Volume 43/Number 1
February 1981

The Cactus and Succulent Journal of Great Britain

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Cover design: *From a linocut by Marion Wilds.*

The Journal is published quarterly by the Society, price £1.50 (ISSN 0007-9375).

The Cactus and Succulent Journal of Great Britain

Volume 43 Number 1 February 1981 **edited by David Hunt and Nigel Taylor**

In this issue

Bring and Buy on 16 May!

The annual Bring & Buy meeting will be held as usual at the New Hall, Royal Horticultural Society, Westminster, at 6 for 6.30 p.m. on Tuesday 16 May. Members may bring up to 3 plants per species for auction, 10% of takings being charged as commission to the Society.

Kew Expedition to Somalia

Peter Brandham, who contributes our first article in this issue, and who has given many talks on his *Aloe* work and travels to Society branches up and down the country, is currently leading a Kew expedition to Somalia in search of new and interesting species. With him are Susan Carter, who also has an article in this issue, our Council member Margaret Johnson, and Chris Bailes, a member of the horticultural staff.

Ballot on Merger discussions

Last November, representatives of the GB and National Societies reached agreement on procedure for a ballot of members, and a ballot paper is enclosed with this issue. The question asked is whether members support the *principle* of a full merger of the Societies and is the subject of a joint message from the Chairmen of the two Societies printed on the next page. Please use your vote!

Special seed offers

Also enclosed with this issue is our 1981 Seedlist, from which you may choose twenty packets free—but order quickly while stocks last. Notes on the items offered are on pp. 16-21. And not only has the free allowance on the Society's list been increased for this 50th Anniversary Year from 10 to 20 packets, but we have arranged a separate discount offer with one of the commercial suppliers, Abbey Brook Cactus Nursery, who have prepared an extensive list of documented items at 10p per packet to GB members only. See page 28.

Brian Fearn of Abbey Brook has spent many years studying seed-germination and contributes an article on the theoretical background on pp. 13-16. The practical method of seed-raising he recommends is printed on p. 17.

Keep a note of the numbers

Judging from the records sent in by seed-raisers last year, most of you keep careful notes of what you raise. As imports (and wild populations) diminish, it is not only the value of seed-raising that is increasing but the scientific importance of recording where the seed came from, especially any available field data or the collector's field number. Many of the items on this year's seedlist have information of this type, and we urge everyone to treat them as having the same value as plants from the wild, even when the seed is not fully identified. Keep a

Shurly Award, 1981

Entries are now invited for this year's Shurly Award, consisting of the Silver Cup presented by the Shurly family in memory of Ernest & Dora Shurly, late Presidents of the Society, and a cash prize of £20. The Award will be made for the best essay in the form of an article for the Journal on the subject 'Introducing—', the title to be completed with the name of a genus of cacti or other succulents selected by the entrant.

Entries must be sent to the Editorial Office not later than 31 August 1981. Copies of the Rules, which are as printed on p. 94 of the November 1979 Journal (Vol. 41 no. 4), omitting rule 3, may be obtained from the editorial office.

A message from the Chairmen of the Cactus and Succulent Society of Great Britain and the National Cactus and Succulent Society

Discussions on a Proposed Merger

We are all painfully aware of the consequences of inflation in our daily lives and take whatever steps are possible to ensure that we obtain value for money in our spending. It is against this background that the Finance and General Purposes Committee of the National Cactus and Succulent Society and the Council of the Cactus and Succulent Society of Great Britain believe that it would be advantageous to discuss seriously the possibility of merging the two Societies. They also consider that such a merger would be rational and logical as it would bring together the complementary aims of the two organizations.

Although the benefits deriving from a combination of the resources can only emerge in detail after appropriate discussions, it is already possible to discern advantages. There will be an overall reduction, in some cases, of the administrative effort, thus enabling dedicated officials to devote more time to the long term objectives of the organization and, hopefully, to their plants. The financial resources will be greater and the overheads per member slightly lower thus providing a hedge against inflation and a base for further expansion of facilities to members.

It is with respect to the journal content that the two existing organizations are most complementary and the plan for an integration of these resources has already been agreed in principle. There would be a quarterly Journal in the present form incorporating the best aspects of both Journals, and a year book, containing the more technical type of material, as an optional extra. Hence, the less experienced members and those primarily interested in cultivation would have their needs met and would not pay for information of limited value to them.

In view of the potential advantages of a merger, members are urged to approve the proposal on the enclosed ballot form, i.e. that discussions shall proceed on the terms for a merger of the two Societies on the understanding that, if successful, the full terms of the proposals emerging from the discussion will be put to members for ratification by further ballot.

PLEASE USE YOUR VOTE

K. V. Mortimer
Chairman, NCSS

W. F. Maddams
Chairman, CSSGB

note of the order numbers and the data (or where to look it up) against the time when the young plants are sufficiently mature to be useful for study and discussion.

To distinguish the seed-items for which there is direct source information available (other than what can be inferred from the plant's identification—if correct), we have appended a code number to the note on each item on our seedlist. This is, in effect, a variation on the system of 'Status Symbols' proposed by Gordon Rowley (in CSJGB 41(1): 7-9. 1979). The pointing system is explained in the introduction to the seedlist. It does not mean that items with no data are of no interest; many well-known and popular species are mostly propagated from plants whose original source has been forgotten. But for the serious enthusiast or student, the field data or collector's number are a bonus.

Name that Succulent

Status symbols and the value of documented plants are among the themes developed in Gordon Rowley's new book, *Name that Succulent*, just published by Stanley Thornes Ltd and reviewed elsewhere in this issue. Following Gordon's highly successful *Illustrated Encyclopedia of Succulents* (Salamander Books, 1978), it should be seen and read by everyone who is interested in the name on the label as well as the plant itself. On a half-serious note, we are sorry that Gordon is still so haunted by hybrid nightmares (see CSJGB 40(3): 63. 1978)—there are 20 new hybrid genera in the book—but grateful for the kind thought on p. 258: 'Since almost all [cactus societies] are run by volunteer labour . . . a measure of indulgence is needed if journals do not arrive on time . . .

And now we present a short sequel by the same author, which might be entitled:

Re-Name that Succulent

by Gordon D. Rowley

Two new names implied but not actually used in 'Name that Succulent' are validated below:

Aloe rubriflora (L. Bolus) G. D. Rowley, **comb. nov.** Basionym: *Apicra rubriflora* L. Bolus in Ann. Bolus Herb. 3: 13–14 (1920); *Poellnitzia rubriflora* (L. Bolus) Uitewaal; *Haworthia rubriflora* (L. Bolus) Parr.

×**Trichopelia atlantica** (Dinter) G. D. Rowley, **comb. nov.** Basionym: *Echidnopsis atlantica* Dinter in Feddes Repert. 30: 191–192 (1932). *Trichocaulon delaetianum* Dinter× *Stapelia ruschiana* Dinter.

The Cactus and Succulent Journal of Great Britain
Volume 43(1): 3-6 (1981)

Aloe aristata: an underrated species

by Peter Brandham

Royal Botanic Gardens, Kew
Richmond, Surrey

If there is any plant to which the saying 'familiarity breeds contempt' applies in the world of succulents, that plant is certainly *Aloe aristata*. Although it is a commonly-grown house-plant, available in chain stores and garden centres, few serious collectors of succulents bother to give it houseroom, let alone greenhouse-room, and most consider it not to be worth growing at all. Nevertheless it takes only a little consideration to realise what an interesting species it can be.

The entire genus *Aloe* is a very big one in more ways than one. There are hundreds of species and quite a few of them are moderate or even large trees or shrubs. The great majority of the rest are single or clump-forming rosettes or sub-shrubs, and most of these also become too big to be worth considering seriously as subjects to grow to maturity in a small greenhouse. In spite of their large size aloes as a group are most attractive and can usually be relied upon to produce at least one inflorescence per year of the brightly coloured, usually tubular flowers which are characteristic of the genus. This makes one or two aloes very desirable additions to the average collection of succulents.

There are quite a few small to medium-sized species which are attractive and well worth growing, for example *Aloe albiflora, A. bakeri, A. bellatula, A. deltoideodonta, A. descoingsii, A. dumetorum, A. erensii, A. forbesii, A. haworthioides, A. humilis, A. jucunda, A. juvenna, A. myriacantha, A. polyphylla, A. rauhii, A. somaliensis* and *A. variegata*, but many of these are difficult to cultivate, losing their roots easily, or they are difficult to obtain, or they do not flower freely in cultivation. *Aloe aristata*, on the other hand, is readily obtainable, since most forms produce offsets freely. It is easy to cultivate, providing it is kept dry in winter, and can be relied upon to flower regularly once it has attained a diameter of 6 cm or so. The flowers are relatively large for the size of the plant and are borne in an inflorescence which is usually simple but can have up to seven side-branches. They are characteristically bicoloured. The petals on the adaxial side of each flower (i.e. away from the erect peduncle as the flower hangs downwards) are pink to dull red whereas those on the abaxial side, nearer to the peduncle, are pale yellow or cream. This interesting colour effect is almost unique in the genus and is genetically controlled, not being associated with shading or otherwise during flower development. Different light intensities merely alter the intensity of the pink/red pigment. They have no effect on the presence or absence of the 'bicolour' character.

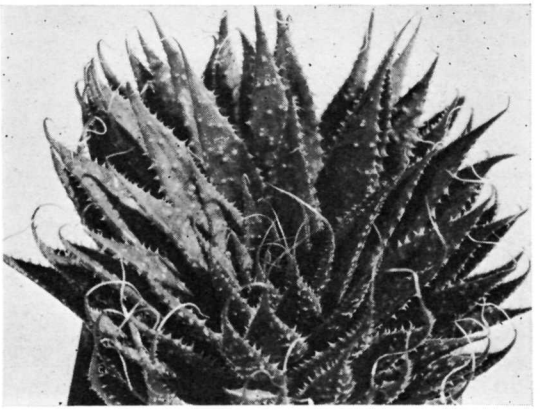
Vegetatively the species is quite unique in the genus and has been put into a series by itself, the *Aristatae* Berger. Plants bear very many leaves, more than most other aloes of similar size (an exception being *A. haworthioides*) and these are furnished with soft marginal prickles and long terminal awns. The leaf surfaces are spotted, with more on the underside, the spots being raised into tubercles or soft spines resembling the lateral ones. On the underside of the leaf, and exceptionally on the upper side also, some of the spinescent spots are often associated either obscurely or distinctly into one or more longitudinal rows.

The species comes from South Africa where it occurs over quite a wide range including the Eastern Cape, the Orange Free State, Lesotho and Natal. Two varieties have been described, var. *leiophylla* Bak. and var. *parvifolia* Bak., but these were considered by Reynolds in his monograph on the Aloes of South Africa (1950) to be included in the normal range of variation of the species and were not upheld as distinct varieties.

In spite of there being no recognized varieties of *A. aristata* there are nevertheless several cultivated forms of unknown wild origin, at least four of which are readily recognized, and these will be described below. All have identical inflorescences.

1. *The 'typical' form.* This produces offsets very freely and is by far the most common in cultivation. It has rather narrow, grey-green leaves on the underside of which the spinescent spots are usually randomly scattered, but sometimes there is a tendency for a few of them to associate obscurely into a single longitudinal row.

Typical form of A. aristata *(photo: Harwood)*



Simple form of A. aristata *(photo: Harwood)*

2. *The 'simple' form.* This can be larger than the typical form (up to 30 cm in diameter), and rarely produces offsets, if at all. It is thus extremely uncommon in cultivation. The leaves are longer and narrower than those of the typical form and the tendency for some of the spinescent spots on the underside of the leaf to associate into a single longitudinal row is more pronounced.

3. *The 'crisp' form (var. crispa Hort.).* This produces offsets quite often and is perhaps the most attractive of the four forms described here. The leaves are shorter and broader than the two preceding forms and have many more of the tuberculate or spinescent spots which are almost white, giving the plant a very pale grey-green overall appearance when viewed from more than arm's-length. Some of the spinescent spots are organized distinctly into two or three rows on the underside of the leaf and obscurely into one or two rows on the upper side.

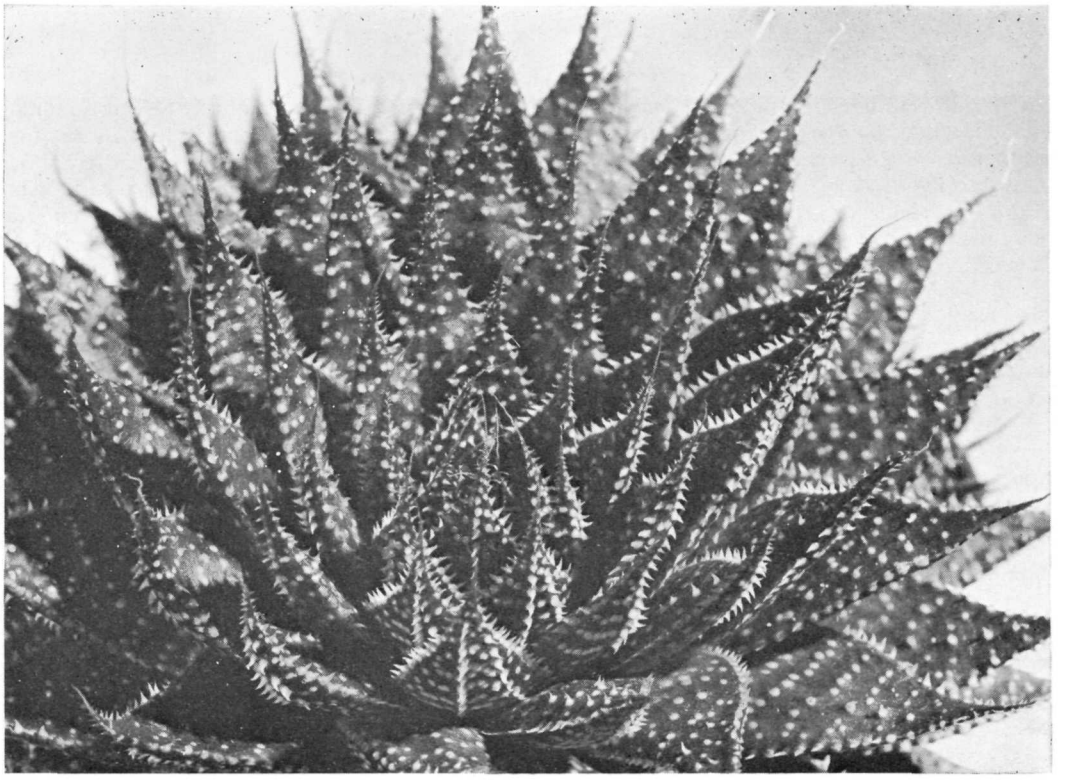
4. *The 'Cathedral Peak' form.* This is a very distinct form, offsetting moderately. It bears broad triangular dark green leaves with hardly any spots on the upper surface and fewer on the under surface than on those of the other three forms. Only the marginal ones and a small number near the mid-line of the leaf are spinescent.

Plants matching this description were sent to me from the Cathedral Peak region of the Drakensberg Mountains in South Africa by David Hardy of Pretoria, but the form has been known in cultivation in Europe for many years under the erroneous name '× *Gastrolea bedinghausii*' (i.e. *Aloe aristata* × *Gasteria* sp.), despite the fact that it has flowers typical of *A. aristata* alone.

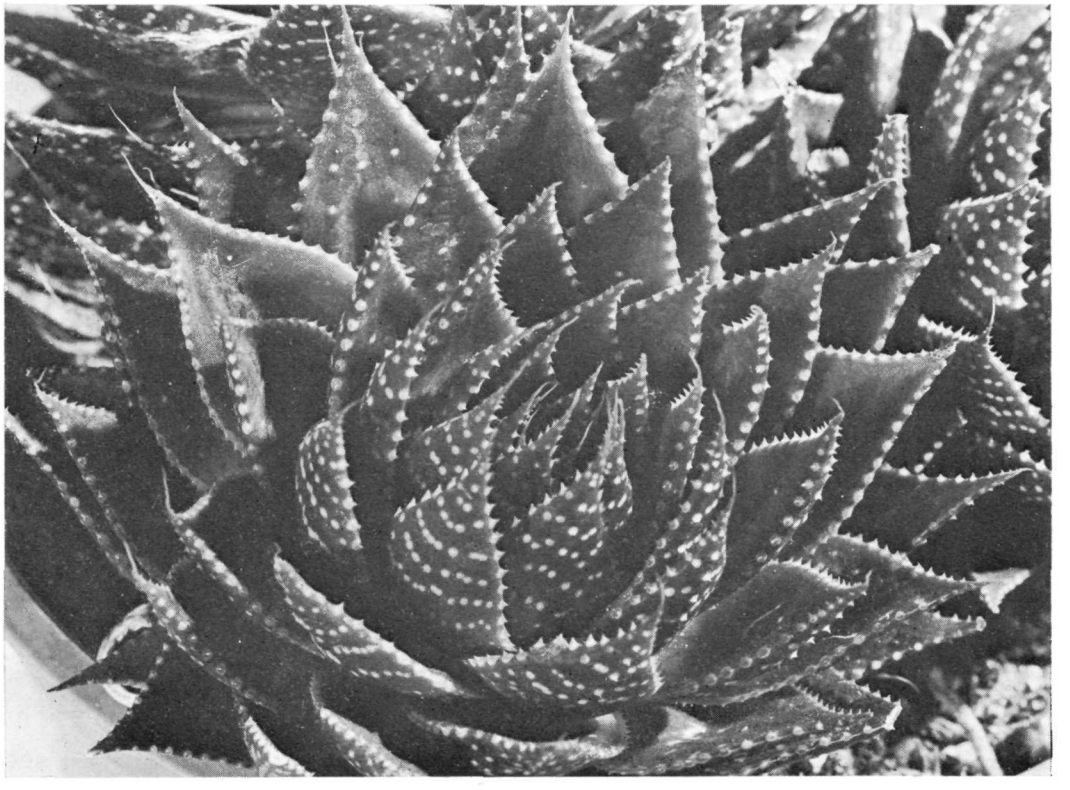
A. aristata can be hybridized readily with species of *Gasteria* to produce bigeneric hybrids, and I have made many such hybrids myself. True hybrids between *A. aristata* and *Gasteria* species have flowers which are always intermediate in shape between those of the parents. *Gasteria* flowers curve away from the peduncle if the latter is held erect and the flowers allowed to hang

The 'Cathedral Peak' form with three flowering heads *(photo: Harwood)*

downwards, but those of *A. aristata* (and most other aloes also) curve towards the peduncle. Flowers of all my *Aloe aristata* × *Gasteria* hybrids are distinctly S-shaped, curving first one way, then the other. Furthermore the pollen fertility of all *Gasteraloe* hybrids is very low, in common with the majority of known bigeneric hybrids. In the so-called '*Gastrolea bedinghausii*' and *Aloe aristata* 'Cathedral Peak' the flowers are exactly similar to typical forms of *A. aristata* in shape and colour, and the pollen fertility is as high as in any other non-hybrid aloe, always being well over 90%. Thus the evidence against a bigeneric hybrid origin for '*Gastrolea bedinghausii*' is overwhelming.



Aloe aristata var. crispa Hort. (above) and 'Cathedral Peak' (below) *(photos: Harwood)*



The hybrids which can be produced between *A. aristata* and species of *Gasteria* are particularly interesting in that they retain a little pollen fertility, most other *Aloe*× *Gasteria* hybrids being completely sterile. I have found that the hybrid between *A. aristata* and *G. lutzii* contains 10–15% fertile pollen in its anthers, and this can be used as a pollen parent in further crosses, especially with other *Gasteria* species. When these crosses are raised they show a tremendous range of variability, even among seedlings derived from a single capsule, because of the different combinations of *Aloe* and *Gasteria* genes within them, and some of these combinations produce plants which are very attractive indeed.

The whole field of controlled hybridization in the Aloineae and in the majority of cacti and succulents is still largely unexplored, at least it is in this country, and providing that accurate records are kept a multitude of interesting and valuable new hybrids awaits us.

With its retention of some fertility in its hybrids *Aloe aristata* is a useful plant with which to begin hybridization experiments, in addition to being an attractive plant in its own right when grown well. One or two forms of this species deserve a place in almost every collection of succulent plants, and even the well-worn excuse that 'there isn't room for any more plants in my greenhouse' cannot be used. I have found that the species is perfectly hardy, at least in the region of Surrey where I live. It has grown happily in my garden for the past three years under light shade, even tolerating the very hard winter of 1978/9. It is offsetting freely to produce a good clump, and has flowered regularly every summer.

The Cactus and Succulent Journal of Great Britain
Volume 43(1): 6–8 (1981)

Two Euphorbias in Danger

by Susan Carter
Royal Botanic Gardens, Kew
Richmond, Surrey

Euphorbia cussonioides Bally in Bothalia 7: 29 (1958); figs. 1, 2.

E. cussonioides is a succulent tree species confined in distribution to the central highlands of Kenya. In this relatively densely populated region cultivation is intense, with the result that almost all the indigenous forest has been cut down. Now only isolated pockets remain, usually in deep gorges or rocky clefts where cultivation would be impossible. With luck, *E. cussonioides* manages to survive at a few of these sites.

It was first discovered and recognized as a new species by Dr. Peter Bally in 1939, less than a year after he arrived to settle in Kenya. The first photograph (fig. 1) is one he took in January 1939 of a group of trees about 12 miles south of Nairobi at Ngong, a very small village at that time, but already encroaching into the surrounding forest which covered the Ngong Hills and part of the plain to the east. The herbarium specimen he prepared as the type for his new species came from one of these trees, thus making this spot the type locality. In the years following he found other groups of trees, mostly to the north and east of Nairobi on the south-eastern slopes of the Aberdare Mountains.

The second photograph (fig. 2), taken in 1977, shows what has happened at Ngong since 1939. A very sizeable village has developed dominated by the Mission Chapel, development which has resulted in the destruction of all but one of the trees, and even that looks very sick.* The species has not been found within the Ngong Hills themselves for many years, almost all tree covering having long since disappeared. Now it is known only from 2 or 3 localities north of Nairobi in deep rocky gorges.

E. cussonioides is a forest species, occurring at 900–1800 m. (3000–6000 ft.), its lofty crown reaching a height of up to 25 metres making it one of the tallest Euphorbias of eastern tropical Africa, second in size only to *E. obovalifolia*, a species of the higher altitude mist forests. Although both trees have fleshy branches, neither are xerophytic, requiring the protection of high altitude forest vegetation for their survival. Once this is removed, a more rapid evaporation rate eventually leads to their death.

Euphorbia wakefieldii N.E. Br. in Flora Trop. Africa 6(1): 583 (1912); Bally in Candollea 21: 369 (1966); figs. 3, 4.

Another species suffering the same fate as *E. cussonioides* is *E. wakefieldii*, which has already been included in the Red Data Book list of endangered plants. It is again a tree species, this time from the indigenous forests clothing the hills behind the Kenya coast. Unhappily the cutting of trees, mainly by charcoal burners, has led to the destruction of vast tracts of this forest, and the few known stands of *E. wakefieldii* are in great danger of disappearing altogether.

It was first collected in 1880 as a small plant by one of the early British missionaries to East Africa, the Revd. Wakefield, and subsequently described by N. E. Brown at Kew, in 1912, as a perennial. It was not until 1948

* The author has just revisited the locality and reports that the tree has now gone(Jan. 1981)—Ed.

Fig. 1. *Trees of Euphorbia cussonioides at the type locality. Photographed by the late Dr. Peter Bally in* 1939

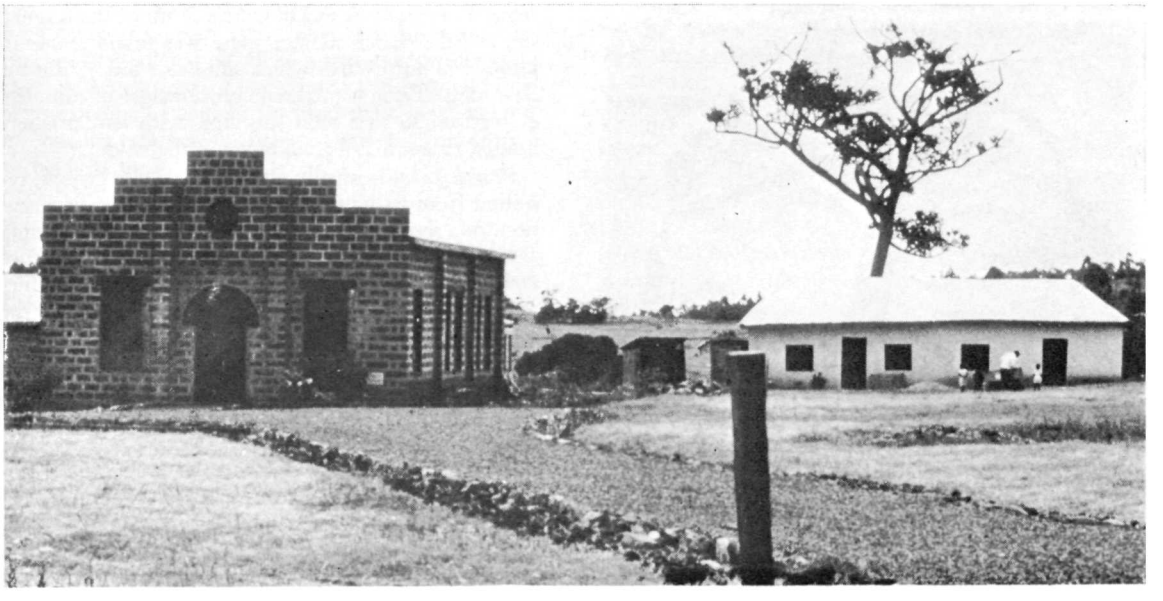


Fig. 2. *The same locality in* 1977, *one tree remaining*

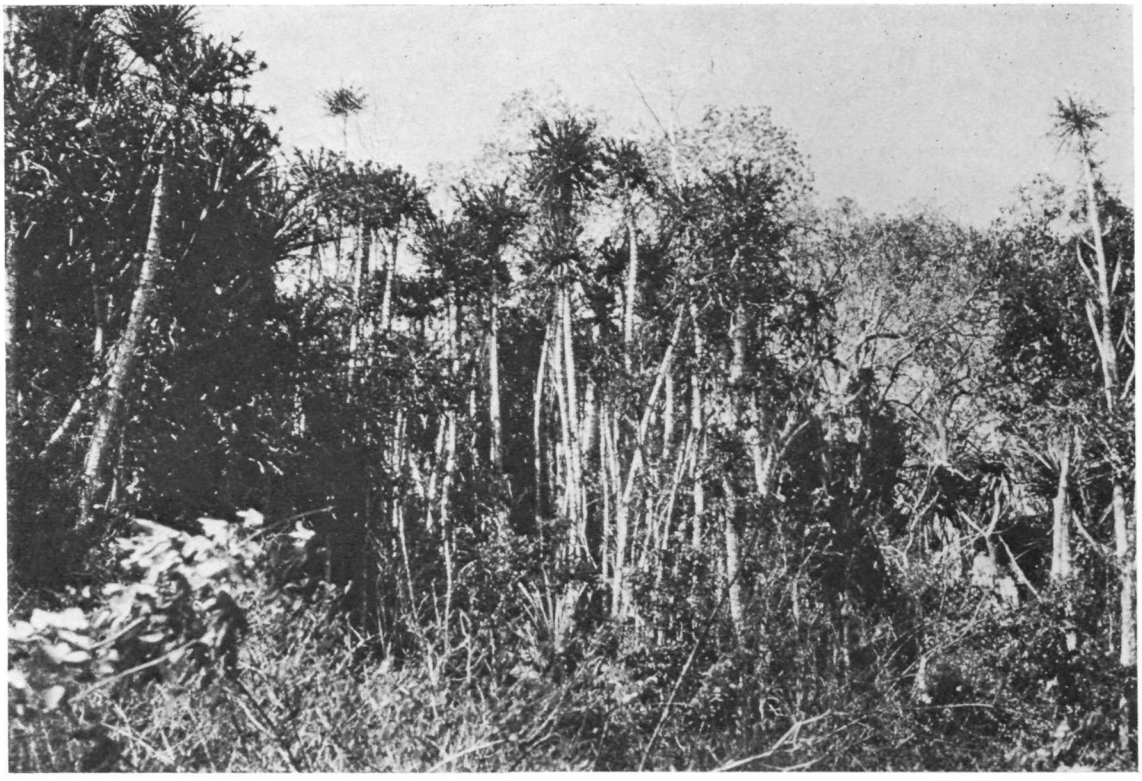
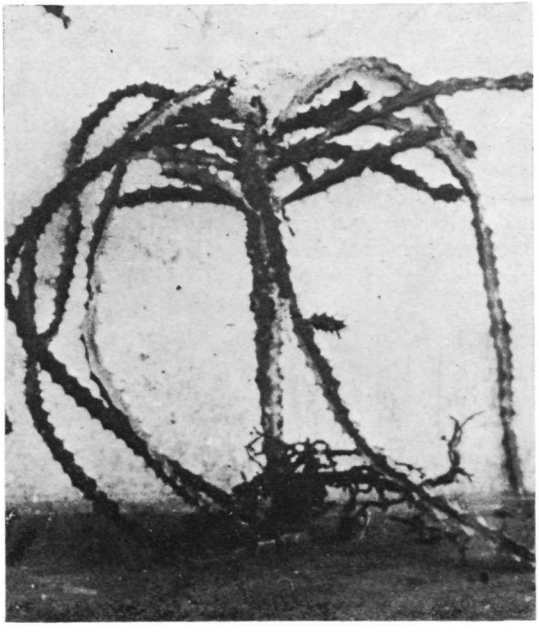


Fig. 3. *Mature stand of Euphorbia wakefieldii*

Fig. 4. *Seedling of E. wakefieldii*



that Peter Bally proved this small plant to be a seedling of a large tree up to 15 metres high, when he found a stand no more than 15 kilometres south of the original site at Ribe. Later another stand was found about 10 kilometres northwards which still exists today. But for how long? These stands are in great danger of complete destruction so that soon this tree, with its extremely limited range, may be unknown in the wild.

E. wakefieldii is usually clustered in dense groups, resulting from its unusual means of vegetative propagation. As a seedling the lowest branches elongate, trailing along the ground and rooting at intervals to produce new plants. Such a group of trees (fig. 3), and a seedling with its trailing branches (fig. 4), are shown in the accompanying photographs.

With its narrow, bright green branches produced in a crown at the top of a slender grey trunk, and its fairly slow growth, *E. wakefieldii* is one of the more attractive and manageable tree Euphorbias when it comes to cultivation. It has been introduced in this country and the States, and is also grown as an ornamental tree in several gardens in Kenya itself. It is to be hoped that, in the future, neither this species nor *E. cussonioides* will exist only in cultivation, where the natural conditions of their forest habitats are virtually impossible to reproduce, and only atypical plants can develop.

The Cactus and Succulent Journal of Great Britain
Volume 43(1) 9-12 (1981)

The Stem Anatomy of Opuntia fragilis (Nutt.) Haw.

by Jonathan Y. Clark

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Summary. The results of an anatomical investigation of the stem of *Opuntia fragilis* (Nutt.) Haw. are presented here. Emphasis is placed on the wood anatomy with a view to confirming the existence of true vessels in the xylem of the Cactaceae. The so-called 'vascular tracheids' are examined in some detail. It is concluded that this species possesses vessels with simple perforation plates and helical to reticulate secondary wall-thickening. The observations made in this study agree with those made by other workers researching in the field of cactus anatomy.

Introduction

The main reason for this study was to attempt to remove any lingering doubt as to the presence of vessels in the xylem of the Cactaceae. The facts have been established by Bailey (1962c), Gibson (1973) and Conde (1975), whose photographs and drawings clearly show the presence of vessels in the Cactaceae. However, most of the anatomical papers by these workers have been published in botanical journals seldom seen outside the libraries of large universities. The average cactophile is thus unaware of the existence of these publications. Therefore, the myth of the absence of vessels in the Cactaceae persists as author after author copies information from early articles such as that of Darbishire (1904). Many of these earlier publications take the view that the vessel-like cells in the xylem of the Cactaceae are tracheids, i.e. primitive vascular cells characterized by the absence of a perforation plate (see later) and the presence of bordered pits. The situation is further confused by the presence of large, usually imperforate cells with pronounced annular (locular) thickening, known as 'vascular tracheids' (Bailey, 1961-64) or 'barrel tracheids' (Conde, 1975).

Materials and Methods

All the plant material used in this investigation was obtained from a single plant in the glasshouses of the Plant Science Laboratories, University of Reading. *Opuntia fragilis* (Nutt.) Haw. was chosen as the subject of the investigation because material was readily available and individual pads were of a convenient size for sectioning by hand. For the benefit of those who are not familiar with the species I quote the following description from Backeberg (1978):

'Bo. low, branching, forming colonies to 20 cm h., 40 cm br.; Seg. ± without Tub., subterete or often ± flattened, mostly dark green, to 4 cm lg.; Ar. small, white; Sp. mostly 1-4, upper one angular, stout, to 3 cm lg., yellowish-brown, often lighter above; Glo. yellowish-whitish; Fl. 5 cm diam., pale yellow to pale reddish-yellow; Fr. dry, tuberculate, very spiny; S. yellow, flat.—British Columbia; USA (Washington; Oregon to Arizona and NW Texas).'

Hand-sectioning of fresh material proved to be almost impossible, mainly due to the large amounts of mucilage present in the stem. Slightly better results were obtained using pads preserved in 70% FAA (Formalin-acetic-alcohol). However, it was still not possible to produce thin enough sections by hand. Sectioning was attempted using an electronic freezing microtome, with no success. Finally, it was decided to employ a standard wax-embedding technique (Johansen, 1940).

Transverse (t.s.) and longitudinal (l.s.) sections, each 10μ m thick, were cut from the resulting wax blocks using a rotary microtome. The wax was removed from the sections using xylene. The sections were later stained with saffranin (which stains lignin) and fast green (which stains cellulose). This process, though time-consuming, yielded satisfactory results. These sections, when examined under a microscope, were seen to be of higher quality than the hand sections, but even so parts had been damaged during processing. However, the sections were quite suitable for detailed examination and indeed for the preparation of photographs. Plate I nos. 1-11 were taken using a photomicroscope.

Results

Figure 1 shows the distribution of the stem tissues as revealed in transverse section. The epidermis is better regarded as a multiple-layered epidermis (Linsbauer, 1930), 2-3 cells thick. According to Metcalfe and Chalk (1950), the lower layers constitute a pseudo-hypoderm. A true hypoderm develops from the ground tissue but it is not possible to determine this from a study of mature tissues. The lower layers of the epidermis consist of lamellar collenchyma, that is collenchyma with thickenings mainly on the tangential cell walls. Details of the epidermis can be seen in Plate I.2. The cuticle (c) is thick, as in many other xerophytes. This prevents excessive water loss by cuticular transpiration. Crystals of calcium oxalate (d), known as druses, are present in some epidermal cells.

The epidermis is perforated by numerous stomata, or 'breathing pores'. Their opening and closing depends on the swelling and shrinking of the guard cells (gc). These cells can also be seen in section in Plate I.3 and in

★ This paper is the winning entry for the Shurly Award, 1980.

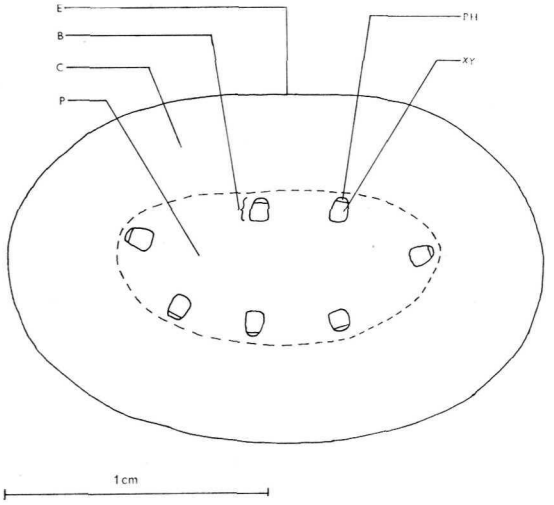


Fig. 1. Diagram of T.S. of stem of *Opuntia fragilis*, showing epidermis (E), cortex (C), pith (P) and vascular bundles (B) with phloem (PH) and xylem (XY).

surface view in Plate I.4. Here the stomatal complex, i.e. the guard cells and the cells immediately surrounding them, can be seen clearly. The subsidiary cells (sc) are positioned on either side of the guard cells and parallel with the long axis of the aperture. Thus the stomatal complex is said to be paracytic in arrangement. The epidermal druses (d) can be seen clearly through the transparent cuticle.

The cortex consists of large parenchyma cells which, in this case, perform a dual function as photosynthetic cells and for water-storage. They are arranged in radial columns, those closest to the epidermis containing more chloroplasts than those nearer the vascular bundles. This is understandable since, in the absence of leaves, the stem becomes the organ of photosynthesis. The parenchyma cells near the vascular bundles possess no chloroplasts, as is also the case with the central core of water-storing parenchyma, the pith. Some cortical parenchyma cells contain stellate druses of calcium oxalate, as shown in Plate I.5.

The pith cells are not arranged in columns, and in fact the change from the columnar arrangement of the cortex cells to the irregular positioning of the cells in the pith is more gradual than may appear from fig. 1. The position of the interface, shown in fig. 1 as a broken line, is drawn in only as a guide.

Vascular bundles can be seen in Plate I.1. An enlargement of the phloem (p) is shown in Plates I.7 and I.10. The phloem contains sieve-tubes, which consist of sieve elements (se) joined end to end to form a continuous tube. The end-walls of the cells are perforated, forming sieve plates (sp) (one is just visible in Plate I.10). Also in the phloem are specialized parenchyma cells known as companion cells (cc). These work in close association with the sieve-tubes in the transport of sugars predominantly down the stem. Other parenchyma cells are present in the phloem, and to a lesser extent in the xylem, and they are often specialized as mucilage cells (mc).

The cambium (c) consists of a rapidly dividing layer of relatively undifferentiated cells, and cannot be easily distinguished from its adjacent daughter cells.

The xylem, or wood, is that part of the cactus stem which has caused confusion amongst taxonomists and anatomists. The absence of vessels in the Cactaceae is indeed a myth, as vessels are clearly shown to be present in *Opuntia fragilis* in Plate I.9. These vessels, with helical to reticulate thickening, possess perforation plates (Plate I.9), whereas tracheids do not. The perforation plate (pp) is the only trace which remains of the end-walls of the xylem vessel-elements. According to Metcalfe and Chalk (1950), the vessels of the Cactaceae possess simple perforation plates. This is confirmed for *O. fragilis* by Plate I.9.

Also in the xylem, there are large, fusiform, imperforate cells with lignified annular, rarely helical thickenings (septa) which project deeply into the lumen of the cell (Plates I.8 and I.11). These cells are known as vascular tracheids (vt) and occur amongst the vessels, but are present in greatest concentration on the inward side of the vascular bundles (see Plate I.1.). In a few sections, the septa of the vascular tracheids were seen in transverse section to be traversed radially by one or two thin straight lines, pits, or grooves. It is possible these lines were artefacts, but they are also shown on the line drawings in Darbishire's account of *Mammillaria elongata* (1904), and therefore may represent true structures.

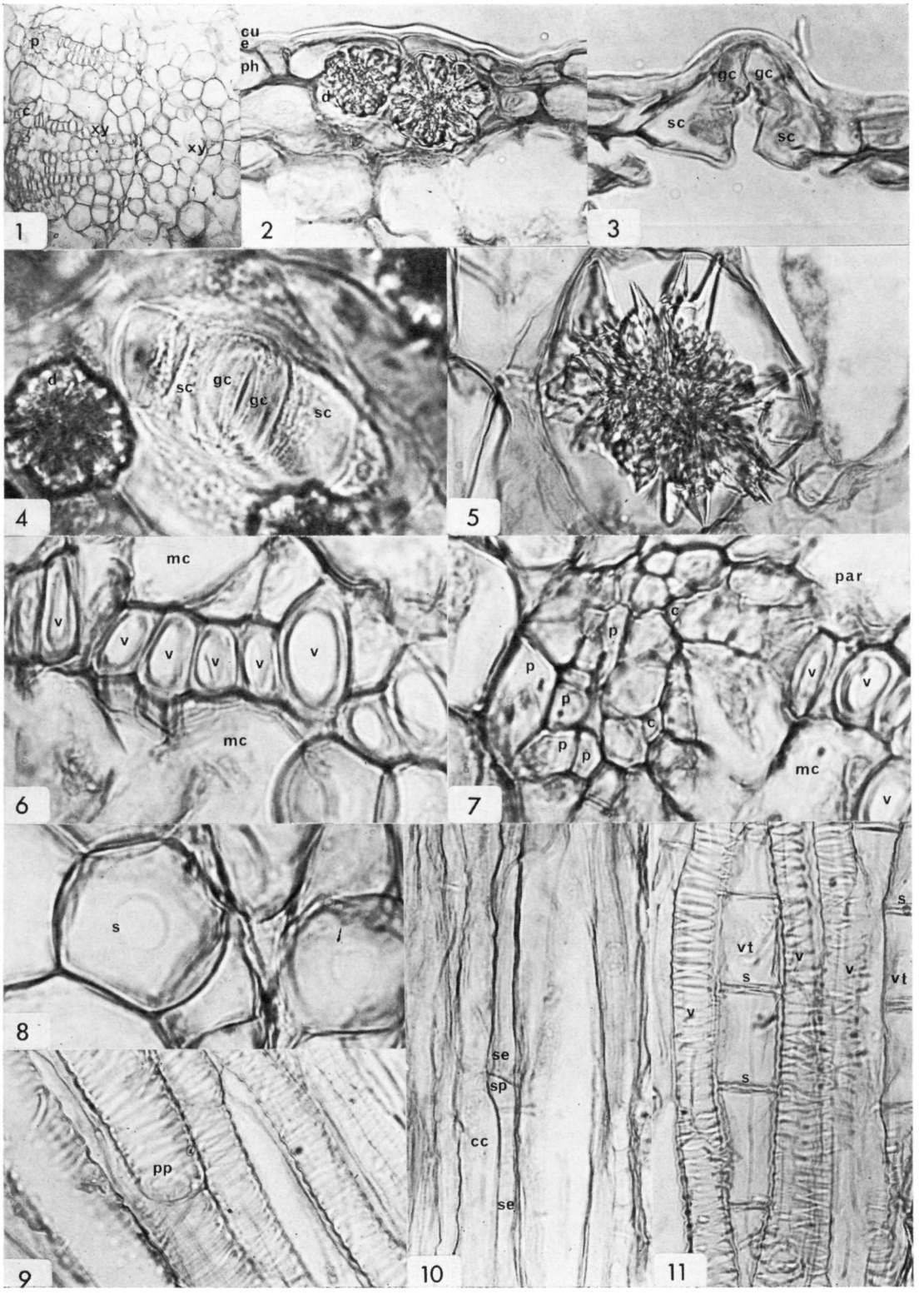
Conclusion

Anatomically, *Opuntia fragilis* (Nutt.) Haw. is typical of the Cactaceae in that it possesses druses of calcium oxalate, mucilage cells, true vessels, vascular tracheids and copious amounts of water-storing parenchyma.

Even *Pereskia*, the most primitive genus of the Cactaceae, in the subfamily Pereskioideae, has vessels (Bailey, 1962c). According to Gibson (1973), the subfamily Cactoideae also possess vessels. Gibson has also

PLATE I

1. Transverse Section of vascular bundle, showing phloem (p), cambium (c) and xylem (xy), × 120; **2.** T.S. of cuticle (cu), epidermis (e) and pseudohypoderm (ph) showing druses (d) of calcium oxalate, × 470; **3.** T.S. of stoma showing guard cells (gc) and subsidiary cells (sc), × 600; **4.** stoma, external view, × 600; **5.** cortical parenchyma cell with large druse, × 600; **6.** T.S. of xylem showing vessels (v) and mucilage cells (mc), × 800; **7.** T.S. of phloem (p) and cambium (c) with xylem vessels (v), mucilage cells (mc) and xylem parenchyma (par), × 800; **8.** T.S. of vascular tracheids showing characteristic annular septa (s), × 800; **9.** Longitudinal Section of xylem vessels showing a simple perforation plate (pp), × 600; **10.** L.S. of phloem showing sieve-tube with sieve-plate (sp) between two sieve-elements (se), and companion cell (cc), × 600; **11.** L.S. of xylem showing vessels (v) and vascular tracheids (vt) with annular septa (s), × 470.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shown that the vascular tracheids form in the ground tissue after the primary xylem is mature and differentiate within the primary xylem long after the vessels are functional (Gibson, 1978). This suggests that the primary function of the vascular tracheids is as a supporting and strengthening tissue, perhaps to prevent excessive shrinkage during drought. Preston (1901) suggested that helical thickening in xylary cells (i.e. vessels and vascular tracheids) gives elasticity to the vascular system. If a section through a cactus stem is subjected to artificial drought, i.e., flooded with 100% alcohol, the walls of the vascular tracheids collapse somewhat, but the annular or helical thickenings remain intact and solid. Thus the vascular tracheids can act as strengthening tissue. It is interesting to note here that the vascular tracheids of *Pereskia aculeata,* a relatively primitive species which does not have to contend with water shortage in its habitat, are very short with only one or two septa (Bailey, 1962c). It is also worth noting that the Compositae (Daisy family) also possess vascular tracheids (Carlquist, 1966). However, those of the Cactaceae, with their characteristic annular or helical thickening, are at the moment thought to be unique in the Plant Kingdom.

Acknowledgments

This report is an extended version of a course project in anatomy leading up to a B.Sc. in Botany at the University of Reading. I should therefore like to thank the Botany Dept. for use of its facilities. I also wish to thank Dr. R. Longton and Mr. P. Crane for help in the preparation of the final manuscript; Mr. M. Soladoye for advice on wax embedding techniques; Mr. W. Harvey for help with the freezing microtome; and Mr. G. D. Rowley for allowing me to use his unique library. Grateful thanks are due to Mr. V. Morris, departmental photographer, for processing the films.

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STENOCACTUS: NO CONSERVATION PROPOSAL NECESSARY

In my article 'Decent re-burial for Echinofossulocactus' (CSJGB 42(4): 105-107), I said that the oldest available name for *Echinofossulocactus* sensu B. & R. is *Brittonrosea* Speg. (1923), and that a proposal to conserve *Stenocactus* (K. Schum.) Backeb. & F. M. Knuth (1935) over *Brittonrosea* would be desirable to legitimize the use of *Stenocactus* when the group is maintained as a genus. I had overlooked, however, that *Brittonrosea* Speg. was illegitimate when published and remains so in spite of the re-lectotypification of *Echinofossulocactus.* This situation is covered by ICBN Art. 63.1 (1978 edition) which states: 'A name is illegitimate and is to be rejected if it was nomenclaturally superfluous when published, i.e. the taxon to which it was applied, as circumscribed by its author, included the type of a name or epithet which ought to have been adopted under the rules.'

The name *Stenocactus* is not illegitimate since it was first published as *Echinocactus* subg. *Stenocactus* K. Schum. prior to Britton & Rose's original lectotypification of *Echinofossulocactus* (cf. ICBN Art. 63.3).

Consequently, conservation of *Stenocactus* K. Schum. is not necessary and it is the correct name for the group at either generic or subgeneric rank. The lectotype species as designated by Taylor (in CSJGB 42(4): 107, 1980), is *Echinocactus crispatus* DC.

D.R.H.

The Cactus and Succulent Journal of Great Britain
Volume 43(1): 13-16 (1981)

Seed Germination: the modern approach

by Brian Fearn

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Introduction

This paper is a review of the current state of knowledge and its implications for the successful growing of cacti from seed. There are few accounts which study either the effects of environmental factors on germination or the viability and longevity of cactus seed (Fearn, 1974, 1977). It has been shown by Alcorn and Kurtz (1959) and McDonough (1964) that light has a stimulating effect on the germination of *Carnegiea gigantea* and *Stenocereus (Marshallocereus) thurberi*. The effect was similar to that found by other workers in lettuce and *Lepidium* (Borthwick *et al.*, 1954).

Dormancy in Seeds

There are two kinds of dormancy in seeds. *Imposed dormancy* is directly induced by environmental factors. If kept dry or at low temperatures the majority of seeds will not germinate until moisture and an appropriate temperature are available. This is not true dormancy but a temporary state imposed by the prevailing conditions. *True dormancy* in seeds is not directly imposed by the environment. It is impossible to make the seeds germinate simply by making the environmental conditions suitable for growth. True dormancy can be broken by exposure to certain specific conditions which may have little in common with the conditions optimal for growth.

The seed can be truly dormant from a number of different causes:

1. The effect of light.
2. The characteristics of the seedcoat or testa.
3. The internal concentrations of growth-promoting and growth-preventing substances.

The effect of light

There are three main types of response by seeds to light:

a) *Indifferent*. Seeds germinate whether illuminated or not. Fortunately most horticultural and agricultural seeds have this response. The author's knowledge is limited to two groups, the Euphorbiaceae and Asclepiadaceae, all of which appear to belong to type a).

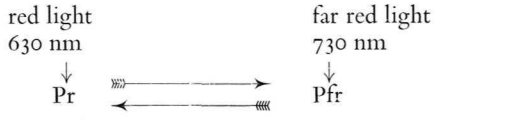
b) *Light sensitive*. Seeds belonging to this group will not germinate unless illuminated in the *imbibed state*, i.e. when the embryo has taken up water. Classic examples are lettuce, foxglove and mistletoe. The author has found that most members of the Cactaceae and Mesembryanthemaceae belong to type b).

c) *Light hard*. Seed will not germinate in the light and must be kept in the dark during germination. *Aloe variegata* is the only species belonging to this group of which I have had experience, but I wonder whether other *Aloe* species are also 'light hard'.

These light responses involve a fundamental physiological system of wide significance which involves a protein called phytochrome. Before light energy can operate on any process it has first to be absorbed. A TV-set has an aerial to absorb a particular wavelength of radio energy. So it is with seeds which require an internal molecular aerial to absorb the very much shorter wavelengths of light energy. These 'molecular aerials' are called pigments. Sunlight contains energy over a range of wavelengths corresponding to the different colours of the visible spectrum, from long-wave red to short-wave blue.

Investigation into the phenomenon began over 30 years ago in America where it was found that the optimum wavelength for breaking dormancy and stimulating germination was orange-red light of 630 nm*. The same wavelength is also responsible for inhibiting the germination of 'light hard' seeds. It was also found that far-red light with a wavelength of 730 nm completely reversed the effect of orange-red illumination. A subsequent exposure to orange-red restored germination and the final response depended on the last exposure.

The pigment part of the phytochrome protein exists in two slightly different forms. One form absorbs orange-red light which changes its molecular structure to the second form, which absorbs far red light, resulting in its conversion back to the first, orange-red absorbing form.



This form prevents the germination of 'light sensitive' seeds. Promotes the germination of 'light hard' seeds.

This form starts the germination process in 'light sensitive' seeds. Prevents germination of 'light hard' seeds.

*1 nm = $\frac{1}{1{,}000{,}000{,}000}$ metre or 10 Å (angstrom units).

Seedcoat characteristics

a) The mechanical restriction of embryo growth and the uptake of water can prevent germination. The only way of getting rid of this restriction is by destroying or modifying the mechanical properties of the seedcoat. Chipping the testa of 'difficult' species such as *Echinocactus horizonthalonius* can produce enhanced germination. This is achieved in nature by natural abrasion by the soil (Koller, 1957; Barton, 1961). Other difficult species may also benefit from this treatment. It is the standard treatment when raising sweet peas from seed, but care must be taken to prevent damage to the embryo.

b) The seedcoat may also prevent the ready exchange of gases with the environment. Oxygen is essential to maintain energy producing processes and thus before a seed can germinate the embryo needs oxygen. This can be limited by seedcoat permeability.

c) Dormancy can be imposed because the seedcoat contains growth inhibitors or regulators. These substances are not hormones as they do not have the property of movement typical of a hormone (i.e. production in one place and action in another). These substances actively prevent the normal chemical processes which are characteristic of the early stages of germination. Coumarin, Caffeic acid, Ferulic acid and Vanillic acid are four such compounds. They are often present in both seeds and fruits. Have you ever seen a tomato seed germinate inside a tomato fruit? This is prevented because the flesh of a tomato is full of the germination inhibitors Caffeic and Ferulic acids. The normal process of rotting by bacteria and fungi removes the inhibiting action. The author has found that *Lithops* fruit capsules are also full of germination inhibitors. The standard test is to make an aqueous extract of the capsule and test the germination of lettuce seeds in the presence or absence of the extract.

Lithops capsules contain a very high inhibitor concentration which is still effective at a 1 in 50 dilution. Most if not all Mesembryanthemaceae also contain germination inhibitors. The seeds of desert plants often contain a rain-gauging mechanism based on inhibitor contents. These enable the seed to measure and respond to quantities of rain adequate for their full development. Only when such sufficient quantities of water have fallen will enough inhibitor be washed out of the seed to allow it to germinate (Evenari, 1949; Tevis, 1958). *Hydrodea bossiana* is an extreme example of this phenomenon. During the great rainy period of 1933–4 in South-West Africa, in the area surrounding Swakopmund, this plant appeared in countless numbers. Apparently not even the oldest inhabitant could remember the plant (Schwantes, 1957). Seeds of this plant would appear to hold the record for longevity amongst the succulents.

Embryo characteristics

The embryo itself can also show dormancy which is independent of the nature of, or even the presence of, the seedcoat. The dormancy can be due to a high concentration of growth-preventing substances or a low concentration of growth-promoting substances. The dormancy is broken by either decreasing the inhibitor content or initiating the synthesis of special growth-promoting substances. Two factors can bring about such changes inside the seeds.

a) *Temperature.* The practice of stratification in which seeds are kept in moist condition at low temperatures can promote germination by allowing the embryo to grow slowly to a certain critical size. Stratification is standard practice in the germination of many fruit-tree seeds, seeds for rose-bush grafting stock, Ash and Hazel seeds, etc.

b) *The effect of light.* Phytochrome regulates the level of growth substances in the embryo. After the seed has imbibed water and has received the correct wavelength of light synthesis of growth-promoting substances or an anti-inhibitor is started and sets off the chain of chemical events leading to germination.

The effect of temperature

In many plants temperature is a major factor affecting both the rate and the percentage germination. It has been shown that relatively small temperature differences may greatly modify germination responses (Roberts, 1972). Seeds of different species and ages also germinate over varying ranges of temperature (Thompson, 1970; Fearn, 1973). It is reasonable to assume that these responses are adaptive, and that success or failure of a population of a species in a particular locality depends on the way in which its germination responses fit the environmental conditions prevalent. It has been reported that variation in the germination requirements of different populations of a particular species also occur. A detailed study of the temperature requirements of twenty species has been made by Fearn (1973). This work suggested that a temperature of 20°C±2°C gave good germination percentages in a wide range of genera. It has also been shown that the germination response may have distinctive characteristics which are associated with the nature of a particular habitat. There also appears to be a relationship between germination and the geographical distribution of a species.

Some observations on the temperature requirements of the Cactaceae

a) Extremes of temperature do not favour germination, i.e. below 12°C and above 28°C are likely to produce poor germination.

b) Different species have different temperature ranges. E.g. *Frailea pumila* 10–40°C, *Rebutia xanthocarpa* var. *salmonea* 11.5–22.8°C.

c) The temperature range is dependent on seed age. This may be associated with changes in metabolic activity. E.g. a 7 year old seed sample of *Parodia chrysacanthion* was compared with a 1 year old sample,

and both gave 100% germination, but the temperature requirements were 11.3–28.3°C for the 1 year sample and 14.25–28.75°C for the 7 year sample.

d) Fluctuating temperatures appear to produce better germination results than constant temperatures. In practice set the propagator thermostat lower than optimal maximum and let the temperature fluctuate upwards during the day.

The effect of seed age on germination potential

Seeds of many plants can survive for very long periods in the soil. Harrington (1970) has published a long list of plants whose seeds can survive 30 years or more in the soil. All might not yet be lost in the sad tale of two habitats described by Paul Sherville (see last issue, p. 117). Provided these two localities remain undisturbed there is just a chance that sufficient seed remains in the soil to replenish the population.

In the Cactaceae it has been noticed that viability was lost very quickly in some genera, e.g. *Frailea* and some but not all members of the genus *Gymnocalycium*. Wide germination differences also occur between species of the same genus, e.g. *Parodia* and *Mammillaria*. Viability is maintained at a relatively high level in other genera, e.g. *Echinocereus, Ferocactus, Eulychnia, Neoporteria* and *Haageocereus*. Seed of *Ferocactus herrerae* collected in Mexico by P. Fearn in 1963 still gave 50% germination in 1980. In contrast seed of *Notocactus haselbergii* does not remain viable for a period longer than 4 years and there is a marked fall in viability after one year (Fearn, 1977).

Another interesting observation is the wide discrepancy between different seed samples of the same species. One sample of *Rebutia minuscula* at 3 years gave zero germination, whilst another at 7 years gave 55%. This may well be due to differences in storage conditions. Many factors such as maturity, temperature, moisture, seed coat characteristics, fungal and insect infestation affect the longevity of seeds under natural or controlled storage conditions (Barton, 1961; Roberts, 1972). Many seeds are now stored and sold under laboratory-controlled conditions. The introduction of vacuum packed vegetable and flower seeds has been a technological breakthrough. If the pack is not opened these seeds will remain viable for a very long time. The idea behind vacuum packing is to maintain a low seed moisture content. Each 1% reduction in seed moisture *doubles* the life of the seed. In addition storage at low temperatures is beneficial. Each 5°C reduction in seed storage temperature down to 0°C doubles the life of the seed. As far as cactus seed is concerned the golden rules are 'keep dry' and 'keep cool'.

An attempt is being made to produce a card index with information on as many species of cacti as possible, showing the decline in viability with age. Detailed information on over 700 species has now been accumulated. As an example of the type of information that is being gathered the decline in viability of *Notocactus haselbergii* is shown in the table.

Seed Sample No.	Age when tested (yrs)	Percent germination
CF 356	1	90
B 560	1	63
B 578	2	75
B 560	3	43
B 577	3	15
B 576	4	8

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The 1981 Seed Distribution

List of seeds and instructions for ordering are enclosed with the Journal: please read the instructions carefully.

N.B. Members may order up to 20 packets (16 from List A and 4 from List B) FREE OF CHARGE. No seed is being offered for sale at this stage, but the attention of those members wishing for additional species of cacti is drawn to Abbey Brook Cactus Nursery's special offer on page 28 of the Journal.

Seeds on List A have been bought specially for this year's distribution by our Seed-Purchasing Officer, Dr. Terry Smale, and packeted by members of Warrington Branch. List B includes items of which a residue of stock remains from 1980.

When ordering, do not forget to complete the gummed label with your name and address and include a 14p stamp or 2 postal reply coupons.

NOTES ON SPECIES OFFERED

by Nigel Taylor (Cacti) & Jonathan Clark (Other Succulents).

The names given below are as received from the suppliers and given on the packets. Species offered under unpublished or incorrect names are printed in italics after the order number. This year, a 'status' code has been added at the end of the notes for each item, indicating that (0) the precise wild origin of the seed is not known, or (1) that a locality of collection has been recorded, or (2) that the locality recorded as the source of the seed is the type locality. Many items are under KK (Karel Knize) numbers.

CACTACEAE

279. Arequipa erectocylindrica. KK 335 (Peru, Arequipa, 2800 m). This plant was originally collected by Rauh at Vulcan Chachani and named by Backeberg in 1956. Kimnach considers it a synonym of *Borzicactus leucotrichus*. The stem is shortly cereoid and eventually sprawling, with reddish-brown spines on the young growth and tubular red flowers c. 7 cm. long. **(1).**

280. Ariocarpus lloydii. A southern variant of *A. fissuratus* distinguished by its scarcely wrinkled tubercles which give it a rather bloated appearance. In well-drained compost and a sunny position *Ariocarpus spp.* will take plenty of water in the summer months. **(0).**

281. Ariocarpus scapharostrus. (5 seeds). The choicest member of its genus, requiring much patience and perhaps a long life-expectancy if flowering this plant from seed is your ambition. I have one survivor from a sowing of ten years ago—now a quaint miniature of the mature plant with dark brownish-green, roughened tubercles on top of a large tuberous rootstock. **(0).**

282. Astrophytum asterias. (Tamaulipas form). Astrophytums are deservedly popular plants of distinctive appearance, and the two species offered here seldom out-grow their welcome. This spineless, Sea Urchinlike cactus will flower in a $2\frac{3}{4}$ inch pot, but is inclined to lose its roots if watered too freely as a seedling. **(0).**

283. Astrophytum myriostigma f. **quadricostatum.** (from San Vicente). See pp. 5–6 of last February's Journal for notes and a picture of this species. Should have only four ribs, but likely to give a mixture of four or five when grown from seed. The rapid germination of *Astrophytum* seeds may surprise you; hopefully the emergent seedlings will not be allowed to languish in the dark for too long! **(1).**

284. Austrocactus coxii. The genus *Austrocactus* is poorly known in cultivation—so here is your opportunity to find out more. It is a small genus allied to *Notocactus,* but as in our species, the central spines are sometimes hooked and the stems are always cylindrical. Flowers pale red. From S. Argentina. **(0)**

285. Calymmanthium substerile. KK 328 (Peru, Balsas, 1800 m). The extraordinary flowering habit of this cereus was clearly illustrated in Ashingtonia 2(4): 76 (1976) and in Gordon Rowley's Encyclopedia, p. 26. A must for those who like the unusual. **(1)**

286. Copiapoa cinerea var. **albispina.** KK 610 (Chile, Taltal, 200 m). Another variety of this beautiful powdery-white species (var. *dealbata* was offered last year). Anyone who has seen habitat pictures of these plants in their native Chile will want to try this one! **(2)**

287. *Copiapoa imbricata.* KK 102 (Chile, El Molle, Rio Elavi, 600 m). Supplied under an unpublished name by Knize. As

Growing Cacti from Seed

To be successful you must try to imitate the conditions in which the plants grow naturally. Cacti are nearly always found under scrub or small bushes, on rocky slopes or on level ground where the soil is porous. This is because:

(1) The slope and porous soil provide adequate drainage.
(2) The scrub provides shade for the seedlings and young plants.
(3) The rocks radiate warmth at night and the crevices between them trap pockets of humid air.

When to sow

If you do not have a heated propagator, the best time to sow is in Spring, i.e. from March until the end of May. Do not sow later than this as the seedlings will not be large enough to withstand the following winter.

If you have a heated propagator or warm window-sill (do *not* use the airing cupboard) you can sow at any time of the year, but January and February are the best months.

Compost

We can recommend the following composts.

Either:

(1) Equal parts of Fisons Levington potting compost, and coarse lime-free sand.

or

(2) One part John Innes No. 1 or 2 and ¼ part coarse lime-free sand.

Sowing

Fill the seed trays or shallow pots to within ¼ in. of the top with compost and level the surface, removing any large lumps. Water with a watering-can fitted with a fine rose. Scatter the seed thinly on the surface of the damp compost. Large seeds can be spaced out and lightly pressed level with the surface using a pencil. Cactus seed needs light before they will germinate, so do not cover the seeds with compost and do not put the containers in a dark cupboard.

Temperature

Temperatures of 15–21°C (60–70°F) are best for germination. Once the seedlings are 2–3 weeks old normal growing temperatures are adequate.

GERMINATION

The percentage of seeds that germinate depends on the species, age of the seed and temperature, but there should be signs of germination within 2–3 weeks. A few seeds may be slow to germinate, and seedlings may not appear until 2–3 months after sowing.

Watering

If possible, water with a fine mist spray, or place the container in a saucer and water from below. Never let the compost dry out, particularly before germination has taken place, or the germinating seeds will be killed. Conversely, do not allow the compost to become waterlogged either, else the seeds will rot. After germination keep the soil moist—not too wet, not too dry. During the first winter the seedlings can be kept completely dry in a minimum temperature of 8°C (45°F).

Care of the young seedlings

Keep the container in an airy place to prevent 'damping off'. Shade the seedlings with a single thickness of tissue or newspaper for the first two months, then avoid direct sunlight for a further 6 months. After that time treat as adult plants. Try to ensure the seedlings remain a healthy deep green (or occasionally brownish) colour—a bright red colour indicates that too much light has been given; thin, spindly pale green seedlings results from too little light.

Transplanting

Do not transplant seedlings until they begin to touch one another in the container—this will depend on the rate of growth of individual species. If in doubt, leave the seedlings in the same container for 1 year, and do not transplant until the spring of the second year. They will not come to any harm even if they look overcrowded.

