather Station, 700—800 m, 1958, Werdermann & Oberdieck 40 (K, PRE) — In valley above Smitswinkel Bay, 1962, van Breda (Z)

Cape Div.: Cape Flats, 1888, Tyson 3012 (SAM) — Cape Flats, 1932, Letty 222 (PRE)

Stellenbosch Div.: Stellenbosch, Ecklon (G-DC) — Jonkers Hoek, Stellenbosch, near a stream, 1919, Garside 1271 (K) — Swartboskloof, 2000 ft., 1960, van der Merwe 2193 (K, PRE)

Paarl Div.: Drakenstein, Thunberg (UPS-THUNB) — Drakensteinbergen, 2000—3000 ft., Drège (BM, K, L, P, S, W) — French Hoek, 1000 ft., 1913, Phillips 1179 (SAM) — French Hoek Peak, 3000 ft., 1954, Esterhuysen 22929 (BOL)

Somerset West Div.: Sir Lowry's Pass, 1800 ft., 1890, Guthrie 2031 (NBG) — Lourensford, Somerset West, 250 m, 1945, Parker 3983 (BOL, K)

Caledon Div.: Near springs of Hottentots Holland Mtn., Bowie (BM) — Mtn. of Baviaans Kloof, near Genadendal, 1815, Burchell 7800 (K) — Moist places at Rivier Zonder Einde Mts., not far from Appelskraal, Ecklon (W); Zeyher 2936 (BOL, S) — Mts., at Grietjesgat, between Sir Lowry's Pass and Palmietrivier, 2000—4000 ft., Ecklon & Zeyher (BOL, L, LD, P, S, UPS, W, Z) — Houhoek, 1894, Penther 1449 (LY, W) — Hermanuspetrusfontein, Klein River Mts., 2000 ft., 1896, Bodkin (NBG) — Riverside near Hermanuspetrusfontein, 50 ft., 1897, Galpin 4171 (GRA, PRE) — "Bought at Hermanus Flower Show", 1924, Rogers 29196 (K, Z) — Mts. E and N of Hermanus, on upper slopes, 1928, Gillett 992 (BOL) —

Viljoen's Pass, 1931, Ryder (K) — Voëlklip, near Hermanus, 1934, Bruyn 192 (PRE) — Near Caledon, 1936, Hafström & Lindeberg (S) — At Palmiet River, on a moor, 1937, Wall (S) — E of Rocklands Peak, Klein River Mts., 1940, Stokoe (SAM) — Riviera, 1942, Barker 1838 (NBG) — Viljoen's Pass, Villiersdorp side, 1946, Davis (SAM) — Top of Viljoen's Pass, road Villiersdorp—Elgin, dense macchia on level ground, 1500 ft., 1947, Story 3051 (GRA, PRE) — Palmiet River, 1949, Martin 221 (NBG) — Hermanus in swamp, 1949, Sidey 1849 (S) — Vogelkloof, Mossel River, Hermanus, 1950, Martin 318 (NBG) — Mossel River, Hermanus, 1951, Maguire 1260 (NBG) — Slopes of Kogelberg, 1953, Stokoe (SAM) — Viljoen's Pass, 1956, Strey 2943 (PRE) — Betty's Bay, on rocky slopes just above highwater mark, 1959, White 5170 (PRE) — Betty's Bay, 1960, van Rensburg 2155 (K, PRE) — Betty's Bay, 1961, van Breda 1458 (PRE) — Kogelberg Reserve, Paardeberg, seaward side, 300 ft., 1961, Grobler 0123 (PRE) — Bobbejaanberg, 4000 ft., 1962, van der Merwe 900 (PRE) — Villiersdorp, 1000 ft., 1963, Bayliss 1635 (Z) — Palmietberge, in the valley of a rivulet, 500 ft., 1963, Norlindh (S) — Kogelberg Reserve, 1964, Wild 6284 (K, NBG) — Betty's Bay, mountain foothills but in moist places, 200—500 ft., 1968, Bayliss 4248 (NBG, Z) — Harold Porter Botanic Reserve, Betty's Bay, 200 ft., 1968, Ebersohn 16/68 (NBG)

Bredasdorp Div.: Rivier Zonder Einde Mts., near Rivier Zonder Einde, damp places near streams, 1949, Wilman 494 (BOL)

SINE LOCO: "In humidis montanis ubique in provinc. occident. CBS", 1846, Alexander Prior (K) — "C. B. S.", 1847, Alexander Prior (Z) — "Cap. b. Sp.", Banks (W) — "Promont. b. Spei", 1771, Banks & Solander (BM) — "C. B. S.", Bauer (W) — "Cap. b. Sp.", Bojer (W) — "Cap. b. Sp.", Boos (W) — Breutel (W) — "Cap de Bonne Espèrance", Brossard (P) — "Cap. Bonae Spei", Burman (G) — "e. C. B. Spei", Ecklon (S) — "C. B. S.", Forbes (K) — "Cape", Forster (BM, K) — "e Cap. b. Sp.", Grubb (SBT-BERG) — "E Cap. bone Spei", 1816, Gröndahl (S) — "Cap. b. Spei", Gröndahl (LD-RETZ) — Kölbing (P) — "Promont. b. Spei", Masson (BM) — "C. B. S.", Niven (BM) — 1772, Oldenburg (BM) — "Cap,", Osbeck (LD-RETZ, S) — "Cap. b. Spei", 1857, Pappe (W) — "Port Natal", Poeppig (W) — Potts (SAM) — "Caledon Div.", Rogers 11050 (Z) — "C. B. S.", Roxburgh (BM) — "SW Cape", 1931, Ryder (K, GRA) — "Cap. b. sp.", Scholl (W) — Sieber Fl. Cap. No. 30 (BR, G-DC, K, L, P, S, W) — "Cap. B. Spei", Sieber (BR, L) — "Cap", Sieber Fl. Cap. No. 187 (P) — "CBS.", 1822, Thorn 423 (K) — "CBS.", Thorn 599 (K) — "Cap. B. Spei", Thunberg (S, SBT-BERG, UPS-THUNB) — "Cape", Villette (K) — "Prom. b. Spei", 1842, Wahlberg (S) — "e Cap. b. Sp.", Wännman (SBT-BERG) — Zeyher (BM)

EX HERB.: Casström (S) — Table Mtn., Harvey (BM) — "Cap.", Jaquin fil. (W) — "Cape of G. Hope", Klatt (W) — Linnaeus, 1029: 4—6 (LINN) — Meerburg (L) — "Cap. b. Spei", Montin (S) — "Cap. B. E.", Du Petit-Thouars (P) — "Cap. b. Spei", Portenschlag (W) — "Cap. b. sp.", Retzius (LD-RETZ) — "Cap", Radlof (S) — van Royen (L) — Schultz Bipontinus (P) — "Cap. de B. Esp.", Sonnerat (P) — Vaillant (P) — Willdenow, 16502—16504 (B) — "Cape Town", 1909, Worsdell (K)

8. Osmitopsis parvifolia (DC.) Hofm.

Hofmeyr 1925 p. 364. — *Osmites parvifolia* DC.; De Candolle 1837 p. 291; Harvey 1865 p. 305; Jackson 1894 p. 381 (*"parviflora"*, sphalm.). — Orig. coll.: Drège, Hottentotshollandberg, 100—200 ft. (G-DC holotype).

ILLUSTR.: Fig. 3 K, p. 18; 4 J, p. 18; 13, p. 45.

MAP: 9, p. 21.

A 10—40 cm high, much-branched, glabrous shrublet. Stems ascending or erect, densely leafy, finally clothed with dry leaves and leaf-bases, terminally bearing a capitulum. Cortex becoming dark greyish brown.

Leaves reflexed, herbaceous, obovate and cuneate, 0.4—1 cm long, 1—3.5 mm wide, acute, basally serrate-dentate, apically serrate; teeth 8—20, triangular-subulate, 0.3—1 mm long, 0.1—1 mm wide, acute—acuminate.

Involucre campanulate, 0.4—1 cm wide. Involucral bracts 8—20, 2—3-seriate, ± narrowly elliptic-oblong or somewhat obovate-oblong, outer narrowly elliptic-lanceolate, 3—7 mm long, 1—2.8 mm wide, laterally plane and scarious, ± apically irregularly denticulate-serrulate and often purplish, acute—acuminate.

Receptacle somewhat conical. Paleae glabrous, scarious, oblong, 2—3.5 mm long, 0.5—1 mm wide, irregularly serrate with 3—7 erect, acute teeth.

Ray-florets 7—15, female, fertile, glabrous. Tube 0 or mostly present, cylindri-

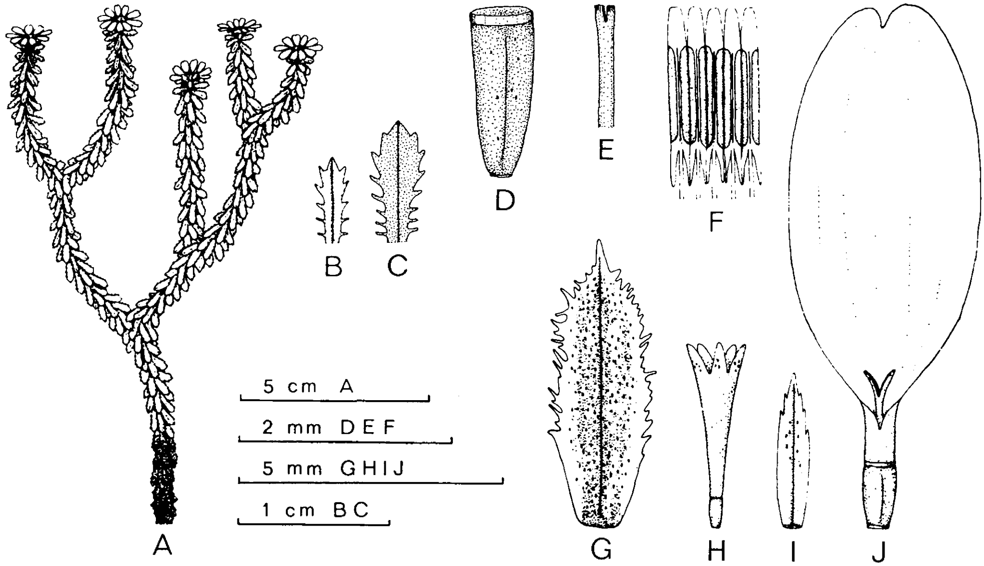

Fig. 13. *O. parvifolia.* — A: Portion of plant. — B, C: Leaves. — D: Achene. — E: Part of style of disc-floret. — F: Stamens. — G: Involucral bract. — H: Disc-floret. — I: Palea. — J: Ray-floret.

A—C, E—J: ROURKE 985 (NBG). — D: SCHLECHTER 5387 (BOL).

cal, gradually widening, up to 1.8 mm long, 0.3—1 mm wide. Lamina elliptic, 5—9 mm long, 2.5—4.5 mm wide, 4—6-veined, apically ± irregularly 3-lobed or sometimes deeply 2-lobed. Style 1.5—2.5 mm long; style-branches 0.3—0.8 mm long, spreading, acute; stylopodium 0.

Achenes oblong-obovate, 1.5—2 mm long, 0.5—1 mm wide, somewhat four-edged, furnished with a white-yellow collar; pappus 0.

Disc-florets c. 40—100, hermaphroditic, ♀-sterile. Corolla funnel-shaped, 2.2—3.2 mm long, 0.5—1 mm wide; corolla lobes ovate-triangular, 0.5—1 mm long, somewhat spreading. Style 1.8—3 mm long; style-branches 0.1—0.3 mm long, coherent; stylopodium somewhat terete, up to 0.3 mm long. Anthers 1.4—1.8 mm long; apical appendage oblong, truncate. Ovarium obovate, 0.5—1 mm long; pappus 0.

FLOWERING SPECIMENS seen from Sept.—Febr.

O. parvifolia is a richly branching shrublet. One could suspect it to have developed a "trunk synflorescence" (see p. 16), but I have not been able to confirm this on the herbarium material available to me.

Young and sparsely branched or unbranched specimens of *O. parvifolia* are sometimes confused with *O. afra,* from which it is easily distinguished through the absence of pappus.

DISTRIBUTION. *O. parvifolia* mainly occurs in the montane regions of southwestern Caledon Division. It grows on rocky and stony mountain slopes (fide coll.).

COLLECTIONS

Somerset West Div.: Sir Lowry's Pass, Hottentots Hollandskloof, 1000—2000 ft., DRÈGE (BM, K, L, P, W) — Sir Lowry's Pass, 1900 ft., 1890, GUTHRIE 2355 (NBG) — In rock fissures, Sir Lowry's Pass, 1600 ft., 1894, SCHLECHTER 5387 (BM, BOL, GRA, K, L, SAM, W, Z) — Among rocks on summit of Hottentots Holland Mts., near Sir Lowry's Pass, 1550 ft., 1896, Herb. Norm. Austr. Afr. 1771 leg. MacOwan 3129 (BM, GRA, K, P, PRE, SAM, UPS, W, Z) — Among rocks, Hottentots Holland Mts., near Sir Lowry's Pass, 1400 ft., Bolus (BOL) — Sir Lowry's Pass, Bolus (BOL, SAM) — Sir Lowry's Pass, 1931, Salter 1825 (BM, K) — Sir Lowry's Pass, 1936, Hafström & Lindeberg (S) — Sir Lowry's Pass, Stokoe (SAM) — On moist rocky ground above Sir Lowry's Pass, 480 m, 1951, Parker 4598 (K)

Caledon Div.: Hottentots Holland, Bowie (BM) — Hottentots Holland, Gueinzius (S) — Hottentotshollandberg, Drège (G-DC) — Summit of mts. at Hottentots Holland, Drège (SAM) — Genadenthal, Drège (S) — In fissures of the rocks, Hottentots Holland Mts., 1846, Alexander Prior (K) — Houhoek, 1894, Penther 2395 (S, W) Rooi Els River, 1923, Stokoe (SAM) — S side of and on summit of Buffels Mtn. near Rooi Els, 1936, Pillans 8237 (BOL) — Hottentots Holland Mts., 1939, Stokoe 7552 (BOL) — Hangklip, 1500 ft., 1942, Compton 13505 (NBG, PRE) — Palmiet River, mtn. tops, 2000 ft., 1942, Compton 14113 (NBG) — Mts. behind Betty's Bay, 1942, Leighton (BOL) — Palmiet River Valley, 1943, Stokoe 8452 (PRE) — Kogelberg, 2000 ft., 1944, Barker 3320 (NBG) — Kogelberg, 5 Beacon Ridge, 3000—3500 ft., 1944, Esterhuysen 9980 (BOL) — Palmiet River Valley, lower slopes of Kogelberg, 1944, Lewis (PRE, UPS) — Kogelberg, Palmiet River Valley, 1944, Sidey 2406 (S) — Kogelberg, 1944, Stokoe (SAM) — Hangklip Estates, 1947, Stokoe (SAM) — Pringle East Peak, small ledges and rocky slopes, 1951, Esterhuysen 18853 (BOL, PRE, UPS) — Mtn. N of Pringle Bay, 2600 ft., 1951, Rycroft 1232 (NBG) — Platberg, Kogelberg Forest Reserve, 2800 ft., 1952, Rycroft 1389 (BOL, NBG) — Palmiet River Valley, Platteberg, 1952, Stokoe (SAM) — Palmiet River Mts., Oudebosch, 1952, Stokoe (SAM) — Pringle Peak, 1954, Maguire 2654 (NBG) — Kogelberg Reserve, Paardeberg, seaward side, 1000 ft., 1962, Grobler 0366 (PRE) — Kogelberg, ledges around the summit, 4100 ft., 1967, Rourke 985 (NBG, PRE)

SINE LOCO: "Port Natal", Gueinzius (W) — "Cape", Mundt (K) — Rogers 11057 (Z) — "SW Cape", 1931, Ryder (K) — "Cape", Stanger (K) — 1939, Stokoe 7553 (BOL) (not Cedarberg Mts.)

Taxa to be Excluded

Osmites L., typus solum; Linnaeus 1764 p. 441 = *Relhania* sp.

Osmites Bellidiastrum L.; Linnaeus 1760 p. 24 = *Relhania* sp.

Osmites calycina L. f.; Linné f. 1781 p. 380 = *Relhania calycina* (L. f.) Poir.

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Studies in Galápagos Plants XII

On the Vegetation of Fernandina before the Eruption in 1968

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ABSTRACT

ELIASSON, U. 1972. Studies in Galápagos plants. XII. On the vegetation of Fernandina before the eruption in 1968. — Bot. Notiser 125: 49—61.

In June 1968 the large volcano of the island of Fernandina (Narborough) in the Galápagos archipelago had a violent eruption that caused great changes in the large central caldera. The vegetation in the caldera was more or less eradicated by the event. In this paper the vegetation of the caldera as it was before the eruption is described. The description is based on field-notes, pictures and collecting made in March 1967. A brief account of the vegetation of the north-east side of Fernandina, from Punta Espinosa to the top of the island, is also given. Floristic similarities of Fernandina and Isabela (Albemarle) are discussed.

TOPOGRAPHY OF FERNANDINA

Fernandina is the westernmost of the large islands in the Galápagos archipelago. It is separated from the large island of Isabela by the shallow strait of Canal Bolívar. It is composed of basaltic lavas and agrees petrologically with the volcanoes of Isabela (MCBIRNEY & AOKI 1966). Fernandina extends about 30 km in SW—NE direction and about 34 km in SE—NW direction. The peripheral parts are gently sloping, while the central part around the caldera is much steeper with slopes of between 30° and 40°. The highest altitude of the rim of the caldera is near 1500 m. The caldera has an elliptical mouth about 6.5 by 4.5 km across. Before the volcanic event in 1968 the caldera floor was about 800 m from the highest part of the rim. The floor of the caldera was flat, more or less horizontal, and about 2.2 by 3.9 km across (SIMKIN & HOWARD 1968).

I visited the caldera in March 1967. I started the descent into the caldera from the north-eastern part of the crater rim at an altitude of 1370 m. In the south-eastern part of the caldera was a well marked plateau (Fig. 7) at an altitude of about 1000 m. The altitude of the floor of the caldera was 670 m. On the south-western part of the floor was a tufa cone (Figs. 5, 10) 110 m high and with a diameter of 600—700 m. The eastern slope of the cone was crater-shaped and had a circular lake (Fig. 5), about 150 m in diameter, with blue-green turbid water. The surface of this water body was about 5 m below the level of the floor of the caldera. The northern part of the caldera floor was covered by a shallow lake (Figs. 5, 6) with warm (estimated temperature 35°—40° C), somewhat sulphurous, but drinkable water.

The size of the lake on the floor of the caldera has been fluctuating. The first visitor to the caldera (in 1906) reported two lakes inside the crater (STEWART 1915 p. 336), one of which must have been the little lake of the tufa cone. Photographs

Fig. 1. View from Punta Espinosa toward the large central volcano. In the foreground lava gravel mixed with shell sand. Some mangrove vegetation can be seen around the bay. In the background is the eastern slope of the volcano. Fresh lava forms black strips between lighter patches of older, vegetated lava. Photo: U. E. 22.III. 1967.

taken by the U. S. Air Force in May 1947 show the crater floor completely covered by water. An expedition in 1957 found the floor almost completely covered (Eibl-Eibesfeldt 1960), while visitors to the caldera in 1958 reported that the entire lake had disappeared (Brunborg & Petersen 1960). Later on it was re-established, increased gradually in size (cf. Perry 1967 p. 30), and on my visit in 1967 covered one fifth or somewhat more of the floor. The results of a limnological study of the lake of the caldera floor as well as of that of the tufa cone have been reported by Colinvaux (1968 a).

The altimeter used on my visit to the caldera was a Swiss-made "Thommen". It was calibrated at sea-level before the climb and checked at sea-level after the descent. The camera used was a Japanese "Topkon RE-2" with a f.1.8/58 mm lens. "Agfa CT 18" colour film was used. The photographs in this paper were transformed to black and white from this colour film.

THE EFFECT OF THE 1968 ERUPTION ON THE CALDERA

Fernandina can probably be regarded as the most active of the volcanoes of the archipelago (cf. Richards 1962). By the violent eruption on June 11, 1968, the south-eastern part of the floor of the caldera sank about 300 m (Simkin & Howard 1968). The lake previously covering the northern part of the floor moved to the south-eastern part. The tufa cone remained intact but sank with the surround-

Fig. 2. *Brachycereus nesioticus* and *Cyperus anderssonii* growing in lava fissures at Punta Espinosa, alt. 5—10 m. Photo: U. E. 22.III. 1967.

ing part of the floor, the little lake on the tufa cone becoming connected with the outer lake. All vegetation on the tufa cone was presumably killed (cf. COLINVAUX 1968 b, 1968 c). Parts of the edge of the caldera fell down into the crater, and the vegetation on the walls of the caldera was dislodged to a large extent by rock avalanches (cf. PERRY 1969). The combined effects of ash coating, heat and root dislocation killed the vegetation on the walls of the caldera and to about 100 m beyond the rim on the north and east sides. On the western side some vegetation was killed as far as 8 km from the rim (SIMKIN & HOWARD 1970 p. 434).

An exhaustive account of the eruption of Fernandina has been given by SIMKIN & HOWARD (op. cit.).

THE VEGETATION

Because of its vast and inhospitable lava fields Fernandina for a long time remained very poorly known botanically. STEWART (1915 pp. 334—336), in his description of the vegetation of the Galápagos Islands, treated only the northern and north-eastern parts of the island. The only important collection of plants from the central caldera prior to my own collection was that of COLINVAUX (COLINVAUX, SCHOFIELD & WIGGINS 1968), who collected 25 species of vascular plants on the central tufa cone in 1966. The results of my own collecting on this tufa cone differ in some respects from those of COLINVAUX. No botanist had collected plants on the rim of the caldera before my visit there.

Fig. 3. Vegetation on a patch of old weathered lava on the north-eastern slope of Fernandina at 510 m elevation. The sparse vegetation consists of *Alternanthera filifolia* ssp. *filifolia, Froelichia nudicaulis* ssp. *lanigera, Jasminocereus thouarsii* var. *sclerocarpus, Darwiniothamnus lancifolius* ssp. *glandulosus* and *Macraea laricifolia*. Photo: U. E. 26.III. 1967.

The Vegetation between Punta Espinosa and the North-East Part of the Rim of the Caldera

Punta Espinosa is the north-eastern corner of the island (Fig. 1). Black lava fields end in the sea. There is a small bay with mangrove vegetation consisting of *Rhizophora mangle* L., *Laguncularia racemosa* (L.) GAERTN. f. and *Avicennia germinans* (L.) L., the two first-named species dominating. Scattered specimens of *Cacabus miersii* (HOOK. f.) WETTST. are found on shell sand. The lava near the shore is sparsely vegetated; only three species are important, viz. *Brachycereus nesioticus* (K. SCHUM.) BACKEB., *Mollugo snodgrassii* ROBINS. and *Cyperus anderssonii* BÖCKELER (Fig. 2). All three species are endemic to Galápagos and are typical inhabitants of young lava. The first-named plant is found only near the shore (alt. up to 20 m) and sometimes forms large clones of up to 400 stems growing together. The two last-named species are also found further inland up to an elevation of 70—80 m. Above this altitude the lava is barren, forming black jagged clinkers or plates, and greyish or reddish solidified streams. At an altitude of 200 or 300 m isolated specimens of *Jasminocereus thouarsii* (WEBER) BACKEB. var. *sclerocarpus* (K. SCHUM.) ANDERSON & WALKINGTON occur, the lowest specimens being several hundred metres from one another. Small

Fig. 4. *Scalesia microcephala* forest on the north-eastern part of the rim of the Fernandina caldera. Other important species in this type of vegetation are *Opuntia insularis, Croton scouleri* and *Zanthoxylum fagara*. The altitude is 1370 m. Photo: U. E. 24.III. 1967.

patches of gravel and cinders are found at this elevation. The first shrubs of *Darwiniothamnus lancifolius* (Hook. f.) Harl. ssp. *glandulosus* Harl. are met with at an elevation of 400—450 m. From this altitude upwards, patches of old lava weathered into gravel and surrounded by younger lava are covered with rather sparse vegetation (Fig. 3). This vegetation consists of *Alternanthera filifolia* (Hook. f.) Howell ssp. *filifolia, Froelichia nudicaulis* Hook. f. ssp. *lanigera* (Anderss.) Eliass., *Jasminocereus thouarsii* var. *sclerocarpus, Lippia rosmarinifolia* Anderss., *Chiococca alba* (L.) Hitchc., *Darwiniothamnus lancifolius* ssp. *glandulosus, Macraea laricifolia* Hook. f., *Scalesia microcephala* Robins. (occurring from about 500 m elevation and higher) and *Bulbostylis hirtella* (Schrad.) Nees ex Urban. The size and the number of these vegetation patches increase with altitude. From 600 m to 1100 m altitude the slope is much steeper than in the lower parts of the island, with gravel and cinders more or less covered with vegetation. At an elevation of 900—1000 m *Cordia leucophlyctis* Hook. f. (sensu Wiggins 1971), *C. revoluta* Hook. f. and *Scalesia affinis* Hook. f. ssp. *gummifera* (Hook. f.) Harl. are also found. Separate specimens of the last-named plant occur in places at lower altitudes. Above 1100 m large areas are covered with lava, forming small craters and solidified, often burst bubbles with jagged clinkers or cinders between. On the otherwise barren young lava at this altitude *Froelichia nudicaulis* ssp. *lanigera* is

Fig. 5. View from the eastern part of the rim of the caldera, alt. 1360 m, before the violent eruption in 1968. The floor of the caldera is ca. 700 m below. The crater-shaped tufa cone on the floor is 110 m high. Photo: U. E. 24.III. 1967.

often found forming dense solid cushions 2—5 dm in thickness and covering areas 10 m^2 or more. Apart from regions with young lava, vegetated areas become more frequent above this elevation. *Drymaria rotundifolia* A. Gray, a small inhabitant of weathered lava at high elevations on Fernandina and the neighbouring island of Isabela, grows on thinly vegetated gravel at an altitude of 1200 m and higher.

The Vegetation on the Rim of the Caldera

Scalesia microcephala increases in numbers above 1200 m elevation. At 1300 m and higher it forms a dense forest (Fig. 4), in places very dense and difficult to penetrate. This forest covers the whole rim of the caldera. The *Scalesia* trees are 2—3 m tall. Other, although less important, trees are *Zanthoxylum fagara* (L.) Sarg., *Croton scouleri* Hook. f. and *Lippia rosmarinifolia*. Scattered specimens of *Opuntia insularis* Stewart, *Duranta repens* L. and *Solanum erianthum* D. Don occur. The first-named species is a characteristic element in the vegetation of the caldera rims of Fernandina and Isabela. Among other species growing in the caldera rim forest of Fernandina are *Anredera ramosa* (Moq.) Eliass., *Calceolaria meistantha* Pennell, *Jaegeria gracilis* Hook. f. and *Bulbostylis hirtella*. It should be noted, however, that this enumeration is far from complete. In open spots on the edge of the caldera *Drymaria rotundifolia* is found.

Fig. 6. The northern and north-eastern parts of the caldera seen from the north-eastern part of the caldera rim, alt. 1360 m. Photo: U. E. 24.III. 1967.

The Vegetation of the North-Eastern Wall of the Caldera before the 1968 Eruption

Apart from steep cinder slopes and the sites of rock avalanches most of the walls of the caldera were covered with vegetation (Fig. 7). The upper part of the wall had about the same plant species as had the caldera rim. Dominating trees and shrubs were *Bursera graveolens* (H. B. K.) TRIAN. & PLANCH., *Croton scouleri, Lippia rosmarinifolia, Scalesia microcephala* and *Macraea laricifolia. Scalesia* was the most important species down to about 900 m elevation but was more or less absent for the last 200 m above the caldera floor. The other trees and shrubs mentioned grew all the way down. *Calceolaria meistantha* was found from the caldera rim down to an elevation of about 1100 m, thus to about 430 m above the caldera floor. The first and hitherto only collection of *Bowlesia palmata* RUIZ & PAVÓN from the archipelago was made just below the edge of the rim (ELIASSON 1970 b). Through the presence of glochids on the fruit this species is well adapted to epizoic dispersal and has probably reached the archipelago through the agency of birds. Other species noted from the north-eastern wall of the caldera were *Adiantum concinnum* HUMB. & BONPL. ex WILLD., *Alternanthera filifolia* ssp. *filifolia, Desmodium limense* HOOK., *Phyllanthus caroliniensis* WALT., *Sida salviifolia* PRESL, *Sclerothrix fasciculata* PRESL, *Apium leptophyllum* (PERS.) F. MUELL., *Tournefortia pubescens* HOOK. f., *Hyptis spicigera* LAM., *Lycopersicon cheesmanii* RILEY forma *cheesmanii, Elaterium carthagenense* JACQ., *Ageratum conyzoides* L.,

Fig. 7. The eastern wall of the caldera, alt. 900 m, before the eruption in 1968. The tree to the left is *Bursera graveolens*. In the background is the south-eastern wall of the caldera with a prominent plateau at an elevation of ca. 1000 m. Photo: U. E. 24.III. 1967.

Chrysanthellum pusillum HOOK. f., *Darwiniothamnus lancifolius* ssp. *glandulosus*, *Jaegeria gracilis*, *Bulbostylis hirtella*, *Cyperus aristatus* ROTTB., *Eragrostis ciliaris* (L.) R. BR., *E. mexicana* (HORNEM.) LINK and *Trichoneura lindleyana* (KUNTH) EKMAN. This list of plants is not complete but comprises a major part of the species at that time growing on the caldera wall.

The Vegetation of the Floor of the Caldera before the Eruption

The largest part of the floor consisted of flat, generally horizontally oriented lava blocks (Fig. 8) with yellowish sulphurous precipitations along the fissures. The very sparse vegetation consisted of *Mollugo snodgrassii*, *Borreria suberecta* HOOK. f. and *Cyperus anderssonii*. On patches with cinders and gravel *Mollugo snodgrassii* was abundant (Fig. 9). Scattered specimens of *Cyperus ligularis* L. were found in the lava fissures, but this species was especially common around the lake in the north part of the caldera floor, in places bordering the lake in a very conspicuous way.

The westernmost part of the floor was slightly higher than the rest of the floor. Tufa had slid down from the western wall. In the transition zone (Fig. 10) between the caldera wall and the floor *Zornia piurensis* MOHLENBROCK, *Sida salviifolia*, *Waltheria ovata* CAV., *Cyperus anderssonii*, *Anthephora hermaphrodita* (L.)

Fig. 8. Petrified lava on the floor of the caldera, alt. 670 m. Photo: U. E. 25.III. 1967.

KUNTZE, *Aristida subspicata* TRIN. & RUPR. and *Muhlenbergia microsperma* (DC.) KUNTH were noted.

The Vegetation of the Tufa Cone before the Eruption

The lower parts of the western slope of the small tufa cone was relatively richly vegetated with *Bursera graveolens* and *Waltheria ovata.* Tall shrubs of *Dodonaea viscosa* (L.) JACQ. var. *spatulata* (J. E. SMITH) BENTHAM grew on the north-western slope. The northern side of the cone sloped down to the southern end of the caldera lake, which was here bordered by a zone of *Cyperus ligularis.* On the adjacent cinder slopes of the cone *Mollugo snodgrassii* was very abundant. The small circular lake in the eastern part of the cone was bordered by a dense growth of *Cyperus ligularis.* Shrubs of *Baccharis gnidiifolia* H.B.K. and *Darwiniothamnus lancifolius* ssp. *glandulosus* grew on the south side of the cone.

I made a botanical investigation of the tufa cone and noted the following 29 species of vascular plants: *Adiantum concinnum, Alternanthera filifolia* ssp. *filifolia, Froelichia nudicaulis* ssp. *lanigera, Mollugo snodgrassii, Cassia picta* G. DON, *Crotalaria pumila* C. G. ORTEGA, *Desmodium glabrum* (MILL.) DC., *Rhynchosia minima* (L.) DC., *Stylosanthes sympodialis* TAUB., *Tephrosia decumbens* BENTH., *Bursera graveolens, Acalypha parvula* HOOK. f., *Chamaesyce punctulata* (ANDERSS.) BURCH, *Dodonaea viscosa* var. *spatulata, Waltheria ovata, Sarcostemma angustissima* (ANDERSS.) R. W. HOLM, *Lippia rosmarinifolia, Cacabus miersii, Borreria suberecta, Baccharis gnidiifolia, Bidens ri-*

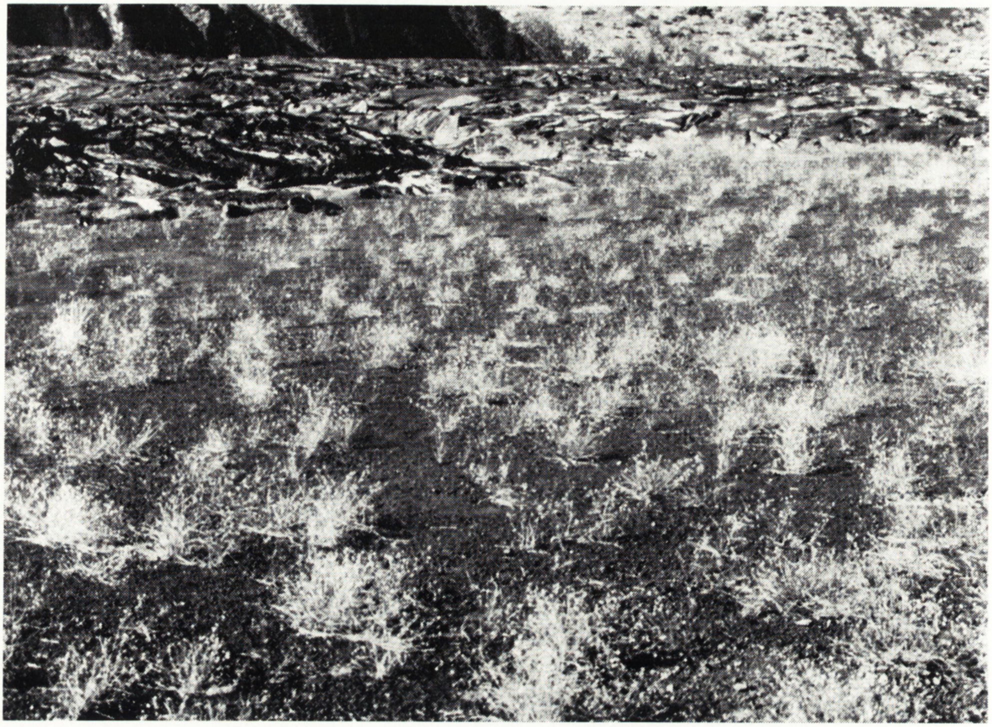

Fig. 9. *Mollugo snodgrassii* on lava gravel at the south-western foot of the tufa cone on the floor of the caldera. In the background is petrified lava. The altitude is 670 m. Photo: U. E. 25.III. 1967.

paria H.B.K. var. *refracta* (BRANDEGEE) O. E. SCHULZ, *Darwiniothamnus lancifolius* ssp. *glandulosus, Macraea laricifolia, Pectis tenuifolia* (DC.) SCHULTZ-BIP., *Cyperus anderssonii, C. ligularis, Aristida repens* TRIN., *Cenchrus platyacanthus* ANDERSS. and *Paspalum galapageium* CHASE.