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stressed last year—note the KK number on the label. **(1)**

288. *Copiapoa militaris.* KK 1389 (Chile, Chanaralillo, 200 m). See above. **(1)**

289. *Copiapoa wagenknechtii.* KK 103 (Chile, El Molle, 800 m). The Ritter plant of this name was collected at El Tambo, Elqui valley (FR 718) and eventually described as **C. coquimbana** var. **wagenknechtii.** It is illustrated at the back of Backeberg's Lexicon. **(1)**

290. Coryphantha grandis. Like no. 292 this plant is a large form of **C. longicornis** described by Lew Bremer in 1978 from N. Durango, Mexico. **(0)**

291. Coryphantha guerkeana. A very stoutly spined plant of smaller proportions than nos. 290 and 292, and from further south near the city of Durango. The nectar secreted from the areolar glands of Coryphanthas must be removed (by regular spraying or by introducing ants which love it) otherwise the wool is likely to develop an unsightly growth of black mould. The same applies to the Ferocacti. **(0)**

292. Coryphantha indensis. Another form of **C. longicornis** from N. Durango (cf. no. 290). Lew Bremer has described many 'new' Coryphanthas in the last few years, but I doubt if any of these will survive a monographic treatment of this genus now in preparation by our good friend Allan Zimmerman. **(0)**

293. Coryphantha vivipara. *D. Speirs* s.n. (Canada, Alberta, nr. Bow City on shallow, N. facing slope, 31/8/1980). We would prefer that this plant be called **Escobaria vivipara,** but our American friends will probably beg to differ. A most successful species (ecologically speaking), having spread and colonised cold lands far from its ancestral home in Mexico. However, the damp winters of the English climate are not so familiar to this plant, which should be kept dry other than during its brief summer growing period, if rotting carcasses are to be avoided. The large magenta flowers with ciliate outer perianth-segments are delightful. **(1)**

294. Echinocereus armatus. A rather dubious name which may relate to one of the allies of *E. pectinatus.* Take note of the Society's seed number and we will endeavour to supply a more definite identification in due course. **(0)**

295. Echinocereus durangensis. Perhaps an ally of *E. acifer,* itself a somewhat poorly known species. Once again we hope to report when our specimens have developed sufficiently. **(0)**

296. *Echinocereus melanocentrus.* An invalid name relating to a rare Texas form of *E. reichenbachii;* illustrated on plate 5 in Weniger's Cacti of the Southwest. Large pinkish-purple flowers and sometimes a solitary dark central spine. **(0)**

297. Echinocereus nivosus. *Lau* 739 (Mexico, Coahuila, Cinco de Mayo). A beautiful novelty with dense white spines and deep magenta flowers, described and figured in CSJA 50(1): 18 (1978). Strongly recommended. **(1)**

298. E. scopulorum. This striking, large-flowered plant may be familiar to some as the picture for September on 1980's KuaS calendar. It is a member of the *E. pectinatus/reichenbachii* group and comes from the Mexican states of Sonora and Sinaloa. **(0)**

299. Echinocereus websteranus. An ally of the above with golden yellow spines, found on San Pedro Nolasco island in the Gulf of California (off the coast of Sonora). **(0)**

300. *Echinofossulocactus guerraianus.* In last November's issue the name *Echinofossulocactus* was disposed of, and not before time for those who are unable to fit this tongue-twister on their labels! It has been suggested that the species previously classified under this name would be better housed in *Ferocactus* subgenus *Stenocactus.* If it is correctly identified the present offering should have the narrow ribs and violet-striped flowers of the widespread Mexican *F. crispatus* complex. **(0)**

301. *Echinofossulocactus hastatus.* This Stenocactus was described by Schumann as having yellowish-white flowers, these being the largest in subgenus *Stenocactus* known to him. However, many of the plants I have seen in collections under this name have pinkish or purplish flowers, and so one wonders what to expect from a packet of seed identified as *'hastatus'.* Schumann's plant came from Hidalgo, Mexico. **(0)**

302. *Echinofossulocactus lloydii.* One of the very narrow-ribbed Stenocacti of *E. multicostatus* affinity, described as having small white flowers by Britton & Rose. Ultimately these too are perhaps little more than a N. Mexican variety of the polymorphic *F. crispatus* complex. **(0)**

303. Echinomastus laui. Glass & Foster consider this plant to be a strongly spined southern variety of **E. unguispinus** from San Luis Potosi, Mexico. *Echinomastus spp.* are close allies of the Sclerocacti and Ancistrocacti, and share their unwillingness to grow, other than when grafted. However, I have managed to keep one seedling from a 1974 sowing of *E. intertextus* alive on its own roots, by watering only when there are positive signs of growth and promise of good weather. This sort of challenge is not to be missed even if it occasionally ends in disappointment for the gambler. **(0)**

304. Echinomastus mapimiensis. Another synonym of **E. unguispinus** from Durango: see Glass & Foster's account of this group in CSJA 47: 218–23 (1975), where both this and no. 303 are illustrated. **(0)**

305. Echinopsis leucantha. The genus *Echinopsis* includes some of the most familiar cacti in cultivation, but sadly they are all-too-often ignored by the specialist grower who favours a more 'modern' genus. The flowers of *E. leucantha* are up to 17 cm long, white, and open during warm summer evenings. From NW. Argentina. **(0)**

306. Echinopsis obrepanda var. *purpurea* (*Pseudolobivia* Group). A delightful dwarf member of its genus which will flower year after year in a 10 cm pot, and needs very little attention. Presumably the seed offered came from a purple-flowered (or stemmed?) plant. Will it breed true? **(0)**

307. Eriosyce aurata. KK 52 (Chile, Huanta, 3000 m). One of the many wild forms of **Eriosyce ceratistes,** which is like a giant *Neoporteria.* **(1)**

308. *Eriosyce ihotzkyanae.* KK 1319 (Chile, Ovalle, 2200 m.) We may expect this plant to receive a valid (?) name in vol. 4 of Ritter's Kakteen in Südamerika. Note that KK number! **(1)**

309. *Escobaria tuberculosa.* Correctly this is **E. strobiliformis,** a slow growing and extremely variable species, but one which is easily recognized by its widely-opening, pale pink, delicately scented flowers, and dull red fruits filled with brown pitted seeds. Needs good drainage. From NE. Mexico and S. Texas. **(0)**

310. Espostoa superba. KK 1444 (Peru, San Ignacio, 1200 m). A synonym of *E. procera* according to Backeberg. This is another re-collection of a Ritter plant by Knize (cf. CSJGB 42: 22. 1980). Espostoas are amongst the most attractive and accomodating cerei for those who possess a sunny corner in the greenhouse where they can develop their candy-floss wool hiding unexpected spines. **(1)**

311. Ferocactus macrodiscus (var. *multiflorus).* The specific name of this plant is self explanatory, and in the wild it will eventually reach a diameter of 30 cm or more. However, growth from seed is quite rapid and plants will flower when only a few inches across. Flowers are white with pinkish-purple striped petals; spines red and yellow, recurved. The varietal name was proposed on the incorrect assumption that the type of this species came from N. Mexico and was a shy flowering form. In fact we know for certain that it came from S. Mexico and was as free-flowering as the form offered here. **(0)**

312. Gymnocactus sp. *Lau* 1159 (N. Mexico, data not available). Gymnocacti are smaller growing relatives of *Thelocactus,* differing only in having ± naked, rather than scaly ovaries. We will report on the identity of this mystery species as soon as possible. **(1)**

313. *Gymnocalycium achirasense.* A form of **G. horridispinum** invalidly described two years ago (the type specimen was a living plant according to its author); see KuaS 30(2): 25–8 (1979). Gymnocalyciums need no introduction save to say that you will require a lot of bench space if a comprehensive collection is desired since there are now a great many forms (and not a few species) in cultivation. **(0)**

314. Gymnocalycium brachypetalum. An ally of *G. gibbosum* from S. Argentina, and therefore probably easy to

grow and flower. Spines 5–7, all radial, yellowish at first; flowers to 5.5 cm long, white. **(o)**

315. Gymnocalycium buenekeri. This species was described and illustrated by Geoff Swales in CSJGB 40(4): 97–100 (1978). It is related to the remarkable *G. horstii,* having few ribs and spines and a rather fat, bloated-looking stem. This pair are of uncertain affinity to the rest of the genus; they come from Rio Grande do Sul, Brazil. **(o)**

316. Gymnocalycium marquezii. KK 521 (Peru, Rio Pilcomayo). Originally a Bolivian plant, this has a dull bluish-green stem to 10 cm diam. Spines 6–7 per areole, appressed to the c. 8-ribbed stem. Flowers with a broad limb, to 4 cm long, and in this form said to be orange rather than pink as described by Backeberg. **(o)**

317. Gymnocalycium mostii. This species has been around for some time. It has recurved or bent yellowish spines, large pinkish flowers to 8 cm diam. and the characteristic chins beneath the areoles. From Argentina (Cordoba). **(o)**

318. Gymnocalycium sutteranum. According to Backeberg this is a close relative of *G. sigelianum,* and like the above it hails from Cordoba and has a large pinkish flower. **(o)**

319. Haageocereus pachystele. KK 1371 (Peru, Rio Huaura, 1000 m). This is a poorly known genus of cerei somewhat intermediate between *Trichocereus* and *Borzicactus.* They are to be recommended on account of their variety of spine colours (good for the winter when the rest of the collection is looking a bit cold and thirsty) and most seem to be relatively slow-growing. **(I)**

320. Leuchtenbergia principis. One of the most unmistakable members of its Family, recognized by the long glaucous, triangular tubercles and equally long papery spines. It is closely related to the *Ferocactus-Thelocactus* group and is not difficult to grow so long as the compost is very sharply drained. Good growers claim they can flower this plant in only five years from seed. Cent. to N. Mexico. **(o)**

321. Lobivia dobeana. A rather controversial plant which Rausch refers to the *L. (Echinopsis) aurea* complex, but Backeberg says is a synonym of *L. andalgalensis.* See illustration in Rausch's 'Lobivia' vol. 3. Argentina (Catamarca). **(o)**

322. Lobivia leucomalla. Even more controversial than the last, this yellow-flowered *Lobivia* (or *Echinopsis)* is often placed as a variety of *L. densispina (L. famatimensis* of Backeb.), but Rausch (see above) refers it to the *L. aurea* complex, and points out that *L. densispina* is found 1,000 km to the north in Argentina. **(o)**

323. *Lobivia tenuispina.* KK 1544. A recent collection for which I have no field data at present. Note the KK no.! **(I)**

324. Lobivia wegheiana. Rausch says this is a synonym of the highly variable *L. pentlandii.* Flowers c. 6 cm long, light lilac, scented. Bolivia. **(o)**

325. Mammillaria denudata (Ser. Lasiacanthae). A variety of the attractive, dwarf *M. lasiacantha.* Stem to 4 cm diam. and hidden by dense white spines; flowers whitish. Best not to water too early or late in the season. Texas to NE. Mexico. **(o)**

326. Mammillaria ernestii (Ser. Polyacanthae). Perhaps only a form of the free flowering *M. backebergiana,* which belongs with *M. spinosissima* and its allies. Cent. Mexico (State of Mexico). **(o)**

327. Mammillaria esperanzaensis (Ser. Heterochlorae). This is a worthwhile variety of *M. discolor* with yellowish radial spines, darker centrals and flowers whitish striped pink. Stems spherical, offsetting at the base. Mexico: Puebla. **(o)**

328. Mammillaria geminispina var. **nobilis** (Ser. Leucocephalae). One of the finest species in the genus for its white spines, this variety having fewer but longer centrals. It will eventually grow into a large plant with many broad stiff stems. Cent. Mexico on limestone. **(o)**

329. Mammillaria heyderi var. **bullingtoniana** (Ser. Macrothelae). Described in 1976 from New Mexico, this plant has depressed stems with short straight spines and large brownish-pink flowers, the petals with a cream border. From S. USA and N. Mexico. **(o)**

330. Mammillaria nejapensis var. **longispina** (Ser. Polyedrae). An attractive species which, like no. 328, has a very stiff spiny stem. Care is needed with long-spined plants on the greenhouse bench to ensure that they do not wound their neighbours. **(o)**

331. Mammillaria pitcayensis var. *chrysodactyla.* Differs from *M. spinosissima* in its smaller more compact tubercles and finer spines. Rings of crimson flowers open almost simultaneously in summer and seem to attract small bumble-bees. One of my favourite plants, which will grow quite tall in age and may need something to lean on. Mexico: Guerrero. **(o)**

332. Mammillaria sp. (Ser. Supertextae). *Lau* 1128 (S. Mexico, Oaxaca, Yolox). The species of Ser. Supertextae (previously Elegantes) are all worth growing for their neat symmetrical appearance and intricate spination. Furthermore, there is such a variety of forms to collect, and we must thank Alfred Lau for a number of very beautiful introductions. **(I)**

333. Matucana ritteri. Treated as a synonym of **Borzicactus aurantiacus** by Kimnach, but differing from the type of this name in having fewer spines (8–15) and more ribs (12–22). The flowers are red, to 9 cm long. Peru. **(o)**

334. Melocactus amstutziae. KK 539 (Peru, Rio Santa Maria, 1600 m). Probably one of the many geographical forms of Vaupel's *M. peruvianus.* Ribs c. 13; spines 6–8(–9), to 2.5 cm long, angular and keeled above, dark brown; cephalium with reddish bristles, flowers red. **(I)**

335. Melocactus rubrisaetosus. A variety of the long-spined, Brazilian **M. oreas.** See last August's issue, p. 68, for an illustration of a young plant from the type locality of the name under which this seed is offered. **(o)**

336. Melocactus trujilloensis var. **schoenii.** KK 1088 (Peru, Laredo, 1000m). Like no. 334, this may also represent a geographical form of *M. peruvianus,* but with only 10 ribs and 11–16 spines. Melocacti are very interesting plants related, I think, to the S. American Cephalocerei. They need extra warmth (c. 10°C/50°F) in winter. **(I)**

337. *Mila longispina.* KK 1403 (Peru, Matucana, 2000 m). This undescribed entity has also been referred to as a variety of *M. caespitosa* by Knize. See CSJGB 39(4): 89–91 (1977) for a discussion of this small and evidently controversial genus by Terry Smale and others. **(I)**

338. *Neoporteria andicola* var. *mollensis* (Horridocactus Group). KK 1611. Donald and Rowley prefer to call this plant **N. curvispina** var, **andicola** f. **mollensis.** It has a stem to 20 cm diam., 14–21 spines to 4 cm or more long and a reddish to yellow flower 5.5 cm long. Chile. **(I).**

339. *Neoporteria carrizalensis* (Horridocactus Group). KK 1489 (no field data available at present, but earlier collections of this taxon by Knize were made at the type locality, Carrizal, Chile). Once again Donald & Rowley refer this plant to **N. curvispina** as a variety. It differs from the last in its much smaller stem to 7 cm diam. and fewer ribs (13 vs 16–24). **(I).**

340. Neoporteria engleri (Horridocactus Group). KK 1479 (no further data available at present). Stem at first hemispherical to 18 cm diam., later elongating to 30 cm high; ribs 16–20; spines 17–28, 4–7 cm long, white or yellowish to brown and black tipped. Flowers to 4.5 cm diam., tepals yellowish with a pink to red midstripe. Chile (Cordillera between Santiago and Valparaiso). **(I)**

341. *Neoporteria minima* (Nichelia Group). KK4 (Chile, Cerro Grande, 500 m). An undescribed mystery plant from Knize. **(I)**

342. Neoporteria subcylindrica. KK 1604 A form of the well-known **N. subgibbosa,** which is an easy species to grow but rather more difficult to flower. **(I)**

343. *Neoporteria unguispina* (Islaya Group). KK 1160 (Peru, Tacna, 300 m). **(I)**

344. *Neoporteria vanbaelii* (Nichelia Group). KK97 (Chile, Rivadavia, 1100 m). **(I)**

345. Neoporteria sp. KK 1644. (from? Culebron). We will report on this and the two preceding numbers once they have grown, and when our understanding of *Neoporteria* (s.l.) is a little better! **(I)**

346. Notocactus arachnites. FR 1935 (Brazil, Rio Grande do Sul, Serra do Herval). A very close ally of the exciting *N. crassigibbus,* but with smaller (3.7 cm long), sulphur-yellow flowers and more numerous radial spines (10–14 vs 7–10), which are similarly bent and curled. **(3)**

347. Notocactus concinnus. *Schlosser* 156 (coll. Uruguay). This is an ideal subject for the beginner, producing large shiny yellow flowers with very little difficulty. Stem depressed-globose with c. 18 ribs and soft curvey spines. Can withstand a winter minimum of 5°C/40°F. **(1)**

348. Notocactus tabularis. A relative of the above and equally-suitable for the novice, differing in its more numerous radial spines (16–18 vs 10–12) and smaller flower (6 cm vs 7 cm long). Uruguay. **(0)**

349. Notocactus vanvlietii. According to Tony Mace this is a member of the 'Mammulosi' group, with up to 30 ribs, the areoles set into deep notches and bearing 14–19 spines to 15 mm long. Flowers 5.7 cm diam., light lemon-yellow. Uruguay. **(0)**

350. Parodia carrerana. KK 1130 (Bolivia, Las Carreras, 2,300 m). Parodias are close allies of *Notocactus.* This Bolivian example has about 14 spiralled ribs and 20 interlacing spines per areole, which are red at first, then white. Flowers to 4 cm long, red. **(2)**

351. *Parodia sotomayorensis.* KK 688 (Bolivia, Sotomayor, 3,500 m). It is likely that this plant, originally found by Ritter, has now been described in the relevant volume of his Kakteen in Südamerika, but I have yet to see a copy. **(2)**

352. Parodia splendens. (KK 973). Described from Chuquisaca, Bolivia by Cardenas, this plant has c. 13 spiralled ribs and up to 17 spines, some reaching 10 cm long, white, to brown at base. Flowers 4 cm long, yellow. **(1)**

353. Peniocereus greggii. A cereoid curiosity, famed for its sometimes enormous tuberous rootstock. Aerial growth is of thin inconspicuous 3–6-angled stems, which seem almost spineless until examined closely. The large nocturnal flowers are rarely produced in cultivation but nevertheless this plant is worth growing just for fun! S. U.S.A. and N. Mexico. **(0)**

354. Rebutia costata. (Mediolobivia Group). A plant of unknown wild origin according to Backeberg, with deep green freely offsetting, 8–9-ribbed stems, and orange-red flowers to 3.5 cm long. **(0)**

355. Rebutia kieslingii (Aylostera Group). *Rausch* 694 (Argentina, Salta Prov., Valle Grande). A new species described in KuaS 28(8):177–8 (1977). **(3)**

356. *Rebutia pilifera* (Mediolobivia Group.) Considered to be a variety of *R. ritteri (Mediolobivia ritteri)* by Backeberg, and differing from this species in the longer somewhat interlacing whitish spines and purplish-red flowers. Bolivia. **(0)**

357. *Rhodocactus sp.* (San Juan Chaco). A **Pereskia sp.** which we will hope to identify once it has grown. **(1)**

358. Thelocactus conothelos var. **aurantiacus.** A beautiful variety of a species which is becoming popular, with golden flowers and denser spines. See Glass & Foster's account of this plant in CSJA 49:219 (1977). N. Mexico. **(0)**

359. Thelocactus nidulans. This plant and the next are varieties of **T. rinconensis** with broad stems of spiralled tubercles. Var. *nidulans* may be recognized by its central spines which break up into separate fibres. Flowers yellowish-white. See Glass & Foster, loc. cit., 245. N. Mexico. **(0)**

360. Thelocactus phymatothelos. Distinguished from the above by its almost spineless or 1–3-spined areoles and pinkish-purple flowers. N. Mexico. **(0)**

361. *Turbinicarpus polaskii.* This is an invalid Backeberg name which relates to **T. schmiedickeanus** var. **schwarzii;** see Glass & Foster in CSJA 49:169 (1977) for a revision of this group and many illustrations. Few species of *Turbinicarpus* require a pot larger than 7.5 cm, and so they are justly popular with collectors of miniatures (and those short of bench space!). **(0)**

OTHER SUCCULENTS

989. Aeonium spathulatum. *Crassulaceae. T. Smale* 77 (Tenerife, road between Orotava and Las Canadas, c. 1,500 m). A most attractive member of its genus with longitudinal reddish lines on the leaves. The leaves are spatula-shaped, as the name implies and slightly sticky with cartilaginous margins. Flowers yellow. **(1)**

990. Aeonium urbicum. *Crassulaceae. T. Smale* 79 (Tenerife, road between Tamaimo and Las Canadas, c. 1,000 m). This species has sharply pointed spathulate leaves with reddish to violet-purple margins. The leaf rosettes can be up to 25 cm diam. Flowers greenish to pinkish-white. Our seed was collected from a plant growing in a very exposed position in black volcanic debris. **(1)**

991. Aloe falcata. *Liliaceae.* Rather an attractive *Aloe* with bluish, lanceolate, somewhat sickle-shaped leaves, rough-granular in appearance and concave on the upperside. From Little Namaqualand, S. Africa. **(0)**

992. Aloe melanacantha. *Liliaceae.* As the name implies, this species possesses black thorns or spines on its leaves when mature. Aloes are usually very easy to grow from seed, so why not try growing one or both of the species offered this year? From Little Namaqualand, S. Africa. **(0)**

993. Ceropegia fusca. *Asclepiadaceae. T. Smale.* 93 (Tenerife, San Isidro, nr. southern airport, c. 200 m). This is one of the 'stick-ceropegias' and is very similar in appearance to *C. dichotoma.* It has a brownish, cylindrical many-branched stem with short-lived linear leaves. Flowers dark red-brown. Like *C. dichotoma,* this species is easy to grow from seed and soon reaches specimen size. Our seed was collected on a red cinder cone amongst *Euphorbia* scrub, in an unshaded position. **(1)**

994. Conophytum calculus. *Aizoaceae.* This is one of the globular-bodied Conophytums, which forms clumps up to 15 cm diam. The bodies are laterally flattened. c. 2 cm high and rather more across, with a cleft about 4 mm across, and somewhat chalky grey-green in colour. The flowers are yellow and c. 12 mm diam. Since most bodies branch into two or three each year, these little plants soon form attractive clumps. From Cape Province, S. Africa. **(0)**

955. Cotyledon wallichii. *Crassulaceae.* This species has a rather fleshy, branching stem, about 3 cm thick and c. 30 cm tall. The grey-green deciduous leaves are 5–10 cm long with a groove on the upperside. After the leaves have dropped, the persistent leaf bases give the plant a somewhat cactus-like appearance. The inflorescence is covered with numerous glandular hairs, the many pendulous flowers being greenish-yellow in colour. Botanically-speaking, this could be a rather interesting plant to grow from seed. It has recently been transferred to the new genus *Tylecodon.* **(0)**

996. Crassula cornuta. *Crassulaceae.* A small succulent perennial with densely packed, triangular-ovate, somewhat united leaves, mealy-grey in colour. The flowers are small and yellowish-white. From Little Namaqualand, Cape, S. Africa. **(0)**

997. Dinteranthus pole-evansii. *Aizoaceae.* To my mind, *Dinteranthus* are the most attractive of the 'stemless' mesems. They most closely resemble *Lithops* in appearance and are generally pinkish-white in colour. This particular species has a distinctly wrinkled upper surface to the leaves and is certainly a collectors' item. *Dinteranthus* are reputed to be difficult to cultivate. However, they present no problem if grown in a compost which contains at least 80% coarse sand. This species has a glossy-yellow flower, c. 4 cm diam. From Prieska District, Cape, S. Africa. **(0)**

998. Euphorbia regis-jubae. *Euphorbiaceae. T. Smale* 78 (data as for no. 990 in this list). This species branches in whorls of 3–5, the cyathia being in a terminal umbel. The fleshy branches possess linear, sessile leaves c. 6 cm long and c. 5 mm across.**(0)**

999. Glottiphyllum regium. *Aizoaceae.* This easily-grown genus has been sadly neglected by growers in recent years.

This is perhaps because these plants have a tendency to grow 'out of character' in cultivation. forming many pairs of lush green leaves. However this can be prevented by growing these plants in a very sandy compost, containing few nutrients. This species is clump-forming with two pairs of smooth, light green leaves, one larger than the other. The flowers are yellow, c. 4 cm diam. From Outshoorn District, Cape, S. Africa. **(o)**

1000. Graptopetalum macdougallii. *Crassulaceae.* This species is most attractive with its deep blue leaves arranged in rosettes 2–7 cm diam. The flowers are c. 2.5 cm across; petals marked with dense red lines. From Oaxaca, Mexico. **(o)**

1001. Juttadinteria insolita. *Aizoaceae.* This mesem has 2–5, pale blue, minutely papillose leaves, each 15–27 mm long and around 10 mm across. This species soon forms attractive clumps and should be grown by every mesem collector. The flowers are just over 3 cm diam. From Little Namaqualand, Cape, S. Africa. **(o)**

1002. Lapidaria margaretae. *Aizoaceae.* A plant much sought after by collectors. It is similar to *Dinteranthus* in appearance, with somewhat three-sided pinkish-white leaves. Although seldom seen in nurseries and collections as the mature plant, this species is surprisingly easy to grow from seed (as with *Dinteranthus,* a very sandy compost is recommended). Flowers 3–5 cm across; golden-yellow. From Great Namaqualand, Cape, S. Africa. **(o)**

1003. Pleiospilos hilmarii. *Aizoaceae.* The 'living granite' plants, as they are sometimes called, are always popular with collectors. The reddish-green, highly succulent leaves are covered in small transluscent dots. In this species, the dots coalesce somewhat to form a diffuse 'window'. *Pleiospilos* are very fast growing from seed and present no difficulty in cultivation if grown in very sandy compost. Flowers c. 2.5 cm diam., golden-yellow. From Ladismith District, Cape, S. Africa. **(o)**

1004. Raphionacme hirsuta. *Asclepiadaceae.* Unlike most other members of this family, this species lacks pollinia and instead sheds its pollen as grains. This is believed to be a primitive character. The plant is scarcely succulent and possesses thin, pubescent leaves, the shoots arising from a swollen caudex. The many-branched inflorescence contains numerous purple flowers. From Transvaal, Orange Free State, Natal, E. Cape, S. Africa. **(o)**

1005. Trichodiadema barbatum. *Aizoaceae.* These little mesems are extremely attractive, with their papillose leaves tipped with blackish bristles. Like most mesems, they are easy to grow from seed and soon form into large prostrate clumps. A must for every mesem collection. Flowers c. 3 cm diam. deep red. From SW. Africa, Cape, Karroo, Karas Mountains. **(o)**

In the bleak mid-winter

by John Pilbeam

With ever-increasing fuel bills there are few growers of cacti and succulent plants who can maintain temperatures high enough through the winter to keep their plants growing. Most cacti will take quite low temperatures without harm, and I have heard intrepid stories of below freezing temperatures being tolerated. What seems to aid these extreme conditions is installation of a blower, without heat of course, to keep the air moving around the plants, and an early drying out at the roots, so that by the time really low temperatures are upon us the plants' sap has thickened and the flesh has started to contract. Whether or not you have any heat going in the winter, your plants, especially cacti, are in general more safe for being kept dry. Exceptions are some succulents, of which more anon, and some cacti, which enjoy a little water during the winter months, like *Notocactus, Wigginsia* and *Cleistocactus,* which seem to keep on growing until well into the winter. But watering those plants which need it in the winter months is by no means comparable to watering in the summer, and it should be only enough to prevent the compost drying out completely. The vast majority of plants will accept willingly the dry period customary in this country in the winter, without too much complaint, and the best and safest advice about watering in the cold months is DON'T!

In fact the cold months do not present so many problems as those of autumn and spring: when to stop watering in the autumn, and when to start in the spring. The period after the day that I decide to give my last good watering in the autumn always seems to be one of grey skies and constantly low temperatures, and the same is liable to occur in the spring. For both first and last heavy waterings it is advisable to try and anticipate a week or two of clear skies, so that the pots do not sit soggy at a time when root action is either on the wane or not existent at all. As to when these operations should be carried out, this rather depends on temperature, both outside and inside. In a mild autumn, or if high temperatures are maintained until the winter really sets in, watering can quite happily continue until the middle of October or later, especially if a minimum of 8–10°C (45–50°F) is to be held throughout the cold months. If lower temperatures are aimed at, the watering should stop in September, especially for pots more than about 5 inches in diameter, which take longer to dry out. If spring gets off to a warm start, or higher temperatures are maintained, watering can start—gently—in March, but for safety's sake hold on for the end of the month, or early April. More plants are lost at this time through injudicious watering than at any time, and most cacti will quite happily await the stronger sunshine before really dipping their toes into deep water. And after this first watering wait a while before the second dose, until there are signs of root activity by the swelling of the plants, or until you are sure they have dried out from the first dose. Hold off really heavy watering until the middle of May or beginning of June.

I like to spray all my cacti in the winter, about once a fortnight on sunny days, and it does no harm at all at this time (providing you rapidly vacate the greenhouse yourself) to incorporate a contact insecticide in the spray to catch out any survivors of your systemic insecticide treatment when the plants were in active growth. In passing it should be mentioned that it is not much good indulging in systemic insecticides (which depend on the roots taking them into the plants) before the plants are in active growth. So wait until the second or third watering before doing this. In late February or March these sprayings get heavier and heavier so that there is some carry-down into the top layers of the soil, preparatory to the first real watering. Watch the way the

spines channel the droplets either back down on to the body and thence to the base, or neatly off the spine-ends in large droplets to where the roots extend.

A few, probably controversial words regarding the treatment of succulent plants will not come amiss, if only to start up some argument. In general, as indicated above, succulents are better off if not allowed to dry out completely, especially those which show tendencies to grow in the winter; but this is far too sweeping a generalization, and I can straightaway think of umpteen exceptions. A few which spring to mind in the category of those which are winter growers are *Pelargonium* and *Sarcocaulon* species, which for me seem to grow in the late summer and through to January or February; Aloes, which often throw up their flower spikes in late autumn and winter; most Gibbaeums wake up in the late summer and autumn and grow steadily through until late winter; *Lithops* and Conophytums, having been started off in early June for the former and for bilobe Conophytums, and July for the smaller Conophytums, seem to grow on until nearly Christmas, and I ease off in November and finally stop in early December; an odd *Aeonium* or two wake up in the autumn—*A. saundersii* springs to mind. And there are others. The main criterion of whether to continue watering a particular plant or not is whether it is in active growth. The other factor is that mentioned earlier: what temperature are you going to maintain? The higher, the longer watering can continue. There is no doubt that if you do grow the other succulents to any extent you should maintain a minimum of 8°C (45°F) at least in the early winter months, especially if you have any of those which prefer some water during the winter.

Note from a Member

Hot water for safe and effective pest-control

by Håkan Nilsson

The use of systemic insecticides to counter pests has certain, perhaps minor, drawbacks. In the article 'Pests apart from the two-legged sort' (CSJGB 42(1): 21. 1980) the author amongst other things points at the risk that resistant strains of the 'bugs' may develop. Further, he doubts that a plant infected by root mealy bug can take the poison into the plant, owing to lack of root activity (a theory that would explain some of my failures). Also, I have noticed that a plant once successfully treated, after some time is attacked again, often much worse. One might even speculate whether there could be some 'natural' defence or immunity that has been destroyed by the systemic (or is it just the eggs that have *not*?). An additional hazard is the uncertainty—will this plant survive the systemic?

To all this is added the anxiety and perhaps the reluctance one feels when it comes to handling a poison. Just reading the safety instructions can cause dizzyness and slight nausea!

So, is there an alternative, except to see the plants perish? Fortunately, there is, and it is quite simple too: just hot water!

I originally got the idea, and some hints on the technique, from the strawberry growers' practice of treating plants with hot water before planting them, thereby killing nematodes. My experience of the method (from 1972 and onwards) shows that it is 100% effective against mealy bug, root mealy bug and nematodes (these are the only pests I've encountered). Better still, the plants don't mind—except *Epiphyllum, Rhipsalis* and other epiphytes. I have never tried the method on grafted plants or succulents other than cacti.

Using ordinary kitchen equipment the procedure is simple:

1. Un-pot the plant, and remove as much soil as possible without destroying too much of the roots.
2. Submerge the plant in water, which has been heated to 55°C (131°F). To get rid of mealy bug, the plant must of course be totally submerged. Use weights!
3. Try to keep the temperature at 55°C for at least 10 minutes.
4. Let the water cool, and remove the plant when the temperature has fallen to approximately 30°C (86°F).
5. Let the plant dry for one or two days, preferably indoors, away from sun and winds, but not too dark.
6. Remove dead roots, and re-pot as usual.
7. Leave the plant lightly shaded and don't water for a week.

It is, of course, wise to sterilise the pots and trays with the same treatment.

I have treated Notocacti, Mammillarias, Ferocacti, Gymnocalyciums, Weingartias, Rebutias and various Cerei in this way with, as of yet, no losses (apart from the pests) with the proviso that the treatment has always been made during late spring or summer.

As I said before, the method is 100% effective, and against root mealy bug it is superior to John Pilbeam's recommendation to 'nip off the infected root system and reroot in fresh compost'. If the attack is noticed soon enough, before the root system is entirely destroyed, the plant after hot water treatment will be in growth within two weeks.

Others have thought of this way to counter pests. In 'Kakteen und andere Sukkulenten' (29/3 page 50) Beatrice Potocki-Roth describes it, and gives an account of her experiences. She recommends beginning by spraying the plant with lukewarm water, and further to submerge it in water which is only 40°C (104°F) at first. The water is then heated to 55–57°C. Otherwise the method, as well as the results, are the same. Perhaps the slower heating of water and plant reduces the shock; however, the more direct approach outlined above has given me excellent results.

Hakan Nilsson,
Vaktelvägen 10,
S-430 20 Veddige, Sweden.

Book Reviews and Notes

Gordon D. Rowley. *Name that Succulent.* Pp. ix+268, numerous line drawings by author; hardback, 8×6 inches. Stanley Thornes (Publishers) Ltd. Price £8.75.

Only two years after the appearance of his highly praised 'Illustrated Encyclopedia of Succulents', Gordon Rowley has produced a follow-up, on rather more serious lines, to enable us to identify and name the plants we like to grow.

'Name that Succulent' sets out to bridge the gap between the uncompromising botanist and the amateur grower bemused by technical jargon and annoyed by unexplained name changes. It goes a long way towards achieving this goal, largely thanks to Gordon Rowley's enviable ability to convey complex ideas and terminology in an easy and readable style. The first five chapters are intended to give the beginner the basis in botany needed to cope with the keys, which form the second and major part of the book. Guidance on the basic aspects of that difficult subject, nomenclature is given, and the reader is wisely warned about the pitfalls to be made if descriptions of new taxa or name changes are entered into without the necessary experience.

Part 2 begins with a short chapter explaining the use of the artificial keys to families and genera, which comprise the next 29 chapters. The main key starts by dividing succulents into three arbitrary groups: Leaf, Stem and Caudiciform, each provided with its own key to families employing vegetative features as far as practical. This method is good since it avoids the novice having to cope with more traditional, but difficult characters, such as those of the ovary and its placentation, which might otherwise have been used. (It should be noted that the heading on page 72 is incorrect and should read 'Key to Families . . .').

Chapters 8–35 deal with the 28 families containing cultivated succulents that the author considers merit inclusion. This is substantially fewer than are listed in Jacobsen's Lexicon of Succulent Plants', but the selection is rational enough (only excepting the inclusion of Gesneriaceae for *Rechsteineria leucotricha,* perhaps, as Gordon himself admits). Each family account is introduced by brief discussion and a list of relevant literature, followed by a key to accepted genera which are listed alphabetically with their synonyms, type species and distribution. The number of species in each is noted along with references to published keys, where these exist, but individual species are not the primary consideration, nor would it be practical in a book of this size. The lay-out of the family accounts is pleasing, except for the notes inserted in the keys to indicate the position of uncultivated allies of keyed genera, which might have been better placed as footnotes. The more important families are provided with line drawings illustrating the important diagnostic floral features. These too are the work of the book's versatile author. One aspect which cannot pass without comment is the large number of bigeneric hybrid names listed and in some cases validated in the accounts of the larger families. Are these all really necessary? Only a few are justified on the grounds that the bigener concerned is widely cultivated. Here the author's interest in hybrids has resulted in their somewhat unbalanced representation in a book which does not help us to identify them as such. Also, the hybrid multiplication sign (×) has managed to creep in front of the non-hybrid *Trichocaulon*, and Gordon should read his own advice (p. 37) on the formation of bigeneric hybrid names, since ×*Gastrolea* (=*Gasteria*×*Aloe,* p. 187) is inadmissible under ICBN Art. H.7!

The author's Preface hints at a revised edition with coloured plates when the identification keys have been widely tested and the 'bugs' removed (there are a few eyebrow-raisers in the generic accounts too). But, like the English edition of Wilhelm Barthlott's 'Cacti', this book is a credit to the publisher, Stanley Thornes, and by no means 'provisional' in format. In fact, one wonders if the hardback is not an unnecessary luxury making the price of £8.75 higher than it could have been. Even so, the outlay is modest for such a valuable work of instruction and reference, and I hope that all who take a scholarly view of the hobby will purchase it.

N.P.T.

Ira L. Wiggins. *Flora of Baja California.* Pp. viii+1025, numerous line drawings; hardback, 10×7 inches. Stanford University Press, Stanford, 1980. Price $65.00 (about £27).

Jeanette Coyle & Norman C. Roberts. *A Field Guide to the common and interesting plants of Baja California.* Pp. xi+206, 189 coloured and several line illustrations; hardback, 9×6 inches. Natural History Publishing Co., P.O. Box 962, La Jolla, Calif. 92037. 1975. Price (then) £8.

The gnarled Mexican finger of land which projects nearly 1300 km from southern California holds a great fascination with its largely endemic cactus flora, dudleyas and curious plants on the fringe of succulentology like the boojum (*Fouquieria columnaris*), *Ibervillea spp.*, *Pachycormus discolor, Bursera spp.* and so on. Since 1839 many botanical collectors have felt it pointing at them, till its flora is probably better known than that of any comparable area of mainland Mexico. According to Prof. Wiggins the peninsula has over 2700 species of which a quarter are endemic, and he has completed an account of them, basically in the form of identification keys, single-handed, against a background of personal fieldwork stretching over 50 years. It is not to diminish the achievement the *Flora* represents to complain that the spacious layout, type-size and thick paper make the

book more grandiose than it need be and less likely to be taken into the field, where the keys would be most useful. For the specialist, the lack of literature references, synonyms, specimen citations and detailed distribution data are a drawback. Viewed separately, the treatment of the Cactaceae, for instance, is a useful overall summary, but leaves one a shade mistrustful of its reliability in matters of detail. The mythical *Mammillaria radiaissima* is recorded as if it were as substantial as *Pachycereus pringlei*, but there is no mention of *M. louisiae* (included, perhaps, under *M. hutchisoniana*, which suffers its common fate of being '*M. hutchinsoniana*') or of *M. estebanensis*.

For those just wanting an attractive and useful introduction to the Baja flora, the Coyle/Roberts *Field Guide* published several years ago deserves recommendation. It has descriptions and general information concerning over 250 species and their habitat and is illustrated with numerous mostly excellent colour plates. The dust-jacket photo features a specimen of *Pachycereus pringlei* 56 feet tall, one of the tallest cacti on record.

D.R.H.

W. F. Maddams. *Meritorious Mammillarias.* Pp. 44, 44 half-tones; paperback, $7\frac{3}{4} \times 5\frac{1}{2}$ inches. Published by Mammillaria Society, 26 Glenfield Road, Banstead, Surrey SM7 2DG. Price £1.20, post free.

In this booklet a brief description is made of 40 species of the genus *Mammillaria* which the author considers to be most worth growing. These are arranged in aphabetical order and the selection includes some lesser known species as well as the more familiar ones. Together they make a good cross-section of the genus. Each species is illustrated and as one would expect they are all correctly named.

The text is presented in a very readable style but one has to search carefully through the description to find the information which characterizes a particular species. Often such information is missing. For example, there are no details at all about seed characteristics and colour, and only two references to type of sap, milky sap in *M. uncinata*, watery sap in *M. glochidiata*. There is no explanation of the classification used in the booklet and reference to the Series *Ancistracanthae, Lasiacanthae* etc., would be meaningless to the uninitiated. Contrary to the experience of Mr. Maddams, the reviewer finds that *M. pottsii* is not easy to cultivate successfully. It is slow-growing, shy-flowering and difficult to grow from seed. A brief bibliography would have been helpful.

Although the work is only 44 pages long, better use could have been made of the blank spaces by enlarging the text or increasing the size or number of the photographs. In addition the type face seems to be unnecessarily large. Some of the photographs have been trimmed rather badly, e.g. pages 5, 20, 27, 28, 40 and 42. This may be because the photographs bleed off the top of the page, which is not to the reviewer's liking.

Despite these minor shortcomings the booklet is an excellent introduction to a popular group of plants. It is written by a person with a deep knowledge and enthusiasm for the genus and this shines through the pages.

BRIAN FEARN

(Mr. Fearn has also written a booklet on Mammillarias, entitled 50 *Choice Mammillarias*, with L. Pearcy as co-author. There is an overlap of only eight species between the two booklets and topics like classification and distribution not dealt with by Mr. Maddams are touched on in Mr. Fearn's, which also has a glossary and bibliography. It runs to 68 pp., has 52 illustrations, and is available from Abbey Brook Cactus Nursery, Matlock, Derbyshire, price £1.50 post free in UK, overseas 25p extra.—Eds.)

A. F. H. Buining. *Discocactus.* Pp. 223, 60 coloured and 84 half-tone illustrations, 33 line-drawings and 6 maps. Succulenta, Venlo, Netherlands. Price £7. In English (Dutch and German versions also available).

A very well-produced book and a fitting memorial to its author. Taxonomists may not accept the Buining philosophy of describing every population as a species (the total for *Discocactus* is now 36, including 11 newly described in the book), but there is perhaps more justification with cacti than with groups more routinely preservable as herbarium specimens. In a letter to me dated 23 November 1973, Buining explained the rationale of his approach thus: 'I think it is better to describe a plant too much, so that we know later on where special plants occur . . . if necessary one can put afterwards these species together under the first name, but then we know where the special forms occurred. You know how much is and will be destroyed also in these developing countries without knowing anything of the biological secrets . . . only if the descriptions are as good as even is possible'. Point taken, but why *name* every population?

D.R.H.

Succulent Publications of South Australia. *Calandrinia.* Pp. 88, numerous line-drawings and half-tones; paperback, $8\frac{1}{2} \times 5\frac{1}{2}$ inches. Succulent Publications of South Australia, P.O. Box 354, Elizabeth, South Australia. Price AUS $3.50 plus 50c postage (about £2).

Originally planned as a yearbook for the Cactus & Succulent Society of South Australia, this booklet is not as might be supposed a monograph of the genus *Calandrinia* but a very good collection of original articles on subjects as diverse as Euphorbias and Epiphyllums, Mesems and Mammillarias. Authors include Bruce Bayer, Clive Innes and Bill Putnam as well as local writers of note, and it is a safe bet that all enthusiasts will find something to interest them. It is

well-printed and can be thoroughly recommended. Another issue is planned in about twelve months time.

Herbert Parkes Riley & Shyamal K. Majumdar. *The Aloineae, a biosystematic survey.* Pp. ix+181, numerous illustrations; hardback, 11×6½ inches. University Press of Kentucky, Lexington, 1980. Price $28.75 (about £12).

Quotes, summarizes and comments on all published material concerning the chromosomes of the Aloe tribe, and attempts to interpret evolutionary trends and the taxonomic significance of chromosomal and other factors. An invaluable review for serious devotees of the tribe.

Urs Eggli. *Gesamtinhaltsverzeichnis fuer Kakteen und andere Sukkulenten,* 1949–1979. Pp. 235; paperback, 9½×6½ inches. Published by the author at Lerchenbergstr. 19, 8703 Erlenbach, Switzerland, 1980. Price not indicated.

Swiss cactophile Urs Eggli has recently made available this very useful computer-assisted 30-year index to the German language journal, KuaS. Entries are listed separately under author, plant name and subject for ease of reference. Would-be purchasers should write direct to Mr. Eggli.

R. Mottram. *Mammillaria Index.* Pp. 103; 9¼×6¾ inches; paperback, Whitestone Gardens Ltd., Thirsk. Price £2.75 plus 35p postage.

Just to hand is this comprehensive typescript listing of Mammillaria names published or in current usage, with places of publication and details of typification where available. Invaluable for Mammillariophiles and would-be monographers.

Pen-friends wanted

Member Ibrahim Bilik, who lives in Turkey, would like to correspond with other members and exchange literature on cacti and succulents for Turkish stamps, books, seeds of native plants, etc. Please write direct to him: Ibrahim Bilik, Büyükdere Cad. Hukukcular Sitesi. Kat: 2, Daire: 17, Mecidiyeköy-Istanbul, Turkey.

Member Giuseppe Casertano, Viale Carlo III, Coop. 'La Speranzas' Sc. F., S. Nicola La Strada (Caserta), Italy, would like to exchange or buy/sell seeds.

'Epiphytes' to reappear

Chris Dawson of 1 Belvidere Park, Great Crosby, Merseyside L23 0SP, is inviting subscriptions of £1.50 for 1981, when it is planned to reissue this quarterly newsletter. Payments should be made to 'The Epiphytic Plant Study Group'. 'Epiphytes' last appeared in 1973. The new editor is John Horobin, 126 Hatherton Road, Cannock, Staffs. WS11 1HH.

Make your own garden compost

For a book entitled 'Successful Composting', members are invited to write (enclosing a second class stamp) to: Garotta Compost Advice Service, Station Mills, Bute Street, Luton, Beds. LU1 2HE.

Bates Collection moves

The Succulent Plant Trust, which looks after Haworthias and other plants from the collection of the late Jack Bates of Hounslow, reports that the plants are now housed by Mr. Melville Roberts of 20 Beta Close, New Ferry, Wirral L62 5BY, where they will be available for study in due course.

Branch Activities

Items for inclusion in the next Issue must reach the Editors no later than 28 March.

Essex

Secretary: F. Braun, 63 Heighams Road, East Ham E6 2JJ.
Meeting Place: Room A3 (film room), Little Ilford Comprehensive School, Church Road, Manor Park, London E.12.
Time: 1st Saturday in month, 7 for 7.30 p.m.

North London

Secretary: Roger Day, 50 Admiral's Walk, Hoddesdon, Herts. EN11 8AG. Tel. no. Hoddesdon (STD code from London: 61) 69521.
Meeting Place: Octagonal Room, Bishops College, Cheshunt, Herts.
Time: 3rd Friday in month, 7.30 p.m.
Future events (please note change of venue):

20 February	Europe '69 (Ron Dale)
20 March	Euphorbias (David Brewerton)

North Surrey

Secretary: W. F. Maddams, 26 Glenfield Road, Banstead, Surrey SM7 2DG.
Meeting Place: Adult School, Benhill Avenue, Sutton.
Time: 1st Tuesday in month, 7.45 p.m.
Future events:

3 March	Propagation & repotting
7 April	Cape Town to the Orange River (Tom Jenkins)
5 May	Plant Auction
3 May (Sunday)	Outing to Abbey Brook Cactus Nursery
2 June	Restricted Branch Competition

Northern Counties

Contact: Lionel Hoggett, M.Sc., 13 Cliftonville Gardens, Whitley Bay, Tyne & Wear NE26 1QJ.
During 1980, the active members met three times at members' houses for informal discussion of collections. Any local members interested should get in touch with Mr. Hoggett.

Warrington & District

Secretary: Mrs. D. Pritchard, 81 Birdwell Drive, Great Sankey, Warrington, tel. no. Penketh (092572) 4699.
Meeting Place: Meeting Lane Leisure Centre, Penketh, Warrington.
Future events:

11March	Haworthias (Tom Bantom)
8 April	Cactus Medley (H. Coulsting)
13 May	Travels in India (Brian Fearn)
28 June (Saturday)	Branch Show at Padgate Community Centre (Judges: Mr. & Mrs. Smeaton)

For a copy of the full branch programme, please contact Mrs. Pritchard.

Wirral

Secretary: Mrs. I. Boote, 110 Mount Pleasant Road, Wallasey, Merseyside L45 5HU, tel. no. Wallasey (051639) 4305.
Meeting Place: The Grange, Grove Road, Wallasey.
Time: 3rd Thursday in month, 7.45–10.30 p.m.

ANNUAL GENERAL MEETING
Saturday 28 March

A reminder that the A.G.M. will be held at the Pickard Motor Hotel, A217 Brighton Road, Burgh Heath, Surrey, on Saturday 28 March at 2.00 p.m., preceded in the morning by illustrated talks by Bill & Yvonne Tree commencing at 10.30 a.m. Coffee from 10 a.m. Plant Sales by 'Pete & Ken'.

Mrs. Maddams has arranged a special 3-course chicken lunch at the Motel, price £4.50 incl. coffee. Please let her know if you wish to partake. Alternatively, there is a Happy Eater restaurant nearby.

Accommodation at the Motel for Friday night 27 March should be booked direct with the Resident Manager, Mr. P. Gale, Pickard Motor Hotel, A217 Brighton Road, Burgh Heath, Tadworth, Surrey KT20 6BW. Special rates are available for those attending the A.G.M. There is ample parking to the side and rear of the hotel. Map of location may be obtained from Mrs Maddams (26 Glenfield Road, Banstead, Surrey SM7 2DG. Tel. no. Burgh Heath (25) 54036). Please send S.A.E.

Nursery List

Nurserymen and others who regularly offer plants or seeds for sale are listed below as a service to members, but this does NOT imply the Society's approval or recommendation of plants or other goods offered.

North & South Yorkshire

Cruck Cottage Cacti (Dorothy & Ronald Wood), Cliff Road, Wrelton, Pickering, North Yorkshire YO18 8PJ. Tel. no. Pickering (0751) 72042. Open daily except Sat. morning. No lists. Nursery in garden setting.

Whitestone Gardens Ltd., The Cactus Houses, Sutton-under-Whitestonecliffe, Thirsk, North Yorkshire YO7 2PZ. Tel. no. Sutton (08456) 467. Open daylight hours every day throughout the year. Send 4 × 8p stamps (UK) or 3 international postal reply coupons for list. Everything for the cactophile; plants, seeds, books, sundries; substantial stocks and extensive collection on view.

Oak Dene Nurseries, 10 Back Lane West, Royston, Barnsley, Yorkshire S71 4SB. Tel. no. Royston (022670) 2253. Open every day, April–Sept. 9–6, Oct.–March 10–4 (closed for lunch 12.30–1.30). S.A.E. for list. Seed, plants, books and sundries.

Merseyside

Jim Bolton, Southview, 39 Altcar Road, Formby, Liverpool L37 8DR. Tel. no. Formby (07048) 73187. Open all day Sundays, advisable to telephone for weekday visits. Large selection of seedlings, etc., all at reasonable prices. No list.

North Wales

Jolly's (G. A. & M. A. Coombes), Glanrafon, Talsarnau, Gwynedd LL47 6YD. Tel. Penrhyndeudraeth (076674) 643. Open any time by appointment. No orders by post; no list. Warm welcome to holidaymakers—we are in the Snowdonia National Park.

Derbyshire

Abbey Brook Cactus Nursery, Old Hackney Lane, Matlock, Derbyshire. Tel. no. Matlock (0629) 55360. Open every afternoon 2–6 except Tuesday (closed all day). List free on request, stamp appreciated. Mail order catalogue illustrated in colour lists over 1700 species of nursery-grown cacti and other succulent plants.

Nottinghamshire

Carlton Forest Cacti, Carlton Forest, Blyth Road, Worksop, Notts. S81 0TP. Tel. no. Worksop (0909) 731642. Almost always open but please telephone to avoid disappointment. S.A.E. for list. Mainly cacti, very few succulents.

Woodside Nurseries (Stuart Dixon), 173 Main St., Burton Joyce, Notts. Tel. no. Burton Joyce (060231) 2142. Closed Mondays, open 10–4.30 other days. S.A.E. for list. Nursery-grown seedlings, specimen plants.

South Humberside & Lincolnshire

Southfield Nurseries (B. Goodey), Louth Road, Holton-le-Clay, Grimsby, South Humberside DN36 5HL. Tel. no. Grimsby (0472) 822157. Open daily 10-5 (closed for lunch 12.30-1.30). Send stamp for list. Seed-grown cacti, Lithops, succulents.

Glenhirst Cacti (N.C. & S.A. Bell), Station Road, Swinehead, near Boston, Lincs. Tel. no. Swineshead (020582) 314. Open most days ('phone call advisable if travelling far to ensure someone available). S.A.E. for list. Lithops, Epiphyllums Asclepiadaceae.

Jumanery Cacti (June & Tom Jenkins), St. Catherine's Lodge, Cranesgate Road, Whaplode St. Catherine, Nr. Spalding, Lincs PE12 6SR. Tel. no. Holbeach St. Johns (040634) 373. Open 9–5 Sunday–Friday, closed Saturday. S.A.E. for list

Norfolk

Richard & Wendy Edginton, The Vines, 2 Green Man Lane, Kirstead, Norwich, Norfolk NR15 1EP. Tel. no. Brooke (0508) 58113. Open most mornings and weekends. S.A.E. for list. Seedling cactus plants 35p upwards.

Barleyfield Succulent Plant Nursery (Victor & Heather Graham), Southburgh, Thetford, Norfolk. Tel. no. Dereham (0362) 820457. Nearly always open, but telephone call appreciated. S.A.E. for list. 'Other' succulents, handmade plant pots. (0362) 820457. Stamp for list. Open Sundays only. Best to 'phone for directions. Very large selection of succulents including some cacti.

Warwickshire

Rod & Ken Preston Mafham, 2 Willoughby Close, Kings Coughton, Alcester, Warwickshire, tel. no. Stratford (0789) 762938, invite members to see their collection at weekends or during school holidays—please 'phone first. Surplus seedlings.

Gloucestershire

W. G. Geissler, 1 Lyefield Road, Charlton Kings, Cheltenham GL53 8BA. Tel. no. Cheltenham (0242) 517846. Open weekends and evenings, No list, no orders by post, but visitors very welcome in Cotswold country.

P. Strong, Green Mead, Green Lane, Chedworth, Cheltenham GL54 4AR. Tel. no. Fossebridge (028572) 581. Surplus seed-raised plants.

Bedfordshire

A. & V. Parker, 31 Southill, Nr. Biggleswade, Beds. SG18 9HU. Tel. no. Hitchin (0462) 814022. Open evenings and weekends ('phone first). No list. Seed-raised plants.

Southwest Seeds (Doug. Rowland), 200 Spring Road, Kempston, Bedford MK42 8ND. Tel. no. Bedford (0234) 58970. Open Sunday afternoons. S.A.E. for comprehensive seed list.

Hertfordshire

R. F. S. & B. R. Dale, Thurnlea, 14 Buttondene Crescent, Old Nazeing Road, Broxbourne, Herts EN10 6RH. Tel. no. Hoddesdon 63234. Open almost any time but write or 'phone. No list. Full range B.E.F. pots, labels, top dressing, etc.

Essex

M. L. Fussell, 29 The Readings, Harlow, Essex CM18 7BT. Tel. no. Harlow (0279) 23246. S.A.E. for list. Service by return of post.

The Cactus Place (David & Barbara Brewerton), 33 Bridge Avenue, Upminster, Essex RM14 2LX. Tel. no. Upminster 29911. No list. Open 9 till dusk, but 'phone first. Large and medium sized specimens.

H. Guirl, Glenholme, Nursery Road, Nazeing, Essex. Tel. no. Hoddesdon 62291. Visitors and parties welcome. A prior telephone call would be appreciated. No list.

East & West Sussex

Mrs. Yvonne Warrick, 122 Barnhorn Road, Little Common, Bexhill, E. Sussex, Tel. no. Cooden (04243) 4726. Not open. S.A.E. for list. Rare succulents and Epiphytics.

Ernest Hepworth, Mira Mar, 133 Ambleside Avenue, Telscombe Cliffs, Sussex BN9 7LG. Tel. no. Peacehaven (07914) 3260. Open by appointment; closed Sundays. Send 12p stamp for list. Lithops, Mesems, Sempervivums.

Holly Gate Nurseries Ltd., Billingshurst Lane, Ashington, Sussex RH20 3BA. Tel. no. (0903) 892439. Open 9–5 every day, incl. weekends and Bank Hols. Send 25p for current catalogue of plants and seeds. Reference collection, entry 25p each.

Dorset

Pine Ridge Cacti (Joan & Dick Smeaton) 197 Ringwood Road, Verwood, Wimborne, Dorset BH21 6AG. Tel. no. Verwood (020123) 2796. Open 10–6, Closed Saturday and Monday. Choice and rarer 'other succulents'.

Shires Mead Cactus Nursery (D. W. & C. E. Sargant) Hampreston Village. Wimborne, Dorset BH21 7LX. Tel. no. Northbourne (02016) 3829. Not open Sundays and Mondays. List 12p. Plants and seeds.

Somerset

John E. White, 64 Bath Road, Ashcott, Bridgwater, Somerset TA7 9QJ. Tel. no. Ashcott (0458) 210256. Open daily except Mondays. Uncommon Succulents.

Devon

Phil Goodson, 1 Marsh Lane, Chudleigh, Newton Abbot, Devon. Tel. no. Chudleigh (0626) 852309. Collection open, plants usually for sale. Between the scenic Teign Valley and Haldon Hills, five miles from M5. 'Phone for directions and convenient times.

G. N. Short, Greenshaws, 7 Reabarn Road, Brixham, Devon TQ5 9DU. Tel. no. Brixham (08045) 2878. Open by appointment. The Devonia Collection of Cacti & Succulents; over 4000 species. Surplus plants for sale or exchange.

Westfield Cacti (Ralph Northcott), 10 Shillingford Road, Alphington, Exeter, Devon. Tel. no. Exeter (0392) 56925. Nursery grown cacti and other succulents. S.A.E. for list. Open to visitors from 1 January 1981, 9.00 a.m. till dusk, by appointment.

Cornwall

The Cactus Nursery (Mrs J. Osmond), Brandy Lane, Rosudgeon, Penzance, Cornwall TR20 9QB. Tel. no. Germoe (073676) 2397. Open 9 till dusk, Spring Bank Holiday to end of September. 'Phone in winter. List 12p. Large selection succulents. Cornish cream teas June–Sept. incl.

ABBEY BROOK CACTUS NURSERY

Old Hackney Lane, Matlock, Derbyshire

(tel. 0629 55360)

Special Seed Offer to CSSGB Members !

These freshly harvested seeds, including many items not on our general 1981 seedlist are offered to CSSGB members at only 10p per packet. Each packet contains 10–15 seeds. We believe the list is unique because *full field data* are available for every item. Many of the items are exclusive to Abbey Brook and are not available from any other source. All seed is tested for germination and we keep accurate germination records of every seed stock. We know there is no finer seed on sale in the UK.

Please order by CF number only. We will not substitute unless requested. All packets are priced at 10p and contain 10–15 seeds. Please add 20p to your payment to cover postage and packing.

F numbers refer to seed collected by B. Fearn in March/April 1980 at different field sites in Mexico. H numbers refer to seed gathered from plants grown from seed originally collected in Mexico by D. Hunt.

ACANTHOCALYCIUM
CF5002 sp. AM
CF5003 variiflorum sp. 31

ACANTHOCEREUS
CF4780 horridus

ACANTHOLOBIVIA
CF5004 tegeleriana var. plominiana

ARIOCARPUS
CF5006 retusus F4140

ARMATOCEREUS
CF4905 giganteus
CF4904 laetus
CF4902 laetus var. balsensis
CF4903 matucanensis
CF4906 oligogonus

ASTROPHYTUM
CF4590 asterias

BROWNINGIA
CF4869 candelaris

COPIAPOA
CF3604 alticostata
CF4868 bridgesii
CF2818 cinerea var. albispina
CF2820 dealbata
CF2821 haseltoniana
CF2825 lembckei var. magnifica

CORYPHANTHA
CF2704 vivipara var. aggregata
CF5008 pallida complex F4151
CF5007 pallida complex F4144
CF5009 sp. F4156

ECHINOCACTUS
CF4256 grandis
CF4736 ingens F4149

ECHINOCEREUS
CF2675 fasiculatus
CF3029 fendleri var. rectispinus
CF2678 polyacanthus
CF4731 ochoterenae
CF2600 stramineus

ECHINOFOSSULOCACTUS
CF5010 sp. F4142

ECHINOPSIS
CF4209 aurea var. quinesensis
CF4874 ayopayana
CF4031 sp. (carminatiflora?) sucre
CF4898 ayacuchensis

FEROCACTUS
CF4732 flavovirens F4154
CF4721 glaucescens F4148
CF4727 histrix F4146
CF4722 latispinus F4152
CF5011 latispinus F4131
CF5014 latispinus F4147
CF4705 macrodiscus F4161
CF5013 recurvus F4165
CF4255 recurvus (Puebla)
CF4733 recurvus F4156
CF4258 robustus (Puebla)
CF4706 robustus F4151
CF5012 sp. F4152

ESPOSTOA
CF2528 churinensis
CF4651 hylaea
CF3609 lanata
CF4649 melanostele
CF4650 procera

GYMNOCALYCIUM
CF4612 sp. U2704

LEMAIREOCEREUS
CF3049 thurberi

LOBIVIA
CF4968 binghamiana
CF4047 haulfinensis
CF5015 johnsoniana
CF4965 lateritia
CF5016 leucorhodon
CF5017 sicuaniensis
CF3134 sp. Lau 459
CF5018 sp. Huancavelica (CF1764)

MAMMILLARIA
CF4711 candida H8653 Huizache
CF5020 dioica (CF266)
CF5032 dioica (CF267)
CF4300 dioica (CF474)
CF5021 dioica (CF546)
CF5022 dioica (Lau 044)
CF5023 discolor H8525
CF5024 goodrichii
CF5025 gigantea? F4146
CF5026 heyderi var. applanata H8586
CF5027 mystax var. huajuapensis
CF5028 rhodantha H8551
CF5019 tegelbergiana
CF5030 weisingeri H8520
CF5031 sp. JE4372
CF5032 sp. F4162
CF5033 sp. (collinsii?) F4164

MELOCACTUS
CF4699 griseoloviridis

MYRTILLOCACTUS
CF4729 schenkii F4163

NEOPORTERIA
CF4847 andicola var. vegasana
CF4848 atroviridis
CF2830 clavata
CF4931 ebenacantha
CF4933 froehlichiana
CF4932 kesselringiana
CF4928 lassiocarpua
CF4930 microsperma
CF4977 microsperma var. serenana
CF2826 napina
CF4934 nigricans
CF5000 senilis
CF4941 subikii
CF2827 transitensis
CF4927 vallenarensis
CF4654 wagenknechtii var. multiflora
CF2219 sp. De Talta
CF4935 sp. Tilama

NOTOCACTUS
CF4713 claviceps
CF4715 magnificus
CF4825 muricactus HU19
CF3162 purpureus var. muegelianus

OREOCEREUS
CF3597 hendriksenianus var. densilanatus
CF3601 lecoriensis
CF3596 sp. KK900

PARODIA
CF4241 mairanana

PHILIPPICEREUS
CF4899 castaneus

RAUHOCEREUS
CF4871 riosaniensis

THELOCACTUS
CF5035 bicolor var. tricolor (Huizache)

WEINGARTIA
CF5036 pilcomayensis

Whitestone

Whitestone Gardens has everything for succulent fanatics and beginners. A large stock of plants, seeds, books and sundries is constantly on view, and the nursery is open to visitors every day.

Our plants are primarily nursery-grown seedlings, but we also stock a range of larger plants. The nursery shop carries almost everything ever likely to be needed by the cactus enthusiast, including a range of books and other publications which is the most comprehensive in the world. We stock every book in print and many that aren't—why be kept waiting by your local bookseller when you can ring or write to us and get your needs by return of post.

Most of the Whitestone Collection is permanently on view to visitors—free of charge. This is constantly expanding, and now represents one of the best displays in the country. It is of special interest to serious students by virtue of the logical arrangement and the high proportion of authenticated reference material.

Anyone who hasn't been before can find us about 3½ miles from Thirsk on the A170 Scarborough road in the heart of North Yorkshire's most attractive tourist countryside.

1981 Whitestone Price List 55 pages of plants, seeds, books, and sundries, illustrated. UK enquiries please send *four second class stamps,* and overseas *three International Postal Reply Coupons.*

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Illustrated Reference on Cacti & Other Succulents (Lamb)
Vols. 1, 2, 3, 4, 5 *£8.50 + 80p post per vol.*

Mammillaria Handbook (Craig) *£10.50 + £1 post*

Mammillaria Index (Mottram) *£2.75 + 35p post*

Lithops (Nel) *£20 + £1.20 post*

Cacti and Succulents (Haage) *£7.95 + 80p post*

Post indicated above applies to UK and surface mail overseas

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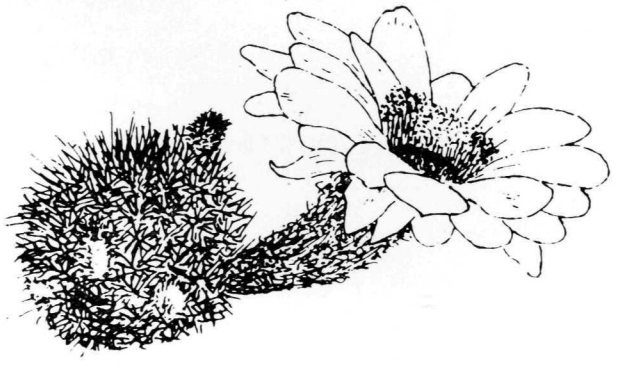
Obsolete publications, especially American journals (we pay 50p per issue), NCSS and GB Society journals (we pay 15p per issue) and all kinds of books for our second-hand trade.



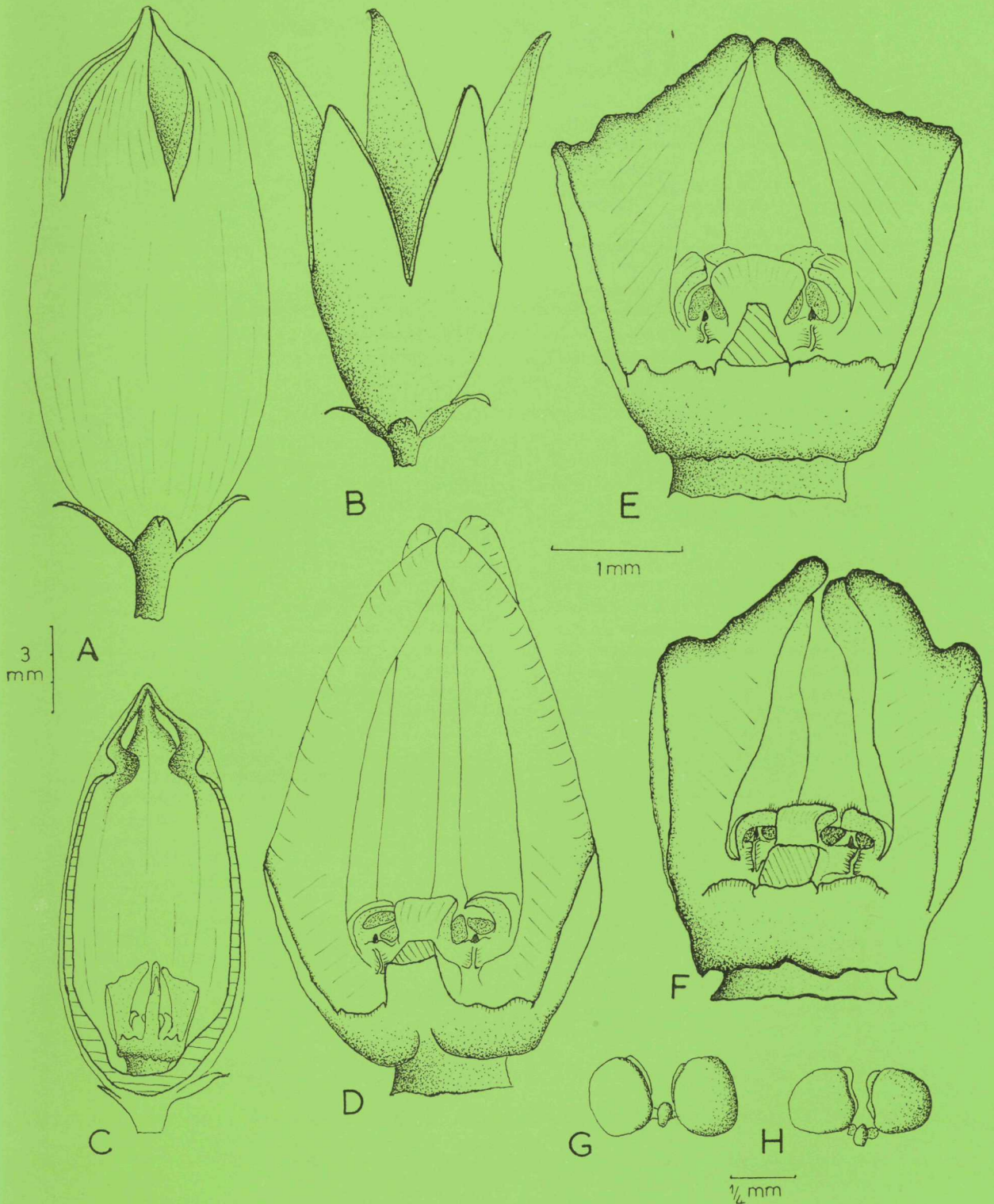
Whitestone Gardens Ltd
The Cactus Houses
Sutton-under-Whitestonecliffe
Thirsk
North Yorkshire YO7 2PZ

Telephone: Sutton 467

Printed in Great Britain by W. H. Houldershaw Ltd., Southend-on-Sea SS1 1PF

Volume 43/Numbers 2-3
Summer 1981

The Cactus and Succulent Journal of Great Britain



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Joint members (two in family) receive one journal but are both entitled to free seeds and voting rights.

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INDEXES

Vol. 26-30 (1964-68)	0.90p
Vol. 31-37 (1969-75)	0.90p

Applications for membership, advertising, back volumes and indexes should be made to the following address:

Cactus & Succulent Society of Great Britain
67 Gloucester Court
Kew Road
RICHMOND
Surrey TW9 3EA
England

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Car sticker	0.30p
Booklet on cultivation	0.30p
Guide to Genera (show classes)	0.20p
Key fobs (mixed colours)	0.25p
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T-Shirts and Sweatshirts	write for details

Order from: **Mrs. J. Ellis, 6 Buxton Crescent, North Cheam, Sutton, Surrey SM3 9TP, England.**

Cheques, etc., should be made payable to the Society and not to individual officers. When remitting in a currency other than sterling, please add the equivalent of £0.70p to cover currency negotiation charges.

Cover design: Drawings of floral structure in *Stapeliopsis saxatilis* by Peter Bruyns. For explanation see page 79.

This issue of the Journal combines the usual quarterly issues for May and August. Price £3 (ISSN 0007-9375).

The Cactus and Succulent Journal of Great Britain

Volume 43 Numbers 2-3 Summer 1981 **edited by David Hunt and Nigel Taylor**

In this issue

Double issue

As announced in this column last November, we have combined the usual May and August Journals this year, partly because of the length of several of the articles and partly to reduce labour costs. Even so, its publication is later than intended and we apologize for keeping readers in suspense.

Ballot

The result of the ballot on merger talks was overwhelmingly in favour of their continuing—about 10 to 1 in favour—and the poll quite good—about 40%. The NCSS reports a majority of about 8 to 1 in favour on a somewhat smaller percentage poll. The Officers and governing bodies of the two Societies have therefore wasted no time in discussing the detailed basis of merger terms. It is hoped to reach agreement and ask members for their final approval by the end of the year, though the actual merger will probably not be practicable before the beginning of 1983.

Speakers at Warrington Weekend

The programme of talks at Warrington will cover a broad spectrum of topics. Travellers tales will be told about Saudi Arabia (Clive Innes), California and Baja (John Pilbeam), the Netherlands Antilles (Chris Rodgers) and the 50th Anniversary Convention of the C. & S.S. of America (Norman Wilbraham). Specialists will specialize on *Gymnocalycium* (Geoff Swales) and *Echeveria* (Les Carruthers), intergeneric boundaries will be crossed (Gordon Rowley, speaking on hybrids) and conservation action reported (David Hunt). Send your booking form to Daphne Pritchard without delay!

CSSGB 50th ANNIVERSARY EVENTS this year

Saturday 26 September Pimlico Show
(see page 86)

24-25 October Warrington Weekend
(details and booking-form enclosed with this issue)

†

BETTY MADDAMS

It is with great sorrow that we record the sudden and untimely passing of Betty Maddams, the Society's Publicity Officer, the dear wife of our Chairman and kind friend to many of us, who collapsed and died on 17 July.

In her roles as Publicity Officer and member of the Show Committee, Betty was well-known throughout the hobby as a loyal and devoted proponent of the Society, organizing many of our events and fund-raising ventures, ably supporting her husband in his work for Council, for the North Surrey Branch and for the Mammillaria Society, and welcoming innumerable colleagues and visitors to the many committee meetings and Open Days held at their Banstead home. She put the same whole-hearted enthusiasm into growing, observing and photographing the many kinds of succulents in their joint collection, into showing and judging, into writing for the various journals and into 'spreading the word' through the popular horticultural press. For several years she was the light-hearted 'gossip columnist' of this Journal, her characteristic style thinly disguised behind the pseudonym *Sally Cornioides*. She had many other horticultural interests too, as well as taking an eager part in the whole gamut of church and local activities, where she will be sadly missed.

To our Society the death of Betty Maddams in this 50th Anniversary Year is as cruel a blow as it was unforeseen. To Bill Maddams, who suffers the deepest personal loss, we offer our heartfelt sympathy. D.H.

A.G.M.
Our Annual General Meeting on 28 March at the Pickard Motor Hotel, Burgh Heath, Surrey, was attended by some 40 members. In the morning, Bill & Yvonne Tree gave us a most enjoyable and varied programme of plant portraits and comment, followed by an artistic kaleidoscope of natural beauty inside and outside the greenhouse with musical commentary.

After lunch, the usual A.G.M. business was despatched with due decorum and commendable swiftness under the magisterial gavel of Chairman Bill Maddams. The Officers were re-elected *nem. con.*, and Dr. Ray Pearce returns to Council after the statutory absence of one year with new bloods Jean Ellis and Will Tjaden.

Visitors welcome
David Hunt expects to be 'at home' at 64 Mincing Lane, Chobham, Surrey, on Sunday 16 August, Saturday 22 August and Sunday 6 September. Society sales goods, publications, BEF pots and surplus plants will be available and a collection of Mammillarias to see. Visitors will be welcome between 11 a.m. and 5 p.m., but please write or telephone (24-hr. tel. no. Chobham (09905) 8317) for confirmation. For location map, send S.A.E.

Library
The Hon. Librarian, recently removed to Addlestone, Surrey, is busy cataloguing and reshelving, and nearly all the books have now been transferred to his new address (see list of officers). By authority of Council, a few duplicate books mostly in very poor repair after repeated passage through the post have been disposed of to Branch libraries or members. Filing boxes have been purchased for the periodicals and these are also being catalogued with a view to obtaining missing numbers where practicable. A list will be issued in due course.

Should the Society merger go through, it is likely that the existing Society libraries will be retained in their present locations, so that members may use whichever is nearer.

International Succulent Institute (ISI)
This organization specializes in the propagation and distribution of interesting and choice cacti and other succulents. It is based in California and has a representative in Britain, Norman E. Wilbraham, 7 Marlborough Drive, Tytherington, Macclesfield, Cheshire SK10 2JX.

Many of the items offered by ISI are not otherwise available and are of special interest to scientists and serious enthusiasts as they are fully documented with field notes, etc. Mr. Wilbraham will be glad to supply lists and prices.

Cactaceas y Suculentas Mexicanas
A few copies of Volume 24 (1980) are available, price £3.50 post free, from 67 Gloucester Court, Kew Road, Richmond, Surrey TW9 3EA. Please make cheques etc. payable to D. R. Hunt, not to the Society.

Repertorium Plantarum Succulentarum
Volume 30 of Gordon Rowley's annual index of new succulent plant names has now been published. It covers names published in 1979 and is being distributed by N. P. Taylor, 47 Heron Dale, Addlestone, Surrey KT15 2JS, price £2.50 post free. Please make cheques etc. payable to Mr. Taylor.

Ants in his plants
We finally found time to sow our 'control' series of CSSGB seeds in late May. Results promise to be better than last year, with a higher average number of viable seeds per packet. Unfortunately, D.H.'s greenhouse has been plagued with ants, some of which repeatedly nested amongst the newly sown pots and transplanted a proportion of the seeds to the floor of the propagator, thus invalidating all our statistics!

Corrections
Dr. Horst Pfennig has written to point out that the late Peter Bally's honorary doctorate was conferred by the University of *Basle*, not of Mainz as stated in CSJGB 42(3): 61 (1980). Obituaries of Dr. Bally have been published in Kakt. u.a. Sukk. 31 (11): 328–9 (1980) (by Dr. Pfennig) and in Cact. Succ. J. Amer. 53: 55 (1981) (by Susan Carter).

Colin Walker tells us that the plant of *Ceropegia rupicola* var. *stictantha* mentioned in CSJGB 42(4): 111 (1980) and figured in Asclepiadaceae no. 19: 19 fig. 3 (1980) is not *Lavranos & Newton* 13109 but was collected by Bob Potter (and not just photographed by him as the caption led us to believe). His locality, 35km N. of Ta'izz, found in 1975, must be very near that of L. & N., if not actually the same.

Nomenclature of fasciated plants
from Len Newton

Thanks to Paul Heath (CSJGB 42(4): 117.1980) for bringing us up to date with ICBN changes. News takes a long time to penetrate as far as my jungle hide-out! In the amazing variety of plant life one can envisage several cases where application of the term monstrosity could be controversial. However, our fasciated plants are very obviously of abnormal growth habit, and their failure to spread widely in the natural habitat suggests that they are at some disadvantage in competition with plants of normal growth habit. Here, I think, is a clear case for continuing to observe the spirit of the old Art. 71. I agree with the Editors in recommending the use of cultivar rank for such plants when they are artificially propagated and distributed in cultivation.

L. E. Newton
University of Science and Technology
Kumasi
Ghana.

The Cactus and Succulent Journal of Great Britain
Volume 43(2/3): 31-32 (1981)

Golden Anniversary at Zurich

*by Urs Eggli**

Foundation and Development

This year, the famous City Succulent Collection (Städtische Sukkulentensammlung) at Zürich celebrates its fiftieth anniversary. Here, on the shore of the Zürich lake, one of the most complete succulent collections has evolved from modest beginnings. A big library and a comprehensive herbarium (ZSS) are adjuncts of the living collection.

The collection was founded in 1931. From the beginning, it was a part of the City's Gartenbauamt or Gardens Department. The first step towards the foundation of the collection can be traced back as far as late 1927 and early 1928. At this time, some important citizens made the proposition that Zürich should buy the large private collection of the cactus dealer J. Gasser, to prevent it from being split up after his death. This outstanding collection was finally bought for the city by J. Brann, then owner of a department store in Zürich. But only in 1931 was the newly built greenhouse ready to house the plants and to be opened to the public. No admission fee has ever been charged.

Hans Krainz, a learned gardener, was appointed in the same year to take care of the newly founded City Succulent Collection. He was responsible for the first forty years of development, acting as curator until his retirement in 1972. Before long the collection was considerably enlarged. In 1932 Dr H. Balsiger presented his extensive collection of *Epiphyllum* hybrids to the town of Zürich, and after a big gardening exhibition which took place in Zürich in 1933, the collection obtained some very large plants from the collection of A. Kuehnrich at quite a modest price. The Kuehnrich collection had been offered as a gift the year before, but this would have involved the building of an expensive new greenhouse and the town of Zürich was, as a result of the world trade crisis, in no financial position to accept the gift.

Through gifts from, and exchanges with, persons and botanical institutions the world over, the collection grew considerably: in 1931 it consisted of some 1500 plants, while in 1945 it already numbered more than 6500 plants, despite the Second World War having intervened. The year 1947 saw the construction of a large new greenhouse providing enough space even for the tall-growing cerei and Euphorbias. In 1952 the Duke Knuth of Knuthenborg, Denmark, presented an extensive collection to the town of Zürich. As a result another greenhouse had to be appended in 1954. In 1958 some further additions to the greenhouses were built, as well as a separate room for housing the rapidly expanding herbarium. And then only three years later, in 1961, another two large greenhouses were opened to the public. The first greenhouse built in 1931 had to be replaced in 1964 because through bad construction and rusting it could not be repaired.

The tallest of the public display houses with tree-Euphorbias, cerei, an Agave and specimens of Ferocactus hystrix

*Temporary student at the Städtische Sukkulentensammlung, Mythenquai 88, CH-8002 Zürich.

Display bed with cacti and other American succulents

In 1972, the curator Hans Krainz, well-known for the publication 'Die Kakteen' in collaboration with the Austrian botanist Prof. Franz Buxbaum, retired. As his successor, the authorities of Zürich appointed the landscape gardener and cactophile Diedrich Supthut. In the autumn of 1980 a rock garden for winter-hardy species was opened to the public, partly to accommodate a collection of Sempervivums donated by Mr Kuisel of Zürich.

The scientific importance of the Collection

As early as 1938 there was the installation of a seed reference collection, at first attached to the 'Zentralforschungsstelle' of the Deutsche Kakteen-Gesellschaft. Only one year after its foundation, this collection contained 463 seed samples, donated by 32 institutes from 8 different nations. Today the seed collection, attached to the herbarium, numbers some 8500 samples of cactus seeds.

Without doubt, the foundation of the IOS at Zürich in 1950 was a major event in the scientific history of the City Collection. In 1955 it was designated the first IOS Reserve Collection with the implication that all material of scientific importance should preferably be given to Zürich. The herbarium (ZSS) was established not long after the foundation of the collection itself in 1931, but only after 1955 did it gain the importance it has nowadays. The herbarium contains some 6000 specimens including much type material of plants described by Rauh, Rausch, Ritter and others. There is a pollen collection with some 700 samples and an extensive collection of transparencies.

As a result of extensive connexions with field collectors of succulent plants, such as Rausch, Lau, Ritter, Knize, Horst and others, the collection now contains a great quantity of new and important material. 1980 alone saw some 3000 additions to the living and herbarium collections. Thanks to the extensive collection of living plants, the comprehensive library and herbarium, the institution is an important place for the study of succulents. This is freely demonstrated by the great number of visits to it paid by important botanists. Moreover, the collection is able to supply material for scientific research projects.

The aims of the collection

Each year the Zürich Succulent Collection is visited by more than 50,000 persons and each year more than 60 guided tours around the collection are arranged for schools, societies, etc. One of its main aims is the promotion of interest and the dissemination of knowledge of succulent plants and their cultivation. In a time when succulents are becoming more and more popular with the general public, this aim gains rapidly in importance. Once a week a consulting hour takes place when the general public can ask for information. Another important aim is the conservation and propagation of threatened or endangered plants. These conservation activities have gained importance during the last few years, when the large scale destruction of the habitats of succulent plants through the action of man, primarily in the countries of the third world, and the demand for imported specimens by the amateur succulent plant grower has played a significant rôle.

All these aims can only be achieved because of the generosity shown by the authorities of Zürich back in 1931 and throughout the subsequent developmental period. The authorities have also had an open ear for the wishes of the collection during recent years. It remains to express the hope that the succulent collection of Zürich will always enjoy recognition as the scientific and community asset that it is, so that the fulfilment of its aims will continue.

The Cactus and Succulent Journal of Great Britain
Volume 43(2/3): 33-36 (1981)

Melocactus macracanthos in habitat

*by C. N. Rodgers and P. A. Evans**

Introduction

Curacao and Bonaire together with their smaller neighbour Aruba are the more southerly of the two island groups that make up the Netherlands Antilles, an autonomous part of the Kingdom of the Netherlands. The group lies apart from the main chain of the Lesser Antilles and to the west of the hurricane zone. The light and variable rainfall, less than 50 cm. per year on Bonaire and 58 cm. on Curacao, is insufficient to support the luxuriant vegetation found on the other Caribbean islands. There is much overgrazing by goats, but cacti and other xerophytes abound. Temperatures reflect the moderating influence of the Easterly Trade Winds, varying little from an annual average of 27°C on Bonaire and ranging between 26–29°C on Curacao. Geologically, both islands consist of igneous rocks surrounded by limestone platforms that were produced by repeated uplifting of the fringing coral reefs. Their contrasting human geography, however, gives them very different characters. Curacao has a population of 160,000 in a total area of 444 sq. km., mainly concentrated in the sprawling suburbs of the capital, Willemstad. The 4000 acre Christoffel National Park in the north of the island has been set aside to protect the remaining wildlife and natural vegetation from further urban encroachment, and offered the best opportunities for our intended research. Bonaire, on the other hand, while having an area of 180 sq. km., only has a population of 10,000 and has escaped the same degree of environmental degradation. The whole of the northern quarter of the island, some 13,500 acres, has been designated an area of particular scientific interest and natural beauty, and named the Washington-Slagbaai National Park. Again this proved to be the most fruitful area for study.

Cactus vegetation on the islands

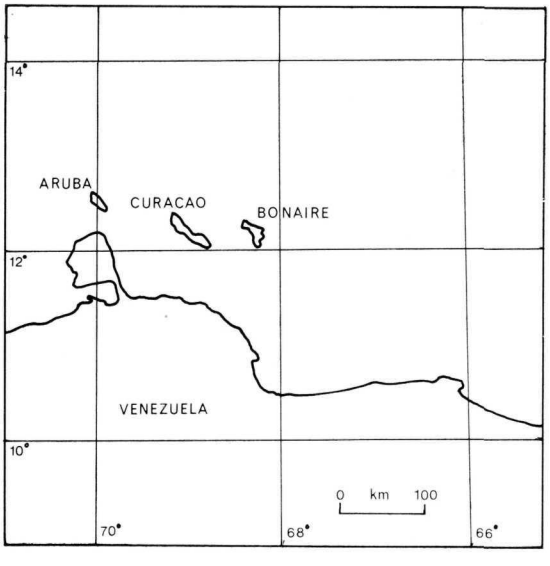
The two dominant species are *Cereus repandus* and *Stenocereus griseus*, both of which are very common. We also found *Cephalocereus lanuginosus*, but this was much less abundant, and the ubiquitous *Opuntia wentiana*, which sometimes grew so densely that it was impossible to venture away from the path. The species that we were most interested in was *Melocactus macracanthos*. This plant, endemic to the islands, was fairly common both on Curacao, where it grew mainly on rocky ground on the slopes and summits of small hills, and on Bonaire, where the normal habitat was in exposed sites on solid volcanic rock.

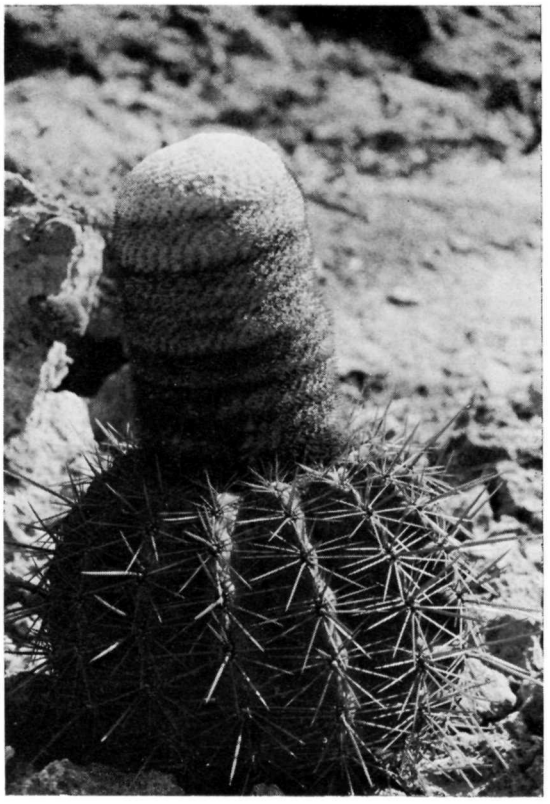
*Participants in the two-man University of Oxford Expedition to Curacao and Bonaire 1980. Correspondence to C. N. Rodgers, c/o Worcester College, Oxford.

One of our main objectives in studying *M. macracanthos* was to form a rough assessment of the degree of variation in the species. We had good reason to believe that this was especially great and remarkable even for a cactus. Up until 1841 seven different *Melocactus* species had been described from Aruba, Bonaire and Curacao, but between 1841 and 1910 W. F. R. and J. V. Suringar described 87 new species and subspecies from these islands, 53 of which were from Aruba, 30 from Curacao and 4 from Bonaire. However, Britton & Rose (1922) recognized only 19 species of *Melocactus* in total, and only one species, *M. macracanthos*, from the Dutch Leeward Islands (cf. Hummelinck, 1938).

The main aim of the expedition was therefore to examine these plants in more detail to try to decide how many distinct varieties are actually present, and hopefully, to seek an explanation as to why such phenomenal diversity should occur in so small an area.

The landscape in the northern part of Curacao is extremely variable, the western side of Mount Christoffel (1300 ft.) being particularly interesting. Here the vegetation was distinctly characteristic of a tropical montane forest, with epiphytic orchids and bromeliads becoming very common at about 800 ft. Also at this height *Cephalocereus lanuginosus* became more abundant and replaced *Stenocereus griseus* and *Cereus repandus* as the dominant cactus species. Between approximately 900 and 1100 ft. we found *Acanthocereus pentagonus*, apparently the only locality where it grows on Curacao,





Melocactus macracanthos on Bonaire (Slagbaai)

although it is fairly common on Aruba and the mainland. We found Melocacti growing on all parts of the mountain and even on the summit itself.

In sharp contrast to these mountain slopes were the coastal areas on the windward side of the island. At Westpunt, on the extreme north-western tip and only 6–8 km. from Christoffelberg, we found very little growing in the desolate landscape apart from scrubby bushes and large colonies of Melocacti, fully exposed to the dry Trade winds and burning sun.

Bonaire and its variable Melocactus populations

Bonaire is an exceptionally beautiful island, famed more for its coral reefs and varied bird life than for its cacti. Many of the animal species are endemic even though Venezuela is just 80 km. away. In fact, some of the reptiles, birds and landsnails are more closely related to species from the far-off Northern Windward Islands than to those of the mainland.

We spent three and a half weeks on Bonaire, long enough for us to make a detailed study of *Melocactus macracanthos* there. As on Curacao, much of our time was spent photographing plants at different localities and collecting seed, but in addition we recorded data on the main characters of mature plants. This involved making notes on the plant body and cephalium dimensions as well as characters such as rib number, spine number, their approximate thickness, colour and arrangement, and the colour of the plant body. The data back up our photographs in demonstrating the remarkably high degree of variability in the species.

The range observed for some of the characters and their mean and modal values are listed in the table.

Character	Mean	Mode	Range
Rib no.	14.3	14	12–23
Plant diam. (cm.)	16.5	18	9–24
Plant height, excluding cephalium (cm.)	12.7	12	8–21
Cent. sp. no.	–	3	1–4
Rad. sp. no.	–	11	9–17
Cephalium diam. (cm.)	7.5	7	4–11
Cephalium height (cm.)	5.0	3	0–23

Most of the plant characters and dimensions gave approximately normal frequency distributions but two interesting exceptions are perhaps worth mentioning:

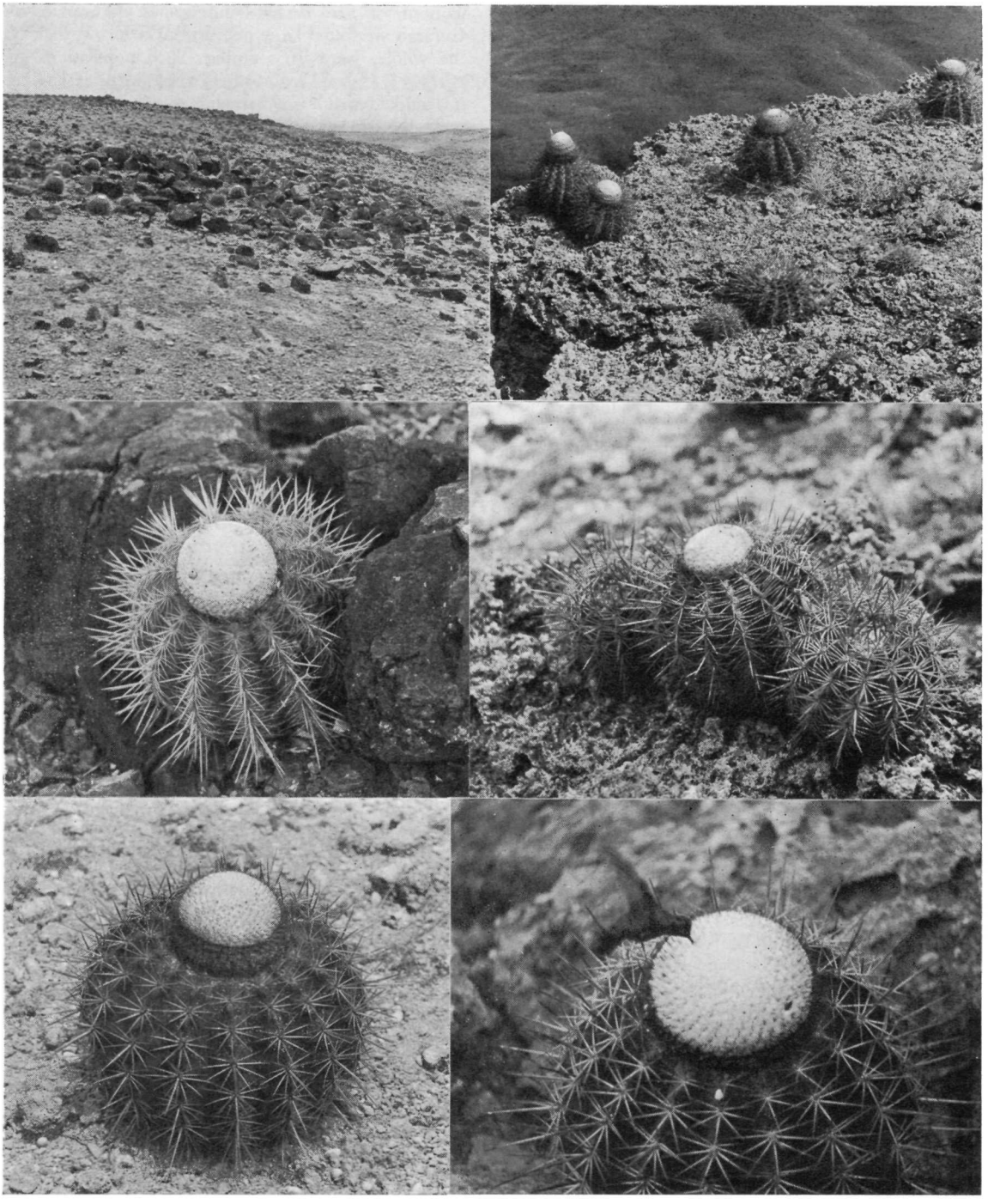
1. The cephalium height distribution was significantly skewed to the left, there being a preponderance of young mature plants with short to medium sized cephaliums (2–4 cm.). There were relatively few plants with new cephaliums (up to 1.5 cm. tall) and for plants with cephaliums taller than 4 cm. there were progressively fewer plants as the cephalium height increased. If it can be assumed that there is an approximately linear relationship between cephalium height and plant age, then this distribution gives a rough guide to the age distribution of the mature Melocacti. However, the age at which plants begin to form a cephalium and its subsequent growth in successive years will almost certainly be affected by environmental factors.

2. The frequency distribution for stem diameter was both surprising and fascinating. Our results give a distribution with two distinct peaks, at 14.5 cm. and 18.5 cm., with a considerable trough between them at 16.5 cm., which is the mean overall. We have no satisfactory explanation for this unusual observation.

Ecology and pollination

We could find no obvious correlation between plant type and the local environment. In fact, very similar plants could often be found growing in widely different habitats, and conversely it was common to see plants totally different in appearance growing side by side. This would suggest that the plant's variability has a solely genetic basis and is not due to environmental effects.

There appears to be no special mechanism for promoting seed dispersal in *M. macracanthos*. The fruit is retained within the cephalium until ripe, at which time it is pushed out and simply falls to the ground. The seeds are therefore probably scattered over only a small area of hillside. This is confirmed by the pattern of plant distribution on a hillside: the oldest plants are usually to



Top left: Melocactus colony at Westpunt, Curacao. Top right: Mature plants and seedlings, Bonaire. Centre left: Specimen growing in Christoffel National Park, Curacao. Centre right: Young plants on Bonaire. Bottom left: Mature plant, Bonaire (Slagbaai). Bottom right: Humming-bird visiting M. macracanthos.

be found near the top of the hill, and the younger and immature specimens are spread over the slopes. Occasionally, however, chance events may cause the wider dispersal of seed and this is probably how new populations arise.

The fact that we did not find more order in the distribution of variants was very surprising to us at first. It has been thought that Melocacti are predominantly self-pollinating or autogamous plants, in which outcrossing rarely takes place. Autogamous plants tend to produce populations of nearly identical, directly descended specimens, and this can easily fool a field-collector into recording many minor variants as separate species (Rowley, 1980). This appears to be precisely what has recently been done for the Melocacti of eastern Brazil (Taylor, 1980).

At the outset of our work on Curacao and Bonaire we expected to be studying a situation paralleling that in eastern Brazil, but as it turned out things were very different. We made a discovery that could explain why variation in *Melocactus macracanthos* does not conform to the pattern in autogamous species described above. On the contrary, *M. macracanthos* is almost certainly a species that is normally cross-pollinated, the main vector being the Fork-tailed Emerald Hummingbird (*Chlorostilbon canivetii caribaeus*), that is fairly common on Curacao and Bonaire. Late every afternoon on both these islands, as the *Melocactus* flowers opened, the hummingbirds could be seen visiting the plants to feed on the nectar from the pink, tubular flowers. Of course, the fact we observed hummingbirds visiting the flowers does not, by itself, prove that they are pollinating agents or that cross-pollination actually occurs, but it does seem extremely likely.

That the hummingbirds do in fact pollinate the flowers in the course of their nectar feeding is supported by the observation that within the *Melocactus* cephaliums we often found rings of many dead dried flowers that had obviously never developed into fruit. We believe that this is due to the fact that in certain past years the hummingbird populations were greatly reduced, possibly due to unfavourable climatic conditions, and consequently pollination of many of the flowers may never have occurred.

We believe that ours is the first reported case of a *Melocactus* species that is mainly cross-pollinated, but suspect that the same is true for other species, particularly the Caribbean Melocacti and those of the Venezuelan mainland, where hummingbirds are known to be common.

If all the different forms of *M. macracanthos* on Bonaire can be successfully cross-pollinated with each other to produce fertile seed, then in the absence of ecological differentiation, there can be little doubt that all the variants belong to one species.

It is worth pointing out that some of the *Melocactus* populations on the islands may still be largely autogamous. In the barren landscape at Westpunt on Curacao we found large populations of plants that, on the whole, were very similar. Such populations are effectively isolated from others, and autogamous, since it is unlikely that it is worthwhile for a hummingbird to make the trip out to them for the comparitively small return of nectar.

Why such a high degree of variation?

The presence of a vector causing cross-pollination provides a good explanation as to how the present high degree of infra-specific variation in *M. macracanthos* could have been maintained, but it does not explain why this should have arisen in the first place. A theoretical explanation is that the species arose as a natural hybrid. Perhaps at some time in the past the arrival of the hummingbird or an environmental change was responsible for the crossing of two distinct *Melocactus* species then co-existing on the islands. This suggestion is interesting in relation to our data on plant body diameter which, as mentioned previously, gave two distinct peaks in a plot of plant diameter vs. frequency. However, more characters must be found to display such a divergence before the presence of recombinant paternal features will be established.

It is hoped that a detailed study of plants raised from the numerous seed collections we obtained will shed more light on this interesting possibility.

Acknowledgements

We are most grateful to everyone who supported and advised the expedition, and full acknowledgement will be given in the expedition report (in Bull. Oxf. Univ. Explor. Club. NS 6 (in preparation)). But here we would like to thank three people in particular for their considerable personal advice and assistance: Dr Ray Pearce, our Home Agent in Oxford, Mr Nigel Taylor (Kew), and Dr I. Kristensen of STINAPA in Curacao.

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The Cactus and Succulent Journal of Great Britain
Volume 43 (2/3): 37-40 (1981)

Reconsolidation of Discocactus Pfeiff.

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Introduction

The genus *Discocactus* was established by Pfeiffer in 1837 for *D. insignis* Pfeiff. However, the earliest description of a plant referable to the genus was that of *Cactus placentiformis* Lehm. (1826). Five more *Discocactus* names were published before the end of the century, but it may be doubted whether any of these are more than varieties of Lehmann's variable species (q.v.). In any case the typification of these old names is problematical, and perhaps only *D. placentiformis* (Lehm.) Schumann can be identified with any certainty. Lehmann's later illustration (in Nov. Act. Nat. Cur. 16: t. 16. 1832) depicts a plant with *acute-edged* ribs which may be compared with specimens collected east of the Rio São Francisco, in the Brazilian states of Minas Gerais and Bahia.

The second readily identifiable *Discocactus* species was described as *Malacocarpus heptacanthus* by Rodrigues in 1898. As interpreted here this is the most widely distributed taxon in the genus, and may contain more than one element worthy of specific rank. Typically the stems have few ribs made up of *large tubercles*, or they can be less tuberculate with *broadly rounded ribs*. In 1903 Schumann (in Gesamtb. Kakt. Nachtr. 82–3) referred Rodrigues's species to the synonymy of the poorly known *Echinocactus alteolens* (Lemaire ex Dietrich) Schumann, while treating *Discocactus* as a subgenus of the broadly circumscribed *Echinocactus*. In addition to *E. alteolens* and *E. placentiformis*, Schumann (l.c.) listed *E. hartmannii*, a distinctive plant from Paraguay described by him in 1900, and characterized by *numerous ribs* composed of *many small tubercles*, and by *short, weak spines*.

Britton & Rose (1922) accepted Schumann's three taxa, but recognized *D. heptacanthus* as a separate species. Rose had made collections in N. Bahia in 1914, and two new species were subsequently described, *D. zehntneri* and *D. bahiensis* B. & R. The first is a very distinctive taxon with *many interlacing spines* and *pinkish-red fruit*, but the second is perhaps only a northern, more spiny variety of *D. placentiformis*. The American authors listed seven taxa in total, including a third new species, *D. subnudus*, which was based solely on a photograph of a rather aberrant or damaged plant said to emanate from the coast of Bahia. It is not possible to suggest a definite relationship for this taxon.

In 1960 Backeberg described *D. paranaensis* from cultivated specimens thought to have originated in the southern Brazilian state of Paraná. This taxon seems to be known only from Backeberg's original illustration which I interpret as depicting a member of the *D. heptacanthus* complex. Three years later Backeberg added *D. boliviensis* from a remote locality in E. Bolivia. This plant was recollected by Horst *et al.* in 1974, and may also be referable to the *D. heptacanthus* complex.

1971 saw the first of a long series of new *Discocactus* taxa described by A. F. H. Buining, following his Brazilian expeditions and those of L. Horst (1966–74). These new descriptions culminated in Buining's book, 'The genus *Discocactus* Pfeiffer' (1980), and, together with a further seven taxa mostly christened while this book was in press, there have now been 32 'new species' published during the past decade. Of these only *D. horstii* is really distinctive and obviously deserving of specific rank.

It might have been expected that Buining's book would provide the justification for so many new entities, or a classification to make their identification practical. However, the order in which his microspecies are listed makes neither taxonomic nor geographic sense, and the two keys presented can scarcely be expected to distinguish such narrowly circumscribed taxa successfully.*

As in the case of the Brazilian Melocacti (cf. Taylor in CSJGB 42(3): 63–70. 1980) a more rational classification of *Discocactus* is now desirable, but the following key and checklist can be little more than the first step towards this goal. For the most part only names, dates and types have been listed, since other details are readily accessible in Buining's book, which includes valuable distribution maps (Buining, 1980).

I am grateful to the Gartenbauamt of Zürich, and to Mr J. D. Supthut, for the opportunity to study living and herbarium material at the Städtische Sukkulenten-Sammlung, Zürich, during February and March this year, when these notes were prepared.

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*An insight into Buining's botanical philosophy may be gained from the letter quoted in CSJGB 43(1): 24 (1981).

Provisional key to Discocactus

1. Fruit pinkish-red; spines >10 per areole, terete and acicular, mostly >20 mm. long, interwoven (N. Bahia)
   1. **D. zehntneri**
1. Fruit whitish, rarely pinkish, brownish or greenish; spines <10 per areole, or <20 mm. long, terete or flattened and mostly subulate, not interwoven though sometimes spreading over the adjacent rib:
   2. Stem to 7 cm. diam.; ribs 15–22, straight and high, of even width, not thickened at the areoles; spines appressed, to 7.5 mm. long, not or scarcely overhanging the broad and deep rib sinuses (Serro do Barao, N. Minas Gerais)
      2. **D. horstii**
   2. Stem >7 cm. diam.; ribs strongly tuberculate, or <16 and broadening towards base; spines various but mostly >10 mm. long, overhanging the shallow rib sinuses:
      3. Ribs 15–22, completely broken up into tubercles; spines <20 mm. long, to 1.5 mm. thick, terete (N. Paraguay and S. Mato Grosso) ..... 3. **D. hartmannii**
      3. Ribs 10–14, or if more then some spines >20 mm. long and >2 mm. thick, often ± flattened:
         4. Ribs rounded and mostly formed from large tubercles often with deep acute sinuses between adjacent areoles on the same rib (E. Bolivia, Mato Grosso, Goias, W. Minas Gerais & W. Bahia)
            4. **D. heptacanthus** complex
         4. Ribs ± acute-edged, not or only slightly tuberculate, without acute sinuses between adjacent areoles on the same rib (E. of Rio Sao Francisco in E. Minas Gerais & E. Bahia) ..... 5. **D. placentiformis**

Checklist of Discocactus names

The numbers in **bold** type refer to the species numbered in the key.

D. albispinus Buin. & Brederoo (1974). Type: *Horst* 390 (U, holo; ZSS!). See **1**.

D. alteolens Lemaire ex Dietrich (1846); ? sensu Buin. (1980). See **5**.

D. araneispinus Buin. & Brederoo ex Buin. (1980). Type: Horst 440 (U, holo; ZSS!). Cf. *D. boomianus*; see **1**.

D. bahiensis B. & R. (1922); Buin. (1980). Type: *Rose* 19783 (US); other collection: *Horst* 437 (U, ZSS!). See **5**.

D. besleri (Link & Otto) F. A. C. Weber (1896); *Melocactus besleri* Link & Otto (1827), nom. illegit.=*D. linkii*.

D. boliviensis Backeb. (1963); Buin. (1980). Type: *Uhlig* 2029 (? not preserved); other collection: *Horst* 457 (U, ZSS!). See **4**.

D. boomianus Buin. & Brederoo ex Buin. (1971). Type: *Horst* 222 (U, holo; ZSS!). See **1**.

D. cangaensis Diers & Esteves Pereira in CSJA 52(3): 107–111, with figs. (1980). Type: Brazil, S. Goias, 750 m, *Esteves* 79 (Succulentarium, PH Rheinland, Abt. Koln, W. Germany cited, but it is not known whether the holotype has been permanently conserved there). See **4**.

D. catingicola Buin. & Brederoo (1974). Type: *Horst* 392 (U). See **4**.

D. cephaliaciculosus Buin. & Brederoo (1975). Type: *Horst* 430/431 (U, holo; ZSS!). See **4**.

D. diersianus Esteves Pereira in CSJA 51(4): 179–83, with figs. (1979). Type: Brazil, SE. Goias, c. 650 m. *Esteves* 87 (Succulentarium, PH Rheinland, Abt. Koln, W. Germany cited, but it is not known whether the holotype has been permanently conserved there). See **4**.

D. estevesii Diers in CSJA 50(2): 83–85, 95, with figs. (1978). Type: Brazil, Goias, Paranaiba, 500–600 m., *Esteves* 2 (see above). See **4**.

D. ferricola Buin. & Brederoo (1975). Type: *Horst*-Uebelmann 195 (U, holo; ZSS!). A distinctive taxon; see **4**.

D. flavispinus Buin. & Brederoo ex Buin. (1980). Type: Horst 326A (U). See **4**.

D. goianus Diers & Esteves Pereira in KuaS 31(3): 73–9, with figs. (1980). Type: Brazil, S. Goias, c. 650–700 m., *Esteves* 10 (Succulentarium PH Rheinland, Abt. Koln, W. Germany cited, but it is not known whether the holotype has been permanently conserved there). Cf. *D. cephaliaciculosus*; see **4**.

D. griseus Buin. & Brederoo (1975). Type: *Horst* 343 (U). See **4**.

D. hartmannii (Schumann) B. & R. (1922); Esser in KuaS 21: 4–8 (1970); Buin. (1980); *Echinocactus hartmannii* Schumann in MDKG 10: 170 (1900) and Gesamtb. Kakt. Nachtr. 83–6 (1903). Type: Paraguay: c. 330 km. from Paraguari, meadows by Rio Capivary, *H. Grosse* (B†). The following from S. Mato Grosso are probably synonyms of this species: *D. patulifolius* Buin. & Brederoo, *D. mamillosus* Buin. & Brederoo and *D. magnimammus* Buin. & Brederoo and its ssp. *bonitoensis* Buin.

D. pachythele Buin. & Brederoo from a little further north links this species to the *D. heptacanthus* complex.

D. heptacanthus (Rodrigues) B. & R. (1922); Buin. (1980); *Malacocarpus heptacanthus* Rodrigues in Pl. Mato Grosso, 29, t. 11 (1898). Type: Brazil, Mato Grosso, Serra da Chapada, nr. Cuyabá, *Rodrigues* (not preserved according to B. & R.); other collection: *Horst* 326 (U, ZSS!). The following are not satisfactorily distinguished from the above: *D. boliviensis* Backeb. (E. Bolivia); *D. melanochlorus* Buin., *D. silvaticus* Buin., *D. semicampaniflorus* Buin. & Brederoo, *D. flavispinus* Buin., *D.silicicola* Buin. & Brederoo (all from Mato Grosso); *D. rapirhizus* Buin. & Brederoo, *D. squamibaccatus* Buin., *D. subterraneo-proliferans* Diers & Esteves Pereira, *D. estevesii* Diers, *D. diersianus* Esteves Pereira, *D. cangaensis* Diers & Esteves Pereira (all from Goais); *D. griseus* Buin. & Brederoo (W. Minas Gerais); *D. nigrisaetosus* Buin., *D. spinosior* Buin. and *D. catingicola* Buin. & Brederoo (all from W. Bahia). The poorly known *D. paranaensis* Backeb. (? from Parana) may also belong here. *D. cephaliaciculosus* Buin. & Brederoo (incl. *D. goianus* Diers & Esteves Pereira) from Goias, with a broad many-ribbed stem and prominent, well-spaced cephalium spines, is a distinctive taxon showing close affinity with the taxa considered here.

D. ferricola Buin. & Brederoo from E. Bolivia and adjacent W. Mato Grosso may be worthy of specific rank, since it differs from *D. heptacanthus* in its spiralled tubercles and long, spreading acicular spines. Field work is required to ascertain whether these are reliable differences.

D. heptacanthus is allied to *D. hartmannii* which occurs further to the south, and *D. pachythele* Buin. & Brederoo is seemingly equivocal between these taxa.

D. horstii Buin & Brederoo ex Buin. (1973). Type: *Horst* 360 (U, holo; ZSS!). Syn. *D. woutersianus* Brederoo & van de Broek.

A very distinct narrow endemic, from high elevation in the Serra do Barao, Minas Gerais.

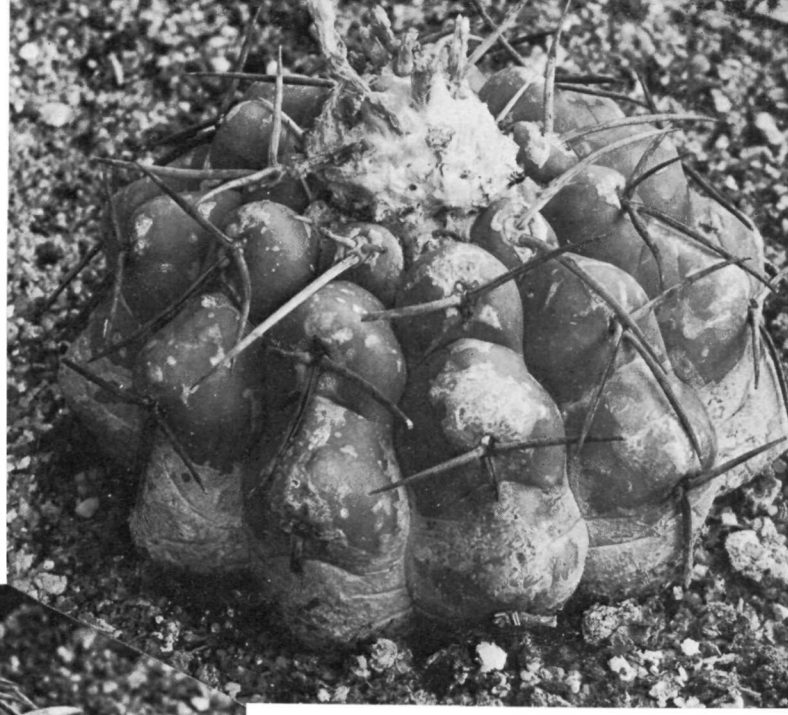
D. insignis Pfeiffer (1837). See **5**.

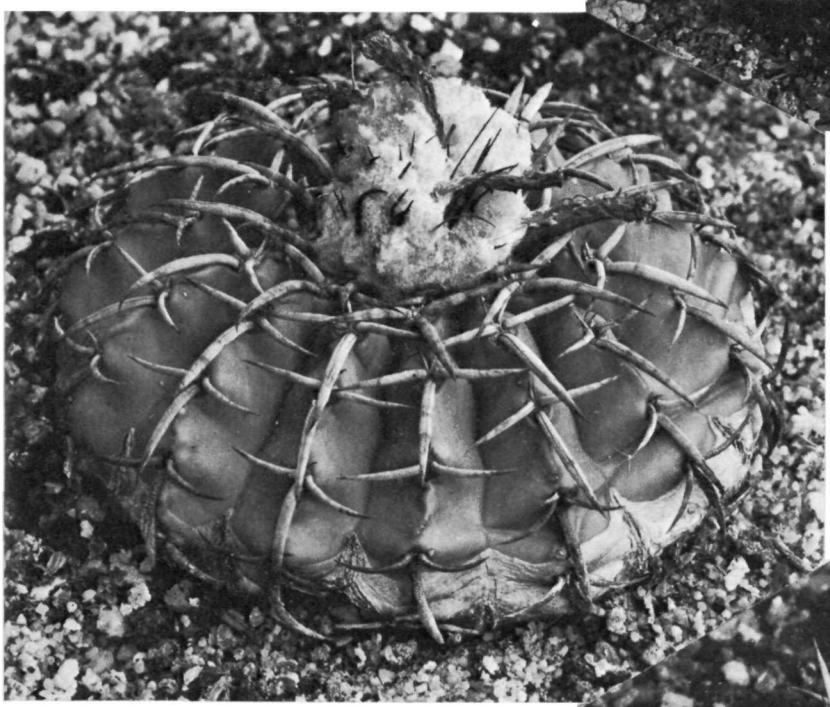
D. latispinus Buin. & Brederoo ex Buin. (1980). Type: *Horst* 146 (U, holo; ZSS!). See **5**.

D. lehmannii Pfeiffer (1839), nom. illegit.=**5**.

D. linkii Pfeiffer (1839); *Melocactus besleri* Link & Otto (1827), nom. illegit. See **5**.

D. heptacanthus: the westernmost habitat variant named D. boliviensis (HU457). Noted the very rounded ribs.





D. placentiformis: the form described as D. latispinus (Horst 146). Note the acute-edged ribs and flattened spines.

D. zehntneri, with many long interlaced terete spines. A very distinctive taxon from N. Bahia.

All photos of plants at the Zurich City Collection, by Adolf Wirth.

D. magnimammus Buin. & Brederoo (1974). Type: *Horst*-Uebelmann 324 (U); *D. magnimammus* ssp. *bonitoensis* Buin. & Brederoo ex Buin. (1980). Type: *Horst* 193 (U). See **3**.

D. mamillosus Buin. & Brederoo (1974). Type: *Horst*-Uebelmann 191 (U). See **3**.

D. melanochlorus Buin. & Brederoo ex Buin. (1980). Type: *Horst* 453 (U). See **4**.

D. multicolorispinus Braun & Brederoo in KuaS 32(3): 59, with figs. (1981). Type: Brazil, Minas Gerais, Serra do Espinhaco, W. part of Serra de Minas, near small village, 1000–1100 m. [collector?] (U), figured as *D. tricornis* in CSJA 51(1): 17, fig. 27 (1979). See **5**.

D. nigrisaetosus Buin. & Brederoo ex Buin. (1980). Type: *Horst* 448 (U, holo; ZSS!). See **4**.

D. pachythele Buin. & Brederoo (1975). Type: *Horst*-Uebelmann 198 (U). A connecting link between **3** and **4**.

D. paranaensis Backeb. (1960), nom. inval. (Art. 37). See **4**.

D. patulifolius Buin. & Brederoo (1974). Type: *Horst* 190 (U, holo; ZSS!). See **3**.

D. placentiformis (Lehm.) Schumann (1894); B. & R. (1922), fig. 233; Buin. (1980); *Cactus placentiformis* Lehm., Sem. hort. bot. Hamburg, 17 (1826), and in Nov. Act. Nat. Cur. 16(1): 318–19, t. 16 (1832); *D. lehmannii* Pfeiffer (1839), nom. illegit. Type: 'Brasilia meridionali'; see t. 16, loc. cit. The following from east of the Rio Sao Francisco are probably synonyms: *D. bahiensis* B. & R., *D. subviridigriseus* Buin. (both from N. Bahia); *D. pugionacanthus* Buin., *D. alteolens* sensu Buin. (1980), *D. latispinus* Buin., *D. pulvinicapitatus* Buin. and *D. multicolorispinus* Braun & Brederoo (all from Minas Gerais). The following older names may also belong here, but their typification is unsatisfactory: *D. alteolens* Lemaire ex Dietrich, *D. linkii* Pfeiffer (*D. besleri* (Link & Otto) F. A. C. Weber, nom. illegit.) and *D. tricornis* Monville ex Pfeiffer.

Under the name *D. insignis* Pfeiffer (which has been consistently referred to the synonymy of *D. placentiformis* by previous authors) Buining (1980) describes and illustrates a distinctive plant collected near the Rio Jequitinhonha in N. Minas Gerais (*Horst* 347 (U, ZSS!)). *D. insignis* can be typified only by Pfeiffer's illustrations (in Nov. Act. Nat. Cur. 19: suppl. 1, t. 15. 1839, and in Abbild. Beschr. Cact. 2(1): t. 1. (1845), and the wild origin of his material is unknown. *Horst* 347 is perhaps worthy of specific rank, but its recognition as *D. insignis* Pfeiffer can be questioned in view of the name's poor typification. It is interesting to note that *D. insignis* sensu Buining seems to be the only likely ally of the remarkable *D. horstii*, and furthermore they are found nearby in N. Minas Gerais.

D. pugionacanthus Buin. & Brederoo ex Buin. (1980). Type: *Horst* 462 (U). See **5**.

D. pulvinicapitatus Buin. & Brederoo ex Buin. (1980). Type: *Horst* 425 (U, holo; ZSS!). See **5**.

D. rapirhizus Buin. & Brederoo (1975). Type: *Horst* 200 (U). See **4**.

D. semicampaniflorus Buin. & Brederoo (1975). Type: *Horst*-Uebelmann 198A (U). See **4**.

D. silicicola Buin. & Brederoo (1957). Type: *Horst*-Uebelmann 325 (U). See **4**.

D. silvaticus Buin. & Brederoo ex Buin. (1980). Type: *Horst* 455 (U, holo; ZSS!). See **4**.

D. spinosior Buin. & Brederoo ex Buin. (1980). Type: *Horst* 205a (U, holo; ZSS!). See **4**.

D. squamibaccatus Buin. & Brederoo ex Buin. (1980). Type: *Horst* 428 (U). See **4**.

D. subnudus B. & R. (1922). Type: a photograph of a damaged plant. Affinity uncertain.

D. subterraneo-proliferans Diers & Esteves Pereira in KuaS 31(9): 266–71, with figs. (1980). Type: Brazil, W. Goias, central region of the valleys of the Araguaia, c. 200–250 m., *Esteves* 12 (Succulentarium, PH Rheinland, Abt. Koln, W. Germany cited, but it is not known whether the holotype has been permanently conserved there). See **4**.

D. subviridigriseus Buin. & Brederoo ex Buin. (1980). Type: *Horst* 438 (U, holo; ZSS!). See **5**.

D. tricornis Monville ex Pfeiffer (1850). See **5**.

D. woutersianus Brederoo & van de Broek in Succulenta 59(9): [197–] 198–203, with figs. (1980). Type: seedlings raised from wild material of *Horst* 360 (U)=**2**.

D. zehntneri B. & R. (1922). Type: *Zehntner s.n.* (US); other collection: *Horst* 441 (U, ZSS!). The following are probably only varieties: *D. boomianus* Buin., *D. albispinus* Buin. & Brederoo and *D. araneispinus* Buin. The above represent a very distinctive, densely-spined, red-fruited species restricted to N. Bahia.

POSTSCRIPT

Since this article went to press yet another 'new species' of *Discocactus* has been described: *D. lindaianus* Diers & Esteves Pereira in CSJA 53 (2): 56-60 with figs. (1981). Type: Brazil, E. to NE. Goias, 1100–1200 m, on broken scaly flat rocks, 1974, *Esteves Pereira* E-9 (Succulentarium, Univ. of Cologne, W. Germany—?permanently preserved). Allied with *D. cephaliaciculosus* according to Diers & Pereira; probably another synonym of *D. heptacanthus*.

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The Cactus and Succulent Journal of Great Britain
Volume 43 (2/3): 41-48 (1981)

Revised Classified List of the genus Mammillaria

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Introduction

This list supersedes my earlier version under the title 'Schumann and Buxbaum reconciled' (Hunt, 1971). It incorporates amendments made over the past decade and summarized for the most part in contributions to this journal (Hunt, 1977 & 1979), with some further minor changes which now seem desirable.

Above the level of species, the restriction of subg. *Dolichothele* to the *M. longimamma* Group as previously defined, plus *M. carretii*, seems to have both practical and theoretical advantages, though important data on one or two of the relevant species are still lacking. The species now excluded are *M. decipiens* and *M. camptotricha* (series *Decipientes* D. R. Hunt, 1979, here transferred to subg. *Mammillaria*), *M. beneckei* (including *M. guiengolensis*; subg. *Oehmea* (F. Buxb.) D. R. Hunt, 1977). *M. zephyranthoides* (series *Ancistracanthae* K. Schum.) and *M. kraehenbuehlii* (series *Sphacelatae* D. R. Hunt, 1977).

M. zephyranthoides is an equivocal species which was made the type of a subgenus (*Archiebnerella*) by Buxbaum and of the series *Zephyranthoides* Kuhn & Hofmann (1979). The groups defined by these authors, however, associate species which are relatively disparate in flower, fruit and seed characters, and to me it seems preferable to recognize several informal groups (mostly monotypic) within series *Ancistracanthae*. This is a temporary solution I also prefer for *M. guelzowiana* and *M. tetrancistra*, formerly assigned to the genus *Krainzia* Backeb. and hence to series *Longiflorae* in my 1971 list.

The relationship of *M. longiflora* itself, the type of *Krainzia* and series *Longiflorae*, to the remainder of that group is not proven, and Kuhn & Hofmann (in Kuhn, 1979) also suggest referring it to the *Ancistracanthae*. They ally the *M. saboae* and *M. napina* Groups not to *M. longiflora* but to *M. pectinifera* (genus *Solisia*), *M. solisioides* and *M. herrerae*, including all the species in a new series *Pectiniferae*. It is an interesting hypothesis not so far-fetched as might at first seem, but again it seems more prudent to recognize informal groups in the already established series until critical studies of e.g. fruit evolution demonstrate more unequivocally that the relationships of the various disjunct elements are natural and not due to convergence. Then the series concerned can be revised as a whole.

With the benefit of several brief periods of travel in Mexico, the development of a living study collection of documented living plants, and the help of many other specialists who have provided me with plants, photographs and ideas, I now feel able to blue-pencil more confidently and perhaps ruthlessly many of the species names to which in 1971 I gave the benefit of the doubt. The following list admits only 168 species (compared with 224 in the earlier version) despite the description of about 30 novelties in the interim. For the most part, the names affected are of taxa that I now consider to be geographical races or vicariants, for which the status of variety or subspecies might be appropriate. Others seem to be variants of a lower order, known from a single collection or population perhaps. Yet others I have discarded for lack of typification and uncertainty as to identity. In general, prior agreement on the species accepted has been reached by John Pilbeam and myself to avoid major discrepancies between my list and the system adopted in his book, *Mammillaria, A Collector's Guide*, being published this summer.

Where variety or forma status has already been formally proposed for vicariant taxa, the appropriate name is given in the list, e.g. *M. longimamma* var. *uberiformis*. Where reductions have yet to be made, the relevant species are included under the earliest-named of the complex with a suffix to the number, e.g. 10. *M. pondii* includes 10a. *M. maritima* and 10b. *M. setispina*. In some cases, further study of the grouping concerned is desirable to verify the facts of variation and distribution; in others it is necessary to determine what would be the correct epithet at the appropriate rank.

For reasons of space, no conspectus of the subgenera, sections and series is given here. A key to the whole genus is in preparation and will be published separately.

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Classified list of species

M. subgenus **Mammilloydia** (F. Buxb.) Moran in Gentes Herb. 8: 324 (1953); Hunt in CSJGB 39(2): 37 (1977).
Type species: *M. candida* Scheidw.

1. *M. candida*
   incl. *M. ortiz-rubiona*

M. subg. **Oehmea** (F. Buxb.) D. R. Hunt, l.c. 38.
Type species: *M. beneckei* Ehrenb.

2. *M. beneckei*
   incl. *M. aylostera, M. balsasensis, M. balsasoides, M. barkeri, M. colonensis, M. guiengolensis, M. nelsonii*

M. subg. **Dolichothele** K. Schum., Gesamt. Kakt., 474 (1898).
Type species: *M. longimamma* DC.

I now restrict this subgenus to the species having large or medium-sized yellow or yellowish flowers with the tube solid in the lower part (series *Longimammae*).

3. *M. longimamma*
   var. *longimamma*
   var. *uberiformis*
4. *M. sphaerica*
5. *M. melaleuca*
6. *M. baumii*
   incl. *M. radiaissima*
7. *M. carretii*
   incl. *M. saffordii*
8. *M. surculosa*
9. *M. heidiae*

M. subg. **Cochemiea** K. Brandegee in Erythea 5: 113 (1897).
Type species: *M. halei* Brandegee.

10. *M. pondii*
    incl. 10a. *M. maritima*
    10b. *M. setispina*
11. *M. halei*
12. *M. poselgeri*

M. subg. **Mamillopsis** (Morren ex B. & R.) Hunt, l.c. 39.
Type species: *M. senilis* Lodd.

13. *M. senilis*
    incl. 13a. *M. diguetii*

M. subg. **Mammillaria**
Section **Hydrochylus** K. Schum., l.c. 514.
Series I. **Longiflorae** Hunt in CSJGB 33: 59 (1971).
Type species: *M. longiflora* (B. & R.) Berger.

Flowers large (over 25 mm. long), salver-shaped or tubular-funnel-shaped, purplish-pink with a distinct tube; fruit partly to completely sunk in the body of the plant; plants mostly small and clustering; central spines rarely hooked (*M. longiflora*) usually straight or absent. 5 species, W. Mexico.

M. LONGIFLORA Group

14. *M. longiflora*
    f. *longiflora*
    f. *stampferi*

M. SABOAE Group (spp. 15, 16)

15. *M. saboae*
    var. *saboae*
    f. *saboae*
    f. *haudeana*
    var. *goldii*
16. *M. theresae*

M. NAPINA Group (spp. 17, 18)

17. *M. napina*
18. *M. deherdtiana*
    var. *deherdtiana*
    var. *dodsonii*

Series II. **Ancistracanthae** K. Schum., l.c. 517; Hunt in CSJGB. 33(3): 59 (1971) & 39(2): 39 (1977).
Lectotype species: *M. dioica* K. Brandegee.

Flowers mostly large, funnel-shaped, purplish-pink, creamy-yellow or white, the tube relatively short; fruit exserted; plants often slenderly columnar or cylindric and densely clustering with relatively stout, firm textured tubercles; one or more central spines typically hooked, but some species with straight-spined forms; seeds black. About 29 species, NW. Mexico and SW. United States (except no. 24).

M. TETRANCISTRA Group

19. *M. tetrancistra* (*M. phellosperma*)

M. GUELZOWIANA Group

20. *M. guelzowiana*

M. BARBATA GROUP (spp. 21–23)

21. *M. wrightii*
    var. *wrightii*
    f. *wrightii*
    f. *wolfii*
    var. *wilcoxii* (*M. meridiorosei*)
22. *M. viridiflora*
    incl. *M. chavezii, M. orestera*
23. *M. barbata*
    incl. *M. garessii, M. morricalii, M. santaclarensis*

M. ZEPHYRANTHOIDES Group

24. *M. zephyranthoides* (Cent. Mexico & Oaxaca)

M. MICROCARPA Group (spp. 25–38)

25. *M. mainiae*
26. *M. thornberi* (*M. fasciculata* auctt.)
27. *M. yaquensis*
28. *M. fraileana*
    incl. ? 28a. *M. slevinii*
29. *M. occidentalis*
30. *M. mazatlanensis*
    incl. 30a. *M. patonii*
31. *M. sheldonii*
    incl. *M. alamensis, M. gueldemanniana, M. guirocobensis, M. pseudoalamensis*

32. *M. microcarpa*
33. *M. grahamii*
incl. *M. marnierana, M. oliviae*
34. *M. insularis*
35. *M. boolii*
36. *M. schumannii*
37. *M. blossfeldiana*
incl. *M. shurliana*
38. *M. goodridgii*
incl. 38a. *M. hutchisoniana (M. bullardiana)*
38b. *M. louisiae*

M. DIOICA Group (spp. 39–47)

39. *M. swinglei*
incl. *M. inaiae*
40. *M. multidigitata*
41. *M. capensis*
42. *M. armillata*
incl. 42a. *M. cerralboa*
43. *M. phitauiana*
44. *M. dioica*
45. *M. angelensis*
incl. 45a. *M. estebanensis*
46. *M. albicans*
47. *M. neopalmeri*

Series III. **Stylothelae** (Pfeiff.) K. Schum., l.c. 516; Hunt, l.c. 61 (1971) & 39(3): 71 (1977).
Lectotype species: *M. wildii* A. Dietr.

Flowers mostly small (less than 20 mm. long), campanulate-funnel-shaped, purplish-pink, creamy-yellow or white, the tube short; plants often globose or shortly cylindric and densely clustering with relatively thin soft-textured tubercles; one or more central spines hooked; seeds black or rarely brown. About 23 species, Cent. Mexico.

M. BOMBYCINA Group (spp. 48–60)

48. *M. fittkaui*
49. *M. zeilmanniana*
incl. 49a. *M. guillauminiana*
50. *M. bombycina*
51. *M. moellerana*
incl. *M. cowperae, M. boedekerana* (?), *M. seideliana* (?)
52. *M. pennispinosa*
var. *pennispinosa*
var. *nazasensis*
53. *M. sinistrohamata*
54. *M. mercadensis*
55. *M. jaliscana*
incl. *M. fuscohamata*
56. *M. zacatecasensis*
57. *M. rettigiana*
incl. *M. flavihamata, M. gilensis, M. posseltiana*
58. *M. weingartiana*
incl. *M. unihamata*
59. *M. stella-de-tacubaya*
incl. *M. gasserana*
60. *M. mathildae*

M.WILDII Group (spp. 61–70)

61. *M. erythrosperma*
incl. *M. multiformis, M. scheidweilerana*
62. *M. bocasana*
incl. 63a. *M. longicoma*
M. hirsuta, M. kunzeana Hort.
63. *M. aurihamata*
incl. *M. aureoviridis, M. erectohamata* (?)
64. *M. leucantha*
incl. *M. haehneliana, M. knebeliana, M. sanluisensis* Hort. non Shurly
65. *M. nana*
incl. *M. eschanzieri* (?), *M. monancistracantha, M. trichacantha* (?)
66. *M. pygmaea*
incl. 66a. *M. pubispina, M. cadereytana, M. mollihamata*
67. *M. painteri*
68. *M. wildii*
incl. *M. calleana, M. criniformis, M. crinita, M. glochidiata*
The newly described *M. anniana* Glass & Foster probably belongs to this group.

M. OTEROI Group

69. *M. oteroi*

M. GLASSII Group

70. *M. glassii*
var. *glassii*
var. *ascensionis*

Series IV. **Proliferae** Hunt in CSJGB 39(3): 73 (1977).
Type species: *M. prolifera* (Mill.) Haw.

Flowers mostly small, campanulate-funnel-shaped, creamy white, short-tubed; plants low-growing, usually freely clustering with straight central spines grading into the radials and the outermost radials hair-like; rarely central spines lacking (*M. gracilis* var. *pulchella*), seeds black. About 7 species, NE. Mexico, one (*M. prolifera*) extending to Texas and W. Indies and reported from Colombia.

M. PROLIFERA Group (spp. 71–75)

71. *M. schwarzii*
72. *M. prolifera*
var. *prolifera*
var. *arachnoidea*
var. *haitiensis*
var. *texana* (*M. multiceps*)
73. *M. pilispina*
incl. *M. sanluisensis* Shurly, *M. subtilis*
74. *M. albicoma*
75. *M. picta*
incl. 75a. *M. viereckii*
M. aurisaeta, M. schieliana

M. GRACILIS Group (spp. 76, 77)

76. *M. vetula*
incl. *M. kuentziana, M. magneticola*

77. *M. gracilis*
incl. *M. fragilis, M. gracilis* var. *pulchella*

Series V. **Lasiacanthae** Hunt in CSJGB 33(3): 63 (1971), l.c. 41(4): 101 (1979).
Type species: *M. lasiacantha* Engelm.

Flowers medium-sized or small, rarely exceeding 2 cm. long, mostly pale pinkish, yellowish or white, rarely purple or purplish-pink; central spines usually absent, rarely present and numerous but grading into the radials (*M. laui* f. *subducta*); radials very numerous; plants mostly depressed globose and clustering, the cylindric-terete tubercles completely or nearly hidden by the spines; seeds black. About 12 species, E. Cent. Mexico.

As already noted (Hunt, 1979), this series is a mixed bag. The five small groups recognized are united more by spination than by flower, fruit and seed characters.

M. LASIACANTHA Group (spp. 78, 79)
78. *M. lasiacantha*
incl. *M. denudata, M. egregia* (?), *M. estanzuelensis*
79. *M. magallanii*
incl. *M. lengdoblerana, M. neobertrandiana* (?), *M. roseocentra*

M. SCHIEDEANA Group (spp. 80–82)
80. *M. plumosa*
81. *M. carmenae*
82. *M. schiedeana*
incl. 82a. *M. dumetorum*

M. HUMBOLDTII Group (spp. 83, 84)
83. *M. humboldtii*
84. *M. laui*
f. *laui*
f. *dasyacantha*
f. *subducta*

M. LENTA Group (spp. 85–87)
85. *M. lenta*
86. *M. aureilanata*
87. *M. herrerae*

M. PECTINIFERA Group (spp. 88, 89)
88. *M. pectinifera*
89. *M. solisioides*

Series VI. **Sphacelatae** Hunt in CSJGB 39(3): 73 (1977).
Type species: *M. sphacelata* Mart.

Flowers medium-sized or small, narrowly funnel-shaped, purplish; central spines straight (one hooked in *M. tonalensis*), similar to the radials; plants slender-stemmed and caespitose with short blunt tubercles; seeds black. 3 species in S. Cent. Mexico.

M. SPHACELATA Group (spp. 90–92)
90. *M. kraehenbuehlii*
91. *M. sphacelata*
var. *sphacelata*
var. *viperina*
92. *M. tonalensis*

Series VII. **Leptocladodae** (Lem.) K. Schum., l.c. 515.
Type species: *M. elongata* DC.

Flowers small, campanulate, creamy-yellow or purplish; central spines straight or absent; plants slender-stemmed; densely clustering or cylindric; seeds brown. 4 species, Cent. & N. Mexico.