COLINVAUX, SCHOFIELD & WIGGINS (1968) have reported 25 species of vascular plants collected by the first-named author on the tufa cone in 1966. Seven species reported by them were not noted by me, viz. *Drymaria cordata** (L.) WILLD., *Cassia occidentalis* L., *Phaseolus mollis* HOOK. f., *Tournefortia pubescens, Aristida subspicata, Setaria setosa* (SW.) BEAUV. and *Trichoneura lindleyana*.

After the eruption Mr. ROGER PERRY visited the caldera in November 1968 and in March 1970. On his first visit he observed no plants in the crater, except a few ones remaining on the very upper slopes. On the second occasion he collected ten plant species and observed another five which were then re-establishing after the eruption. Mr. PERRY kindly sent me the collected plants, all of which had been taken around the base of the old central cone. These plants were *Mollugo snodgrassii, Cassia picta, Crotalaria pumila, Acalypha parvula, Chamaesyce punctulata, Sida spinosa* L., *Cacabus miersii, Lycopersicon cheesmanii* forma *minor* MULLER and *Aristida repens*. Mr. PERRY also noted *Waltheria ovata, Lippia rosmarinifolia, Solanum erianthum, Darwiniothamnus lancifolius* ssp. *glandulosus* and *Cyperus anderssonii*. *Cacabus miersii* was found to form quite extensive patches around parts of the

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* The occurrence of *Drymaria cordata* in this locality seems most unlikely. I cannot help but suspect that this plant was confused with *D. rotundifolia*.

Fig. 10. The south-western part of the tufa cone seen from the western part of the floor of the caldera, alt. 670 m. In the foreground are *Aristida subspicata* and shrubs of *Waltheria ovata*. Photo: U. E. 25.III. 1967.

base of the cone and on the less steep talus slopes of the walls of the caldera (PERRY in litt.).

FLORISTIC RELATIONS BETWEEN FERNANDINA AND ISABELA

The short distance between Fernandina and Isabela, the similar petrology, and the similar altitudinal conditions make these two islands closely associated also in floristic respects. Eight endemic Galápagos taxa seem restricted to these two islands, viz. *Mollugo snodgrassii, Froelichia nudicaulis* ssp. *lanigera, Jasminocereus thouarsii* var. *sclerocarpus, Opuntia insularis, Darwiniothamnus lancifolius* ssp. *glandulosus, Scalesia affinis* ssp. *gummifera, S. microcephala* and *Pennisetum pauperum* NEES ex STEUD.

Mollugo snodgrassii inhabits relatively fresh lava fields as well as lava gravel from near sea level up to an altitude of 1600 m (Volcán Wolf). On Isabela it has been collected at low altitudes in numerous localities, and at high elevations on Volcán Wolf (at 1600 m), V. Darwin (at 1200 m), V. Santo Tomás (=Sierra Negra) (at 930 m) and Cerro Azul (at 1530 m).

CHRISTOPHERSEN (1932 p. 75) described *M. snodgrassii* var. *santacruziana* from Santa Cruz in the Galápagos archipelago. This taxon has since been regarded as a distinct subspecies of *M. floriana* (ELIASSON 1970 a p. 266).

Froelichia nudicaulis ssp. *lanigera* is generally found on fresh lava. Although it may be found at low elevations, it is much more common at higher altitudes where it may sometimes form a dense growth on otherwise barren lava. On Isabela it has been collected on Volcán Wolf, V. Darwin and V. Alcedo. It has hitherto not been collected above 1200 m elevation (collected at this altitude on V. Darwin).

Jasminocereus thouarsii var. *sclerocarpus* grows from near sea level up to at least 1120 m (V. Darwin). Isolated specimens are sometimes found on otherwise barren lava on Fernandina and on the north-eastern slope of Volcán Wolf on Isabela. On Isabela I have noted it on V. Wolf (up to an altitude of more than 800 m where it can be found bearing epiphytically growing *Tillandsia insularis* MEZ), V. Darwin (up to 1120 m), V. Alcedo (on the floor of the caldera, alt. ca. 750 m), and near sea level in the vicinity of Villamil.

Opuntia insularis grows from near sea level up to at least 1600 m elevation (Volcán Wolf). It is a characteristic element in the vegetation of the crater rim of Fernandina as well as of the rims of V. Wolf, V. Darwin and V. Alcedo on Isabela.

Darwiniothamnus lancifolius ssp. *glandulosus* grows on weathered lava at elevations between 150 m and 1200 m. On Isabela it is known from V. Wolf, V. Darwin and V. Alcedo.

Scalesia affinis ssp. *gummifera* occurs as scattered specimens or small groups from near sea level up to ca. 1000 m elevation (Fernandina). On Isabela it is known at low levels from at least Villamil in the south to Punta Albemarle in the north. On the western slope of Volcán Darwin it extends to between 400 and 500 m elevation, and on the north-eastern slope of V. Alcedo to about 300 m elevation.

Scalesia microcephala is the most important species in the caldera rim forests on Fernandina as well as on Volcán Wolf, V. Darwin and V. Alcedo on Isabela. It extends to heights above 1600 m on V. Wolf. On the north-eastern side of V. Alcedo it occurs from the rim down to about 700 m. South of Istmo Perry on Isabela it is replaced by *S. cordata* STEWART, but the delimitation of these two taxa needs further research.

Pennisetum pauperum is known only from high elevations in lava and cinder beds on Fernandina and Isabela (REEDER & REEDER 1971 p. 876).

Of non-endemic species only three seem to have been found on both Fernandina and Isabela but, so far, not on other islands in the archipelago. These species are *Drymaria rotundifolia, Calceolaria meistantha* and *Duranta repens.* The first-named plant grows in open patches on cinders and weathered lava at elevations above 1100 m. On Isabela it has been collected on Volcán Wolf (at 1600 m), V. Darwin (at 1180—1220 m) and Cerro Azul (at 1300—1350 m). Outside Fernandina *Calceolaria meistantha* has been found only on Cerro Azul on Isabela at 960 and 1530 m elevation (ELIASSON 1968 p. 245). *Duranta repens* forms a constituent of the shrubby vegetation at about 1350 m elevation on Fernandina and at ca. 1200 and ca. 1100 m altitude on Volcán Darwin and V. Alcedo respectively on Isabela. More non-endemic species common only to Fernandina and Isabela may probably be found when these islands have been better explored. Many species to-day known only from Isabela may be expected to occur on Fernandina as well.

ACKNOWLEDGEMENTS

Mr. ROGER PERRY, at that time the Head of the Charles Darwin Research Station, Dr. IAN THORNTON, now Professor of Zoology at La Trobe University, Australia, and Mr. CALAPUCHO, of the Yumbo tribe, Ecuador, were my companions on the visit to the Fernandina caldera in March 1967. Mr. PERRY's great experience from earlier visits to Fernandina greatly facilitated our climb. I am indebted to him also for some plants collected in the caldera two years after the eruption. Professor THORNTON kindly read the manuscript and checked the English. My collections of grasses from Fernandina as well as from other islands in the Galápagos were determined by Professor JOHN REEDER and Mrs. CHARLOTTE REEDER, Department of Botany, University of Wyoming, U.S.A.

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Four Species of Allium sect. Allium in Greece

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ABSTRACT

BOTHMER, R. VON 1972. Four species of Allium sect. Allium in Greece. — Bot. Notiser 125: 62—76.

The morphological variation in the species *Allium rotundum* L., *A. sphaerocephalum* L., *A. chamaespathum* BOISS., and *A. amethystinum* TAUSCH is described. The two last-mentioned species are typified. *A. amethystinum* TAUSCH is suggested as the correct name for *A. descendens* L., which has been declared a nomen ambiguum.

INTRODUCTION

When studying the *Allium ampeloprasum* complex in Greece I had to consider the incorrectly determined herbarium material, and hence all more or less tall-grown, red- or white-flowered species of *Allium* sect. *Allium* in the area had to be included in the investigation. The morphological variation within *A. sphaerocephalum* L., *A. amethystinum* TAUSCH, and *A. chamaespathum* BOISS. was studied. These species differ from the *A. ampeloprasum* complex, for example in having fistulose, more or less canaliculate leaves. Though only distantly related and morphologically dissimilar, *A. rotundum* L. is also included.

Principal discussions about morphological characters and systematic positions of species in sect. *Allium* in Greece will be published later.

MATERIAL

Living material has been collected by the author and colleagues from Lund during journeys in Greece from 1958 to 1970, and has been cultivated in the Botanical Garden, Lund. Material from the following herbaria has been studied: BM, C, DR, E, G, GB, JE, K, LD, LY, M, S, TO, W, WU. The abbreviations are in accordance with the "Index Herbariorum" (LANJOUW & STAFLEU 1964).

KEY TO SPECIES TREATED

1.	Leaves flat, more or less carinate	2
	Leaves fistulose, more or less canaliculate	3
2.	Bulbils dark red to almost black, leaf margin smooth or with sparse, irregular teeth	*A. rotundum*
	Bulbils yellowish brown to dark brown, leaf margin with dense, regular teeth	*A. ampeloprasum* complex
3.	Spathe 2—4(—5)-valvate, shortly acute, persistent	*A. sphaerocephalum*
	Spathe univalvate, deciduous	4
4.	Leaf sheathing the scape up to the inflorescence	*A. chamaespathum*
	Leaf sheathing up to about 1/2 of the scape	*A. amethystinum*

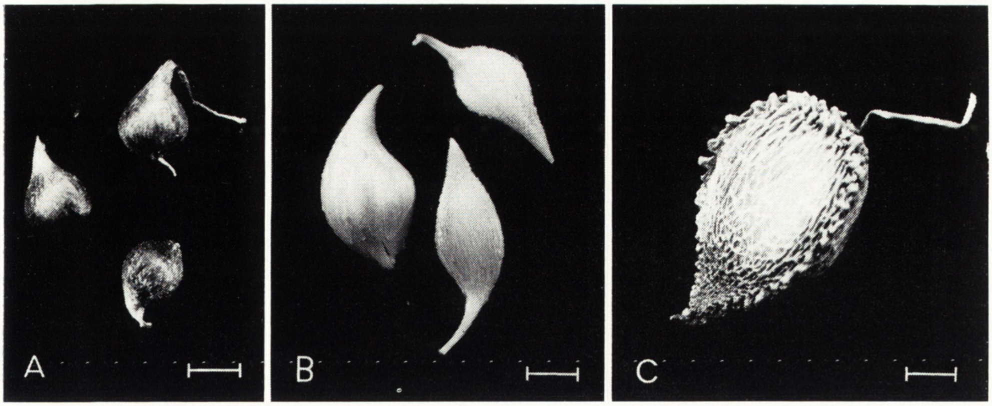

Fig. 1. Bulbils from A: *Allium rotundum* L. — B: *A. sphaerocephalum* L. — C: *A. amethystinum* Tausch. — The scale units given are equal to 0.5 cm.

TAXONOMY

Allium rotundum L.

Linnaeus 1762 p. 423.

A. porphyroprasum Heldr. & Sart.; Heldreich 1898 p. 394.

Habit: (21—)25—75(—91) cm tall, leaf sheath covering 1/2—1/5 of the scape. — *Main bulb* rounded, rarely ovoid, (0.5—) 0.7—1.8(—2.3) cm in diameter, bulb coats dark red or rarely dark brown, outer sheaths usually fibrous. — *Bulbils* 0—6 (—18), situated on or rarely up to 3.2(—4.1) cm above the main bulb, 4.0—10.3 mm long and 3.1—8.2 mm broad, varying in shape, rounded to semi-circular in transverse section, apex somewhat exserted (Fig. 1 A); one dark red coat. — *Leaves* 2—5(—9) per flowering stem, flattened, indistinctly carinate; uppermost leaf 8—21(—33) cm long, 0.2—0.7(—1.0) cm broad; second leaf 9—23(—?) cm long, 0.3—0.8(—1.0) cm broad. Lower leaf sheaths sometimes fibrous. — *Inflorescence* usually spherical, rarely ovoid, 1.0—4.5(—5.0) cm in diameter (Fig. 2 A). — *Spathe* deciduous, only occasionally observed in the material collected. — *Flowers* pink to red. — *Outer tepals* 4.2—6.1(—7.5) mm long, (1.2—)1.4—2.5(—2.8) mm broad, broadest at about the middle; apex obtuse (Fig. 3 F, G). Abaxial surface with small and sometimes also with large papillae. — *Inner tepals* (3.8—) 4.2—6.4(—6.9) mm long, (1.7—)2.0—3.2 (—3.6) mm broad, usually clawed; apex obtuse to truncate (Fig. 3 F, G). Abaxial surface rather sparsely covered with small papillae. — *Stamens* (2.4—)2.6—4.7(—5.2) mm long, always shorter than the tepals (sometimes lateral appendages of the inner stamens extending), inner stamens usually somewhat longer than the outer ones (Fig. 3 F, G). Outer stamens basally more or less sparsely covered with lateral papillae. Inner stamens tricuspidate, flat part of the filament about 2/3 of the length of the whole stamen; lateral appendages 1.6—2.8(—3.2) mm long. — *Pistil* (2.4—)2.8—4.5(—5.0) mm long. — *Capsule* 2.0—3.5 mm in diameter, the valves rounded. — *Seeds* 2.2—3.1 mm long, 1.1—1.8 mm broad, triquetrous in transverse section.

A. rotundum is best characterized by the dark red bulbs and bulbils, the stamens shorter than the tepals, and the very broad inner tepals.

DISTRIBUTION: Central and southern Europe, Asia Minor, northern Iran. Distribution in Greece shown in Fig. 4.

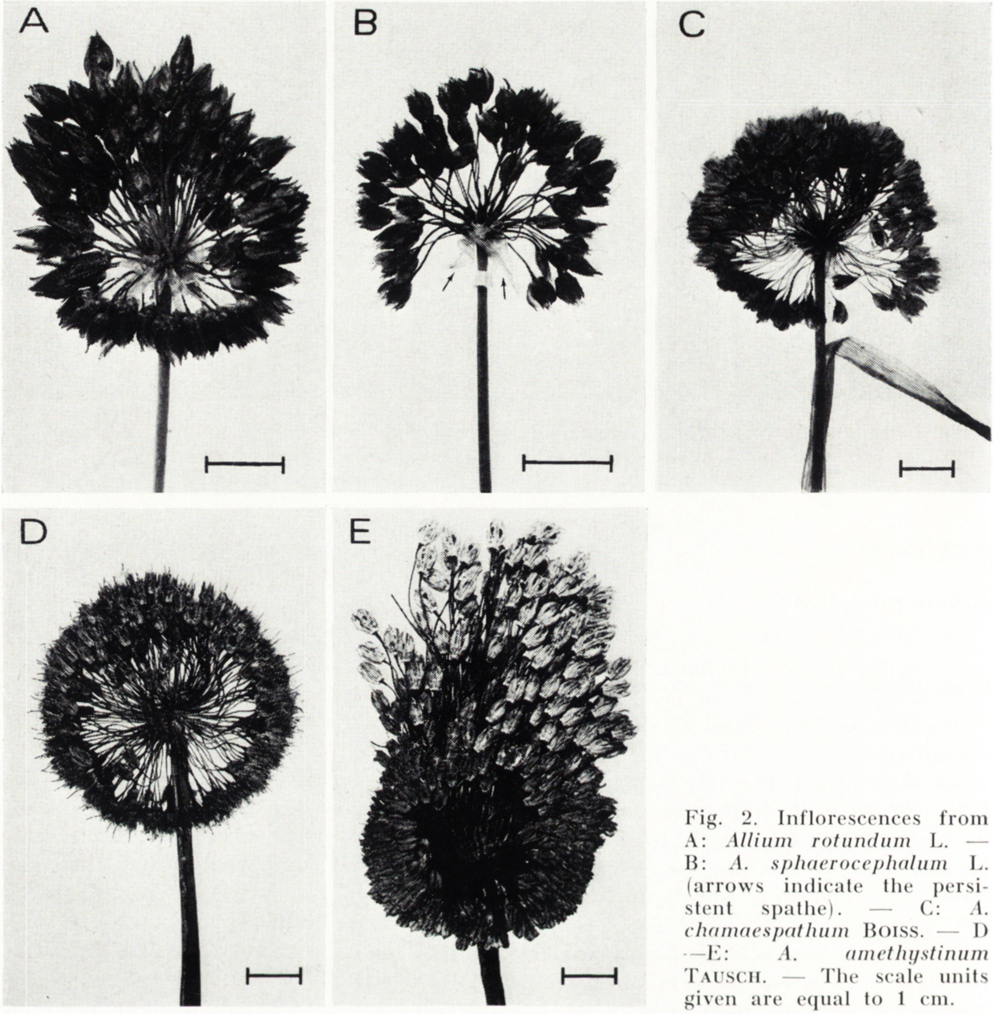

Fig. 2. Inflorescences from A: *Allium rotundum* L. — B: *A. sphaerocephalum* L. (arrows indicate the persistent spathe). — C: *A. chamaespathum* Boiss. — D —E: *A. amethystinum* Tausch. — The scale units given are equal to 1 cm.

ECOLOGY: Montane, rarely weedy.

FLOWERING PERIOD: May—July.

VARIATION. According to Vvedensky (1935), *A. rotundum* varies widely in the Caucasus and Crimea areas, especially in the shape and colour of the tepals, and a separate species is described (*A. jajlae* Vved.). Material from these areas is in need of more detailed study.

In Greece the species is rather constant with only some variation in size characters (stem height and inflorescence diameter). Plants both with and without fibrous leaf sheaths occur.

Allium sphaerocephalum L.

Linnaeus 1753 p. 297.

The description below is based on material from the whole range of distribution of the species. *A. sphaerocephalum* shows considerable morphological variation in

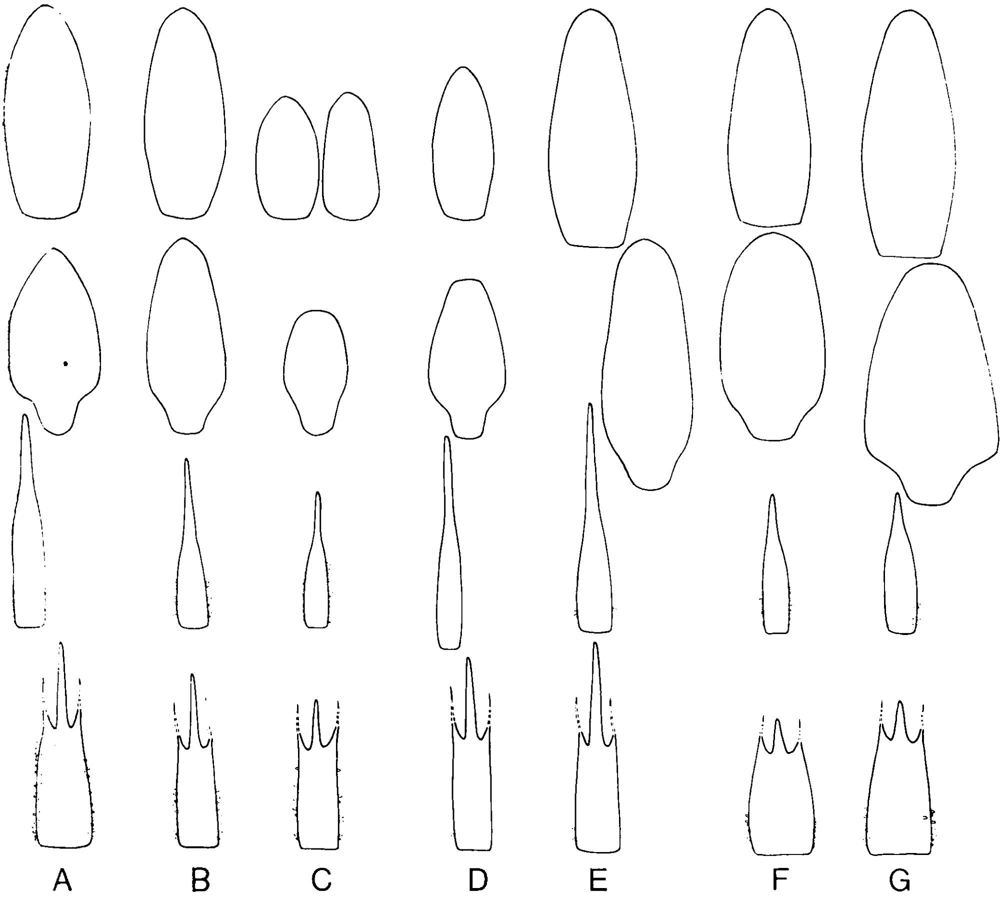

Fig. 3. Shapes of tepals and stamens in A—E: *Allium sphaerocephalum* L. — F—G: *A. rotundum* L. — Upper row: Outer tepals. — Second row: Inner tepals. — Third row: Filaments of outer stamens. — Fourth row: Filaments of inner stamens. — A: Amorgos, Greece (BOTHMER no. 491, LD). — B: Palermo, Sicily (ROSS 1904, LD). — C: Korinthos, Greece (BOTHMER no. 63, LD). — D: Piliscaba, Hungary (FILARSZKY no. 793, LD). — E: Wallis, Switzerland (SIMON 24.7. 1936, LD). — F: Neusiedler See, Hungary (KREBS 12.6. 1895, LD). — G: Kythraea, Cyprus (SINTENIS Mai 1880, LD). — Approx. ×6.

both size and shape of several organs, and many taxa have been described (see REGEL 1875, RICHTER 1890, and ASCHERSON & GRAEBNER 1905—1907).

Habit: (20—)30—90(—115) cm tall, leaf sheaths covering 1/2—1/3(—1/4) of the scape. — *Main bulb* ovoid, 0.4—2.2 cm in diameter, with vellum-like or rarely fibrous tunics. — *Bulbils* 0—3(—11), situated on or up to 2.0(—8.5) cm above the main bulb, 0.5—1.8(—2.3) cm long, acuminate, lanceolate, with one pale yellow, rough or smooth coat (Fig. 1 B). — *Leaves* (1—)2—5(—7) per flowering stem, usually withered, fistulose, cylindrical or somewhat canaliculate and then with a scabrous margin. Uppermost leaf 10—30 cm long, 1—4 mm broad. — *Inflorescence* spherical or somewhat elongate, (0.8—)1.3—5.0(—6.4) cm in dia-

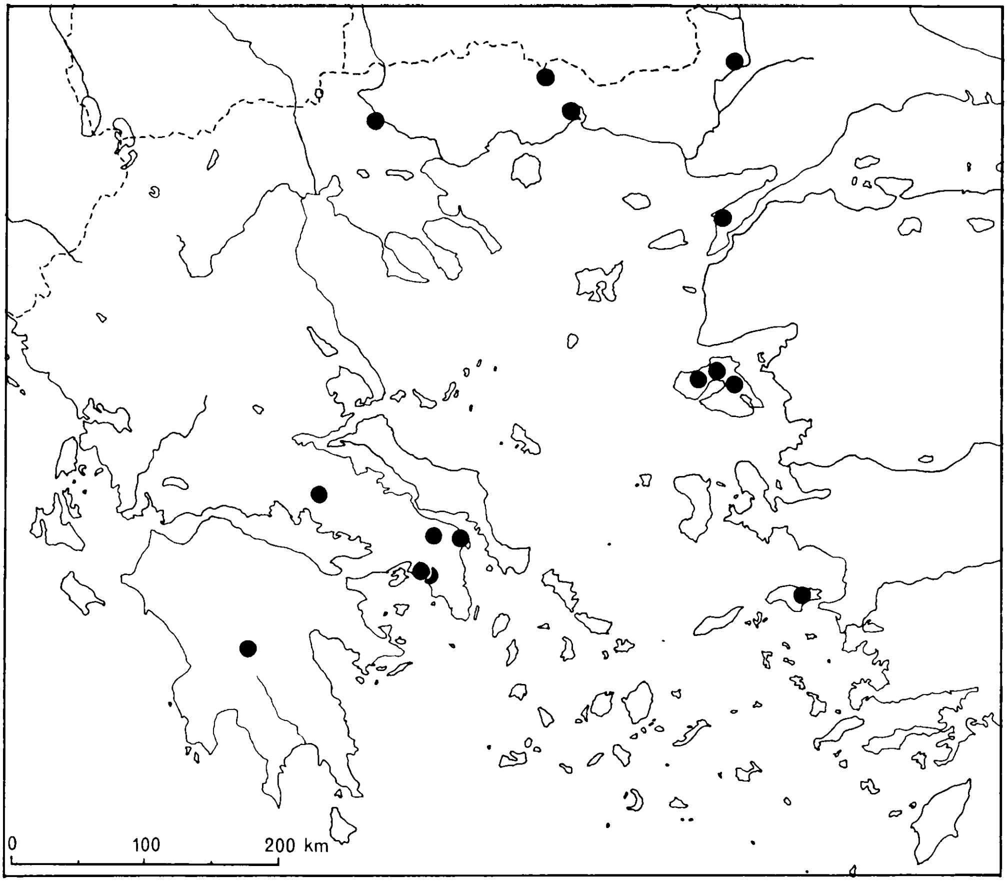

Fig. 4. *Allium rotundum* L. Distribution in Greece.

meter (Fig. 2 B). — *Spathe* persistent, 2—4(—5)-valvate, valves 0.5—2.0(—2.5) cm long (Fig. 2 B). — *Flowers* rose-coloured or purple, sometimes white. — *Outer tepals* (2.6—)3.5—5.5(—6.2) mm long, 1.2—2.3 mm broad, equalling the inner stamens or sometimes slightly shorter, broadest at or somewhat below the middle; apex obtuse (Fig. 3 A—E). Abaxial surface more or less densely covered with large and/or small papillae, rarely smooth (Fig. 7). — *Inner tepals* (2.6—)3.5—5.5(—6.2) mm long, 1.5—2.6 mm broad, widely varying in shape, sometimes ovate but usually clawed (c. 1 mm); apex truncate to obtuse, rarely sub-acute (Fig. 3 A—E). Abaxial surface more or less densely covered with large and/or small papillae, sometimes smooth. — *Stamens* (3.0—)3.5—5.5(—6.2) mm long, the two whorls equal in size and usually longer than the tepals, rarely of the same length or somewhat shorter (Fig. 3 A—E). Outer stamens with sparse, lateral papillae on lower half of the flat part of the filament; lateral appendages rarely frequent. Inner stamens tricuspidate, flat part of the filament 1/2—2/3 of the length of the stamen, lateral papillae more or less dense; lateral appendages 1.5—3.0(—4.0)

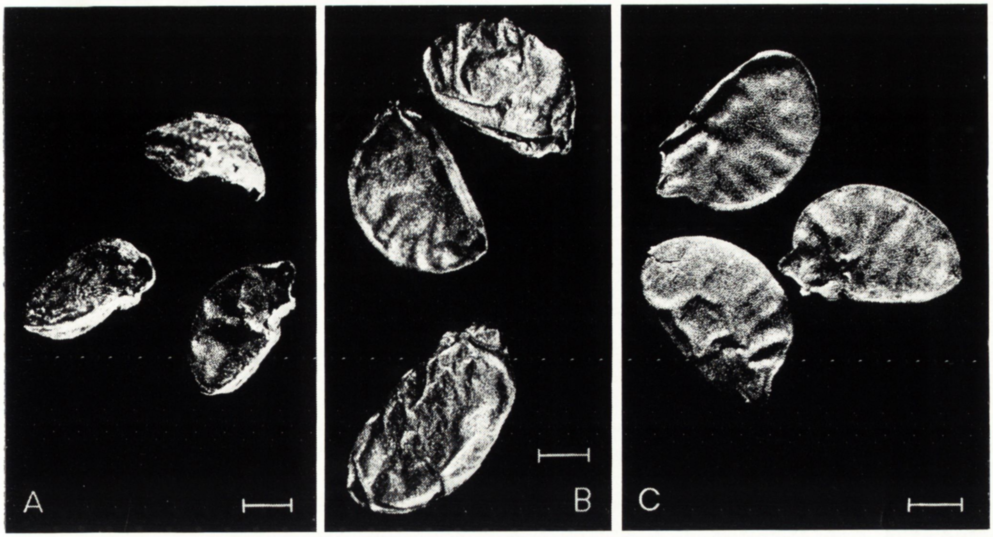

Fig. 5. Seeds from A: *Allium sphaerocephalum* L. — B: *A. chamaespathum* BOISS. — C: *A. amethystinum* TAUSCH. — The scale units given are equal to 1 mm.

mm long. — *Pistil* (3.4—)4.0—7.5(—8.1) mm long. — *Capsule* 2.0—3.0 mm in diameter, the valves rounded. — *Seeds* (1.8—)2.0—3.2(—3.4) mm long, 0.9—1.9 (—2.1) mm broad, triquetrous in transection (Fig. 5 A).

A. sphaerocephalum is extremely variable. Main characteristics are the persistent, 2—4-valvate spathe, pale yellow bulbils, which are attenuated at both ends and acuminate at apex, and the usually clawed inner tepals (the latter character is also found in *A. rotundum*).

DISTRIBUTION: Central and southern Europe, the Mediterranean, Asia Minor and the Middle East. In the latter area the species is rare and some earlier reports are dubious (cf. FEINBRUN 1943).

ECOLOGY: Dry limestone and sandstone cliffs or rocky slopes and gravel, rarely a weed or in sand dunes.

FLOWERING PERIOD: June—August.

VARIATION: The great variation and division upon several form series makes *A. sphaerocephalum* a complicated aggregate. The appropriate rank of the form series is at present uncertain. The complex is in need of more careful revision both concerning morphological variation and nomenclature, preferably using material in cultivation taken from the whole distribution area. The present treatment is preliminary and taxonomic rank is not given to the different types recognized in Greece. These are three or possibly four in number (cf. Fig. 6):

1. *arvense* type (cf. *A. arvense* GUSS.; GUSSONE 1827 p. 403). Flowers usually white, with large tepals (Fig. 3 A—B) and lacking papillae on tepals and pedicels The type occurs on the Kikladhes, one population also found on SE Peloponnisos. The morphology of the Greek collections agrees well with material from southern Italy. *A. aegaeum* HELDR. & HALÁCSY belongs to this form series.

2. *trachypus* type (cf. *A. trachypus* BOISS. & SPRUN.; BOISSIER 1846 p. 114; *A. sphaerocephalum* γ *trachypus* BOISS.; BOISSIER 1884 p. 236). Flowers intensely

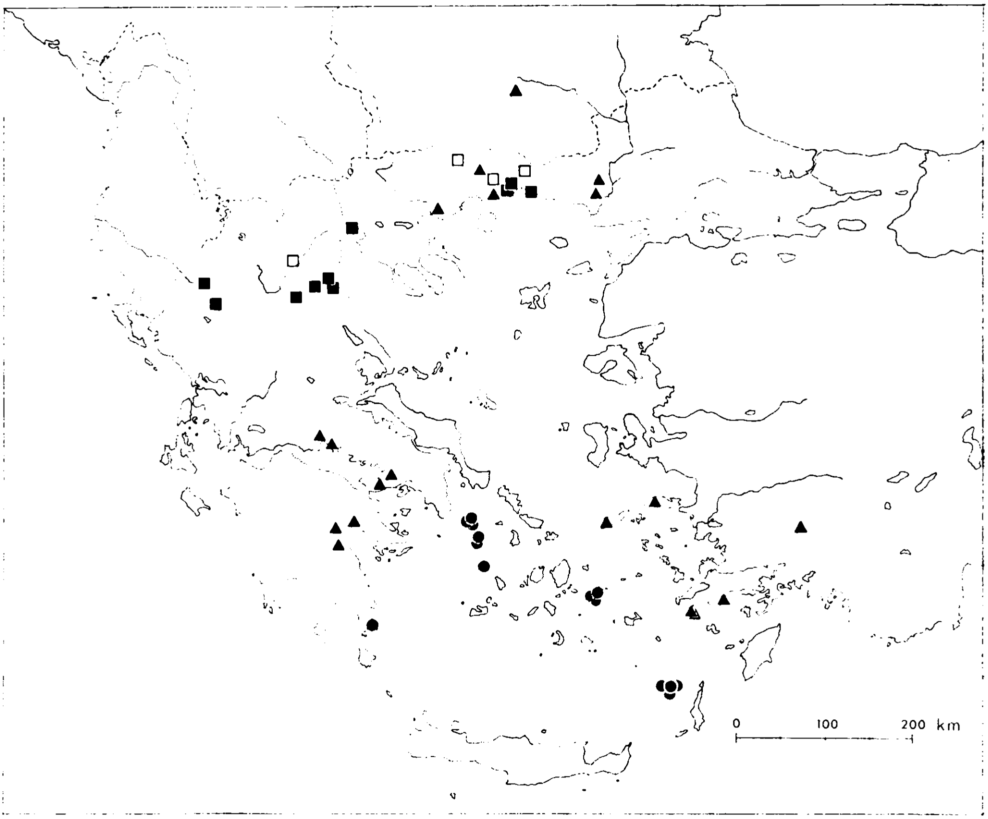

Fig. 6. *Allium sphaerocephalum* L. Distribution in Greece; ● *arvense* type, ▲ *trachypus* type, ■ *sphaerocephalum* type, □ intermediates between *trachypus* and *sphaerocephalum* types. The special type found on Amorgos (Kikladhes) is here referred to the *arvense* type.

red, sometimes purple, usually with small tepals (Fig. 3 C), pedicels and tepals densely covered with small papillae (Fig. 7 C). The type is distributed on Peloponnisos, Attica, western Thrace, western Turkey and on the eastern Aegean islands.

3. *sphaerocephalum* type. Flowers pink or red, with tepals of varying size (Fig. 3 D, E), and with large, sparse papillae on tepals but usually lacking papillae on pedicels (Fig. 7 A). This type occurs in northern Greece and eastern Thessaly and resembles material from central Europe.

In areas where *trachypus* and *sphaerocephalum* types meet intermediate specimens occur having both small and large papillae on the tepals, and with some papillae on the pedicels (Fig. 7 B).

Amorgos type. All collected material (five populations) from the island of Amorgos (Kikladhes) has tepals with very small papillae, which differ from the type common in the *trachypus* form series.

Allium chamaespathum Boiss.

Boissier 1846 p. 113. — Orig. coll.: Margot, Hab. in insula Zacyntho (apparently in G, but on loan elsewhere).