M. POTTSII Group
93. *M. pottsii* (*M. leona*)

M. ELONGATA Group (spp. 94–96)
94. *M. elongata*
incl. *M. echinaria*
95. *M. microhelia*
incl. *M. droegeana* Hort., *M. microheliopsis*
96. *M. densispina*
incl. *M. mieheana*

Series VIII. **Decipientes** Hunt in CSJGB 41(4): 95 (1979) (under subg. *Dolichothele*).

Flowers small, whitish, campanulate-funnel-shaped; central spine straight or absent, radials 10 or fewer; plants globose-stemmed and densely clustering with elongate-terete tubercles; seeds brown. Probably only one variable species, E. Cent. Mexico.

The well-named *M. decipiens* ('deceptive') and its vicariant *M. camptotricha* resemble several other groups: subg. *Dolichothele* in the long tubercles, few spines and greenish fruits, series *Stylothelae* in the flowers and series *Leptocladodae* in the seeds. If *Dolichothele* is restricted to series *Longimammae*, the seed characters argue that ser. *Decipientes* should go at the end of sect. *Hydrochylus*, with ser. *Leptocladodae*, rather than after ser. *Stylothelae*. It is of interest in this connection that the only inter-series hybrid (known to me, at least) is that between *M. decipiens* and *M. elongata* (*M.* x *kuentzii*).

M. DECIPIENS Group
97. *M. decipiens*
incl. 97a. *M. camptotricha*
M. albescens

Section **Subhydrochylus** Backeb. ex Hunt in CSJGB 39(3): 74 (1977).
Type species *M. guerreronis* (Bravo) Boed.
Series IX. **Heterochlorae** (Salm-Dyck) K. Schum., l.c. 517; Hunt in CSJGB 33(3): 65 (1971) & 39(3): 74 (1977).
Lectotype species: *M. discolor* Haw.

Flowers small, campanulate, purplish-pink or creamy-yellow; fruits greenish, maroon or purplish, maturing during the winter after flowering; central and radial spines sharply differentiated by colour and thickness, or radials reduced to bristles or absent; central spines not hooked, radials not lending the whole plant a white appearance; plants depressed globose to stoutly columnar, mostly erect, solitary. About 4 variable species, Cent. Mexico (N. of Volcanic Belt).

M. RHODANTHA Group
98. *M. rhodantha*
incl. 98a. *M. fera-rubra*
98b. *M. mollendorffiana*

98c. *M. aureiceps*
98d. *M. pringlei*
M. calacantha, M. fuscata, M. mundtii Hort., *M. parensis*

M. POLYTHELE Group

99. *M. polythele*
incl. 99a. *M. kewensis*
99b. *M. durispina*
99c. *M. obconella*
M. dolichocentra, M. hidalgensis, M. hoffmanniana, M. ingens, M. kellerana, M. neophaeacantha, M. subdurispina, M. tetracantha

M. DISCOLOR Group (spp. 100, 101)

100. *M. wiesingeri*
incl. 100a. *M. erectacantha* Hort.

101. *M. discolor*
incl. 101a. *M. esperanzaensis*
101b. *M. schmollii*
M. amoena Hort., *M. bonavitii, M. ochoterenae, M. pachyrhiza*

Series X. **Polyacanthae** (Salm-Dyck) K. Schum. l.c. 516; Hunt in CSJGB 33(3): 65 (1971) & 39(3): 74 (1977). Type species: *M. spinosissima.*

Flowers very small (less than 10 mm. long), to medium-sized, deep red or purplish-red or rarely pale yellow; fruits green, maroon or purplish, maturing during the year after flowering; spines usually numerous; central spines straight or one or more hooked, radials rarely lending the whole plant a white appearance (*M. guerreronis*); plants slenderly to stoutly cylindric, erect or pendent often clustering from the base. About 11 species, Cent. Mexico (S. of Volcanic Belt).

M. SPINOSISSIMA Group (spp. 102–105)

102. *M. backebergiana* (*M. fertilis* Hort.)
incl. *M. ernestii*

103. *M. meyranii*

104. *M. matudae*

105. *M. spinosissima*
incl. 105a. *M. pilcayensis*
M. auricoma, M. centraliplumosa, M. flava, M. virginis

M. NUNEZII Group (spp. 106–111)

106. *M. nunezii*
incl. 106a. *M. bella* (*M. deliusiana*)
M. gasterantha, M. solisii, M. wuthenauiana

107. *M. guerreronis*
incl. *M. zapilotensis*

108. *M. rekoi*
incl. *M. mitlensis, M. pseudorekoi, M. pullihamata, M. rekoiana*

109. *M. duoformis*
incl. *M. erythrocalix, M. hamata* Hort., *M. heeriana* Hort.

110. *M. magnifica*

111. *M. xaltianguensis*

M. ERIACANTHA Group

112. *M. eriacantha*

Series XI. **Supertextae** Hunt in CSJGB 39(4): 98 (1977). Type species: *M. supertexta* Mart.

Flowers small or very small, usually purplish, rarely yellowish-pink; fruits bright red; central spines straight, curved or absent, radials usually obscuring the stem and giving the whole a white or rarely yellowish or brownish appearance; plants shortly cylindric to stoutly columnar, often clustering, tubercles relatively small. About 7 closely related species, S. Mexico, one extending to Jamaica, Colombia and Venezuela.

M. SUPERTEXTA Group (spp. 113–119)

113. *M. haageana*
var. *haageana*
incl. *M. albidula, M. collina, M. conspicua, M. dealbata, M. donatii, M. dyckiana, M. elegans* Hort., *M. vaupelii*
var. *schmollii* (*M. meissneri* Hort.)

114. *M. supertexta*
incl. *M. lanata, M. martinezii*

115. *M. crucigera* (*M. buchenaui*)

116. *M. huitzilopochtli*

117. *M. dixanthocentron* (*Neom. celsiana* sensu B. & R.)
incl. *M. flavicentra*

118. *M. albilanata*
incl. 118a. *M. fuauxiana*
118b. *M. reppenhagenii*
118c. *M. tegelbergiana*

119. *M. columbiana*
incl. 119a. *M. ruestii*
119b. *M. yucatanensis*
M. bogotensis, M. graessnerana, M. hennisii, M. soehlemannii, M. tamayonis

Section **Mammillaria** *(Galactochylus)*

Series XII. **Leucocephalae** (Lem.) K. Schum., l.c. 561; Hunt in CSJGB 33(3): 67 (1971) & 39(4): 99 (1977). Type species: *M. parkinsonii* Ehrenb.

Flowers small, purple, pink or whitish; central spines straight or curved, radials often numerous, white, giving the whole plant a white appearance, in one species (*M. sempervivi*), reduced or commonly absent; axillary bristles often conspicuous; plants depressed globose with small tubercles, often branching dichotomously to form mounds. About 9 species in E. and NE. Cent. Mexico.

M. GEMINISPINA Group (spp. 120–125)

120. *M. geminispina*
incl. *M. leucocentra* (?)

121. *M. perbella*
incl. *M. 'aljibensis', M. avila-camachoi, M. caderey-tensis, M. infernillensis, M. queretarica, M. pseudoperbella, M. tiegeliana, M. vonwyssiana*

122. *M. hahniana*
incl. *M. brauneana* Hort., *M. bravoae, M. mendeliana, M. saetigera, M. woodsii*

123. *M. klissingiana*

124. *M. muehlenpfordtii* (*M. neopotosina*)

125. *M. parkinsonii*
incl. *M. auriareolis, M. morganiana, M. rosensis*
M. SEMPERVIVI Group (spp. 126–128)
126. *M. chionocephala*
incl. *M. caerulea, M. ritterana*
127. *M. formosa*
incl. *M. microthele*
128. *M. sempervivi*
incl. 128a. *M. pseudocrucigera*

Series XIII. **Macrothelae** (Salm-Dyck) K. Schum., l.c. 561; Hunt in CSJGB 33(3): 67 (1971) & 39(4): 100 (1977).
Type species (as of the genus): *M. mammillaris* (L.) Karsten.

Flowers medium-sized, often broadly campanulate, purplish, creamy-yellow or white, rarely bright yellow (*M. marksiana*); spines usually relatively few, these often strong, not obsuring the body, centrals straight or curved, very rarely hooked (*M. uncinata*); axillary bristles usually absent or inconspicuous; plants depressed globose to clavate-cylindric mostly with large gibbous or pyramidal tubercles, commonly offsetting freely to form mounds, or else solitary, massive. About 36 species, N. and Cent. Mexico, extending into the SW. United States, W. Indies and N. South America.

M. MAMMILLARIS Group (spp. 129, 130)
129. *M. mammillaris (M. simplex)*
incl. *M. ekmanii* (?), *M. glomerata* (?), *M. pseudosimplex*
130. *M. nivosa*
incl. *M. flavescens* (?)
M. HEYDERI Group (spp. 131–136)
131. *M. heyderi*
incl. 131a. *M. gaumeri*
131b. *M. hemisphaerica*
131c. *M. gummifera*
131d. *M. meiacantha*
M. applanata, M. macdougalii
132. *M. grusonii*
incl. *M. mexicensis, M. pachycylindrica*
133. *M. zeyerana*
incl. *M. wagnerana* (?)
134. *M. coahuilensis*
incl. 134a. *M. albiarmata*
135. *M. melanocentra*
incl. *M. euthele*
136. *M. uncinata*
incl. *M. lloydii*
M. PETTERSSONII Group (spp. 137–139)
137. *M. rubrograndis*
138. *M. petterssonii*
incl. *M. hamiton-hoytea, M. obscura, M. ocotillensis, M. pilensis, M. saint-pieana*
139. *M. gigantea*
incl. *M. armatissima, M. hastifera*
M. STANDLEYI Group (spp. 140–145)
140. *M. standleyi*
141. *M. hertrichiana*
142. *M. lindsayi*
143. *M. canelensis*
incl. *M. auricantha, M. auritricha, M. bellacantha, M. floresii, M. laneusumma, M. mayensis, M. montensis, M. xanthina* (?)
144. *M. miegiana*
145. *M. tayloriorum*
M. SONORENSIS Group (spp. 146–150)
146. *M. sonorensis*
incl. *M. bellisiana, M. tesopacensis*
147. *M. bocensis*
incl. *M. neoschwarzeana, M. ortegae* (?), *M. rubida*
148. *M. marksiana*
149. *M. craigii*
incl. *M. movensis* (?)
150. *M. scrippsiana*
incl. *M. pseudoscrippsiana*
M. COMPRESSA Group
151. *M. compressa*
incl. *M. seitziana* Hort., *M. tolimensis*
M. MAGNIMAMMA Group (spp. 152–154)
152. *M. winterae*
incl. *M. zahniana*
153. *M. roseoalba*
incl. *M. melispina*
154. *M. magnimamma*
incl. 154a. *M. vagaspina*
M. bucareliensis, M. centricirrha, M. flavovirens, M. macracantha, M. zuccariniana
M. BRANDEGEI Group
155. *M. brandegei*
incl. 155a. *M. glareosa (M. dawsonii)*
M. gabbii, M. lewisiana
M. PETROPHILA Group (spp. 156–159)
156. *M. peninsularis*
157. *M. baxterana*
incl. 157a. *M. marshalliana*
M. arida (?), *M. gatesii, M. pacifica*
158. *M. petrophila*
159. *M. evermanniana*
160. *M. johnstonii*

Series XIV. **Polyedrae** (Pfeiff.) K. Schum., l.c. 563; Hunt in CSJGB 33(3): 70 (1971) & 39(4): 100 (1977).
Type species: *M. polyedra* Mart.

Flowers medium-sized, usually creamy-yellow with reddish outer segments, otherwise pink or purplish; spines usually few, often unequal or radials absent, axillary bristles more or less conspicuous (absent in *M. carnea*); plants globose to short columnar with medium-sized, conic, often angled tubercles, often offsetting or dichotomizing to form clumps, rarely solitary. About 8 species in S. Mexico, one species extending to Guatemala *(M. voburnensis)*.

M. KARWINSKIANA Group (spp. 160–162)
161. *M. knippeliana*

162. *M. karwinskiana*
incl. 162a. *M. nejapensis*
M. confusa, M. conzattii, M. ebenacantha, M. neomystax
163. *M. voburnensis*
incl. 163a. *M. collinsii*
163b. *M. eichlamii*
163c. *M. beiselii*
M. esserana, M. jozef-bergeri, M. strobilina, M. praelii
M. POLYEDRA Group (spp. 164, 165)
164. *M. polyedra*
165. *M. carnea*
incl. *M. orcuttii* Boed.
M. MYSTAX Group (spp. 166–168)
166. *M. sartorii (M. tenampensis)*
167. *M. mystax*
incl. 167a. *M. casoi*
167b. *M. huajuapensis*
M. atroflorens, M. crispiseta, M. mixtecensis, M. multiseta.
168. *M. varieaculeata*

INDEX

Accepted species are in Roman type, vicariants and synonyms in italic. A few historic names used by R. T. Craig (Mammillaria Handbook, 1945) but discarded by the present author as their correct application is uncertain are not included in the classified list but indexed here as 'dub.' (*nomina dubia*).

The Cactus and Succulent Journal of Great Britain
Volume 43(2/3): 49-60 (1981)

A commentary on Copiapoa

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Introduction

During the past thirty years most new literature on the systematics of the N. Chilean genus *Copiapoa*, amounting to over 150 printed pages, has resulted from the activities of three men: P. C. Hutchison (1953), F. Ritter (1959, 1960, 1961, 1963, 1980) and C. Backeberg (1959, 1962).

Hutchison (l.c.) wrote detailed, well illustrated accounts of two species he had studied in the field between 1952–53. His work should be consulted by anyone desiring a basic knowledge of the ecology and gross morphology of *Copiapoa*. Hutchison's discussion of geographical and general variability in *C. cinerea* gave clear guidelines to would-be describers of new *Copiapoa* species. However, his very rational views were not shared by the two other authors mentioned above.

Ritter, after spending many fruitful years in the field, has now described no less than 36 new species. His most recent work, cited above, contains useful descriptive and distributional information, but far too many ill-defined taxa. However, he does provide an arrangement of species into informal sections which, by and large, seems to make sense. I have followed his sectional groupings in the key to the distribution map (p. 60), but his book should be consulted for details of their circumscription.

Backeberg has done little to improve our understanding of *Copiapoa*. Volume 3 of 'Die Cactaceae' is particularly misleading, containing numerous errors of identification and various improper and unnecessary names. Ritter (1980) has already pointed out many of the faults in Backeberg's writings on the genus, which are best consulted with due caution.

The present account is primarily intended to list the taxa that have been named to date, and summarize their most important data and references; the reader is referred to Ritter (1980) for their descriptions. An attempt has been made to group together the most narrowly defined of Ritter's microspecies and indicate their probable synonymy. Only in the case of *C. cinerea* do we have a slightly better understanding of geographic and ecological variation, which permits the establishment of five varieties in this species (one requiring a new combination: *C. cinerea* var. *haseltoniana*). Otherwise considerable further field study—by someone with a synthetic approach to the problem—is necessary if a key is to be constructed and proper species-limits established.

The typification of old Copiapoa epithets

About 15 binomials were published prior to 1890 which have since been considered, by various authors, to belong in *Copiapoa*. Excepting the three species described by Philippi in 1860, it seems likely that most, if not all, of the names that can still be identified, were based on plants collected by the Englishman Thomas Bridges (1807–65), who spent a considerable part of the period 1828 to c. 1851 working in Chile (cf. Pfeiffer, 1847; Johnston, 1928). Bridges made a number of plant-collecting trips in different parts of Chile, but a study of his itinerary suggests that only one of these, in the latter half of 1841, concerns us here.

The extent of our knowledge of Bridges's travels between July and the end of 1841 has been recorded by Johnston (l.c.), who lists the following relevant localities in their probable chronological order: Port of Copiapo (Puerto Viejo), Copiapo, Chañarcillo, Totoral, Los Pozos*, Vallenar, Freirina, Huasco (all in Prov. Atacama); Coquimbo, Valle Elqui, Vicuna, etc. (Prov. Coquimbo). Early the following year Bridges intended to return to Valparaiso, from where presumably he would have despatched any cacti he had found to interested persons in Europe: probably to Salm-Dyck, Schelhase, Pfeiffer and W. J. Hooker. Pfeiffer's reference (l.c.) to Valparaiso as the locality of his *E. columnaris* is perhaps another example of a not infrequent mistake made by early describers of cacti: that of giving the port or town of despatch, rather than the actual place of wild origin.

Bridges's only other recorded excursions to N. Chile seem both to have been in 1844, when he twice landed at the little port of Cobija, located between Antofagasta and Tocopilla, in Prov. Antofagasta (then part of Bolivia), before making his way inland. Only the recently discovered *Copiapoa tocopillana* is known from this part of Chile. Therefore, on the evidence available

*It is possible that this is not the same place as appears on most maps SE. of Chañaral. In Bridges's catalogue (at BM) of his 1841 collections there are no other references to localities north of the valley of Copiapo, and he gives the name in double quotation marks, perhaps indicating that he only heard it said, or was uncertain about it. The catalogue is no longer intact having suffered slight damage in a fire during World War II. Unfortunately, the vital end of Bridges's sentence stating the position of 'Los Pozos' is missing. There are two other, smaller places with this name S. of the Rio Limari, Prov. Coquimbo.

Studying the catalogue one wonders how Johnston (l.c., 103) deduced the probable chronological sequence of Bridges's localities, for it seems that the latter's numbering system was anything but chronological. However, Johnston may have gained some clues from the phenological data recorded in the catalogue.

we should try to apply names such as *Echinocactus bolivianus, E. bridgesii, E. columnaris* (all of Pfeiffer), *E. echinoides, E. malletianus* (both Salm-Dyck) and *E. streptocaulon* Hook., to plants that grow in the Provinces of Atacama and Coquimbo, and not to those from Prov. Antofagasta as Britton & Rose, Backeberg, Lembcke and Ritter have done. Pfeiffer's references to Bolivia are doubtless also in error, though whether Bridges or he is to blame we will probably never know.

A decade after Bridges, R. A. Philippi made a long journey through the Atacama Desert during 1853–54. Subsequently, he based three names on plants from Prov. Antofagasta which have since been taken up in *Copiapoa*. Two of these comprise the well-known *C. cinerea* and *C. humilis* (cf. Hutchison, 1953); the third is discussed below.

Of the older names as defined here, the following have been used recently and merit individual mention; none are known to have extant holotypes:

C. marginata; Echinocactus marginatus Salm-Dyck (1845). The original description on its own is insufficient to permit reliable identification of this name, but its application can be clarified so long as *E. columnaris* Pfeiffer (1847), illustrated in Pfeiffer (1850), is considered to be the same. Its rediscovery by Ritter in 1956, at Morro Copiapo, SW. of Caldera (Prov. Atacama) may be within the area traversed by Bridges in 1841. In the past *C. marginata* has been used in a different sense by Britton & Rose and Ritter (see Checklist). *C. streptocaulon* based on *E. streptocaulon* Hook. (1851) clearly must be a synonym of *C. marginata* as applied here.

C. echinoides; *Echinocactus echinoides* Salm-Dyck (1845). Ritter (1980) has rejected this name, and Britton & Rose (1922) remark 'we know the plant only from descriptions and illustrations'. However, the fine illustration in Pfeiffer (1850) and our knowledge of Bridges's activities leads me to suggest an identity for *E. echinoides*. One of the localities visited by Bridges was Totoral, and Ritter has described *C. dura* from east of this tiny settlement, which matches the descriptions of Salm-Dyck and Pfeiffer, and the latter's illustration, fairly well. Backeberg (1959), who was followed by Lembcke, has applied *C. echinoides* to a plant growing a little to the south of the town of Antofagasta, but, as already discussed, we have no evidence to suggest that Bridges visited this area.

C. boliviana; *Echinocactus bolivianus* Pfeiffer (1847). Known only from its original brief description, and in any case reduced to synonymy under *E. echinoides* in 1850 by Pfeiffer himself. However, Ritter, rather unwisely, has resurrected this name and used it for the plant from near Antofagasta mentioned above. A name of no value.

C. bridgesii; *Echinocactus bridgesii* Pfeiffer (1847), with tab. Ritter has applied this name to a very distinctive plant found near the northern limit of the region traversed by Bridges. However, while the remarkable cephalium-like development of wool at the stem apex, mentioned by Pfeiffer, is matched in the Ritter plant, it is otherwise rather tall-growing, and seldom globose or conical as Pfeiffer's description and figure requires. For the time being it seems best to allow this questionable identification to stand, since there is no other name currently available for what is an unmistakable and beautiful species.

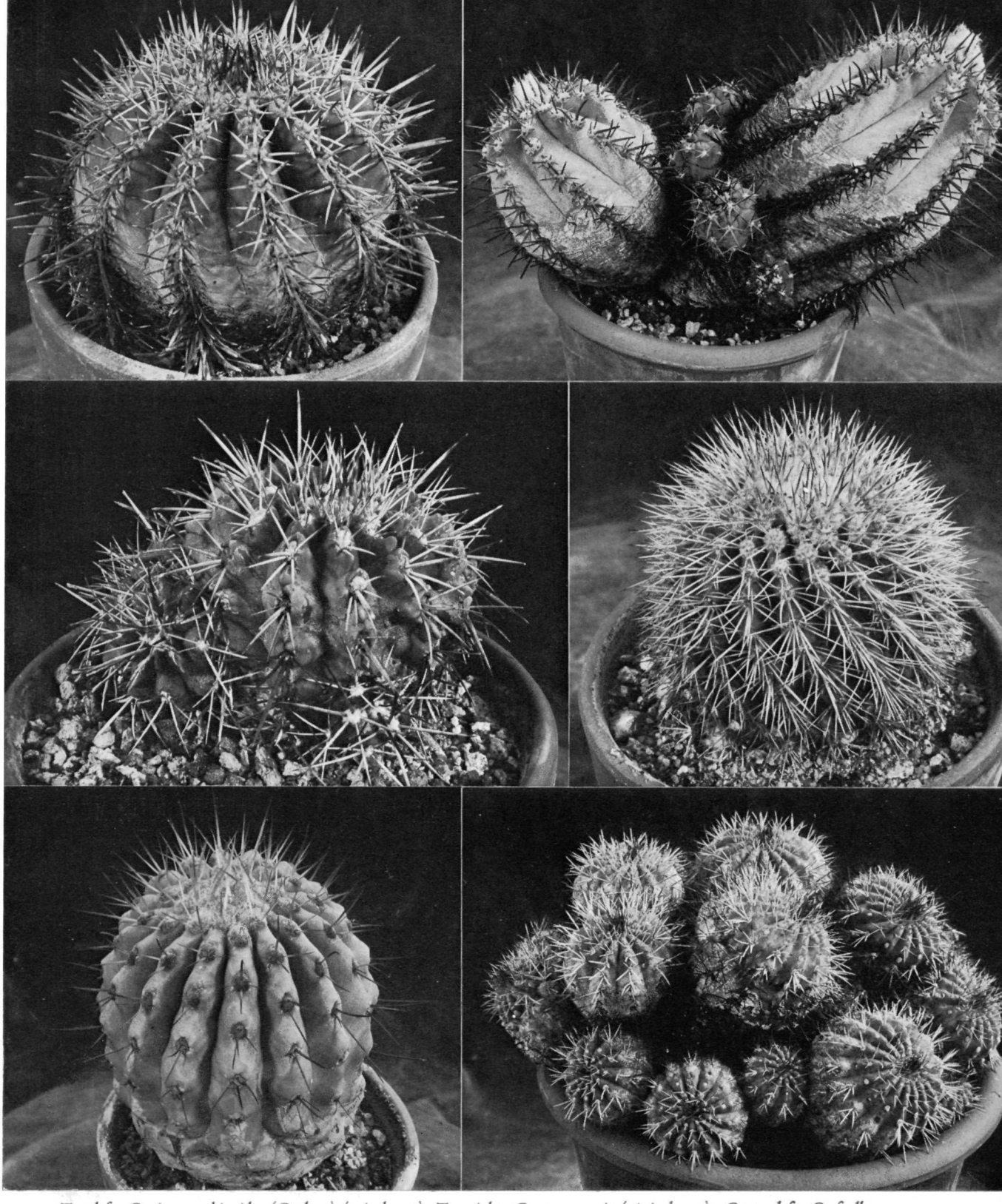
C. cinerascens; *Echinocactus cinerascens* Salm-Dyck (1845); *?E. copiapensis* Pfeiffer (1847). Of the old names accepted here *E. cinerascens* is the most uncertain as to type, since we have only Salm-Dyck's description and cited locality of 'Copiapo' to help in its typification. Ritter (1980) uses it for a plant growing north of Chañaral, which is somewhat north of the region we know Bridges to have visited, though within Dept. Copiapo. Despite some misgivings I am following Ritter's identification because there is no real discrepancy between Salm-Dyck's description and Ritter's plant, nor is there an alternative name for it (save for the equally poorly typified *C. applanata* Backeb.).

C. malletiana; *Echinocactus malletianus* Salm-Dyck (1845). Although there is no illustration to clarify the application of this name, the original description could well relate to one of the varieties of *C. cinerea*, such as var. *dealbata* which grows within the area traversed by Bridges. *E. malletiana* is best treated as an inadequately typified name and ignored, otherwise the well-known *C. cinerea* (*E. cinereus* Philippi, 1860) will be at risk of being lost in its synonymy.

E. conglomeratus Philippi (1860) has been applied to the distinctive *C. solaris* (Ritter, 1961) by Lembcke in KuaS 17: 29–30 (1966) and in Aloe 17: 13 (1979). Philippi's type locality is precise, and correct for *C. solaris*, while his epithet is also very appropriate. However, in the absence of a type specimen or illustration, only the original description can typify the name, and here it is clear that Philippi must have confused his materials, for the description bears no relation to the plant at his locality. Lembcke's use of *C. conglomerata* is thus illegitimate, since his circumscription effectively excludes Philippi's type, as determined by the latter's original description. *E. conglomerata* as to description cannot be positively identified, at least while the holotype remains unknown.

C. cupreata; *Echinocactus cupreatus* Poselger ex Hildmann (1885); and *C. coquimbana*; *E. coquimbana* Karw. ex Ruempler (1885). Both known only from very brief descriptions. The former suggests a form of *C. fiedlerana* (*E. fiedleranus* Schumann, 1903) collected by Knize (no. 21, as '*C. cuprea*'), but is too poorly typified to upset the younger Schumann epithet, while the latter could well apply to either of two plants recorded by Ritter in the vicinity of Coquimbo and the Rio Elqui. Both names are best abandoned.

C. pepiniana Backeb. (1935); Backeb. (1959). Backeberg's first publication of this name was a combination



Top left: Copiapoa echinoides (C. dura) (5 inch pot). Top right: C. atacamensis (4½ inch pot). Centre left: C. fiedlerana. Centre right: C. serpentisulcata (3½ inch pot). Bottom left: C. cinerea var. haseltoniana (4 inch pot). Bottom right: 'C. minima' Knize 1132 (cf. C. cinerea var. dealbata). *(Photos by Adolf Wirth)*

for *Echinocactus pepinianus* Lemaire ex Foerster (1846) which, as a bare name, must be considered a combination for *Cereus pepinianus* Lemaire ex Salm-Dyck in Allg. Gartenz. 13: 354 (1845) (?*E. pepinianus* Lemaire, Cat. Cels. 1845, *nom. nud.*). Britton & Rose (Cact. 2: 137. 1920) refer Salm-Dyck's plant to the synonymy of *Trichocereus chiloensis* (Colla) B. & R., but it is, however, a very doubtful name. In 1959 Backeberg published '*Copiapoa pepiniana*' again, this time basing it on *Echinocactus pepinianus* sensu Schumann (Gesamtb. Kakt. 420. 1898) while stating 'non Lemaire' [ex Foerster]. Schumann's plant might be a true *Copiapoa* (however, cf. Ritter, 1980, p. 1106–7), but more important is that *C. pepiniana* Backeb. (1959) cannot be used, since it is a homonym of *C. pepiniana* Backeb. (1935), being based on a different type as indicated by Backeberg, and therefore illegitimate.

Acknowledgements

I would like to thank Herr J. D. Supthut, Director of the Städtische Sukkulenten-Sammlung, Zürich and Herr U. Eggli for their help and encouragement while I studied at the above establishment during February and March this year. I am also very grateful to Herr Mächler (Switzerland) and Mr G. Charles (UK) for allowing me to examine their fine collections of *Copiapoa*. The last named has prepared the notes on the cultivation of the genus appended to this article, and together with Herr A. Wirth (Zürich), has kindly supplied the illustrations which accompany it.

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SALM-REIFFERSCHEID-DYCK, J. (1845). Einige neuen Cacteen. In Allg. Gartenz. 13: 386–87.

Checklist (see also map, page 60)

C. alticostata F. Ritter in Taxon 12: 29 (1963); Kakt. Südamer. 3: 1079–80, fig. 1009 (1980). Type: Prov. Atacama, Dept. Freirina, N. of Nicolasa, 1957, *Ritter* 717 (U).

Distinctive; *C. cuprea*, *C. fiedlerana* and *C. pendulina* (s.l.) are growing nearby.

C. applanata Backeb. (1959)=*C. cinerascens*.

C. atacamensis Middleditch (1980). See *C. calderana*.

'*C. barquitensis*' F. Ritter, *nom. nud.*=*C. hypogaea*.

C. boliviana (Pfeiffer) F. Ritter, Kakt. Südamer. 3: 1089 (1980); *Echinocactus bolivianus* Pfeiffer, Abbild. Beschr. Cact. 2(3): sub t. 14 (1847). Based on plants collected by Thomas Bridges (c. 1841). As discussed earlier, it is rather unlikely that Bridges collected the plant to which Ritter is now applying this poorly typified name. The correct name for Ritter's plant, which may not merit specific status, is *C. atacamensis* Middleditch.

C. bridgesii (Pfeiffer) Backeb., Die Cact. 3: 1909 (1959); F. Ritter, Kakt. Südamer, 3: 1057–1060, figs. 971 & 972 (1980); *Echinocactus bridgesii* Pfeiffer, Abbild. Beschr. Cact. 2(3): t. 14 (1847). Type (see t. 14, l.c.) collected in Chile by Thomas Bridges, probably in 1841. Ritter (l.c.) has provided a neotype: Prov. Atacama, N. of Chañaral airfield, 1954, *Ritter* 245 (ZSS!). Range: from midway between Caldera and Chañaral to 20 km. N. of Chañaral. Other illustration: The Chileans 11(38): 169 (1980).

A beautiful taxon for its cylindric stem with copious apical wool and long upwardly directed central spines. Doubtfully distinct from *C. marginata*; closely allied to *C. echinoides* and *C. rupestris*.

C. calderana F. Ritter in Cactus (Paris) 14(65): 197–98, with fig. (1959); Kakt. Südamer. 3: 1081–82, figs. 1011 & 1012 (1980). Type: Prov. Atacama, coast N. of Caldera, 1956, *Ritter* 507 (ZSS cited, but type never received). Syn. *C. lembckei* Backeb., Die Cact. 3: 1922, t. 160 (1959), *nom. inval.* (Art. 37); *C. calderana* var. *spinosior* F. Ritter, loc. cit., fig. 1013 (1980).

To be considered here is **C. atacamensis** Middleditch in The Chileans 11(37): 21 (1979, publ. 1980). Type: Prov. Antofagasta, coastal hills around Antofagasta, 1914, *Rose* 19410 (?NY). Syn. *C. marginata* sensu B. & R. (1922), pro parte, et F. Ritter in KuaS 12: 6, fig. 2 (1961); *C. echinoides* sensu Backeb. (1959) et Lembcke in KuaS 17: 29 (1966); *C. boliviana* sensu F. Ritter, Kakt. Südamer. 3: 1089–90, figs. 1029 & 1030 (1980), *non Echinocactus bolivianus* Pfeiffer (1847). Range: between La Chimba and Blanco Encalada.

Cf. *C. cinerascens* and *C. hypogaea*.

C. carrizalensis F. Ritter (1959)=*C. cinerea* var. *dealbata*.

C. chaniaralensis F. Ritter, Kakt. Südamer. 3: 1063–64, figs. 979 & 980 (1980). Type: Prov. Atacama, near the town of Chañaral, 1956, *Ritter* 527 (U).

Placed in the same section as *C. humilis* by Ritter.

C. cinerascens (Salm-Dyck) B. & R., Cact. 3: 88 (1922); F. Ritter, Kakt. Südamer. 3: 1083–84, figs. 1015 & 1016 (1980); *Echinocactus cinerascens* Salm-Dyck in Allg. Gartenz. 13: 387 (1845) ('spec. de Copiapo spinis albis Cat. Cels.'). Type: a plant in the collection of Salm-Dyck, probably collected by Thomas Bridges, c. 1841. Typified only by the following original description: 'Stem depressed-globose, c.9 cm. diam., greyish dirty green, convex and grey-woolly at apex; ribs 20, narrow, subcompressed, tuberculate, indented between the ar.; ar. crowded, roundish, c. 6–9 mm. apart, with grey or blackish felt; rad. sp. 8, 10–13 mm. long, lower ones longest, spreading and intertwined; cent. sp. 2, 18–21 mm. long; all spines very rigid, at first blackish, then ash grey. Fl. medium sized, yellow, sur-

rounded by spines; lowermost per. segs narrowly lanceolate, upper ones broader and red at the tip, recurved; inner per. segs. broadly lanceolate, erect, acute, margin denticulate; stamens numerous, grouped together, anthers yellow; style thick and hollow with 8 yellow stigmas'. Ritter applies this old name to a plant growing 11–25 km. N. of Chañaral, and S. of Barquito (Prov. Atacama, Dept. Copiapo). He designates *Ritter* 524 as a neotype, but the specimen has not been received at ZSS, the place of deposition cited. Ritter has also described *C. cinerascens* var. *intermedia* (loc. cit., figs. 1017 & 1018) in which he includes the poorly known *C. applanata* Backeb., Die Cact. 3: 1913 (1959).

A distinctive plant to which *C. calderana*, *C. megarhiza* and *C. fiedleriana* seem to be allied.

C. cinerea (Philippi) B. & R., Cact. 3: 86, fig. 98 (1922); P. Hutchison in CSJA 25: 63–72, numerous figs. (1953); *Echinocactus cinereus* Philippi, Fl. Atac. 23 (appendix in 'Reise durch die Wueste Atacama 1853–54', publ. 1860). Lectotype: Prov. Antofagasta, Dept. Taltal, Quebrada Taltal, Hueso Parado, 1854, *R. Philippi s.n.* (SGO 052667). This very variable species is divisible into at least five varieties, each composed of various habitat forms, arranged in the following sequence from north to south:

var. **haseltoniana** (Backeb.) N. P. Taylor, **comb. nov.** Basionym: *C. haseltoniana* Backeb., Descr. Cact. Nov. [1:] 33 (1956); Die Cact. 3: 1903–06, fig. 1833 (1959); *C. gigantea* var. *haseltoniana* (Backeb.) F. Ritter, Kakt. Südamer. 3: 1101, fig. 1052 (1980); *C. gigantea* Backeb. in Jahrb. Deutsch. Kakt.-Ges. 1: 104 (1936); Blätter f. Kakteenforsch. 1937: [8], unpaged (1937); Die Cact. 3: 1903, fig. 1832 (1959); F. Ritter, op. cit. 1099–1101, fig. 1051 (1980). ? including *C. eremophila* F. Ritter, op. cit. 1104 (1980). Range: E. & W. of Paposo (Prov. Antofagasta). Other illustrations: Aloe 13(4): 117 (1975); CSJA 44: 241, fig. 11 (1972).

var. **albispina** F. Ritter in Taxon 12: 30 (1963); Kakt. Südamer. 3: 1098, figs. 1050 (1980). Type: Prov. Antofagasta, c. 10 km. N. of Taltal, coastal rocks, 1954, *Ritter* 207a (ZSS!). Cf. *C. krainziana*, also from N. of Taltal.

var. **cinerea**. ?including *C. longistaminea* F. Ritter in Taxon 12: 31 (1963); Kakt. Südamer. 3: 1096, figs. 1037 & 1038; *C. tenebrosa* F. Ritter, op. cit. 1098–99, figs. 1045 & 1058 (1980). Range: ca. Taltal, S. to Esmeralda (Prov. Antofagasta).

var. **columna-alba** (F. Ritter) Backeb., Die Cact. 6: 3820 (1962); *C. columna-alba* F. Ritter in Cactus (Paris) 14(65): 199–200, with figs. (1959); Kakt. Südamer. 3: 1094–95, figs. 1039–1041 (1980). Type: Prov. Antofagasta, 26°S., near the coast, 1956, *Ritter* 530 (ZSS cited, but type never received). ? including *C. melanohystrix* F. Ritter, op. cit. 1096–97, fig. 1043 (1980). Range: Esmeralda, S. to near Chañaral (Prov. Atacama). Other illustrations: KuaS 26(3): 58; (4): 90 (1975).

var. **dealbata** (F. Ritter) Backeb., Die Cact. 6: 3823 (1962); *C. dealbata* F. Ritter in Cactus (Paris) 14(63): 137–38, with figs. (1959). Type: Prov. Atacama, coast at c. 28° S. (Carrizal Bajo), 1956, *Ritter* 509 (ZSS cited, but type never received). Syn. *C. carrizalensis* F. Ritter, loc. cit. 139–40, with figs. (1959); *C. carrizalensis* var. *gigantea* F. Ritter in Taxon 12: 29–30 (1963); Kakt. Südamer. 3: 1091, figs. 1033 & 1034 (1980). Range: Carrizal Bajo and at a point c. halfway towards Totoral. Other illustrations: CSJA 44: 239, fig. 1 (1972); KuaS 26(2): 41 (1975); Aloe 17(1): 14, fig. 14 (1979). The oldest name for this disjunct taxon may be the poorly typified *Echinocactus malletianus* Salm-Dyck (1845), which also antedates *E. cinereus* Philippi (1860): see *C. malletiana*. Knize's '*C. minima*' may be an inland ally of this variety, collected at Carrizal Alto (600 m.).

The range of variation apparent in this species raises the question of whether the closely allied *C. krainziana* should be included as well.

C. columna-alba F. Ritter (1959)=*C. cinerea*.

C. conglomerata (Philippi) Lembcke in KuaS 17: 29–30 (1966); *Echinocactus conglomeratus* Philippi, Fl. Atac. 23 (appendix in 'Reise durch die Wueste Atacama 1853–54', publ. 1860). Type locality: Prov. Antofagasta, 24° 24′ S., between Chaguar del Jote and El Cobre. (Type apparently not preserved.) Ritter (1980) has wisely rejected Lembcke's resurrection of *E. conglomerata* Philippi for *C. solaris* (F. Ritter) F. Ritter. Lembcke was persuaded by Philippi's accurate type locality and apt epithet, but in the absence of a type specimen this name must be typified by the original description, which clearly cannot accommodate the Ritter-Lembcke plant. Perhaps Philippi saw and collected *C. solaris* at his locality, but then confused the field data with a different plant, upon which he subsequently based his description.

C. coquimbana (Karw. ex Ruempler) B. & R., Cact. 3: 87 (1922); *Echinocactus coquimbanus* Karw. ex Ruempler in Foerster, Handb. Cacteenk., ed. 2, 601 (1885). Based on a cultivated plant thought to have been collected near the Chilean town of Coquimbo. Typified by the brief and unsatisfactory original description only: 'elongate-globose, bright green; ribs very inconspicuous, but tubercles more evident; ar. convex with short wool when young, later glabrous; rad. sp. 5–6, to 10 mm. long blackish-brown, later grey, curved, horizontal; cent. sp. 0'. The explorations of Ritter have shown that there is clearly more than one taxon in the vicinity of Coquimbo to which this name could apply. In the sense of Britton & Rose it was the plant that Ritter has named *C. pseudocoquimbana*, while he himself now uses *C. coquimbana* for the following:

C. coquimbana var. **wagenknechtii** F. Ritter in Taxon 12: 30 (1963) ('*C. wagenknectii*', *nom. nud.*); Kakt. Südamer, 3: 1074–75, figs. 1000 & 1001 (1980). Type: Prov. Coquimbo, Dept. La Serena, Elqui valley, El Tambo, *Ritter* 718 (U). Including *C. coquimbana* var. *armata* F. Ritter, Kakt. Südamer. 3: 1075, fig. 1002 (1980). Range: inland in the Elqui and Choros valleys (Dept. La Serena). Other illustration: Backeberg, Cactus Lexicon, fig. 72 (1978).

A distinctive plant, quite common in cultivation labelled *C. coquimbana*. However, as noted above, Ruempler's epithet is of doubtful application, and *if* this taxon is considered a good species, it would be preferable that var. *wagenknechtii* be raised to specific rank and used instead; but cf. *C. pendulina* and *C. fiedlerana*.

C. cuprea F. Ritter (1959). See *C. echinoides*.

C. cupreata (Poselger ex Hildmann) Backeb., Die Cact. 3: 1920 (1959); *Echinocactus cupreatus* Poselger ex Hildmann apud Ruempler in Foerster, Handb. Cacteenk., ed. 2, 602 (1885). Based on a plant of unknown origin in the collection of Poselger (not preserved). Typified only by the brief original description: 'stem globose, dark brown; ribs tuberculate, notched, tubercles 3–5 mm. high and broad, rhombic with rounded angles, the lowermost angle produced, nose-like, sinuses sinuate; ar. impressed with short whitish-grey wool; rad. sp. (5–)6, not really at the edge of the areole, the uppermost short, others longer, bent outwards, dirty yellow below, brown-black above; cent. sp. O.' In the absence of an illustration and provenance data it is not possible to apply this name with any certainty. However, the tubercle shape and stem colour described suggest a form of *C. fiedlerana* now in cultivation (see illustration, p. 58).

C. dealbata F. Ritter (1959)=*C. cinerea*.

C. desertorum F. Ritter, Kakt. Südamer. 3: 1060–61, fig. 974 (1980). Type: Prov. Antofagasta, Dept. Taltal, E. of Cifuncho on the way to Las Breas, 1956, *Ritter* 529 (U). Placed near *C. rupestris* by Ritter and perhaps only a variety.

C. dura F. Ritter (1963). See *C. echinoides*.

C. echinata F. Ritter (1959). See *C. megarhiza*.

C. echinoides (Lemaire ex Salm-Dyck) B. & R., Cact. 3: 88 (1922); *Echinocactus echinoides* Lemaire ex Salm-Dyck in Allg. Gartenz. 13: 386 (1845); Pfeiffer, Abbild. Beschr. Cact. 2(6): t. 29 (1850). Type: probably collected in Chile by Thomas Bridges in 1841. The following is typified by a plant collected in the region traversed by Bridges in 1841 (cf. Johnston, 1928) and could well be identical with the original *E. echinoides*: **C. dura** F. Ritter in Taxon 12: 31 (1963); Kakt. Südamer. 3: 1053–54, fig. 969 (1980). Type: Prov. Atacama, E. of Totoral, 1956 *Ritter* 546 (U).

To be considered here is **C. cuprea** F. Ritter in Cactus (Paris) 14(63): 136–7, with fig. (1959); Kakt. Südamer, 3: 1053, figs. 967 & 968 (1980). Type: Prov. Atacama, region of Nicolasa, 28°25′S., 1956, *Ritter* 510 (ZSS cited, but specimen never received).

The above are closely allied to, and perhaps not specifically distinct from, *C. marginata*. *C. rupestris* is also related, and may be referable here, but it comes from much farther north.

C. eremophila F. Ritter (1980). See *C. cinerea* var. *haseltoniana*.

C. esmeraldana F. Ritter, Kakt. Südamer. 3: 1064–65, fig. 978 (1980). Type: Prov. Antofagasta, Dept. Taltal, S. of Esmeralda, 1969, *Ritter* 1457 (U).

Placed near to *C. humilis* by Ritter, l.c.

C. ferox Lembcke & Backeb. ex Backeb. (1959), *nom. inval.* (Arts 9 & 37). See *C. solaris*.

C. fiedlerana (Schumann) Backeb. in Backeb. & F. Knuth, Kaktus-ABC, 280 (1935); F. Ritter, Kakt. Südamer. 3: 1078–79, fig. 999 (1980); *Echinocactus fiedlerianus* Schumann, Gesamtb. Kakt. Nachtr. 121–22 (1903); *C. pepiniana* var. *fiedleriana* Backeb., Die Cact. 3: 1919, figs. 1850 & 1851 (1959). Type: S. Prov. Atacama, on the shore [? coast] near Huasco, *Soehrens* 28 (B†). Syn. *C. megarhiza* sensu Backeb., Die Cact. 3: 1914, fig. 1844 (1959), *non* B. & R. (1922); *C. pepiniana* Backeb., Die Cact. 3: 1917, figs. 1848 & 1849 (1959), *nom. illegit.*; ? *Echinocactus pepinianus* sensu Schumann, Gesamtb. Kakt. 420 (1898). Range: Huasco to N. of Carrizal Bajo;? to near Copiapo, see Backeb., Die Cact. 3: 1914, fig. 1844 (1959). Cf. *C. cinerascens* and *C. megarhiza*.

To be considered here is **C. vallenarensis** F. Ritter, Kakt. Südamer. 3: 1077–78, fig. 994 (1980). Type: Prov. Atacama, Huasco valley, airfield at Vallenar, *Ritter* 1087 (U). Syn. *Echinocactus fiedlerianus* sensu B. & R., Cact. 3: 87 (1922), *non* Schumann. Range: Huasco valley, from near the coast to 30 km. E. of Vallenar. Cf. *C. coquimbana* var. *wagenknechtii*.

C. gigantea Backeb. (1936)=*C. cinerea* var. *haseltoniana*.

C. grandiflora F. Ritter in Taxon 12: 30 (1963); Kakt. Südamer. 3: 1087, fig. 1014 (1980). Type: Prov. Antofagasta, Dept. Taltal, Esmeralda, 1956, *Ritter* 523 (U). Other illustration: Backeberg, Cactus Lexicon, fig. 68 (1978).

Distinctive; cf. *C. hypogaea* and *C. cinerascens*.

C. haseltoniana Backeb. (1956)=*C. cinerea*.

C. hornilloensis F. Ritter, Kakt. Südamer. 3: 1060, fig. 973 (1980). Type: Prov. Antofagasta, Dept. Taltal, N. of Esmeralda, Cerro Hornillo, 1963, *Ritter* 1149 (U).

Placed near to *C. rupestris* by Ritter, and perhaps only a variety.

C. humilis (Philippi) P. Hutchison in CSJA 25: 34–7, with figs. (1953); *Echinocactus humilis* Philippi, Fl. Atac. 23 (appendix in 'Reise durch die Wueste Atacama 1853–54', publ. 1860). Type: Prov. Antofagasta, Dept. Taltal, near Paposo, 1854, *R. Philippi* (apparently not preserved). Neotype: loc. cit., coastal hills above Paposo, 1952, *P. Hutchison* 405 (UC). Apparently a very complex species or species aggregate, the following perhaps representing geographical varieties or, in some cases, critical species, listed here in sequence from north to south:

C. tocopillana F. Ritter, Kakt. Südamer. 3: 1072–73, figs. 991–993 (1980). Type: Prov. Antofagasta, N. of Tocopilla, 1960, *Ritter* 1057 (U). Range: N. of Tocopilla to midway between Tocopilla and Antofagasta.

C. tenuissima F. Ritter in Taxon 12: (1963); Kakt. Südamer. 3: 1070–72, figs. 987–989 (1980). Syntypes: Prov. Antofagasta, S. of Antofagasta, coastal mountains, 1956, *Ritter* 540 & 539 (U). Very distinctive; the spination and dwarf habit suggests that it might have arisen as a fixed juvenile form.

C. variispinata F. Ritter, Kakt. Südamer. 3: 1070, figs. 981 & 982 (1980). Type: Prov. Antofagasta, 50 km. N. of Paposo, coastal mountains, 1968, *Ritter* 1447 (U). Very distinctive.

C. paposoensis F. Ritter, Kakt. Südamer. 3: 1068–69, fig. 986 (1980), *nom. inval.* (Art. 37). Type locality: Prov. Antofagasta, 20 km. N. of Paposo, 1956, *Ritter* (?).

C. taltalensis (Werderm.) Looser in Rev. Chil. Hist. Nat. 33: 614 (1929); F. Ritter, Kakt. Südamer. 3: 1065–66, fig. 990 (1980); *Echinocactus taltalensis* Werderm. in Notizbl. Bot. Gart. Berlin 10: 763–64 (1929). Type: Prov. Antofagasta, Dept. Taltal, Sierra Esmeralda, between Posado Hidalgos and Quebrada Cachina, c. 25°50′S., 1925, *I. M. Johnston* 5676 (B†). Range: Cachina valley near Placilla Esmeralda (according to Ritter).

C. longispina F. Ritter in Taxon 12: 31 (1963); Kakt. Südamer. 3: 1062–63, fig. 977 (1980). Type: Prov. Atacama, Sierra Hornillos, S. of Copiapo, 1956, *Ritter* 505 (U).

C. chaniaralensis F. Ritter and *C. esmeraldana* F. Ritter are further taxa classified in the same group as *C. humilis* by Ritter (1980).

C. hypogaea F. Ritter in Cactus (Paris) 15(66): 19–20, with fig. (1960); Kakt. Südamer. 3: 1085–86, figs. 1019, 1020 & 1023 (1980). Type: Prov. Atacama, Dept. Chañaral, 1954, *Ritter* 261 (ZSS!). Syn. *C. hypogaea* var. *barquitensis* F. Ritter, Kakt. Südamer. 3: 1086, figs. 1021 & 1022 (1980) ('*C. barquitensis*', nom. nud.). Other illustrations: Krainz, Die Kakteen, Lfg. 53 (1973); CSJGB 41(1): 13 (1979). The following is closely allied and may only be a variety of the above:

C. montana F. Ritter in Cactus (Paris) 15(66): 21–22 (1960); Kakt. Südamer. 3: 1087–88, fig. 1026 (1980). Type: Prov. Antofagasta, Dept. Taltal, N. of Taltal, 1954, *Ritter* 522 (211a) (ZSS cited, but specimen never received). ? including *C. mollicula* F. Ritter in Taxon 12: 30 (1963); Kakt. Südamer. 3: 1086, figs. 1024 & 1025 (1980); *C. olivana* F. Ritter, Kakt. Südamer. 3: 1088, fig. 1027 (1980); *C. rarissima* F. Ritter, loc. cit. fig. 1028 (1980). Range: Chañaral to N. of Taltal.

C. hypogaea (s.l.) belongs in the same group as *C. cinerascens*, *C. calderana* and *C. grandiflora*.

C. krainziana F. Ritter in Taxon 12: 30 (1963); Kakt. Südamer. 3: 1102–04, figs. 1053–1055 (1980). Type: Prov. Antofagasta, Dept. Taltal, N. of Taltal, high coastal mountains, 1954, *Ritter* 210 (ZSS!). Syn. *C. krainziana* var. *scopulina* F. Ritter, ll. cc. ('*C. scopulina*', nom. nud.).

Doubtfully distinct from *C. cinerea*, especially its var. *albispina*.

C. lembckei Backeb. (1959), *nom. inval.*=*C. calderana*.

C. laui Diers in KuaS 31(12): 362–5, with figs. (1980). Type: Chile, Prov. Antofagasta, Dept. Taltal, Esmeralda, 100 m., *Lau* 891 (Succulentarium PH Rheinland, Abt. Koln cited, but it is not known whether the type has been permanently conserved there).

A poorly known plant at present, but probably allied to either the *C. humilis* complex or *C. hypogaea*.

C. longispina F. Ritter (1963). See *C. humilis*.

C. longistaminea F. Ritter (1963). See *C. cinerea* var. *cinerea*.

C. malletiana (Lemaire ex Salm-Dyck) Backeb. in Backeb. & F. Knuth, Kaktus-ABC, 280 (1935); *Echinocactus malletianus* Lemaire ex Salm-Dyck in Allg. Gartenz. 13: 387 (1845). Type probably collected in Chile by Thomas Bridges in 1841, but neither preserved nor illustrated by Salm-Dyck or his contemporaries. Typified only by the original description: 'stem depressed-globose, 7.5–10 cm. diam., light green covered in a thick chalky crust and therefore ash-coloured, apex impressed, white-woolly; ribs 15–17, narrow above, convex, gibbosely notched between the areoles, completely flattened and blackish-rugose below; ar. impressed, 14–17 mm. apart, elongate, black-felted; rad. sp. 14–17 mm. long, straight, acicular, rigid, black, erect, outer 5–6 suberect, or spreading; cent. sp. 1, stronger.'

The above description suggests *C. cinerea* var. *dealbata*, a plant which Bridges could well have seen and collected in 1841. If the poorly typified *C. malletiana* is used in the way suggested here, it will supplant the well-known name *C. cinerea*.

C. marginata (Salm-Dyck) B. & R., Cact. 3: 86 (1922) (pro parte excl. *Rose* 19410, vide *C. atacamensis* sub *C. calderana*); F. Ritter, Kakt. Südamer. 3: 1054–57, fig. 978 (1980), *non* F. Ritter in KuaS 12: 6, fig. 2 (1961); *Echinocactus marginatus* Salm-Dyck in Allg. Gartenz. 13: 386 (1845); Pfeiffer, Abbild. Beschr. Cact. 2(6): t. 30 (1850). Type probably collected in Chile by Thomas Bridges in 1841. Ritter, loc. cit., has provided a neotype: Prov. Atacama, SW. of Caldera, Morro Copiapo, 1956, *Ritter* 511 (ZSS cited, but specimen never received). Syn. *Echinocactus columnaris* Pfeiffer, Abbild. Beschr. Cact. 2(3): sub t. 14 (1847) (typified by the plate in Pfeiffer, op. cit. (1850)); *E. streptocaulon* Hook. in Bot. Mag. 77: t. 4562 (1851); *C. streptocaulon* (Hook.) v. Oosten in Succulenta 22: 16 (1940); F. Ritter in KuaS 12: 4–6, fig. 1 (1961). The present application of *C. marginata* rests on the assumption that Pfeiffer was correct in using *E. marginatus* Salm-Dyck (1845) for his *E. columnaris* (1847), when he illustrated the latter in 1850. If these taxa are ever considered to be specifically different (cf. Middleditch in The Chileans 11(37): [17–] 18–20 (1980), who draws attention to discrepancies between the original descriptions), then the correct name for this species will become '*C. columnaris*', while *C. marginata* must be abandoned for lack of typification.

Taxonomically and geographically between *C. echinoides* and *C. bridgesii*.

C. megarhiza B. & R., Cact. 3: 89 (1922); F. Ritter, Kakt. Südamer. 3: 1081, fig. 1010 (1980), *non* Backeb. (1959) (= *C. fiedlerana*). Type: Prov. Atacama, near Copiapo, dry granitic hills, 1914, *Rose* 19323 (US). Ritter has described the following variety: *C. megarhiza* var. *microrhiza* F. Ritter, loc. cit. (1980). Range: Copiapo valley, from E. of Paipote to W. of Toleda.

To be considered here is **C. echinata** F. Ritter in Cactus (Paris) 14 (63): 133, with fig. (1959); Kakt. Südamer. 3: 1080, figs. 997 & 998 (1980). Type: Prov. Atacama, Carrizal Bajo, 1956, *Ritter* 506 (ZSS cited, but type never received). Syn. *C. echinata* var. *borealis* F. Ritter, ll.cc.; *C. totoralensis* F. Ritter in Cactus (Paris) 15(66): 23–24, with fig. (1960). Range: from the Rio Copiapo valley to Carrizal Bajo (Dept. Copiapo). Sympatric in part with *C. megarhiza*, according to Ritter (1980).

Cf. *C. calderana* and *C. fiedlerana*.

C. melanohystrix F. Ritter (1980). See *C. cinerea* var. *columna-alba*.

'*C. minima*' K. Knize, *nom. nud.* A name without description for the distinctive *Knize* 1132 (ZSS!), from Carrizal Alto (above Carrizal Bajo) at 600 m. This plant is perhaps a dwarf ally of *C. cinerea* var. *dealbata*, and merits a valid name.

C. mollicula F. Ritter (1963). See *C. hypogaea*.

C. montana F. Ritter (1960). See *C. hypogaea*.

C. paposoensis F. Ritter (1980), *nom. inval.* See *C. humilis*.

C. pendulina F. Ritter in Cactus (Paris) 14(63): 134–5, with fig. (1959); Kakt. Südamer. 3: 1073, figs. 995 & 996 (1980). Type: Prov. Coquimbo, Dept. Ovalle, Fray Jorge, 1955, *Ritter* 504 (ZSS cited, but type never received). Range: from the type locality to 40 km. farther south. Other illustrations: Krainz, Die Kakteen, Lfg. 52 (1973); CSJA 44: 239, fig. 2 (1972).

The following are probably only varieties of the above: *C. pseudocoquimbana* F. Ritter in Taxon 12: 30 (1963); Kakt. Südamer. 3: 1076–77, figs. 1003–1005 & 1008 (1980); *C. pseudocoquimbana* var. *vulgata* F. Ritter, ll.cc.; *C. pseudocoquimbana* vars. *chaniarensis* and *domeykoensis* F. Ritter, loc., cit. figs. 1006 & 1007 (1980); *C. coquimbana* sensu B. & R. (1922), fide Ritter. Range: S. border of Prov. Atacama (SW. of Domeyko and near Carizalillo) to Fray Jorge, Prov. Coquimbo.

Cf. *C. fiedlerana* and *C. coquimbana* var. *wagenknechtii*.

C. pepiniana (Lemaire [ex Salm-Dyck]) Backeb. in Backeb. & F. Knuth, Kaktus-ABC, 281 (1935); *Cereus pepinianus* Lemaire ex Salm-Dyck in Allg. Gartenz. 13: 354 (1845); *Echinocactus pepinianus* [Salm-Dyck] Lemaire ex Foerster, Handb. Cacteenk. ed. 1, 347 (1846). A name of uncertain application, but probably not of this genus.

'*C. pepiniana*' Backeb., Die Cact. 3: 1917 (1959), *nom. illegit.* (see *C. fiedlerana*), *non* (Lemaire ex Salm-Dyck) Backeb. (1935).

C. pseudocoquimbana F. Ritter (1963). See *C. pendulina*.

C. rarissima F. Ritter (1980). See *C. hypogaea*.

C. rubriflora F. Ritter (1963). See *C. rupestris*.

C. rupestris F. Ritter in Taxon 12: 31 (1963); Kakt. Südamer. 3: 1061, fig. 975 (1980). Type: Prov. Antofagasta, Dept. Taltal, Cifuncho, 1956, *Ritter* 528 (U).

The following is probably only a variety: *C. rubriflora* F. Ritter in Taxon 12: 31 (1963); Kakt. Südamer. 3: 1061–62, fig. 976 (1980). Type: Prov. Antofagasta, S. of Taltal, 1954, *Ritter* 211 (ZSS). *C. hornilloensis* and *C. desertorum* may also belong here.

Doubtfully distinct from *C. echinoides*.

'*C. scopulina*' F. Ritter, *nom. nud.* = *C. krainziana*.

C. serenana Voldan in KuaS 27(8): 185–86, with fig. (1976). Type: a seedling raised from seed of a dead plant found between the stems of a clump of '*C. coquimbana*', originating from the Knize nursery, and perhaps from Dept. La Serena (? preserved at W). Affinity uncertain, the illustration being of a very young cultivated plant flowering for the first time.

C. serpentisulcata F. Ritter in Cactus (Paris) 15(66): 22, with fig. (1960); Kakt. Südamer. 3: 1093, fig. 1044 (1980). Type: Prov. Atacama, N. of Chañaral, 1954, *Ritter* 246 (ZSS!). Syn. *C. serpentisulcata* var. *castanea* F. Ritter, loc. cit., fig. 1015 (1980). Growing with *C. cinerascens*.

Very distinctive. Placed in the same section as *C. cinerea* by Ritter.

C. solaris (F. Ritter) F. Ritter, Kakt. Südamer. 3: 1047–48, figs. 963–966 (1980); *Pilocopiapoa solaris* F. Ritter in KuaS 12: 20–22, with figs. (1961). Type: Prov. Antofagasta, El Cobre, 1956, Ritter 541 (U). Type species of *Copiapoa* subg. *Pilocopiapoa* (F. Ritter) F. Ritter, op. cit. (1980). Syn. *C. ferox* Lembcke & Backeb. ex Backeb., Die Cact. 3: 1922–23, t. 160 (1959), *nom. inval.*. (Arts 9 & 37—the type was growing in the Uebelmann collection in Switzerland until March 1981, when it was given to ZSS for preservation); *C. conglomerata* Lembcke in KuaS 17: 29–30 (1966), *non Echinocactus conglomeratus* Philippi (1860). Range: between El Cobre and Blanco Encalada.

(*C. solaris*, contd.)

An interesting and perhaps ancient species, which may represent the connexion between *Copiapoa* and its presumed cereoid ancestor.

C. streptocaulon (Hook.) v. Oosten (1940)=*C. marginata.*

C. taltalensis (Werderm.) Looser (1929). See *C. humilis.*

C. tenebrosa F. Ritter (1980). See *C. cinerea* var. *cinerea.*

C. tenuissima F. Ritter (1963). See *C. humilis.*

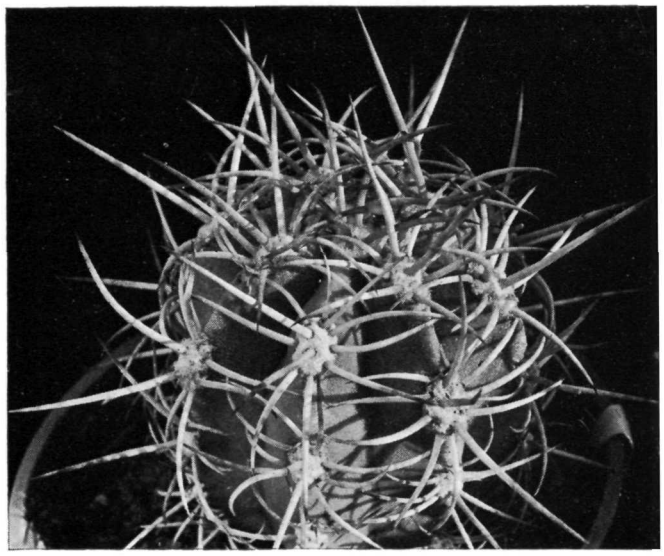
C. tocopillana F. Ritter (1980). See *C. humilis.*

C. totoralensis F. Ritter (1960). See *C. megarhiza.*

C. vallenarensis F. Ritter (1980). See *C. fiedlerana.*

C. variispinata F. Ritter (1980). See *C. humilis.*

'*C. wagenknechtii*' F. Ritter, *nom. nud.*=*C. coquimbana* var. *wagenknechtii.*



C. solaris (Group 1). *Photo by Graham Charles*
(For explanation of Groups, see p. 60)

APPENDIX

NOTES ON THE CULTIVATION OF COPIAPOA

by Graham Charles

Considering that Copiapoas come from a habitat with such an extreme climate, they are remarkably tolerant of pot culture in Britain. Outlined below are the methods of cultivation which I have arrived at, having grown a range of species over many years. It is important to remember that most species are slow growing: it is foolish to try and rush them. Although I suspect that cultivated plants are far removed in appearance from their counterparts in the wild, it is still possible to grow well-spined, shapely specimens, with patience.

The numerous collected plants offered in recent years have generally proven quite easy to establish, although I have no experience with huge *C. cinerea* specimens, which I imagine could be more difficult as older plants often are. Given an open soil of peat or gravel, roots are soon formed. I used to grow on in peat-based soils, but found this caused problems in the longer term. Large pots stay wet for too long, and all peat composts lose their structure and begin to clog if not replaced frequently. This change of structure proves fatal to the roots, and so frequent re-potting is unavoidable. The work involved and the detrimental effect on the plants' growth of constant disturbance made me look for a more permanent soil. The use of a mixture comprising mainly gravel with John Innes compost, fertiliser and some peat/leafmould has produced better long term results and saved time on management. Since many species have tuberous roots, a large pot is often required and sharp drainage around the neck of the plant is essential.

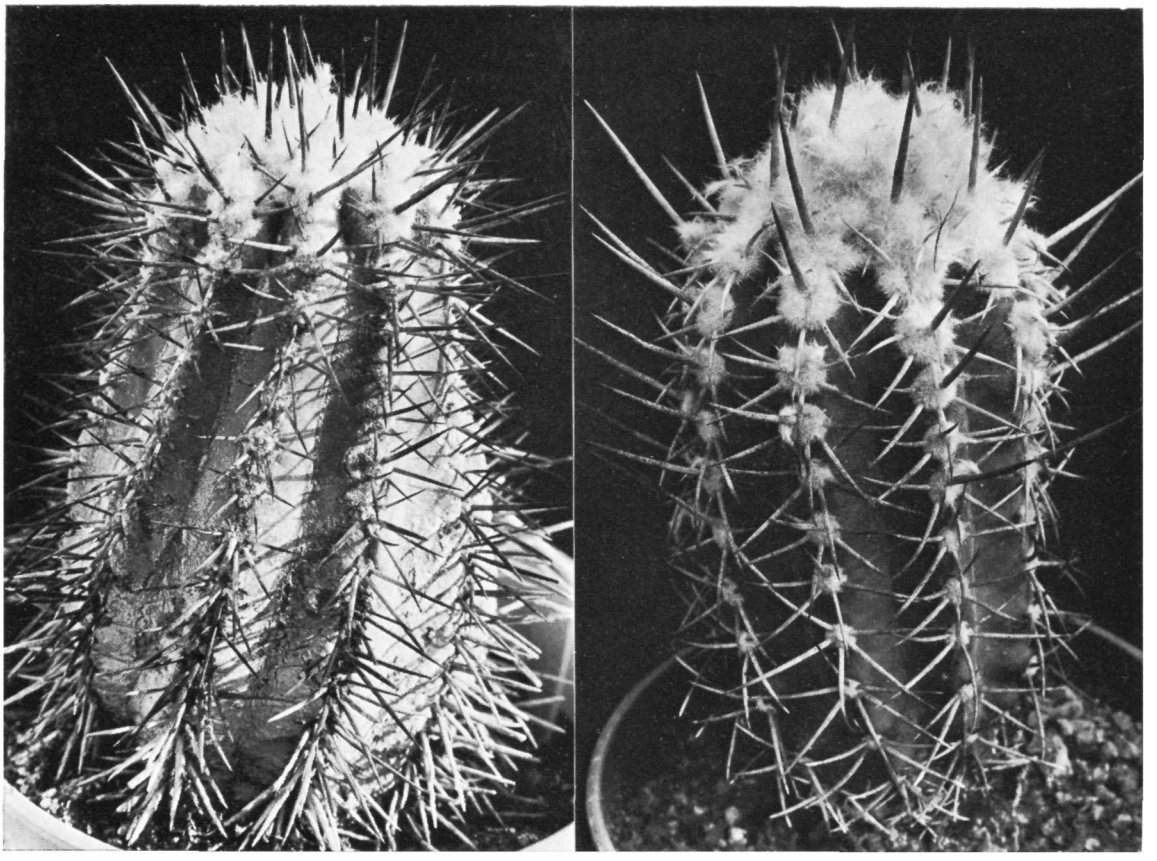
To obtain the best spine development, and the greatest chance of flowers, a sunny locality in the greenhouse is necessary. Care is needed to avoid scorching, to which Copiapoas seem particularly susceptible. Plants near the glass are most vulnerable. In my view, this scorching is caused by insufficient ventilation and excess dryness at the roots. It can also be caused when plants are moved, or turned round, into a position where they are suddenly subjected to direct sunlight. Adequate ventilation, which often is not available from vents alone, can be provided by a fan.

As long as the soil is very sharply drained, Copiapoas will take liberal watering during the growing season, but care should be exercised early in the year with the soft-bodied species (*C. humilis, C. hypogaea, C. tenuissima,* etc.) which might split if overwatered.

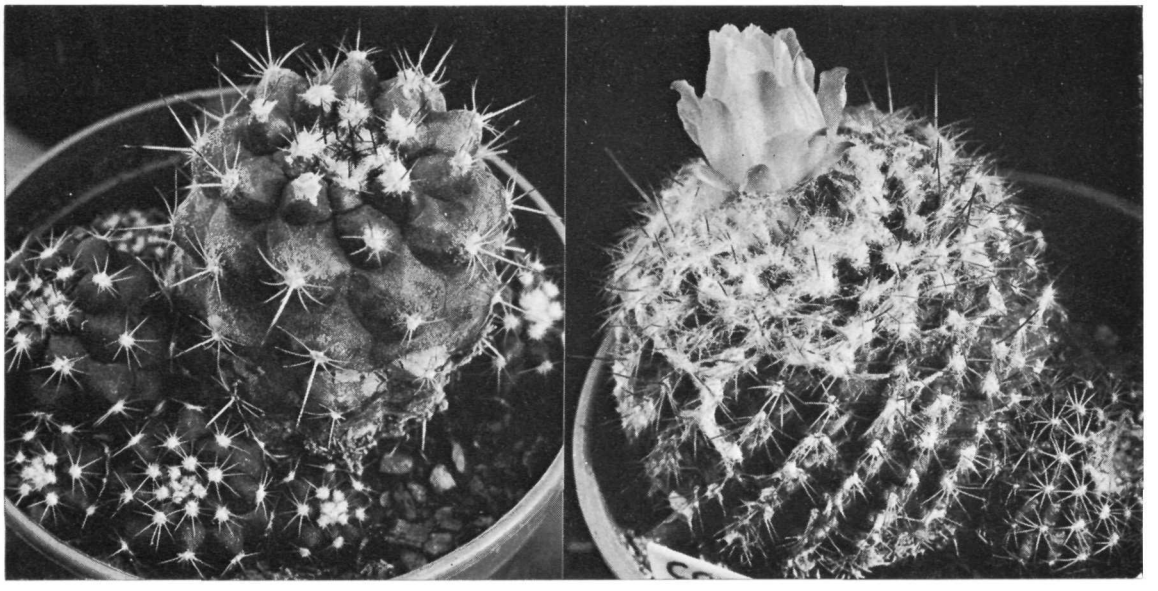
Growth rates are often slow, so that grafting may be considered. Although I am generally in favour of grafting as a method of cultivation, I feel that it rarely produces a good *Copiapoa.* It often, in my experience, causes the plants to elongate out of character and produce weak spination. The best stock to use would probably be *Eriocereus jusbertii,* but on the whole, I favour growing this genus on its own roots.

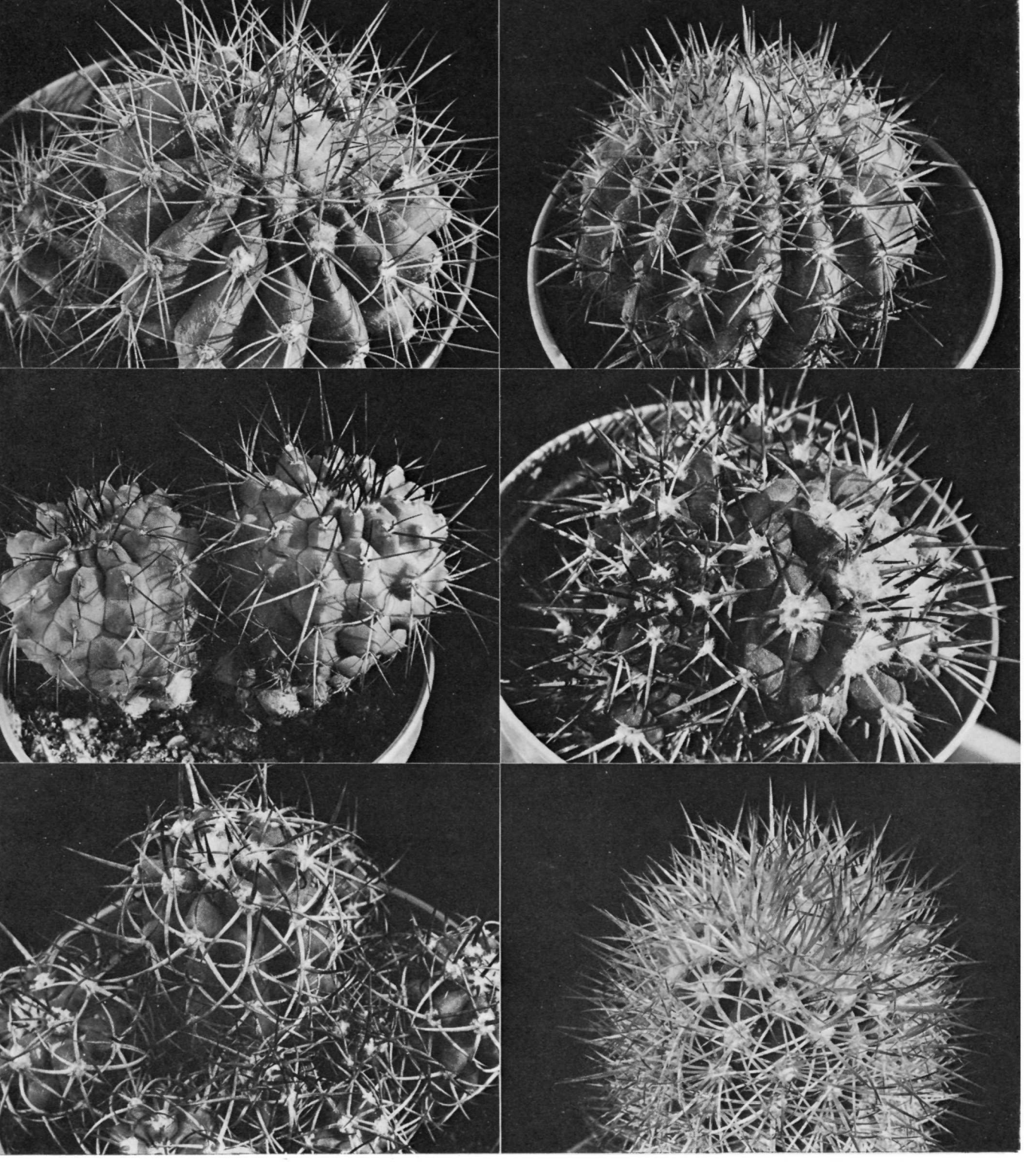
There is a wide choice of species offered for sale as seed, which with patience can be raised into fine plants. It is unfortunate that many Copiapoas look identical in their early years, not developing their individual characteristics until much later. Strangely, the white covering associated with *C. cinerea* does not seem to develop on seedlings, although imported plants continue to produce it in cultivation.

Flowering of Copiapoas can easily be achieved in the softer bodied, smaller growing species such as *C. humilis,* etc. Plants such as *C. montana, C. taltalensis, C. longispina, C. marginata* and *C. megarhiza* also will oblige without much problem. The hard-bodied species around *C. cinerea, C. dura,* etc., can be rather less reliable but flowering is still possible—more than can be said for that outstanding species, *C. krainziana,* which has never flowered in Britain to my knowledge!

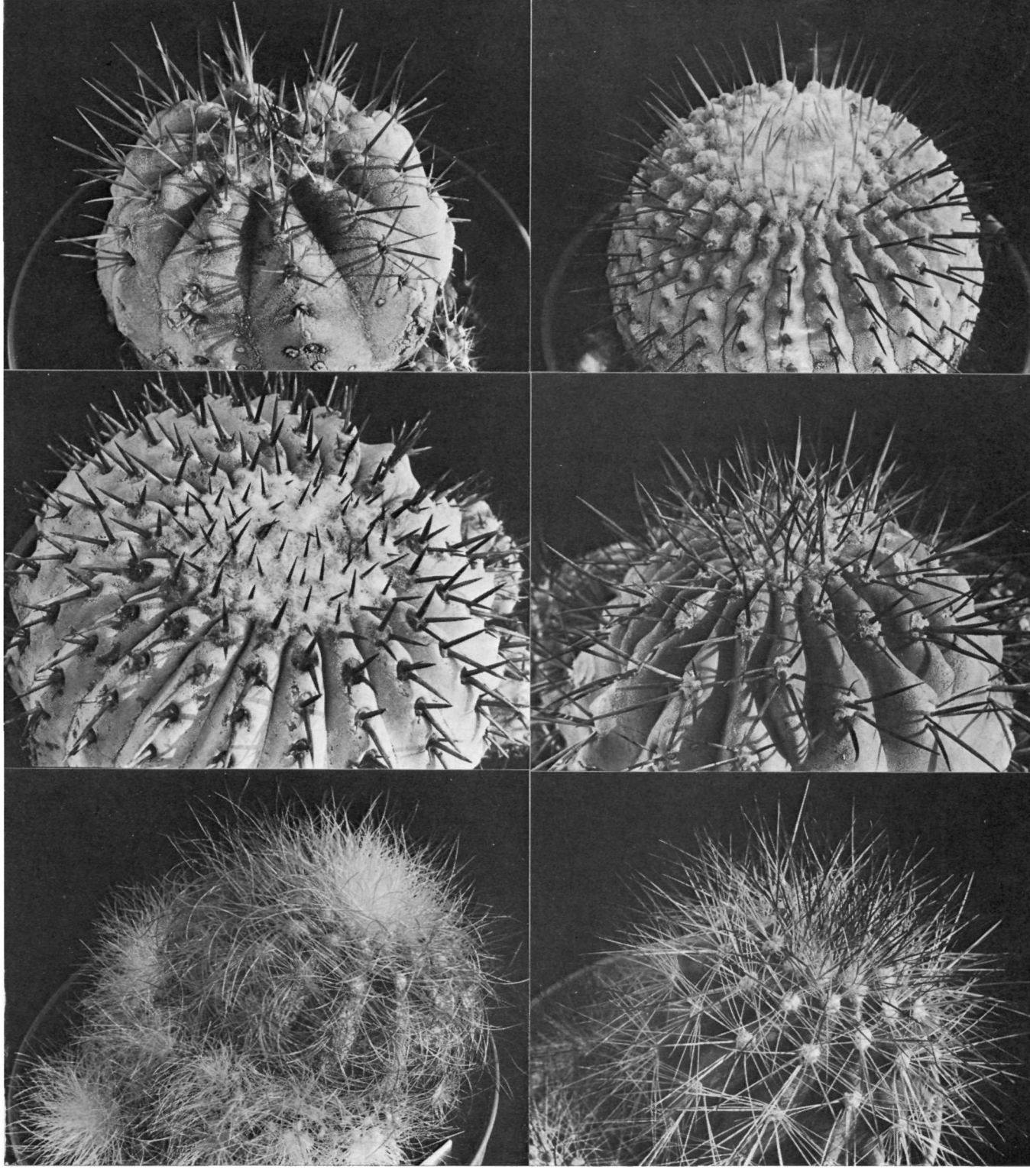


Above, taxa from Group 2. Left: C. marginata; right: C. bridgesii. Below, taxa from Group 3. left: C. humilis; right: C. tenuissima (3½ inch pot). *(Photos by Graham Charles)*

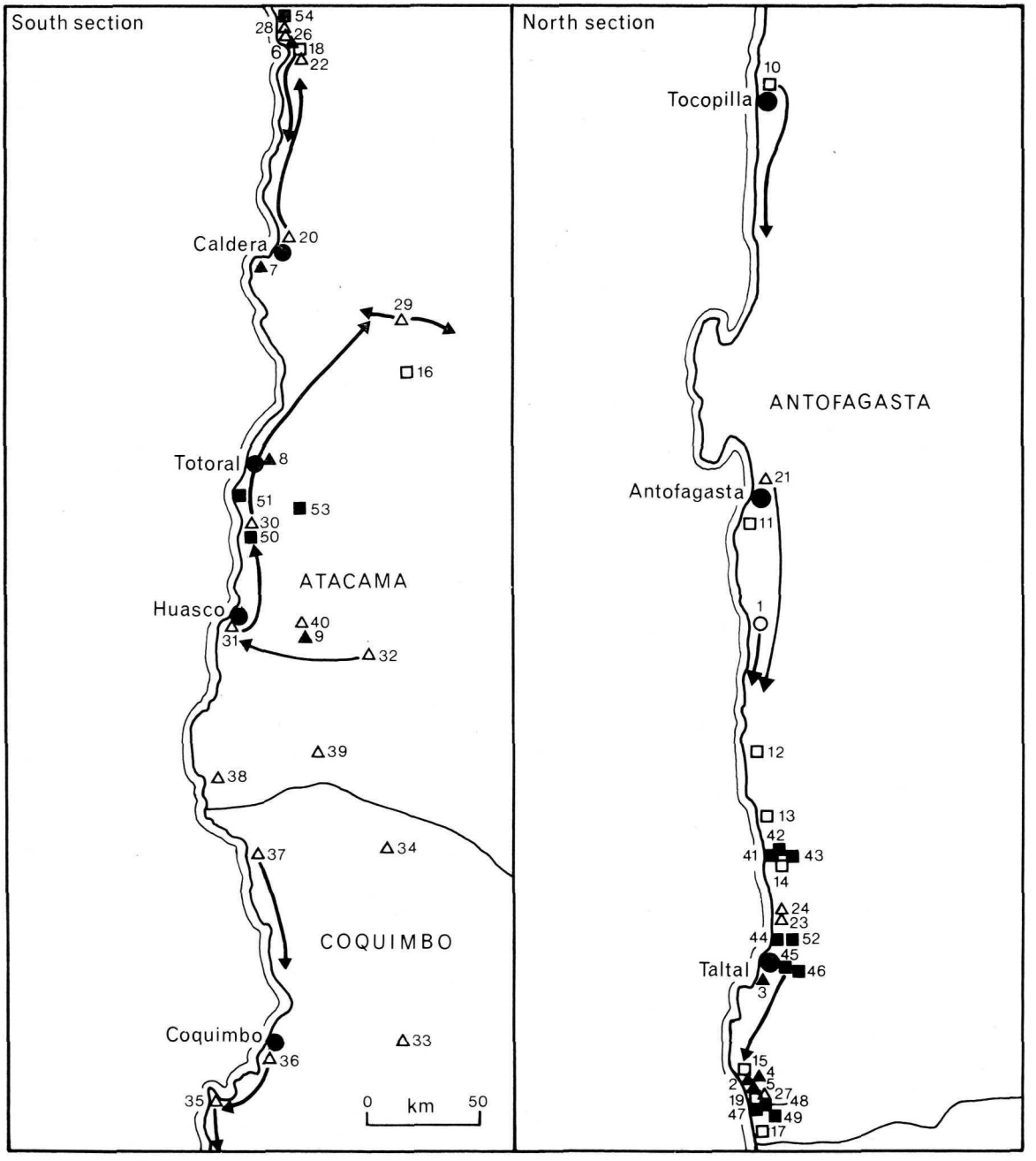




Examples of Group 4. Top left: C. grandiflora (6 inch pot). Top right: C. cinerascens. Centre left: C. montana (4½ inch pot) Centre right: C. fiedlerana fa. Knize 21 (perhaps identical with the poorly typified C. cupreata; see text). Bottom left: 'C. coquimbana' var. wagenknechtii (6 inch pot). Bottom right: C. megarhiza from W. of Copiapo, collected by (?) Lau (5 inch pot). (Photos by Graham Charles.) For an illustration of C. hypogaea, see CSJGB 41(1): 13 (1979).



Examples of Group 5. Top left: C. cinerea var. albispina (5 inch pot). Top right: C. cinerea var. columna-alba (5 inch pot). Centre left: C. cinerea var cinerea. Centre right: C. cinerea var. dealbata. Bottom left: C. krainziana (5 inch pot). Bottom right: C. krainziana, the form described as var. scopulina (cf. C. cinerea var. albispina). *(Photos by Graham Charles)*



Symbols mark the approximate position of the type or neotype localities of the taxa listed below (or of their synonyms given in brackets); arrows indicate range, where known. The different symbols, representing numbers 1, 2–9, 10–19, 20–40 and 41–54, correspond with Ritter's five informal sections (Ritter, 1980). Distinctive taxa listed in bold type.

1. **C. solaris.** C. ECHINOIDES GROUP (nos. 2–9): 2. **C. rupestris,** 3. *C. rubriflora,* 4. *C. desertorum,* 5. *C. hornilloensis;* 6. **C. bridgesii;** 7. **C. marginata;** 8. **C. echinoides** *(C. dura).* 9. *C. cuprea.* **C. humilis complex** (nos. 10–16): 10. *C. tocopillana,* 11. *C. tenuissima,* 12. *C. variispinata,* 13. *'C. paposoensis',* 14. *C. humilis,* 15. *C. taltalensis,* 16. *C. longispina;* 17. *C. esmeraldana;* 18. *C. chaniaralensis;* 19. *C. laui* (cf. no. 22 also). C. CINERASCENS GROUP (nos. 20–40): 20. **C. calderana,** 21. *C. atacamensis;* 22. **C. hypogaea** (var. *barquitensis*), 23. *C. montana,* 24. *C. olivana,* 25. *C. rarissima* (not marked—Dept. Taltal), 26. *C. mollicula;* 27. **C. grandiflora;** 28. **C. cinerascens;** 29. **C. megarhiza,** 30. *C. echinata;* 31. **C. fiedlerana,** 32. *C. vallenarensis;* 33. *C. coquimbana* var. **wagenknechtii,** 34. *C. coquimbana* var. *armata;* 35. **C. pendulina,** 36. *C. pseudocoquimbana* var. *vulgata,* 37. *C. pseudocoquimbana* var. *pseudocoquimbana,* 38. *C. pseudocoquimbana* var. *chaniarensis,* 39. *C. pseudocoquimbana* var. *domeykoensis;* 40. **C. alticostata. C. cinerea** (nos. 41–51): 41. var. **haseltoniana,** 42. *C. gigantea,* 43. *C. eremophila,* 44. var. **albispina,** 45. var. **cinerea,** 46. *C. tenebrosa,* 47. *C. longistaminea,* 48. var. **columna-alba,** 49. *C. melanohystrix,* 50. var. **dealbata,** 51. *C. carrizalensis* var. *gigantea;* 52. **C. krainziana** (cf. no. 44); 53. *'C. minima'* (KK 1132, cf. no. 50); 54. **C. serpentisulcata.**

The Cactus and Succulent Journal of Great Britain
Volume 43(2/3): 61–83 (1981)

A Review of Pectinaria Haw., Stapeliopsis Pillans and a New Genus, Ophionella (Asclepiadaceae)

*by P. V. Bruyns**

Summary. Pectinaria sensu lato is rearranged to include *P. articulata* Haw. with *P. asperiflora* N.E.Br. and *P. articulata* var. *namaquensis* as subspecies of this species. A further sub-species, *P. articulata* subsp. *borealis* is proposed for a new taxon from the Richtersveld. Also included are *Caralluma longipes* N.E.Br. and *C. maughanii*. A monotypic genus, *Ophionella*, is erected for the species *P. arcuata* N.E.Br. and *P. mirkinii* Pillans is accorded varietal status under this species. Of the remaining species, *P. saxatilis* N.E.Br., *P. pillansii* N.E.Br., *P. breviloba* R. A. Dyer and *P. exasperata* Bruyns are transferred to *Stapeliopsis* Pillans. *P. tulipiflora* is reduced to synonymy and *P. stayneri* is accorded subspecific status under *S. saxatilis*.

Introduction and historical background

Pectinaria has previously been differentiated from other genera in the *Stapelieae* by the corolla-lobes being united at the tips.

Haworth founded the genus in 1819 on the single species *P. articulata* in which this character is generally reliable and, in 1904 and 1909, N. E. Brown added further species, using this character as the main distinguishing feature for the genus. An anomalous situation arose when species were added (in particular *P. mirkinii*, *P. pillansii* and *P. exasperata*), which were clearly very closely related to others already in *Pectinaria*, but in which the corolla-lobes are rarely, if ever, joined at the tips. Pillans (1940) noted that *P. mirkinii* differed 'from all others in the genus by its free . . . corolla-lobes' but did not modify the generic definition to accommodate this deviation. This apparent reluctance to change the generic description to accommodate all of its members adequately possibly stems from the realization that it would entirely destroy the superficially 'neat' definition of the genus. This situation changed somewhat when Bayer (1975) gave an account of the genus, pointing out that it actually consists of three sections which are not at all related and between which there are no intermediate forms.

It was suggested by Lavranos (1966) that *Stapeliopsis* might be included in *Pectinaria* but he considered that the former genus was adequately separated from *Pectinaria* by the corolla-lobes being free at the tips. As this has proved to be an unreliable character, the possibility once more arises that *Stapeliopsis* could be included in *Pectinaria*. Examination of specimens available, both living and preserved, has made it quite clear that *Pectinaria* is not well constituted and that a new arrangement is desirable. This is particularly so in view of the recent discovery of *P. exasperata*, and since *Caralluma maughanii* and *C. longipes* can also be incorporated in *Pectinaria*.

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Discussion

The taxa closely associated with *P. articulata* are *P. articulata* var. *namaquensis* and *P. asperiflora*. These are all characterized by having subglobose, 6-angled stems with the flowers arising singly, with no associated peduncle or peduncular patch, near the stem-apex where young growth has occurred. In all three taxa the outer corona and dorsal appendage of the inner corona are divided into numerous, approximately cylindrical, erect to semi-erect teeth which form a ring around the top of the column (resembling a comb—hence the name *Pectinaria*). In the species *Caralluma longipes* and *C. maughanii*, the stem form is virtually indistinguishable from that of the '*articulata*' group and the inner and outer corona-lobes combine to form a similar toothed ring except that the teeth are either shorter or fewer and less obviously constitute a ring. In these two species of *Caralluma* the corolla-lobes are always free at their tips while in all the three taxa of *Pectinaria* sensu stricto they are united at their tips and this constitutes the most important difference between them. On the strength of the vegetative and staminal column similarity, these species are now all included in *Pectinaria*.

The remainder of the genus falls easily into two sections distinguished from the '*articulata*' section by the 4-angled stems and the presence of a definite peduncle or peduncular patch usually arising near the base of the stems.

The first, and smaller, section consists of *P. arcuata* and *P. mirkinii* and is recognized by the narrow, arched stems with strongly subterranean habit and broadly flattened angles with small scale-like teeth. Here the inner corona-lobes are dominated by a large, broad dorsal projection which remains approximately level with the top of the column and there is a small limb incumbent on the backs of the anthers. These two taxa are placed in a new genus *Ophionella*.

The remaining six species fall into the final section. Here the stems are again 4-angled, but, if creeping, are

comparatively thicker than and not as strongly arched as members of the '*arcuata*' section. All species have sharp-pointed teeth arising on a conical, pointed tubercle. The staminal column is entirely different from that in either of the other sections, being dominated by the erect inner corona-lobes. These are laterally flattened, rising up above the anthers to meet in the centre over the stigmatic surface and leave the anthers uncovered to their base. These six species are placed in *Stapeliopsis* for reasons discussed later.

KEY TO GENERA DISCUSSED

1. Stems 6-angled, flowers arising singly near stem apex without peduncle or peduncular patch, outer corona-lobes bifid into fingerlike teeth, dorsal projection on inner lobe divided into fingerlike processes ..... **Pectinaria**
1. Stems 4-angled, flowers arising in small groups usually from a prominent peduncle or peduncular patch in lower ½ of stem, corona not as above .....
   2. Interior of corolla devoid of hairs, column at least twice as broad as tall, inner corona-lobes scarcely rising above column with prominent, massive dorsal projection and narrow limb adnate to back of anther ..... **Ophionella**
   2. Interior of corolla with stiff, simple hairs, column at least as tall as broad, inner corona-lobes rising high above column, usually meeting in the centre, only touching anthers near their base, dorsal projection far smaller than limb ..... **Stapeliopsis**

PECTINARIA

Pectinaria Haw., Syn. Pl. Succ. 14 (1819); Sweet, Hort. Brit. ed. 1, 276 (1827); G. Don, Gen. Syst. 4: 122 (1837); K. Schum. in Engl. & Prantl, Nat. Pflanzenfam. 4: 281 (1897); Schlechter in J. Bot. 36: 486 (1898), omn. p. p. quoad *P. articulata*; N. E. Br. in Fl. Cap. 4: 867 (1909); Berger, Stap. und Kleinien, 331 (1910); White & Sloane, Stap. ed. 2, 2: 727 (1937); Phillips, Gen. S. Afr. Fl. Pl.: 505 (1951); R. A. Dyer, Gen. Southern Afr. Fl. Pl. 1: 495 (1975); Bayer & Plowes in Excelsa 5: 76 (1975); Bayer in J. S. Afr. Bot. 41 (3): 163 (1975). Species typica: *P. articulata* (Aiton) Haw.

DESCRIPTION. *Stems* 6-angled, subglobose, tubercles prominent with very small teeth, procumbent, forming mats, 2–8 cm. long. *Flowers* solitary or rarely in pairs, arising between angles near the stem apex without any peduncle or peduncular patch. *Pedicel* variable in length, up to 35 mm. long. *Corolla* either expanded, not papillate (sect. *Erectiflora*), or lobes joined at tips and inside of corolla densely covered with prominent papillae (sect. *Pectinaria*); *tube* variable in length, in sect. *Erectiflora* very small, scarcely containing column, usually deeply conical in sect. *Pectinaria*; *lobes* variable in shape, often with margins conspicuously folded. *Corona*: *outer lobes* bifid into two slightly diverging, erect to semi-erect horns, joining to dorsal projection of inner lobes; *inner lobes* adnate to backs of anthers, limb approx. deltoid, sometimes much reduced to a small protuberance, dorsal projections divided into numerous semi-erect, fingerlike processes which form a 'pectinate' (comb-like) ring with the outer lobes. *Pollinia* usually ovoid-elliptic, pellucid margin along shorter side, 0.22 mm. long, 0.14 mm. broad (approx. circular in *P. maughanii*, 0.22 mm. diam.).

All the species of this genus inhabit the drier inland areas of the Cape Province (see fig. 1) and generally appear to prefer the eastern edge of the winter rainfall area, often existing on the fringe zones which receive a moderate amount (by Karoo standards) of summer rainfall as well. This latter factor is evidently closely linked with the flowering of these species which generally takes place from September until late December.

In the Western Cape, to which this fairly compactly distributed genus is restricted there are only a few other genera to which it could be related. I have dealt (in Asclepiadaceae No. 16. 1979) with the relation of *P. longipes* and *P. maughanii* to the remaining species of *Caralluma* in the Western Cape. This same relation now holds, by the inclusion of these two species in *Pectinaria*, between *Pectinaria* and *Caralluma* and need not be further amplified here. As far as the species of *Caralluma* over the rest of Africa are concerned there also appears to be little, if any, affinity with *Pectinaria*. White & Sloane (p. 287) mention that the corona of *C. piaranthoides* Oberm. (now *C. schweinfurthii* Bgr.) is very close to that of *P. articulata* subsp. *asperiflora*. However, this species with its 4-angled stems and conspicuous, widely separated, acute tubercles is vegetatively unacceptable as a member of *Pectinaria*. Its affinities almost certainly lie with the subtropically distributed genera *Orbeopsis* and *Pachycymbium* and the isolated and actually only superficial similarity of the staminal column to that of the temperate-Mediterranean distributed *Pectinaria* is not relevant here.

Two other genera, *Duvalia* and *Piaranthus*, in which the stems are small, essentially subglobose and 'mat-forming' could conceivably be related to *Pectinaria* by these features and geographic proximity. However, the very distinctive structure of the flower and the rather conspicuous tooth on each tubercle (often with two denticles on either side of it)—particularly observable in the young shoots—found in *Duvalia* rule out any close relation between this genus and *Pectinaria*.

Stems of *Piaranthus* and those of *Pectinaria* also cannot be confused. Those of the former are more or less exclusively 4-angled with far fewer, more widely spaced tubercles than those of the latter. The flowers are larger (with the exception of *P. parvulus* N. E. Br.) than those found in *Pectinaria* and in all species there is the formation of a peduncle or peduncular patch not found in *Pectinaria*.

In comparison to the relatively obvious relation between, for example, *Orbea* and *Orbeopsis*, it is difficult to speculate on the phyletic relationship of *Pectinaria* to other Stapeliad genera. The somewhat tesselate stems and approximately similar flowering habit suggests that *Pectinaria* may represent an offshoot of the pan-African genus *Echidnopsis*. The small, 'mat-forming' stems could suggest a derivation from one of the other small-stemmed genera mentioned above. That a phyletic relationship is difficult to suggest is probably just another manifestation of the extreme complexity of the flora of the Western Cape.

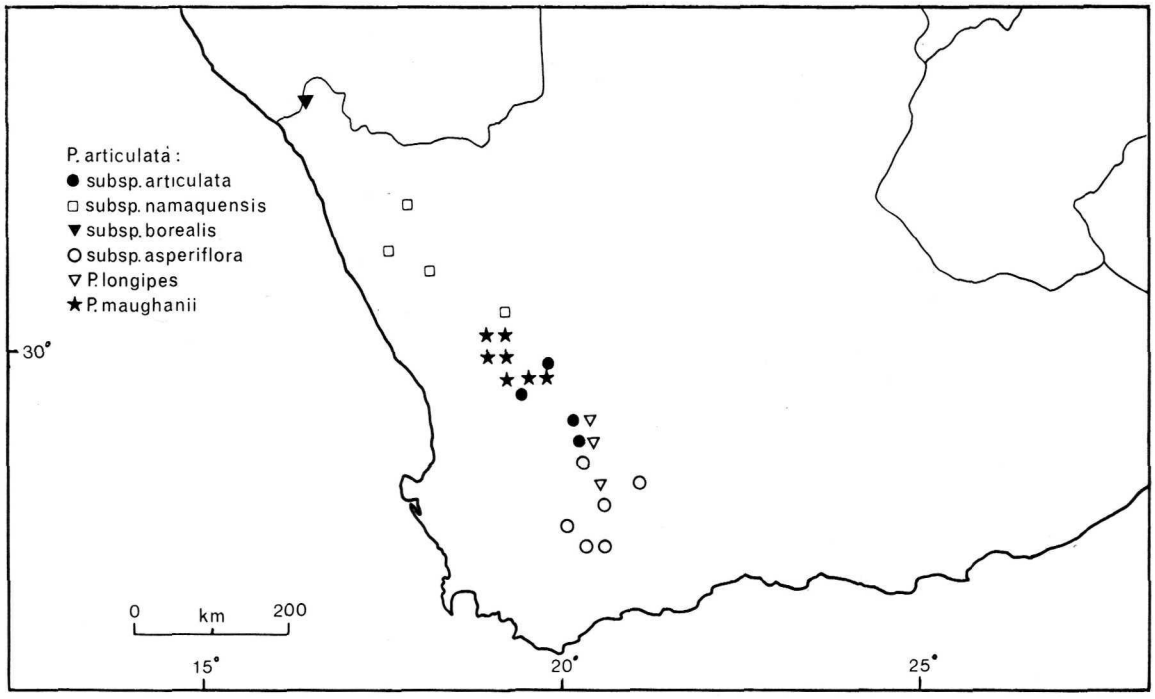

Fig. 1. Distribution of Pectinaria Haw.

KEY TO SECTIONS OF PECTINARIA

1. Pedicel short and stout, corolla lobes joined at tips, inner face of corolla papillate ..... sect. **Pectinaria**
1. Pedicel long and slender, corolla lobes free at tips, inner face devoid of papillae ..... sect. **Erectiflora**

Pectinaria sect. **Pectinaria,** *lobis corollae intus dense papillatis, apice conjunctis, papillis spiculatis. Species typica: P. articulata* (Ait.) Haw.

Section *Pectinaria* includes the three taxa previously in *Pectinaria* and is characterized by having the corolla-lobes united at their tips and the inner face of the corolla densely papillate with prominent, spiculate papillae while the exterior is covered with glabrous papillae. The flowers are generally borne on a short, stout pedicel held close to the stem.

Pectinaria sect. **Erectiflora** Bruyns, **sect. nov.,** *lobis corollae patentibus, apice liberis, intus spiculatis haud papillatis. Species typica: P. longipes* (N. E. Br.) Bruyns.

In the section *Erectiflora* the species *Caralluma longipes* and *C. maughanii* are included. These are easily distinguished from those in the previous section by the fully expanded corolla, devoid of papillae both inside and outside, but covered in fine spicules. In general the flowers are held well above the stem by an elongated, fairly slender pedicel but this is not always the case and occasionally the pedicel may be quite short.

KEY TO SPECIES AND SUBSPECIES

Sect. **Pectinaria**

1. Papillae in tube widely interspaced, spicules on papillae round-topped; margin of corolla-lobe only slightly folded to give V-shaped cross-section ..... 2.
1. Papillae in tube densely crowded, with sharp-pointed spicules: margin of corolla-lobe folded back so as to touch exterior of lobe ..... 3.
2. Corolla-tube occupying all or almost all of length of corolla ..... 1a. **P. articulata** subsp. **articulata**
2. Corolla-tube occupying ½ length of corolla 1d. **P. articulata** subsp. **borealis**
3. Interior of corolla with columnar papillae; corolla-tube almost ½ as long as lobes or longer 1b. **P. articulata** subsp. **asperiflora**
3. Interior of corolla with dome-like papillae; depth of corolla-tube less than a quarter the length of lobes 1c. **P. articulata** subsp. **namaquensis**

Sect. **Erectiflora**

1. Corolla-lobes deltoid-ovate; inner corona-lobes reduced to small rounded bump leaving anthers entirely uncovered 2. **P. longipes**
1. Corolla-lobes at least 2× as long as broad; inner corona-lobes covering most of the anthers, meeting or nearly meeting in centre ..... 3. **P. maughanii**

Sect. PECTINARIA

1. **P. articulata** (Ait.) Haw. in Suppl. Pl. Succ.: 14 (1819).

DESCRIPTION. *Stems* prostrate, subglobose, forming dense tufts, 6-angled, up to 6 cm. long and 2 cm. thick, angles rounded with a very small, soft point on each tubercle. *Flowers* solitary or rarely two, arising between angles near apex of stem, usually on young tissue. *Pedicel* 2–15 mm. long, variously oriented, stout (about 1.5 mm. thick). *Sepals* acute, about 2 mm. long. *Corolla* truncate and flat-topped to conical, 5–8 mm. diam. at widest, exterior densely to sparsely covered with rounded, glabrous papillae, interior with variously shaped, crystalline, spiculate papillae, colour purplish-brown, reddish-brown or pale yellow; *tube* 1–3.5 mm. long, very shallow to shortly conical or bowl-shaped, reaching maximum width at mouth; *lobes* joined at tips, 1.7–6 mm. long, margins slightly to considerably folded back. *Corona* about 2 mm. in diam. across top; *outer lobes* bifid into 2 finger-like, erect to semi-erect, slightly diverging lobes, joined about ½ way up to the inner lobes, 0.3–0.4 mm. long; *inner lobes* adpressed to backs of anthers, limb 0.3–0.4 mm. long, deltoid to truncate, dorsal projection divided up into finger-like parts forming a ring around the column with the outer lobes. *Anthers* laterally flattened with rectangular upper surface, often entirely hidden under limb of inner corona lobes. *Pollinia* 0.2–0.22 mm. long, 0.14 mm. broad, pellucid margin on shorter side.

Four subspecies are recognized:

a. subsp. **articulata**

Pectinaria articulata (Ait.) Haw. in Suppl. Pl. Succ.: 14 (1819); K. Schum. in Engl. & Prantl, Pflanzenfam. 4(2): 281 (1897); Schlechter in J. Bot. 36: 486 (1898); N. E. Br. in Fl. Cap. 4: 867 (1909); Berger, Stap. und Kleinien, 331 (1910); White & Sloane, Stap., ed. 2, 2: 727 (1937); Luckhoff, Stap. S. Afr.: 160 (1952); Jacobsen, Handb. Succ. Pl. 2: 721 (1960) et Lexicon Succ. Pl., 314 (1974); Bayer & Plowes in Excelsa 5: 76 (1975); Bayer in J. S. Afr. Bot. 41(3): 163 (1975).

Stapelia articulata Ait., Hort. Kew., ed. 1, 1: 310 (1789); Ait. f., Hort. Kew., ed. 2, 2: 90 (1811); Masson, Stap. Nov., 20, t. 30 (1796); Thunb., Travels, ed. 3, 2: 171 (1795); Willd., Sp. Pl. 1: 1287 (1797); Persoon, Syn. Pl. 1: 279 (1805); Haw., Syn. Pl. Succ., 27 (1812); Schultes, Syst. Veg. 6: 26 (1820); Spreng., Syst. Veg. 1: 841 (1824); Decne. in DC., Prodr. 8: 663 (1844). Type: The description was based on a plant cultivated at Kew. No specimen was preserved and Tab. 30 of Masson, Stap. Nov. (1796) is selected as neotype.

DESCRIPTION. *Pedicel* 5–15 mm. long, usually parallel to ground but holding flower facing upwards. *Corolla* flat-topped, ± bowl-shaped, 5–8 mm. diam., densely papillate and purplish-brown outside (pale yellow in Calvinia form which is sparsely papillate outside), inside deep purple (pale yellow in Calvinia form), densely covered with crystalline, columnar papillae, 0.25–0.3 mm. in height, covered with round-topped, transparent spicules; *tube* 2.5–3.5 mm. long and as wide at the mouth as diam. of corolla, bowl-shaped to very slightly conical; *lobes* joined at their tips at a point within tube, 2.5–3.5 mm. long, 3–3.5 mm. broad at base, margins folded back only very slightly (to give V-shaped cross-section near their middle). *Corona* dark-purple (pale yellow in Calvinia form); *inner lobes:* limb about 0.4 mm. long, deltoid with rounded tip.

DISTRIBUTION. CAPE: 3119 (Calvinia): Calvinia (–BD), without precise locality, fl. 1974, light yellow form, *Hanekom* 2323 (PRE); 2 miles S. of Calvinia (–DA), fl. Dec. 1975, light yellow form, *Bruyns* 1161 (NBG). 3220 (Sutherland): 'Fransplaas' (–AB), fl. 1920 *Marloth* 9804 (PRE); 'Voëlfontein' (–AD), *Hall* 3320 (NBG); Bovis R. (–AB), *Bayer* 814 (NBG); S. of Noudrift (–AB), *Bayer* 815 (NBG).

As already noted (Bayer & Plowes, 1975), the plant described by Aiton as *P. articulata* was not preserved, but the drawing by Masson, Stap. Nov. t. 30 (1796) is generally considered to be conspecific and is selected as a neotype. Plants resembling this drawing have recently been introduced into cultivation. It is not clear on what basis Marloth identified his specimen, no. 9804, but this represents the same taxon as *Hall* 3320.

Contrary to the opinion of Bayer & Plowes (1975), N. E. Brown was aware of the presence of numerous papillae within the corolla ('. . . pearly-papillate and blackish-red within . . .'). This information was known to Haworth (who saw plants in cultivation) and in fact the description by Brown in the Flora Capensis is that of Haworth, as Brown never saw live or preserved material of this species (Brown, 1909). Furthermore, Haworth (and consequently Brown) made no comment on the shape of the corolla of subsp. *articulata* and Brown only commented on this in the case of his var. *namaquensis* (cf. Bayer & Plowes, l.c.). Unfortunately Masson's drawing does not include a flower in side view which would have clarified the identity of '*articulata*' in terms of the taxa known today. However, a notable feature of the drawing is that the lobes show very little reflection of the margins (despite what Brown says in the description—'with reflexed margins'). As this is almost exactly as in *Hall* 3320 and as no other related taxon with a similar feature is known from that region, it is felt that the Roggeveld collections represent that taxon depicted by Masson.

This subspecies (see fig. 2) is usually clearly distinguishable from the others by the manner in which the flower is held opening upwards and by the peculiar truncated appearance of the corolla caused by the lobes bending back into the tube and being joined at their tips within the tube. However, neither of these characters is completely reliable and in particular it is found that flowers of the pale yellow form from Calvinia have the lobes meeting sometimes within the tube, sometimes at the mouth and very occasionally slightly outside the tube as well. In both the pale yellow and the typical dark form the papillae inside the corolla are large and columnar and are entirely covered with small, round-topped spicules.

The typical subspecies is not common except in a small area to the north-west of Sutherland. Here it sometimes occurs with *P. longipes* and hybridization between these two species appears to take place. The pale yellowish form already referred to is known from a few miles south of Calvinia but it appears to be restricted to this vicinity.

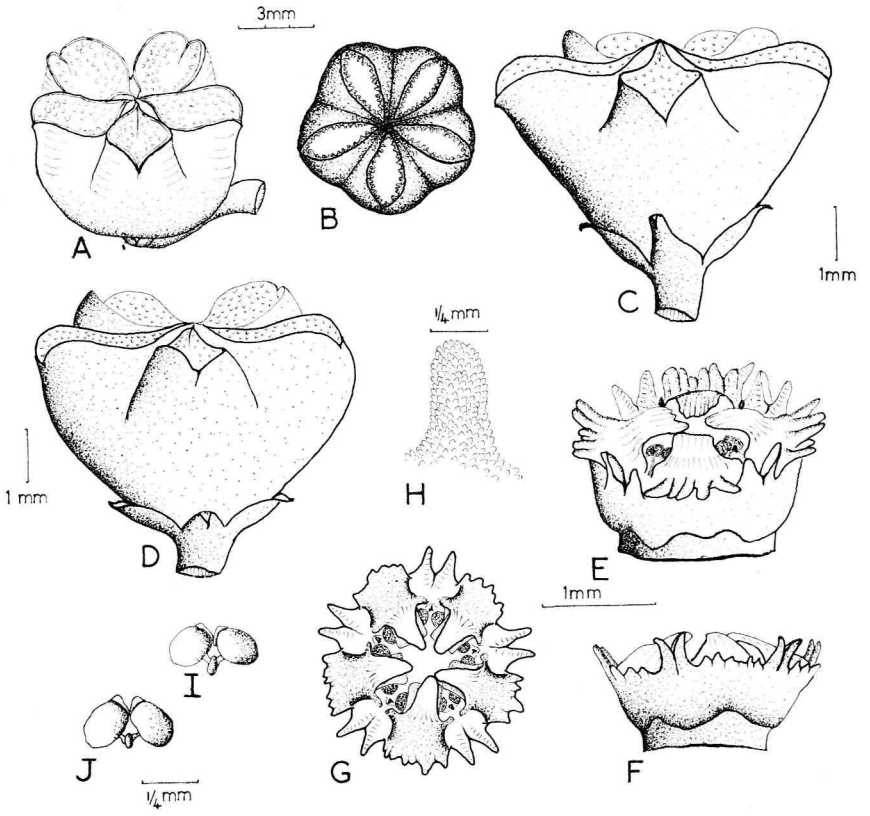

Fig. 2. **Pectinaria articulata** subsp. **articulata.**
A, oblique view of flower;
B, face view of flower;
C, D, side view of flower (yellow form);
E, oblique view of staminal column;
F, side view of staminal column (yellow form);
G, face view of staminal column (yellow form);
H, papilla from inside of corolla;
I, pollinia;
J, pollinia (yellow form).
A, B, E, H, from *Bruyns* 978.
I, N, from *Bruyns* 981.
C, D, G, J, from *Bruyns* 1161.

b. subsp. **asperiflora** (N. E. Br.) Bruyns, **stat. nov.**
Pectinaria asperiflora N. E. Br. in Fl. Cap. 5(1): 871 (1909); Berger, Stap. und Kleinien, 336 (1910); Marloth, Fl. S. Afr. 3(1): 96, t. 22 (1932); White & Sloane, Stap., ed. 2, 2: 737 (1937); Luckhoff, Stap. S. Afr., 162 (1952); Jacobsen, Handb. Succ. Pl. 2: 721 (1960) et Lexicon Succ. Pl., 314 (1974); Bayer & Plowes in Excelsa 5: 76 (1975); Bayer in J. S. Afr. Bot. 41(3): 163 (1975). Type: 2 miles NW Matjiesfontein, Jan. 1904, *Pillans* 70 (BOL!).

DESCRIPTION. *Pedicel* decurved and holding flower facing downwards. Corolla conical, 6–8 mm. diam., outside densely papillate inside deep purple with columnar papillae covered with small sharp-pointed spicules; *tube* 2.3–3.2 mm. long, widest point of corolla not at mouth but a little further out along lobes, conical; *lobes* joined at tips at a distance of up to 5 mm. from tube mouth, 3.6–6 mm. long, about 3.5 mm. broad at base, margins sometimes conspicuously folded back so as to touch each other. *Corona inner lobes:* limb 0.3–0.4 mm. long, sometimes deltoid but often truncate with variously incised tip, usually exceeding the anthers in length, dorsal process much incised into erect to semi-erect, fingerlike processes, raised fleshy area often occurring between these processes and limb of lobes.

DISTRIBUTION. CAPE: 3220 (Sutherland): Onderwadrif turn-off on Karoopoort-Sutherland road (–CB), *Bayer* 807 (NBG). 3221 (Merweville): 30 miles S.W. Merweville (–CC), Jan. 1976, *Bruyns* 1257 (NBG). 3320 (Montagu): S. of Nougaspoort, Touws R. (–AC), *Bayer* 1971 (NBG); Constable Stn. (–AC), *Compton* s.n. in NBG 1611/48 (NBG); 2 miles N.W. Matjiesfontein (–BA), Jan. 1904, *Pillans* 70 (BOL); 6 km. E. Matjiesfontein (–BA), June 1974, *Bayer* 808 (NBG); Matjiesfontein (–BA), *Stayner* s.n. in Karoo Garden 558/59 (NBG); Dobbelaars Kloof (–CB), *Hall* s.n. in NBG 331/53 (NBG) & 551/58 (NBG); W. of Kareevlakte (–DA), 1960, *Admiraal* 265 (PRE); Kareevlakte (–DA), *Hall* s.n. in NBG 350353 (NBG); Anysberg Pass (–DA), *Bayer* 799 (NBG).

The most widely distributed taxon in *Pectinaria*, this subsp. (see fig. 3) is found on the eastern edge of the Ceres Karoo, in the south-west of the Great Karoo from Constable Station to near Merweville and on the Little Karoo south of Laingsburg and east of Montagu. It is most plentiful around Matjiesfontein where it grows in the shelter of the 'doringvy' *Ruschia spinescens*. North of Matjiesfontein it occurs within 5 km. of *P. longipes* but the two species do not appear ever to be sympatric.

Subsp. *asperiflora* is easily recognized by its dependent flowers with the corolla-lobes meeting some distance outside the prominent, conical tube. It is very variable in the shape of the corolla which ranges from being shortly conical to quite elongated and the corolla-lobes may meet at a distance of up to 1.5 times the tube length from the tube-mouth. The papillae inside the corolla are similarly shaped to those of the typical subspecies but are covered with very sharply spinescent spicules as opposed to the round-topped spicules in subsp. *articulata*.

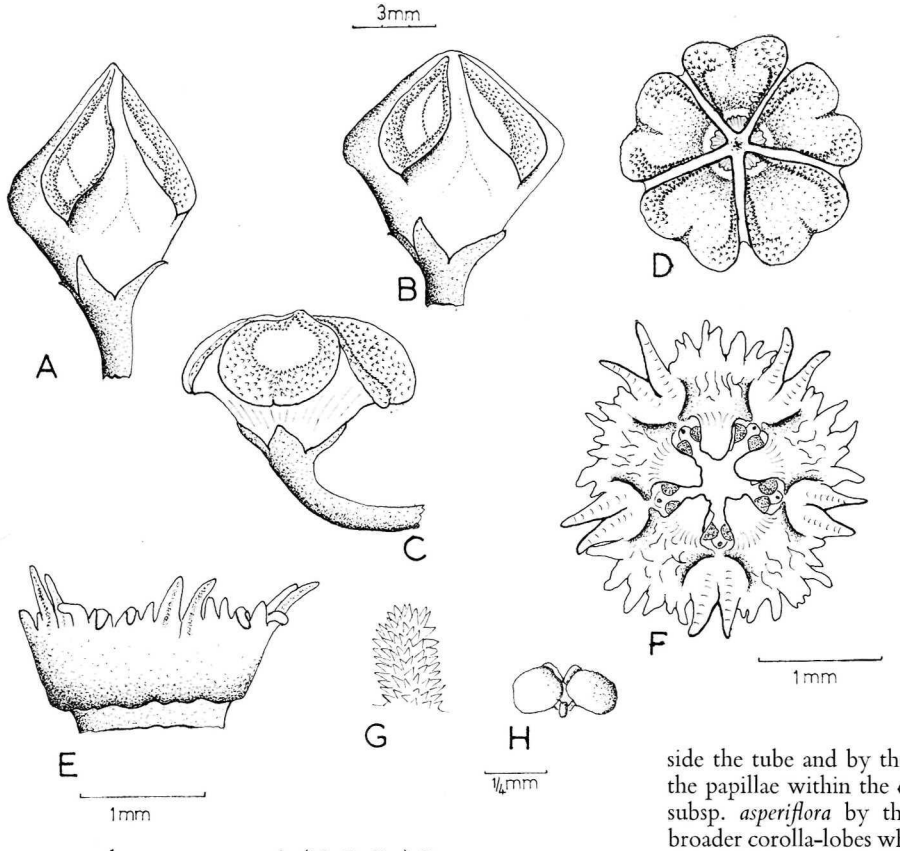

Fig. 3. **Pectinaria articulata** subsp. **asperiflora.**
A-C, side views of flower;
D, face view of flower;
E, side view of staminal column;
F, face view of staminal column;
G, papilla from inner face of corolla;
H, pollinia.
A,B,H, from *Bruyns* 1897.
C,D, from *Bruyns* 1229.
E,F, from *Bruyns* 1237.
G, from *Bruyns* 1257.

c. subsp. **namaquensis** (N. E. Br.) Bruyns, **stat. nov.**
Pectinaria articulata var. *namaquensis* N. E. Brown in Fl. Cap. 5(1): 871 (1909); Berger, Stap. und Kleinien, 336 (1910); White & Sloane, Stap. ed. 2, 2: 736 (1937); Jacobsen, Handb. Succ. Pl. 2: 721 (1960) et Lexicon Succ. Pl., 314 (1974); Bayer & Plowes in Excelsa 5: 76 (1975); Bayer in J. S. Afr. Bot. 41(3): 164 (1975). Type: Little Namaqualand, *Templeman sub Pillans* 22 (BOL!).

DESCRIPTION. *Flowers* usually facing horizontally or upwards in Loeriesfontein form. *Pedicel* 2–10 mm. long. *Corolla* shortly conical, usually about 5 mm. diam., pale greyish-yellow or dark reddish-purple, inside densely covered with rounded, dome-like papillae, 0.15–0.2 mm. tall, covered with spinescent, transparent spicules; *tube* just containing staminal column; *lobes* almost as long as corolla, margins strongly folded back so as to touch each other near tip of lobe, leaving only small opening to corolla interior. *Corona inner lobes:* divisions of dorsal projections projecting outwards almost horizontally.

DISTRIBUTION. CAPE: 2918 (Gamoep): 30 km. S.E. of Springbok (-CA), *Wisura* 2921 (NBG); 18 km. S.E. of Springbok (-CA), *Bayer* 807 (NBG). 3017 (Hondeklip Bay): Khamieskroon (-BB), without precise locality, *Villet* s.n. in Karoo Garden 150/59 (NBG). 3018 (Khamiesberg): Platbakkies (-AD), Nov. 1973, *v. Breda* s.n. (NBG). 3019 (Loeriesfontein): S. of Loeriesfontein (-CD), *Bruyns* 1344 and 1504 (NBG).

Subspecies *namaquensis* (see fig. 4) is distinguished from subsp. *articulata* by the somewhat conical shape of the flower with the tips of the corolla-lobes joined outside the tube and by the sharply spinescent spicules on the papillae within the corolla. It is distinguished from subsp. *asperiflora* by the more flattened flower with broader corolla-lobes which occupy over ¾ of the length of the corolla and by the corolla-tube which is very short and often scarcely visible. The papillae within the corolla-tube are generally very broad and dome-like as opposed to the columnar papillae in the other two subsp. The possibility has been considered that these highly flattened papillae may be sufficient (with the other above-mentioned differences) to characterize this element as a species distinct from the other subspecies. However, specimens have been observed in which these papillae become fairly tall and columnar around the staminal column and so subspecific rank is more appropriate.

The typical form of this subspecies, with pale yellow-green flowers, is confined to the western perimeter of Bushmanland occurring from south of Platbakkies to about two miles east of Springbok. It is not uncommon on the slopes and plateaux of the granitic mountains around Springbok, but it does not appear to come west of Springbok at all. It inhabits a somewhat different terrain in Bushmanland between Gamoep and Platbakkies where it grows (albeit in granitic soils) in the flats under *Ruschia spinescens* usually on rockier, slightly raised ground.

A dark reddish-purple flowered form of this taxon is also known from the vicinity of Loeriesfontein (*Bruyns* 1504). In this form the flowers usually face upwards but there are no further significant differences from the typical form.

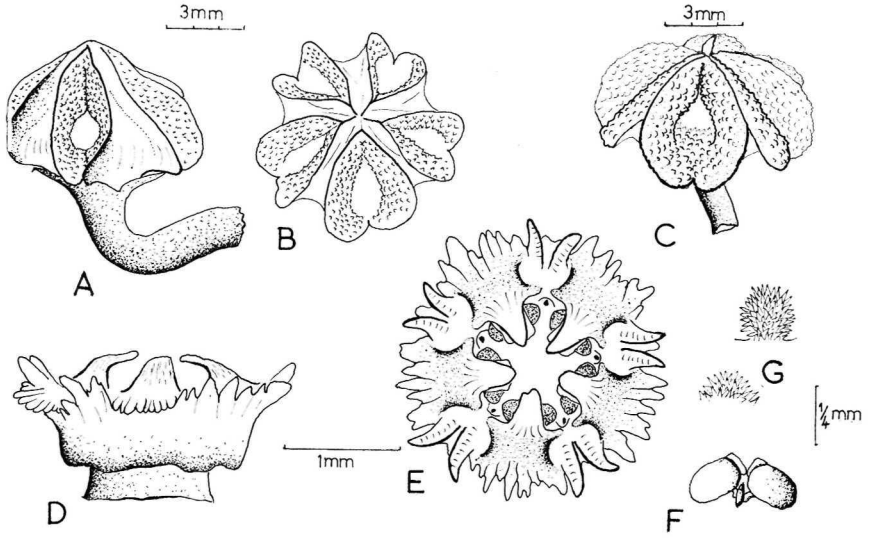

Fig. 4. **Pectinaria articulata** subsp. **namaquensis.**
A,C, side view of flower;
B, face view of flower;
D, staminal column, side view (anthers and pollinia omitted);
E, staminal column, front view;
F, pollinia;
G, papillae from different parts of interior of flower.
A,B,F, from *Bruyns* 1670.
C, from *Bruyns* 1504 (dark form).
D,E,G, from *Bruyns* 1340.

d. subsp. **borealis** Bruyns, **subsp. nov.;** *a subspecie typica tubo ½ longitudinis corollae occupante discedit et a ceteris subspeciebus spiculis papillis apice rotundatis differt. Holotypus*: Cape, Hellskloof, Richtersveld, *Bayer* 1506 (NBG).

DESCRIPTION. *Flowers* facing upwards. *Corolla* 3.5 mm. long, 7 mm. broad, ½ of length occupied by tube, exterior densely covered with rounded, glabrous papillae, interior with spaced, columnar papillae covered with round-topped spicules, dark purple-brown. *Corona*: outer lobes forming relatively large, clear-cut pockets between dorsal projections of inner lobes.

This new subspecies (see fig. 5), first discovered by H. R. Tölken and E. G. H. Oliver, is probably closest related to subsp. *namaquensis* on account of the similar, shortly conical flower and the relative geographical proximity of this subspecies. However, it is readily distinguished from this subspecies by the longer corolla-tube and the much longer, columnar papillae covered with round-topped spicules found inside the corolla. In this latter feature it is similar to subsp. *articulata* but is distinguished from it by the far shorter corolla-tube.

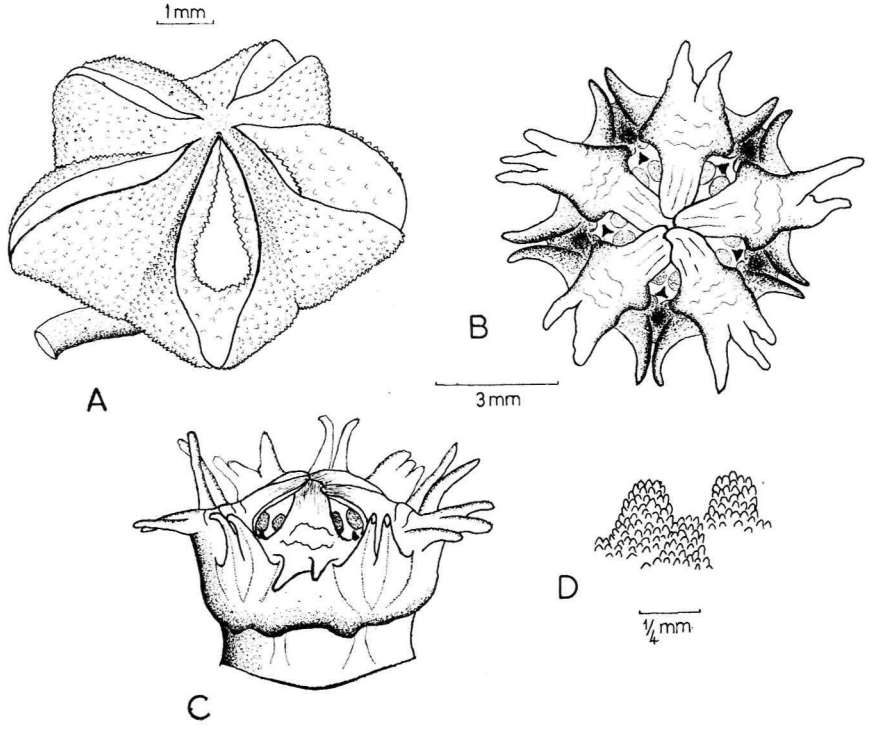

Fig. 5 **Pectinaria articulata** subsp. **borealis.**
A, oblique view of flower;
B, staminal column, front view;
C, staminal column, side view;
D, papillae.
All from *Bayer* 1560.

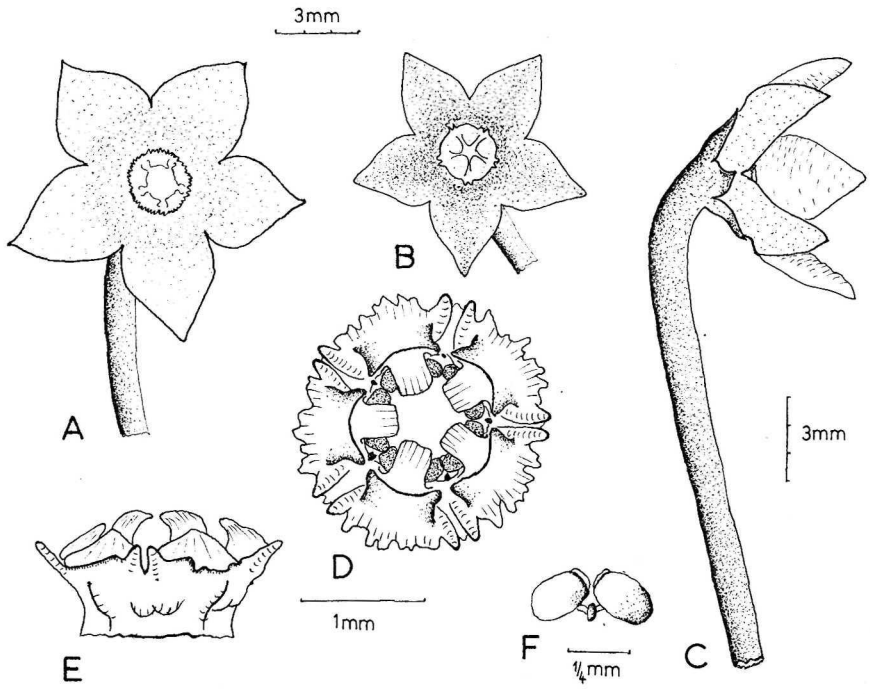

Fig. 6. **Pectinaria longipes.**
A,B, face view of flower;
C, side view of flower;
D, face view of staminal column;
E, side view of staminal column;
F, pollinia.
A,D,F, from *Bruyns* 1406.
B,C,E, from *Bruyns* 982.

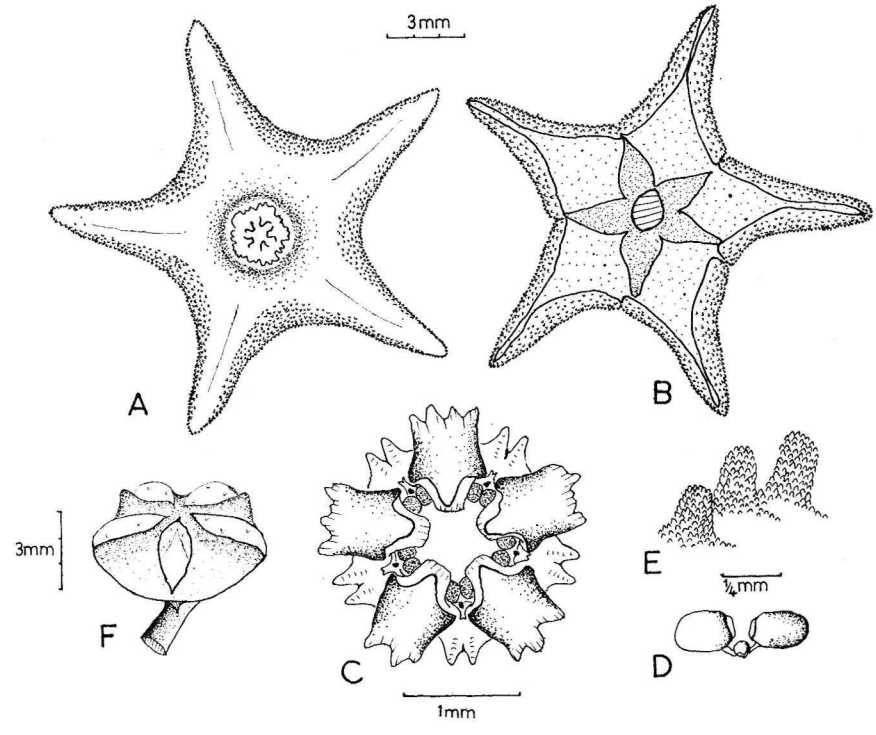

Fig. 7. **Pectinaria longipes** x **P. articulata** subsp. **articulata.**
A, face view of flower;
B, rear view of flower;
C, staminal column, face view;
D, pollinia;
E, papillae on inner surface of corolla;
F, oblique view of other putative hybrid from the same locality mentioned in the text.
A-E, from *Bruyns* 1168.

Sect. ERECTIFLORA

2. **P. longipes** (N. E. Br.) Bruyns, **comb. nov.**

Caralluma longipes N. E. Br. in Fl. Cap. 4(1): 887 (1909); Berger, Stap. und Kleinien, 131 (1910); Marloth, Fl. S. Afr. 3(1): 98, t. 23, fig. 49 (1932); White & Sloane, Stap. ed. 2, 1: 282 (1937); Jacobsen, Handb. Succ. Pl. 1: 249 (1960) et Lexicon Succ. Pl., 126 (1974). Type: Near Sutherland, coll. 1905, fl. 1906, *Marloth* 3799 (BOL!, PRE!)

DESCRIPTION. *Stems* prostrate, mat-forming, up to 6 cm. long, 1–1.5 cm. in diam., 6-angled, angles armed with a pointed, very rarely hard tooth, brownish-green. *Flowers* usually solitary, arising near apex of the stem on young growth. *Pedicel* 1–3.5 cm. long, erect then bending at top to hold flower horizontally, slender, up to 1.2 mm. thick. *Sepals* about 2 mm. long, shortly acute. *Corolla* 8–12 mm. diam., flat, yellow, covered with very fine translucent spicules; *tube* small, just containing column; *lobes* spreading, deltoid to broadly ovate-deltoid, margins not folding back, 2.5–3 mm. long, 2.5–3 mm. broad at base, yellow ('with green tips' fide Marloth, but I have never seen flowers with this change of colour on the tips of the lobes). *Corona* yellow-orange, about 2 mm. diam. across top; *outer lobes* each bifid (sometimes only very slightly) into 2 semi-erect, somewhat cylindrical lobes, 0.3–0.4 mm. long, joining near their tip to the dorsal projection of the inner lobe; *inner lobes:* limb reduced to a tiny bump just touching the back of the anther near its base or lacking, dorsal projections divided into numerous small rounded processes or hardly at all. Anthers ± rectangular, flat-topped, entirely exposed. *Pollinia* as for genus.

DISTRIBUTION. CAPE: 3220 (Sutherland): Near Sutherland, coll. 1905, fl. 1906 *Marloth* 3799 (BOL, PRE); near 'Noudrift' (–AB), *Bayer* 825 (NBG); 'Voëlfontein' (–AD), 1968 *Hall* 3321, 3341 (NBG); 40 miles S. of Sutherland (–DC), *Leighton* s.n. in NBG 862/64 (NBG) & Sept. 1954, *Leighton* 3205 (BOL); N. of Matjiesfontein (–DC), *Hall* s.n. in NBG 254/55 (NBG).

P. longipes (see fig. 6) is a very distinct species recognizable by its yellow flowers nodding on the end of an often disproportionately long pedicel. The flower faces horizontally on the erect pedicel and the corolla-lobes are ovate-deltoid without any folding of the margins. In all specimens examined the limb of the inner corona-lobe was reduced to a slight bump or was missing and the anthers were entirely exposed on the top of the column. The dorsal projection of the inner corona-lobe is also much reduced to a dentate lump, but the 'pectinate' ring formed by it and the outer corona is still discernible.

It is interesting to note that at a locality where *P. longipes* and *P. articulata* grow together, plants of probable hybrid origin occur. In one the colour and shape of the corolla are essentially that of *P. articulata* subsp. *articulata* but the flower is held facing horizontally on an erect slender pedicel and the inner surface of the corolla has only a very small number of the large papillae typical of *P. articulata*. In the other plant collected the flower is almost white but the orientation and shape the same as that of *P. longipes* except for considerable folding of the corolla-lobe margins. Also on the face of the corolla are numerous large, columnar papillae with spicules exactly as in subsp. *articulata* (see fig. 7).

This species occurs on the Roggeveld plateau around Sutherland and on some of the nearby higher ranges. It does not appear to occur much further north than the Bo-Vis River region but comes as far south as the Klein Roggeveld Mountains, some 50 miles south of Sutherland. The Koedoesberge form the western limit of the range, where it is uncommon.