Habit: (10—)20—45(—61) cm tall. — *Main bulb* ovoid, 1.8—2.6 cm in diam.,

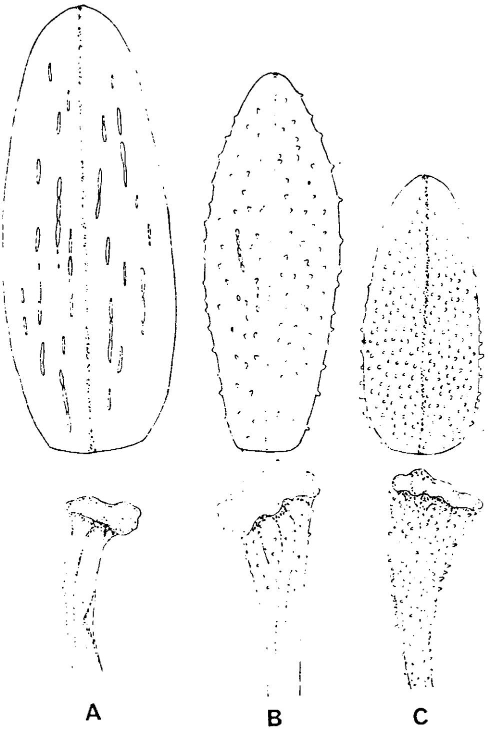

Fig. 7. *Allium sphaerocephalum* L. Outer tepals and pedicels. — A: *sphaerocephalum* type. — B: Intermediate between *sphaerocephalum* and *trachypus* types. — C: *trachypus* type. — Approx. ×10.

with some layers of white, vellum-like tunics. — *Bulbils* not observed in the material collected. — *Leaves* 2—3 per flowering stem, almost withered, fistulose, canaliculate, with conspicuous nerves, the uppermost just below the inflorescence (Fig. 2 C). The distance from the second to the uppermost leaf (9—)11—22(—28) cm. The transition between leaf and leaf sheath markedly thickened. — *Inflorescence* spherical or semi-spherical, (2.4—) 3.0—4.5 cm in diameter (Fig. 2 C). — *Spathe* 2.5—4.5 cm long, univalvate, deciduous, or often wedged into and remaining within uppermost leaf (Fig. 8 B). — *Flowers* cylindrical, white to greenish with dark green nerves. — *Outer tepals* (3.5—)3.9—4.7(—5.1) mm long, 1.3—1.8 mm broad, usually shorter than the inner tepals, broadest at or somewhat above the middle, sometimes of uniform breadth; apex obtuse to truncate (Fig. 9). Abaxial surface with low ridges. — *Inner tepals* 3.9—5.1 mm long, 1.3—1.6 mm broad, spathulate; apex truncate or emarginate (Fig. 9). Abaxial surface with low ridges. — *Stamens* 4.0—5.2(—5.5) mm long, the two whorls equal in size and of about the same size as the inner tepals (Fig. 9). Outer stamens somewhat varying in breadth, basally or up to the middle of the flat part of the filament more or less densely covered with small papillae. Inner stamens tricuspidate, flat part of the filament about half as long as the whole stamen or slightly longer; lateral appendages (1.0—)1.5—2.5 mm long. — *Pistil* (4.9—)5.2—6.3(—7.5) mm long. — *Capsule* 4.0—4.8(—5.2) mm in diameter, with characteristic rounded cusp, the valves rounded (Fig. 12 D). — *Seeds* 3.2—4.3 mm long, 1.8—2.3(—2.5) mm broad, flat (Fig. 5 B).

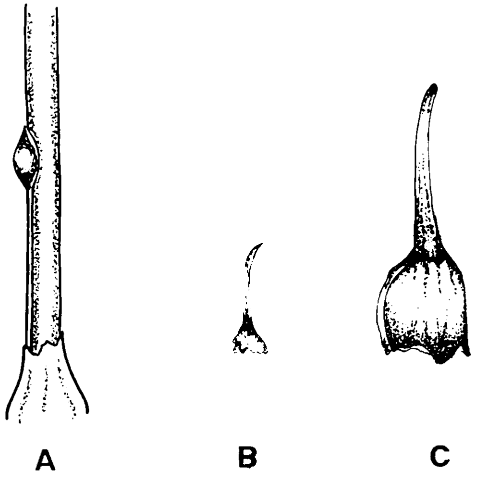

Fig. 8. A: *Allium amethystinum* TAUSCH, bulbil upgrown on the scape (tunics removed). — B: Spathe of *A. chamaespathum* BOISS. — C: Spathe of *A. amethystinum* TAUSCH. — Half natural size.

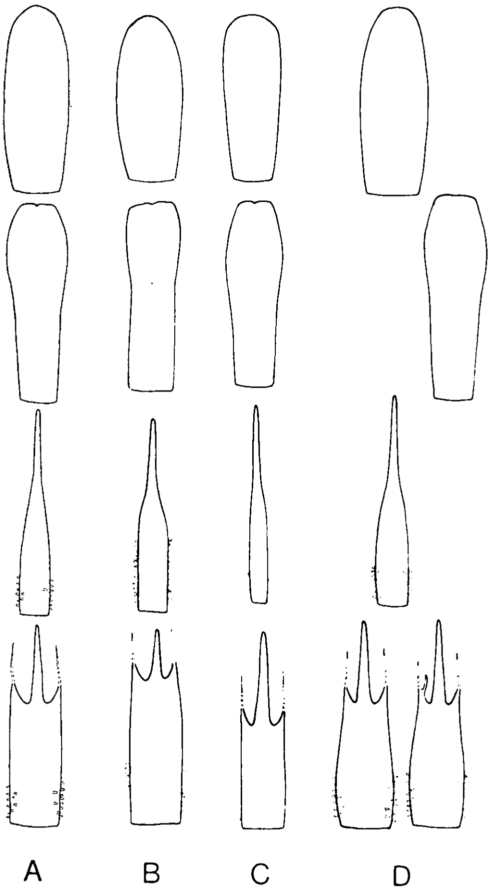

Fig. 9. *Allium chamaespathum* BOISS. Shapes of tepals and stamens. — Upper row: Outer tepals. — Second row: Inner tepals. — Third row: Filaments of outer stamens. — Fourth row: Filaments of inner stamens. — A: Parnes, Greece (GUIOL no. 293, BM). — B: Lycabettos, Greece (HELDREICH no. 1196, LD). — C: Gazi, Crete (GREUTER no. 7580, LD). — D: Vallona, Albania (HANNIBAL Sept. 1903, BM). — Approx. ×6.

A. chamaespathum is best characterized by the leaves sheathing the flowering stem up to the inflorescence, and a small spathe, which is usually covered by the uppermost leaf. Inner tepals are spathulate and truncate or emarginate. The tepals lack papillae, but have a system of low, longitudinal ridges (cf. *A. amethystinum*). The seeds are flat.

DISTRIBUTION (map in Fig. 10): The Balkan Peninsula and on Crete. From the limited material available the species could be rare throughout the range of distribution, but the late time of flowering may account for this as very few botanists have collected in this area during the autumn.

ECOLOGY: Rocky limestone slopes.

FLOWERING PERIOD: September—October.

VARIATION: The species is distinct with very little morphological variation. One collection (Lycabettos, Attica, HELDREICH no. 1196) differs in that the flat part of the inner filament is c. 3/4 of the length of the whole stamen (in other collections the ratio is 1/2—2/3, Fig. 9).

Allium amethystinum TAUSCH

TAUSCH 1828 p. 256. — Orig. coll.: Herb. TAUSCH, ε Dalmatia (PRC lectotype).

A. segetum JAN ex J. A. & J. H. SCHULTES; JAN ex J. A. & J. H. SCHULTES in ROEMER & SCHULTES 1830 p. 1020. — Orig. coll.: Not seen, inquired for unsuccessfully in B, BM, GE, K, M, RO.

?*A. eminens* GREN.; GRENIER 1833 (not seen, cited in GRENIER & GODRON 1855 as a synonym of *A. descendens* L.).

A. rollii TERR; TERRACCIANO 1889 p. 289. — Orig. coll.: Not seen, inquired for unsuccessfully in BM, GE, NAP, RO.

A. descendens L.; LINNAEUS 1753 p. 298, nom. ambig. (KOLLMANN 1970).

A. segetale JAN; JAN 1827 p. 25, nom. nud. (KOLLMANN 1971).

The Linnaean name for this taxon, i.e. *A. descendens,* was by KOLLMANN (1970) declared as a nomen ambiguum. Later on (1971) she suggested *A. segetum* JAN ex SCHULTES (1830) as the correct name. However, *A. amethystinum* TAUSCH antedates this and has priority. The type material (in PRC) of the latter name is well preserved and easily identifiable.

Habit: (32—)50—110(—124) cm tall, scape usually rose or red. — *Main bulb*

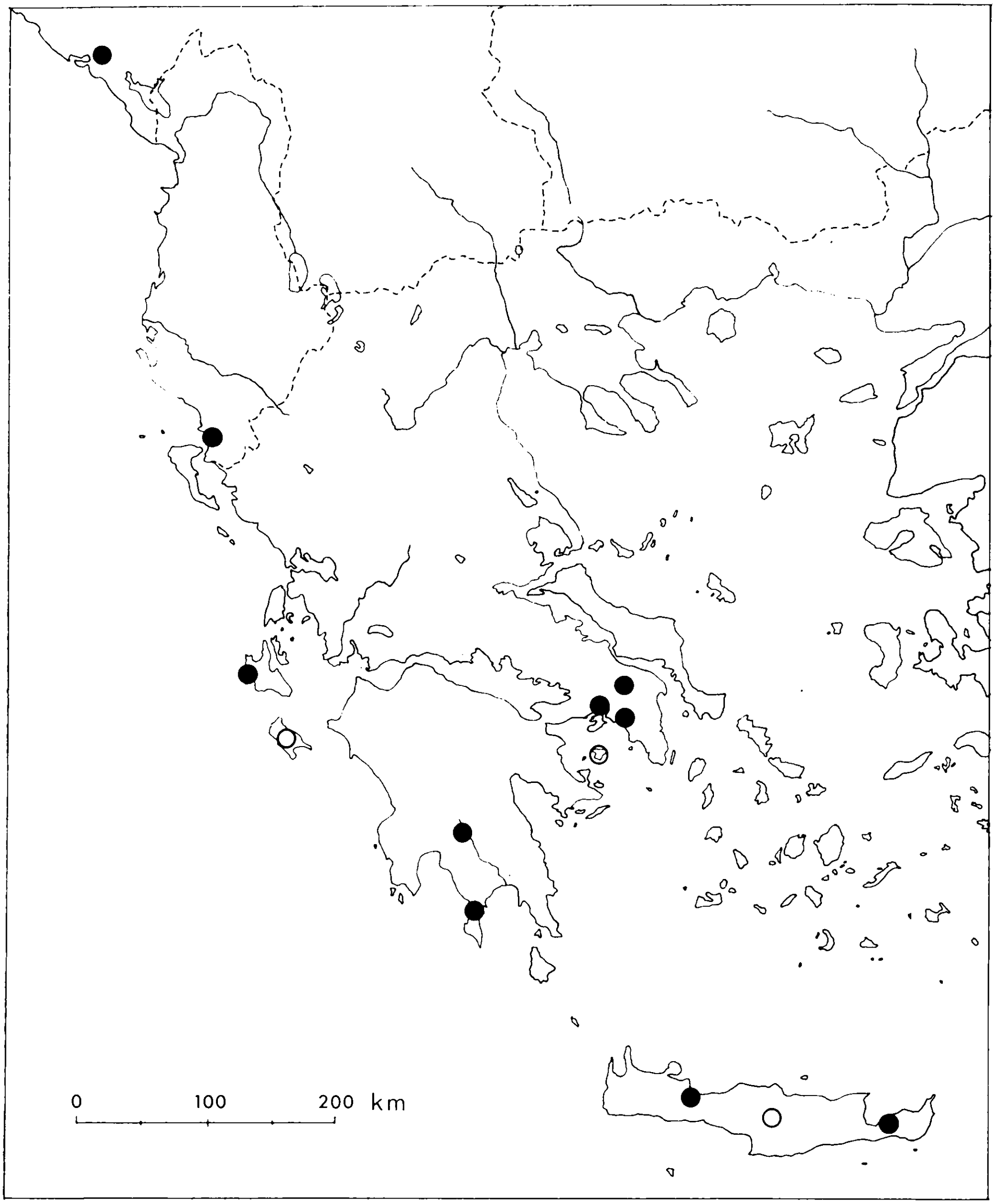

Fig. 10. *Allium chamaespathum* Boiss. Total distribution (○ literature reports).

spherical, with several layers of white, vellum-like tunics with sparse nerves; outermost bulb coat thick, white with a rough, plicated surface. — *Bulbils* usually lacking, if present 1—4 per specimen, 1—2.5 cm long, greyish yellow, with a reticulate surface and a single, thin bulb coat (Fig. 1 C); situated on the scape 3—5 cm above the main bulb and connected with this by a "stipe" (Fig. 8 A). — *Leaves* (3—)4—5 per flowering stem, withered, fistulose, 0.2—0.8 cm broad, canaliculate, usually carinate (see KOLLMANN 1971, Fig. 2 e), edges with sparse, small teeth. — *Inflorescence* spherical, 2.5—6.6 cm in diameter; pedicels of central flowers in fruiting stage usually elongated to about twice the length in anthesis (Fig. 2 D, E). — *Spathe* 2.1—7.8 cm long, univalvate, deciduous (Fig. 8 C). — *Flowers* usually cylindrical, at first usually purple, later paler, and sometimes almost white. — *Outer tepals* (2.7—)3.1—4.6(—5.5) mm long, 0.9—1.9 mm broad, usually shorter than inner tepals (rarely of the same length), broadest at or somewhat above the middle or uniformly broad; apex obtuse to truncate, rarely acute (Fig. 11). Abaxial surface with low ridges or rarely with small papillae at the base. — *Inner tepals* (3.1—)3.5—5.3(—6.3) mm long, 0.6—1.4 mm broad, spathulate or uniformly broad; apex obtuse, truncate or emarginate (Fig. 11). Abaxial surface with low ridges. — *Stamens* (3.0—)3.4—5.3(—5.5) mm long, the two whorls equal in size and usually shorter than the inner tepals (Fig. 11). Outer stamens very narrow, basally more or less sparsely covered with lateral papillae. Inner stamens tricuspidate, flat part of filament 1/2—2/3 as long as the whole stamen, usually with sparse lateral papillae; lateral appendages (3.0—)3.5—4.5(—5.0) mm long. — *Pistil* 3.7—6.0 mm long, often red coloured. — *Capsule* valves round or cordate (Fig. 12 A—C). — *Seeds* 2.9—4.3 mm long, 1.7—2.7 mm broad, flat (Fig. 5 C).

A. amethystinum is best characterized by the narrow inner tepals, the reticulate bulbils, the white and rough outer bulb coat, and by the pedicels of the central flowers prolonging after fertilization to about double length, forming a "secondary inflorescence" in the fruiting stage (Fig. 2 E).

DISTRIBUTION (map in Fig. 13): Southern Italy, Dalmatia, Albania, Greece, western Turkey (cf. KOLLMANN 1971, Fig. 3). One report from Caucasus is probably incorrect (cf. VVEDENSKY 1935, and FEINBRUN 1943).

ECOLOGY: Usually a weed in cultivated or abandoned fields, sometimes in rocky slopes.

FLOWERING PERIOD: May—June.

VARIATION. There are large differences in the time of flowering between central and lateral flowers in the same inflorescence. When the central flowers are in bloom the lateral ones are still green buds. When the central flowers are in fruiting stage and form a "secondary inflorescence" (Fig. 2 E), the lateral ones are usually withered and reflexed. However, in material from the Dodekanese Islands and the Peninsula of Datca, Turkey, almost all flowers in the inflorescence set seed, usually without forming a "secondary inflorescence". Some specimens have been found in western Turkey which have ripe seeds in the lateral flowers when the central ones are in anthesis.

Many authors have suggested that the lateral flowers of an inflorescence are

Fig. 11. *Allium amethystinum* TAUSCH. Shapes of tepals and stamens. — Upper row: Outer tepals. — Second row: Inner tepals. — Third row: Filaments of outer stamens. — Fourth row: Filaments of inner stamens. — A: Giölbaschi, Turkey (LUSIHAN June 1882, WU). — B: Lesbos, Greece (RECHINGER no. 5928, LD). — C: Tripolis, Greece (BOTHMER no. 522, LD). — D: Palermo, Sicily (ROSS July 1909, LD). — E: Neapel, Italy (WALL 3.7. 1925, S). — F: Luma, Albania (DÖRFLER no. 654, LD). — G: Cattaro, Yugoslavia (MÜLLNER 12.6. 1898, LD). — H: Corcyra, Greece (TUNTAS no. 1685, W). — I: Sipikordagh, Turkey (SINTENIS 1890, LD). — J: Rodhos, Greece (BOTHMER no. 268, LD). — K: Ayvalic, Turkey (BOTHMER no. 315 A, LD). — L: Nisiros, Greece (BOTHMER no. 212, LD). — Approx. ×6.5.

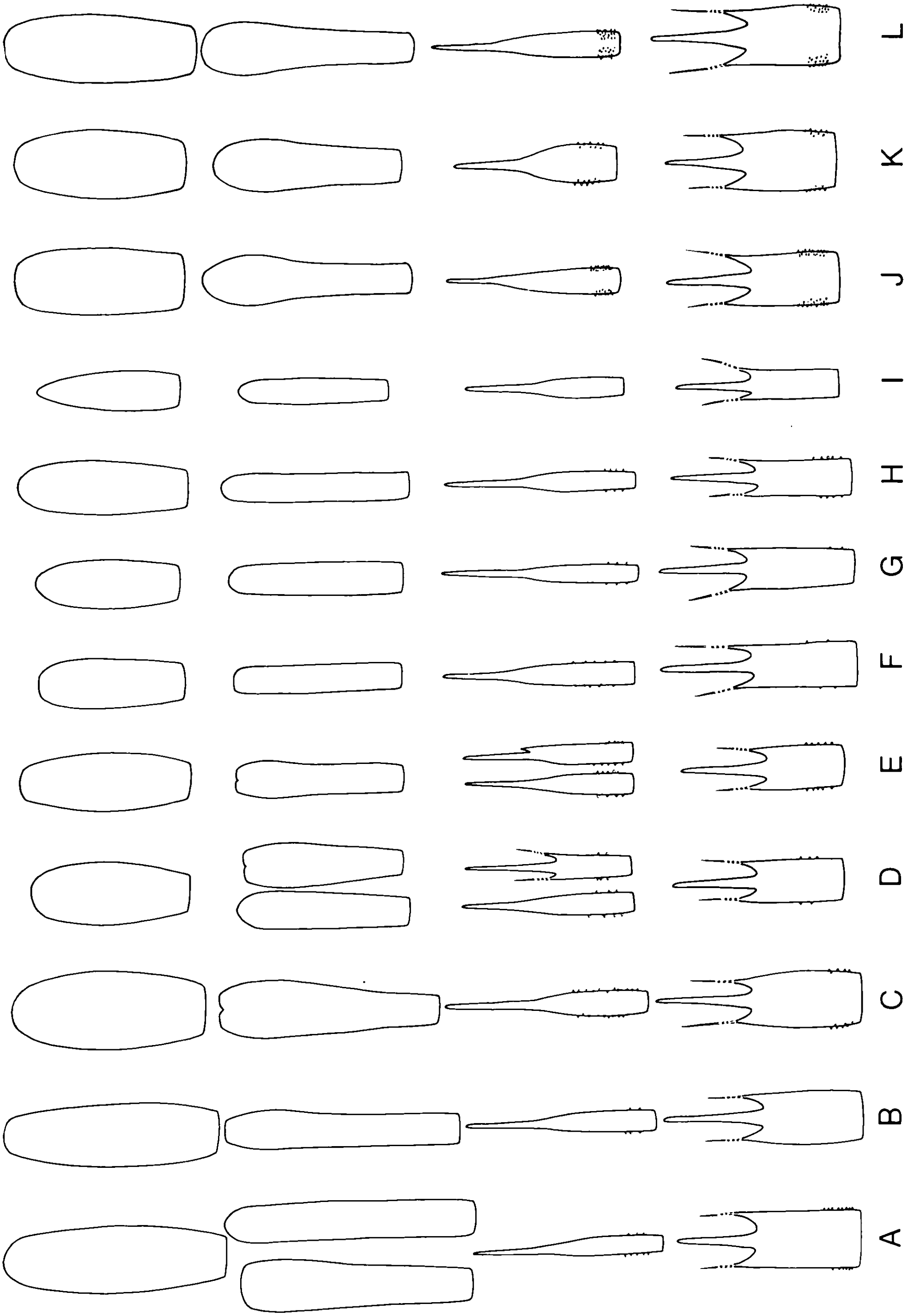

Fig. 11.

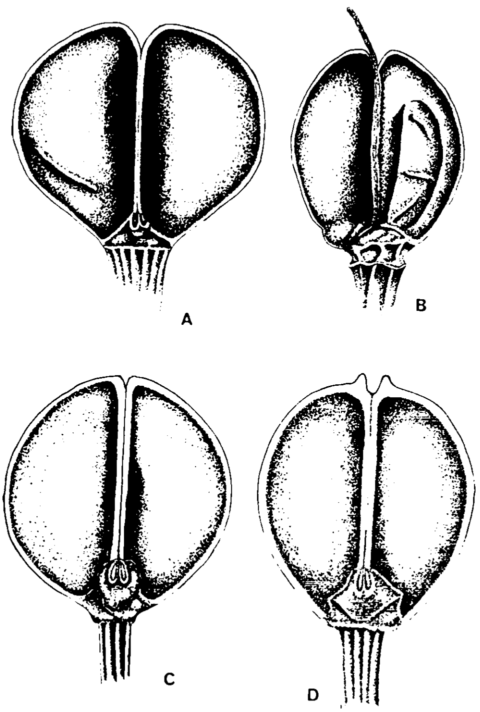

Fig. 12. Capsule valves in A—C: *Allium amethystinum* TAUSCH. — D: *A. chamaespathum* BOISS. — A: Rodhos, Greece (BOTHMER no. 55, LD). — B: Borhonyie, Turkey (BOTHMER no. 329, LD). — C: Amorgos, Greece (BOTHMER no. 498, LD). — D: Lycabettos, Greece (HELDREICH no. 1196, K). — Approx. ×6.5.

sterile (see e.g. BOISSIER 1884, and KOLLMANN 1971). This is apparently not the case, since these flowers have a normal anthesis and sometimes give rise to ripe seeds (cf. FEINBRUN 1943). In four collections the pollen stainability in lactophenol has been studied with respect to possible differences between central and lateral flowers. Five specimens from each collection were chosen and from each specimen five lateral and five central flowers were investigated. In three cases the percentage of viable pollen was very high ($\geq$ 93 %) in both central and lateral flowers. One collection, no. B 522 from Peloponnisos, with lowered pollen stainability (60 % in lateral and 72 % in central flowers) is triploid. The fact that the lateral flowers wither before seed setting may be a consequence of nutritional deficiency.

With respect to the shape of inner tepals two geographically distinct form series can be recognized, one with the tepals more or less uniformly broad (Fig. 11 F—I), distributed in Yugoslavia, Albania, on the Greek mainland and in NW Turkey, the other with the tepals spathulate. This form series occurs in Italy, where the tepals have a truncate or emarginate apex (Fig. 11 E), and in western Turkey and east Aegean Islands, where the tepals have an obtuse apex (Fig. 11 J—L).

In two collections (Palermo, ROSS no. 881, GB, LD, WU; and Giölbaschi, LUSIHAN 1882, WU) both spathulate and uniformly broad tepals occur (Fig. 11 A, D), and the material from Tripolis, Peloponnisos (my collection no. B 522) differs in having broad and spathulate inner tepals (Fig. 11 C). In the collection from Palermo, about 1.5 mm long lateral appendages on the outer stamens are found in some flowers (Fig. 11 D). Traces of lateral appendages on the outer stamens are also found in some other collections.

The shape of the capsule valves is variable and two types occur, the distribution of which, however, do not coincide with that of the two different types of inner tepals. Cordate valves occur in populations from Thessaly, Dodekanisos, Lesbos and the Datca Peninsula (Fig. 12 A), and round, more narrow ones in other areas (Fig. 12 B, C).

Though morphologically distinct, *A. amethystinum* has usually been placed in *A. sphaerocephalum* as an infraspecific taxon. By some authors, e.g. REGEL (1875), *A. amethystinum* has been placed in *A. margaritaceum* SIBTH. & SM., which it sometimes resembles in habit. Both species have narrow tepals and deciduous spathes; *A. margaritaceum* rarely has red

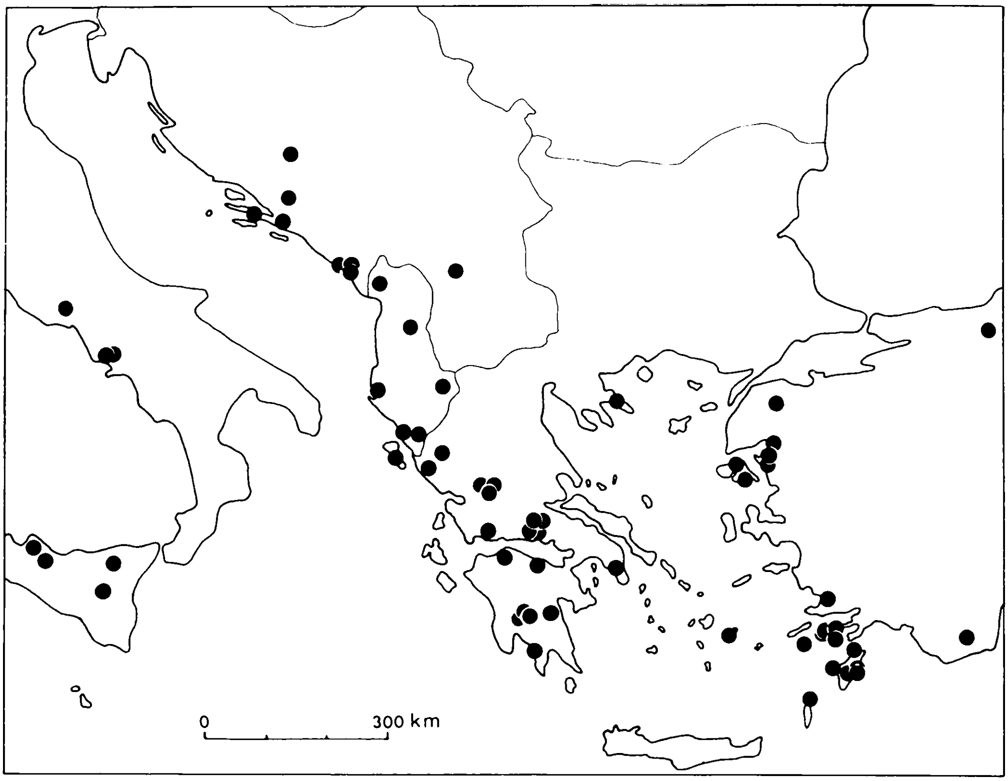

Fig. 13. *Allium amethystinum* TAUSCH. Total distribution.

flowers, and tall specimens, especially from Dalmatia, have often been incorrectly identified as *A. amethystinum.* In one collection of *A. margaritaceum* from Macedonia (DURHAM 1926, K), a "secondary inflorescence" similar to that in *A. amethystinum* was found. However, there are many characters useful in distinguishing the two taxa. Thus, for example, the seeds are flattened in *A. amethystinum* and triquetrous in *A. margaritaceum,* and the bulbils are characteristically reticulate in the former and more or less smooth in the latter.

DISCUSSION

Though dissimilar in habit, *A. amethystinum* and *A. chamaespathum* have some in my opinion important characters in common, e.g. large, flat seeds, in contrast to triquetrous ones in other taxa of the section in the area, narrow tepals with low ridges on the abaxial surface, deciduous spathe and similar types of fistulose, somewhat carinate leaves.

As pointed out elsewhere (BOTHMER 1970), the karyotype in the genus *Allium* is more or less symmetrical and stable. For this reason conclusions about relationships based on similarities in chromosome morphology must be very uncertain. *A. amethystinum* has, however, a karyotype which differs markedly from the usual one in the section (BOTHMER op. cit.), and in *A. chamaespathum* I found the same type of marker chromosomes (unpublished data).

Morphological and cytological data together indicate a possible phylogenetic relationship between the two taxa, which have a rather isolated position in the section.

An isolating factor between *A. amethystinum* and *A. chamaespathum* is the different time of flowering. The former flowers in May—June, the latter in September—October.

ACKNOWLEDGEMENT

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Die taxonomische Behandlung von Artenpaaren bei den Flechten

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ABSTRACT

POELT, J. 1972. Die taxonomische Behandlung von Artenpaaren bei den Flechten. — Bot. Notiser 125: 77—81.

The problems of the taxonomy of the so-called species pairs are discussed. It seems, at least at this moment, most useful to name both the primary and the secondary taxon species; the secondary ones are isolated by more or less complete apomictic behaviour. "Chemical strains", often reduced to varieties or not recognized at all, are probably in many cases descendants of different primary species, evolved by convergent evolution. They should be separated as taxa.

Aufbauend auf eine Studie von DU RIETZ (1924) wurde vom Verfasser (POELT 1970) das Konzept der Artenpaare entwickelt, das z.B. für die Beurteilung der Florengenese der Flechten von Bedeutung sein kann (POELT 1963). Es gründet sich auf die Erfahrung, daß sich — insbesondere bei den Laubflechten — zu sorediösen und isidiösen, selten oder nie mit Apothecien anzutreffenden Sippen gewöhnlich unschwer morphologisch und chemisch identische Parallelsippen finden lassen, welche soredien- und isidienfrei sind und dafür regelmäßig Apothecien tragen. In einem Fall erfolgt die Fortpflanzung vergleichsweise unkompliziert durch das Auskeimen der vegetativen Diasporen, im anderen Fall ist für jeden einzelnen Fortpflanzungsakt eine Neukombination von Ascospore und Alge notwendig. Die Parallelsippen, die Partner eines solchen Paares, sind also der Definition nach morphologisch und chemisch gleich; ihre faßbaren Unterschiede liegen in der Art der Fortpflanzungsorgane. In selteneren Fällen scheint es möglich, Trios oder Quartette von Sippen mit verschiedener Fortpflanzungsweise (Sporen, Lobuli, Soredien, Isidien) zusammenzustellen. Hingewiesen sei auf die Gruppe von *Parmelia subrudecta* (W. CULBERSON 1962, W. & CH. CULBERSON 1956, HALE 1965). Dieser Fall sei hier nicht näher verfolgt.

Pflanzen, die sich ± ausschließlich vegetativ vermehren, sind als Apomikten zu betrachten. Apomikten müssen, allen gültigen Vorstellungen zufolge, von sexuell sich fortpflanzenden Arten abstammen. Bei Gefäßpflanzen wird in sehr vielen Fällen Apomixis offenbar durch Bastardierung induziert. Bei den Flechten besteht für eine solche Annahme kein Grund, doch muß zugegeben werden, daß über die Ursache des Funktionswechsels von der generativen zur vegetativen Fortpflanzung nichts bekannt ist. Auf jeden Fall kann man sicher annehmen, daß innerhalb von Artenpaaren der sorediöse bzw. isidiöse Partner phyletisch aus Formen hervorgegangen sein muß, die man heute der generativen Sippe zurechnen würde, und nicht umgekehrt. Der genera-

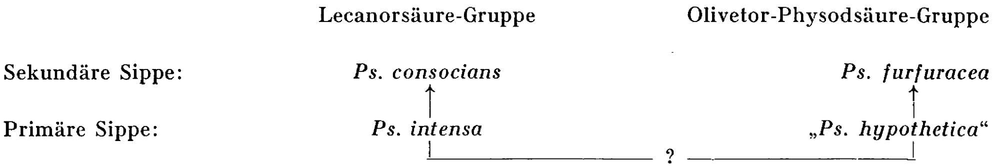

Abb. 1. Die Evolution der *Pseudevernia furfuracea*-Gruppe.

tive Partner ist der ältere, die Primärart, der vegetative der jüngere, die Sekundärart. Wie aus cytogenetischen Gründen leicht einzusehen, sind Apomikten genetisch starr; ihre wesentlichen Eigenschaften müssen vorhanden gewesen sein, bevor der Übergang zur Apomixis sich vollzog. Dies scheint für die Flechten in gleicher Weise zu gelten wie für die Gefäßpflanzen. Die sorediösen und isidiösen Sippen der Laubflechten sind gewöhnlich gut abgegrenzt und über riesige Areale einheitlich.

Aus den dargestellten Gründen lassen sich nun Folgerungen für die taxonomische Behandlung von Artenpaaren ziehen, die teilweise im Zusammenhang mit der vieldiskutierten Frage der sogenannten „chemischen“ Sippen stehen.

Das Prinzip sei zunächst am Beispiel der von Hale (1968) analysierten kleinen Flechtengattung *Pseudevernia* erläutert. Die Gattung enthält in Europa isidiöse, selten fruchtende Formen mit den eng verwandten Stoffen Olivetor- und Physodsäure als kennzeichnenden Inhaltsstoffen. Sie mögen hier als *Ps. furfuracea* (L.) Zopf bezeichnet werden. (Das Problem der europäischen Chemospecies ist für die weitere Diskussion nicht von Belang; desgleichen sei die „sorediöse“ *Ps. soralifera* (Bitt.) Zopf nicht weiter behandelt, da sie unseres Erachtens keine Sippe, sondern eine Abnormität ist.) Im östlichen Nordamerika findet sich eine morphologisch mit *Ps. furfuracea* ± übereinstimmende Sippe, die anstelle der genannten Stoffe das einfach gebaute Depsid Lecanorsäure enthält und von Hale als *Ps. consocians* (Vain.) Hale & W. Culb. unterschieden wird. Im südlichen Nordamerika wächst eine chemisch mit dieser identische Flechte, *Ps. intensa* (Nyl.) Hale & W. Culb., die unseren Anforderungen an eine Primärart voll entspricht: Isidien fehlen, Apothecien sind auf allen ausgewachsenen, ungehemmten Thalli reichlich zu finden. Wir sind der Meinung, daß *Ps. consocians* als apomiktisches Derivat an die generative *Ps. intensa* anzuschließen ist. Für die europäische einheitlich isidiöse Art fehlt eine entsprechende sexuelle Parallelsippe heute; sie muß unseren Vorstellungen zufolge einst existiert haben und sei im folgenden als „*Ps. hypothetica*“ bezeichnet. Die Evolution der Gruppe muß sich, sicher sehr vereinfacht ausgedrückt, entsprechend dem Schema in Abb. 1 vollzogen haben.

Die taxonomische Behandlung der Gruppe muß unseres Erachtens im Einklang mit diesen Überlegungen stehen. Die sicher einfachste, aber in ihrer Aussage völlig unbefriedigende Lösung ist es, alle Sippen zusammen zu einer Art zusammenzufassen (noch Hale 1956) und innerhalb der Art taxonomisch nicht faßbare chemische und morphologische Variation zu sehen. Eine zweite Möglichkeit wäre es, wenn man die Unterscheidung „chemischer“ Arten ablehnt, die isidiösen Sippen als eine Art mit mehreren chemischen Stämmen zusammenzufassen. Gerade dies muß unseren Überlegungen zufolge falsch sein. Eher denkbar wäre es, eine amerikanische und eine europäische Art zu unterscheiden und innerhalb der amerikanischen Lecanorsäure-Species die Primär- und Sekundärsippe als Unterarten aufzufassen; die unterschiedliche

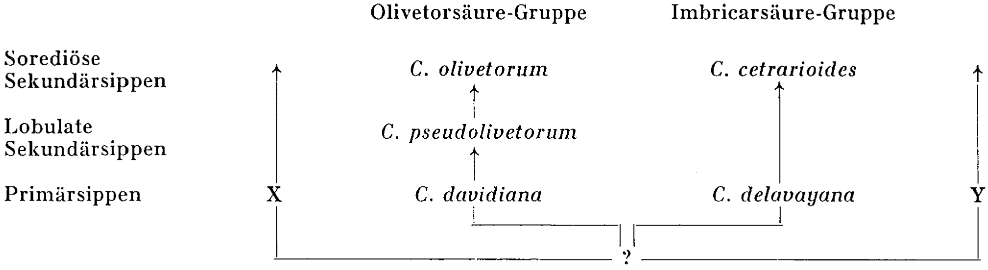

Abb. 2. Verwandtschaftsschema der *Cetrelia olivetorum*-Gruppe. Unter X und Y wären weitere vor allem chemisch unterschiedene Primärsippen zu verstehen, die Ausgangspunkt ähnlicher Ableitungen sind oder sein könnten.

Verbreitung erlaubt keine geringere Einstufung. Hält man sich aber an die bei Blütenpflanzen üblichen Verfahrensweisen — über größere Areale einheitliche Apomikten werden im allgemeinen als Arten gewertet — so sollte man *Ps. intensa, Ps. consocians* und *Ps. furfuracea* als eigene Species betrachten.

Das Problem sei an einem weiteren Beispiel analysiert. Einige Artenpaare lassen sich aus der Monographie der Gattung *Cetrelia* von W. CULBERSON & CH. CULBERSON (1968) entnehmen. In beiden Fällen ist die Primärsippe auf SW-China, das reichste Reliktengebiet der holarktischen Flora beschränkt, während die sorediösen Sekundärsippen mit unterschiedlichen Schwerpunkten über die großen Laubwaldgebiete der temperierten Zone der Holarktis verbreitet sind. Partner der Olivetorsäure-haltigen Primärart *Cetrelia davidiana* CULB. & CULB. ist die im östlichen Nordamerika, in Europa und in SO-Asien verbreitete *C. olivetorum* (NYL.) CULB. & CULB., Partner der Imbricarsäure-haltigen Primärsippe *C. delavayana* CULB. & CULB. wäre die vor allem in Europa vorkommende *C. cetrarioides* (DEL. ex DUBY) CULB. & CULB., ebenfalls mit Imbricarsäure oder der sehr ähnlichen Perlatolsäure ausgestattet.

Es ist leicht verständlich, daß die beiden in Europa vorkommenden sorediösen Sippen, die sich im wesentlichen durch eine ausreichende chemische Differenz unterscheiden, lange Zeit als chemische Stämme ein und derselben Art betrachtet wurden, zuletzt bei JØRGENSEN & RYVARDEN 1970 (als *C. olivetorum* (NYL.) CULB. & CULB. em. P. M. JØRG. & RYV.). Unter dem hier dargestellten Aspekt kann diese Lösung kaum richtig sein. Wir sind auch hier der Meinung, daß die chemisch verschiedenen sorediösen Sippen den entsprechenden Primärarten angeschlossen werden müssen; für eine Art somatischer Mutation, mit deren Hilfe die eine Chemospecies aus der anderen entstehen könnte, fehlen jegliche Anhaltspunkte. Nimmt man, um das Bild den wahren Verhältnissen der Gattung etwas mehr anzugleichen, die in die Olivetorsäure-Gruppe gehörige ostasiatische *C. pseudolivetorum* (ASAH.) CULB. & CULB. als lobulates Glied mit in die Betrachtung hinein, so ergibt sich das einfache Verwandtschaftsschema in Abb. 2.

Es bieten sich für eine taxonomische Gliederung folgende Möglichkeiten an:

1. *C. olivetorum* spec. coll.

Alle Sippen der Gruppe, und hier folgerichtigerweise ± alle Sippen der ganzen Gattung werden als eine einzige Art ohne formelle Unterscheidung infraspezifischer Sippen zusammengefaßt. Da schon die Primärsippen unter sich als „chemical strains" betrachtet werden können, ließe sich ein solches Verfahren nach üblicher

Behandlung begründen. Es würde aber Verzicht auf jegliche eingehende Information über die Gruppe, ihre Phylogenie und ihre Ausbreitungsgeschichte bedeuten und damit einen wesentlichen Zweck taxonomischer Arbeit verfehlen.

2. *C. olivetorum*
  ssp. *olivetorum*
    var. *davidiana*
    var. *pseudolivetorum*
    var. *olivetorum*
  ssp. *cetrarioides*
    var. *delavayana*
    var. *cetrarioides*
  ssp. x usw.

Alle Sippen der Gruppe und hier folgerichtigerweise ± alle Sippen der ganzen Gattung werden zu einer Art zusammengefaßt; die infraspezifische Variation wird hierarchisch in Subspecies und Varietäten ausgedrückt.

Diese Lösung wäre begründbar, scheint uns aber zu einer äußerst schwerfälligen, wenig praktikablen Gliederung zu führen, die zudem der Isolierung der Sippen und ihren auf langes selbständiges Schicksal zurückgehenden Verbreitungsunterschieden nicht gerecht wird. Unschön dabei ist es, daß zur Kennzeichnung der übergeordneten Rangstufen die Namen der phyletisch abgeleitetsten Sippen verwandt werden müssen.

3. *C. olivetorum*
  ssp. *davidiana*
  ssp. *pseudolivetorum*
  ssp. *olivetorum*

C. cetrarioides
  ssp. *delavayana*
  ssp. *cetrarioides*

Die beiden (und die weiteren) Entwicklungsreihen werden als Arten unterschieden, die zugehörigen abgeleiteten Sippen als Unterarten.

Diese Gliederung scheint praktikabel zu sein. Es muß aber dagegen eingewendet werden, daß dabei phyletisch richtig, aber systematisch wohl falsch Sippen zusammengefaßt werden, die heute streng isoliert sind, während mit der spezifischen Trennung der Primärsippen möglicherweise Taxa auseinandergerissen werden, die noch in genetischem Austausch stehen.

4. *C. olivetorum* coll.
C. davidiana coll.

Die Primärsippen und die (sorediösen) Sekundärsippen werden jeweils zu Arten vereint, wie lange geschehen.

Es ist verständlich, daß damit kein phyletisches, sondern ein Organisationsstufensystem entsteht, das in dem Augenblick seine Berechtigung verloren hat, in dem es als solches erkannt ist.

5. *C. davidiana*
C. pseudolivetorum
C. olivetorum
C. delavayana
C. cetrarioides

Alle Sippen werden als Arten behandelt, die „chemical strains" insoweit als sie den etwa bei J. Santesson 1970 dargestellten Kriterien entsprechen.

Dieses System hat sicher den Nachteil, daß es Sippen verselbständigt, die man bis dato als „chemical strains" betrachtete. Es ist aber praktikabel, wird der ± vollständigen Isolierung der vegetativen Sippen gerecht und sagt schließlich nicht mehr aus als bekannt ist; es steht zu vermuten, daß sich aus einer besseren Durchforschung des westchinesischen Raumes Änderungen ergeben werden, die sich in ein System aus beigeordneten Sippen leichter einbringen lassen als in ein stark hierarchisch gegliedertes.

Zusammengefaßt: Lösung 1 ist systematisch sinnlos; Lösung 2 wäre begründbar, wird aber der Isolierung der abgeleiteten Sippen und den Verbreitungsunterschieden nicht gerecht, und ist zudem sehr schwerfällig; Lösung 3 verbindet, zwar phyletisch richtig, das was isoliert ist, trennt aber möglicherweise nicht isolierte Sippen; Lösung 4 ist systematisch falsch, weil es zu einem Organisationsstufensystem führt; Lösung 5 scheint uns wenigstens beim derzeitigen Kenntnisstand die günstigste zu sein.

Den Herren Prof. Dr. H. HERTEL und Prof. Dr. CH. LEUCKERT sei für kritische Diskussion des Problems herzlich gedankt, Herrn Doc. Dr. O. ALMBORN für Diskussion und verschiedene Hilfen.

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Studies in the Genus Allium IV

Vegetative Reproduction in Allium unifolium and some other American Species

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ABSTRACT

EKBERG, L. 1972. Studies in the genus Allium IV. Vegetative reproduction in Allium unifolium and some other American species. — Bot. Notiser 125: 82—86.

In *Allium unifolium* KELLOGG the increase and renewal bulbs are developed terminally on runners growing out from the stemplate of the old bulb. One renewal bulb and usually one or two increase bulbs are formed. There is one storage cataphyll in the bulb which is surrounded by a protective cataphyll. The tunics of a bulb consist of this protective cataphyll and the basal parts of a leaf sheath. There is no similar type of vegetative reproduction and bulb morphology among Alliums so far known from the Old World.

INTRODUCTION

During morphological studies on the *Allium* species of the Old World, it was of interest to learn about the conditions of the American species separated in the subgenus *Amerallium* TRAUB. *A. unifolium* was studied more closely and compared with *A. amplectens* TORR., *A. cernuum* ROTH and *A. drummondii* REGEL.

MATERIAL

The material studied was cultivated in the Botanical Garden of Göteborg. Voucher specimens are kept in the herbarium of Göteborg (GB).

Allium amplectens TORR., cult. 1967, EKBERG E 59, B 49; origin unknown.
A. cernuum ROTH, cult. 1967, EKBERG E 10, B 58; from Hatz 1930.
A. drummondii REGEL, cult. 1967, EKBERG E 140, B 50; from München 1935.

Fig. 1. *Allium unifolium* KELLOGG — A: Diagram of a plant before flowering; the internodes have been elongated to show the individual leaves. — B: Schematic cross-section through bulb to show the principle of bulb formation. The storage and sprout leaves are removed. The two dots in the centre of *a* and *b*, represent increase bulbs and scapes, in *c* only an increase bulb. The circles represent foliage leaves. — C: Orientation of the bulb showing the connection between the mother bulb and the new bulbs. — D: Flat vernation. — E: Longitudinal section through a bulb at the beginning of growth. The bulb is asymmetrical. ×0.5. — F: The same bulbs as in E at an earlier stage; the sprout leaf will squeeze through the storage cataphyll in the loose tissue. ×1. — G: 1—4: The formation of new bulbs is shown by removal of different leaves. ×0.5. — 5—7: The new bulbs are formed at the base of the innermost leaf sheath. ×1.

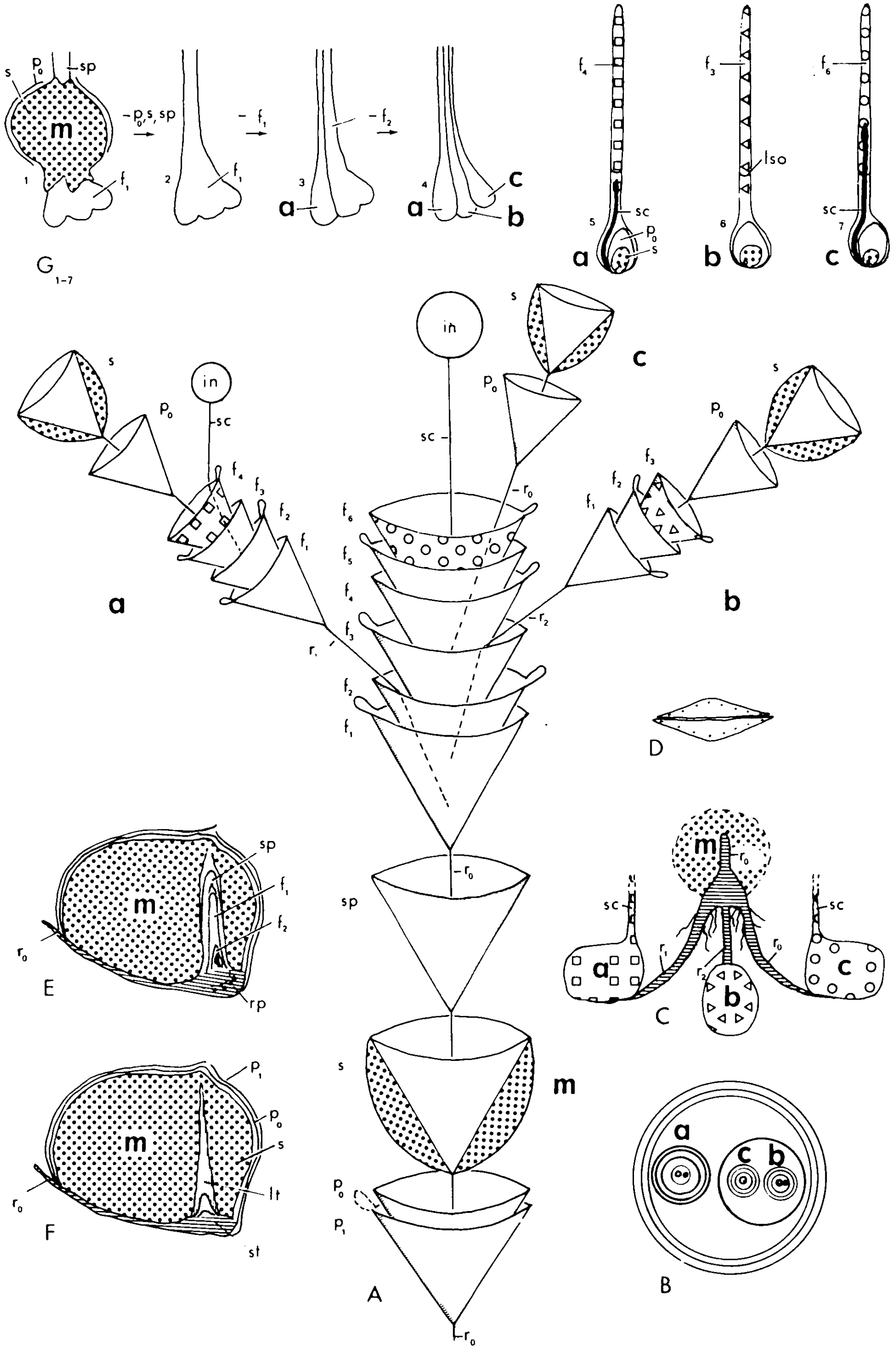
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Fig. 1.

A. unifolium KELLOGG, cult.; from C. G. VAN TUBERGEN, Haarlem, Holland.

ABBREVIATIONS USED IN THE FIGURES

a, b, i.b., increase bulbs; c, r.b., renewal bulbs; f, foliage leaf; in, inflorescence; lso, leaf sheath opening; lt, loose tissue; m, mother-bulb; p, protective leaf or cataphyll; r, runner; rp, root primordium; s, storage cataphyll; sc, scape; sp, sprout leaf; st, stem-plate.

VEGETATIVE REPRODUCTION IN ALLIUM UNIFOLIUM

In Fig. 1 the reproduction from a "mother-bulb" into one renewal and two increase bulbs is illustrated. Normally one or two increase bulbs are formed besides the renewal bulb. One or sometimes two scapes have been observed emanating from one mother-bulb. From the stem-plate of the mother-bulb, in the illustrated case (Fig. 1 C), three runners grow out ending in terminal bulbs. The first stages of this development are shown in Fig. 1 G: 1—4. The three new bulbs, each surrounded by a protective cataphyll and a leaf sheath (Fig. 1 G: 5—7), become larger at the same time as the runners grow out from the stem-plate. The three bulbs a, b and c are kept together in the first stages of development by a foliage leaf sheath (f), a sprout leaf (sp) and a storage cataphyll (s). In Fig. 1 C the storage cataphyll of the mother-bulb has decayed and the bulbs are only united by the runners (r) until these also will decay later in the season. The new bulbs are formed between the scape and the leaf sheath (f). The protective cataphyll (p_0) is rather thick and rich in storage material at the beginning of development, but later on, this material is restored in a storage cataphyll. Thus the protective cataphyll (p_0) will be very thin and surround the bulb as a papyraceous envelope (Fig. 1 E—F). The storage cataphyll (s) is considerably thicker at one side giving the bulb an asymmetric form.

Other Types of Vegetative Regeneration in American Species

In *A. drummondii* (Fig. 2 A) compared to *A. unifolium,* the new bulbs are formed in quite a different way. As is shown in Fig. 2 A: 1—2, there are several storage cataphylls but no protective cataphyll (p_0). The bulb-tunics consist of reticulate-fibrous remains of the leaf sheaths from the previous year.

In *A. cernuum* (Fig. 2 B) the storage material is found in the several swollen basal parts of the leaf sheaths. The innermost part of the bulb is built up by primordial foliage leaves. The bulb is protected by several layers of brownish red papyraceous old leaf sheaths (p). A "twin-bulb" (Fig. 2 B: 2—3) is often formed in the centre of the bulb. This structure is formed by the inner part of the main bulb and a side shoot from this. A parallel development of the two shoots will result in two more or less equal sized bulbs close together.

In *A. amplectens* the renewal bulb has only one storage cataphyll (s) (Fig. 2 C: 1—2). This cataphyll is surrounded by a brownish red protective cataphyll (p_0). The epidermal layer of the storage cataphyll has a wave-like horizontal pattern characteristic for the species. This pattern is also found in the basal parts of the leaf sheaths. Similar patterns are found in some other American Alliums and also in the East Asiatic species *A. monanthum* MAXIM.

Fig. 2. A: *Allium drummondii* REGEL — B: *A. cernuum* ROTH — C: *A. amplectens* TORR. — A_1, B_1, C_1: Diagrams of plants at the time of flowering; the internodes have been elongated to show the individual leaves. — A_2: Longitudinal section through a renewal bulb. — B_2: Cross section through a bulb at the base to show the orientation of the scapes and the "twin-bulb". — B_3: "Twin-bulb" from side. — C_2: Renewal bulb.

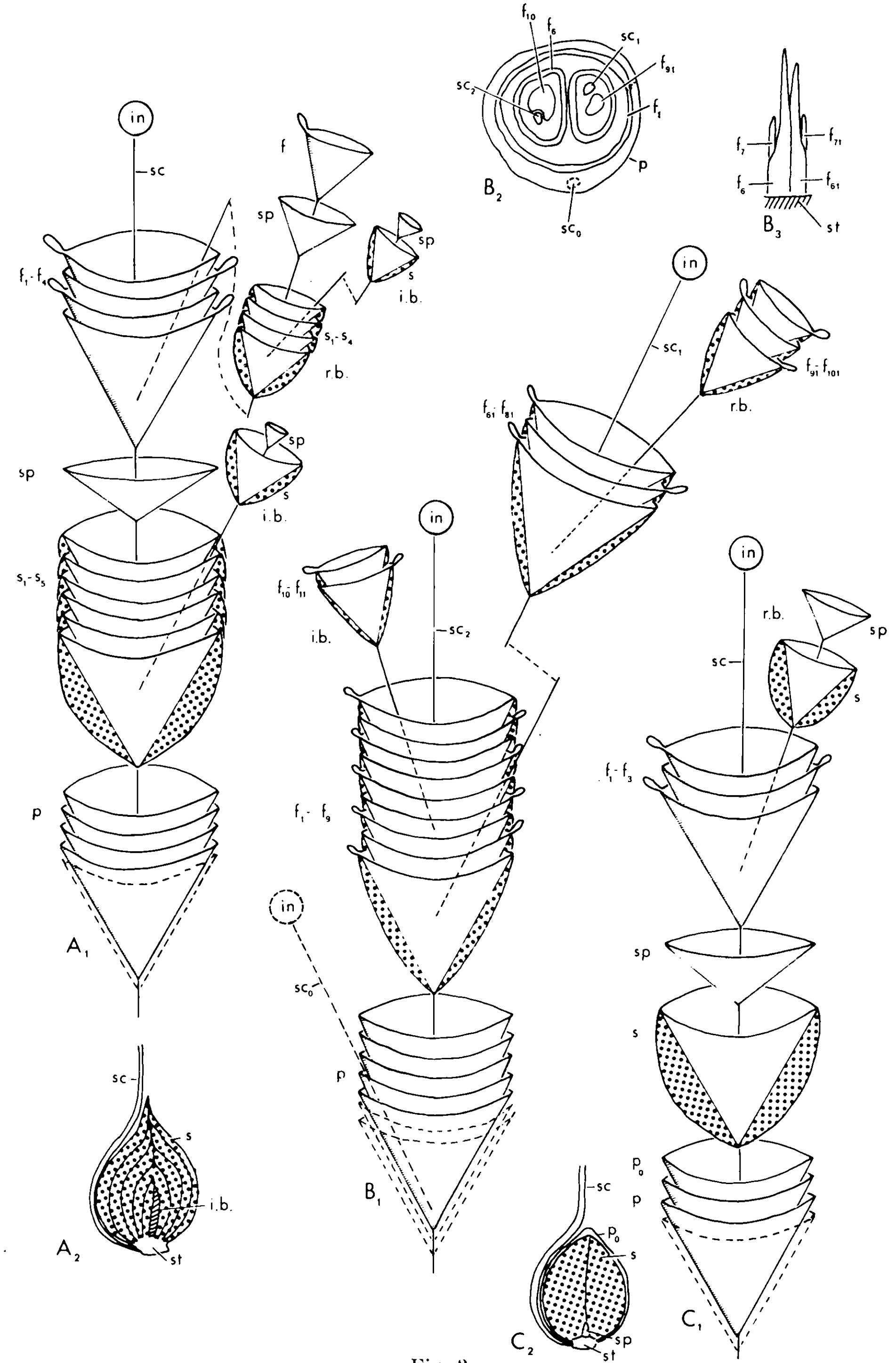
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Fig. 2.

DISCUSSION

Ownbey & Aase (1955 p. 1) pointed out that the indigenous American species, with the exception of *A. schoenoprasum* L. and *A. tricoccum* Aiton, are closely related and that they "show no particularly close affinity to any Old World species of the genus".

The basic chromosome number x = 7, is characteristic for the American species except for the two species mentioned above (Ownbey & Aase 1955 p. 14).

The subgenus *Amerallium* was described by Traub (1968 b p. 159). He includes most indigenous American species and some Mediterranean species in section *Molium*. *A. unifolium* is placed in section *Lophioprason* Traub, subsection *Bolanderiana* Traub (1968 a p. 127). *A. amplectens* is placed in section *Lophioprason*, subsection *Acuminata* Traub and *A. cernuum* in the same section, subsection *Cernua* Traub, while *A. drummondii* is placed in section *Amerallium*, subsection *Canadensia* Traub.

There are other American species with similar types of vegetative reproduction to that found in *A. unifolium* (Traub 1968 a p. 128). These are *A. glandulosum* Link & Otto and *A. longifolium* (H.B.K.) Spreng. Both are placed in section *Rhophetoprason* Traub (1968 a p. 134). Living material of these species has not been available for comparison with *A. unifolium*. Traub has used the outer bulb-tunics (p) as the decisive systematic character for the classification of *A. unifolium*, *A. glandulosum* and *A. longifolium*. In some cases species from different sections of *Allium* show greater similarity in the structure of the bulb-tunics than species of the same section do *inter se*. Adaptive convergency may be the explanation of this (Ekberg 1970 p. 117) and thus one may easily be led to totally wrong taxonomic conclusions when using the bulb-tunics as a decisive character. The similar, and in *Allium* uncommon, kind of vegetative reproduction in the three species raises the question if Traub's idea of separating them in two sections is well-founded.

The four species treated in this paper, viz. *A. unifolium, A. amplectens, A. cernuum* and *A. drummondii*, differ in the structure of the bulb as well as in the principle of storing material in the bulbs and in vegetative reproduction. This fact raises the question as to whether the American species are of monophyletic or polyphyletic origin. There are differences in the bulb structures which are at least as fundamental as between Old World species placed in different subgenera. On the other hand there is a homogeneity in chromosome numbers as all species have the basic number x = 7 which is rather unusual within the genus.

If the American *Allium* species are of a monophyletic origin, there must have been a diversification of wide range in the vegetative growth not met with in other parts of the genus.

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Studies in the Genus Allium V

Bulb Structure in the Section Anguinum

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ABSTRACT

Ekberg, L. 1972. Studies in the genus Allium V. Bulb structure in the section Anguinum. — Bot. Notiser 125: 87—92.

The species *A. tricoccum* Aiton and *A. victorialis* L. s.l. of the section *Anguinum* Koch share an involute—revolute vernation of the foliage leaves. They also have the same kind of bulb organization. There are mostly 2—3 petiolate foliage leaves and three sprout leaves also with some storage function. The storage tissues in *A. tricoccum* are found in the basal parts of the leaf sheaths. In *A. victorialis* no well developed storage structures can be traced. The cone-shaped tapering increase and renewal bulbs have small amounts of storage tissues in the sprout leaves. The "rhizomes" are built up of more or less dead old stem-plates accumulating from year to year because no abscission layers are present.

INTRODUCTION

The relationships between *A. victorialis* L., the type species of section *Anguinum* Koch, and *A. tricoccum* Aiton have been discussed by Stearn (1947 p. 36). He also discusses the similarity in habit between *A. tricoccum* and *A. ursinum* L. Stearn claims that *A. tricoccum* should be kept in a monotypic section *Validallium* (Small) Stearn. One reason should be that *A. tricoccum* has only one ovule in each locus. This character seems rather vague as reductions may occur. Traub (1947 p. 69) and Barrie (1949 p. 81) found variations in seed formation from three to one in each capsule.

Traub (1968 p. 152) suggests putting *A. tricoccum* in section *Anguinum* Koch: "This latter species (*A. victorialis*) apparently has a common ancestry with the North American *A. tricoccum* Aiton (2n =—, 32)". He does not give any new arguments for putting *A. tricoccum* in section *Anguinum*. There are, however, similarities in habit between the two species: The reticulate-fibrous bulb coats, often two petiolate broad leaves (Fig. 2) and the shape of the capsule. One main difference is the condition of the leaves at the time of flowering. In *A. victorialis* they persist during flowering, but in *A. tricoccum* they decay at the time when the scape begins to elongate.

MATERIAL

The material studied was cultivated in the Botanical Garden of Göteborg.

A. tricoccum Aiton, cult.; from Canada, Quebec: Gatineau national park, at McCloskey Road. J. Eriksson, 1968, s.n.

A. victorialis L. s.l., cult. 1967, Ekberg E74, B65; from China, Shansi; Pa shui ko, SW of Tai yuan fu about half the way to the border of Shensi. On rather dry sunny forest ground. H. Smith no. II, 210, 1924. Voucher specimen in the herbarium of Göteborg (GB).

THE BULB STRUCTURE OF A. TRICOCCUM AND A. VICTORIALIS

In Fig. 1 the bulb structures of one specimen of *A. tricoccum* and one specimen of *A. victorialis* are illustrated. The specimens selected have the same number of foliage leaves (f). Some small variations occur in the number of the foliage leaves. When the bulb has a scape, there is nearly always a third foliage leaf (f) present. But if the bulb lacks a scape there are more often only two foliage leaves. There is a striking resemblance between the two diagrams A and B of Fig. 1. One main difference is the much more developed storage function of the basal parts of the leaf-sheaths in *A. tricoccum* (f_1—f_3).

Both species have conical, tapering increase and renewal bulbs. These bulbs are mainly built up by usually three conical sprout leaves (sp) with small storage function. The primordial foliage leaves, f_1 and f_2 respectively, are involute and revolute in vernation (the vernation is illustrated between A and B in Fig. 1) thus fitting well in the folds of each other. They are petiolate and about the same shape in the two species. The stem-plate from the previous year will not be detached from the new one by an abscission layer as for example occurs in the species of the subgenus *Melanocrommyum* (WEBB & BERTH.) WENDELBO. The old stem-plates will accumulate to a rhizome-like structure to which the old leaf sheaths (p) are attached. The reticulate-fibrous basal parts of the old leaf-sheaths will persist and form the outer tunics of the bulb. There are several more outer tunics persistent in *A. victorialis* than in *A. tricoccum*. In both species they are of the same reticulate-fibrous character.

Why do the Leaves Decay before Flowering Time in A. tricoccum?

That the leaves decay more or less before the scape is fully developed is a fact known from other *Allium* species. The strongest factor contributing to this wilting and disappearance of the leaves seem to be drought in arid regions. In *A. tricoccum,* growing in deciduous forests, the wilting of the leaves is genetically fixed and could most probably be regarded as an adaptation to the light conditions in the forest: enough light before leaves are formed and a deficiency of light when the foliage of the trees is fully developed during summer time.

The ecology of *A. victorialis* is somewhat different from that of *A. tricoccum.* The former species grows under sunnier conditions in mountain regions from Portugal more or less continuously eastwards to China and Kamchatka, with the subspecies *platyphyllum* HULTÉN on the island of Attu in the western part of the Aleutian islands. In *A. victorialis* the leaves do not wilt until late in the vegetation period. The basal parts of the leaves do not have the distinct storage function which is characteristic for *A. tricoccum.*

The similarity in habit between the broad-leaved species *A. ursinum* on one side and *A. tricoccum* and *A. victorialis* on the other, discussed by STEARN (1947 p. 36), does not extend as far as to the internal structure of the bulbs.

The anatomy of *A. ursinum,* section *Ophioscorodon* (WALLR.) ENDL., is described by RUBAT DU MÉRAC (1949). This species grows in dense forests and flowers before or at the beginning of the leafing of the trees, but unlike *A. tricoccum* it keeps its leaves until the time of flowering. *A. ursinum* has quite another bulb structure than that found in section *Anguinum.* There is one well developed storage cataphyll, one sprout leaf and two foliage leaves, which are both revolute in the vernation. The basic chromosome number of the monotypic section *Ophioscorodon* is $x=7$, compared to $x=8$ in section *Anguinum.* The broad-leaved *A. ursinum* in Europe grows under similar ecological conditions as *A. tricoccum* in Canada. The leaves of *A. ursinum* do not wilt and dis-

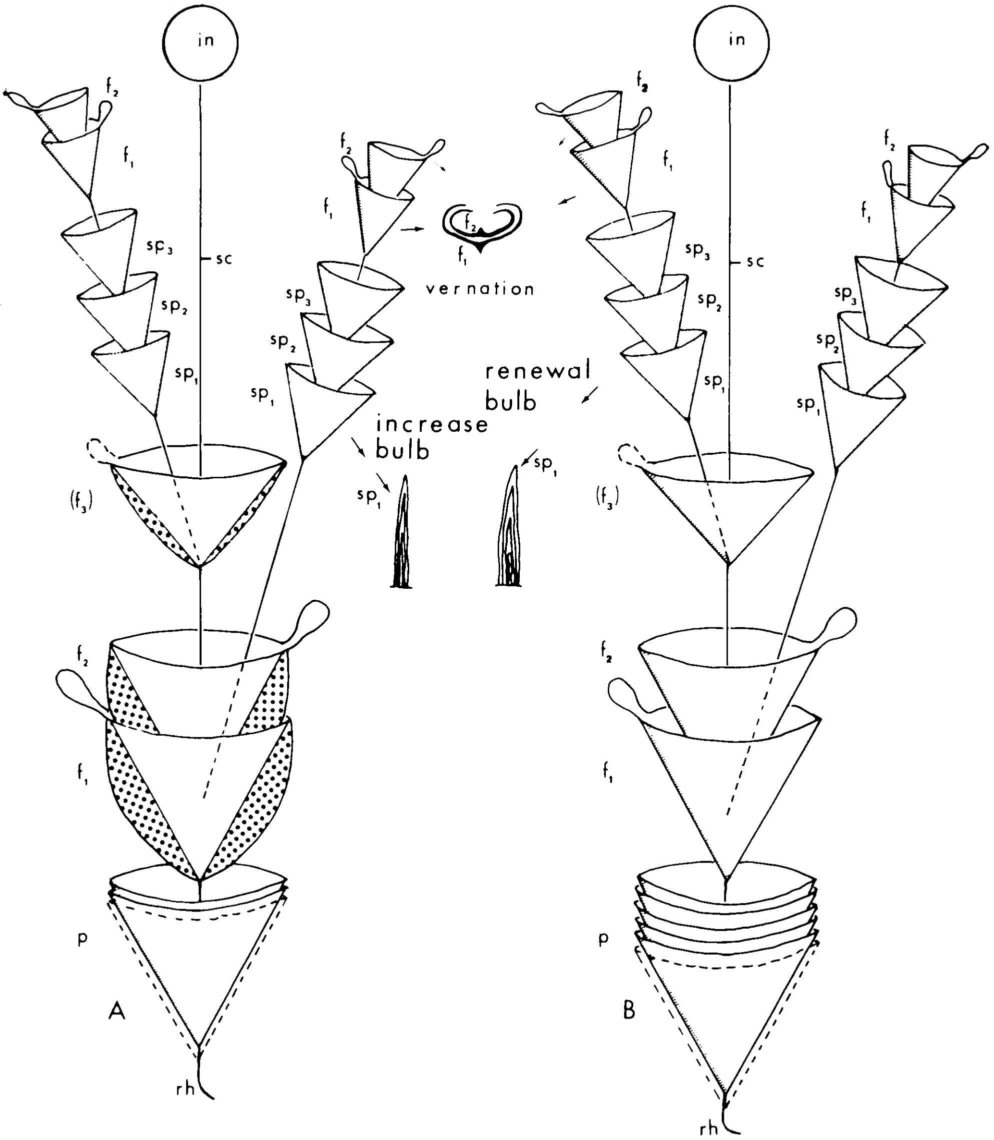

Fig. 1. A: *Allium tricoccum* AITON — B: *A. victorialis* L. Diagrams of plants at flowering time; the internodes have been elongated to show the individual leaves. — f, foliage leaf; in, inflorescence; p, protective leaf; rh, rhizome; sc, scape; sp, sprout leaf.

appear before the time of flowering. It is difficult to explain this fact adequately but there may be other factors involved besides light.

Storing of Material in Bulbs Depends on the Effective Period of Assimilation

The large genus *Allium* has a vast distribution over the northern hemisphere from desert regions in the south to arctic areas in the north. The species grow under the most different conditions and therefore the possibilities to study the storing of material in the bulbs are excellent within the genus. Generally it seems as if the amount of storage material built up in the bulb depends on the length of the effective assimilation period. In species growing in dry regions with short seasonal rain periods, a considerable amount of storage material serve to a quick build up of an assimilating plant. Good examples of this type are found in the subgenus *Melanocrommyum*. In temperate regions the vegetation period for the *Allium* species is longer than in dry regions. Consequently the period of rest is shorter and the plants are not adapted to a quick build up of assimilation tissues.

The discussion above may be applied to the relation between *A. tricoccum* and *A. victorialis*. The period of possible assimilation is short for *A. tricoccum*; thus there is built up more storage material than in *A. victorialis* which can go on with assimilation for a longer time.

OTHER SPECIES OF SECTION ANGUINUM

Several other species, viz. *A. caput-medusae* AIRY-SHAW, *A. funchiifolium* HAND.-MAZZ., *A. latissimum* PROKH., *A. listera* STEARN, *A. microdictyon* PROKH. and *A. ovalifilum* HAND.-MAZZ. are included by STEARN (1944) in a key to the species of the section *Anguinum*. A distribution map for *A. victorialis* and *A. prattii* C. H. WRIGHT (STEARN 1960 p. 165) shows that the two species are not separated by a distributional gap. An interesting remark by STEARN (1960 p. 172) is that also in the narrow-leaved *A. prattii* the leaf-margins are inrolled in vernation, a character common to the broad-leaved *A. tricoccum* and *A. victorialis*.

After having seen the material of this group in the herbaria of Kew and the British Museum and the very fine collections of Dr. H. SMITH, Uppsala, from China, I feel sceptical about treating the above-mentioned taxa as distinct species. A more convenient classification would be to give them subspecific rank under *A. victorialis*.

There is also a great variation in other Himalayan groups of Alliums. *A. lancifolium* STEARN has broad leaves. It seems to be an aberrant form of *A. wallichii* KUNTH of the section *Bromatorrhiza* EKBERG which has slender leaves.

Before further conclusions regarding the taxonomy of the *A. victorialis* group are drawn, it is necessary to make an exhaustive study of material from the whole area, especially from Himalaya and China.

BULB-TUNICS IN SECTION ANGUINUM

The characteristic reticulate fibrous bulb-tunics of *A. victorialis* were used in a superstitious way in ancient times until the beginning of the 20th century. In the work of VON HOFSTEN (1958 p. 87) the use is described: "The root (rhizome) has a reticular envelope (the outermost scale leaves) which has — or had to the lively imagination of mediaeval man — a certain resemblance to a coat of mail, if worn as an amulet, therefore, it renders the same service as such a coat, i.e. protects the wearer against wounds and ensures victory."