3. **Pectinaria maughanii** (R. A. Dyer) Bruyns, **comb. nov.**

Caralluma maughanii R. A. Dyer in Rec. Alb. Mus. 4(1): 115 (1931); White & Sloane, Stap., ed. 2, 1: 283 (1937); Luckhoff, Stap. S. Afr., 36 (1952); Jacobsen, Handb. Succ. Pl. 1: 251 (1960) et Lexicon Succ. Pl., 127 (1974). Type: Near Nieuwoudtville, fl. Jan. 1929, *Maughan Brown* 20 (GRA!).

DESCRIPTION. *Stems* prostrate to semi-erect, forming mats, up to 8 cm. long, 1–1.5 cm. in diam., 6-angled with a pointed but rarely hard tooth on each tubercle, green to brownish-green. *Flowers* usually solitary on young growth. *Pedicel* slender, erect, holding flower facing upwards, 5–25 mm. in length. *Sepals* 2 mm. long, acute, lanceolate. *Corolla* 12–16 mm. diam. with shallow tube containing the staminal column, entire surface covered with fine, transparent spicules, not papillate; *lobes* 5–7 mm. long, about 2.5 mm. broad at base, margins considerably replicated, sometimes uniform deep yellow in colour, often with lower quarter of lobes and tube reddish-purple. *Corona* uniformly dark purple-black; *outer corona lobes* bifid into slender, diverging, cylindrical horns up to 1 mm. long, joining about ¾ way down their length to the dorsal processes of the inner lobes; *limb of inner lobes* adnate to backs of anthers, often very broad and overlapping in the centre or deltoid and not quite meeting in the centre, apex usually irregularly emarginate, dorsal projection divided up into (usually) 3 fingerlike, horizontally projecting processes almost as long as the outer lobes (sometimes only divided into numerous short processes). *Anthers* entirely or almost entirely hidden. *Pollinia* approx. circular in outline, 0.22 mm. diam.

DISTRIBUTION. CAPE: 3119 (Calvinia): N. of 'Grasberg' (–AA), *Bruyns* 1095 (NBG); 10 km. N. of Grasberg (–AA), 1974, *Wisura* 2905 (NBG); 60 km. SE. of Loeriesfontein (–AB), *Bruyns* 1346 (NBG); near Nieuwoudtville (–AC), fl. Jan. 1929, *Maughan Brown* 20 (GRA); 17 km. E. of Nieuwoudtville (–AD), 1962, *Barker* 9808 (NBG); 22 km. E. of Nieuwoudtville (–AD), *Bruyns* 1105 (NBG); 10 km. N. of Botterkloof Pass (–CB), *Bruyns* 1066 (NBG); Bloukrantz Pass (–DA), *Acocks* 18246, photograph only (PRE); 'Nooiensrivier' (–DB), *Bruyns* 1114 (NBG).

This species (see fig. 8) is again easily recognizable and is certainly the most attractive member of the genus when in flower. It is characterized by the upright habit of the flowers which (as in *P. longipes*) are held erect but in this case face upwards as well. In this species the corolla-lobe margins show considerable replication and the lobes are at least twice as long as broad, as opposed to the deltoid lobes of *P. longipes*. Further differences are to be found in the staminal column. Here the teeth of the 'pectinate' ring are considerably fewer in number and longer than those in *P. longipes* (or in any other species of *Pectinaria*), and the anthers are exposed only near their tips or not at all.

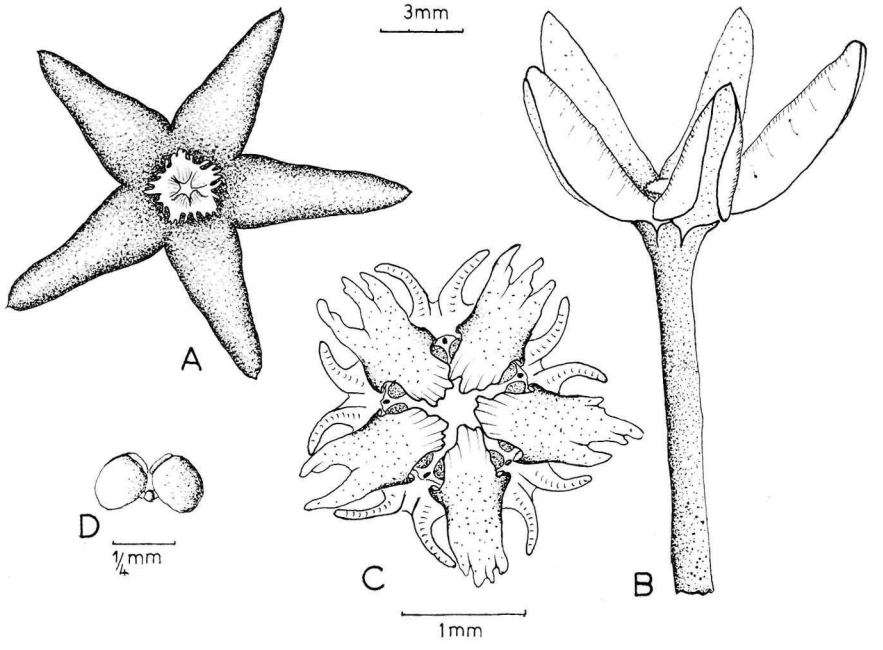

Fig. 8. **Pectinaria maughanii.**
A, face view of flower;
B, side view of flower;
C, face view of staminal column;
D, pollinia.
All from *Bruyns* 1114.

P. maughanii is confined to the Nieuwoudtville plateau and the highlying region to the east and north-east of this, west of the Hantam Mountains. It also extends as far south as Botterkloof Pass and about 30 km. south of Calvinia in the east.

Doubtful Taxon

Luckhoff, in 1938, described *Caralluma longipes* var. *villetii* (Luckhoff in S.A. Gardening 28(4): 227 (1938) et in Stap. S. Afr., 36 (1952)). No type specimen of this variety has been found—the type (near Loeriesfontein, *Villet* in *Luckhoff* 263) having vanished with the Luckhoff herbarium. There is, however, a painting of it in the Bolus Herbarium by Dr C. T. Villet which confirms some facts about it. The very small (5–6 mm. diam.) corolla faces upwards on an erect but short pedicel with the corolla-lobe margins slightly folded back and the lobes at most twice as long as broad at the base. Unfortunately the staminal column is rather stylized and all that one can reliably conclude from it is that the limb of the inner corona lobe is adnate to the back of the anther for a short distance. Villet mentions in a footnote to the painting that the plant came from Nieuwoudtville (!).

This interesting plant seems to have close affinities to *P. longipes* but various features of *P. maughanii* are also to be seen in it—notably the upward-facing flower, the folding of the corolla lobe margins (albeit slight) and the inner corona lobes incumbent on the anthers. As it is not clear to which of the two species it is more closely related and as no specimens (preserved or live) exist to my knowledge this taxon is omitted from this survey.

Excluded Species

Pectinaria mammillaris Sweet=**Caralluma mammillaris** (L.) N. E. Br.

OPHIONELLA

Ophionella Bruyns **genus novum** *Asclepiadacearum* (*Stapelieae*), *hucusque in Pectinaria* Haw. *sensu lato inclusum, a Pectinaria caulibus quadrangulis, floribus e pedunculo ad basim caulis exortis, lobis coronae exterioribus interioribusque annulum pectinatum circa columnam haud efficientibus differt; caulibus angustis, angulis complanatis, apice caulium terram penetrante, corolla intus haud ciliata, columna staminali minimum bis latiore quam altiore, coronae lobis interioribus gibbositate magna lataque ornatis et limbo angusto ad antheras arcte incumbente, a Stapeliopside* Pillans *differt. Species typica: Ophionella arcuata* (N. E. Br.) Bruyns.

Description. *Stems* 4–25 cm. long, 0.4–0.8 cm. thick, arching-procumbent, with the tips ending under the soil surface, obtusely 4-angled, with flattened tubercles, in younger growth each with a dark tear mark along their base, topped with a very small, scale-like tooth, grey-brown to green-brown, covered with rounded dome-like papillae. *Flowers* 1–4 together arising from each short peduncle or peduncular patch, opening successively, peduncles arising between the angles usually near the base of the stems. *Pedicel* 1–4 mm. long, glabrous. *Sepals* acute to ovate-acute, 0.8–2 mm. long, glabrous. *Corolla* either acuminate from a short ovoid tube or with a broadly cupular tube and short, sometimes diverging lobes, inner surface entirely covered with fine, columnar, round-topped spicules; *tube* ovoid to broadly cupular, about 4 mm. long, 3–7 mm. broad at mouth, purple-red in base, rest creamy-white, fairly prominently thickened at mouth (i.e. at base of corolla lobes); *lobes* 3.5–8 mm. long, 2–4 mm. broad at base, sometimes joined at their tips, usually with an obvious outward projecting fold on either side at their base. *Corona* 2–3.2 mm. broad across top, up to 1.5 mm. tall, bright yellow, occasionally with reddish-purple patches on dorsal projection of inner lobes (in var. *mirkinii*); *outer lobes* truncated, entire, joining to dorsal projection of inner lobes near their base, less than 0.5 mm. long; *inner lobes* with large, thick, subclavate dorsal projection up to 1 mm. long (often with tubercled upper surface), projecting horizontally outwards and not rising much above stigmatic surface with broad base adnate to base of anther, forming a small channel in which

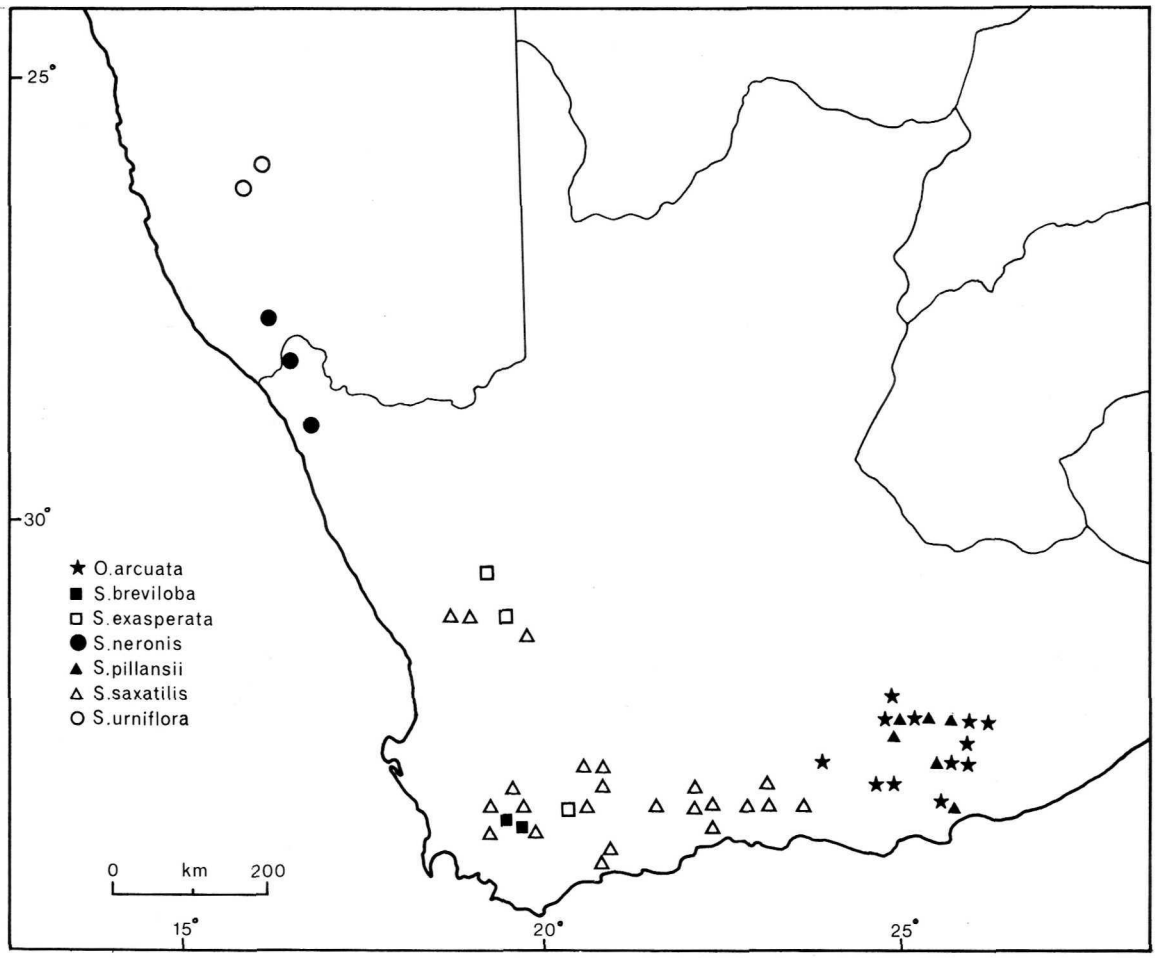

Fig. 9. Distribution of Ophionella Bruyns and Stapeliopsis Pillans

anther wings are situated, with small, narrow limb up to 0.5 mm. long adnate to back of anther, usually exceeding them in length. *Pollinia* ovoid-elliptic, about 0.25 mm. long 0.16 mm. broad with pellucid margin on shorter side.

This monotypic genus has no really obvious affinities with any of the other species originally in *Pectinaria* or with any other genus in the *Stapelieae*. The slightly papillate stems with strongly creeping habit are reminiscent of *Pseudopectinaria malum* Lavranos from Somalia but it seems unlikely that these two genera are actually related.

Ophionella differs from the '*saxatilis*' group by the very narrow, brownish stems with more or less all the terminal buds under the soil surface, the broad, flattened tubercles with a dark tearmark running along their base and the small scale-like teeth topping each tubercle. The flower, pale flesh-coloured outside but with the striking combination of creamy-white and dark purple-red within (an uncommon combination in the *Stapelieae*) is superficially like those in the '*saxatilis*' group. However, the staminal column is very different from that of any member of this group in that the inner corona-lobes are dominated by a broad, massive dorsal appendage not much exceeding the height of the staminal column and with a small limb adpressed to the backs of the anthers. The broad base of the inner lobes entirely covers the lower part of the anthers and leaves only a small channel in which the anther wings are situated. This is actually very similar to *Pectinaria* sensu stricto and in fact the pollinia in these two genera are also very similar. However, there are no further similarities in the flower and this and the vegetative differences make it best to separate *Ophionella* from the present concept of *Pectinaria*.

An unusual feature of this genus is to be observed in the seedling. Here the terminal bud ceases growth very soon and two sideshoots are produced at an angle of about 45 deg. to the main stem but facing downwards.

This downward inclination is obvious after about 2 mm. of shoot has been produced. This is very different from the seedling of any other species of *Pectinaria* sensu lato (and in particular in the case of the stoloniferous species) in which the first pair of sideshoots are produced initially pointing upwards and then bend downwards to the soil surface after some time.

The genus is represented by only one species, *O. arcuata*, of which two varieties are recognized. Both varieties inhabit the eastern part of the Cape Province, the westernmost known point in their distribution being near Willowmore (see fig. 9).

Ophionella arcuata (N. E. Br.) Bruyns, **comb. nov.**
Pectinaria arcuata N. E. Br. in Fl. Cap. 4(1): 870 (1909); Berger, Stap. und Kleinien, 334 (1910); White & Sloane, Stap. ed. 2, 2: 729 (1937); Dyer in Fl. Pl. of S. Afr. 20: t. 774 (1940); Jacobsen, Handb. Succ. Pl. 2: 721 (1960) et Lexicon Succ. Pl., 314 (1974); Bayer & Plowes in Excelsa 5: 77 (1975); Bayer in J. S. Afr. Bot. 41(3): 164 (1975). Type: Cape, south of Bedford, *Pillans* 182 (BOL!).

O. arcuata has never been well-known. Plants are extremely difficult to locate in the field owing to the manner in which the narrow, brownish, snake-like stems become covered with leaf-litter and other debris under the small shrubs beneath which it always grows. However, it is often surprising how large the plants are once they have been ferreted out and I have seen a number of specimens almost a foot in diameter, consisting of vast numbers of stems very densely interwoven and entangled.

KEY TO VARIETIES

1. Corolla-lobes at least 3 times as long as broad at base; corolla-tube as long as or slightly longer than broad 1a. var. **arcuata**
1. Corolla-lobes up to 1.5 times as long as broad at base; corolla-tube at least 1.5 times as broad as long . . . . 1b. var. **mirkinii**

a. var. **arcuata**

DESCRIPTION. *Corolla tube* up to 5 mm. broad near mouth and 4 mm. in length; *lobes* 7–8.5 mm. long, less than 3 mm. broad at base. *Staminal column* about 2.3 mm. broad across top, 1–1.5 mm. tall. Otherwise as for the genus.

DISTRIBUTION. CAPE: 3225 (Somerset East): Eastpoort (–DB), May 1937, *Coetzee* s.n. (BOL); Middleton (–DD), *Reynolds* 2191 (PRE); N. of Middleton (–DD), *Bruyns* 1572 (NBG). 3226 (Fort Beaufort): S. of Bedford (–CA), *Pillans* 182 (BOL); Bedford (–CA), *v. Breda* s.n. (NBG). 3325 (Port Elizabeth): 'Bracefield' (–BA), *Bruyns* 1567 (NBG); W. of Kommadagga (–BB), *Bruyns* 1568.

The typical variety (see fig. 10) seems to be fairly common between Somerset East and Bedford going as far south as the Suurberg Mountains near Kommadagga. It is almost exclusively found in low-lying areas which appear to become seasonally moist (often occuring under *Ruschia* sp. aff. *R. spinescens* or a *Drosanthemum*). It is recognized by the long flower with elongated corolla-lobes arising from a short, approximately ovoid tube and by the somewhat more upright aspect of the dorsal

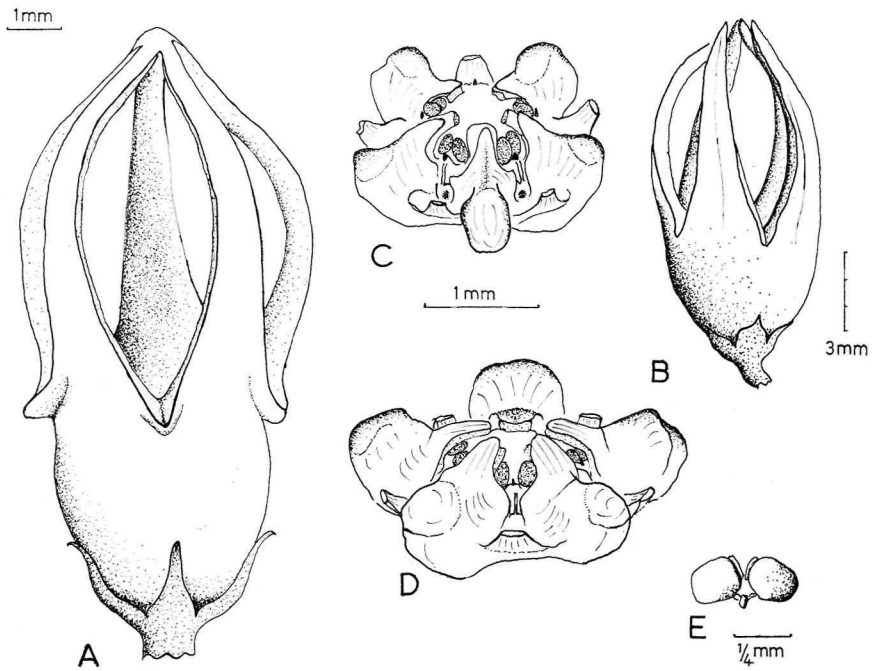

Fig. 10. **Ophionella arcuata** var. **arcuata.**
A, side view of typical flower;
B, side view of flower with somewhat broader tube;
C, oblique view of typical staminal column;
D, oblique view of staminal column of flower in **B** (very similar to that of var. *mirkinii*);
E, pollinia.
A,C,E, from *Bruyns* 1572.
B,D, from *Bruyns* 1567.

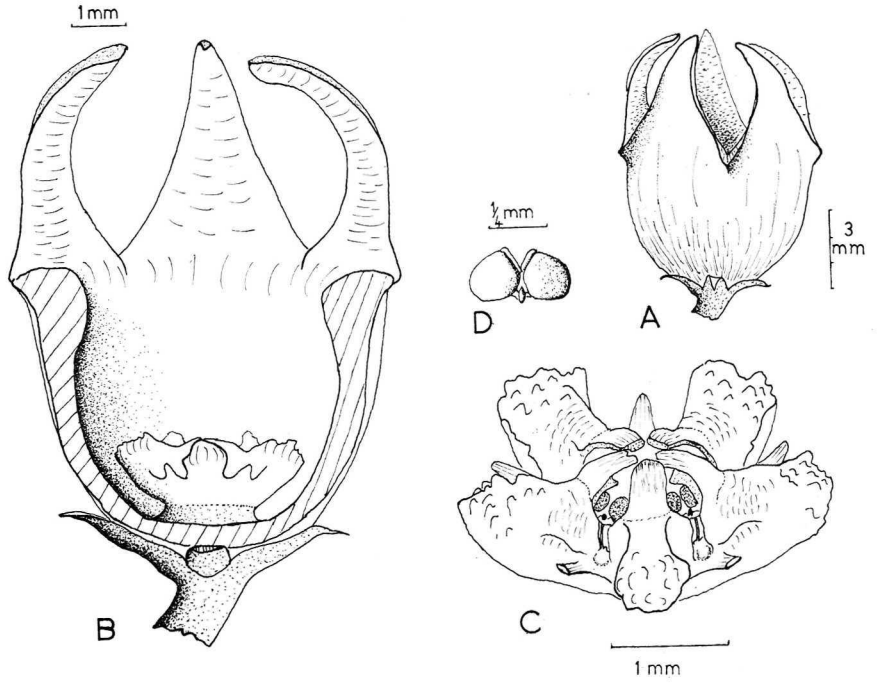

Fig. 11. **Ophionella arcuata** var. **mirkinii.** **A,** side view of flower; **B,** side view with corolla cut away to show staminal column; **C,** oblique view of staminal column; **D,** pollinia. **A,B,C,** from *Bruyns* 1601. **D,** from *Bruyns* 1590.

projections of the inner corona-lobes. Since so few collections have been made it is not possible to assess the extent to which it varies and it appears that intermediates between it and var. *mirkinii* are not known. However, a collection made in 1977, north of the Suurberg Pass (*Bruyns* 1567) was found to have a considerably broader corolla-tube and staminal column than is generally the case in var. *arcuata*, and this may indeed represent such an intermediate form.

b. var. **mirkinii** (Pillans) Bruyns **stat. nov.**

Pectinaria mirkinii Pillans in J. S. Afr. Bot. 5: 64 (1939); Bayer & Plowes in Excelsa 5: 77 (1975); Bayer in J. S. Afr. Bot. 41(3): 164 (1975). Type: Steytlerville, Feb. 1939, *Mirkin* in BOL 22432 (BOL!).

DESCRIPTION. *Corolla tube* 5–7 mm. broad at mouth, up to 4 mm. in length; *lobes* 3–3.5 mm. broad at their base, up to 4 mm. long. *Staminal column* 2.8–3.2 mm. broad across top, 1–1.2 mm. tall. Otherwise as for the genus.

DISTRIBUTION. CAPE: 3224 (Graaf Reinet): near 'Ashbourne' (–BD), *Bruyns* 1801 (NBG); 'Cranemere' (–DB), *Bruyns* 1794 (NBG). 3225 (Somerset East); Pearston district (–CA), *Jenkins* in PRE 39795, a single flower (PRE). 3323 (Willowmore): Knoetze Stn. (–BB), 1972, *Bayer* 803 (NBG). 3324 (Steytlerville): Steytlerville, Feb. 1939, *Mirkin in* BOL 22432 (BOL); Springbokvlakte (–BD), 1948, *Compton* 1085 (NBG). 3325 (Port Elizabeth): Dead Man's Gulch (–DA), May 1938, *James* 205 (BOL).

Vegetatively indistinguishable from the typical variety, this taxon (see fig. 11) is not, as has been suggested elsewhere, clearly geographically separated from it. In fact the distribution of the two varieties seems to be very closely interlinked, with the distribution of var. *mirkinii* a much larger one than that of var. *arcuata*. Var. *mirkinii* occurs from near Willowmore (Knoetze Siding being the westernmost known locality) in the west to a few miles south of Addo in the east.

It is distinguished from the typical variety by the much broader corolla-tube, the almost deltoid corolla-lobes and the slightly broader and flatter staminal column. It should be noted that the original drawing by Miss B. O. Carter (J. S. Afr. Bot. 5: 64. 1939) depicts a flower with corolla tube 5 mm. broad and 2 mm. deep (from base of lobes). The description by Pillans, however, states that the tube is 4 mm. deep and this is taken as meaning from the base of the lobes to the base of the corolla-tube which agrees with the type specimen and not with the drawing.

STAPELIOPSIS

Stapeliopsis Pillans in S. Afr. Gard. 18: 32 (1928); White & Sloane, Stap. ed. 2, 2: 720 (1937); Luckhoff, Stap. S. Afr.: 156 (1952); Jacobsen, Handb. Succ. Pl. 2: 881 (1960) et Lexicon Succ. Pl., 385 (1974); Huber in Merxm. Prodr. Fl. SWA 114: 64 (1967); R. A. Dyer, Gen. Southern Afr. Fl. Pl. 1: 493 (1975). Species typica: *Stapeliopsis neronis* Pillans.

DESCRIPTION. *Stems* prominently 4-angled with usually hard-tipped, triangular teeth on each angle, erect or prostrate, glabrous, glaucous green or rarely brownish (sect. *Cageliorona*), or papillate with round-topped, columnar papillae and blue-green, mottled with purple (sect. *Stapeliopsis*), terminal bud, if stem prostrate, parallel to surface of soil, apical bud often somewhat depressed. *Flowers* produced in small groups on an irregularly shaped peduncle up to 2.5 cm. long which usually arises near the base of the stem. *Corolla* exterior glabrous except in *S. neronis* (where it is covered with sharp-pointed hairs), interior either covered with prominent papillae which become smaller towards base of tube where they are tipped with a stiff hair or

without papillae but always with stiff hairs and covered with fine spicules; *tube* urceolate, subglobose to cylindrical (shortly ovoid or conical only in *S. pillansii* and occasionally in *S. saxatilis*), variable in length and diameter; *lobes* variable but usually considerably shorter than tube and often very small in relation to tube, sometimes joined at tips. *Corona: outer lobes* either each reduced to a small, truncate (sometimes bifid) tooth at the base of the inner lobes just concealing nectarial orifice (sect. *Cageliorona*) or else modified to form tube containing at least the lower half of staminal column, the lobes appearing as small indentations or teeth around the mouth of this tube (sect. *Stapeliopsis*); *inner lobes* joined dorsally near their base to the outer corona tube (sect. *Stapeliopsis*) or meeting the outer lobes laterally near their base (sect. *Cageliorona*), touching anthers only near their base, limb of lobes rising up above stigmatic surface, usually meeting in the centre, laterally flattened with rounded tips. *Pollinia* ovate-elliptic, pellucid margin along longest side, about 0.32 mm. long, 0.2 mm. broad (slightly rectangular in *S. neronis*).

Pillans, in founding *Stapeliopsis*, did so entirely because of the tubular outer corona found in *S. neronis*. He was basing the definition of the genus on a single character and when the second species was added the importance of this character fell away. It is quite natural that he did not associate the rather well-hidden inner corona-lobes of *S. neronis* with those of the '*saxatilis*' group of *Pectinaria* sensu lato but it is nevertheless true that the staminal column has essentially the same structure as is found in this group, except for the greatly modified outer corona and the rather elongated inner corona-lobes. This is far more obvious in *S. urniflora* where the outer corona is much reduced and the inner corona is as in the '*saxatilis*' group.

The vegetative peculiarities of *Stapeliopsis* are essentially the papillate, blue-green, mottled stems with depressed apical bud. The papillae on the stems are unlike anything known in any species of *Pectinaria* sensu lato but it is possible that these papillae have a water-absorbing as well as a transpiration-prevention function. It is likely that they are then a special adaptation to the presence of sea-mists from which many of the plants growing on the West Coast in the vicinity of the Orange River derive much of their moisture. The depressed apical bud is also found to a smaller degree in *S. exasperata* and the mottling of the stems is similar to that sometimes observed in *S. saxatilis*, so that the presence of papillae on the stems constitutes the main vegetative difference between *Stapeliopsis* and *Pectinaria* sensu lato.

One is inclined to believe that such papillae are of great significance in the classification of the plants concerned. However, similar translucent, columnar papillae are to be found on some specimens of *Piaranthus cornutus* N. E. Br.—in particular on specimens from the vicinity of Steinkopf—and the fact that they are not always present diminishes their taxonomic importance somewhat.

The six species in the '*saxatilis*' section of the original *Pectinaria* divide into those in which the stem ends are erect and those in which the stem ends are horizontal. The species with erect stem ends (*S. exasperata* and *S. breviloba*) lead on naturally to *Stapeliopsis* as far as vegetative similarity is concerned. In fact *S. exasperata* and *S. urniflora* look extremely similar in the field and only on a closer examination of the stem surface can a difference be detected. It must also be noted that *S. exasperata* is the northernmost representative of the '*saxatilis*' section and it seems that the species previously in *Stapeliopsis* represent an adaptation of the '*saxatilis*' section of *Pectinaria* sensu lato to the more extreme conditions extant in the Richtersveld and southern South West Africa.

Two floral features of importance are, firstly, that the flowers in *Stapeliopsis* and the '*saxatilis*' group have a very similar urceolate shape (with the exceptions mentioned above) with the lobes occupying less than a quarter of the length of the corolla, the corolla-tube being the most important feature of the flower. As pointed out by Lavranos (1966), this shape is rare among the *Stapelieae* and is only encountered elsewhere in a few species of *Echidnopsis* Hook. f. Secondly the stiff, simple hairs, projecting out perpendicular to the tube-wall, found on the interior of the corolla of all these species but not in any of the other members of the original *Pectinaria*, are also of importance in their classification.

As *S. urniflora* is very similar to *S. exasperata* it seems best to place the '*saxatilis*' section of the original *Pectinaria* in *Stapeliopsis*, rather than create a new genus for it. *S. neronis* can then be regarded as an aberrant species within the genus—its close relationship to *S. urniflora* indicates that these two are congeneric. The relationships between the species may be expressed by the establishment of two sections: one for those in which the stems are papillate and in which the outer corona is somewhat modified (comprised of the two species originally in *Stapeliopsis*) and the other for those with glabrous stems and in which the outer corona is much reduced (the species previously in *Pectinaria*). For distribution see fig. 9.

As in the case of *Pectinaria* (and *Ophionella*) there are no obvious relatives for this genus either from which it could be said to have been derived or to which it has given rise. The suggestion has been made that *Stultitia miscella* (N. E. Br.) Luckhoff and thus the apparently synonymous *Caralluma bredae* R. A. Dyer are related to *Stapeliopsis*. Vegetatively this species is almost indistinguishable from *Stapeliopsis breviloba* as far as shape and size of the stems are concerned. However, the mode of branching of *S. miscella* is rather different in mature specimens where small clusters of short stems are often produced above ground level on a single shoot. The manner of production of flowers is somewhat different too: they are solitary (rarely 2 to 3) arising without a peduncular patch usually above the middle of the stem (in *S. breviloba* flowers arise in quite dense, successively opening clusters from a peduncle produced near the base of the stem and frequently subterranean). Also, the flower is entirely different in *S. miscella*. The corolla-

lobes occupy more or less the whole of the fully expanded corolla which has a fairly conspicuous annulus around the mouth of the tube. The corolla-surface, though slightly rugulose, lacks both the hairs and the fine spicules which cover the inner surface of the generally urniform flowers of *Stapeliopsis*. These differences as well as the distribution of this species and its ally, *Caralluma ubomboensis* Verdoorn, with possible links to some East African species, make it best to exclude it from *Stapeliopsis*. It is assumed that the vegetative similarity with *S. breviloba* is the manifestation of convergence rather than of a close phyletic relationship between them.

KEY TO SECTIONS OF STAPELIOPSIS

1. Stems papillate with translucent, cylindrical papillae, outer corona forming a tube containing at least ½ of staminal column ..... sect. **Stapeliopsis**
1. Stems not papillate, outer corona lobes each reduced to a small, sometimes bifid tooth, not tube-forming sect. **Cageliorona**

Stapeliopsis sect. **Stapeliopsis,** *caulibus papillatis, corona exteriore tubulari, dimidio longitudinis columnae staminalis et eam circumcludente distinguenda. Species typica: S. neronis* Pillans.

Sect. *Stapeliopsis* is easily distinguished by the papillate, blue-green stems with purple mottling. The outer corona is also more highly modified than in the other section and forms a tube enclosing at least the lower half of the staminal column, reaching an extreme form in *S. neronis*. Species of this section occur in the Richtersveld and in Southern SWA, south of Helmeringhausen.

Stapeliopsis sect. **Cageliorona** Bruyns **sect. nov.,** *caulibus glabris, coronae lobis exterioribus ad basim loborum interiorum exortis, ad dentes minutos redactis, orificium nectariferum paene tegentibus cognoscenda. Species typica: S. saxatilis* (N. E. Br.) Bruyns.

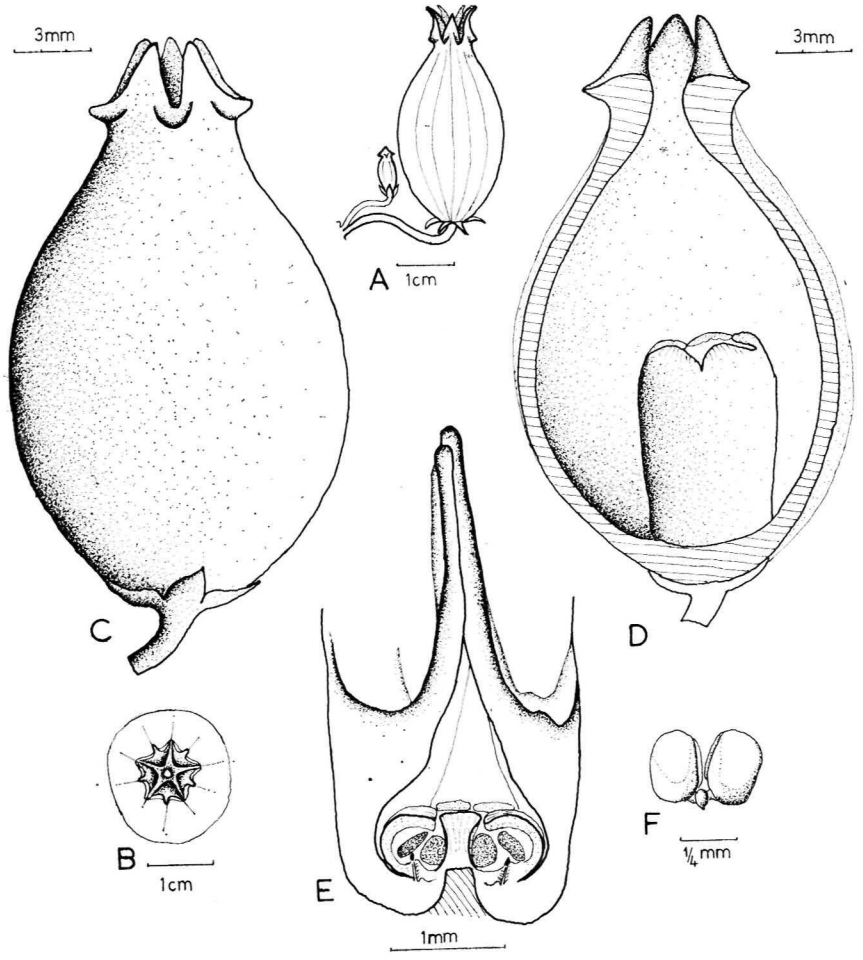

Fig. 12. **Stapeliopsis neronis.**
A,C, side view of flower;
B, face view of flower;
D, side view of flower with corolla cut away to show staminal column;
E, side view of staminal column with outer corona-tube removed;
F, pollinia.
A,B,E,F, from *Bruyns* 1385.
C,D, from *Bruyns* 1534.

Sect. *Cageliorona* contains the species transferred from *Pectinaria* and is characterised by the glabrous stems with a glaucous green or (in *S. breviloba*) a brownish colour. The outer corona-lobes are much reduced to tiny, suberect teeth arising near the base of the inner lobes and just conceal the nectarial orifice. The species in this section occur from Loeriesfontein to Somerset East but are commonest in the area between Laingsburg, Worcester and Oudtshoorn. This section can be divided into those species with erect stem ends with a stoloniferous habit and no angles on the underground portions of the stems (*S. exasperata* and *S. breviloba*) and those in which the stems are prostrate, mostly above the soil surface and prominently 4-angled throughout.

KEY TO SPECIES

Sect. **Stapeliopsis**

1. Exterior of corolla covered with sharp-pointed papillae, corolla tube considerably thickened at mouth, outer corona a prominent tube enclosing entire column with lobes reduced to indentations around its mouth ..... 1. **S. neronis**
1. Exterior of corolla glabrous, tube not thickened at mouth, outer corona tube enclosing lower half of column, lobes bifid into small outward pointing teeth ..... 2. **S. urniflora**

Sect. **Cageliorona**

1. Stem-tips erect, underground portion without angles, stoloniferous ..... 2.
1. Stem-tips prostrate, all portions obviously 4-angled and similar in shape, not stoloniferous ..... 3.
2. Stems more than 1 cm. thick, flowers uniformly fleshcoloured outside, covered inside with columnar papillae, lobes more than 5 mm long ..... 6. **S. exasperata**
2. Stems less than 5 mm. thick, flowers greyish brown with faint lines outside, interior with small papillae near base of tube, lobes less than 3 mm. long ..... 5. **S. breviloba**
3. Corolla-tube with very thick, rigid fabric, folds between lobes prominent, almost ½ as broad as lobes, flowers held facing horizontally or downwards ..... 4. **S. pillansii**
3. Corolla-tube fabric thin, folds between lobes absent, flowers held upright ..... 3. **S. saxatilis**

Sect. STAPELIOPSIS

1. **S. neronis** Pillans in S. Afr. Gard. 18: 32 (1928); White & Sloane, Stap. ed. 2, 2: 721 (1937); Luckhoff, Stap. S. Afr., 156 (1952); Jacobsen, Handb. Succ. Pl. 2: 881 (1960) et Lexicon Succ. Pl., 385 (1974); Huber in Merxm., Prodr. Fl. SWA 114: 64 (1967); Lavranos in Aloe 13(3): 75 (1972); R. A. Dyer in Fl. Pl. Afr. 44: t. 1744 (1977). Type: Richtersveld, Annisfontein, Oct. 1926, *Pillans* 5728 (BOL!).

DESCRIPTION. As in Dyer (1977).

DISTRIBUTION. SWA: 2716 (Witputz): Spitzkop (-DC), *Giess* 13113, photographs only, corolla lobes apparently remaining joined at tips (PRE).

CAPE: 2816 (Oranjemund): Richterveld, Annisfontein (-BD), Oct. 1926, *Pillans* 5728 (BOL). 2917 (Springbok): Karrachab Poort (-AA), *Tölken* 5321 (PRE); *Lavranos* s.n., only two flowers (PRE); *Bruyns* 1385 (NBG); North of Karrachab (-AA), *Bruyns* 1534 (NBG).

S. neronis has received a fair amount of attention since its reappearance in cultivation in 1972, and a comparison between it and *S. urniflora* will be made under the latter.

The most remarkable feature of the flower other than the outer corona is the presence on the exterior of large numbers of small, dagger-like papillae which give the flower a downy appearance. These papillae are also found on the base of the outer corona-tube and this is the only species in this genus in which the corona has any papillae on it of any sort. Dyer (1977) mentions the presence of a short, stout base to the staminal column in the collection of this species by Giess and, as the sketches show, this is found in at least some flowers of *S. urniflora* as well.

Plants of *S. neronis* may become very large and specimens nearly a third of a metre across do occur. Such plants were sometimes observed to be almost entirely exposed with just a few dead twigs and loose debris remaining of the original cover, but so well did the colouring of the stems blend in with the surroundings that they could easily be missed. *S. neronis* has not been seen at the type locality since its original discovery, but this area is extremely seriously denuded by overgrazing and this may have destroyed the few specimens that were in existence there.

2. **S. urniflora** Lavranos in J. S. Afr. Bot. 32: 195 (1966) ('*urnæflora*'); Huber in Merxm., Prodr. Fl. SWA. 114: 64 (1967); Jacobsen, Lexicon Succ. Pl., 385 (1974). Type: Tiras Mtns., SWA, fl. March–April, 1965 *Lofty-Eaton* in *Lavranos* 2536 (PRE!).

DESCRIPTION. As in Lavranos (1966) with the following addition: *Pollinia* circular to very slightly bean-shaped with pellucid margin on longer side, about 0.25 mm. diam.

DISTRIBUTION. SWA: 2616 (Aus): S. of Aus (-AC), 1965, *Littlewood* s.n. in Karoo Garden 77/65 (NBG); Tiras Mtns. (-BA), fl. March–April, 1965, *Lofty-Eaton* in *Lavranos* 2536 (PRE).

As is indicated by the specimens above, this species (see fig. 13) has remained very little known since its discovery in 1963. It is not uncommon in the Tiras Mountains to the north of Aus, but it is not known how far south it occurs and whether or not it occurs with *S. neronis* at any localities.

As distinctive as *S. neronis*, *S. urniflora* is easily separated from this species by the glabrous, shiny exterior to the corolla and the much reduced outer corona-tube, containing the lower half of the column. Other distinguishing features are the prominent papillae on the inner surface of the corolla-tube and the lack of any thickening in the corolla at the mouth of the tube which is very obvious in *S. neronis*. *S. urniflora* does not have either the same narrow cylindrical opening to the corolla-tube or the prominent outward-pointing folds between the corolla-lobes as are found in *S. neronis*. The corolla-lobes also do not have a white inner face as is found in *S. neronis*.

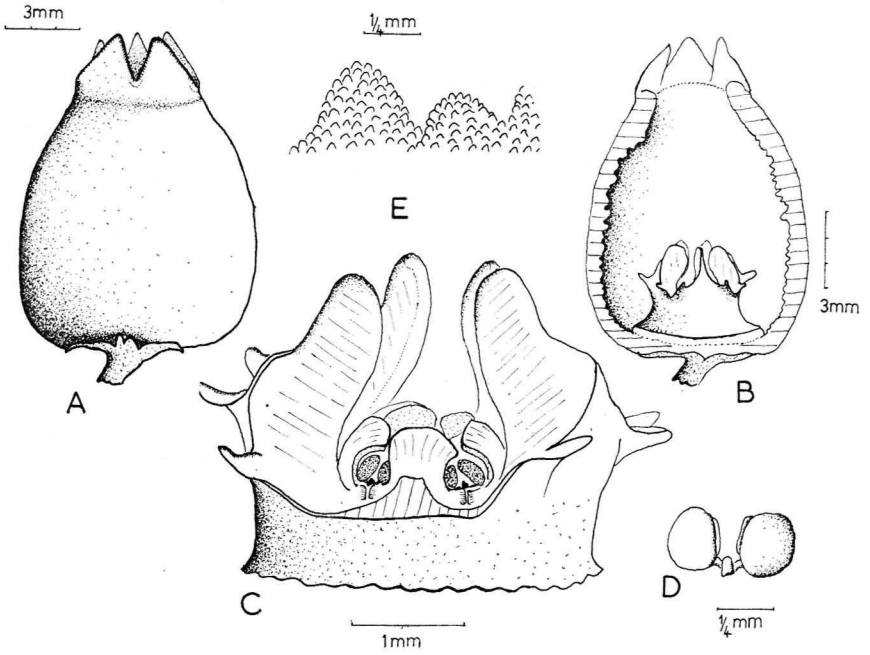

Fig. 13. **Stapeliopsis urniflora.**
A, side view of flower;
B, corolla cut away to show staminal column;
C, side view of staminal column with one corona-lobe removed to show anthers;
D, pollinia;
E, papillae on inner face of corolla.
All from *Cole* CX10.

However, it must be noted that the corolla-tube of *S. neronis* can be as elongated as in *S. urniflora* and in fact it is often the latter that is more globose in the tube than the former. The flower of *S. urniflora* is often quite small and ranges from 1–1.5 cm. in length, and may be up to 1 cm. in diameter. The staminal column is seated on a very slightly raised 'platform', and it appears that the inner corona-lobes do not generally meet in the centre.

Vegetatively *S. urniflora* and *S. neronis* differ in various respects. The stems of *S. neronis* are far larger than those in the other and are generally entirely above the surface of the soil. In *S. urniflora* the stems are frequently (but not always) stoloniferous with the underground portion much narrower than the above-ground portions and without obvious angles. This, combined with the fact that the peduncle often arises beneath the soil-surface, indicates a close relationship with *S. exasperata*, which does not hold for *S. neronis*.

It will be noted that the epithet '*urniflora*' has been changed in spelling from '*urnaeflora*' since the original publication by Lavranos. The new and correct spelling was first used by Huber in 1967. This is in accordance with Recommendation 73G of the ICBN (1978 and previous years) which stipulates that, when two Latin substantives are joined, the stem of the first shall be used and an 'i' placed between them (the situation is different when one or more of them is Greek).

Sect. CAGELIORONA

3. **S. saxatilis** (N. E. Br.) Bruyns, **comb. nov.**

Pectinaria saxatilis N. E. Br. in Gard. Chron. 35: 211 (1904) et in Fl. Cap. 4(1): 868 (1909); Berger, Stap. und Kleinien 332 (1910); R. A. Dyer in Fl. Pl. S. Afr. 16: t. 618 (1936); White & Sloane, Stap. ed. 2, 2: 730 (1937); Luckhoff, Stap. S. Afr., 163 (1952). Jacobsen, Handb. Succ. Pl. 2: 722 (1960) et Lexicon Succ. Pl., 314 (1974); Bayer & Plowes in Excelsa 5: 78 (1975); Bayer in J. S. Afr. Bot. 41(3): 165 (1975). Type: Cape, Zout Kloof farm, north-west of Laingsburg, Nov. 1902, *Pillans* 115 (BOL!).

DESCRIPTION. *Stems* 0.8–2.5 cm. thick, prostrate, often becoming buried, young shoots rarely developing underground, 4-angled, angles slightly flattened, each topped by a deltoid, hard-tipped tooth up to 0.8 cm. long, glabrous. *Flowers* arising from a prominent peduncular patch or peduncle near the base of the stem in groups of 2–8. *Pedicel* up to 1 cm. long, holding flower upright. *Sepals* lanceolate, with recurved tips. *Corolla* variously shaped, ovoid to elliptic to subcampanulate, up to 16 mm. long and 6 mm. broad at widest, dark purple to pale pinkish red or pale pink, glabrous outside, inside finely spiculate with minute acute spicules and with straight white hairs very occasionally each arising from a small sub-conical papilla; *tube* cupular to ovoid to conical, wall less than 0.5 mm. thick; *lobes* 4–8 mm. long, ovate-lanceolate to acute, usually united at tips, without folds between them or recurved margins. *Corona* pale yellow to dark-purple; *outer lobes* very small, truncate; *inner lobes* rising above column and meeting in centre, laterally flattened but of variable thickness, linear to obtusely acute with rounded (occasionally ensiform) dorsal projection usually just below middle, 2.0–3.5 mm. long, dark purple-brown or yellow. *Anthers* dorsally flattened, sometimes with a pointed tip and a few transparent, rigid hairs along tip. *Pollinia* circular to bean-shaped, pellucid margin on longer side, about 0.25 mm. in diam.

S. saxatilis is by far the most widespread and variable species in the genus. The northern known limit of its distribution is near Vanrhynsdorp. From here it passes through the Ceres Karoo, into the Worcester-Robertson Karoo and Little Karoo and goes as far east as Cockscomb Peak, east of Steytlerville. Two subspecies are recognized, the second being the taxon described as *Pectinaria stayneri* Bayer which occurs near the mouth of the Breede River.

a. subsp. **saxatilis**

Pectinaria tulipiflora Luckhoff in S. A. Gard. 24(4): 101 (1934) et Stap. S. Afr. 162 (1952); White & Sloane, Stap. ed. 2, 2: 734 (1937); Jacobsen, Handb. Succ. Pl. 2: 722 (1960) et Lexicon Succ. Pl., 314 (1974); Bayer & Plowes in Excelsa 5: 78 (1975); Bayer in J. S. Afr. Bot. 41(3): 165 (1975). Type: Vanrhynsdorp, at foot of Bokkeveld Mtns., *Luckhoff* s.n., no specimen is known to exist.

DESCRIPTION. *Stems* 0.8–2.5 cm. thick. *Corolla* shortly ovoid to elongated-elliptic or slightly conical, up to 16 mm. long, 6 mm. broad in tube (widest in tube if corolla lobes joined at tips), dark purple to pale pinkish-red or reddish; *tube* deeply ovoid to cupular (occasionally conical); *lobes* up to 8 mm. long. *Pollinia* circular to slightly bean-shaped, approx. 0.25 mm. diam.

DISTRIBUTION. CAPE: 3118 (Vanrhynsdorp): Steenkampskop (–BD), *Bruyns* 1089 (NBG). 3119 (Calvinia): Vanrhyn's Pass (–AC), *Hall* 2085 (NBG); Foot of Vanrhyn's Pass (–AC), *Bruyns* 1443 (NBG); 'Nooiensrivier' (–DB), *Bruyns* 1115 (NBG). 3319 (Worcester): Osplaas Stn (–BC), *Bayer* 806 (NBG); 3 km. N. of Worcester (–CB), *Bayer* 802 (NBG); 8 km. N. of Worcester (–CB), March 1944, *Glickmann* s.n. (BOL); Lemoenpoort (–CD), *Bayer* 813 (NBG); 40 km. SE. of Worcester on S. bank of Breede R. (–DA), *Villet* in BOL 25379 (BOL); 'Tweefontein' (–DA), 1959, *v. Breda* 75, with drawing (PRE); SE. of Robertson (–DD), *Bruyns* 1680 (NBG); Le Chasseur (–DD), *Bruyns* 1681 (NBG); SW. of Robertson (–DD), *Schwegmann* s.n. in KG 203/72 (NBG). 3320 (Montagu): 2 miles N. of Matjiesfontein (–BA), *Hardy* 2457 (PRE); Laingsburg – Ladismith (–BB), *Bayer* 801 (NBG); Rooinek Pass (–BD), *Bruyns* s.n. in KG 10/76 (NBG); E. of Anysberg Pass (–DA), *Bayer* 800 (NBG). 3321 (Ladismith): 12 km. S. of Calitzdorp (–DA), *Bayer* s.n. in KG 127/72 (NBG). 3322 (Oudtshoorn); Between Prince Albert and Swartberg Pass (–AC), June 1945, *James* s.n. (BOL); 1 mile S. of Oudtshoorn (–CA), *Bayer* 798 (NBG); Kandelaars R. (–CA), *Bruyns* 1679 (NBG); Volmoed (–CA), *Bruyns* 1219 (NBG); Kamanassie Dam (–CB), *Bayer* s.n. in KG 148/72 (NBG); Zebra (–CD), *Bayer* 804 (NBG); Buffelskip (–DB), *Bayer* 811 & *Bruyns* 1200 (NBG). 3323 (Willowmore): 11 km. E. of Buffelsklip (–AC), *Bruyns* 1854 (NBG); Uniondale Poort (–CA), *James* s.n. (BOL); Nuwekloof (–DA), *Bruyns* 1612 (NBG).

Subsp. *saxatilis* is fairly common from Oudtshoorn to Worcester, in the Hex R. Valley and also in the south-western Great Karoo between Laingsburg and Matjiesfontein. Throughout these areas it is generally found on north to east-facing—hence warmer and drier—fairly steep, rocky slopes and very rarely occurs in flat, low-lying areas. It always grows under bushes and in fact in most cases will be found under *Crassula rupestris* Thunb. East of Oudtshoorn and west of Willowmore its distribution becomes far more patchy and it seems to be restricted to a few isolated, dense patches of *C. rupestris* where it is locally common. Recently it has been found to grow in the Baviaanskloof (*Bruyns* 1612) and also high up on Cockscomb Peak (*Bruyns* 1834) and these collections extend its range practically to Uitenhage. In both these localities the plants, which are locally numerous, grow in small, dense clumps of the fern *Cheilanthes hirta* Sw. The sight of a Stapeliad creeping out of the base of a fern clump is a most curious one indeed.

Proceeding north of Laingsburg the distribution again becomes disjointed and although it is reputed to occur on the western perimeter of the Ceres Karoo this still has to be verified. North of the Ceres Karoo it is represented by what was known as *P. tulipiflora* which occurs around Vanrhyn's Pass and extends as far east as Calvinia, where it is very scarce. In this area habitats vary considerably but the largest population that I have seen was in a very extensive patch of *Crassula rupestris* on a steep shale slope. However, it also occurs here on Table Mountain Sandstone soils where it is considerably rarer.

Subsp. *saxatilis* is very variable in the shape of the corolla (see fig. 14) which ranges from being slightly ovoid to elongated elliptical or conical (if corolla-lobes free at tips). The length of the corolla-lobes is also variable and can be up to the same length as the tube. In general the corolla is very dark purple but occasional plants are found where it is light pinkish-yellow or reddish. The staminal column is also usually dark purple but may be yellowish.

In all the collections from east of De Rust the stems have a conspicuous purple-red mottling. In specimens from Buffelsklip and in James' collection from Uniondale Poort the flower had very short corolla-lobes and showed small indentations in the corolla just below the sinuses of the lobes. However, plants from further east (with the same mottled stems) have had quite normal flowers and so there is no consistent variation in the flower concomitant with the unusual colour of the stems, thus not warranting separate status for these 'far east' forms.

P. tulipiflora Luckhoff is distinguished from '*saxatilis*' by the narrower (1 cm. thick) stems, the paler, reddish, funnel-shaped flowers with yellow staminal column and the lack of 'frosted' appearance supposedly characteristic of '*saxatilis*' (White & Sloane, p. 734). Plants collected at Vanrhyn's Pass itself did show somewhat narrow stems but specimens found west of the Pass had stems up to 2 cm. in diameter. The unreliability of this character in this species is emphasized by the existence of forms of '*saxatilis*' from Rooinek Pass which have stems varying from 2.5 to 0.8 cm. thick sometimes on the same plant. Plants observed in flower at Vanrhyn's Pass did not always show the typical 'funnel-shaped' tube and some were elliptical in shape. The yellow staminal column and pale purple-reddish colour of the flower are not distinctive either, having been observed in plants growing south of Worcester. The lack of 'frosted appearance' commented on by White and Sloane appears in fact to be an error as Luckhoff mentions the presence of 'minute papillae' inside the corolla which have been found (in specimens from Vanrhynsdorp) to be the same as the spicules commonly observed in '*saxatilis*' which give it the frosted appearance remarked on by Pillans. The name '*tulipiflora*' is thus reduced to synonymy under subsp. *saxatilis*.

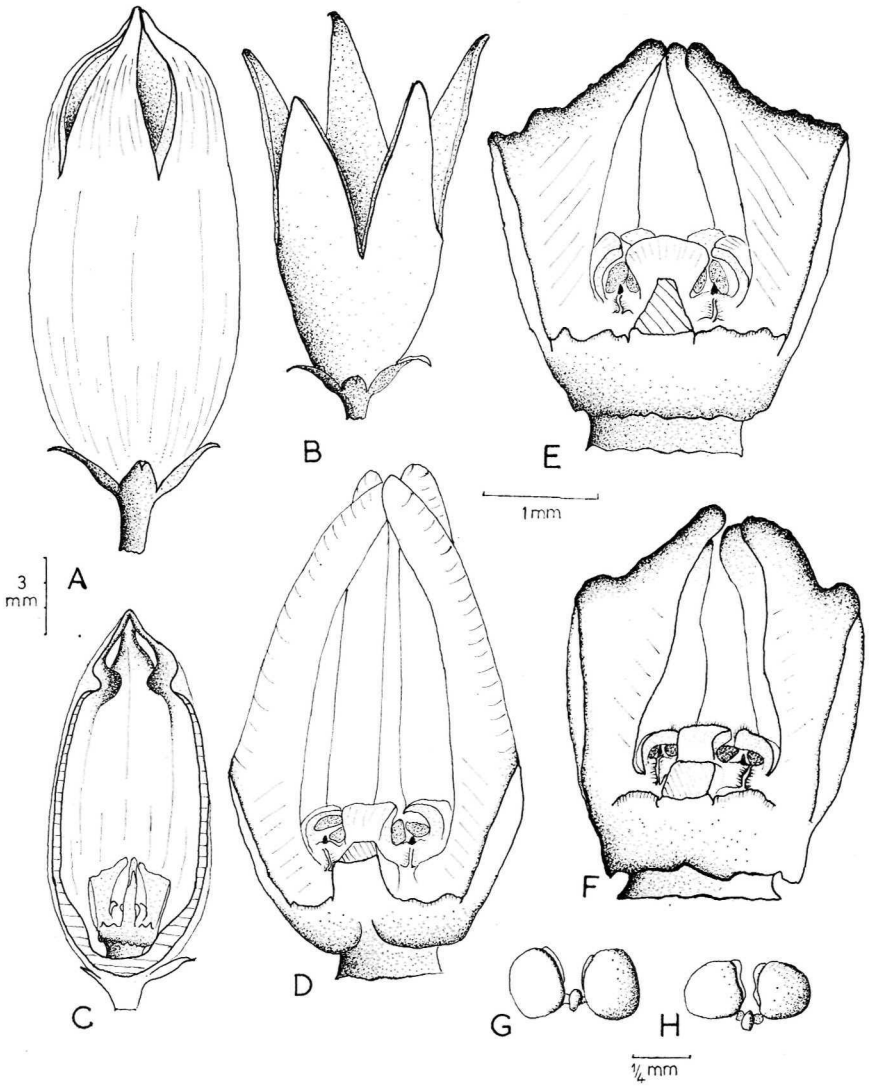

Fig. 14. **Stapeliopsis saxatilis** subsp. **saxatilis.** **A,B,** side view of flower; **C,** side view of flower of Eastern form with corolla cut away; **D-F,** side view of staminal column (one inner corona-lobe removed); **G,H,** pollinia. **A,D,H,** from *Bruyns* 965. **B,F,** from *Bruyns* 1089. **C,E,G,** from *Bruyns* 1200.

b. subsp. **stayneri** (Bayer) Bruyns, **stat. nov.**

Pectinaria stayneri Bayer in J. S. Afr. Bot. 41(3): 166 (1975). Type: About 8 km. inland from Infanta on bank of Breede R., *Stayner* s.n. in KG 731/71 (NBG!).

DESCRIPTION. *Stems* 1 cm. thick. *Corolla* subcampanulate, 6 mm. across at widest point (about ½ way down corolla lobes) pale pink becoming whitish near base, with small, straight hairs towards base of tube in interior; *tube* 4 mm. wide for most of length, 4–6 mm. long; *lobes* 4–6 mm. long. *Corona* pale yellow; *inner lobes* 2.8–3 mm. long, 0.5 mm. broad at base, dorsal projection rounded. *Pollinia* bean-shaped, 0.26 mm. long, 0.18 mm. broad.

DISTRIBUTION. CAPE: 3420 (Bredasdorp): about 8 km. inland from Infanta on bank of Breede R. (-BD), *Stayner* s.n. in KG 731/71 (NBG); 10 miles N. of Infanta (-BC), Jan. 1976, *Bruyns* 1262 (NBG); near Grasrug (-BD), *Bruyns* 1263 (NBG).

This subsp. (see fig. 15) is restricted to the lower 20 km. of the Breede R. and has only been seen twice since the original collection by Stayner. It inhabits dry karroid, north-facing or east-facing slopes which occur on both banks and which are surrounded by *fynbos* (on the west bank) or *Aloe*-scrub (on the east bank). The plants become up to a third of a metre in diameter forming dense mats of interwoven stems on steep slopes, usually well protected by a low shrub.

Subsp. *stayneri* is separated from subsp. *saxatilis* by the smaller, pale pink, subcampanulate flowers. In the type collection the subcampanulate shape of the flower is very clear but subsequent collections have not had such obviously subcampanulate flowers and these may even be slightly ovoid. However, in the ovoid flowers of subsp. *saxatilis* the widest point of the corolla is in the tube near its mouth while in subsp. *stayneri* the widest point of the flower is always about half-way down the corolla-lobes. In forms of the typical subspecies with flowers of com-

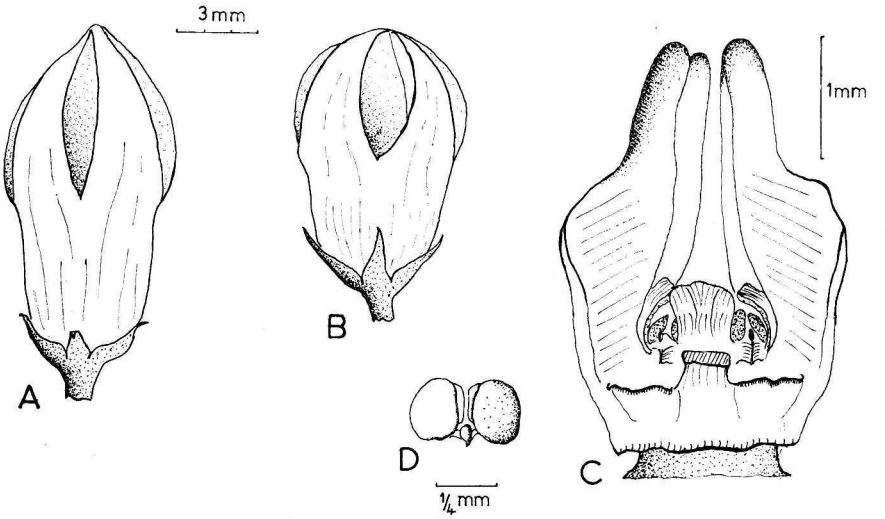

Fig. 15. **Stapeliopsis saxatilis** subsp. **stayneri.**
A,B, side view of flower;
C, side view of staminal column;
D, pollinia.
A, from *Stayner* s.n. (type coll.).
B,D, from *Bruyns* 1262.
C, from *Bruyns* 1263.

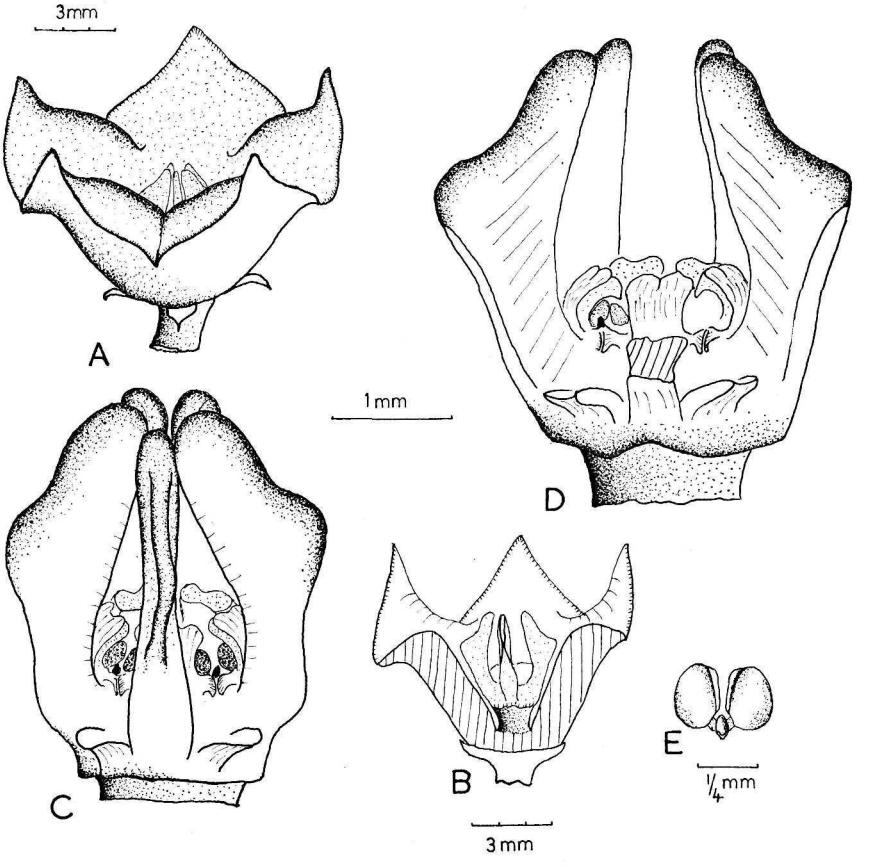

Fig. 16. **Stapeliopsis pillansii.**
A, oblique view of flower;
B, corolla cut away to show thickness of fabric;
C,D, side view of staminal column, one inner corona-lobe removed in **D** (one anther-theca empty in **D**);
E, pollinia.
All from *Bayer* 816.

parable length to those of subsp. *stayneri*, the corolla is much broader than in the latter. Flowers of subsp. *stayneri* are always very pale pink becoming whitish towards the base and I have never observed this in subsp. *saxatilis*. Bayer (1975) mentions that the stems are 'half as thick as those of *P. saxatilis*' but, as already mentioned, this character is not a reliable one in this species.

None of these features seems significant enough to uphold '*stayneri*' as a distinct species. It is very closely related to the typical subspecies and its geographically discrete distribution suggests that the status of subspecies accurately indicates its relation to subsp. *saxatilis*.

4. **S. pillansii** (N. E. Br.) Bruyns, **comb. nov.**

Pectinaria pillansii N. E. Br. in Fl. Cap. 4(1): 869 (1909); Berger, Stap. und Kleinien, 333 (1910); White & Sloane, Stap. ed. 2, 2: 732 (1937); Jacobsen, Handb. Succ. Pl. 2: 722 (1960) et Lexicon Succ. Pl., 314 (1974); R. A. Dyer in Fl. Pl. Afr. 38: t. 1483B (1967); Bayer & Plowes in Excelsa 5: 79 (1975); Bayer in J. S. Afr. Bot. 41(3): 164 (1975). Type: Glen Avon Estate, Somerset East July 1930, *Pillans* 180, (BOL! & K).

DESCRIPTION. *Pollinia* bean-shaped, pellucid margin on longer side, 0.16 mm. broad, 0.26 mm. long. Otherwise as in Brown (1909).

DISTRIBUTION. CAPE: 3224 (Graaf Reinet): 'Cranemere' (-DB), Feb. 1937, *Jenkins* s.n. in PRE 29834 (PRE); 29 km. S. of Pearston towards Jansenville (-DD), *Bruyns* 1808 (NBG). 3225 (Somerset East): 3 km. S. of Pearston (-CA), *Bruyns* 1589 (NBG); Glen Avon Estate, Somerset East (-DA), July 1903, *Pillans* 180 (BOL). 3325 (Port Elizabeth): NW of Ann's Villa (-BA), *Bayer* 816 and *Bruyns* 1561 (NBG); Dead Man's Gulch (-DA), April 1938, *James* 201, with painting (BOL); Addo (-DA), Feb. 1937, *King* s.n. in BOL 22863 (BOL).

This species also has a fairly wide distribution but is uncommon throughout. The reason for its apparent rarity is that it seems only very occasionally to form colonies of plants—as opposed to *S. saxatilis* which produces extensive colonies—and widely scattered specimens are usually the most that one can find. In fact out of a total of six localities at which this species was observed, at only two were more than five plants seen. It generally inhabits low, stony ridges and grows in or under bushes, often forming very dense mats. These sheltering bushes may be anything from *Lycium* clumps to *Euphorbia* of the '*ferox*' type or small composite shrubs.