Reticulate fibrous tunics are found in several sections of *Allium* especially in species growing under subdesertic conditions (EKBERG 1970 p. 117). The accumulation of bulb-tunics in *A. victorialis* may be an adaptation to drier soil conditions, as they may help in protecting the bulb from drying out. Under moister conditions, testified in cultivation by Mr. J. ENGSTRÖM (personal communication), gardener of the Botanical Garden of Göteborg, species with such reticulate fibrous bulb-tunics will accumulate water and the bulbs may rot. In *A. tricoccum* few tunics persist and the bulbs have a small number or are even without tunics.

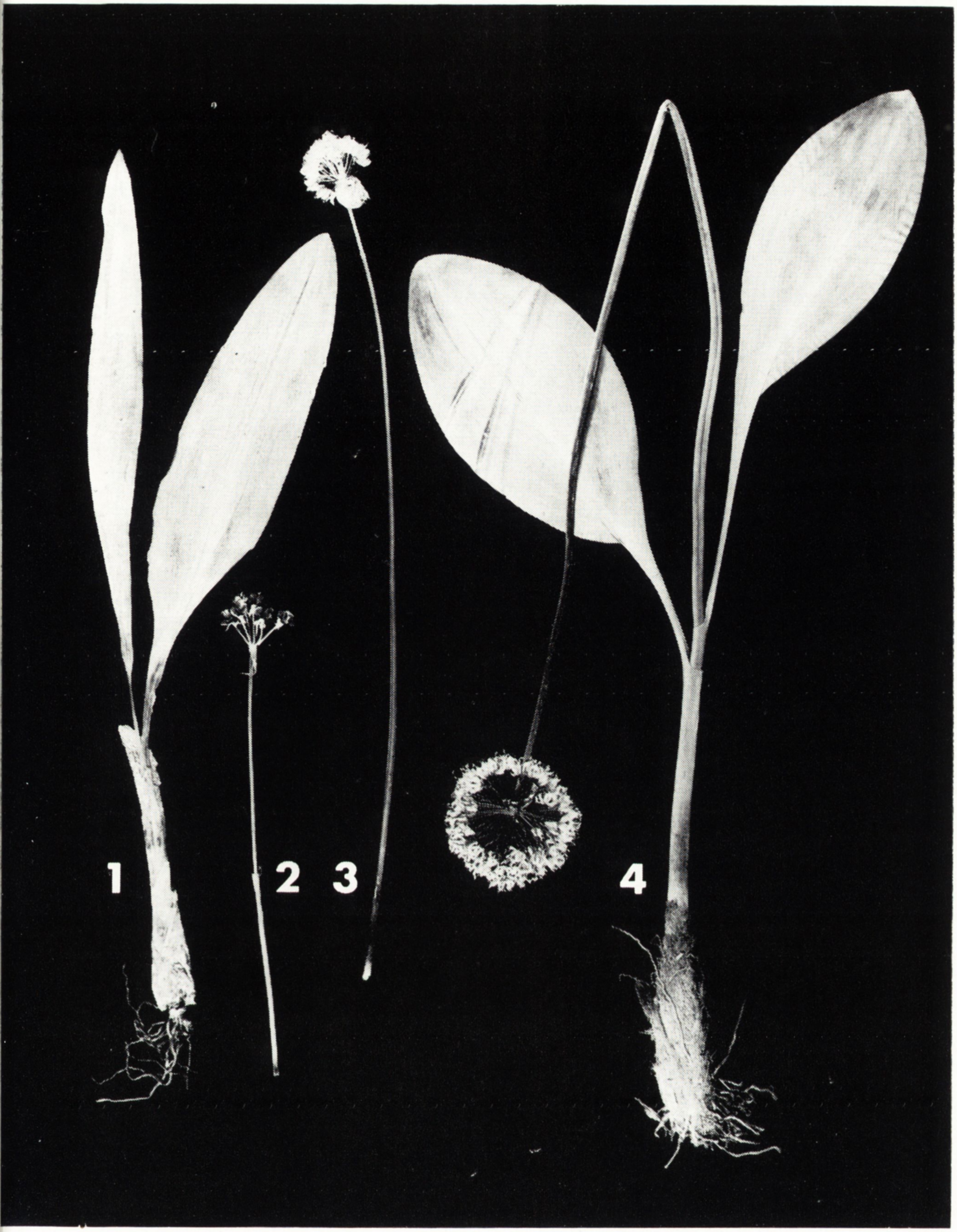

Fig. 2. 1—3: *Allium tricoccum* AITON — 1: Bulb with leaves. — 2: Scape with fruiting inflorescence. — 3: Inflorescence. The scape elongates after the leaves have wilted. — 4: *A. victorialis* L. The leaves are still fresh at the time of flowering. — 1—3: L. M. UMBACH, 1895, s.n. — 4: S. HAMAYA no. 353, 1961. — ×0.4.

CONCLUSIONS

The section *Anguinum* should be placed in the subgenus *Rhizirideum* (KOCH) WENDELBO. The species of the section have a rhizome and the increase and renewal bulbs are slender and tapering with only a small storage function. There are two species of the section, viz. *A. tricoccum* and *A. victorialis.* Especially in Asia the latter species is extremely variable and many forms have been described as species.

The section *Anguinum* has a boreal circumpolar geographical range. A similar distribution but even more boreal has section *Schoenoprasum* DUMORTIER also of the subgenus *Rhizirideum. A. schoenoprasum* occurs in Canada and in Eurasia. A second species of the section *A. atrosanguineum* SCHRENK s.l. constitutes a very complex, exceedingly polymorphic cycle in Asia analogous to the polymorphism of *A. victorialis* L. s.l.

ACKNOWLEDGEMENTS

I am indebted to the late Dr. H. SMITH, Uppsala, for sending his material of *Allium* on loan and to Dr. J. ERIKSSON, Göteborg, for bringing living material of *Allium tricoccum* from Canada.

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Studies in the Genus Allium VI

Bulb Structure in the Subgenus Melanocrommyum

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ABSTRACT

EKBERG, L. 1972. Studies in the genus Allium VI. Bulb structure in the subgenus Melanocrommyum. — Bot. Notiser 125: 93—101.

In the subgenus *Melanocrommyum* (WEBB & BERTH.) WENDELBO the characteristic structure of the bulb is very uniform. The outer tunic consists of the old storage cataphyll which is shrunken and crusty. Inside this is the old dark basal parts of the leaf-sheaths, which are often papyraceous or fibrous. They have a protective function. There is one large swollen storage cataphyll followed by two sprout leaves of which the outer is richer in storage material. The function of this outer sprout leaf is to pass through the storage cataphyll and facilitate the penetration of the other leaves. The foliage leaves (one to several in number) are always cucullate at their apex. They are spirally arranged and have a convolute vernation. The bulbs of the species of this subgenus are inedible due to bitter liquids. The liquid is often red to brownish red and has been used as a dye.

INTRODUCTION

The subgenus *Melanocrommyum* (WEBB & BERTH.) WENDELBO (1969 p. 27) has a wide distribution in West and Central Asia. In Flora URSS 45 species of the subgenus (VVEDENSKY 1935) are listed and in Flora Iranica (WENDELBO 1971) 47 species. There is a great variation in size from for example the small one-leaved *Allium monophyllum* VVED. to the several-leaved *A. giganteum* REGEL which may be taller than a man.

The species of subgenus *Melanocrommyum* are easy to recognize and to distinguish from other taxa of *Allium*. Characteristic are the more or less basal, spirally arranged, strongly cucullate and flat, often broad, leaves. The very distinctly cucullate leaf apex is not found in any species of the other subgenera of *Allium*.

MATERIAL

It has been possible to study living material both in cultivation in the Botanical Garden of Göteborg and in the field during a collecting expedition in Afghanistan 1969 arranged by Mr. I. HEDGE of Edinburgh and Prof. P. WENDELBO of Göteborg. The 33 species listed below are or have been in cultivation in Göteborg. I have had opportunities to follow them during their development through the whole vegetation period.

In the following list, W stands for WENDELBO.

Sect. Acanthoprason Wendelbo

A. akaka GMEL., POLUNIN 2631
A. breviscapum STAPF, FURSE 2593
A. cristophii TRAUTV., C. G. VAN TUBERGEN cult.
A. derderianum REGEL, ŽUMER 691
A. elburzense WENDELBO, ŽUMER 808
A. shelkovnikovii GROSSH., ARCHIBALD 2075

Sect. Kaloprason C. Koch

A. caspium (Pallas) M. B., Furse 7610
A. protensum Wendelbo, W. 7773
A. schubertii Zucc., C. G. van Tubergen, cult.

Sect. Megaloprason Wendelbo

A. aflatunense B. Fedtsch., C. G. van Tubergen, cult.
A. altissimum Regel, W. 8237
A. badakhshanicum Wendelbo, W. 9414 and typus
A. calocephalum Wendelbo, Furse, cult.
A. chelotum Wendelbo, Darli, Iran, W. s.n.
A. giganteum Regel, C. G. van Tubergen, cult. and W. 8127
A. karataviense Regel, C. G. van Tubergen, cult.
A. macleanii Baker, C. G. van Tubergen, cult. and W. 7334
A. rosenbachianum Regel, Lindberg 634
A. sarawschanicum Regel, W. 3781
A. stipitatum Regel, C. G. van Tubergen, cult.
A. suworowii Regel, W. 8104

Sect. Melanocrommyum

A. aschersonianum L., Central Negev, Israel, W. s.n.
A. cardiostemon Fisch., Davis 29315
A. colchicifolium Boiss., Archibald 1167
A. nigrum L., Davis 16549
A. rothii Zucc., Central Negev, Israel, W. s.n.

Sect. Regeloprason Wendelbo

A. cathodicarpum Wendelbo, Hewer 937
A. regelii Trautv., W. 8243
A. winklerianum Regel, W. 8627

Sect. Thaumasioprason Wendelbo

A. caroli-henrici Wendelbo, W. 7272
A. cucullatum Wendelbo, Furse 8552
A. mirum Wendelbo, Furse 8784

ABBREVIATIONS

Abbreviations used in text and figures 1—3: a.l., abscission layer; f, foliage leaf; f.p., flower primordium; i.b., increase bulb; in, inflorescence; o.st., old stem-plate (from previous year); p, protective leaf (tunic); p_o, protective cataphyll surrounding an increase bulb; p_s, protective cataphyll consisting of the storage cataphyll from the previous year; p.p., pedicel primordium; r.b., renewal bulb; r.p., root primordium; s, storage cataphyll; sc, scape; sp, sprout leaf; st.pl., stem-plate.

THE ORGANIZATION OF THE BULB IN MELANOCROMMYUM

The different kinds of cataphylls and leaves of the bulb are illustrated in Figures 1—3.

When a *Melanocrommyum* bulb is carefully dug up, the outer tunics often will be intact. The outermost tunic (p_s) is crusty and falls off very easily. It is formed by the remains of the storage cataphyll (s) from the previous year. The inner tunics are either papyraceous or fibrous. They are the remains of the basal parts of the sprout (sp) and foliage (f) leaves from the previous year. All these protective leaves are marked p in Fig. 1. The term tunic is used for the outermost scales of the bulb. Together with the inner tunics, the basal parts of the different kinds of old leaves, they serve as protection against desiccation of the renewal bulb. Inside the protective leaves (p) comes the only storage cataphyll (s), which is thick and rich in storage material. The storage cataphyll is normally followed by two sprout leaves. The outer sprout leaf (sp_1) is more swollen than the inner (sp_2) which grows higher up than the first (sp_1) and out of the bulb for a short distance (Fig. 3 O). A higher number than two sprout leaves is exceptional and only observed in *A. cristophii* on cultivated luxuriant material. Normally also this species has two sprout leaves. It has been noted only one sprout leaf in *A. aschersonianum* and *A. rothii* from Israel. This material was rather weak in cultivation.

The number of foliage leaves varies from one in several species up to fourteen in *A. cristophii,* but most usually there are 3 to 5. The leaves are cucullate at the apex and spirally arranged with a convolute vernation (Fig. 2 E).

The foliage leaves have double rows of vascular bundles — one dorsal and one ventral (Fig. 4 C—D). There is no keel or midrib on the leaf. The leaves are arranged in concentric circles at their

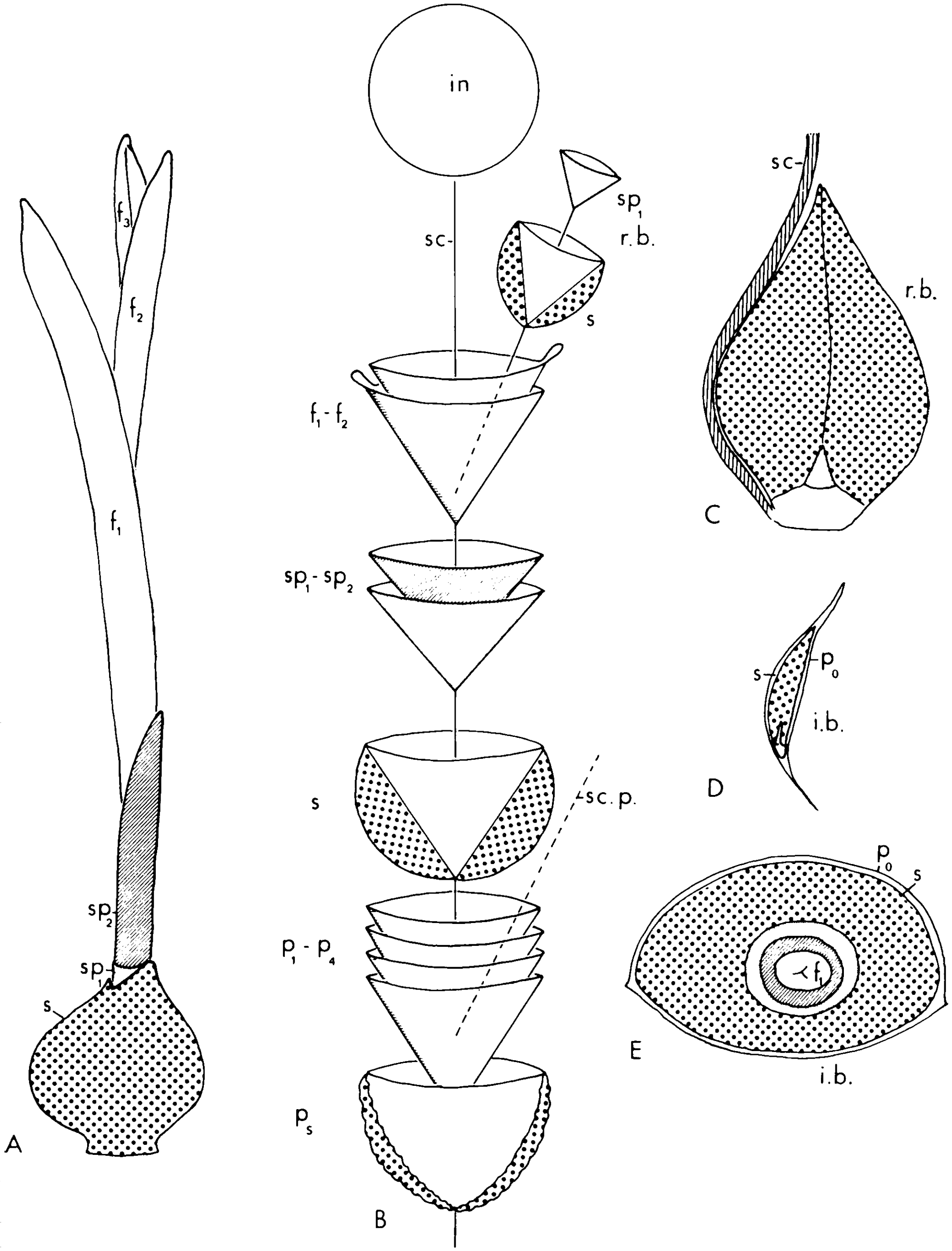


Fig. 1. A: Sprouting *Allium schubertii* Zucc. The foliage leaves are cucullate. Protective leaves removed. ×0.5. — B: Diagram of a plant of *A. karataviense* Regel at the time of flowering. The internodes have been elongated to show the individual leaves. — C—E: *A. giganteum* Regel — C: Renewal bulb and scape at time of fruiting. ×0.5. — D: Increase bulb, side view; P_0 is a hard brown shell. ×0.5. — E: Cross section of an increase bulb at the time when growth begins. ×5.

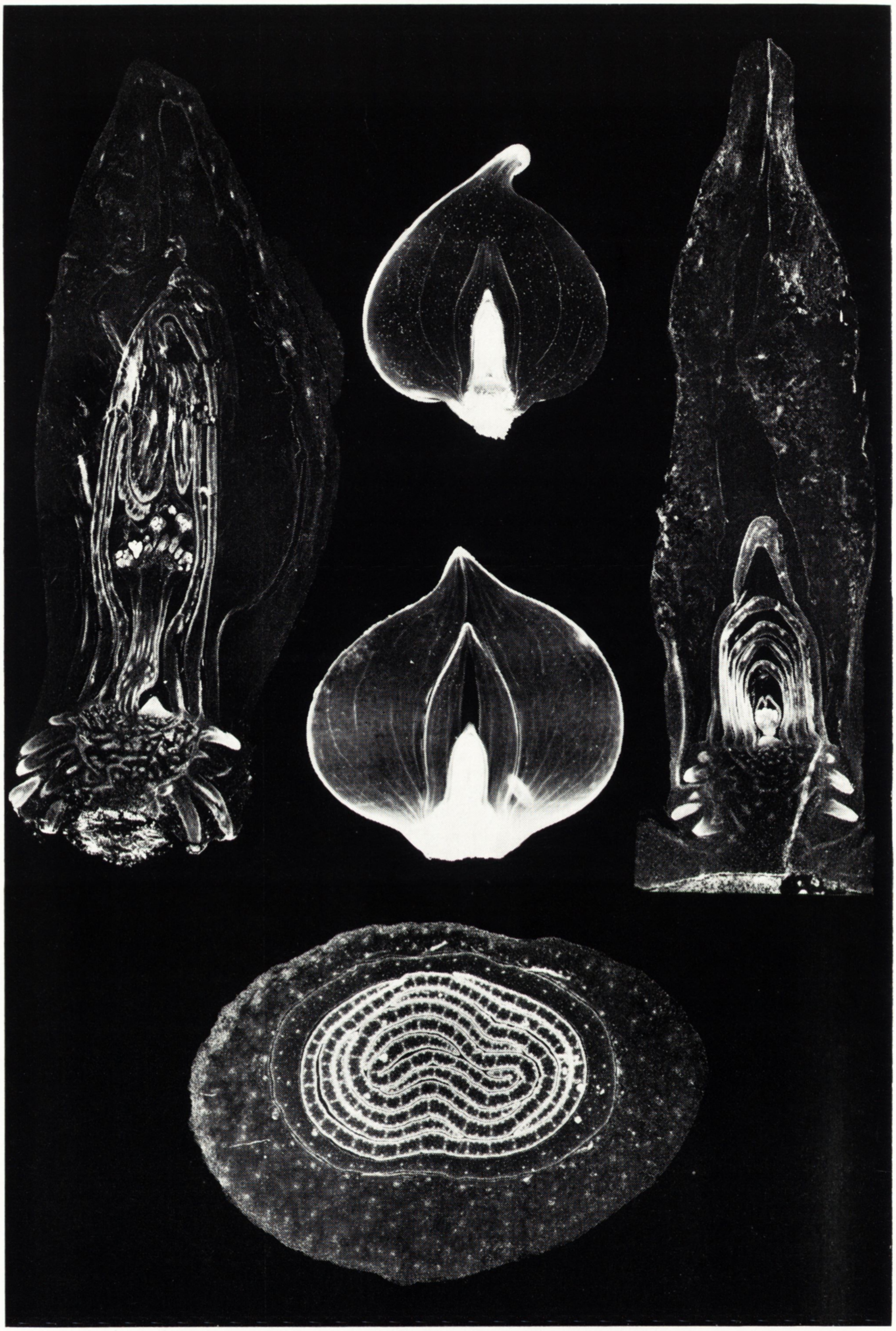
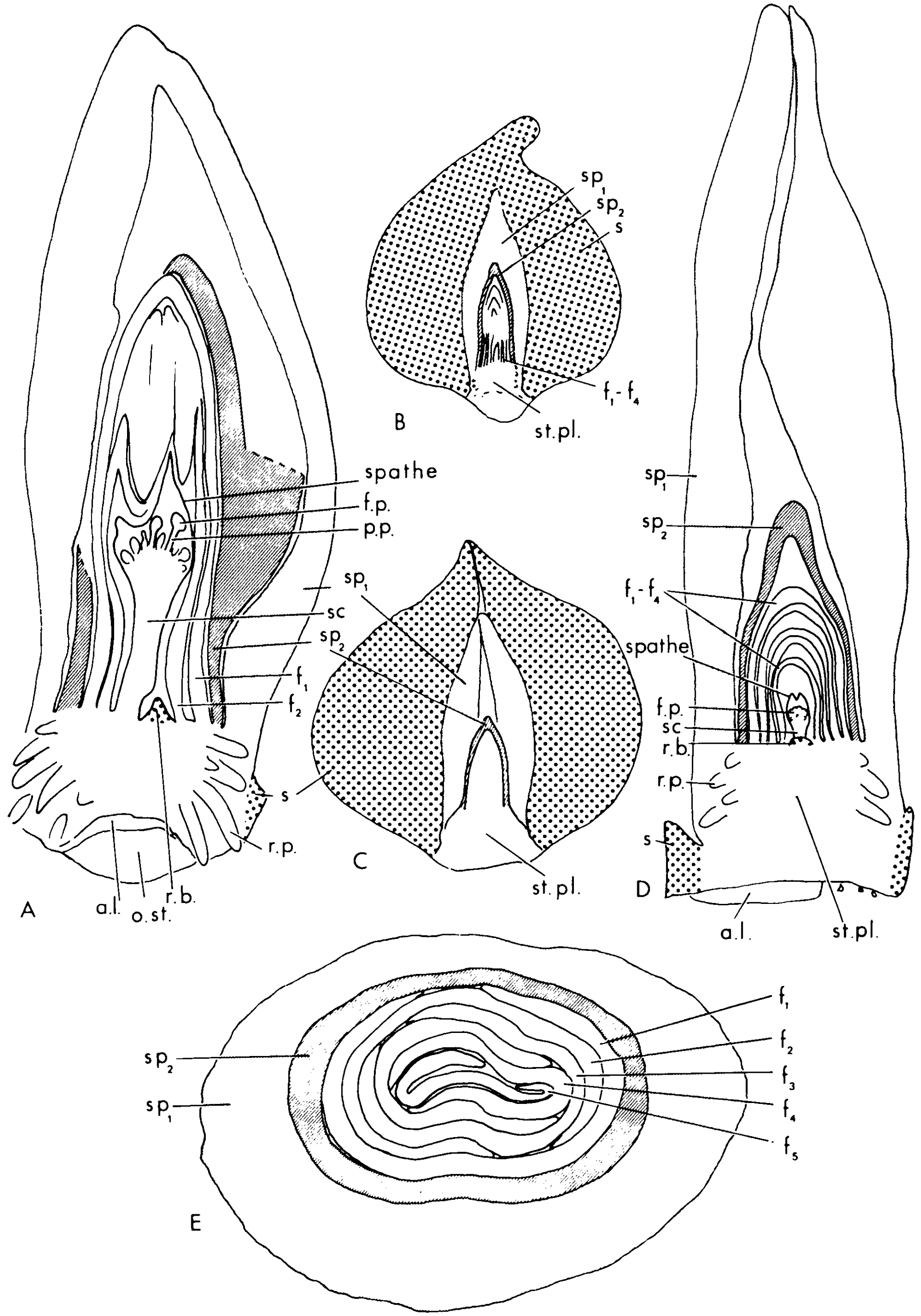


Fig. 2.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f₅

Fig. 2.

attachment to the stem-plate (Fig. 3 N). The innermost leaf surrounds the renewal bulb and scape. There is never a protective cataphyll (p_0) around the new bulb. As the bulb increases very rapidly in size during growth the scape becomes curved at the base and forms a shallow groove in the bulb.

Occasionally more than one bulb will be formed especially when there is some damage or an incision in the stem-plate. These bulbs do not occur normally, but can be regarded as increase bulbs arising in cultivation and developed by abnormal conditions. They are not surrounded by any protective cataphylls.

Another kind of increase bulbs is mentioned by EKBERG (1969 p. 66). These increase bulbs are stalked and have a hard protective cataphyll surrounding the bulb like a nut-shell (Fig. 1 D—E). They are developed between the foliage leaves thus have a flattened shape. Such bulbs are commonly found in the species *aflatunense, giganteum, regelii* and *winklerianum.*

The stem-plate from the previous year will always be detached by a well-developed abscission layer (a.l.) at the base of the new stemplate (Fig. 2 A, D).

The Formation of a Renewal Bulb

Even in the early stages of the growth period of the main bulb, a renewal bulb and a scape are easily recognizable in a primordial stage (Fig. 2 A, D).

When the foliage leaves are just protruding from the bulb (Fig. 1 A), the renewal bulb is already well developed. It seems as if this quick growth cannot be due to assimilation by the leaves but rather is caused by a restoring of material which is directly transferred via the stem-plate from the thick storage cataphyll of the renewal bulb. This could be an adaptation to a short vegetation period which some years may fail due to drought. In such a case the storage material will be transferred very quickly to the new bulb and the bulb will be able to survive to the next vegetation period, even if some material has been lost.

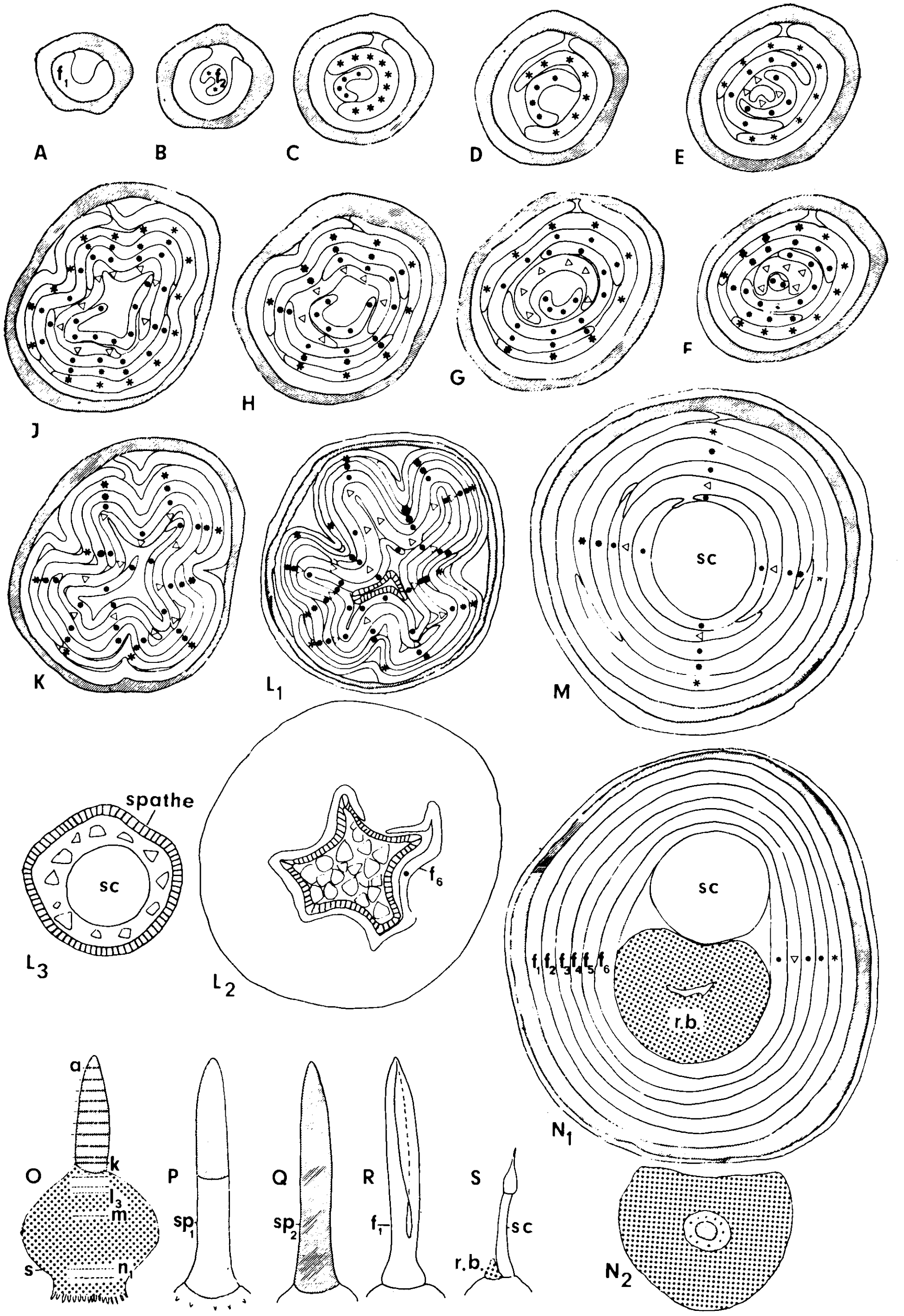
CHARACTERIZATION OF THE SUBGENUS MELANOCROMMYUM

It is difficult to find useful characters for the different subgenera and sections from herbarium material. It is only by studying living material during the whole yearly cycle that many characters hidden or absent in dried material will be revealed.

In Fig. 4, a leaf of *A. giganteum* is given as an example of the orientation of vascular bundles in *Melanocrommyum.* The same kind of orientation is seen in *A. cristophii, A. karataviense, A. macleanii* and *A. stipitatum. A. oreophilum* C. A.

Fig. 2. A—D: Longitudinal sections through bulbs at the time of the beginning of growth period. In A and D the storage cataphylls are removed. — E: Cross section through a bulb above spathe (storage cataphyll removed). — A: *Allium karataviense* REGEL, ×4. — B: *A. schubertii* ZUCC., ×1. — C: *A. stipitatum* REGEL, ×1. — D: *A. giganteum* REGEL, ×5. — Photo: H. RASPER. a l, abscission layer; f, foliage leaf primordium; f.p., flower primordium; o.st., old stem-plate; p.p., pedicel primordium; r.b., renewal bulb primordium; r.p., root primordium; s, storage cataphyll; sc, scape; sp, sprout leaf primordium; st.pl., stem-plate.

Fig. 3. *Allium macleanii* BAKER. — A—N: Cross sections of a sprouting bulb at levels marked respectively A—N in O. ×c. 3. — P—S: The same bulb as in A—N in sideview, ×0.33. In O the bulb is illustrated with the protective leaves removed. The storage cataphyll hides the first sprout leaf. In Q the second sprout leaf is not yet opened. — R: The first foliage leaf in vernation. — S: The scape and renewal bulb is exposed when the sixth foliage leaf is removed. There is no protective cataphyll around the renewal bulb. A cross section of the renewal bulb at base is shown in N_2.


A
B
C
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E
f_1
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f_6
N_1
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N_2

Fig. 3.

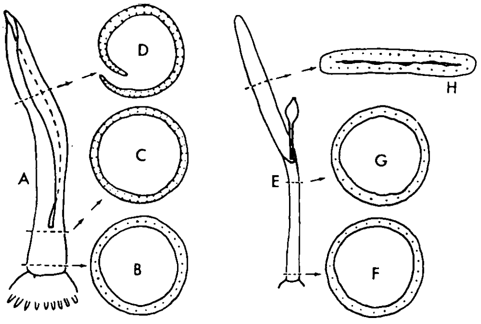

Fig. 4. Schematic figure of orientation of vascular bundles in different kinds of *Allium* leaves. — A—D: *A. giganteum* REGEL — E—H: *A. oreophilum* C. A. MEY. Only the leaves are marked in the cross sections. — A, E: Young stages in which the outer leaves are removed to show the innermost leaf. — B—D, F—H: Cross sections at different levels to show the number of rows of vascular bundles. The only row in B splits up into two (C) just above the base. In E—H the vascular bundles do not split. In A the scape will grow up in center and the leaf will open, but in E the scape must break through the leaf.

Two rows of vascular bundles in a leaf can arise either by splitting of one row into two (D) or by the original bundles not splitting but the primary circular leaf flattening out so that the bundles will lie opposite each other as in H.

MEY. of the sect. *Porphyroprason* EKBERG of subgenus *Molium* (KOCH) WENDELBO is chosen as an example of an *Allium* with two rows of vascular bundles, but with another development of the leaf.

There is a difference between the leaves of *Melanocrommyum* species and other *Allium* species with two rows of vascular bundles. In *Melanocrommyum* there is primarily one row which divides into two, but in species from other groups of *Allium* the two rows originate from a flattened circular leaf (Fig. 4 H). The scape breaks through the leaf, but in the subgenus *Melanocrommyum* the leaf opens gradually as there is an inhibition of growth near the top in one point of the at this stage conical primordial leaf.

As a result of anatomical studies of *Allium* leaves, MENZ (1922 p. 23) proposed transferring *A. nigrum* (the only species studied of the subgenus *Melanocrommyum*) from section *Molium* to the subsection *Pseudomolium*.

Typical for the subgenus *Melanocrommyum* are the following features:

1. More than two ovules in each loculus of the ovary.

2. The leaves, which have a cucullate apex, have two rows of vascular bundles splitting from one row at the very base of the leaves (Fig. 4). The only row at the base of the leaf very soon divides into one ventral and one dorsal row of bundles (Fig. 2 E).

3. One large storage cataphyll in connection with two well-developed sprout leaves of which the outer contains more storage material.

4. The scape never breaks through the foliage leaf, but the leaf opens gradually by inhibition of growth in one point at the top of the conical primordial leaf.

5. An early development of the scape and the renewal bulb which lack any protective cataphyll. The renewal bulb can be seen at base of the scape. At this stage the foliage leaves of the main bulb are primordial and not even the sprout leaves have passed through the storage cataphyll. The only sign of growth in the bulb from outside are the root-tips coming out from the stem-plate.

6. The characteristic alliaceous smell is not present. Often there is a more or less dark brownish-red coloured liquid of bitter taste occurring in most parts of the plant. If the leaves are cut off this liquid will colour the cut-surface very soon.

DISCUSSION

The characters of points 3 and 5 above are partly relative but even so significant. The largest bulbs of those with only one storage cataphyll in *Allium* are found in the subgenus *Melanocrommyum*. The time for development of the scape and the renewal bulb is generally of systematic importance in *Allium.*

As many characters are specific for the subgenus *Melanocrommyum* this subgenus could be split off from *Allium* as a genus of its own although the chromosome numbers do not support this. The normal basic chromosome number of the subgenera *Allium, Rhizirideum* (C. Koch) Wendelbo and *Melanocrommyum* is x=8 (Vakhtina 1964, 1965 and 1969). There are several exceptions to the normal chromosome number in the subgenus *Melanocrommyum,* e.g. *A. karataviense* 2n=18 (Pedersen & Wendelbo 1966), *A. chelotum* Wendelbo 2n=20, *A. decipiens* Fisch. 2n=20 (Vakhtina 1969 p. 145).

Stalked increase bulbs surrounded by one or a few protective cataphylls are very frequent in the subgenera *Allium* and *Molium.* They are rarely found in *Melanocrommyum* but their occurrence in a few species would also indicate a relationship between *Melanocrommyum* and the former subgenera.

ACKNOWLEDGEMENTS

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The Genus Hypocalyptus Thunb. (Fabaceae)

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ABSTRACT

DAHLGREN, R. 1972. The genus Hypocalyptus Thunb. (Fabaceae). — Bot. Notiser 125: 102—125.

The genus *Hypocalyptus* THUNB. has been investigated. It has been extended to include the former genus *Loddigesia* SIMS as well as what formerly was known as *Crotalaria* sect. *Purpureae* BENTH., each consisting of one species. *Hypocalyptus* in this new sense thus comprises three species. Reasons for the inclusion of the last two groups are given. The general morphology and the pollen of the species are described. The hairs in all three species have more prominent projections on the surface than in other genera showing otherwise similarities. Comparison is made between *Hypocalyptus* and other genera, viz. *Crotalaria, Podalyria, Amphithalea, Priestleya* and *Cytisus.* Though displaying similarities with these and other genera, *Hypocalyptus* appears to be a morphologically isolated genus of the Genisteae both in South Africa and in other regions, having no decidedly close affinity with any other genus. Surface structures of hairs are pointed out as being a useful complementary tool in fabaceous taxonomy. — New combination: *Hypocalyptus coluteoides* (LAM.) R. DAHLGR.

INTRODUCTION

In 1966 I collected what appeared to be a species of *Hypocalyptus* in the lower part of a kloof on the eastern side of the Hottentots Holland Mountains in Caledon Division, South Africa. The species agreed in all essential characters with the species known as *H. sophoroides,* except that the legumes were much more inflated and rather like those of *Colutea.*

A closer study revealed that the species is not rare and had previously been described as *Crotalaria coluteoides* by LAMARCK and as *Crotalaria purpurea* by VENTENAT. The most appropriate place for the species should be in *Hypocalyptus,* however. In POLHILL's account of *Crotalaria* (1968 p. 173) the similarity between *C. purpurea* and *Hypocalyptus* was pointed out, but POLHILL refrained from transferring the species. *C. purpurea* (*C. coluteoides*) was still retained in a special, very aberrant section, *Purpureae* (established by BENTHAM as early as 1843), under *Crotalaria.*

As the genus displays interesting examples of variation and further presents a problem of generic distinction, namely the justification of the genus *Loddigesia* SIMS, it has been studied more extensively than was originally intended. The study is based on material from the following herbaria, abbreviated according to LANJOUW & STAFLEU (1964): BOL, CT, LD, NBG, PRE, S, SAM, SBT, STE, and UPS, and on material collected by Dr. A. STRID and myself during 1965—66.

The English text has kindly been checked by Mrs. MARGARET PETERSSON.

PREVIOUS LITERATURE

The genus *Hypocalyptus* was described by THUNBERG in "Genera Nova Plantarum" (1800 b). In this work it comprised 8 species, 6 of which now fall within *Podalyria* LAM. (1793) and one (*H. capensis*) in *Virgilia* POIR. (1808). Thus only one species, *H. obcordatus*, remains in the present genus *Hypocalyptus*, and for most of its history the genus has indeed been regarded as monotypic. *Hypocalyptus* has accordingly undergone considerable emendation, and subsequent reduction since first being described.

Of the 8 *Hypocalyptus* species in THUNBERG 1800 b, four of them (*H. cordatus, calyptratus, pedunculatus,* and *capensis*) had been previously described by THUNBERG in the first part of his Prodromus (1794), under the genus *Sophora*. Four only were therefore described under *Hypocalyptus* in the second part of the Prodromus (THUNBERG 1800 a), viz. *H. glaucus, sericeus, canescens,* and *obcordatus*. All of the first four species were transferred to *Podalyria* by WILLDENOW (1799) and BROWN (in AITON 1811), and three of the last four were later placed in this genus by BROWN (op. cit.), DE CANDOLLE (1825) and others. Of the eight species mentioned, further reference will mainly be made to *H. obcordatus* THUNB.

Hypocalyptus obcordatus was considerably antedated by two other names applied to the same species, namely *Spartium sophoroides* BERGIUS (1767 p. 198) and the superfluous name *Crotalaria cordifolia* LINNAEUS (1771 p. 266). In THUNBERG 1800 a, *Spartium sophoroides* BERG. was cited as a synonym of *Hypocalyptus obcordatus*, and in THUNBERG 1800 b of *Crotalaria cordifolia* L., so that *H. obcordatus* must also be regarded as superfluous from the point of view of nomenclature, and is thus illegitimate. However, there is nothing in the Code that states that a valid description of a genus must be accompanied by a legitimate specific name.

In WILLDENOW's Species plantarum (1802) the genus *Hypocalyptus* does not appear at all. *H. obcordatus* as well as *Spartium sophoroides* were included as synonyms of *Crotalaria cordifolia* L.

R. BROWN (in AITON 1811) was the first to transfer some of the *Hypocalyptus* species to *Podalyria*, and DE CANDOLLE (1825) accepted the transfer, treating *Hypocalyptus* as monotypic with the single species *H. obcordatus*. It was also later recorded under this name by ECKLON & ZEYHER (1836 p. 173) and MEYER (1836 p. 28), in CURTIS's Botanical Magazine (1842, plate 3894), and by HARVEY in Flora Capensis (1862 p. 82).

BAILLON (1870 p. 336) was the first to use the combination *Hypocalyptus sophoroides* (in a foot-note, with a careful account of basionym), which has subsequently been neglected by botanists. BAILLON (loc. cit.) also included the genus *Loddigesia* in *Hypocalyptus*, and even (in another foot-note) used the combination *Hypocalyptus oxalidifolius*, which has likewise been overlooked by later botanists, e.g. PHILLIPS (1942 p. 284), who later claimed the latter combination to be new. BAILLON finally labelled the plates "Bot. Reg., t. 128" and "Bot. Mag., t. 1913" *Hypocalyptus* (both *H. coluteoides* in this paper), though he did not regard them to be distinct from *H. sophoroides*, a mistake repeated by HUTCHINSON about 75 years later (1946 p. 183)!

The second species of *Hypocalyptus*, viz. *H. coluteoides* (LAM.) R. DAHLGR. comb. nov., was first described as *Crotalaria coluteoides* by LAMARCK (1786 p. 200). Later, it was independently described as *Crotalaria purpurea* by VENTENAT (1804, plate 66). It was recorded under the latter name by ECKLON & ZEYHER (1836 p. 173) and illustrated in Botanical Register (1816, plate 128) as well as in CURTIS's Botanical Magazine (1817, plate 1913). BENTHAM (1843 p. 590) gave *C. coluteoides* (in spite of being the first name) as a synonym of *C. purpurea* and placed the species in a separate section of *Crotalaria*, "*Purpureae*", with obvious doubts as to the position of the species. BAKER (1914 p. 358) contributed further information on the distribution.

VERDOORN (1928 p. 393) noted that *C. purpurea* "approaches *Hypocalyptus,* but differs in having the inflated pod of *Crotalaria*". This point of similarity with *Hypocalyptus* was further documented by POLHILL (1968 p. 173), but resulted in no changes in nomenclature or systematic position.

The assembled evidence in this article has finally resulted in the removal of the species *coluteoides* from *Crotalaria* to *Hypocalyptus,* which is accordingly done for the first time.

The third species treated here, *Hypocalyptus oxalidifolius* (SIMS) BAILL., was first described as *Loddigesia oxalidifolia* by SIMS in CURTIS's Botanical Magazine (SIMS 1806) with a plate, no. 965, of the plant drawn from a specimen cultivated in England. The genus was named after LODDIGES, a famous English gardener. Since then, *L. oxalidifolia* has been mentioned in botanical works by DE CANDOLLE (1825 p. 136), ECKLON & ZEYHER (1836 p. 173), MEYER (1836 p. 36), BENTHAM (1844 p. 355), HARVEY (1862 p. 82) and BENTHAM & HOOKER (1867 p. 485). It was first included in *Hypocalyptus* by BAILLON (1870 p. 336, see above) and later, independently, by PHILLIPS (1942 p. 284; se also PHILLIPS 1951 p. 409).

The species is doubtless distinct but with such close affinities to the previous two that it is here included in *Hypocalyptus.* The reasons for this will be explained further on.

THE GENUS HYPOCALYPTUS

Hypocalyptus THUNBERG 1800 b, emend. BAILLON 1870, emend. DAHLGREN 1972 (incl. *Loddigesia* SIMS 1806 et *Crotalaria* L. sect. *Purpureae* BENTHAM 1843).

Type species: *Hypocalyptus sophoroides* (BERG.) BAILL. (syn. *H. obcordatus* THUNB.).

Shrubs, or rarely trees, 0.2—3(—6) metres high, usually with dark reddish, smooth or longitudinally striated to sulcate branches, glabrous or sparsely to closely pubescent on the youngest parts. Hairs 3-celled, unbranched, with rough surface, prominently warty to papillate (Fig. 8) when seen under the microscope.

Leaves alternate, trifoliolate, petiolate, basally with shortly triangular to longer, linear stipules; leaflets oblanceolate to broadly obovate, entire, generally with distinct apical tip.

Inflorescence a terminal raceme with from 2 to more than 50 flowers borne in axils of simple, linear(—lanceolate), narrow, entire or sometimes laterally denticulate, usually caducous bracts.

Pedicel usually rather long, with a pair of bracteoles similar in shape to, but narrower than the bracts.

Calyx in bud stage narrowly campanulate, but at the onset of anthesis drawn backwards around the base (as in *Priestleya, Cyclopia* and *Podalyria*); upper two lobes more or less united medially up to less than 1 mm from the apices, lateral incisions deeper; lower lobes deltoid to narrowly triangular.

Corolla papilionaceous, glabrous, more or less violet but usually with yellow basal spot on the vexillum. Vexillum blade ovate—circular, sometimes relatively small, with short claw. One small, disc-shaped callus present on each side of the vexillum base on the inner sides of the claw. Ala blades elongate, rounded, and in the apical half much widened, basally with 1—2 rows of transverse to oblique, slight folds on the upper parts; claws relatively short. Carina lunate to subrostrate, not as exserted as is usual in *Crotalaria,* without prominent lateral spurs, basally with a rather prominent upper ear, and with rather short but distinct claws.

Filaments united along most of their length into a tube also closed on the upper side. Basifixed anthers only slightly (about 10—20 per cent) longer than the dorsifixed.

Pistil glabrous, with thick stipe of somewhat variable length, with a linear, smooth or somewhat striated ovary containing 3—about 30 ovules, with ascending, glabrous style, and with a capitate, regular stigma.

Fruit varying much more than pistil between the species, representing either a linear, 5—6-seeded legume 35—65×5—6 mm — or an inflated, rather *Colutea*-like legume 23—38×10—14 mm in size, with parchment-like walls — or a rather flat, obovate legume 13—18×6—8 mm in size, pointed at both ends. Seeds dark, rather large, with a whitish, annular, collar-like strophiole.

DISTRIBUTION AND HABITAT

The genus is restricted to the Cape Province, ranging from the Clanwilliam Division in the north-west to the Caledon and Bredasdorp Divisions in the south-west and — north as well as south of the Little Karroo — eastwards to the Port Elizabeth and Uitenhage Divisions.

The three species generally occur on rather moist ground, on steep slopes or in kloofs and often associated with water courses. They usually grow on sandy soil.

KEY TO THE SPECIES

1 A. Calyx tube with short, adpressed hairs .... *H. coluteoides*
1 B. Calyx tube glabrous or almost glabrous.
  2 A. Flowers usually 30 or more, in a dense raceme with tomentose axis; legume linear, 35—65 mm long .... *H. sophoroides*
  2 B. Flowers fewer, usually less than 8 but sometimes up to 15, in short racemes; legume flat, obovate, less than 20 mm long .... *H. oxalidifolius*

Hypocalyptus sophoroides (Berg.) Baill.

Baillon 1870 p. 336 (foot-note). — *Hypocalyptus sophoroides* (Berg.) Druce 1917 p. 628; Hutchinson 1946 p. 183; Rice & Compton 1950 plate 41; Hutchinson 1964 p. 351; Polhill 1968 p. 173. — *Spartium sophoroides* Berg.; Bergius 1767 p. 198. — Type: In Bergius' herbarium (SBT, holotype).

Crotalaria cordifolia L., nom. illeg.; Linnaeus 1771 p. 266. — The name is illegitimate since *Spartium sophoroides* Berg. was given as a synonym and is automatically rejected as being superfluous. — *Hypocalyptus cordifolius* (L) Taub.; Taubert 1894 p. 240. — A specimen in LINN (895: 30) named *Crotalaria cordifolia* in Linnaeus's handwriting corresponds well with the species here discussed.

Hypocalyptus obcordatus Thunb., nom. illeg.; Thunberg 1800 a p. 154 and 1800 b p. 124. The name is illegitimate and superfluous for the above reasons; *Spartium sophoroides* Berg. (in Thunberg 1800 a) and *Crotalaria cordifolia* L. (in Th. 1800 b) respectively were given as synonyms. The species was mentioned under the name *H. obcordatus* Thunb., for example, by de Candolle 1825 p. 135, Curtis & Hooker 1842 plate 3894, Bentham 1844 p. 354, Harvey 1862 p. 82, and Phillips 1951 p. 409.

A much-branched shrub usually 1—3 metres or more high, seldom a basally unbranched tree up to 4 or rarely 6 m high. Branches dark, longitudinally striated or somewhat sulcate, ends sparsely tomentose or villous.

Leaves. Stipules subulate, usually 1.0—4.0 mm long, often later falling off, subglabrous or more or less hairy on the inner side. Petiole straight, rigid, firmly suberect to erect, varying in length from less than 4 mm to more than 13 mm, glabrous or rarely hairy. Leaflets with petiolule 0.5—3 mm long; lamina oblanceolate to obtriangular-obovate, 9—30 (—40)×6.5—18(—22) mm, narrowly cuneate at the base, obtuse or usually distinctly obcordate at the apex but with an acute to subulate point occasionally up to 1.5 mm long. Upper surface of leaflets glabrous, rather smooth, with faintly reticulate veinlets, canaliculate along the mid-vein; lower surface paler, with prominent mid-vein, subglabrous or very sparsely tomentose. Lateral halves of leaflets often folded up against each other, the upper surface thus being not or slightly exposed.

Inflorescence a dense, terminal raceme with generally more than 30 flowers borne only 1 mm or less from each other on a sparsely to densely tomentose axis. Raceme first spike-like and obtusely pyramidal, the buds in the apical part being closely set and greatly exceeded in length by the setaceous-filiform bracts; inflorescence later ovate and bracts gradually shed as anthesis proceeds.

Bracts setaceous, tapering, filiform towards the apex, 9—15(—18) mm long and 1.0—2.2 mm broad, caducous (see above), pubescent at least on basal parts and margins, sometimes with subhyaline margins in the basal half.

Pedicel usually 6—13 mm long during anthesis, rather slender, sparsely villous but glabrous towards the calyx.

Bracteoles situated near middle of pedicel, filiform, usually 3.5—7.5 mm long, pubescent.

Calyx externally glabrous, reddish, smooth, campanulate in the bud stage but with the basal parts drawn backwards towards the onset of anthesis. Upper two lobes joined medially into an upper "double lobe" up to a point only 0.3—0.6 mm from the apices; lateral incisions deeper, especially the lower ones; lobes triangular, the lowest, median lobe 1.5—2.6 mm long.

Petals glabrous, purple, but the vexillum blade centrally with a basal, large, light-yellow, violet-shaped spot. — Vexillum blade circular, usually 11—13.5× 11—15 mm in size, rounded at the apex, with the sides slightly deflexed during anthesis (as shown in Fig. 1 D); claw short, about 1 mm long or less, with lateral callus discs c. 0.8 mm in size. — Ala blades elongate, widened and rounded towards the apex, 11—14.5(—15.5) mm long and 4.5—7.0(—8.0) mm broad at the widest part; basal half with a main longitudinal fold and on the upper part with some rather slight transverse to oblique foldlets; claws usually 1.5—3.2 mm long. — Carina blades lunate, somewhat beaked, 9.0—11.5×(3.6—)4.0—5.0(—5.4) mm in size; claws 2.0—3.2 mm long.

Stamens. Basifixed anthers 0.9—1.1 mm and dorsifixed ones about 0.7—0.9 mm long.

Pistil. Ovary with 5—8(—12) ovules.

Fruit a linear legume usually 3.5—6.5 cm long and 4—6 mm broad, rather smooth, with distinct convexities for the (4—)5—6 seeds that mature, first pea-green, later reddish brown to almost black. Seeds dark brown to almost black, ovoid (Fig. 1 J), 4.0—4.8×c. 2.5 mm.

DISTRIBUTION

The distribution of *H. sophoroides* ranges from the Cedarberg Mountains, Clanwilliam Division, in the north-west along the mountains southwards to the Stellenbosch and Paarl Divisions (but not to the Cape Peninsula or to the southern parts of the Caledon Division). The species continues eastwards along the Groot Swartberg Ranges as far as Prince Albert Division. It is also found in the mountains south of Little Karroo, namely in the Langeberg Mountains of the Swellendam and Riversdale Divisions, but it is apparently rare in these regions, where on the other hand *H. coluteoides* is more common.

Fig. 1. *Hypocalyptus sophoroides.* — A—H: DAHLGREN & STRID no. 3368 from a kloof near Du Toit's Kloof Pass, Worcester Div.; I—J: DRÈGE sine no., from the same region; K: SIDEY no. 1879. — A: Leaf. — B: Bract. — C: Bracteole. — D: Flower. — E: Calyx (flowering stage). — F: Ala petal. — G: Carina petal. — H: Pistil. — I: Legume. — J: Seed. — K: Bud, to show the long calyx tube before becoming deflexed basally. — A and I ×2; B—H and K ×4; J ×8.

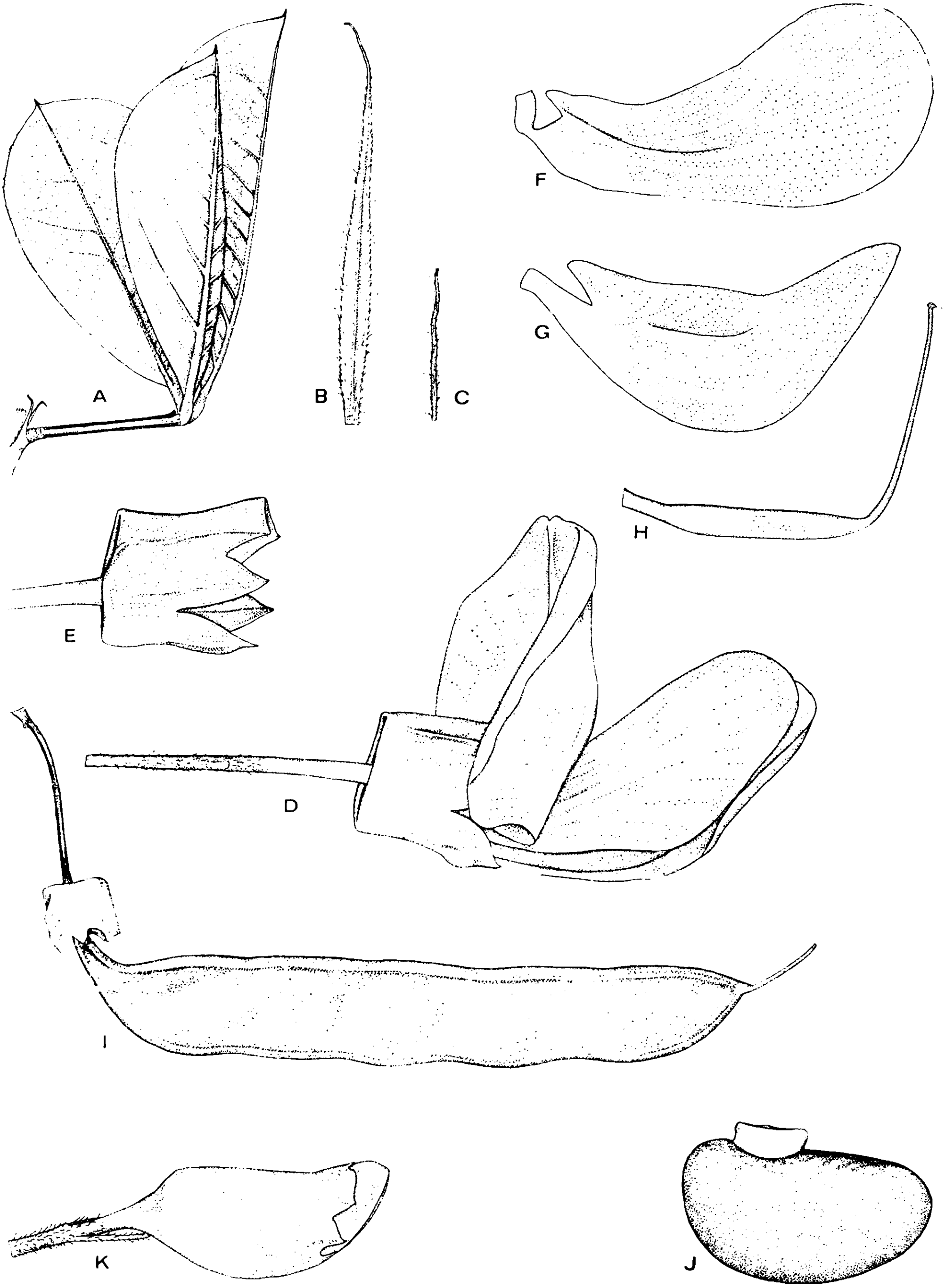

Fig. 1.

VARIATION

The geographical variation is difficult to survey because of the great difference in size and shape of leaves found on the same shrubs depending on their position on the shrub, the season, and the age of the shrub. However, in the material studied the populations in the Clanwilliam Division, in the Ceres and Tulbagh Divisions, and in the Hex River Valley in the Worcester Division in general have relatively small leaves with short petioles and strongly obcordate leaflets. More elongate and larger leaflets are found in populations south-east of the Breede River Valley and in the Groot Swartberg Mountains.

ECOLOGY

H. sophoroides grows in somewhat shaded and sheltered positions on mountain slopes at varying altitudes, from less than 200 feet (for example at Nieuwe Kloof, Tulbagh Division, and at Banhoek, Stellenbosch Division) up to altitudes of 5,000 feet or more, for example on the Middleberg in Cedarberg Mountains, Clanwilliam Division, and in the Groot Swartberg Mountains, Laingsburg—Prince Albert Divisions.

Habitat: Somewhat sheltered places, often steep slopes facing south and kloofs, especially near streams and in other damp places. The species grows on rocky or sandy slopes mainly in sand weathered from the sandstone of the Table Mountain Series (Cape System). In positions which have long been protected from fire the species may attain considerable height. I have seen trees 4 m high growing along a stream in a side kloof joining up with Du Toit's Kloof, Worcester Division, and H. S. GENTRY has recorded it (on a label) as being 6 m high (!) in the same region.

The species is found in fynbos or Cape macchia vegetation. In a typical habitat, a rocky slope above a stream, in Bain's Kloof, Wellington Division, F. WHITE recorded (on a label) the following associated species: *Royena glabra, Protea cynaroides, Cliffortia ruscifolia, Thamnochortus dichotomus, Stoebe plumosa, Gymnosporia laurina,* and *Psoralea aphylla.*

Hypocalyptus coluteoides (LAM.) R. DAHLGR., comb. nov.

Basionym: *Crotalaria coluteoides* LAM.; LAMARCK 1786 p. 200, DE CANDOLLE 1825 p. 131; BENTHAM 1843 p. 590 and HARVEY 1862 p. 46 (in these works as a synonym of *C. purpurea* VENT.); POLHILL 1968 p. 245. — Type: A specimen with the designation "*Crotalaria coluteoides* enc." in P-LAM (holotype).

Crotalaria purpurea VENT.; VENTENAT 1804 plate 66; Bot. Register 1816 plate 128; SIMS 1817 plate 1913; DE CANDOLLE 1825 p. 133; BENTHAM 1843 p. 590; HARVEY 1862 p. 46; TAUBERT 1894 p. 229; BAKER 1914 p. 358; VERDOORN 1928 p. 393; POLHILL 1968 pp. 173 and 245. — Type: The illustration in VENTENAT 1804 mentioned above, if the prototype of this plate cannot be found. The illustration is extraordinarily well drawn.

"*Crotalaria elegans* hortul." was given as a synonym of *Crotalaria purpurea* VENT. in DE CANDOLLE 1825 p. 134, and has not been validly published.

A tall shrub usually 1.5—2.5(—3) metres high, much branched with slender, dark brownish-purple, and smooth or longitudinally striated branches sparsely to densely puberulous on the youngest parts.

Leaves. Stipules less than 1 mm long

Fig. 2. *Hypocalyptus coluteoides*, mainly from the Kogelberg region, Hottentots Holland Mts, Caledon Div. — A—C and F—K: DAHLGREN & STRID no. 4239; D—E: STOKOE, SAM no. 54527; L: BARNARD, SAM no. 44598. — A: Leaf, stipules fallen off. — B: Stipulate base of young leaf. — C: Flower. — D: Bract. — E: Bracteole. — F: Calyx at flowering stage. — G: Ala petal. — H: Carina petal. — I: Pistil. — J: Four of the stamens cut off at some distance from the base. — K: Fruit. — L: Seed. — A ×1.2; B—I ×4; J and L ×8; K ×2.

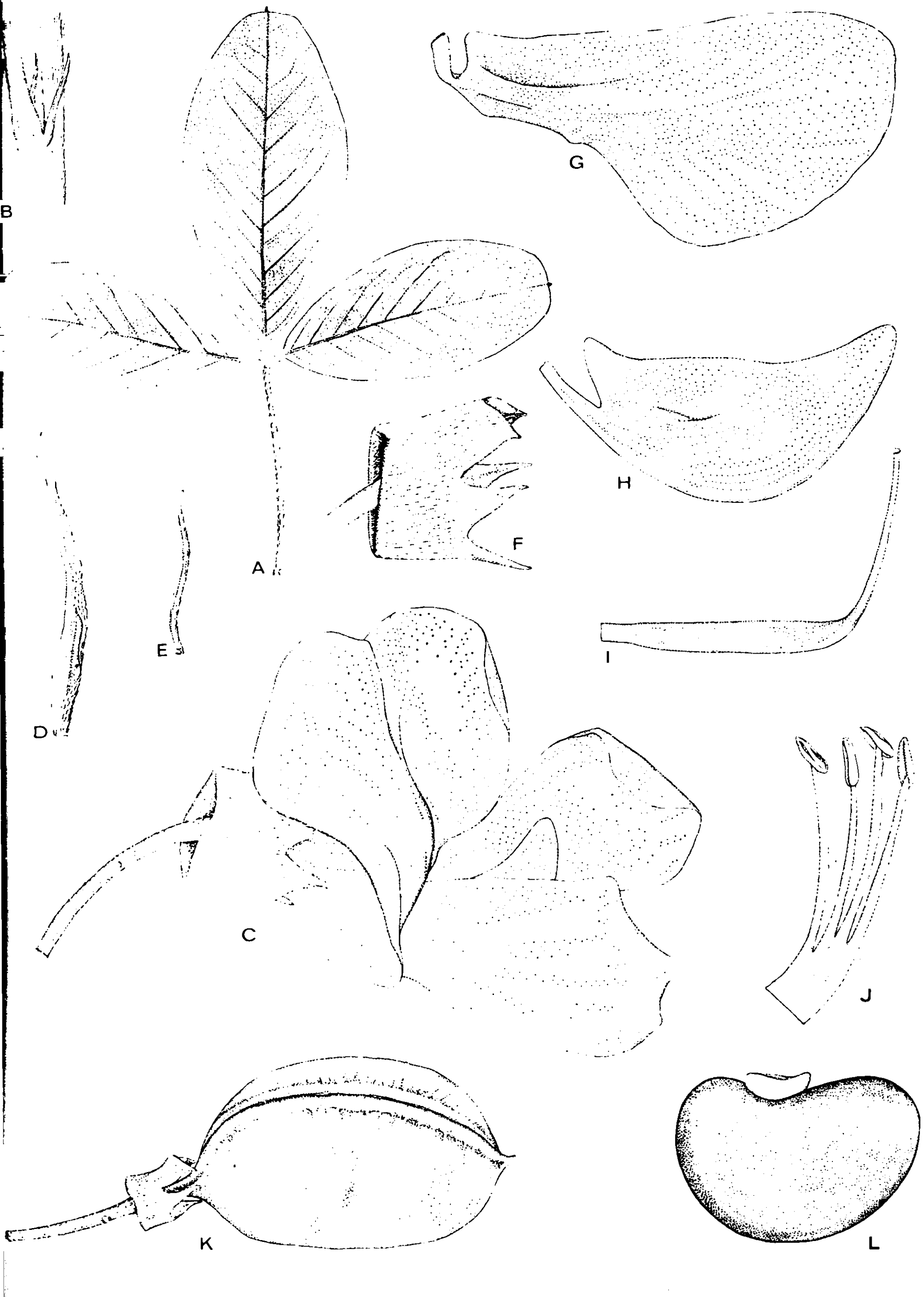

Fig. 2.

and triangular or narrowly triangular in most forms, but in certain western forms (see map in Fig. 6) usually 3.5—5.5 mm long, linear, and similar to the bracts of *H. sophoroides,* puberulous on most parts, often shed, however, at an early stage. Petioles of adult leaves 0.9—2.5 (—3) cm long, adpressedly puberulous, first half-erect, becoming deflexed at the base as axillary branches develop. Leaflets narrowly obovate, usually rather drooping, generally 2.3—5.0 cm long and 1.3—2.5(—3.0) cm broad; central leaflets generally slightly longer than the lateral ones. Leaflets with a basal petiolule 1.5—3(—5) mm long and sparsely to very closely pubescent; lamina rounded-obtuse to truncate at the apex but with the midrib ending as a little tip less than 0.5 mm in length; surface rather smooth, sparsely to very sparsely adpressed-puberulous.

Inflorescence a sparse or rarely dense raceme of 6—15(—25) flowers on a pubescent axis usually 3—6 cm in length.

Flower buds in the axils of linear, entire bracts, but these often falling off in early bud stage, seldom persistent until flowering and fruiting stages; in the lower part of the spike up to 10 mm long or more, somewhat shorter in the upper part, linear-setaceous, often more or less U-shaped in transverse section, short-sericeous at least on the basal parts and on mid-vein of the lower side.

Pedicel 3.5—10(—12) mm long (in fruiting stage often longer), rather slender, short-sericeous.

Bracteoles generally shed in the early bud stage, similar to the bracts but shorter, 3.0—5.0(—6.0) mm long.

Calyx tube covered with short, adpressed, rather sparse hairs. Upper two lobes medially united only to about 0.2—0.8 mm from the tips, forming a more or less square "double lobe"; lateral and especially the lower lateral incisions deeper; lowest lobe 1.5—2.8(—3.5) mm long.

Petals glabrous, bright mauvish pink, but the centre of the vexillum basally yellow. — Vexillum blade orbicular, (11—)12—15(—16) × (10.5—)11.5—16 mm in size, rounded at the apex, with a yellow, rectangular spot about 6×3 mm in size at the base of the inner side; claw only 0.7—1.5 mm long, rather broad, with lateral callus discs c. 0.8 mm in size. — Ala blades of shape as in Fig. 2 G, the apical half wide and expanded, the basal half narrower, firmer and longitudinally slightly folded; (10.5—)11.5—14.5 × (5.5—)6.0—8.5 mm; basal upper parts with some diffuse transverse folds; claws 2.2—4.0 mm long. — Carina blades lunate and slightly beaked, 8.5—11.5(—12.0) × 4.0—6.0 mm in size; claws 2.5—3.4 mm long.

Stamens. Basifixed anthers 0.9—1.1 mm and dorsifixed ones about 0.7—0.9 mm long.

Pistil with (18—)20—30 ovules.

Fruit inflated, rather *Colutea*-like but harder, greenish when unripe, deep brown when ripe, usually 10—14 mm broad (between upper and lower "sutures") and 23—38 mm long including the stout 3—5 mm long stipe. Ripe seeds seldom seen, up to about 4.3×2.7 mm in size, dark brown to black.

DISTRIBUTION

The distribution is southern (Fig. 6 B). It ranges from the Hottentots Holland Mountains in the western parts of the Caledon Division in the west as far as Port Elizabeth in the east, mainly along the southern ranges, the Riversonderend, Langeberg, Outeniqua and Zizikama Mountains.

VARIATION

The regional variation is not particularly great. However, the forms in the southern parts of the Hottentots Holland Mountains, the Kogelberg, and other mountains in the region of the lower Palmiet River in the westernmost part of the Caledon Division deviate from all the other forms in some respects. They have long stipules (Fig. 3 A—C), usually 3.5—5.5 mm, the ends of the branches are usually much more closely pubescent, and the inflorescences are denser with more flowers, though far fewer than in *H. sophoroides*.

ECOLOGY

H. coluteoides has been reported from an altitude of 5,000 feet on the Somerset Sneeuwkop in the Hottentots Holland Mountains in the west, but is generally found at much lower altitudes. For instance I have seen it growing at low altitudes in the lower part of Spinnekop Nes Kloof, Kogelberg, in the same region. It has been recorded from altitudes between 500 and 3,000 feet in the Riversonderend Mountains, between 1,200 and 3,700 feet in the mountains around Garcia's Pass, Riversdale Division, and usually below 1,000 feet in the Divisions of Knysna and Humansdorp.

The species is pronouncedly dependent upon a moist habitat and is usually recorded as growing on sandy soil. It generally occurs in rather tall scrub mainly of fynbos character. It was recorded by J. MUIR from "borders of marsh" in the Riversdale Division. On the banks of a stream in a shaded kloof at Garcia's Pass in the same Division it was found by E. P. PHILLIPS growing "as a small tree, 10—12 feet high". The species has also been recorded from stream beds in the eastern divisions, and according to L. L. BRITTEN it grows in "bracken association near the river" at Hofmansbosch, Humansdorp Division, and may be rather common there. In the Knysna and Humansdorp Divisions it also grows in forest margins.

Hypocalyptus oxalidifolius (SIMS) BAILL.

BAILLON 1870 p. 336 (in foot-note). — *Hypocalyptus oxalidifolius* ("*oxalidifolia*", ortogr.) (SIMS) PHILL.; PHILLIPS 1942 p. 284; 1951 p. 409. This supposedly new combination was antedated by BAILLON's. — *Loddigesia oxalidifolia* SIMS; SIMS 1806 plate 965; DE CANDOLLE 1825 p. 136; BENTHAM 1844 p. 355; HARVEY 1862 p. 82; BENTHAM & HOOKER 1867 p. 485; TAUBERT 1894 p. 240; HUTCHINSON 1964 p. 351; POLHILL 1968 p. 173 (included in *Hypocalyptus*). — "*Crotalaria oxalidifolia.* Hortulanis" given as a synonym of *Loddigesia oxalidifolia* in SIMS 1806, but not validly published. — Type material: As type material should be selected the prototype of plate 965 in SIMS 1806; one such specimen sent by LODDIGES and his son can be found in S.