The stems of *S. pillansii* closely resemble those of *S. saxatilis*, but have a harder, shinier epidermis with less flattened, more conical, recurved teeth. The really significant differences between the two species, however, lie in the flower. In *S. pillansii* (see fig. 16) the tube is very short and cupular with thick, rigid walls—more than 1 mm. thick—and the corolla-lobes are similarly fleshy. These are deltoid with a prominent, thick fold between each of them which is about half as broad as the lobes themselves. The lobes sometimes remain with their tips fairly close together giving the corolla a pear shape but may also expand fully. The flower is also held horizontal to the soil-surface or facing slightly downwards whereas in all other species of the genus it is held upright. In the specimens examined it was found that the hairs within the corolla had a thickened end but whether or not this is a reliable character cannot be deduced from the small number of flowers seen. The spicules on the corolla are also very globular and are not acute-tipped as in *S. saxatilis*.

Much has been said (Brown, 1909; White & Sloane, 1937; Dyer, 1967) about the manner in which this species produces its flowers underground. This may well be the case sometimes, but is certainly not always true as was observed in specimens from north of the Suurberg Pass flowering at the Karoo Botanic Garden and as is shown by a painting by Mr. J. R. James of his number 201 in the Bolus Herbarium. As is the case with *S. exasperata* this is determined by the consistency of the soil in which the plant is growing and flowers will probably not be produced underground in a firm soil in which the pollinators can only have difficult access to them.

5. **S. breviloba** (R. A. Dyer) Bruyns, **comb. nov.**

Pectinaria breviloba R. A. Dyer in J. S. Afr. Bot. 20(4): 155 (1954); Jacobsen, Handb. Succ. Pl. 2: 722 (1960) et Lexicon Succ. Pl. 314 (1974); Bayer & Plowes in Excelsa 5: 79 (1975); Bayer in J. S. Afr. Bot. 41(3): 165 (1975). Type: Cape, 'Tweefontein', fl. 1952, *v. Breda* 183 (PRE!).

P. villetii Luckhoff, Stap. S. Afr., 160 (1952), nom. nud.

DESCRIPTION. *Pollinia* bean-shaped, pellucid margin on longer side, 0.2 mm. broad, 0.3 mm. long. Otherwise as in Dyer (1954).

DISTRIBUTION. CAPE: 3319 (Worcester): 3 km. N. of Worcester (-CB), *Bruyns* 1699 (NBG); Worcester (-CB), *Lavranos* s.n. in PRE 39790 (PRE); 2 miles towards Ceres from Worcester (-CB), May 1953, *Villet* s.n. (BOL); Lemoenpoort (-CD), *Bruyns* 964 (NBG); Overhex (-DA), 1954, *Hall* 872 (NBG); E. of Sandberg Hills (-DA), May 1978, *Bruyns* 1704 (NBG); 5 miles SW of Robertson (-DD), *Hall* 2628 (NBG).

This very clearly defined species is known only from the Worcester-Robertson Karoo and has its distribution centred around Worcester itself. It is found to be most common in sandy situations usually at the foot of a hill or in flat areas particularly south of the Breede River near Worcester. It also occurs on quite hard, stony ground as, for example, on top of a hill in the Karoo Botanic Garden (*Bruyns* 1699). In the latter situation the plants are extremely small and highly stoloniferous, usually consisting only of widely scattered stems, most of the plant being underground. In the former situation the plants often become quite large and densely tufted with stems up to 10 cm. long.

The narrow, greyish-brown stems with fairly prominent angles each bearing a fine, sharp, acute (not deltoid)

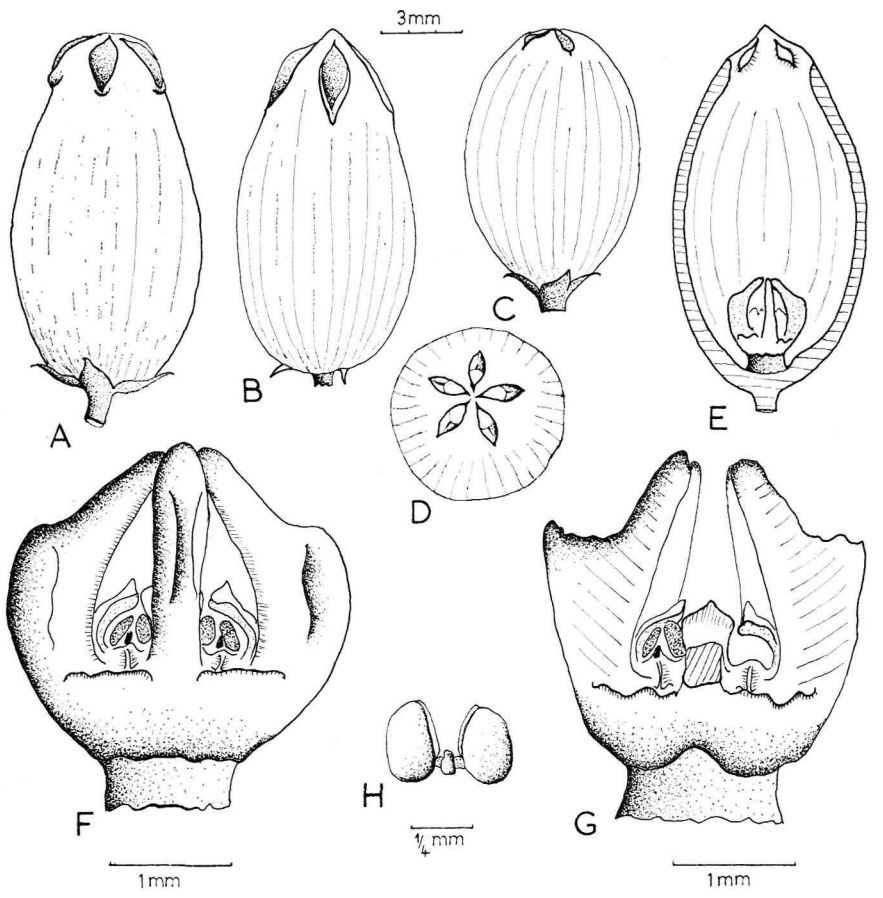

Fig. 17. **Stapeliopsis breviloba.**
A-C, side view of flower;
D, face view of flower;
E, corolla cut away to show staminal column;
F,G, side view of staminal column;
H, pollinia.
A,G,H, from *Bruyns* 964.
B,E,F, from *Bruyns* 1704.
C,D, from *Bruyns* 1699.

tooth which branch, often copiously, beneath the soil surface, rising erect above the surface, make this species easily distinguishable from those already discussed. The stems are rarely more than 0.5 cm. thick. *S. exasperata* is the other species in which the stem ends are erect but here they are generally over 1 cm. thick and armed with shortly conical angles each with a small, sharp but broadly deltoid tooth.

The flowers in *S. breviloba* (see fig. 17) are also very distinctive both in colouring and in shape. The exterior is grey-brown with numerous fine, longitudinal, translucent veins and the interior is dark purple-red becoming yellow on the lobes. The corolla-lobes are shorter than in any other species in the genus (usually less than 4 mm.) and almost always remain joined at the tips. The interior of the corolla occasionally has a few slightly raised papillae near the base of the tube and is densely covered with fine spicules (with scattered, straight hairs). In this respect and in the globose form of the corolla it cannot be confused with *S. exasperata*. It should be noted that the flowers of *S. breviloba* are quite often partially submerged in the soil and frequently arise from an underground peduncle.

6. **S. exasperata** (Bruyns) Bruyns **comb. nov.**
Pectinaria exasperata Bruyns in J. S. Afr. Bot. 44(2): 153 (1978). Type: Cape, 20 miles north of Calvinia, *Bruyns* 1345 (NBG).

DESCRIPTION. *Pollinia* very slightly bean-shaped with long pellucid margin, 0.20 mm. broad, 0.26 mm. long. Otherwise as in Bruyns (1978).

DISTRIBUTION. CAPE: 3019 (Loeriesfontein): Loeriesfontein (-CD), April 1940, *Malherbe* s.n. in BOL 22864 (BOL). 3320 (Montagu): Dobbelaar's Kloof (-CB), fl. April 1953, *Hall* s.n. in NBG 336/53 (NBG); S. of Dobbelaar's Kloof (-CB), *Bruyns* 1742 (NBG).

This species has a wide distribution but, judging from the number of recorded collections, is very rare. The erect, quadrangular, pyramid-shaped stems with very small, deltoid teeth make it distinctive. The manner in which the stems become abruptly thicker just before emerging from the soil and the peduncle arises under the ground is similar to that sometimes found in *S. urniflora* and the numerous, large papillae (see fig. 18) in the corolla-tube also point to a close relation between these two species.

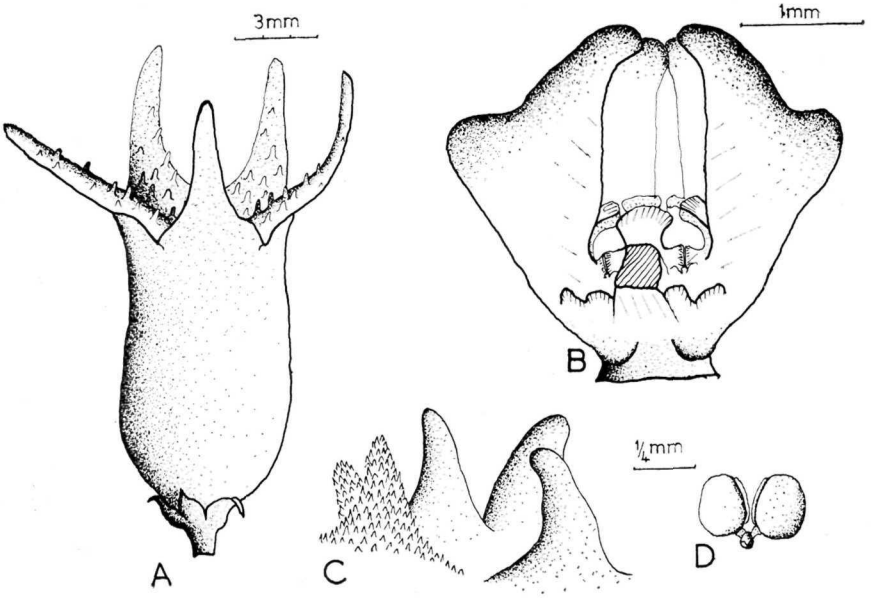

Fig. 18. **Stapeliopsis exasperata.**
A, corolla, side view;
B, side view of staminal column with one inner corona-lobe removed (no pollinia in thecae);
C, papillae on inner surface of corolla (two only are shown with spicules);
D, pollinia.
All from *Bruyns* 1345.

EXCLUDED SPECIES

Stapeliopsis cooperi Phillips=**Orbea cooperi** (Phillips) Leach.

Stapeliopsis madagascariensis Choux=**Stapelianthus madagascariensis** (Choux) Choux.

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Acknowledgements

I wish to thank Mr M. B. Bayer of the Karoo Botanical Garden for much help, use of facilities at the garden and permission to examine specimens in the collection. Also I wish to thank the curators of the Bolus, Compton and National Herbaria for permission to examine specimens. Finally, I am very grateful to Prof. D. T. Cole for flowers of *Stapeliopsis urniflora* as my own collection had not flowered at the time of preparation of the drawings for this paper, to Miss P. Perry and Mr P. v.d. Westhuisen of the Karoo Garden and the Hester Malan Reserve respectively for their hospitality on numerous visits and also to Mrs E. Latti of Baviaanskloof for much help and information on this remarkable area.

Index to species discussed

Upheld species are given in bold type, taxa not upheld in italics and others mentioned in the text in ordinary roman type.

THE CACTUS & SUCCULENT SOCIETY OF GREAT BRITAIN

Report of the Council for the year ended 31st December 1980

Perhaps due to the inevitable celebrations in the offing for next year's 50th Anniversary of the Society, 1980 has been comparatively quiet but our membership continues to grow.

Since the abolition of regular monthly meetings in London the strength of the Society has relied more heavily on the quality and contents of its Journal and this our Editor—David Hunt—has certainly maintained with many excellent articles by notable cactophiles, three coloured covers and eight colour plates inside the four issues of volume 42. Council would like to place on record its continued thanks to David and his able Assistant—Nigel Taylor.

The Annual General Meeting was held at Capel Manor Primary School, Enfield, on Saturday, 1 March, when the Officers and members of the North London Branch acted as our hosts. The business side of the meeting took rather longer than anticipated and Council regrets that the subsequent entertainment by the Achalay Group of musicians was somewhat curtailed due to lack of time but Council would like to express its thanks to Mr Sherville and the other Officers and members of the North London Branch whose efforts made the event so enjoyable.

Discussions with The National Cactus and Succulent Society on merger proposals have continued. It became evident during the year that there are fundamental difficulties inherent in the two organisations sharing a journal but having otherwise separate identities. Hence the emphasis has moved to exploratory talks on the basic problems involved in a complete merger. These have reached the stage when the Executives of the two Societies believe that more detailed discussions are warranted and the approval of the respective members for this additional step is being sought.

1980 was the first year in which the Shurly Award was competed for, the award was established in memory of the Society's late Presidents and the first winner was Jonathan Clark, a student of Reading University, who won the silver cup and cheque for £20 and to whom Council offers its congratulations.

The Society held its customary Bring and Buy Auction at the RHS and the event attracted a good attendance and raised the sum of £12 for the Society's funds.

Council would like to thank David Hunt and Bill and Betty Maddams for providing Open Days on 22 and 29 June, when members were able to browse around these splendid collections and partake of refreshments. It was unfortunate that the weather was anything but kind on the first of these occasions.

Although it had originally been agreed that the Society would not hold its usual June and October Shows in 1980, by popular demand the Autumn Show was staged at St. Saviours Church Hall, Pimlico, on Saturday, 4 October, and proved quite successful. Derek Bowdery kindly agreed early in the year to undertake the duties of Show Secretary and all credit must be given to him on his first effort. There was the usual clamour to purchase plants from the platform where Pine Ridge Cacti were offering plants for sale. It is hoped that this event will be repeated next year.

The Annual Dinner was held at a new venue—the Caprini Restaurant, Waterloo Road, SE1, on 22 November when some 40 members and their guests sat down to an enjoyable meal followed by an illustrated talk by Will Tjaden on his recent trip to Mexico. The Chairman and his wife are to be thanked for the arrangements.

The Society's Branches continue to provide a useful back-up service and Council wish to congratulate in particular the Warrington Branch who staged an award-winning exhibit at the Southport Flower Show. It is regretted that the Society was again unable to stage an exhibit at Chelsea.

Miss Johnson and Messrs Grantham and Pilbeam are welcomed to Council and thanks are due to Hazel Hodgson, Mr Best and Dr Pearce for their advice and help during their terms of office.

Thanks must also be extended to Mr G. G. Leighton-Boyce for his work over many years as the Society's Librarian. He will be remembered particularly for his efforts in compiling a 10 year index for the journal. The Library itself has now been moved to Kew and Council is pleased to welcome Nigel Taylor in his dual capacity as Assistant Editor and Librarian. Due to high postal charges it is no longer felt practical or economic to offer books to members via the post.

Council wishes to conclude by offering its sincere thanks to all the senior and junior officials of the Society, to its own members and the Society's Honorary Auditors, to the various Speakers and Show Organisers and all the Society's Branch Officials who have assisted in any way with the organisation of the Society or the stewarding of its Shows.

R. H. I. READ
Hon. Secretary

TREASURER'S REPORT

As may be seen from the figures, the Journal continues to account for an ever higher proportion of the Society's expenditure, actually about 79% during the year under review. The cost of the journal, postage and subscription management amounted to about £4.75 per subscription, or 95%. In these circumstances, a watchful financial eye over the size and pictorial content of the Journal is essential to keep the balance between receipts and expenditure and give subscribers value for money but not so much value that the Society risks bankruptcy! The net reserve or accumulated funds of £1650 (about £1.50 per member) may seem relatively low when a single issue of the journal can cost as much, but when advance subscriptions are taken into account, plus stocks of back numbers, society goods, etc., it is, I think, a satisfactory sum, sufficient for the unexpected but not leaving a substantial part of current subscription income unspent.

In connection with Society Sales, which have brought in about the same amount (around £200) for several years, I should perhaps draw attention to our investment in new stock of journal binders and T-shirts, amounting to nearly £700, which was our major expense outside the journal in 1980.

The Society's ancillary activities, including meetings, shows and seed distribution, accounted for about 3% of our net costs, and what might be termed administration (officers' expenses, stationery, postage, etc.) about 2%. In subscription terms, these add up to about 28p per member, or 7% of the ordinary £5 subscription. Our income from journal back numbers and Building Society interest amounted to £640, giving us an overall surplus of £400.

Though I am not one to doubt the truth of the saying 'many a mickle makes a muckle', an inordinate amount of time can be spent dealing with trifling sums of money, such as those received in payment for extra packets of seeds purchased over and above the free quota. Seed sales totalled only 1.8% of total receipts in 1979 and 2.6% in 1980. By making the seed distribution free in 1981 we shall save everyone time and trouble and I believe make our services to members more attractive. The cynical will argue that they have to pay for the seeds via their subscription anyway, but even they will grant, I think, that it is a more efficient method, saving the time of the honorary officers, if not their own.

About one-third of members took advantage of the seed offer in 1980. The Annual Show in London, which cost a net 4p per member, was supported by a much smaller number, inevitably drawn very largely from the London area. Again, I do not feel it is unreasonable to give this activity the financial support it needs out of subscription income, since any other

way of raising the money, such as by a voluntary contribution from interested members, would involve extra work.

This brings me to a brief analysis of membership in 1980, which exceeded 1200 as hoped and expected, probably for the first time in the Society's history. The total figure of 1225 is the number of journals sent out and does not include the 'better halves' of joint members, who are technically individual members in their own right, since they are entitled to vote. Of the total of 1225, 840 were British members and 385 members and library subscribers overseas; that is, very nearly one-third of the total, and a slightly higher proportion than in 1979. We have an increasing number of members in the USA and Australia, thanks at least in part to the efforts of our Hon. Agents there, Dana Craig and Neil Davis.

In conclusion, I should like to make some comments on the possibility of our merging with the NCSS. Although in the past few years, it has been our policy to avoid competing with NCSS, mainly through the greater specialist appeal of the journal, there is inevitably a duplication of administrative effort in our both maintaining subscription lists and sending out quarterly journals. Subscription management and journal despatch are together the most time-consuming work of the officers, closely followed by that of the editor. Yet it is here that both societies are heavily dependent on the stamina of very few individuals. Those who would regret a merger for the loss of one of the quarterly journals should, I think, be aware of the dilemma. There is no throng of enthusiastic volunteers longing to run either Society rather than read the journal or look at their plants, but the cost of employing someone as subscription manager or clerk to our society would certainly mean more than doubling the subscription, assuming 1000 or more members were still prepared to pay, which seems unlikely. I personally hope that the merger will go through as I believe it will be entirely in the best interest of the hobby in this country and the international reputation of our publications.

D. R. HUNT
Hon. Treasurer

EXPENDITURE AND RECEIPTS FOR THE YEAR ENDING 31st DECEMBER 1980

EXPENDITURE

1979 £		1980 £
5332.11	Journal: printing, etc.	5209.47
713.00	Journal: postage and handling ..	1160.52
160.42	Officers' postage, etc.	48.67
364.07	Printing, stationery	114.34
22.37	RHS Affiliation fee and hire of rooms	39.88
302.32	Seed purchases, packets	278.18
181.66	Show expenses and engraving ..	190.48
264.60	Society Sales items, new stock purchased	674.01
—	Annual General Meeting	52.35
28.50	Display (Warrington Branch) ..	40.00
607.58	Annual Dinner	190.00
—	Back numbers repurchased ..	40.00
50.29	Sundries and refunds	23.70
16.00	Returned cheques	—
8042.92		8161.60
(900.84)	Surplus (deficit 1979) carried to balance sheet	401.96
7142.08		8463.56

RECEIPTS

1979 £		1980 £
	Subscriptions for year:	
392.23	Paid in advance	2058.29
4014.22	Paid during year	4004.61
4406.45		6062.90
	Journal sales:	
729.92	Back numbers	687.53
156.45	Offprints	230.50
264.00	Advertising	302.00
201.00	Journal donations	—
83.44	Booklet sales	7.70
128.85	Seed sales	223.72
161.68	Raffles and plant sales	22.20
269.19	Society Sales items	238.92
491.00	Annual Dinner	198.00
50.50	Donations	5.50
189.67	Pimlico Show	142.20
9.93	Building Society interest	330.34
—	Sundries	12.05
7142.08		8463.56

BALANCE SHEET 31st DECEMBER 1980

	Accumulated funds:	
2152.48	Balance at 1.1.80	1251.64
(900.84)	*Add* surplus for year (deduct deficit, 1979)	401.96
1251.64		1653.60
	Current liabilities:	
—	Unpresented cheque	995.19
2058.29	Subscriptions in advance ..	1241.00
3309.93		3889.79

800.00	Cash at Barclays Bank	2189.52
2509.93	Halifax Building Society	74.18
—	Britannia Building Society ..	1616.09
—	National Giro deposit	10.00
3309.93		3889.79

Audited and found correct: J. S. KEESING, D. PHILCOX.
D. R. HUNT, Hon. Treasurer.

THE CACTUS & SUCCULENT SOCIETY OF GREAT BRITAIN

50th Anniversary Show 26 September 1981

The Show Committee hope that all members within reach of the London area will help to make this special show a success. It is being held at the now usual venue, St. Saviours Hall, St. Georges Square, Pimlico, on 26 September from 1.45–5.15 p.m. Staging will be from 9.15 to 10.45 a.m. on the day. Please ask your Branch Secretaries for schedules and entry forms or send direct to the Show Secretary: Mr D. Bowdery, 14 Callender Road, Catford SE6 2QD, enclosing a stamped, addressed, foolscap envelope.

There will be the usual side attractions: plant sales, Society goods, Grand Draw (tickets already available; contact Mr Bowdery or Mrs J. Ellis), tombola and refreshments. If you can donate items or funds for the two latter or will help steward on the way or with serving refreshments please contact either of the two people above.

Admission will be 20p (senior citizens and children, 10p) but those entering five or more classes will get a free entry pass.

There have been some changes from the 1980 schedule. All classes are listed below:

A. Open Classes:

1. 6 Cacti.
2. 3 plants from Mammillaria, Coryphantha or Thelocactus Groups.
3. 6 plants from Mammillaria Group in pots not exceeding 4½-in. diameter.
4. 1 Mammillaria (Sarah Cutler Cup).
5. 1 Astrophytum.
6. 1 Notocactus and 1 Parodia.
7. 2 Gymnocalyciums and/or Weingartias.
8. 2 Plants from Echinocactus Group.
9. 3 Plants from Echinocactus Group (3½-in. pot).
10. 1 Plant in Cereus Group.
11. 1 Echinocereus.
12. Cacti raised from seed since 1 January, 1978, in 15-in. by 15-in. maximum container.
13. 4 Cacti in pots not exceeding 6-in. diameter (Luty Wells Cup).
14. 3 Euphorbiaceae (P. V. Collings Cup).
15. 3 Crassulaceae (4½-in. maximum).
16. 1 Plant in Asclepiadaceae.
17. 2 Plants in Liliaceae.
18. 1 other Succulent.
19. 3 Succulents (Joan Farrow Cup).
20. 6 South African Succulents (4½-in.), as defined in Jacobsen.
21. 3 Conophytums and/or Ophthalmophyllums.
22. 6 Stemless Mesembryanthemums.
23. 3 Lithops.
24. Succulents raised from seed since 1978.

B. Intermediate Classes (for members who have not won a First Prize in Open Classes at any Show):

25. 3 Cacti.
26. 3 other Succulents.

C. Novice Classes (for members who have not won a First Prize in any classes except Miniature garden and Juniors):

27. 3 Cacti.
28. 3 other Succulents.

Note the pot restrictions have been withdrawn from Intermediate and Novice classes. If sufficient Junior entries are received the Novice classes will be divided.

D. Mixed Classes:

29. 1 Cactus and 1 other Succulent (6-in. pot maximum)
30. Miniature Garden.
31. Group of Cacti and/or other Succulents, 18-in. by 18-in. (Denton Memorial Trophy).

Unless otherwise stated the Groups and Families mentioned are those in the Society's 'Guide to Genera for Show Purposes' and the stemless mesembryanthemums according to those listed in the same booklet Copies can be obtained from Mr Bowdery—35p. including postage. Please help the Show Secretary by sending your entry forms in good time.

Society Branches

Essex
Secretary: F. Braun, 63 Heighams Road, East Ham E6 2JJ.
Meeting Place: Room A3 (film room), Little Ilford Comprehensive School, Church Road, Manor Park, London E.12.
Time: 1st Saturday in month, 7 for 7.30 p.m.

Hatfield & District
Contact: Mrs. P. Jenkins, 33 Bridge Road, Welwyn Garden City.

North London
Secretary: Roger Day, 50 Admiral's Walk, Hoddesdon, Herts. EN11 8AG. Tel. no. Hoddesdon (STD code from London: 61) 69521.
Meeting Place: Octagonal Room, Bishops College, Cheshunt, Herts.
Time: 3rd Friday in month, 7.30 p.m.

North Surrey
Secretary: W. F. Maddams, 26 Glenfield Road, Banstead, Surrey SM7 2DG.
Meeting Place: Adult School, Benhill Avenue, Sutton.
Time: 1st Tuesday in month, 7.45 p.m.

Northern Counties
Contact: Lionel Hoggett, M.Sc., 13 Cliftonville Gardens, Whitley Bay, Tyne & Wear NE26 1QJ.

Warrington & District
Secretary: Mrs. D. Pritchard, 81 Birdwell Drive, Great Sankey, Warrington, tel. no. Penketh (092572) 4699.
Meeting Place: Meeting Lane Leisure Centre, Penketh, Warrington.

Wirral
Secretary: Mrs. I. Boote, 110 Mount Pleasant Road, Wallasey Merseyside L45 5HU, tel. no. Wallasey (051639) 4305.
Meeting Place: The Grange, Grove Road, Wallasey.
Time: 3rd Thursday in month, 7.45–10.30 p.m.

Nursery List

Nurserymen and others who regularly offer plants or seeds for sale are listed below as a service to members, but this does NOT imply the Society's approval or recommendation of plants or other goods offered.

North & South Yorkshire

Cruck Cottage Cacti (Dorothy & Ronald Wood), Cliff Road, Wrelton, Pickering, North Yorkshire YO18 8PJ. Tel. no. Pickering (0751) 72042. Open daily except Sat. morning. No lists. Nursery in garden setting.

Whitestone Gardens Ltd., The Cactus Houses, Sutton-under-Whitestonecliffe, Thirsk, North Yorkshire YO7 2PZ. Tel. no. Sutton (08456) 467. Open daylight hours every day throughout the year. Send 4×8p stamps (UK) or 3 international postal reply coupons for list. Everything for the cactophile; plants, seeds, books, sundries; substantial stocks and extensive collection on view.

Oak Dene Nurseries, 10 Back Lane West, Royston, Barnsley, Yorkshire S71 4SB. Tel. no. Royston (022670) 2253. Open every day, April–Sept. 9–6, Oct.–March 10–4 (closed for lunch 12.30–1.30). S.A.E. for list. Seed, plants, books and sundries.

Merseyside & Lancashire

Jim Bolton, Southview, 39 Altcar Road, Formby, Liverpool L37 8DR. Tel. no. Formby (07048) 73187. Open all day Sundays, advisable to telephone for weekday visits. Large selection of seedlings, etc., all at reasonable prices. No list.

Harry Mays, Woodsleigh, Moss Lane, St. Michaels on Wyre, Preston PR3 0TY tel. no. St Michaels (09958) 295. Surplus seedlings for sale to visitors only. Prior 'phone call essential.

North Wales

Jolly's (G. A. & M. A. Coombes), Glanrafon, Talsarnau, Gwynedd LL47 6YD. Tel. Penrhyndeudraeth (076674) 643. Open any time by appointment. No orders by post; no list. Warm welcome to holidaymakers—we are in the Snowdonia National Park.

Derbyshire

Abbey Brook Cactus Nursery, Old Hackney Lane, Matlock, Derbyshire. Tel. no. Matlock (0629) 55360. Open every afternoon 2–6 except Tuesday (closed all day). List free on request, stamp appreciated. Mail order catalogue illustrated in colour lists over 1700 species of nursery-grown cacti and other succulent plants.

South Humberside & Lincolnshire

Southfield Nurseries (B. Goodey), Louth Road, Holton-le-Clay, Grimsby, South Humberside DN36 5HL. Tel. no. Grimsby (0472) 822157. Open daily 10-5 (closed for lunch 12.30-1.30). Send stamp for list. Seed-grown cacti, Lithops, succulents.

Jumanery Cacti (June & Tom Jenkins), St. Catherine's Lodge, Cranesgate Road,Whaplode St. Catherine, Nr. Spalding, Lincs PE12 6SR. Tel. no. Holbeach St. Johns (040634) 373. Open 9–5 Sunday–Friday, closed Saturday. S.A.E. for list.

Norfolk

Richard & Wendy Edginton, The Vines, 2 Green Man Lane, Kirstead, Norwich, Norfolk NR15 1EP. Tel. no. Brooke (0508) 58113. Open most mornings and weekends. S.A.E. for list. Seedling cactus plants 35p upwards.

Barleyfield Succulent Plant Nursery (Victor & Heather Graham), Southburgh, Thetford, Norfolk. Tel. no. Dereham (0362) 820457. Nearly always open, but telephone call appreciated. S.A.E. for list. 'Other' succulents, handmade plant pots. (0362) 820457. Stamp for list. Open Sundays only. Best to 'phone for directions. Very large selection of succulents including some cacti.

Warwickshire

Rod & Ken Preston Mafham, 2 Willoughby Close, Kings Coughton, Alcester, Warwickshire, tel. no. Stratford (0789) 762938, invite members to see their collection at weekends or during school holidays—please 'phone first. Surplus seedlings.

Gloucestershire

W. G. Geissler, 1 Lyefield Road, Charlton Kings, Cheltenham GL53 8BA. Tel. no. Cheltenham (0242) 517846. Open weekends and evenings, No list, no orders by post, but visitors very welcome in Cotswold country.

P. Strong, Green Mead, Green Lane, Chedworth, Cheltenham GL54 4AR. Tel. no. Fossebridge (028572) 581. Surplus seed-raised plants.

Bedfordshire

A. & V. Parker, 31 Southill, Nr. Biggleswade, Beds. SG18 9HU. Tel. no. Hitchin (0462) 814022. Open evenings and weekends ('phone first). No list. Seed-raised plants.

Southwest Seeds (Doug. Rowland), 200 Spring Road, Kempston, Bedford MK42 8ND. Tel. no. Bedford (0234) 58970. Open Sunday afternoons. S.A.E. for comprehensive seed list.

Hertfordshire

R. F. S. & B. R. Dale, Thurnlea, 14 Buttondene Crescent, Old Nazeing Road, Broxbourne, Herts EN10 6RH. Tel. no. Hoddesdon 63234. Open almost any time but write or 'phone. No list. Full range B.E.F. pots, labels, top dressing, etc.

Essex

M. L. Fussell, 29 The Readings, Harlow, Essex CM18 7BT. Tel. no. Harlow (0279) 23246. S.A.E. for list. Service by return of post.

The Cactus Place (David & Barbara Brewerton), 33 Bridge Avenue, Upminster, Essex RM14 2LX. Tel. no. Upminster 29911. No list. Open 9 till dusk, but 'phone first. Large and medium sized specimens.

H. Guirl, Glenholme, Nursery Road, Nazeing, Essex. Tel. no. Hoddesdon 62291. Visitors and parties welcome. A prior telephone call would be appreciated. No list.

East & West Sussex

Ernest Hepworth, Mira Mar, 133 Ambleside Avenue, Telscombe Cliffs, Sussex BN9 7LG. Tel. no. Peacehaven (07914) 3260. Open by appointment; closed Sundays. Send 12p stamp for list. Lithops, Mesems, Sempervivums.

Holly Gate Nurseries Ltd., Billingshurst Lane, Ashington, Sussex RH20 3BA. Tel. no. (0903) 892439. Open 9–5 every day, incl. weekends and Bank Hols. Send 25p for current catalogue of plants and seeds. Reference collection, entry 25p each.

Dorset

Pine Ridge Cacti (Joan & Dick Smeaton) 197 Ringwood Road, Verwood, Wimborne, Dorset BH21 6AG. Tel. no. Verwood (020123) 2796. Open 10–6, Closed Saturday and Monday. Choice and rarer 'other succulents'.

Shires Mead Cactus Nursery (D. W. & C. E. Sargant) Hampreston Village. Wimborne, Dorset BH21 7LX. Tel. no. Northbourne (02016) 3829. Not open Sundays and Mondays. List 12p. Plants and seeds.

Somerset

John E. White, 64 Bath Road, Ashcott, Bridgwater, Somerset TA7 9QJ. Tel. no. Ashcott (0458) 210256. Open daily except Mondays. Uncommon Succulents.

Devon

Phil Goodson, 1 Marsh Lane, Chudleigh, Newton Abbot, Devon. Tel. no. Chudleigh (0626) 852309. Collection open, plants usually for sale. Between the scenic Teign Valley and Haldon Hills, five miles from M5. 'Phone for directions and convenient times.

G. N. Short, Greenshaws, 7 Reabarn Road, Brixham, Devon TQ5 9DU. Tel. no. Brixham (08045) 2878. Open by appointment. The Devonia Collection of Cacti & Succuients; over 4000 species. Surplus plants for sale or exchange.

Westfield Cacti (Ralph Northcott), 10 Shillingford Road, Alphington, Exeter, Devon. Tel. no. Exeter (0392) 56925. Nursery grown cacti and other succulents. S.A.E. for list. Open to visitors from 1 January 1981, 9.00 a.m. till dusk, by appointment.

Cornwall

The Cactus Nursery (Mrs J. Osmond), Brandy Lane, Rosudgeon, Penzance, Cornwall TR20 9QB. Tel. no. Germoe (073676) 2397. Open 9 till dusk, Spring Bank Holiday to end of September. 'Phone in winter. List 12p. Large selection succulents. Cornish cream teas June–Sept. incl.

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Whitestone Gardens has everything for succulent fanatics and beginners. A large stock of plants, seeds, books and sundries is constantly on view, and the nursery is open to visitors every day.

Our plants are primarily nursery-grown seedlings, but we also stock a range of larger plants. The nursery shop carries almost everything ever likely to be needed by the cactus enthusiast, including a range of books and other publications which is the most comprehensive in the world. We stock every book in print and many that aren't—why be kept waiting by your local bookseller when you can ring or write to us and get your needs by return of post.

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Mammillaria Index (Mottram) *£2.75 + 35p post*

Lithops (Nel) *£20 + £1.20 post*

Cacti and Succulents (Haage) *£7.95 + 80p post*

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Volume 43/Number 4
November 1981

The Cactus and Succulent Journal of Great Britain

SUBSCRIPTION RATES 1982

Enrolment fee (new subscribers only)	0.50p
Full Membership	£6.50
Joint Membership	£7.50
Junior Membership (under 18 years)	£4.00
Senior Citizens	£4.00

Joint members (two in family) receive one journal but are both entitled to free seeds and voting rights.

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Vol. 24 (1962)—Vol. 36 (1974), per volume	£2.50
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Cover illustration: *Echinopsis obrepanda,* from Curtis's Botanical Magazine, t.4687 (1852). See page 95.

The Journal is published quarterly by the Society This issue price £1.50 (ISSN 0007-9375).

The Cactus and Succulent Journal of Great Britain

Volume 43 Number 4 November 1981 **edited by David Hunt and Nigel Taylor**

In this issue

Fifty years ago, and now

On 28th November, 1931, the late Ernest William Shurly convened a meeting at St. Bride's Institute in London at which the keel of our Society was laid, to be followed by its official launching on 8th March, 1932. Mr. Shurly was successively the Society's Secretary, Editor and President. His own account of the inception of the Society is reprinted on page 91.

After the 1939-45 war, the active centres of the cactus hobby in England were some 200 or more miles apart, north and south, before the days of the M1 or the high-speed train, and, inevitably perhaps, what should have been one national society was allowed to be two, the new 'National' and the old 'Great Britain'. Nowadays, distances are shorter, people travel to cactus meetings all over the country (even the NCSS holds its most important committee meetings in London!) and most serious enthusiasts belong to both societies.

The *rationale* of merging the two societies is accepted by the great majority of members. The vote to continue discussions proves this beyond doubt. What more happy event could we hope for than that the merger should be successfully negotiated during the GB's 50th Anniversary year?

Your 1982 Subscriptions please!

Meanwhile, while negotiations proceed on a draft constitution and such symbolic matters as the choice of a name and badge for the new grouping, the two societies will retain their independent existence in 1982 and look for your continued support. Our subscription rates remain the same as this year, except that new applicants will be required to pay an enrolment fee of 50p. A new departure is the inclusion of the seedlist with the present issue, enabling you to renew your subscription and order seeds with one letter and payment. Please read the notes on the seed-offer carefully, and send your renewal promptly, so as to assist the Society's honorary officers at their busiest time of year.

Nigel in Nepal

After his cactoclastic exertions on *Discocactus* and *Copiapoa,* our Asst. Editor/Librarian has disappeared to Nepal on one of Kew's plant-collecting expeditions. According to reliable sources, there are few cacti in the Himalaya, but Nigel is enjoying all the fresh air up there and the very different diet. All those whose *Discocactus* collections have been decimated by Nigel's revelations can comfort themselves that the turn of the other S. American genera is some way off. I must apologize, however, for being unable to supply, in his absence, the brief notes on the seedlist items which he has contributed in recent years.

Celebrations in Zurich

The Golden Anniversary of the City Succulent Collection in Zurich (see previous issue, pp. 31-2) was celebrated on 26-27 September with a programme of speeches and lectures in the palatial offices of the Schweizerischen Rückversicherungs-Gesellschaft near the collection itself, which has never looked better. Plans are laid for new offices and glasshouses at the collection, and the extensive publicity given to the collection in the Swiss press and on television, as well as in many Zurich stores and offices, should help the Director, Dieter Supthut, to secure the large financial commitment from the city for which he is hoping. The unique and important asset that the collection represents was stressed by all the speakers, including John Donald on behalf of the International Organization for Succulent Plant Study.

IOS Board meets in Zurich

Following the celebrations just mentioned, the IOS Board held its annual meeting and discussed possible changes in membership structure and arrangements

for the next Congress, which will be held in Vienna, 22-28 August, 1982. Non-members will be able to attend the Congress as personal guests of members, but it is likely that more of the meeting will be given over to seminars or working parties of groups of members only than has been the pattern at recent congresses.

Annual General Meeting
As announced on page 108, our 50th Anniversary A.G.M. will be held at Kew Gardens on Saturday 27th March, 1982. A full day's programme is being planned including visits behind the scenes and one or more lectures. Full details will be given in the next Journal, but any overseas member who is thinking of coming should let the Editor know so that the programme can be sent by airmail.

Rowley retiring . . . and rhyming
We send greetings and best wishes to Gordon Rowley, who has recently retired from his teaching post at Reading University. His future plans, we understand, are a closely guarded secret, but it can be no coincidence that Professor Nodrog Yelwor has also retired. What great tome are they incubating together? An Illustrated Encyclopedia of Ice-Cream, perhaps (complete with freezer and succulent range of samples?). To mark his retirement, Gordon has issued a little anthology of his poems and other fancies, composed between 1931 and 1981, and the tempation to quote is irresistible:

There was a young lady called Tucker
Of flowers a passionate plucker,
Till she leapt in the air
With a yell of despair—
'Twas a large Yucca sucker that stuck her!

Shurly Award
No award will be made this year.

Notes from members
The Editors would welcome your letters, comments or notes for publication in the Journal. These need not be learned or scientific and old hands can sometimes learn from those who are quite new to the hobby. We can also attempt to answer your questions, too, if you will send them to us. The address to write to is 67 Gloucester Court, Kew Road, Richmond, Surrey TW9 3EA.

Seed-raising
After the ants came the moss, and after the moss the sciara flies . . . We have not had a successful year and will look for a more sterile environment for seed-raising next time! To those who were more successful and have sent us germination data, thank you. The picture is certainly that germination of GB seed was better this year, and we hope the same will be true of the seed Terry Smale has obtained for you to sow in 1982.

British Cactus Sales Fair
The first British Cactus Sales Fair was held in Harrogate on 15 August, 1981. More than a dozen nurseries sold a wide variety of succulents with cacti by far the most conspicuous family represented. Prices ranged from 50p for small nursery-grown plants of the more commonly cultivated species to £60 for a specimen of *Carnegiea gigantea* about eighteen inches high and £85 for a very large specimen of *Mammillaria plumosa*.

Field-collected plants were on sale at several stalls, in some cases prominently displayed. One stall, for instance, had a section labelled 'Habitats from America and S. Africa'. The South African specimens were mainly species of *Euphorbia,* which like the Cactaceae are all included in the Appendix II of the Washington Convention on Trade in Endangered Species (CITES) and subject to licensing. Another stall had a range of small 'collected imports', whereas on other stalls habitat-collected plants were mixed in with nursery-grown specimens.

The continuing exploitation of wild populations of genera such as *Ariocarpus, Obregonia* and *Pelecyphora* (all on sale at the Fair) is causing concern, and at the meeting of countries party to the CITES convention in New Delhi earlier this year, various species were transferred to Appendix I. This means that international trade in the listed species will, in effect, be banned —provided that the country of origin (Mexico) enforces its own legislation.

Has your Calibanus flowered?
If so, we'd like to hear about it. Earlier this year, I acquired a plant of *Calibanus hookeri* from Jackie Panter and handed it over to Kew colleague Margaret Johnson to have its chromosomes counted. Evidently sensing that the end might be nigh, it promptly decided to flower for the first time, much to Jackie's *chagrin*. In fact, being tipped out of its pot (for root-tips) may not have been the stimulus to flower, because the *C. hookeri* owned by another Kew collector, Richard Strong, also decided to flower for the first time this year. Now comes the interesting bit. Mine (well, Jackie's) turned out to be a little girl *Calibanus*, and by very good luck. . . Richard's is a little boy, so we hope to raise a family!

If your *Calibanus* has flowered, do let us know. Did you notice whether it was male or female, or both (as apparently the big plant at Holly Gate is)? Did you get your plant from Holly Gate in that batch they were selling several years back? Jackie and Richard did, and we believe they were seedlings from the batch distributed by ISI in 1971.

Stop Press: A.G.M. Speaker
Professor W. T. Stearn, President of the Linnean Society, has kindly consented to give the principal lecture after the Annual General Meeting next March.

The Inception of the Society

The late E. W. Shurly's personal account of the founding of our Society, reprinted from the first issue of the Journal, which appeared in September 1932

I had been collecting cacti for a number of years as a result of seeing a collection of miniature plants at a People's Palace Flower Show about 1915.

I thought I had a fine collection, and that I knew quite a lot about my hobby. I was a member of the German, Dutch and American Societies, and I was garnering knowledge and experience all the time. I bewailed the lack of cacti literature in this country, I had the foreign journals and deplored the absence of an English Society and Journal.

My ever-increasing collection disclosed the immense variety of form, flowers and colours, and with the passing years I considered myself quite an expert.

Then, one by one, came the blows to my pride. I had ample proof that I was not an expert, I had not such a wonderful collection as I thought. I learnt basic facts from people who had a few cacti in a warm greenhouse and who watered them almost as ordinary plants. At a village show, where I was making an educational exhibit to interest my fellow villagers, a cottager showed three echinocacti, all of a kind, about eight inches in diameter, dark and vivid green and swollen with water, having several immense blooms and buds on each. In many ways and from very diverse sources I was learning to reverse much of the advice I had read and which many are still reading.

I realised the seriousness of the lack of opportunity to foregather with other collectors for the simple reason that I knew of no one who 'collected' cacti. There were several who had an odd plant or two, unnamed, and the owners did not know anything about them and appealed to me for advice. They had the plants for show only and to interest any visitors. There were no avenues of information open to me in this country, as I thought, and I soon commenced to dally with the idea of forming some sort of an association where collectors could mutually help and advise each other. I was in the midst of organising a religious body and business also kept me busy, and the idea remained an idea only.

Letters from Mr. F. E. Cooper, of Shanklin, and our Editor, Mrs. Higgins, appeared in the American Journal and spurred me to action. Mr. Cooper said there were so few collectors in this country, Mrs. Higgins told of the success of some collectors at the Shows. I simply did not know Mr. Cooper was wrong, but I have the combative spirit and had to prove him wrong. I began to collect names and addresses of those interested in cacti. I contributed articles to the gardening papers appealing for names and addresses with fair results.

These came in too slowly for my energetic soul and I approached the 'enemy', Mr. Cooper, on the matter. I had met him a few years before and had purchased some of his plants. He was good enough to loan me his address book and gave me permission to circularise them. He was doubtful of any possibility of success, but with the material he had provided my imagination was fired. Any one who collects cacti will not need much to make them realise my feelings. I had now over one thousand names and I decided to send my first circular letter to those in London and the Home Counties.

I received most encouraging replies and decided to book a hall at St. Bride's Foundation Institute. I made the necessary booking and sent a notice to all those who had replied.

On November 28th, 1931, my ideal was realised. I had got together sixty collectors, and Sir William Lawrence was kind enough to agree to take the chair. I was indeed grateful to Sir William, as his reputation would be of great assistance, and that he should officially act for me is a striking tribute to his good nature. The result was a foregone conclusion. Sixty collectors were met together, suffering under the same disabilities as myself, and were only too eager to band together for mutual help. Forty-three associate subscriptions were paid at this meeting, a committee was formed of Mr. Collings, Mr. Farden, Mr. Harrison, Mrs. Higgins, Mr. O'Donoghue and myself, and we were entrusted with the preliminary details.

After meetings and mutual collaboration, the rules and other preliminaries were prepared and a meeting was called for March 8th, 1932, at the R.H.S. New Hall, which again was attended by sixty people. Enthusiastically it was decided to form the Society, the rules were adopted and the President and Council were appointed.

The first Council meeting was held on March 14th, when Mr. Farden was elected Chairman of the Council and it was arranged to hold monthly meetings, and the first was held on April 5th.

At the next Council meetings on May 5th, it was decided, as full memberships were now satisfactory (the membership was nearing two hundred), to commence the publication of a magazine. We were fortunate in obtaining Mrs. Higgins' agreement to act as Editor.

We are already talking about an Exhibition of our very own in 1933. We are showing our American cousins that 'pep' is not merely native to the U.S.A.!

It is difficult to give thanks to all the willing helpers as they were so many, but I would like to mention the

Provisional Committee in its entirety, also Mr. Cooper, Mr. Haage, Mr. Endean, the American, German and Dutch Societies, as well as Lt.-Col. Durham, the popular Secretary of the R.H.S., for their encouragement and help to me during the formation and early days, with a special commendation to Mrs. Higgins, Sir William Lawrence, and to mention once more, Mr. F. E. Cooper for their exceptional support.

Do not forget these dates and events.

November 28th, 1931	Preliminary meeting.
March 8th, 1932	Official founding of the Society.
April 5th, 1932	First monthly meeting.
May 3rd, 1932	Decision to publish magazine.
September, 1932	Publication of magazine.
1933	First Exhibition.

And now for the one thousand membership and onwards to beat the record of our American friends!

E. SHURLY,
Hon. Secretary

Society Branches, 1981

Essex
Secretary: F. Braun, 63 Heighams Road, East Ham E6 2JJ.
Meeting Place: Room A3 (film room), Little Ilford Comprehensive School, Church Road, Manor Park, London E.12.
Time: 1st Saturday in month, 7 for 7.30 p.m.

Hatfield & District
Contact: Mrs. P. Jenkins, 33 Bridge Road, Welwyn Garden City.

North London
Secretary: Roger Day, 50 Admiral's Walk, Hoddesdon, Herts. EN11 8AG. Tel. no. Hoddesdon (STD code from London: 61) 69521.
Meeting Place: Octagonal Room, Bishops College, Cheshunt, Herts.
Time: 3rd Friday in month, 7.30 p.m.

North Surrey
Secretary: W. F. Maddams, 26 Glenfield Road, Banstead, Surrey SM7 2DG.
Meeting Place: Adult School, Benhill Avenue, Sutton.
Time: 1st Tuesday in month, 7.45 p.m.

Northern Counties
Contact: Lionel Hoggett, M.Sc., 13 Cliftonville Gardens, Whitley Bay, Tyne & Wear NE26 1QJ.

Warrington & District
Secretary: Mrs. D. Pritchard, 81 Birdwell Drive, Great Sankey, Warrington, tel. no. Penketh (092572) 4699.
Meeting Place: Meeting Lane Leisure Centre, Penketh, Warrington.

Wirral
Secretary: Mrs. I. Boote, 110 Mount Pleasant Road, Wallasey, Merseyside L45 5HU, tel. no. Wallasey (051639) 4305.
Meeting Place: The Grange, Grove Road, Wallasey.
Time: 3rd Thursday in month, 7.45–10.30 p.m.

Branch and Affiliate Secretaries, please note: Mrs. Pritchard (Warrington Branch, address above) is compiling a 1982 Calendar of Events for our next issue. Please send your programme to her as soon as you can!

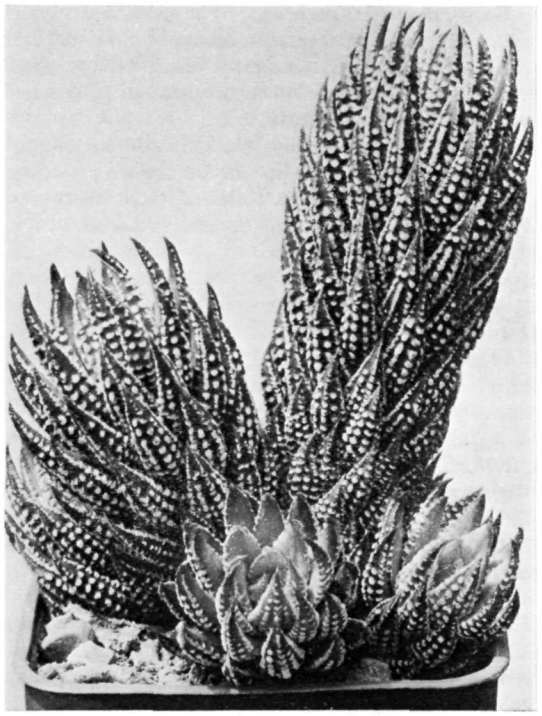
Choice Liliaceae

contributed by Derek Tribble

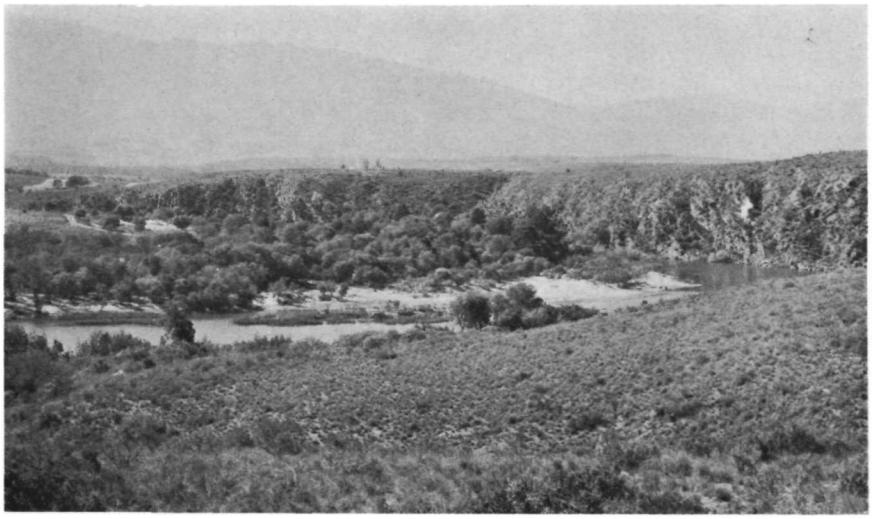
4. Haworthia reinwardtii f. **kaffirdriftensis**

G. G. Smith remarked when he described this plant that it was without doubt the loveliest of all varieties of *H. reinwardtii* and few people would argue. It is distinguished by its clear white tubercles which are arranged in lines along the dark green leaves. M. B. Bayer retained the plant as a *forma* in his excellent Haworthia Handbook, together with three other forms and a variety, while the closely related *H. coarctata* is given three varieties and one subspecies. Bayer separates *H. coarctata* from *H. reinwardtii* on their different arrangement of leaf-spirals which makes *H. coarctata* appear to have fewer wider leaves in relation to its branch width. This classification is somewhat clearer than splitting *H. reinwardtii* into 23 varieties based on trivial differences such as G. G. Smith and von Poellnitz used in the nineteen-thirties and 'forties!

The illustrated plant has grown well in a compost of John Innes No. 2 plus one-third extra sand, and seems to appreciate watering all the year round whenever the leaves in the centre of the heads close up. It grows best in half-shade—such as under the greenhouse staging. Kaffirs Drift is on the Great Fish River on the eastern side of Cape Province, South Africa, just ten miles



Haworthia reinwardtii f. *kaffirdriftensis*



Habitat of H. venosa beside the Breede River

inland from the Indian Ocean. This region receives a lot of rain, especially in summer, and thus our plant is probably used to lusher conditions than other South African succulents from the drier Karroos.

5. Haworthia venosa

The photographs show a general view and close-up of a habitat for this species by the Breede River near Swellendam in SW. Cape Province. Colonies of *H. venosa* grow on exposed light-brown shale in the gully in the foreground and further to the right on top of the cliffs above the river. In the background, the Langeberg mountain chain can be seen peaking up to 1500 m. These mountains separate the relatively well-watered coastal plains, used for dairy-farming and crops, from the much drier Little Karroo behind.

Unfortunately, *H. venosa* is quite rare in cultivation. It is a beautiful plant to see since plants growing in full sun are a similar light brown colour to the surrounding rock. Plants growing in shade are pale green and, being more turgid, appear to have more pronounced windows. The leaves vary from 5 to 8 cm. long. Other succulents growing nearby were a colony of Glottiphyllums, also exposed to full sun on flat shale outcrops, a few pink-flowered Anacampseroses of the Telephiastrum group, growing singly beneath bushes, a small *Crassula* and tall *Aloe ferox* trees. To judge from the habitat, *H. venosa* will need to be kept moist in winter with a drier resting period in summer if it is to be grown successfully.

Derek Tribble
93 Barrenger Road
Muswell Hill
London N10 1HU

Haworthia venosa

Sulcorebutia canigueralii *(photo: Zabeau)*

Connoisseurs' Cacti

chosen by Jackie Panter and David Hunt

14. Sulcorebutia canigueralii

Several of the Sulcorebutias have brilliant bi-coloured flowers but this must be one the most stunning. Moreover, it isn't finnicky—no special requirements—grows quite fast and flowers profusely. An asset in any collection! It was named after Father Juan Canigueral who found it in Bolivia in 1961 and described (originally under *Rebutia*) by Cardenas in the Cactus & Succulent Journal of America, vol. 36: 26–7 (1964). Its locality is in the heart of *Sulcorebutia* territory, in depto. Chuquisaca, prov. Oropeza, alt. 2800 m.—no further details given.

As Bill Putnam has said, writing in the 'National' journal (vol. 32(3):59. 1977), *S. canigueralii* is a very small plant which branches readily. The stems are an attractive dull slaty green and the 15 or so comb-like spines set in a long, sunken areole are a typical 'Sulco' feature. The photograph shows my plant when it was in a 2¾-inch (7 cm) square pot, so it is shown somewhat larger than life-size. I have now moved it on to a 3½-inch (9 cm) round pot and the largest head is 1½ inches (4 cm) in diameter. Ultimately it should make quite a large cluster—if I don't give in to too many requests for offsets!

J.P.

15. Mammillaria napina

This rare and sought-after species was discovered by C. A. Purpus near the Mexican town of Tehuacan in 1908 and described by his brother J. A. a few years later (Monatsschr. Kakt. 22: 161. 1912). Named for its stout tuberous root (Latin, *napinus*, turnip-like), it has never been common in collections and has a reputation for being slow-growing and difficult to keep. The plant illustrated was generously given to me by Prof. Dr. Kurt Schreier of Nuremburg in 1975 and has subsequently been the subject of much anxiety on the part of its new custodian but no other V.I.P. (Very Important Plant) treatment in matters of watering and temperature, etc. I have not dared, however, to repot it from the very small pot and weathered granite compost (no organic matter) in which Professor Schreier gave it to me, and have merely stood the pot in a larger one (12.5 cm), filling up the space between with my

Mammillaria napina *(photo: Svanderlik)*

inevitable (unweathered) granite chips. Thus confined and watered rather sparingly from below, it opened ten flowers at once in the summer of 1980 and rather fewer this year, which may seem to support the old theory that starved or underpotted plants flower better.

I have not seen the fruit or seed of *M. napina* described and am uncertain whether the species is self-fertile. The plant illustrated has produced small colourless fruits with a few fertile seeds deeply immersed between the tubercles. Time will tell whether I shall be able to keep the resulting seedlings alive long enough to detect whether they had more than one parent.

D.H.

16. Echinopsis obrepanda *(see cover illustration)*
In its typical white-flowered form, *Echinopsis obrepanda* is found around Cochabamba, Bolivia, where it was first collected by Thomas Bridges in 1844. As interpreted by Walter Rausch, in his book 'Lobivia', part I, p.48 (1975), it is a very variable species with many flower-colour forms extending southwards through Bolivia to Santa Victoria in Argentina. Fitch's illustration for Curtis's Botanical Magazine, t.4687 (1852), was of Bridges's white form and shows the characteristic broad-petalled *Echinopsis*-like flowers combined with a stem which has as much of *Lobivia* as *Echinopsis* about it and induced Backeberg and others to put it in an intermediate genus *Pseudolobivia*.

Complications over the name have little bearing on the beauty of the plant, except that part of its attraction does lie in the combination of the large, night-blooming *Echinopsis* flower with the more compact and younger flowering habit of *Lobivia*. It is an easy plant to grow and will take plenty of water in the growing season. It does not usually offset, so propagation is normally by seed, but the natural variation of the species, plus the risk of hybridization in the greenhouse mean that many plants one sees are more or less atypical. Fitch's illustration, however, shows the genuine article.

D.H.

SEED OFFER, 1982

To be sure of obtaining the items you desire, please send us your subscription renewal and seed-order form promptly!
There are about 100 packets of each seed-item available; first come, first served!

The Cactus and Succulent Journal of Great Britain
Volume 43(4): 96-100 (1981)

Notes on the genus Cephalophyllum*
3. The status of Cheiridopsis cuprea (L. Bol.) N.E.Br.

by Heidrun E. K. Hartmann

Institut für Allgemeine Botanik und Botanischer Garten, Hamburg, West Germany

Summary. Recent studies by the author have clarified the distinction between *Cephalophyllum* N.E.Br. and *Cheiridopsis* N.E.Br. The position of *Cheiridopsis cuprea* (L. Bol.) N.E.Br. is considered in the light of revised circumscriptions of the above genera. It is concluded that the species is referable to *Cephalophyllum*. The name *Cephalophyllum caespitosum* Hartmann, nom. nov. is proposed, the epithet *cupreum* being preoccupied in *Cephalophyllum* by *C. cupreum* L. Bol., a different species.

Introduction

During investigations into the genus *Cephalophyllum* N.E.Br., it soon became apparent that the boundaries of the genus were not as clear-cut as had been supposed. An initial survey of growth-form and fruit-morphology enabled a preliminary circumscription to be made (Hartmann, 1978) and extensive studies of leaf-surfaces (Hartmann, 1979) and flower characters have now completed the study. In the present paper the delimination of *Cephalophyllum* vis à vis *Cheiridopsis* N.E.Br. will be considered. As a consequence of the revised boundaries, one species of *Cheiridopsis, C. cuprea* (L. Bol.) N.E.Br., will be transferred to *Cephalophyllum*.

Comparison of Cephalophyllum and Cheiridopsis

It is rarely practicable to separate taxa of the rank of genus by a single character and in general it is necessary to use a set of correlated characters or 'character syndrome'. This is true of the two genera in question.

CEPHALOPHYLLUM

Plants of the genus *Cephalophyllum* form annual growths of several internodes with several leaf-pairs, often resulting in long runners (fig. 1). The *leaves* are all similar (isophyllic), but heteromorphy can be observed occasionally during early ontogeny, and differences in leaf-size are known from all plants with 'heads' (Hartmann, 1978). In fine structure, the *leaf-surface* appears flat, with the surface cells even in most species. They can be slightly elevated in some groups, but they are never papillate (fig. 2). The *wax cover* consists of a continuous layer, in later stages often broken into plates (mostly one per cell). The surface of the wax cover can be smooth or loosely covered with local wax extrusions shaped like rodlets or flakes. In all cases, the underlying wax stratum determines the aspect of the surface.

Flowers in the genus *Cephalophyllum* possess no filamentaceous staminodes (with the possible exception of *C. staminodiosum* L. Bol., a species which needs to be studied in more detail). The distinction between petaloid staminodes (petals) and stamens is clear. *Fruits* are borne on procumbent peduncles and have broad valve-wings which equal or exceed in width the expanding keels. The covering membranes of the locule form a trumpet-shaped opening near the distal end and at the base of the trumpet a spongy thickening is developed touching the placental tubercle (Hartmann, 1978).

CHEIRIDOPSIS

Plants of the genus *Cheiridopsis* develop one or two *leaf-pairs* per season, (fig. 1). When two pairs are produced, heterophylly occurs—the leaves differ in shape, size and seasonal development. The *leaf-surface* (epidermis) consists of papillate cells of varying heights, in few species the leaf surface is differentiated into elevated and depressed areas (as described for the genus *Odontophorus* by Hartmann, 1976). A dimorphic *wax cover* is developed on each single epidermal cell: Part of the cell is covered by a thick smooth plate-like layer, while the remaining area exhibits a continuous stratum with dense local wax extrusions. After air-drying, these particles show flake or rodlet shapes under the scanning

Fig. 1. *Cephalophyllum* (upper right) and *Cheiridopsis* (centre) growing together in nature.

*Continued from Cact. Succ. J. Gt Brit. 39(4): 94 (1977).

Fig. 2. SEM-view of leaf-surface of *Cephalophyllum*.

Fig. 3. Leaf-surface of *Cheiridopsis*.

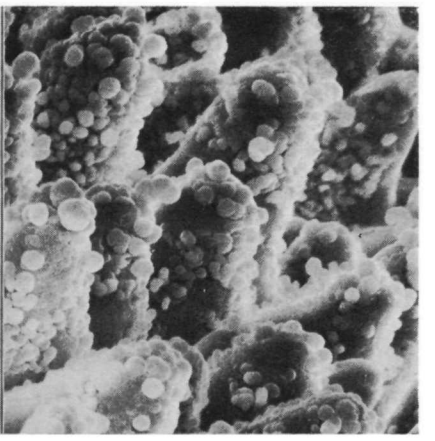


Fig. 4. Leaf-surface of *Cheiridopsis* after deep-freeze treatment.

electron microscope (fig. 3). After deep-freeze treatment, however, the local wax formations appear as small, rounded, rather amorphic bodies (fig. 4). To date it has not been possible to determine which of these surface sculptures exists *in vivo*.

Two types of *flowers* can be distinguished: Isophyllic plants possess several series of petals, with the length of petals decreasing from the outer to the inner series. Heterophyllic plants develop fewer series of uniform petals. No filamentaceous staminodes are found. *Fruits* are borne upright or procumbent. Their valve-wings are narrow, often reduced into awns towards the tips. In many cases, the covering membranes show peculiar additional structures near the centre of the fruit: local elevations shaped like chimneys or pipes which can serve as outlets for seeds (Schwantes, 1952). The distal part of the covering membrane can be elevated slightly, but lacks additional closing mechanisms and is never trumpet-shaped (Hartmann, 1978).

'Cheiridopsis cuprea'

About 750 collections of the genera *Cephalophyllum* and *Cheiridopsis* have been examined with reference to the above character syndromes, and it was found possible to assign most populations to one or other genus. Difficulties arose in the case of 23 examples, which agreed well with each other in their characters but are not easy to place into either genus at first sight. The compact growth suggests relationship to the genus *Cheiridopsis,* but the broad winged valves indicate that the plants might have to be placed in the genus *Cephalophyllum*. Further studies reveal the following characters:

The *plants* form rather dense cushions (fig. 5) especially on gravelly soils. Yet the annual growth consists of several internodes with several leaf-pairs. In loamy soil, the axes grow longer, and the spreading-procumbent habit becomes more obvious (fig. 6). The isophyllic *leaves* grow upright or spreading, the leaf-tip is crowned by a small tooth (mucro), which can fall off on older

Fig. 5. '*Cheiridopsis cuprea*' (gravelly soil)

Fig. 6. '*C. cuprea*' (loamy soil)

leaves. No heterophyllic stages have been observed in ontogeny (fig. 7). *Leaf-surfaces* are smooth and even, with only the subsidiary cells slightly elevated (fig. 9). The *wax cover* consists of solid plates on top of a continuous underlying wax stratum. In general, one plate per cell can be recognized, but additional cleavages can occur (fig. 8). Plates on subsidiary cells exceed those of normal epidermal cells in diameter (fig. 9). Additional local wax formations rarely occur.

A total of 63 *flowers* have been examined in the species, their diameter ranging from 18 to 60 mm. around a mean value of 34 mm. Colouring varies in many respects, the only constant feature observed is the fact that in any given plant the colour patterns are identical. Variation includes different colours and different patterns in petals and stamens. Of particular interest are differences between the portions the colours cover in one petal, and four main types can be distinguished (fig. 10). In this connection it has to be remembered that flowers of Mesembryanthema grow during their anthesis (flowering-time) and consequently the lower part and its colour extends during that time. In addition, bright colours like purple and copper lose intensity and become lighter during anthesis. Filaments of stamens can either show uniform yellow colouring or a differentiation into an orange tip and a yellow base. Yellow anthers dominate in flowers with yellow petals, purple anthers in flowers with purple petals. In most flowers with white or cream dominance in the colour of the petals, the yellowish anthers are suffused with purple. Only light or bright yellow colours have been observed in the pollen.

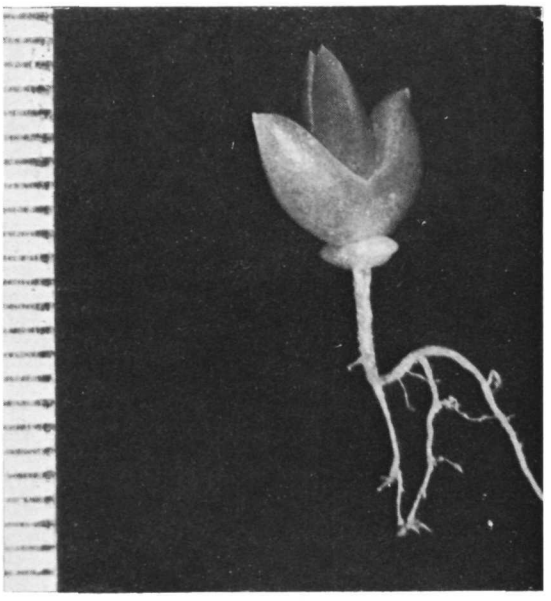


Fig. 7. Seedling of '*C. cuprea*' (scale in mm.).