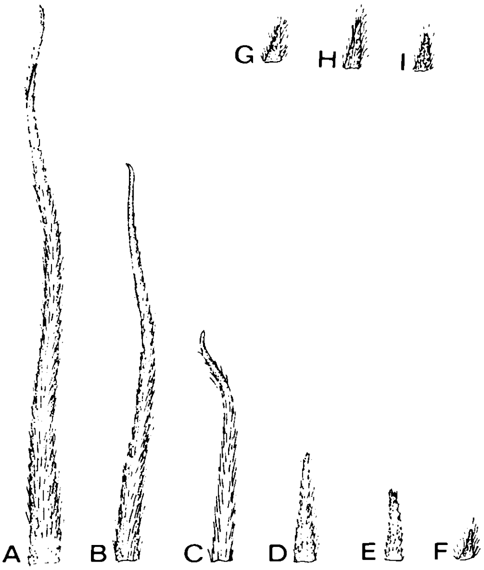

Fig. 3. *Hypocalyptus coluteoides.* — Stipules in random representatives along the distribution area, mainly from west to east. — A: COMPTON no. 18940 from Kogelberg, Caledon Div. — B: COMPTON no. 1360 from the same region. — C: DAHLGREN & STRID no. 4239 from the same region. — D: STOKOE, SAM no. 59602 from Somerset Sneeuwkop, Somerset West Div. — E: THORNE, SAM no. 56251 from Riversonderend Mountains, Caledon Div. — F: PHILLIPS no. 349 from Garcia's Pass, Riversdale Div. — G: TENNANT no. 18 from Langeberg Mountains near George. — H: WALL, from Buffel's Nek, Knysna Div. — I: BATTEN no. 3: 110 from Patensie, Humansdorp Div. — All ×8.

A low shrublet, almost prostrate to suberect, usually 25—50 cm high, with slender, usually dark reddish—black branches sometimes longitudinally sulcate, glabrous or with sparse hairs on the youngest parts (occasionally, a form on the Potteberg, with hairs on small, conical projections from the branchlet surface; Fig. 4 M).

Leaves. Stipules linear-subulate (—subfiliform), 1—3 mm long, attenuating, glabrous or with some hairs on basal inner parts. Petiole usually 2.5—7 mm long on the fully developed leaves, glabrous, slender, suberect. Leaflets often drooping against the petiole, obovate—circular; petiolules about 0.7 mm long or less; laminae 3—11 (—14) mm long and 4—8 (—9.5) mm broad, rounded to slightly retuse at apex but mid-rib usually ending as a little cusp less than 0.5 mm long; upper leaflet surface darkish green, distinctly canaliculate along the mid-vein; lower surface pale green, with prominent mid-vein and partly reticulate, distinct lateral veinlets; mid-vein and base of leaflets sometimes with sparse hairs.

Inflorescence a short terminal raceme usually with only 2—6 flowers, but in certain forms (in the Caledon—Genadendal regions) with as many as 15 flowers. Axis glabrous or sparsely hispid.

Flowers in the axils of linear-subulate, narrow bracts usually 1—3 mm long, in some forms with a lateral tooth on each side.

Pedicel 3.0—6.5 mm long, rather slender, usually glabrous.

Bracteoles on the outer part of the pedicel, similar to the bract, usually persistent during anthesis, 0.5—1.5 mm long.

Calyx purplish, glabrous or with a few short scattered hairs, drawn backwards at base at the onset of flowering, but narrowly campanulate in bud, during anthesis appearing short, only 3 mm or usually less along the median upper line. Upper two lobes united medially to a point only about 1 mm from the apices; lower incisions deeper; lobes deltoid-triangular, the lowest median lobe 0.7—1.2 (—1.5) mm long.

Petals. Vexillum and alae almost white to pale purplish, apically sometimes a deeper purple, the carina with deep or dark purple apex. — Vexillum blade usually extremely small and almost hood-like, but sometimes rather large (variation discussed below), (2.8—) 3.0—6.0 (—9.0) mm long and 2.5—6.5 (—8.5) mm broad, thus generally much shorter than the other petals, with more or less flat sides at an acute angle, with subacute or seldom rounded (occasionally retuse) apex; claw extremely short, usually less than 0.5 mm, on the inner side with two closely standing, lateral callus bodies c. 0.5 mm long. — Ala blades elongate, (6.7—) 7.5—9.2 (—10.5) mm long and 2.3—3.0 (—3.6) mm broad in the somewhat widened apical part, often slightly twisted, reaching well beyond the keel; basal upper parts with oblique or transverse folds; claws 0.8—1.8 mm long. — Carina blades lunate and somewhat beaked, (4.3—) 5.0—6.3 (—6.9) mm long and 2.2—3.2 mm broad; claws (1.0—) 1.3—2.1 mm long.

Stamens. Basifixed anthers about 0.5 mm long, dorsifixed ones about 0.4 mm.

Pistil. Ovary with 3—7 ovules.

Fruit a rather flat, obovate—fusiform legume, pointed at both ends, usually 13—18×6—8 mm in size; stipe curved somewhat backwards; when ripe with walls pale yellowish to intensely light-brown, somewhat papery, firm but not very hard. Ripe seeds usually solitary in each fruit, elliptic, about 3×2 mm, dark brown to black.

DISTRIBUTION

The distribution is southern and ranges between the Hottentots Holland Mountains, Caledon Division, in the west and the coastal parts of the Humansdorp Division in the east. A more inland locality is the Prince Alfred's Pass, Uniondale Division.

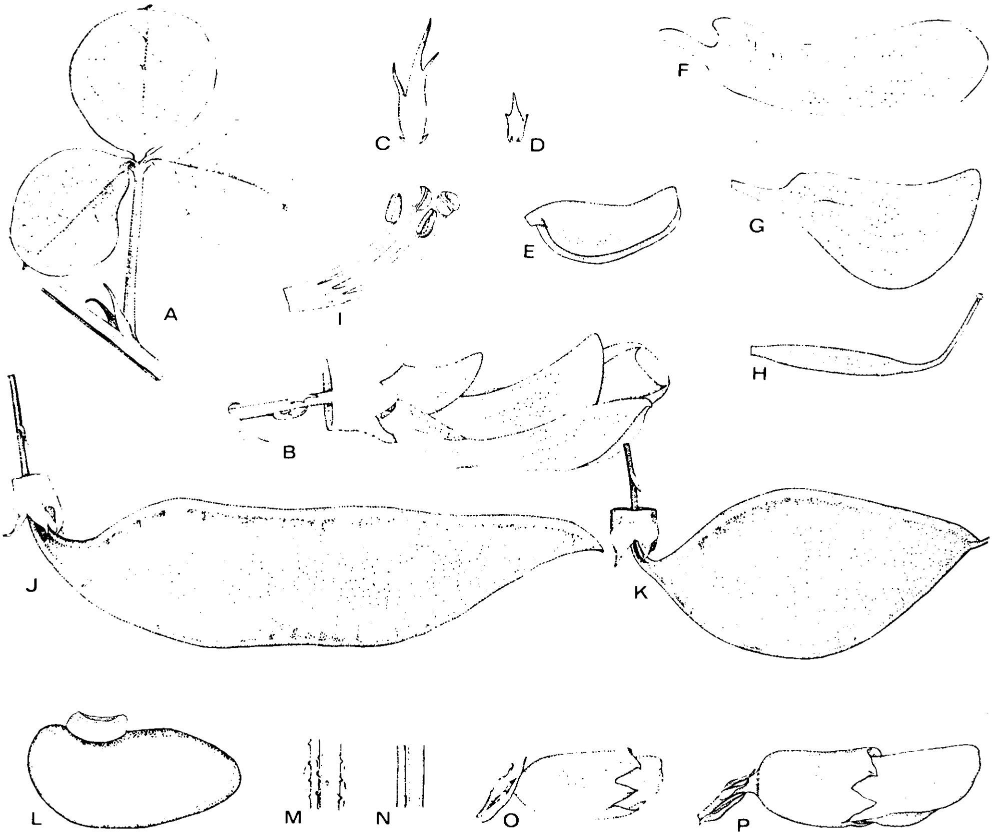

Fig. 4. *Hypocalyptus oxalidifolius.* — A—I: DAHLGREN & STRID no. 2091 from near Hermanus, Caledon Div.; J—L: DRÈGE, Genadendal region, Caledon Div.; M: ESTERHUYSEN no. 32272 from the Potteberg, Bredasdorp Div.; N—P: VAN NIEKERK no. 329 from "Silvermine", Caledon Div. — A: Leaf. — B: Flower of a form with relatively small vexillum. — C: Bract (unusually lobate). — D: Bracteole. — E: Vexillum. — F: Ala petal. — G: Carina petal. — H: Pistil. — I: Four of the stamens, cut off at some distance from the base. — J—K: Legumes, two forms, K being the most common one. — L: Seed. — M—N: Sections of the stem of the common glabrous type and an aberrant, tuberculate-hispid form, M. — O—P: Buds, to show the calyx tube in the early, campanulate stage (O) and at a stage just before the deflexion of the base (P); vexillum in both buds completely hidden in the calyx tube. — A—B, E—H, J—K, and O—P ×4; C, D, I, and L—N ×8.

VARIATION

The vegetative parts of *H. oxalidifolius* show considerable variation, but the species is characteristic. The habit varies somewhat, as do the length of the stipules and the size of the leaves. In a conspicuously aberrant sample from the Potteberg Mountain, Bredasdorp Division, mentioned below, the ends of the branches are covered with scattered hispid hairs sitting on small projections from the epidermis. This has not been seen in any other form. Particularly in the Caledon—Genadendal regions, the branch ends may be covered with sparse short hairs, but in most forms the branches are glabrous or almost so.

The pedicels vary in length and the bracts and bracteoles vary in size. A couple of very small (? stipular) teeth are often found at the base, and in addition there is often a lateral lobe on each side in the middle or apical part of the bract, although these are seldom as prominent as in the form shown in Fig. 4 C. The bracts and bracteoles are often entire.

Variation in petals is most conspicuous in the species. This is of particular interest as the definition of the genus was largely based on the extraordinarily short vexillum.

Fig. 5 shows the considerable range of variation of the petals (vexillum and alae are shown). However, the vexillum shows much greater variation than do the other petals.

The forms with the (totally as well as proportionally) smallest vexillum, in which the lamina is generally 2.8—3.6 mm long, are found in the east, in the Humansdorp (Fig. 5 E) as well as in the George—Riversdale Divisions, but also in the west, in the regions of the Hottentots Holland and Klein River Mountains of western Caledon Division (Fig. 5 A).

Somewhat larger vexillum blades occur in the Knysna (and Uniondale, Fig. 5 D) Division, where the species seems to be rather common.

Forms with relatively small petals but with a vexillum that is large in proportion to the other petals are found in the regions of Caledon, Genadendal and Riversonderend, Caledon Division (Fig. 5 B). The apex of the vexillum (and also the ala apices) in these forms is more incurved than in other populations. These forms also deviate in having denser inflorescences with as a rule 8—15 flowers (fewer in the other forms).

Finally, a sample from the Potteberg Mountain, Bredasdorp—Swellendam Division border (Fig. 5 C), deviates in having larger petals than other forms: the slender ala blades are more than 10 mm long, and — what is more noteworthy — the vexillum blade is about 9 mm long. The inflorescences in this form are few-flowered. This form, like the next preceding ones, lacks the typical "*Loddigesia* appearance".

Variation in the shape and size of the legume is not possible to estimate from the limited material on hand. The specimens on which *Loddigesia oxalidifolia* β *rostrata* E. MEY. has been based, have no ripe fruits, which may partly explain the narrower and somewhat more rostrate shape.

ECOLOGY

The species grows at low and moderate altitudes on hills and mountain slopes. The highest altitudes recorded are from the Outeniqua Pass, George Division, and Prince Alfred's Pass, Uniondale Division, where the species occurs along streamlets above 2,000 feet. Otherwise it is usually known up to altitudes of 1,500 feet, and at the base of Klein River Mountains east of Hermanus, Caledon Division, I have seen the species growing at altitudes of about 100 feet or less.

H. oxalidifolius occurs along streams and in other somewhat moist places, and especially in the Knysna region some-

Fig. 5. *Hypocalyptus oxalidifolius.* — Above: Diagrammatic presentation of length of vexillum (left) and ala (right) blades in samples from different regions of the distribution (cf. Fig. 6 C). The piles in the diagrams are 1.3 times the measured length of the petals. Two flowers were studied in each sample, and the average is given. — Below: Flowers in five of the samples measured above; the letters correspond to those in the map. — A: BOLUS no. 6800 from near Elim, Bredasdorp Div. — B: MARLOTH no. 6071 from near Caledon, Caledon Div. — C: ESTERHUYSEN no. 23272 from the Potteberg, Bredasdorp—Swellendam Div. border. — D: DAHLGREN & STRID no. 2994 from Prince Alfred's Pass, Uniondale Div.; similar forms prevail in the Knysna Div. — E: FOURCADE no. 2286 from Witte Els Bosch, Humansdorp Div. — All drawings ×4.

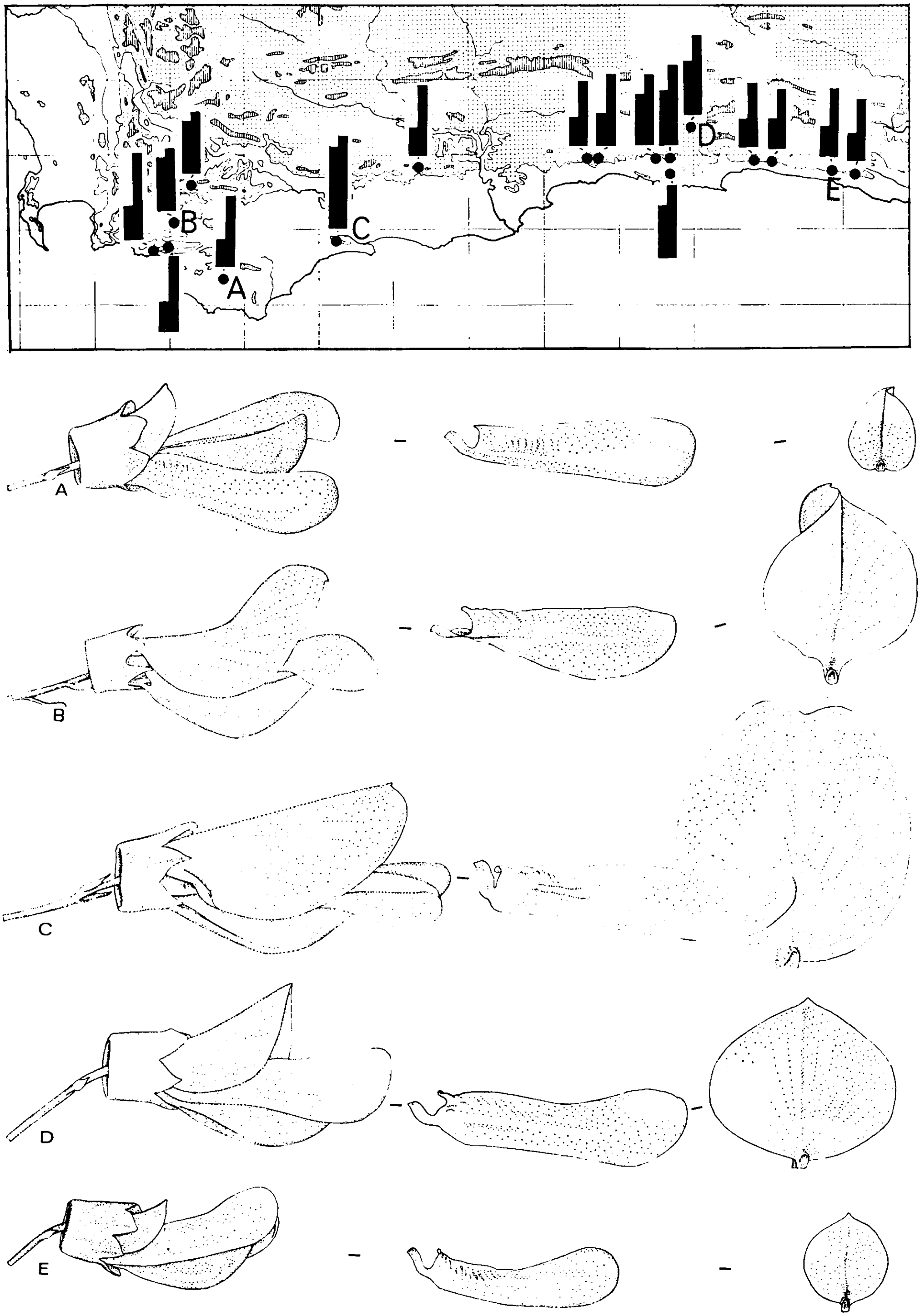

Fig. 5.

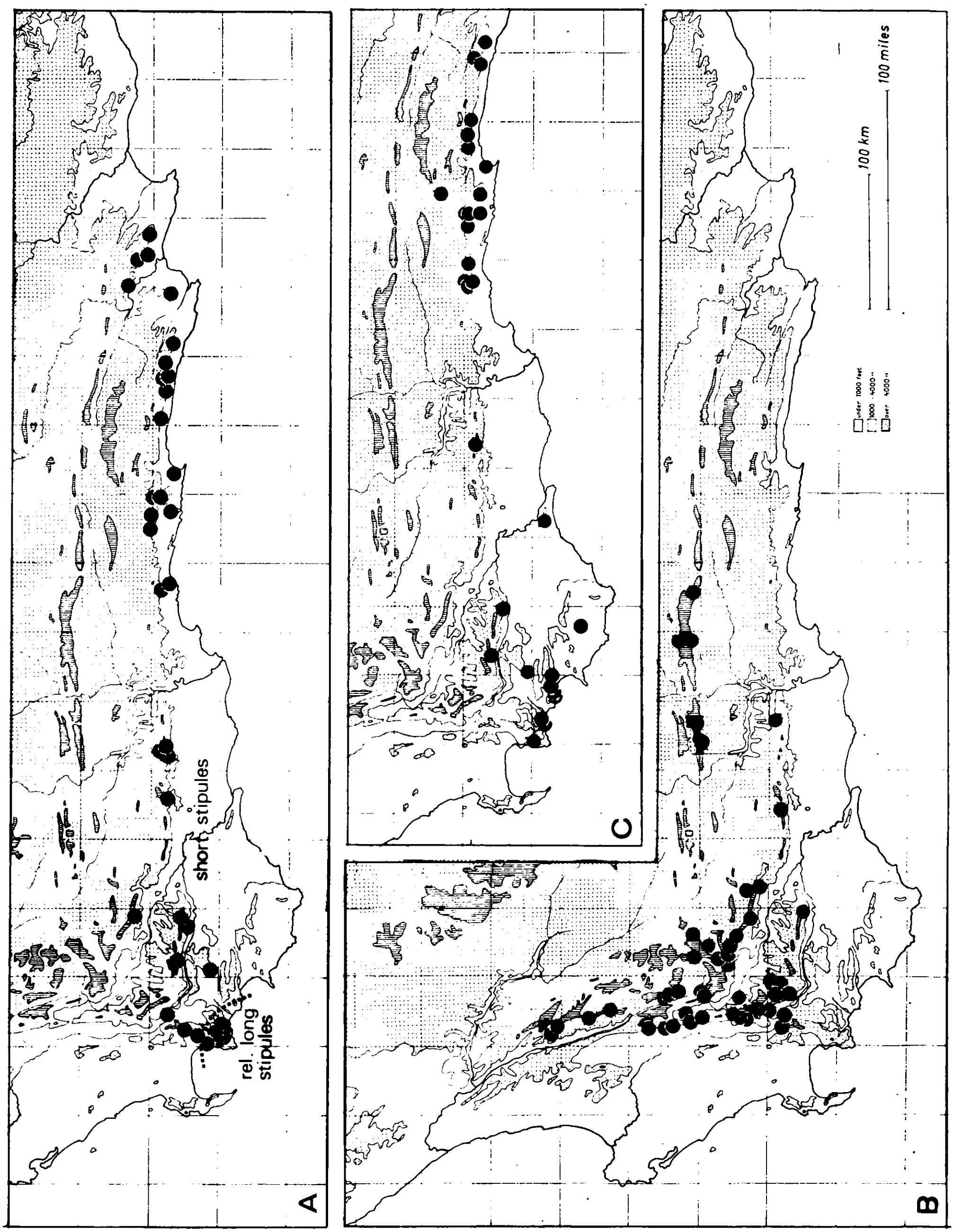

Fig. 6. Documented distributions of A: *Hypocalyptus coluteoides*, B: *H. sophoroides*, and C: *H. oxalidifolius*. It is shown that the former two species are mainly, but not completely vicarious. The long-stipulate forms of *H. coluteoides* in the most south-western part of the Caledon Division are indicated.

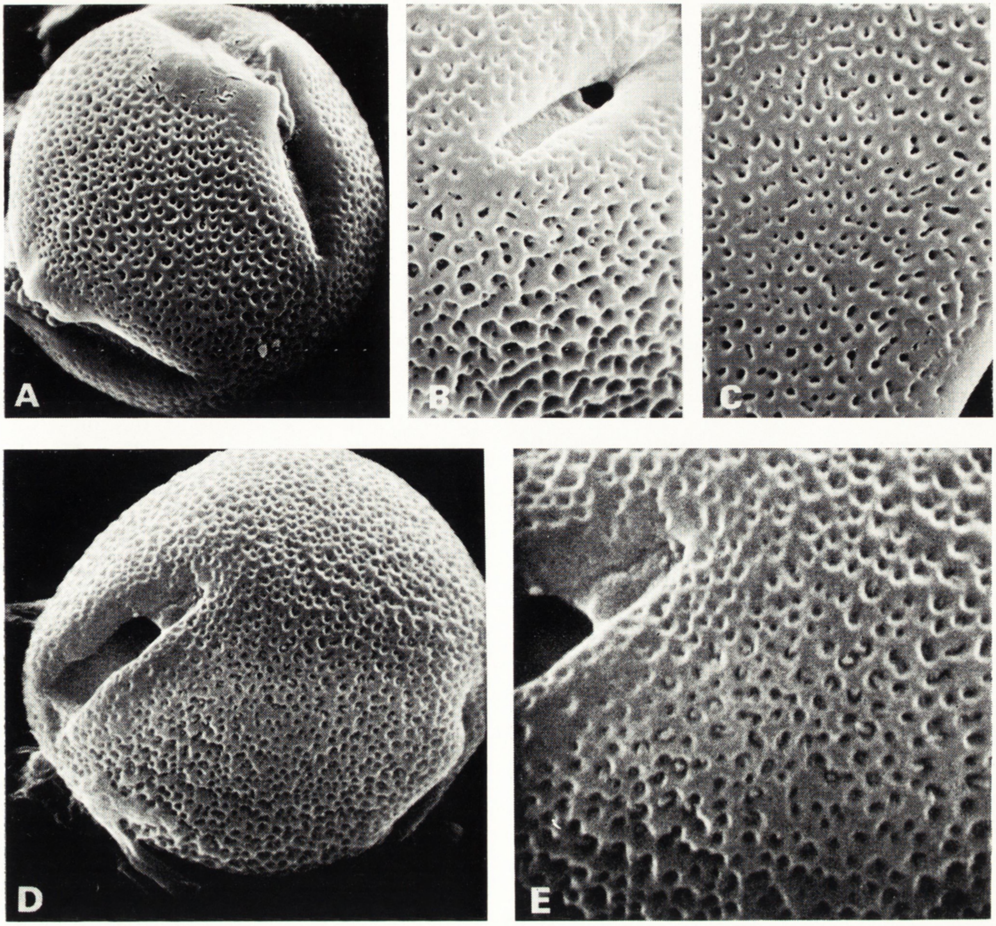

Fig. 7. Electroscan photo micrographs of pollen grains in *Hypocalyptus*. — A—C: *H. sophoroides*, Dahlgren & Strid no. 3368. — D—E: *H. oxalidifolius*, D. & S. no. 2091. — A and D: Entire grains in oblique views, × c. 2,600. — B, C, and E: Wall structure with perforations, × c. 5,200; B and E show the area adjacent to the colpi, C the mesocolpium-centre. — Made by Dr. Siwert Nilsson, the Palynological Laboratory, Stockholm.

times turns up where the vegetation has been burnt off or cleared in other ways. As the other species, it seems to prefer sandy soil.

PALYNOLOGICAL OBSERVATIONS

In the studied material of *Hypocalyptus sophoroides* (Dahlgren & Strid no. 3368) the pollen grains are subprolate, about 27×19 μ in size, 3-colporate, distinctly constricti-colpate, with more or less lalongate ora. The mesocolpium as well as apocolpium surfaces are scrobiculate (to almost reticulate but with small lumina); the margins of the colpi, however, are very sparsely scrobiculate-punctate to almost psilate.

The pollen grains of *H. coluteoides* studied (Wall, sine no.) resemble those of *H. sophoroides*, but have slightly coarser, scrobiculate-reticulate ornamentation. They are about 25×20 μ in size.

Also *H. oxalidifolius* (DAHLGREN & STRID no. 2091 studied) is similar, but the grains are more squarish, about 27×21 μ, the surface is more irregular and rugged between the perforations, and the colpi are not so constricted at the centre as in the other two species. These differences seem to be minor, however.

Size characters mentioned here are very approximate. Only one collection of each species has been studied. Measurements were made on acetolyzed grains.

Corresponding studies, partly also with scanning electron microscopy, have been made on material from other genera showing similarities with *Hypocalyptus* and discussed below. As only single species have been studied in each genus the following observations should be taken with caution.

Pollen grains similar in all respects to those in *Hypocalyptus* were found in *Crotalaria* (studied in greater detail: *C. valida* BAKER). The surface structure is most similar to that of *H. oxalidifolius.*

In *Priestleya* [*P. umbellifera* (THUNB.) DC. studied in greater detail] the openings are larger than in *Hypocalyptus* and form distinct lumina so that the ornamentation is reticulate. Similar grains, but with even somewhat wider lumina were found in *Cyclopia* (where *C. intermedia* E. MEY. has been studied in greater detail).

In *Amphithalea,* where *A. ericifolia* (L.) ECKL. & ZEYH. has been studied, the pollen surface may be classed as punctate-scrobiculate. The punctae vary somewhat in size and the surface in between is rather irregular. The character of the pollen surface thus is different from that in *Priestleya,* next to which it is usually placed. A pattern similar to that in *Amphithalea,* though with even more irregularly scattered perforations and with a more bulging surface between these was found in *Coelidium,* of which *C. ciliare* (ECKL. & ZEYH.) WALP. has been studied in detail.

Pollen characters vary conspicuously among South African *Genisteae* and may prove taxonomically useful in combination with other morphological features. However, in this case they give no clear evidence of affinity between *Hypocalyptus* and any other particular group. A more extensive study of this subject has been started.

HAIR CHARACTERS

The different species of *Hypocalyptus* show considerable variation of the hairs in length as well as in denseness. However, they agree in all three species in having characteristic projections in the form of rounded warts or of short, rounded ridges.

In *H. sophoroides* (Fig. 8 A—D), where the hairs are long and mostly flattened (Fig. 8 C—D), the projections mainly have the shape of isolated warts, whereas in *H. coluteoides* (Fig. 8 E—H), where the hairs are shorter, the projections are generally more elongate in the direction of the hair and sometimes arranged in rows (Fig. 8 F).

The shortest hairs are found in *H. oxalidifolius* (Fig. 8 I—K), where they are also very sparse. The projections are intermediate in shape between those of the two preceding species.

The similar surface structure of the hairs supports the view that the three species here placed together in *Hypocalyptus* are closely related. The warty surface of the hairs is readily seen under an ordinary microscope.

The study was extended to some other genera in order to test the corresponding surface characters. Great difference was found between different genera and as in the material studied (a few species of each genus) different species of the same genera were mostly similar, surface pattern may prove a useful tool from the taxonomical point of view in the study of *Genisteae* s. lat. An ordinary Leitz microscope was used, but a few representative samples have been studied with the electroscan technique as well and are illustrated in Fig. 9.

Warts of a type similar to that found in *Hypocalyptus* were found in the Mediterranean *Cytisus* (s. lat.) (Fig. 9 A—B), though the warts are smaller. A surface structure similar to that in *Hypocalyptus* but less prominent and hardly visible under the ordinary microscope was found

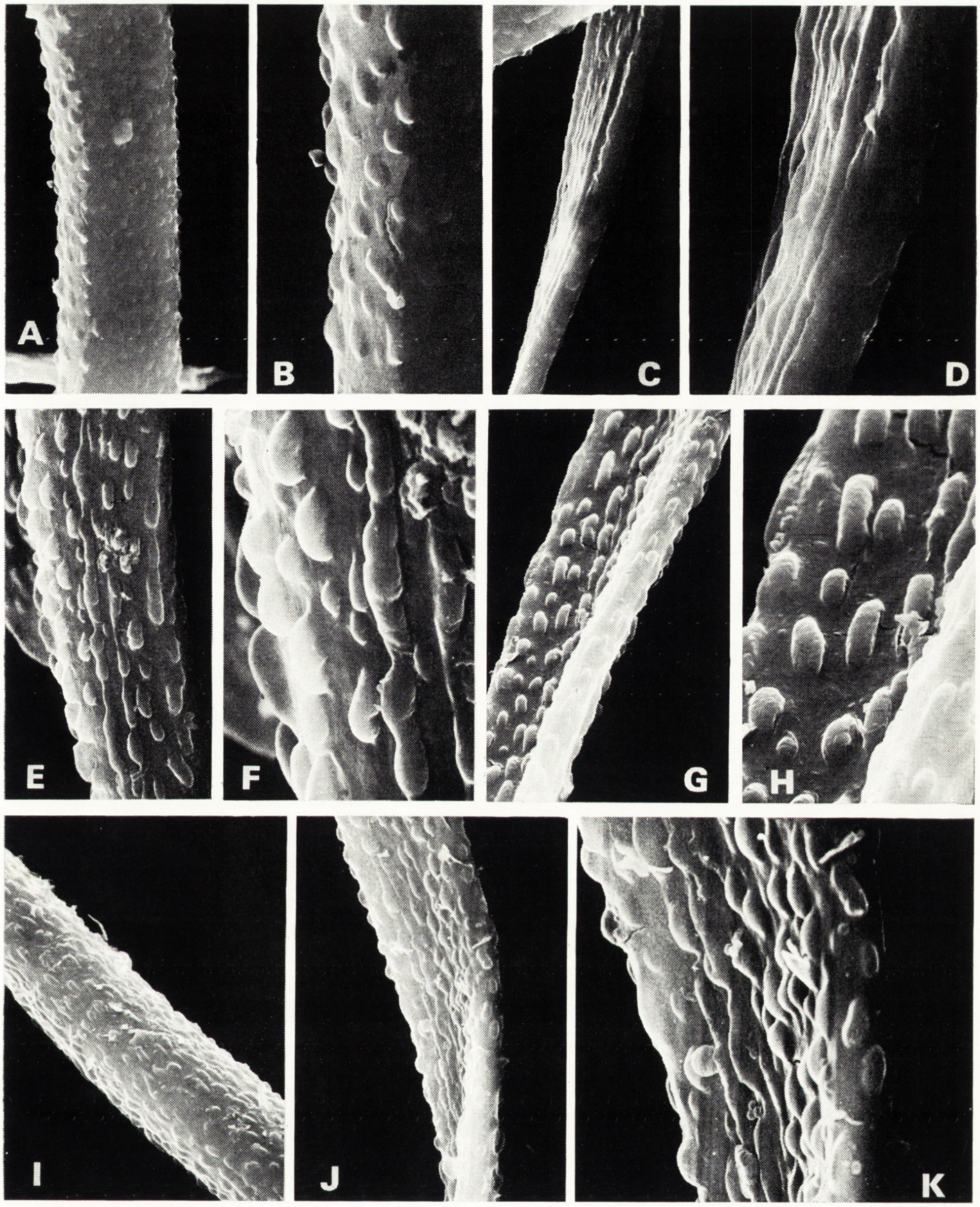

Fig. 8. Electroscan photo micrographs of hairs in *Hypocalyptus*. — A—D: *H. sophoroides,* Hafström & Lindeberg, Bain's Kloof. — E—H: *H. coluteoides,* Stokoe, SAM no. 54527. I—K: *H. oxalidifolius,* Marloth no. 7061. — A, C, E, G, I, and J ×1,200; B, D, F, H, and K ×3,000. — Made at the Electroscan Laboratory, the Zoological Institute, Lund.

in *Crotalaria valida* (Fig. 9 C—D). In *Podalyria* (Fig. 9 E—F), on the other hand, warts or rounded ridges are absent and the surface is striated, the thinner and sharper ridges being hardly visible under the ordinary microscope. In the species of *Amphithalea* (Fig. 9 G—H) and *Priestleya* (Fig. 9 I—J) investigated the hairs are even smoother (looking entirely smooth under the ordinary microscope), and showing only fine, longitudinal striation mainly in the form of narrow fissures.

Among the above genera *Hypocalyptus* most closely resembles the representatives of *Crotalaria* and *Cytisus,* but it is not possible from this to draw conclusions about possible relationships, especially in view of the limited material investigated. In some of the larger genera there is some variation in the character of the surface. Thus, in the South African genus *Wiborgia* Thunb. (also in *Genisteae*) the hairs have been found to have a warty surface in one particular group of species, but almost smooth surface in another group (Dahlgren unpubl.). It is interesting to note that there is not always agreement between pollen and hair characters between genera. Thus, for example the pollen grains are widely different but the hair surface very similar in the two genera *Amphithalea* and *Priestleya.*

MORPHOLOGICAL DISCUSSION, CONCLUSIONS

The Generic Limits of Hypocalyptus

As defined here, *Hypocalyptus* beside the type species, *H. sophoroides,* has been extended to include:

1) the genus *Loddigesia*
2) the section *Purpureae* of *Crotalaria*

Each of these represent one species.

The genus *Loddigesia* was distinguished from *Hypocalyptus* mainly because of the smaller size, the very small vexillum, and the deviating fruit. There are also minor differences in detail, but hardly any of ultimate importance in distinguishing genera.

As shown above *H. oxalidifolius* (= *Loddigesia*) displays great regional variation in regard to size and shape of the vexillum. In populations of the Caledon —Genadendal—Riversonderend regions, Caledon Division, as well as in a (somewhat deviating) sample on the Potteberg Mountain, Bredasdorp Division, the vexillum is considerably larger in relation to alae and carina than in the other populations, and is of a size quite comparable to that of the vexillum in *H. sophoroides* and *H. coluteoides.* Thus this character does not constitute a difference.

The fruit is different from those of the other two species, but it should be noted that the pistils are very similar in all respects except ovule number. The other two species here included in *Hypocalyptus* in spite of great similarities in other respects also have fruits that are very different. In this group fruit shape is accordingly a variable character, though the broad upper suture, the wall structure and especially the seeds are similar.

The plants also differ in size and habit, but the differences do not extend to details of the vegetative parts.

Finally, supplementary characters of *H. oxalidifolius* such as the callosities of the vexillum base, surface micro-pattern of the hairs, shape and surface structure of pollen grains, etc. agree well with the characters in the other species.

Until now *H. coluteoides* has been placed in *Crotalaria.* This is a very large genus displaying such wide morphological variation that comparison is justified. In this genus, the species *coluteoides* (more commonly called *purpurea*) was placed in a special section, *Purpureae,* for example in the careful revision made by Polhill 1968. However, this monotypic section differs in the following respects from all (or most) other species of *Crota-*

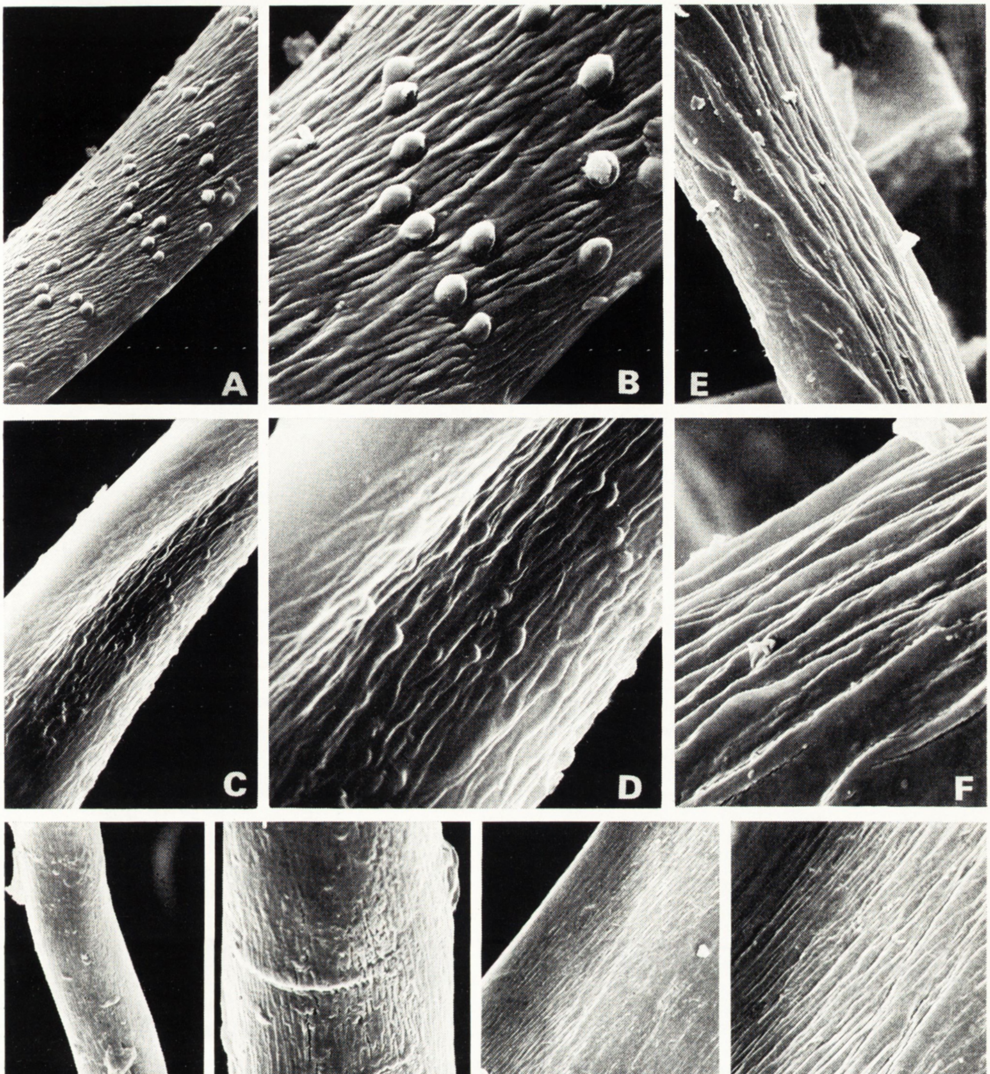

Fig. 9. Electroscan photo micrographs of hairs in species of *Cytisus, Crotalaria, Podalyria, Amphithalea,* and *Priestleya.* — A—B: *Cytisus supinus* L. [=*Chamaecytisus supinus* (L.) LINK]; ČERNOCH no. 15602. — C—D: *Crotalaria valida* BAKER; FRIES, NORLINDH, & WEIMARCK no. 3629. — E—F: *Podalyria biflora* LAM.; DAHLGREN & STRID no. 2845. — G—H: *Amphithalea ericifolia* (L.) ECKL. & ZEYH.; D. & S. no. 2729. — I—J: *Priestleya vestita* (THUNB.) DC.; D. & S. no. 3609. — A, C, E, G, and I ×1,200; B, D, F, H, and J ×3,000. — Made at the Electroscan Laboratory, the Zoological Institute, Lund.

laria (according to table on p. 180 in POLHILL's account):

1) vexillum appendages small, disc-shaped, located mainly on the claw (higher up, on the lamina in all other *Crotalaria* species)
2) beak of carina not twisted (twisted in many *Crotalaria* species)
3) calyx different from those of all other *Crotalaria* species
4) style lacking hairs (present in practically all other *Crotalaria* species either on the inner side or on both sides of the style, only absent in one or two species)
5) style ascending from the base (not curved, constricted, attenuate or geniculate as in practically all other *Crotalaria* species).

Moreover the filaments form a closed sheath in *H. coluteoides,* but in *Crotalaria* there is a split on either side of the upper median stamen. However, the sheath in *H. coluteoides* normally splits later on as the fruit develops.

The difference in length between the basifixed and the dorsifixed anthers is also much less in *H. coluteoides* than in *Crotalaria* proper.

The strophiole, so prominent in *H. coluteoides,* is variable in *Crotalaria* and is reported to be prominent in two of the sections.

Though some connection with *Crotalaria* is likely — there is, for example similarity in the surface structures of pollen grains as well as hairs — the above evidence should justify moving *C. coluteoides* to *Hypocalyptus,* with which it agrees in all respects mentioned and many others. The only conspicuous difference between *H. coluteoides* and *H. sophoroides* is the fruit shape. Their close affinity is also emphasized by similarities in pollen (similar in *Crotalaria* too, however) and in the fine structure of the hairs.

Comparison with other Genera

Hypocalyptus in its present sense occupies a rather isolated position among the South African genera of Fabaceae.

In the very individual shape of the calyx it resembles *Cyclopia* and *Podalyria,* but in these the filaments are connate only at the very base. (This character is not necessarily a primary feature, but may be of secondary origin.) The violet-flowered species of *Podalyria* in particular closely resemble the species of *Hypocalyptus.* There are also similarities in habit, branching, inflorescence (certain species), stipule shape, general shape of petals, construction of small folds on ala base, shape of style and stigma and of seed appearance. POLHILL (1968) also suggested that "*Crotalaria purpurea*" as well as *Hypocalyptus* "are separate derivates from a general 'Podalyroid' stock". — Noteworthy differences between *Podalyria* and *Hypocalyptus* are that the former lacks petiole and lateral leaflets, that the walls of the hairs are smooth, that the filaments are separate (however, in both genera the anthers are almost equal in length), and that the ovary is always pubescent.

Similarities in a great number of features are also found between *Hypocalyptus* and the genera *Priestleya, Amphithalea, Lathriogyne,* and *Coelidium,* all of which have strophiolate seeds similar to those in *Hypocalyptus.* In *Priestleya,* where the corolla is yellow, the calyx tube shows the same intrusion at the base, in *Lathriogyne* the two upper calyx lobes are united medially just as in *Hypocalyptus,* but the tube has no basal intrusion. The flowers in *Amphithalea, Lathriogyne* and some species of *Coelidium* are more or less purple. The leaves are simple in all these genera, the staminal sheath has a split on either or both sides of the upper median stamen, and the hairs in the material investigated have a smooth surface.

Of the Mediterranean genera of *Genisteae* s. lat. the strophiolate genus *Cytisus* and some related genera have several features in common with *Hypocalyptus,* and together with *Hypocalyptus* they compose the tribe *Cytiseae* in HUTCHINSON

1964 (p. 350). At the same time there do not seem to be any particular similarities between *Hypocalyptus* and any of these genera. Details of calyx and corolla characters are mostly different. The affinity with the Mediterranean genera does not seem to be closer than with the abovementioned genera in South Africa.

LIST OF MATERIAL EXAMINED

Hypocalyptus sophoroides

Clanwilliam Div.: Cedarbergen, 2800—3500 ft, Drège (BOL, S) — Cedarberg, Nieuwoudt Pass, 2500 ft, 1923, Pocock 795 (STE) — Cedarberg, Suurvlei Berg above Algeria, 1939, Esterhuysen 2497 (BOL) — Cedarberg, Middleberg, 3000 and 5200 ft, 1923, Pocock 120 (PRE, STE); 1967, Kerfoot 6160 (NBG).

Ceres Div.: Elands Kloof, 1940, Bond 619 (NBG) — Skoongesig, Koue Bokkeveld, 1967, Hanekom 982 (PRE, STE) — 1 mile SW of top of Gydo Pass, 1965, Dahlgren & Strid 4142 (LD) — Schurfdeberg, Zeyher, SAM 15383 (SAM) — W base of Schurfdeberg, 1941, Pillans 9592 (BOL) — Agter Witzenberg Pass, 3000 ft, 1966, Rourke 648 (NBG) — Mitchell's Pass, 1893, Bolus 2606 (BOL, SAM); 1941, Compton 11933 (NBG) — Ceres Mt, 1925, Marloth (PRE) — Matroosberg near Laaken Vlei, 3500 ft, 1917, Phillips 1946 (SAM) — Bokkerivier Farms, 1963, Middlemost 2245 (NBG).

Piketberg Div.: Mt slopes, Porterville, 1910, Edwards 258 (BOL) — Flats between 14 River Mt Ridge and Grootkliphuis River, behind Porterville, 2500 ft, 1969, Boucher & Kruger 3 (STE).

Tulbagh Div.: Tulbagh, Pappe (S, UPS) — Kloof behind Upper Waterfall, 800 ft, 1920, Andreae 657 (STE) — Nieuwe Kloof Valley, 1000 ft, 1899, Mc Owan 3366 (SAM, UPS) — De Hoek Estates, Saron, 1936, Lewis, BOL 22079 (BOL) — Saron, 1941, Stokoe (PRE) — Mts near Saron, 2500 ft, 1896, Schlechter 10666 (PRE, S).

Wellington Div.: Bain's Kloof, 1928, Hutchinson 1007 (BOL); 1936, Hafström & Lindeberg (S); 1945, Compton 17500 (NBG); 1959, White 5635 (PRE) — Mts near Wellington, 1926, Rossouw (STE).

Worcester Div.: Du Toit's Kloof, Drège (S); 1947, Barker 4842 (NBG); 1949, Barker 5987 (BOL); 1951, Compton 22837 (NBG); 1960, Gentry 19002 (PRE) — Near Du Toit's Kloof, in the side valley of Eland's Kloof, 1965, Dahlgren & Strid 3368 (LD) — Badsberg West, 4 miles W of Goudini, 1000—1500 ft, 1963, Taylor 5383 (PRE, STE) — Hex River Kloof near Worcester, 1949, Sidey 1879 (PRE, S); 1953, Sidey 2311 (PRE, S) — Few miles from Worcester on Hex River road, 1949, Acocks 15515 (PRE) — Sandhills, 1959, van Breda 643 (UPS) — De Doorns, kloof on W side, 1893, Marloth 1971 (PRE) — Hex River Valley near De Doorns, 1700 ft, 1907, Bolus (PRE) — Hex River Valley, 2000 ft, 1881, Tyson 675 (PRE, SAM) — Keeromsberg, Bosch Kloof, 2500 ft, 1930, Barnard, SAM 48703 (SAM) — Rabiesberg, 3000 ft, 1935, Compton 5821 (BOL, NBG) — Onklaarberg, 20 miles S of Worcester, W side, 1200 ft, 1924, Stokoe 1178 (PRE) — Louwshoek Mt, 1946, Stokoe, SAM 59614 (SAM).

Paarl Div.: Tierkloof, Wemmershoek Mts, 1943, Wasserfall 555 (NBG); 1950, Gray, BOL 26047 (BOL) — French Hoek Valley, 1913, Marloth 5328 (PRE, STE) — Groot Drakenstein, 1933, Hartwig (STE) — Duiwels Tooth, Groot Drakenstein, 1966, Thompson 241 (STE).

Stellenbosch Div.: Drakenstein Mts, Banhoek, near Stellenbosch, 200 m, 1961, Ihlenfeldt 1740 (PRE).

Caledon Div.: Villiersdorp, 1936, Thorne, SAM 52522 (SAM) — River Sonderend Peak, 1940, Stokoe (PRE).

Robertson Div.: Donker Kloof, 1500 ft, 1946, Compton 18462 (NBG).

Montagu Div.: Naudesberg, Koo, 1959, Middlemost 2040 (NBG) — Between Montagu and Triangle, 1922, Michell 34 (PRE) — Koghmanskloof, Ecklon (S); 1965, Dahlgren & Strid 3473 (LD) — Hot Baths near Montagu, 1921, Page 63 (BOL, PRE).

Swellendam Div.: Between Puspasvalley and Koghmanskloof, Ecklon & Zeyher 1255 (S, SAM) — Boesmanspad, 1000 ft, 1921, Joubert, STE 10234 (STE) — 6 miles from Barrydale into Tradu Pass, 1000 ft, 1968, Marsh 967 (PRE, STE).

Riversdale Div.: N side of Langeberg, 1923, Muir 2789 (PRE); 1929, Muir 4475 (PRE).

Ladismith Div.: Waterkloof near Ladismith, 1928, Hutchinson 1107 (BOL) — Elandsberg (Torenberg), Klein Swartberg, 3000 ft, 1953, Wurts 1194 (NBG).

Ladismith-Laingsburg Div. border: Seven Weeks Poort, 1912, Phillips 1427 (SAM); 1919, Pole Evans (PRE); 1931, Compton 3930 (BOL); 1932, Barker 134 (PRE); 1938, Wall (S); 1966, Wells 3756 (PRE); 1967, Grobbelaar 647 (PRE); 1970, Wisura (NBG).

Oudtshoorn Div.: Near Melville Dam, 1951, Zinn, SAM 66050 (SAM) — Spitskop, Swartberg Mts, 4000 ft, 1953, Taylor 654 (NBG) — Swartberg Pass, 2700—5000 ft, 1905, Bolus 11791 (BOL, PRE); 1928, Hutchinson 1159 (BOL); 1938, Hafström & Acocks 617 (PRE, S); 1951, Stokoe, SAM 66049 (SAM).

?Prince Albert Div.: Swartberg, kloof in mts, 4400 ft, 1926, Pocock S 185 (PRE) — Albertsberg, Swartberg, 4000 ft, 1954, Taylor 1459 (PRE).

Hypocalyptus coluteoides

Paarl Div.: French Hoek, 1912, Marloth 5326 (PRE).

Somerset West Div.: Somerset Sneeuwkop, 500 ft, 1946, Stokoe, SAM 59602 (SAM) — Rocky slopes of Sir Lowry's Pass, 1886, Mc Owan 3356 (SAM).

Caledon Div.: Hottentots Holland Mts, 1939, Stokoe, SAM 54527 (SAM) — Kogelberg, 2000 ft, 1946, Compton 18940 (NBG) — Kogelberg Forest Reserve, margin of Wynand Louws Bos, 1300 ft, 1952, Rycroft 1360 (NBG) — Lower part of Spinnekop Nes Kloof, 1965, Dahlgren & Strid 4239 (LD) — Kogelberg Forest Reserve, Paardeberg, 1970, Boucher 1199 (PRE, STE) — Palmiet River Mts, 1923, Stokoe (PRE) — Palmiet River Valley, Stokoe 6155 (PRE) — Caledon, Zwarteberg near the Baths, Zeyher (S) — Zwarteberg, Ecklon & Zeyher 1257 p.p. (BOL, S, SAM, PRE); 1835, Pappe (S) — Baviaansberg near Genadendal, Ecklon (S) — Mt near Genadendal, 1500—2500 ft, Drège (S); 1846, Prior (PRE) — Soetemelks River, Sonderende, 300 ft, 1894, Grishoek, Guthrie 3279 (NBG) — Riversonderend Peak, 2000—3000 ft, 1928, Thorne, SAM 45792 (SAM) — Riversonderend Mts above Grootwadersbos, Zeyher 2296 (SAM) — Riversonderend Mts, 2500—3000 ft, 1919, Barnard, SAM 44598 (SAM); 1940, Stokoe 7372 (BOL, NBG); 500 ft, 1943, Stokoe, SAM 56251 (SAM).

Robertson Div.: Foothills of Langeberg Mts near Robertson, 1919, Marloth 8350 (PRE).

Swellendam Div.: Mt ridges at Riversonderend, Stormsvlei, Hassaquaskloof and Breede River, c. 1830, Zeyher 2296 p.p. (PRE) — Grootwadersbosch and adjacent mts, Ecklon & Zeyher 1257 p.p. (BOL, S, SAM, PRE).

Riversdale Div.: Corente River, 1000 ft, 1908, Muir 76 (PRE, SAM) — Oudebosch, Langeberg, W of Garcia's Pass, 600 ft, 1950, Taylor 148 (NBG) — Garcia's Pass, 1897, Galpin 3956 (PRE); 1908, Phillips 349 (SAM); 1926, Thorne, SAM 38860 (SAM); 1929, Nels, STE 9617 (STE); 1959, van Breda 739 (NBG, PRE); 1961, van Breda 1100 (PRE); 1967, Killick 3464 (PRE); 1969, Barker 10620 (NBG); Gentry & Barclay 18866 (PRE).

George Div.: George, 1962, Tennant 18 (NBG) — George, forest margin, c. 1830, Drège (PRE, S) — W side of Kaaimans River, 1814, Burchell 5792 (BOL, PRE, S).

Knysna Div.: Knysna region (without particulars), 700 ft, 1888—1889, Tyson 3001 (BOL, PRE, SAM) — Farleigh Forest, Springs, 1000 ft, 1918, Keet (PRE, STE) — Millwood, 1900 ft, 1936, Fourcade 5299 (BOL) — Near Knysna, 1888, Tyson 982 (S, SAM) — Diepwalle (Diep Walls), 1929, Wicht 23 (STE) — Buffels Nek, 1937, Wall (S) — Plettenberg Bay, 1921, Smart (PRE).

Humansdorp Div.: Elands River, Zizikama, 500 ft, 1897, Galpin 3557 (PRE) — 50 miles from Humansdorp on Storms River road, 1947, Story 2848 (PRE) — Ratelsbosch, 650 ft, 1905, Fourcade 48 (BOL) — Mt slopes above Witte Els Bosch, 1928, Hutchinson 1402 (BOL) — Between Assegai Bosch and Witte Els Bosch, 1930, Thode A 2527 (PRE) — Hoffmans Bosch near river, 1919, Britten 1316 (PRE) — Clarkson, 1926, Thode A 793 (PRE) — Near Humansdorp, 200 ft, "A. K." 325 (PRE) — Blueberg, Loerie Plantation, 1934, Dix 9 (BOL) — Patensie, mt side, 1962, Batten 3: 110 (NBG).

Port Elizabeth Div.: Van Stadens Gorge, 1908, West 289 (BOL) — Van Stadades Berg, Zeyher (S); Ecklon & Zeyher 1257 pp. (BOL, PRE, S, SAM) — Thornhill, 1911, Paterson 2074 (PRE).

Hypocalyptus oxalidifolius

Caledon Div.: Hottentots Holland, Stokoe 6134 (PRE) — Palmiet River Mouth, 1949, Davis, SAM 61424 (SAM) — Kleinmond, 1927, Stokoe, BOL 18726 (BOL) — Hermanuspetersfontein, 1896, Bodkin (BOL) — Hermanus region, Mossel River, 1951, Maguire 1267 (NBG) — C. 1 1/2 miles E of Mossel River, base of Klein River Mts, 600 m, 1965, Dahlgren & Strid 2091 (LD) — Vogelklip Vlei, 1942, Barker 1855 (NBG) — Klein River Mts, 1940, Esterhuysen 2913 (PRE) — Near mouth of Klein River, Zeyher 2315; Ecklon & Zeyher 1256 p.p. (PRE, S, SAM) — Silvermyn, 1943, van Niekerk 329 (NBG) — Caledon, 1915, Marloth 7061 (PRE) — Genadendal, ? Zeyher (S, SAM) — Near Genadendal, Drège (S) — Mts at Riversonderend, Ecklon & Zeyher, SAM 15385 (SAM).

Bredasdorp Div.: Mt slope near Elim, 1894, Bolus 6800 (BOL, NBG, PRE) — Potteberg, S slopes, 1954, Esterhuysen 23272 (BOL).

Riversdale Div.: Garcia's Pass, 1908, Phillips 365 (SAM); 1923, Muir 2699 (PRE).

George Div.: George region (without particulars), 1880, YOUNG, BOLUS 5515 (BOL) — George, forest margin, DRÈGE (S) — George, ROGERS 4298 (SAM) — Topping Peak, along railway line, 1961, VAN BREDA 1136 (PRE) — Outeniqua Pass, 2200 ft, 1956, no collector stated (LD) — Montagu Pass, 2000—2500 ft, 1931, THORNE, SAM 51657 (SAM) — Touws River, 1814, BURCHELL 5751 (BOL).

Knysna Div.: Millwood gold fields, 1500 ft, 1888, TYSON (BOL, SAM) — Sour Flats, on way to Millwood, 1929, WICHT, STE 10366 (STE) — Farleigh Plantation, 1956, DICKIN 67 (BOL) — Portlands, 750 ft, 1942, FOURCADE 5712 (BOL) — Knysna Forest near the Globe, 700 ft, 1897, GALPIN 3955 (BOL, PRE) — Avontuur—Knysna road, 1930, FRIES, NORLINDH & WEIMARCK 1618 and 1799 (LD, S) — Plettenberg Bay, 1921, SMART (PRE) — Keurboom River Forest Reserve, 1970, CLARKE 83 (PRE) — Blauw Krans Plantation, 900 ft, 1920, KEET 567 (PRE, STE).

Uniondale Div.: Prince Alfred's Pass, 5 miles N of De Vlugt, 710 m, 1965, DAHLGREN & STRID 2994 (LD).

Humansdorp Div.: Coldstream, 700 ft, 1952, TAYLOR 571 (NBG) — Flats, Ratels Bosch, 650 ft, 1905, FOURCADE 35 (BOL) — Elandsbos River, 500 ft, 1960, ACOCKS 21188 (PRE) — Flats, Witte Els Bosch, 700 ft, 1922, FOURCADE 2286 (BOL) — Between Assegai Bosch and Witte Els Bosch, 1930, THODE A 2529 (PRE) — Clarkson, 1926, THODE A 795 (PRE).

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Botanical Literature

HYLANDER, N. †: Prima loca plantarum vascularium sueciae. Plantae subspontaneae vel in tempore recentiore adventitiae. — Suppl. Svensk Bot. Tidskr. 64 (1970). — 332 pp., in Swedish with introduction in English.

This work is a complete and thoroughly prepared list of the first discoveries of all vascular plants introduced into Sweden during recent times, adventitious as well as those escaped from cultivation. The author has chosen to list all reports, even for accidental escapes from cultivation such as *Tropaeolum majus* L., *Phoenix dactylifera* L. and *Hosta lancifolia* ENGL., which have hardly any chance to establish themselves. The difficulty in making decisions for a large number of cases, however, leads to the conclusion that an unselected list of this type is the only possible solution.

The author endeavoured to control, as far as possible, the identity of all material reported. The resulting corrections of determinations, citations of synonyms, comments on doubtful reports etc., make this book much more valuable than an uncommentated list of references. One shortcoming in a list of this type is the fact that many species become extinct in their first locality, but later reinvade successfully from some other direction. The present work, however, contains not only a citation of the first locality but also many comments on extinctions, spreading, ways of introduction etc.

A book like this is not only valuable from the point of view of curiosity. Some introduced species establish themselves successfully and become part of the local flora as members of natural plant communities. Examples of recent successful invaders in Sweden are *Senecio vernalis* W. & K., *Juncus tenuis* WILLD., *Matricaria matricarioides* (BONG.) PORT., and *Epilobium adenocaulon* HAUSSKN. It is of great interest to establish as accurately as possible the history and starting points of such invasions. This will be possible in the future only if all introductions are kept under constant observation and are recorded.

Points to be criticized in this book are mainly technical details. With a more compact setting, smaller types etc. the volume could have been considerably reduced in size.

No other Swedish botanist could, as HYLANDER, combine a thorough knowledge of Scandinavian floristic literature with wide experience of adventitious and cultivated plants. During his prolonged achievements as a flora-writer he had also become acquainted with all collections and specialists of any importance in this area. All this was necessary for the successful compilation of a work like this. It is very satisfactory that this large amount of information gathered could be published in spite of the sudden death of the author. This was made possible by the commendable efforts of several botanists at the Institute of Systematic Botany, Uppsala, who finished the manuscript and saw it through the press.

SVEN SNOGERUP

The Biology and Chemistry of the Umbelliferae. Edited by V. H. HEYWOOD. Published 1971 as a supplement to the Botanical Journal of the Linnean Society by Academic Press, London. 438 pp. $ 25.00, £ 8.50.

This volume is the result of a symposium held at the University of Reading in 1970. It consists of 22 papers dealing with most diverse aspects of the family Umbelliferae.

The Umbelliferae was perhaps the first family in the plant kingdom to be correctly defined (1583) and one of the first on which a "modern" monograph was written (MORISON 1672). It is also one of the chemically best-known families. Nevertheless, the classification is very unsatisfactory throughout. Even more irritating is the poverty of knowledge of biological aspects such as breeding systems, evolutionary trends and cytology. As a matter of fact, few experimental studies with a taxonomic approach have been made, probably due to the fact that the species are difficult or impossible to cross, and to the small chromosomes which do not encourage detailed cytological investigation.

Unfortunately, 22 papers can not be presented in detail. The first section of the book is a survey of the family, its systematics, and its relations to other families. L. CONSTANCE gives an initiated historical report on the systematic treatment of the Umbelliferae. Many different principles for systematics have been tried since 1583 at least when CESALPINO first recognized Umbelliferae as a group. None was particularly successful until DRUDE selected the best of them and created a system of classification which is that still most widely used. M. MATHIAS gives a survey of what has been done and what remains to be done with the New World Umbelliferae. The same task has been undertaken for the Old World species by HEYWOOD. The good impression is somewhat spoilt by some incorrectnesses such as placing *Malabaila* in the tribe Smyrnieae. *Balansaea* is said to have two species instead of one. The SW Asiatic *Conopodium* species should preferably be placed in other genera such as *Scaligeria, Sphallerocarpus* etc.

J. W. DAWSON presents the New Zealand Umbelliferae and discusses their relations to continental species. A fascinating problem is the origin of the alpine flora. The high mountains of New Zealand are supposed to have been elevated in the late Tertiary. At that time the distance to the nearest land area was nearly 1000 miles.

R. RODRIGUES discusses the subdivision of Umbelliferae and its relations to other families. The wood anatomy indicates close relations to Araliaceae and the smaller families Nyssaceae, Cornaceae, Garryaceae, Alangiaceae and Rhizophoraceae. It is also possible to trace similarities with Caprifoliaceae and Pittosporaceae, for example.

The second part of the volume deals with more specialized aspects of the family. The works of CERCEAU-LARRIVAL on cotyledons and in particular pollen grains have already become classics. The classification of pollen to some extent supports DRUDE'S system but some important changes are indicated. It is interesting that these changes are supported by the study of stoma development presented by M. GUYOT.

R. BELL has summarized his own and other botanists' observations on breeding systems and floral biology. As mentioned, very few facts are known. However, the discussion is interesting. There seems to be some specialization in the otherwise homogeneous flower of Apioideae e.g. in the corolla form, size and shape of stylopodium, and the amount of nectar produced. Here is a wide field for further research, which should increase our knowledge of the lines of evolution within the family.

H. FROEBE has studied the structure of the inflorescence and W. THEOBALD has made a comparative study of fruit development. The latter shows that the same type of fruit can be formed along different lines of development. That is interesting because it questions the foundations of the systematics of the whole family.

Chromosome numbers are known for about 30 % of the species in Umbelliferae. D. MOORE has summarized all numbers known. The basic number in Hydrocotyloideae and Saniculoideae is 8 in most species, and in Apioideae 11. Umbelliferae has a reputation for being poor in polyploids. This opinion must to some extent be modified. Cytological data have been very little used for taxonomic purposes in Umbelliferae. One exception is the caryosystematics of *Bupleurum* worked out by A.-M. CAUWET. It is an ingenious work showing the usefulness of a detailed knowledge of the chromosome numbers.

V. HEYWOOD and K. DAKSHIANI have studied the fruit structure in Caucalideae with the aid of a scanning electron microscope and found microstructures which may prove helpful in taxonomic work.

The same group is treated by HARBORNE in the third part of the volume, dealing with the chemical components of Umbelliferae. HEGENAUER gives a report of chemical patterns and relationships in the Umbelliferae. Three authors write about the presence and differentiation of chemical groups, HARBORNE about flavonoids and phenylpropanoids, BOHLMAN about acetylenic compounds and NIELSEN about coumarins. The flavonoids in particular, seem to be of great interest to the taxonomist. It is shown that flavones are present only in Scandicineae, while flavonols exist in all tribes of Hydrocotyloideae and Saniculoideae but also in some tribes of Apioideae.

A more specialized paper is presented by PICHERING and FAIRBROTHER. They have used the serological technique to compare the tribes of Apioideae. The results are very interesting but the technique is perhaps a little too complicated for routine taxonomic work.

A further three papers treat chemical components in separate groups of plants. MOLHO, JÖSSANG, JARREAU and CARBONNIER have made a phylogenetic study of some *Heracleum* species with the help of furannocoumarins, FAIRBAIRN has examined the alkaloids in *Conium,* and HILLER has worked out the chemosystematics of Saniculoideae.

The last paper in the volume, by D. FRENCH, is a fascinating survey of Umbelliferous plants that have been used by man for some purpose. All parts of the plants, fruits, leaves, roots and stems, have been used in medicines or as food. The paper is accompanied by a list of ethnobotanically interesting species.

The present book is very valuable and will no doubt stimulate further research. It has been published at the right time, when data from new techniques have begun to accumulate and there is a great need for a survey.

The volume is well illustrated. In particular the scanning micrographs of pollen grains presented by CERCEAU-LARRIVAL are worth mentioning. The very complete lists of references that accompany each separate paper are also exceedingly valuable.

LENNART ENGSTRAND

OZENDA, P. & CLAUZADE, G.: Les Lichens, Étude Biologique et Flore Illustrée. — Masson et Cie, 1970. 802 pp., 642 figures. Price Fr. 400: —.

The appearance of a large Lichen Flora of France and adjacent territories is a remarkable event in lichenological literature. France has a long tradition in this field. Lichens were recorded in most of the floras from the end of the 18th and the beginning of the 19th centuries, e.g., in the classical work by LAMARCK and DE CANDOLLE, Flore de France (1805—1815). The beginning of our century saw a major work, viz., HARMAND, Lichens de France (1905—1913), which, however, was never completed. A compilation by GUILLAUMOT, Flore des Lichens de France et de Grande-Bretagne (1951), has proved to be of little use.

The present volume is an impressive work, one of the largest one-volume lichen floras ever published. Professor OZENDA (University of Grenoble) is responsible for the general part (126 pp.). This is on the whole a summary of the same author's "Lichens" in Handbuch der Pflanzenanatomie (1963); cf. review in Bot. Notiser 1965 p. 129. The ten chapters deal with the definition of a lichen, external and internal morphology, reproduction, development and growth, constituents of a lichen, symbiosis (including paragraphs on physiology and metabolism and on parasitism and parasymbiosis), biochemistry, distribution ecology and sociology, practical use and finally a brief chapter, how to study lichens. The text is clear and comprehensive, and the illustrations are of the highest quality. One sometimes finds a few anachronistic terms, like gonidia for the algal component (phycobiont). The distinction between ascohymenial and ascolocular fruiting bodies is discussed summarily, but the importance of these concepts in lichen ontogeny and taxonomy is questioned. As a matter of fact, however, these ideas, first developed by NANNFELDT (1932), have been generally accepted by mycologists and, beginning with SANTESSON (1952) also by an increasing number of lichenologists. The chapter on chemistry is remarkably condensed and reflects a very limited part of the large amount of knowledge accumulated especially in the lastest few decades.

The major part of this work (mainly by Dr. G. CLAUZADE) is a complete lichen flora of France and neighbouring parts of Europe. It contains keys to and descriptions of some 2200 species. Most of them are characterized rather briefly (in 3—10 lines). The identification of a species is highly facilitated by a large number of drawings and photographs in black-and-white. These are extremely well reproduced and show a lot of details otherwise difficult to describe. It is a pleasure to state that these illustrations are unrivalled in any lichenological work.

The authors have followed the classical ZAHLBRUCKNER system (from 1907) with some minor modifications. The arrangement starts with the Pyrenocarpales and ends with Basidiolichenes and Hypholichenes. The latter group (="Lichenes imperfecti") is very heterogeneous including very disparate elements like *Lepraria, Cystocoleus* and *Thamnolia.* It it regrettable that such a conservative attitude towards modern ideas has made the systematic part of this work somewhat obsolete. Several genera, nowadays accepted by most lichen taxonomists, have been included in other genera, e.g., *Pseudocyphellaria* in *Sticta, Hypogymnia, Menegazzia* and *Pseudevernia* in *Parmelia.* On the other hand, *Psora* has been segregated from *Lecidea, Bilimbia* from *Bacidia,* and *Aspicilia* from *Lecanora.* Recent changes of the nomenclature of several species, according to the Code of Nomenclature, have often been ignored. *Catillaria griffithii* is recorded as *C. tricolor, Cornicularia aculeata* as *C. tenuissima, Umbilicaria torrefacta* as *U. erosa, Usnea subfloridana* as *U. comosa,* etc. A great deal of incorrect quotations of authors' names derive from ZAHLBRUCKNER's Catalogus, e.g., RÖHLING, whose name has often been attributed to combinations on a specific level. In spite of his seemingly binary nomenclature it is fully clear that he did accept these taxa as varieties.

The work is completed with a bibliography and an index. A great variety of lichenological publications from all parts of the world are listed. Some important articles should have been mentioned (and considered in the text), e.g., SALISBURY's monograph of *Thelocarpon* (1966) and several papers on pyrenocarpous lichens by SWINSCOW in "The Lichenologist". The index has references from species and other taxa, not to pages but to numbers of species. These are not always listed in numerical order in the text, and it is sometimes difficult to find a species at once.

Despite these remarks the reviewer would strongly emphasize the fact that this volume is an important milestone in European lichenology. The authors who have ventured to undertake such an enormous task are to be congratulated, and also the publishers who have afforded high costs in producing printing and illustrations of an extremely high class.

Ove Almborn

Galun, Margalith: The lichens of Israel. — The Israel Academy of Sciences and Humanities, Jerusalem 1970. 116 pp., 1 coloured plate (illustrating 9 species), 28 plates in black-and-white (illustrating 102 species and several crystal forms of lichen substances), 19 figures in text, 2 maps.

The "manna sent from the heavens", which according to the Bible alleviated the hunger of the Israelites during their passage through the Sinai desert has been supposed to be identical to the lichen *Lecanora esculenta.* If so this is probably the earliest record of a lichen. Otherwise we find very few notes in literature about lichens from Israel. Professor I. Reichert, the pioneer of Israelic mycology, also published some papers on lichens in the 1930's and 40's. One of his students Dr. Margalith Galun has now published a survey of the lichens of Israel.

This flora begins, somewhat unconventionally, with the lichen system without any introductory chapters on morphology, chemistry, etc. A glossary at the end of the book explains the terms used. The sequential order of the families and genera follows the scheme proposed by Hale (1967) starting with the Collemataceae and ending with the Dirinaceae. Keys and descriptions are well-defined. At least on the specific level it is evident that they are based, to a high extent, on the author's own investigation. Many good photographs and drawings facilitate the identification of the species considerably.

It is surprising how few lichen species are recorded in this work. There are 50 genera and 160 species altogether, e.g. only 3 species of *Cladonia* and 5 species of *Parmelia.* It is evident that deserts and other arid areas offer few habitats suitable for a rich lichen flora. In many cases, it seems probable, however, that further research will increase the number of species. Some earlier records should have been quoted, e.g., Müller Arg. (Lichens de Palestine, 1884), who described several new taxa, i.a. *Lecania nazarena* from Nazareth and *Asteroporum perminimum* from Jericho. These will need further investigation. The types are in Geneva.

Dr. Galun's book is a good introduction to the lichen flora of Israel and a useful base for further studies.

Ove Almborn