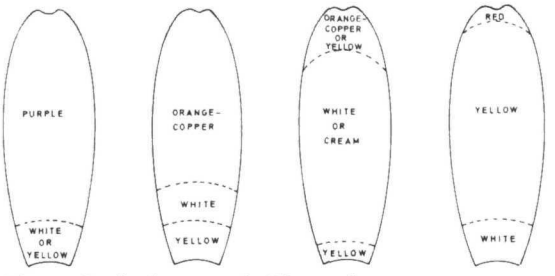


Fig. 10. Petal-colour types in '*C. cuprea*'.

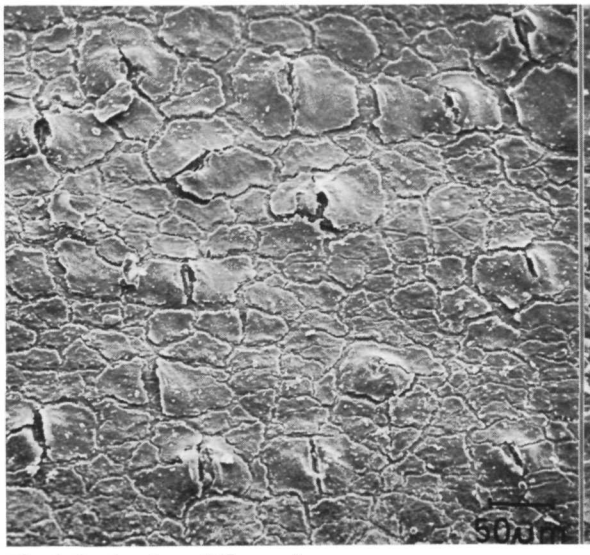


Fig. 8. Leaf-surface of '*C. cuprea*'.

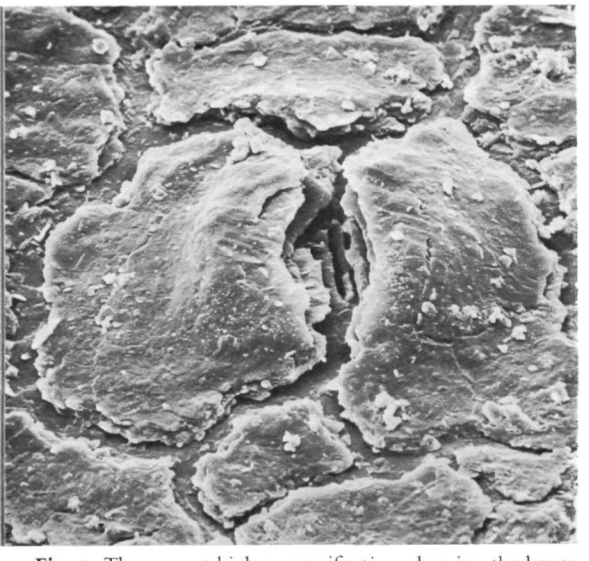


Fig. 9. The same at higher magnification, showing the larger wax plates on the subsidiary cells.

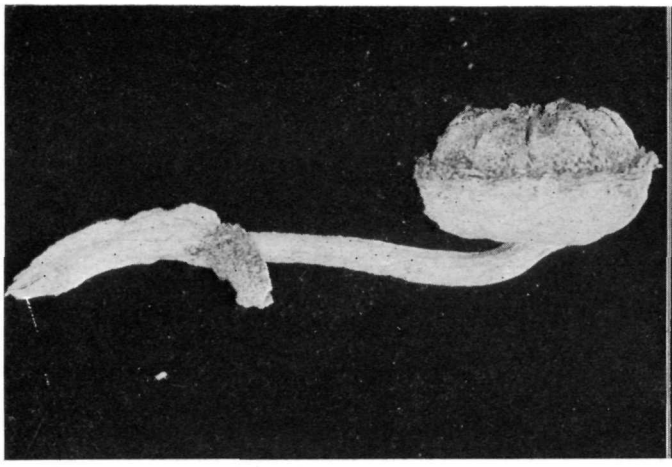


Fig. 11. Fruit of '*C. cuprea*'.

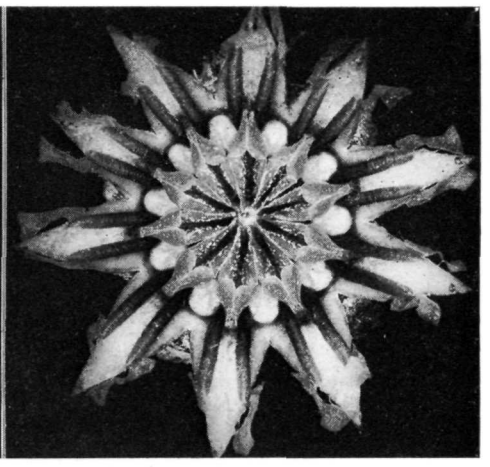


Fig. 12. Fruit of '*C. cuprea*' showing broad-winged valves.

Fruits are borne on persistent, mostly procumbent peduncles (fig. 11). The valves possess broad wings (fig. 12). The covering membranes form a trumpet-shaped opening at the distal end of the locule with a basal thickening as an additional closing mechanism. In side view, the basal part of the capsule is bowl-shaped with a distinct rim (marked by the remains of calyx-lobes, petals and stamens). The bracts reach a third of the length of the peduncle (fig. 11). The lower part is papery and brittle and their upper part remains hard. Counts of the numbers of locules per fruit show that the mean value for most populations is close to 10 (fig. 13), but careful examination of the data reveals slight differences. The south-western populations contain more fruits with 8 or 9 locules per fruit than the north-eastern ones (fig. 14). Thus two geographical subtypes can be distinguished according to locule number, but no correlations with other characters have been found, and exceptions are known, so the feature is of minor taxonomic significance.

Measurements of fruit-length and capsule-diameter reveal considerable variation (fig. 15) which could be due to climatic factors. The height of the capsule (H) and of its upper part (O) measured in side-view (as seen in fig. 11) show a rather constant relationship (fig. 16), the upper part (consisting of the free portions of the valves) never exceeding half the overall height of the capsule (dotted line in fig. 16).

In its geographical distribution, the species is restricted to the Knersvlakte, an area north of Vanrhynsdorp in the Cape Province (fig. 14). Here the plants grow at the edges of quartz fields or in sandy-loamy depressions together with species of the genera *Argyroderma* N.E.Br., *Dactylopsis* N.E.Br., *Dicrocaulon* N.E.Br., *Monilaria* Schwant., *Oophytum* N.E.Br., and others. Flowering seems to occur towards the end of the rainy season (August) in habitat, and fruits ripen during the following dry season.

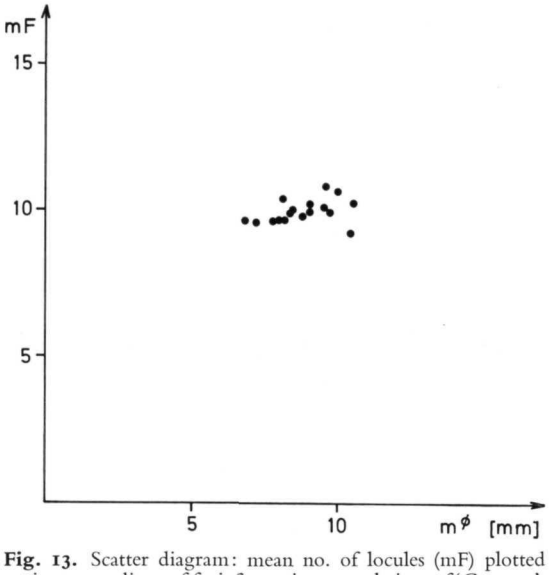


Fig. 13. Scatter diagram: mean no. of locules (mF) plotted against mean diam. of fruit for various populations of '*C. cuprea*'.

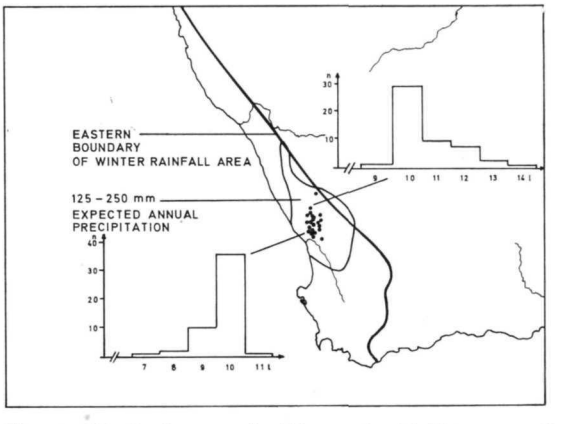


Fig. 14. Distribution map for '*C. cuprea*' with histograms of locule nos. per fruit in the SW and NE populations.

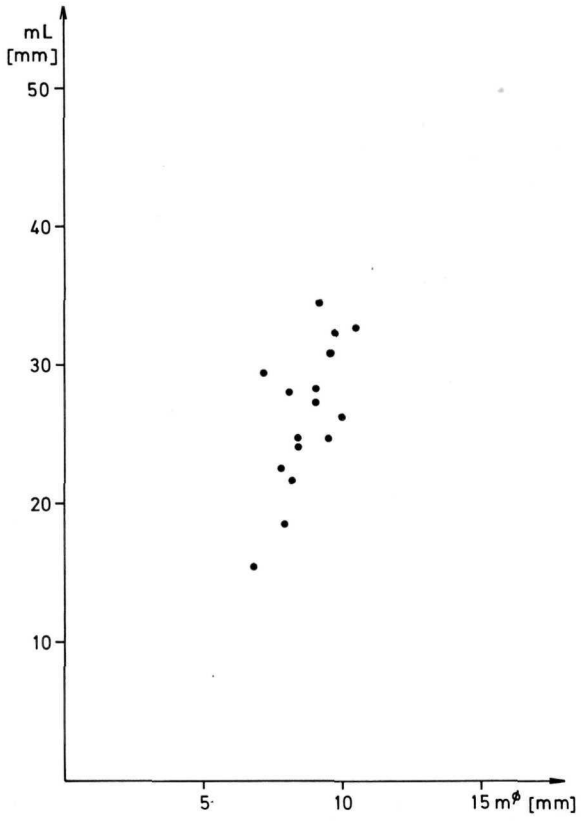


Fig. 15. Scatter diagram: mean fruit length (mL) plotted against mean diam. of fruit.

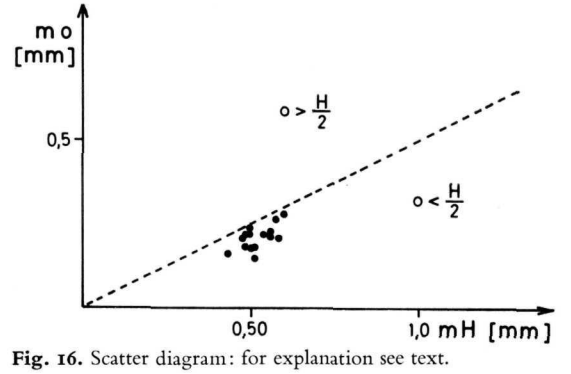


Fig. 16. Scatter diagram: for explanation see text.

Taxonomic and nomenclatural implications

The characters described above, when taken as a whole and compared with those of *Cephalophyllum* and *Cheiridopsis* clearly reveal that in spite of its compact habit the species in question is misplaced in *Cheiridopsis* and should be transferred to *Cephalophyllum*. The characters which most strongly associate the species with the latter genus are (1) the multi-nodal annual growth; (2) smooth leaf-surface; (3) wax cover in plates; (4) very variable flower colour; (5) procumbent fruits with broad valve-wings, additional closing mechanism and covering membrane trumpet-shaped at its distal end.

During the course of this investigation, the type of *Cheiridopsis cuprea* has been studied and found to agree nearly perfectly with the general description given above, as does the plant cultivated by collectors under this name. The holotype material consists only of a dissected flower, but a drawing attached to the sheet clearly shows the shiny leaf-surface typical of *Cephalophyllum,* the peculiar variation in flower colour and the slightly elongated vegetative branches. A total of 122 type sheets of *Cephalophyllum* and all relevant species-descriptions, have also been examined, but there is evidently no alternative name already available in this genus.

Unfortunately, a straightforward nomenclatural transfer is not permissible, since the name *Cephalophyllum cupreum* has already been used for a different species by L. Bolus. Consequently a new epithet must be chosen. Because of the rather compact, highly branched habit, *caespitosum* seems appropriate. The new name and relevant synonymy are formally published here:

Cephalophyllum caespitosum H. Hartmann, **nom. nov.;** basionym: *Mesembryanthemum cupreum* L. Bolus in Ann. Bolus Herb. 3: 159 (1923). Type: *Watermeyer* 122/23 (BOL!). Synonym: *Cheiridopsis cuprea* (L. Bolus) N. E. Brown in Gard. Chron. 79: 407 (1926). (Not *Cephalophyllum cupreum* L. Bolus in Notes Mesemb. 2: 114. 1929).

Acknowledgments

Financial support from the Deutsche Forschungsgemeinschaft is gratefully acknowledged. Additional grants were received from CSIR (RSA) and from the Kirstenbosch Jubilee Fellowship Council, all of which allowed extensive field studies in the years 1969, 1971, 1974 and 1977 in the area, for which I am most grateful. Last—but not least—I should like to thank Curator Harry Hall and his wife Lisabel, who drew my attention to these plants during my stay with them in the Knersvlakte in 1971.

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The Cactus and Succulent Journal of Great Britain
Volume 43(4): 101-108 (1981)

Epidermal Anatomy of some North American globular cacti

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Introduction

The surface of a cactus forms an essential barrier between the plant and a particularly hostile environment. It is certainly of interest from a functional point of view and may be of taxonomic value. There has been surprisingly little taxonomic work on this subject. Gibson & Horak (1979) demonstrated that surface anatomy is likely to be of taxonomic value in cereoid cacti, and the present work is an attempt to discover the taxonomic potential of surface characters in some of the globular cacti. Many of the genera are difficult to circumscribe and opinions differ on how they should be arranged in a natural classification. The placing of individual species is often problematical also. These are all matters where it is possible that anatomical studies may help to support or refute hypotheses at present largely based on gross morphological data.

Material and methods

All the material examined was taken from living plants in the collection of Mr. D. R. Hunt. The identifications are by Mr. Hunt *(Mammillaria)* and Mr. N. P. Taylor (other genera).

Transverse sections and epidermal strips of tubercles were prepared using several different techniques. Tubercles were removed from live specimens, and were sectioned on a Reichert sledge microtome at thicknesses between 30–40 μm. Where the material was too soft to section when fresh, it was fixed in formalin acetic alcohol for 24 hours and then hardened in 95% methylated spirits for a further 48 hours before sectioning. Epidermal preparations were made by cutting the surface of a tubercle and then pulling off a small area of the surface with forceps. The sections and peels were either mounted unstained in 50% glycerol, or stained in 1% safranin in 50% alcohol and aqueous alcian blue, dehydrated and mounted in euparal.

The outer layers of tubercles of species with thickened hypodermal cell walls were removed and macerated in Jeffrey's Solution, washed in water, stained as above and mounted in glycerine jelly to investigate the nature of the hypodermis.

Surfaces of most of the species under investigation were also examined in a Jeol JSM-35 scanning electron microscope. Since the tubercles of many species are difficult to dehydrate without shrinkage and distortion, it was necessary to use the critical point drying technique. The desiccated tubercle was then attached to a stub with Dotite and coated with platinum using a Polaron sputter coater E5000.

Drawings of transverse sections, tubercle surfaces and hypodermis macerations were made using a drawing tube attached to a Wild light microscope.

Description of tubercle surfaces and transverse sections

The description that follows outlines the characters exhibited by the species examined. Where the generic name is given alone, without a specific epithet, the character is exhibited in all the species examined from that genus. Where only one species was examined from a particular genus the specific epithet is given.

The *epidermis* consists of epidermal cells, guard cells, and their associated surrounding subsidiary cells. In surface view, the epidermal cells vary in shape or are polygonal. Their anticlinal walls are straight or sinuous to a varying degree. In all cases the subsidiary cells directly adjacent to the stomata are paracytic or parallelocytic, but in *Ferocactus* (*Thelocactus*) *leucacanthus* the paracytic and parallelocytic stomata are surrounded by an additional single cyclocytic ring.

In transverse section, the *cuticle* differs considerably in thickness between species. In most species it consists of a single layer (as observed under the light microscope) but occasionally there is more than one discrete layer. The surface is smooth in all species except for *Mammillaria polythele* and *M. perbella*, but in some species from other genera, a central papilla occurs on each epidermal cell. The *hypodermis* is either uniseriate or bi- to triseriate. It may be composed of parenchyma cells, sclereids, or thick-walled cells which otherwise resemble parenchyma cells. Prismatic crystals or druses occur in the lumina of some sclereids in certain species. The *cortex* consists of uniform unspecialized parenchyma cells, but in some species some cortical cells contain a single druse.

The characters exhibited by each species are summarized in Table 1 (page 108).

1. *Tubercle Surface*

Epidermal Cells. Anticlinal walls sinuous in *Escobaria, Mammillaria, Coryphantha elephantidens, Gymnocactus aguirreanus, G. beguinii* and *Turbinicarpus schmiedickeanus.*

Cells polygonal with straight anticlinal walls in *Thelocactus rinconensis, T. hexaedrophorus,* and slightly sinuous walls in *Ferocactus leucacanthus.* Anticlinal walls predominantly straight but cells not polygonal in *Ferocactus latispinus* and *F. uncinatus.* Surface of epidermal cells smooth, except in *Mammillaria polythele* and *M. perbella* which are sparsely verrucose.

A single central papilla was observed on each epidermal cell of *Turbinicarpus schmiedickeanus, Ferocactus uncinatus, Thelocactus rinconensis* and *T. hexaedrophorus.*

Stomata. Paracytic, with a tendency towards parallelocytic in all species examined. *Ferocactus* (*Thelocactus*) *leucacanthus* is the only species with an additional cyclocytic ring surrounding each paracytic stoma.

2. *Hypodermal Surface View*

In species with a hypodermis composed of sclereids, a stomatal pore was always observed below each stomatal complex. This is surrounded by 2 sickle-shaped sclereids. (For an exception to this, in *Mammillaria lloydii*, see Leuenberger & Schill (1974)). The sclereids vary from very thick-walled with hardly any lumen to thin-walled with wide lumina. Pits are usually very prominent.

3. *Transverse Section*

Cuticle. Thinner than outer periclinal wall of epidermal cells and only visible at magnifications greater than ×200 in *Escobaria, Coryphantha elephantidens, Gymnocactus aguirreanus, Mammillaria pygmaea, M. hutchisoniana, M.* aff. *haageana* and *Ferocactus leucacanthus* (for approximate measurements see Table 1).

Approximately the same thickness as outer periclinal wall of epidermal cells in *M. polythele, Ferocactus uncinatus* and *Gymnocactus beguinii.*

Visible at magnifications less than ×200, but thinner than outer periclinal wall of epidermal cells in *M. magnimamma, M. perbella, Thelocactus hexaedrophorus* and *Ferocactus latispinus.*

Thicker than outer periclinal wall of epidermal cells in *Thelocactus rinconensis*, forming one discrete layer, but forming two or more discrete layers in *Turbinicarpus schmiedickeanus.*

Epidermis. Epidermal cells are all square or rectangular in transverse section (The shape depends on the part of the cell that is sectioned). Papillae occur in some species (see list above under 1. *Tubercle Surface*). Periclinal and anticlinal walls are of the same thickness except in *M. polythele, M. perbella, M.* aff. *haageana* and *Ferocactus latispinus* where the outer periclinal wall is thicker than the other walls. The cell walls are thicker than normal in *M. magnimamma* and the anticlinal walls of *Thelocactus rinconensis* are disproportionately thick (especially as seen in surface view).

The epidermis is uniseriate in all the species examined except *M. perbella*★. The stomatal guard cells and subsidiary cells are frequently sunken below the epidermal surface in *M. magnimamma* and *Coryphantha elephantidens.* In *Thelocactus hexaedrophorus* the stomata are sunken, with the inner periclinal walls of the cells of the stomatal complex often on the same level as the inner periclinal walls of the adjacent epidermal cells.

Hypodermis. (a) Uniseriate, consisting of parenchyma cells in *Escobaria, Mammillaria pygmaea, Thelocactus hexaedrophorus,* and *Ferocactus leucacanthus.* The hypodermis is also parenchymatous and uniseriate but poorly defined in *Gymnocactus aguirreanus, M. hutchisoniana* and *Coryphantha elephantidens.*

Uniseriate, consisting of osteosclereids (i.e. bone-shaped sclereids) in *M. polythele, Ferocactus latispinus* and *Turbinicarpus schmiedickeanus.* Sclereids square or with curved sides in *M. magnimamma, M. perbella* and *M.* aff. *haageana.*

(b) Bi- to triseriate, thick-walled with round lumina in *Thelocactus rinconensis*, thick-walled with rectangular lumina in *Ferocactus uncinatus*, and with lumina of varying shape in *Gymnocactus beguinii.*

Crystals were observed in sclereid lumina of two species: in *Thelocactus rinconensis* as large spherical druses, and in *Turbinicarpus schmiedickeanus* as large prismatic crystals approximately the same size as adjacent epidermal cells.

Cortex. In all species this consists of large unspecialized parenchyma cells. Some cortical cells contain a single spherical druse in *Gymnocactus aguirreanus, Mammillaria perbella* and *Turbinicarpus schmiedickeanus.* The druses vary considerably in size in *G. aguirreanus.*

Discussion

The species examined exhibit a wide range of anatomical and morphological modifications apparently directed at water retention★★. This study was concerned only with anatomical characters of the surface, i.e. epidermis and hypodermis. In some species the surface does not seem to be xeromorphically modified to any great extent, but there are other adaptations serving the same purpose, including the number, size and density of spines covering the stem. Stomata were frequent on the tubercle surfaces of all species.

It is possible to divide the seventeen species examined into three groups according to their epidermal anatomy alone. The first comprises both species of *Escobaria, Coryphantha elephantidens, Gymnocactus aguirreanus* and the Mammillarias of section *Hydrochylus*, namely *M. hutchisoniana* and *M. pygmaea.* These six exhibit the least xeromorphic surface features: a thin cuticle and a

★In this species a periderm develops from the epidermis in the older, basal area of the tubercles. Stomata were observed on the outside of the periderm, indicating that divisions of the epidermis are to the inside. Stomatal pores occur in the hypodermis below the periderm where stomata occur, but periderm cells block the path between the stomatal pore and the guard cells. This suggests that such stomata are inoperative.

★★Hypodermal sclereids may reduce penetration of ultra-violet light, which would protect the chloroplasts in the underlying cells of the cortex.

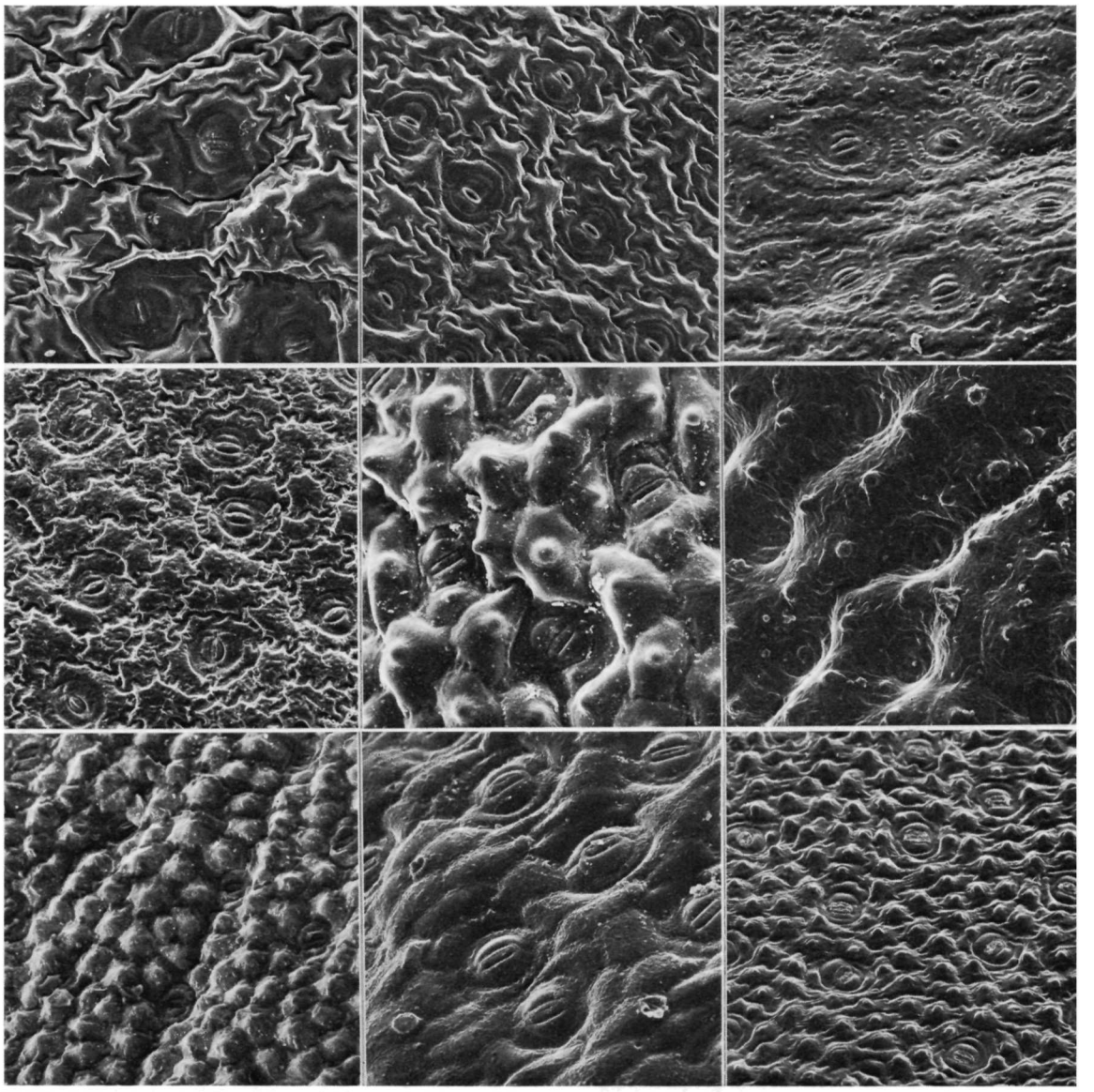
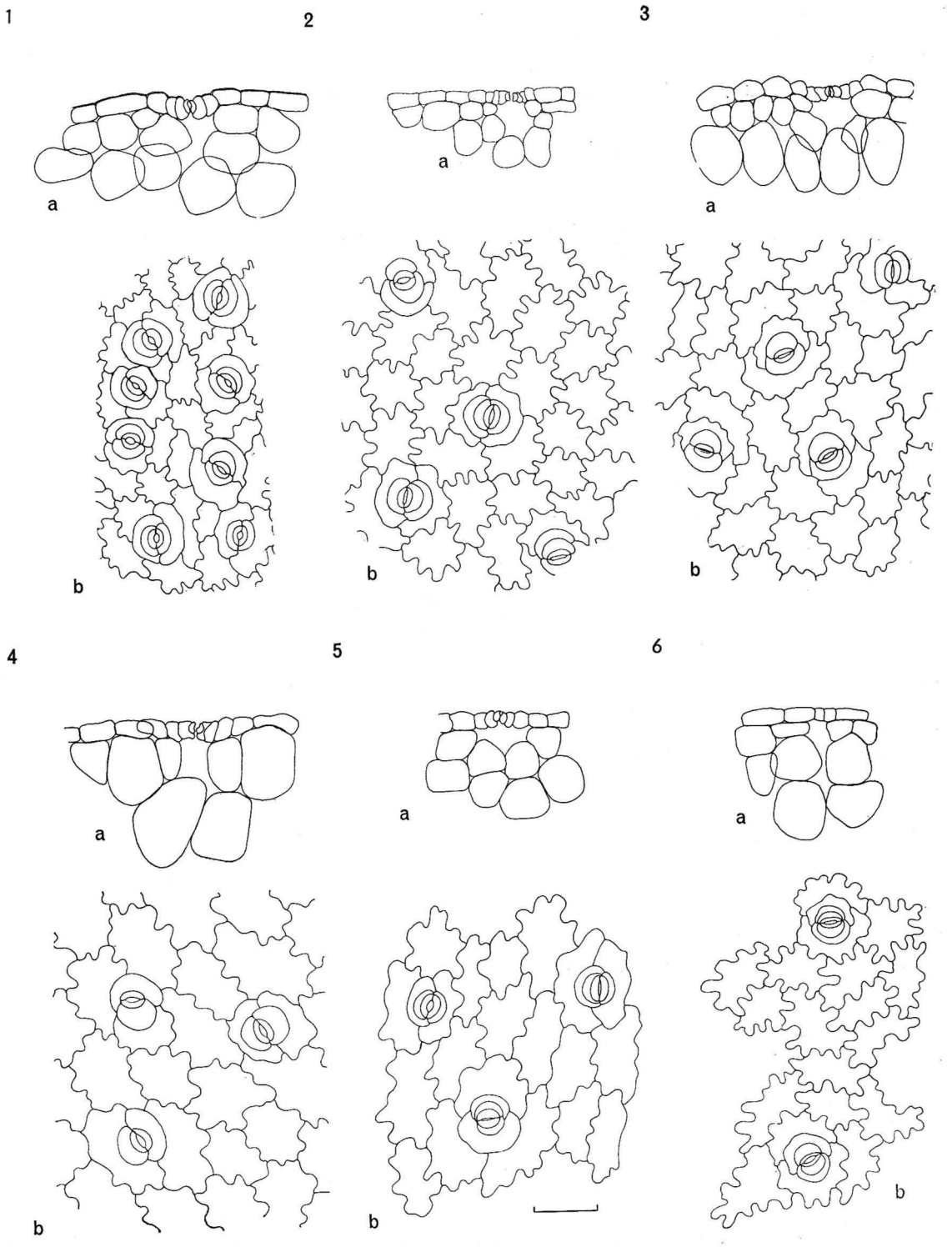
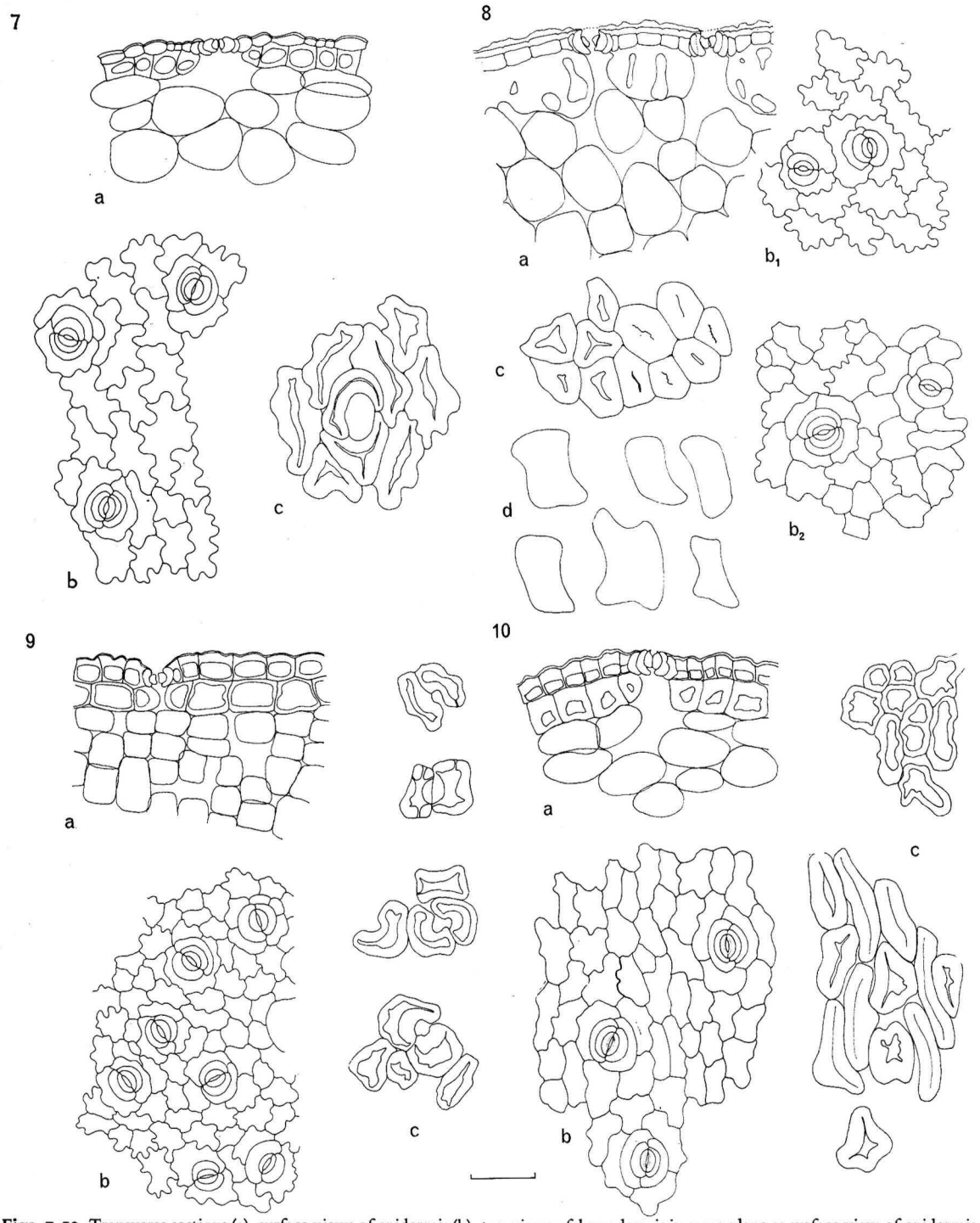


PLATE I. **Top row.** Left, *Escobaria strobiliformis*. Shrinkage of the cells is apparent. Centre, *Mammillaria pygmaea*. Similar in appearance to *E. strobiliformis* but without shrinkage. Right, *M. perbella*. Sparsely verrucose patterning on the cuticle. **Middle row.** Left, *M. polythele*. Centre, *Ferocactus uncinatus*. Epidermal cells with papillae. Right, *Thelocactus hexaedrophorus*. Sunken stomata and epidermal cells with papillae. **Bottom row.** Left, *T. rinconensis*. The papilla on each cell is very large, giving the cell a domed appearance. Centre, *Ferocactus (Thelocactus) leucacanthus*. Papillae absent. Right, *Turbinicarpus schmiedickeanus*. Epidermal cells with papillae. All × 133.

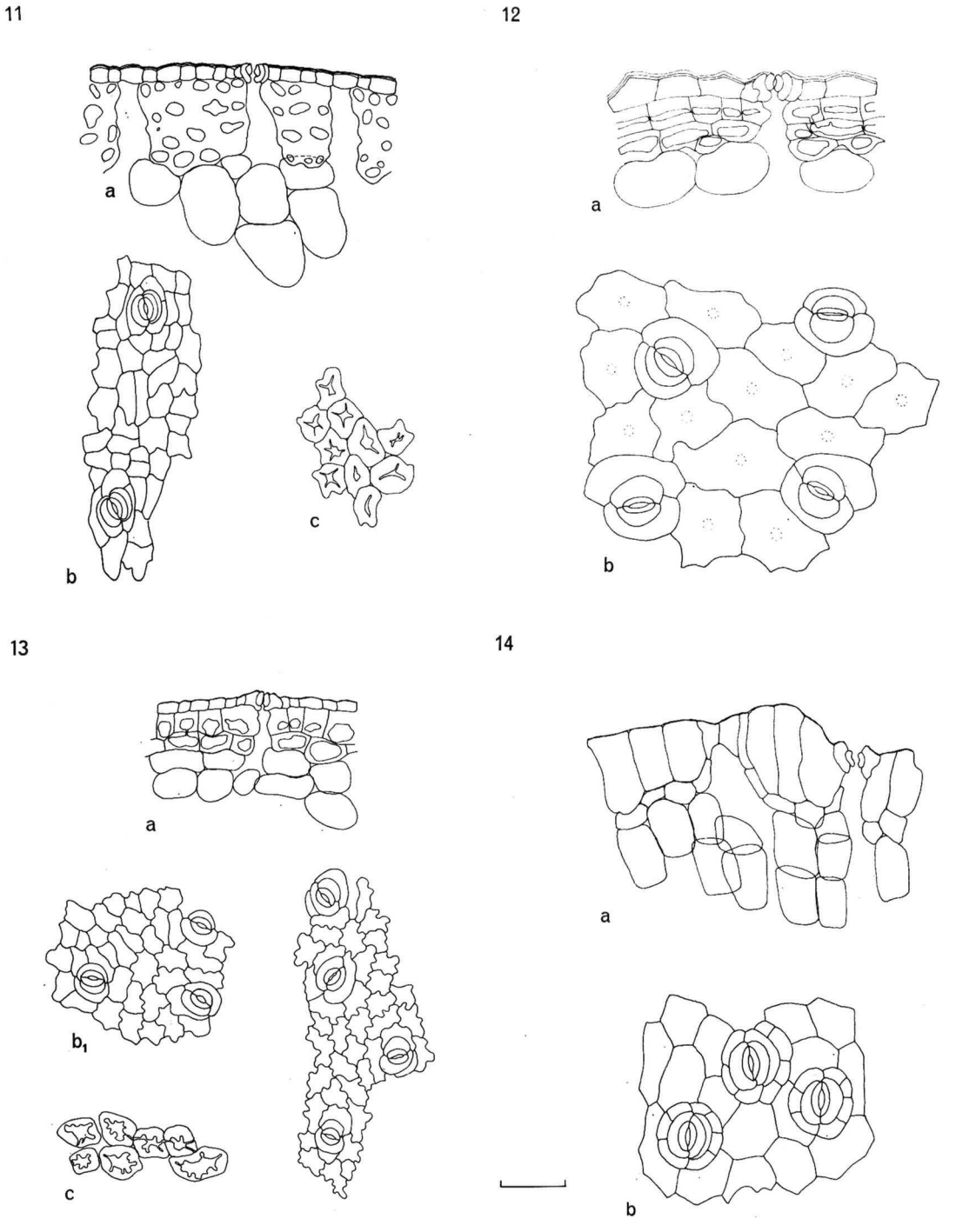
parenchymatous, uniseriate epidermis and hypodermis. The second group is represented by the four other *Mammillaria* species (sects. *Subhydrochylus* and *Mammillaria*). They differ from the '*Escobaria*' type in having thicker epidermal cell walls and a thick-walled, sclereidal hypodermis with substomatal cavities. The remaining seven species form a third somewhat heterogeneous group. The three Thelocacti and two Ferocacti are distinguished from the foregoing by their predominantly straight, rather than sinuous, anticlinal epidermal walls. Another difference in *T. rinconensis, T. hexaedrophorus, F. uncinatus* and *Turbinicarpus schmiedickeanus* is the presence of a single papilla on each epidermal cell, while *Ferocactus* (*Thelocactus*) *leucacanthus* has a unique stomatal subsidiary cell arrangement. *Gymnocactus beguinii* is distinguished by its 2–3-seriate and thickened sclereidal hypodermis, which also occurs in *F. uncinatus* and *T. rinconensis*.



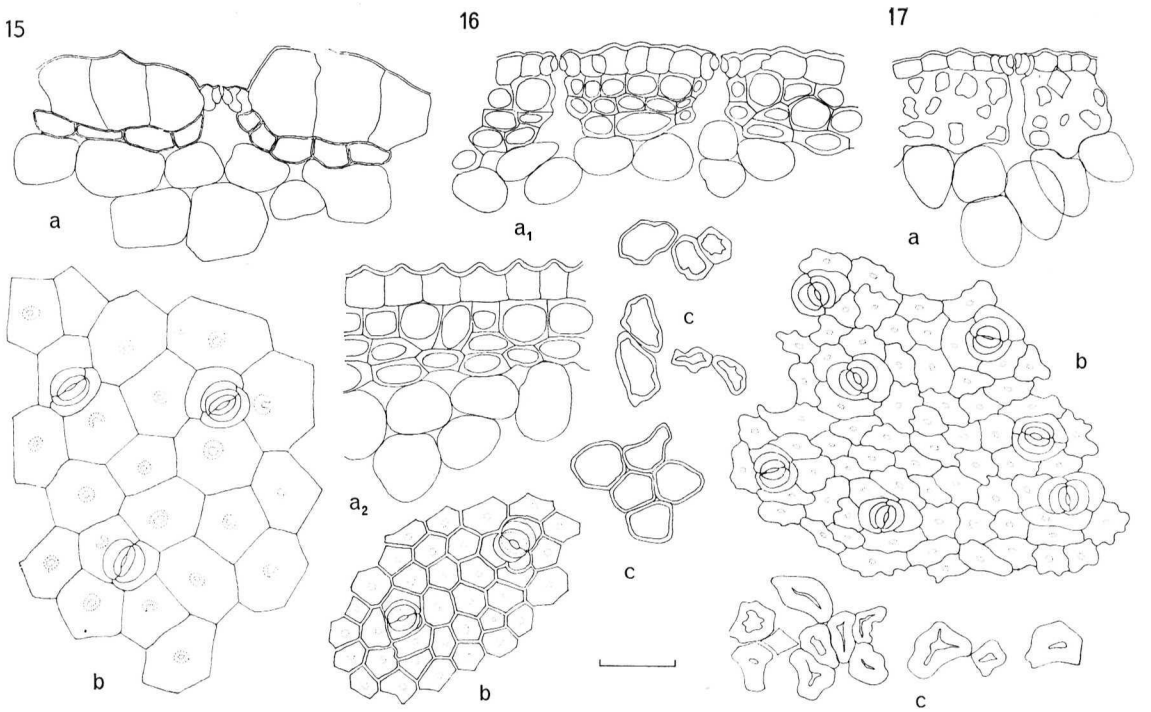
Figs. 1–6. Transverse sections (a) and surface views of epidermis (b). **1,** *Coryphantha elephantidens.* **2,** *Escobaria dasyacantha.* **3,** *E. strobiliformis.* **4,** *Gymnocactus aguirreanus.* **5,** *Mammillaria hutchisoniana.* **6,** *M. pygmaea.* Scale line = 100 μm.



Figs. 7–10. Transverse sections (a), surface views of epidermis (b), top views of hypodermis in same plane as surface view of epidermis (c) and side view of macerated hypodermal cells (d). **7,** *Mammillaria* aff. *haageana*. **8,** *M. polythele*. The cell-wall boundaries in the hypodermis are indistinct and are omitted in (a); (b_1) and (b_2) show the extremes in variation of epidermal cell-shape in a single plant. **9,** *M. magnimamma*. **10,** *M. perbella*. The shape, wall-thickness and lumen-size of the hypodermal sclereids varies considerably in this species. Scale line = 100 μm.



Figs. 11–14. Transverse sections (a), surface views of epidermis (b) and top views of hypodermis (c). **11,** *Ferocactus latispinus.* **12,** *F. uncinatus.* **13,** *Gymnocactus beguinii.* **14,** *F. (Thelocactus) leucacanthus.* Scale line = 100 μm.



Figs. 15–17. Transverse sections (a), surface views of epidermis (b) and top views of hypodermis (c). **15,** *Thelocactus hexaedrophorus*. **16,** *T. rinconensis*. The section (a_2) passes more centrally through the papillae than it does in (a_1). **17,** *Turbinicarpus schmiedickeanus*. Note the solitary prismatic crystals in the hypodermis. One is depicted to the right of the stomatal pore in (a) and in maceration in (c). Scale line = 100 μm.

It is worth noting that groups one and two have juicy indehiscent fruits while group three has drier dehiscent fruits. Thus in the two *Gymnocactus* species examined (*G. aguirreanus* in Group 1 and *G. beguinii* in Group 3) the considerable differences in epidermal anatomy are correlated with divergence in fruit type. *G. aguirreanus* Glass & Foster (1972) is closely allied to *G. roseanus* which has been referred to *Escobaria* by Buxbaum (1951) on the basis of seed morphology. Certainly the epidermal anatomy of *G. aguirreanus* indicates a closer relationship with *Escobaria* than with its congener *G. beguinii,* which in turn seems to share some anatomical features with *Thelocactus rinconensis* and *Ferocactus latispinus*. A second point worth noting is that the anatomical differences demonstrated here between *Mammillaria* sect. *Hydrochylus* (Group 1) and *M.* sections *Subhydrochylus* and *Mammillaria* (both Group 2) correlate with the well-known distinction of watery versus milky sap, laticifers being absent from the former section and other species placed in Group 1 (Mauseth, 1978).

The small number of taxa examined in this preliminary survey clearly limits the extent to which taxonomic inferences can be drawn. However, the diversity apparent among the two *Thelocactus* and three *Ferocactus* species examined suggests that a comprehensive anatomical investigation of the North American Echinocacti would be of value, as it has been with the Mexican columnar cacti (Gibson & Horak, 1979).

Acknowledgments

I should like to thank N. P. Taylor, Dr. P. Rudall, Mrs. R. Gale and Dr. D. F. Cutler for their help and advice during the preparation of this paper. M. Svanderlik and T. Harwood processed the photographs.

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TABLE 1

No.	Identification (H.=Hunt Field No.)	Cuticle (1)	(2)	Epidermis (3)	(4)	(5)	(6)	Hypodermis (7)	(8)	(9)	Cortex (10)
1	Coryphantha elephantidens H.9007	1.8	S	—	S(St)	—		+	P		
2	Escobaria dasyacantha H.9575	0.9	S	—	S	—		+	P		
3	Escobaria strobiliformis H.9554	0.9	S	—	S	—		+	P		
4	Gymnocactus aguirreanus	0.7	S	—	S	—		+	P		D
5	M. hutchisoniana H.8735	0.9	S	—	S	—		+	P		
6	M. pygmaea H.8643	0.4	S	—	S	—		+	P		
7	M. aff. haageana H.9094A	0.9	S	—	S	+		+	S		
8	M. polythele	7.0	V	—	S(St)	+		+	S		
9	M. magnimamma	3.9	S	+	S(St)	+		+	S		
10	M. perbella H.8634	3.5	V	+	S(St)	+		+	S		D
11	Ferocactus latispinus	3.5	S	—	(S)St	+		+	S		
12	F. uncinatus H.9555	3.5	S	—	S	—	+	++	S		
13	Gymnocactus beguinii	0.9	S	—	S	—		++	S	D	D
14	Ferocactus leucacanthus	3.5	W	—	St(P)	—		+	P		
15	T. hexaedrophorus	5.3	W	—	St P	—	+	+	P		
16	T. rinconensis	7.0	S	+	St P	+	+	++	S	D	
17	Turbinicarpus schmiedickeanus	4.4	S	—	(S)(St)	—	+	+	S	S	

Key to data columns. CUTICLE: (1) approx. thickness, μm; (2) sculpturing, smooth (S), sparsely verrucose (V), some wrinkling (W) apparently due to shrinkage in preparation. **EPIDERMIS:** (3) anticlinal walls less than (—) or more than (+) 1 μm thick; (4) anticlinal walls sinuous (S), straight (St), or cells polygonal (P); (5) outer periclinal walls 0.9–4.4 μm (—) or 5.3–12.3 μm (+) thick; (6) papillae present (+). **HYPODERMIS:** (7) 1-seriate (+) or 2-3-seriate (++); (8) cells parenchymatous (P) or sclereidal/thick-walled (S); (9) druses (D) or solitary prismatic crystals (S) present. **CORTEX:** (10) druses present (D).

Annual General Meeting

IN ACCORDANCE WITH Rule 6, I hereby give notice that an Annual General Meeting of the Cactus and Succulent Society of Great Britain will be held on Saturday, 27 March 1982, at the Royal Botanic Gardens, Kew, Richmond, Surrey, by kind permision of the Director, commencing at 11.30 a.m.

The attention of members is drawn to Rule 5, sections (d) and (e) which define the procedure to be followed in the election of Officers and Council. The Rule requires that the several Vice-Presidents be elected annually by a show of hands at the Annual General Meeting. The Chairman, Honorary Secretary, Honorary Treasurer and Members of Council to fill the vacancies resulting from the retirement of members who have completed their three-year term of office will be elected by postal ballot in the event of the number of nominations exceeding the number of vacancies. Following the change in Rule 5(d) made at the 1979 Annual General Meeting retiring members of Council are ineligible for re-election for one year.

Nominations are therefore invited for the offices of Chairman, Honorary Secretary, Honorary Treasurer and three members of Council. These nominations must be in writing and must bear the signature of a proposer and seconder and be accompanied by the written and signed consent of the person nominated. Such nominations must be in the hands of the Honorary Secretary not less than nine weeks prior to the Annual General Meeting, that is, not later than Friday, 22 January 1982.

The following are due to retire:—

Chairman	Mr. W. F. Maddams	eligible for re-nomination
Honorary Secretary	Mr. R. H. I. Read	
Honorary Treasurer	Mr. D. R. Hunt	
Members of Council	Dr. C. W. Bird, Mrs. D. Pritchard, Mr. P. Sherville	

In the event of the number of nominations exceeding the number of vacancies a Ballot Paper will be circulated to paid-up members not less than six weeks prior to the Annual General Meeting.

R. H. I. READ
Honorary Secretary.

The Cactus and Succulent Journal of Great Britain
Volume 43(4): 109-113 (1981)

Pollen Morphology in the subtribe Borzicactinae F. Buxb. (Cactaceae)

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Introduction

The systematics of the subtribe Borzicactinae F. Buxb. have been the subject of fairly close scrutiny over the last fifteen years resulting in the proposal of a number of differing classifications. Buxbaum (1958) originally erected the subtribe to include the genera *Loxanthocereus* Backeb., *Maritimocereus* Akers & Buin., *Borzicactus* Riccob., *Bolivicereus* Cárdenas, *Denmoza* Britton & Rose, *Cleistocactus* Lemaire, *Seticereus* Backeb., *Oreocereus* (A. Berger) Riccob., *Morawetzia* Backeb., *Arequipa* Britton & Rose, *Matucana* Britton & Rose and *Oroya* Britton & Rose. Kimnach (1960) added the genera *Clistanthocereus* Backeb., *Arequipiopsis* Kreuz. & Buin., *Submatucana* Backeb. and *Cephalocleistocactus* F. Ritter while Donald (1970–71) added the subsequently published genera, *Akersia* Buin., *Hildewintera* F. Ritter and *Eomatucana* F. Ritter.

The large number of narrowly defined genera found in this tribe and, indeed, in the family as a whole, has been strongly criticised by a number of taxonomists, notably Kimnach (1960), Hunt (1967) and Donald (1970–71). As Kimnach points out, numerous taxa have been published based on trivial criteria. Because subsequently discovered variants did not exactly match the descriptions of these narrowly defined taxa, further new taxa have been created. Many descriptions provide inadequate information and have frequently been based on incomplete material. In an effort to bring the classification of the Cactaceae into line with that of other angiosperm families, Kimnach proposed a new conservative treatment of the subtribe Borzicactinae, reducing the number of genera from sixteen to four, based upon the shape of the floral limb. He also reduced the number of species in the largest genus, *Borzicactus*, from seventy to eighteen. Kimnach's work has been followed by that of Donald (1970–71) who has discussed the affinities of the various genera at some length and has proposed new formal classifications at specific and subspecific levels.

Similar conservative treatments in the family have been published by other authors. Rowley (1958) published a new classification of *Opuntia* and its allies and Hunt (1967) proposed a new classification of the whole family, reducing the number of genera to eighty four, and upholding Kimnach's wider concept of the genus *Borzicactus*. The interesting taxonomic situation in the Borzicactinae, with a conflict between narrow and wide species concepts led to an investigation of the pollen morphology of eight genera of the group.

Pollen data are widely used in plant systematics in attempting to elucidate difficult taxonomic problems. The pollen morphology of the Cactaceae first received significant attention from Kurtz (1948) who showed that there was appreciable variation in the pollen morphology of various Arizona cacti. Erdtman (1952) briefly reviewed the palynology of the family and indicated the range of variability and Kurtz (1963) later produced a wide survey of the superficial morphology of the pollen of some seven hundred species in one hundred and ten genera. Tsukada (1964) looked more closely at thirty seven species in fourteen genera using light microscopy, distinguished eight distinct pollen morphological types and also suggested three evolutionary lines. Nowicke (1975) studied twelve taxa of Cactaceae in a survey of the Order Centrospermae. There have also been a number of more recent studies, using both light and electron microscopy, which have produced further information on pollen structure in the family, all of which are reviewed by Leuenberger (1976a). In a comprehensive study, Leuenberger (1976a, b) investigated the pollen of over six hundred species from nearly all the genera of the Cactaceae, with about half the samples being studied by scanning electron microscopy. Skvarla and Nowicke (1976) and Nowicke and Skvarla (1979) have reviewed the palynology of the family in relation to this and other features of the Centrospermae and those of other families outside this order.

Pollen characters

Among the pollen characters most commonly used in taxonomic studies are the shape and dimensions of the grain, the number, position and form of the apertures, the structure and thickness of the pollen wall and the form of the outer sculpturing of the exine. All these characters were examined in the course of the present study, and, for convenience, the terms used in descriptions will follow those used by Leuenberger. All measurements were made with light microscopy from a minimum of thirty grains for each sample.

Materials and Methods

Thirty-seven pollen samples from the genera *Arequipa* (1), *Bolivicereus* (1), *Borzicactus* sensu stricto (4), *Eomatucana* (1), *Hildewintera* (1), *Matucana* (11), *Oroya* (6) and

Submatucana (12) were investigated.

Samples were obtained, chiefly from plants of known wild origin, from Mr. J. D. Donald, Mr. D. J. Lewis and from the Reference Collection maintained by Holly Gate Nurseries. The work was undertaken as part of an undergraduate course at the Department of Botany, University of Reading.

All samples were subjected to acetolysis treatment following Erdtman (1960) and mounted in glycerine jelly for light microscopy, a portion being retained for scanning electron microscopy. Pollen grains were sectioned after mounting in gelatin using a microtome mounted in a Slee freezing cabinet. Samples for scanning electron microscopy were coated with gold in an Edwards 306 coating unit and examined using a JEOL Type JSM microscope. I am indebted to Professor V. H. Heywood for providing facilities, all those who kindly provided pollen samples and Dr. S. Blackmore, Dr. P. D. Barnard and Dr. I. K. Ferguson for their help and advice.

Results

All the pollen samples yielded grains of the same basic type corresponding to the 3-zonicolpate spinulate type of Tsukada (1964: 52) and the Cereus-type of Leuenberger (1976a: 77). It is described below and detailed sample measurements are provided in Table 1.

Grains oblate to spheroidal, tricolpate, spinulate. Colpi very long and very sharply pointed at either end. Colpus membrane present. Tectum with scattered minute perforations (puncta) each usually surrounded by a raised ring. Tectum supported by closely spaced, simple columellae.

Two reasonably distinct forms of this pollen type are found. Form A includes all the samples from the genera *Arequipa, Bolivicereus, Borzicactus, Eomatucana, Hildewintera, Matucana* and *Submatucana.*

Form A: Equatorial diameter 47.8–87.8 μm. Outline in polar view circular. Exine 1.5–3 μm thick, sometimes a little thicker at the poles, spinulate. Spinules to about 2 μm tall and 2 μm wide at the base. Tectum thicker than nexine. Colpus membrane often bearing closely spaced spinules. (See plate I).

Form B pollen includes all the samples from the genus *Oroya.*

Form B: Equatorial diameter 37.9–55.6 μm. Outline in polar view deltoid. Exine 1.5–2.5 μm thick at equator, but much thicker at the poles, often 3–3.5 μm, spinulate. Spinules small, usually less than 1 μm tall and less than 1 μm wide at the base, not visible using light microscopy. Tectum and nexine of about the same thickness (see plate I).

Within pollen form A, there is a large degree of variation. Thirty one samples fall into this group, and these cover a continuous series of ranges of grain diameters from 47.8 μm (*Hildewintera aureispina*) to 86.8 μm (*Matucana fruticosa*). All are markedly spinulate, some, such as *Submatucana calvescens* Sample A, coarsely so, with individual spinules some 2 μm long and 2 μm wide at the base, while others such as *Matucana cylindrica* are more finely spinulate. Spinule densities range more or less continuously from 2.8/100 μm^2 in *Submatucana calvescens* to 14.2/100 μm^2 in *Submatucana formosa* var. *minor.* Similarly there is a continuous series of ranges of overlapping punctum densities with no isolated samples, ranging from 5.0/100 μm^2 in *Matucana celendinensis* to 20.6/100 μm^2 in *Submatucana madisoniorum.*

Within pollen form B, the six samples are all comparatively similar and cover a continuous series of ranges of grain diameter from 38 μm in *Oroya peruviana* var. *conaikensis* to 55.6 μm in *Oroya neoperuviana* var. *subocculta.* Using light microscopy, this group appears to possess no spinules although the puncta can be detected. However, scanning electron micrographs reveal that the tectum bears very small spinules and confirms the presence of puncta. There are no qualitative characters separating the samples in this group, although it would be possible to distinguish some of them on the basis of their size ranges. Characteristically, all form B pollen samples show an appreciable thickening of the exine at the poles; sometimes the exine may be twice as thick as in the non-polar regions.

Discussion

The results of this study are closely supported by the findings of earlier authors. Kurtz (1963) found the tricolpate grain to be widespread and states that *Oroya* pollen has a diameter of 44–46 μm with a pitted exine, whereas *Matucana* and *Borzicactus* pollen possesses a pitted exine with spinules, grain diameters being 58–90 μm and 49–53 μm respectively. Tsukada (1964) looked at the pollen of *Borzicactus morleyanus* Britton & Rose and provided a detailed description of its 3-zonicolpate, spinulate pollen which agrees well with the pollen of allied taxa. Nowicke (1975) and Nowicke and Skvarla (1977) also studied the pollen of *Borzicactus tenuiserpens* (Rauh & Backeb.) Kimnach.

The most comprehensive contribution to the study of the palynology of this group is by Leuenberger (1976a, b) who studied the pollen of some 66 samples from taxa in the Borzicactinae. He found that the *Cereus* type of exine occurred throughout the subtribe (1976b: 81) but observed that *Oroya* was noteworthy for its smaller, more numerous exine elements. In this study, the pollen of *Oroya* was found to be distinguishable from that of the other genera studied by its generally smaller grains, its smaller spinules, its locally thickened exine and its proportionately thicker nexine (see plate I).

Kimnach (1960), Hunt (1967) and Donald (1970–71) all recognize only four genera within the subtribe Borzicactinae, namely *Oroya, Borzicactus, Denmoza* and *Cleistocactus,* most of the remaining genera being grouped together under *Borzicactus.* The pollen of *Cleistocactus* and *Denmoza* was investigated by Leuenberger (1976a) and is of the *Borzicactus* sensu lato type and therefore distinguishable from that of *Oroya.*

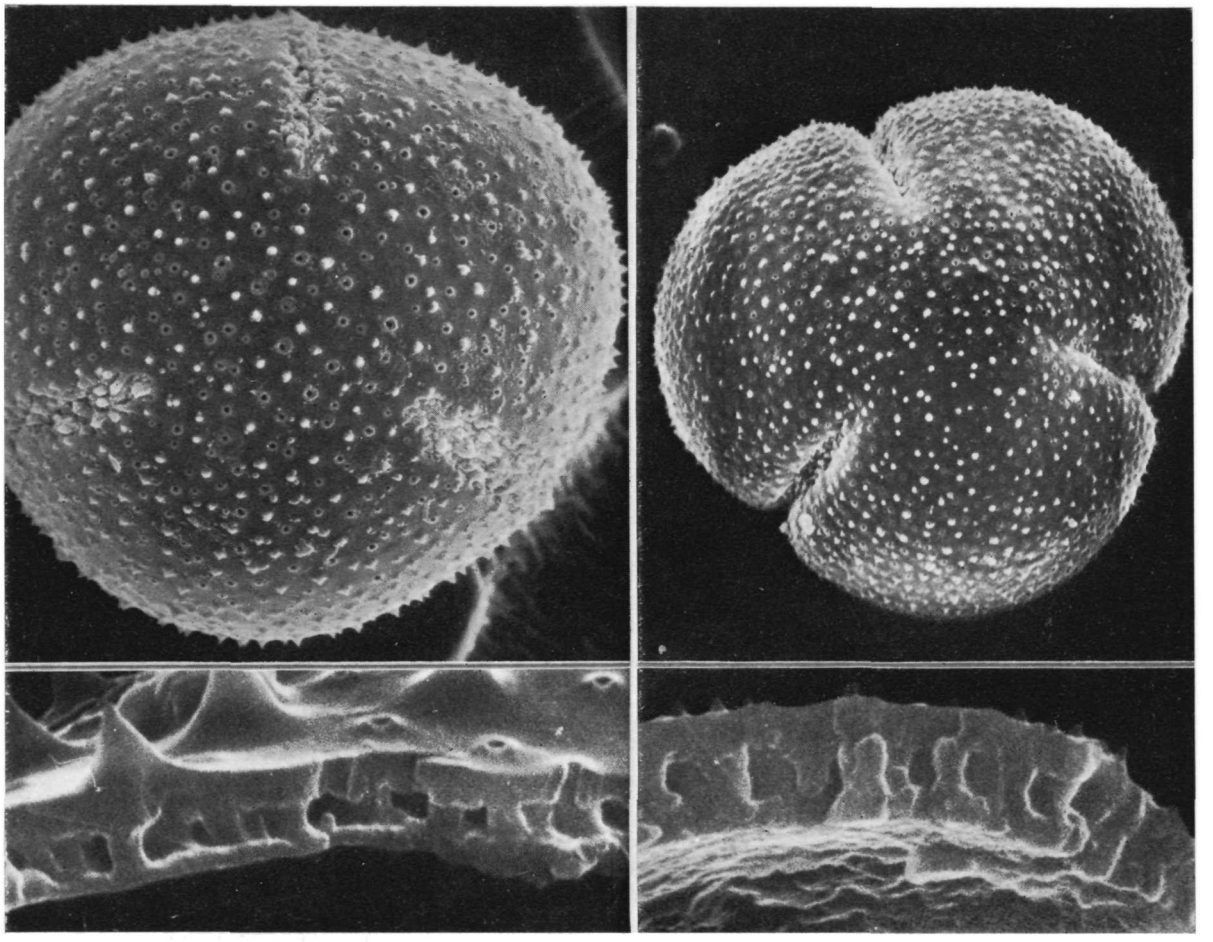

PLATE I. **Left,** pollen form A. Whole grain of *Borzicactus samaipatanus*, × 1450 (above) and section of wall of *Submatucana madisoniorum*, × 36000 (below) showing tectum thicker than nexine. **Right,** pollen form B. Whole grain, × 1825 (above) and section of wall, × 27250 (below), of *Oroya peruviana* var. *conaikensis*, showing tectum and nexine approx. equal thickness.

Oroya has a fairly narrow distribution, occurring only in a narrow region from the Junin to the Apurimac Departments of Peru and in a single area in Ancash Department, at altitudes of 3000–4500 m. It is remarkable in the Borzicactinae in possessing actinomorphic, campanulate flowers together with long, narrow areoles and pectinate lateral spines. The stem is also very reduced, mature plants having flattened-globose to very short-cylindrical bodies. The pollen differences could be a by-product of physiological adaptation to high altitude conditions or a result of selection for compatibility with specialized pollinators of the actinomorphic flowers, or merely a result of isolation and independent development without any specific adaptive function.

Nevertheless, the underlying similarity of *Oroya* pollen to that of the rest of the Borzicactinae (tricolpate, spinulate, punctate grains) makes the use of pollen data unwise for the delimitation of genera in this group. Leuenberger (1976a) has shown that in the Cactaceae, tricolpate, spinulate, punctate grains are found in the subfamily Pereskioideae and in all the tribes of the Cactoideae and are only absent from the Opuntioideae. Further, Nowicke (1975) and Nowicke and Skvarla (1977, 1979), in a survey of the 16 families in the Order Centrospermae which includes Cactaceae, have shown that this type is also by no means uncommon in the Aizoaceae (see also Dupont, 1980), Caryophyllaceae, Molluginaceae, Nyctaginaceae, Phytolaccaceae and Portulacaceae. This form of tricolpate grain has either evolved on a large number of occasions, its distribution being due to parallelism, or, as seems more likely, it is a relatively primitive character state which has been retained unchanged in a number of different evolutionary lines.

Pollen morphology in the Borzicactinae is consequently of little use in elucidating relationships because the pollen type is a rather widespread one in the family as a whole and in the Centrospermae and therefore cannot be used as a diagnostic character.

Many of the taxa are red-flowered and the possible influence of common pollination vectors causing selection for a particular pollen type cannot be completely ruled out. Porsch (1937) suggested that there was a supra-generic humming bird-pollinated group of 'Andine Loxanthocerei' where ornithophilous adaptations had become fixed in the tribe. If so, it is possible that the pollen morphology of a number of taxa could be less diverse than might otherwise be expected. On the other hand, Leuenberger (1976: 203) concluded that, 'the data obtained so far do not support the assumption that clear correlations exist between exine sculpturing and pollination types'.

Pollen characters are no different from other morphological characters in that sometimes they are taxonomically useful and sometimes they are not. Barthlott and Rauh (1974–75) warned that 'the characteristics of pollen morphology must . . . be interpreted with great caution', on the basis of failing to segregate morphologically distinct species in *Rhipsalis* while in other studies, e.g. Barthlott (1974), pollen data have proved very useful. Tsukada (1964) was greatly puzzled by the possession of a supposedly advanced pollen type (12 panto-colpate) by the genus *Pereskia*, supposed by most Cactaceae phylogenists to be one of the most 'primitive' genera. There is no anomaly here for it must be remembered that it is characters which are primitive or advanced, not species, nor any other taxon. Each taxon will possess a mixture of both primitive and advanced characters, and it is therefore meaningless to talk of the genus *Pereskia* being 'primitive'. Leuenberger (1976a) subsequently found that in the subfamily Pereskioideae, 3–15 colpate pollen grains occur and rightly concludes that there is a heterobathmy of characters shown in the subfamily.

In summary, pollen morphology is of little help in elucidating generic relationships and delimitation in the Borzicactinae. *Oroya* pollen is distinctive in the generally smaller grains, smaller spinules, locally thickened exine and thinner nexine, but the pollen of *Arequipa, Bolivicereus, Borzicactus, Eomatucana, Hildewintera, Matucana* and *Submatucana* is not distinguishable at a generic level.

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TABLE 1

Taxon	Source Data Key: DM, De Munter field collection; FR, F. Ritter field collection; KZ, K. Knize field collection; HG, Holly Gate Reference Collection	Range of diameter μm	Range of Spinule Density/ 100 μm^2	Range of Punctum Density/ 100 μm^2	Exine Thickness μm
Arequipa rettigii	Peru, Arequipa, *Lau* 123	59.7–66.4	5.7–7.8	10.0–15.7	2.5
Bolivicereus samaipatanus	Bolivia, Samaipata	51.5–58.3	5.7–8.5	12.8–20.6	2.0–2.5
Borzicactus madisoniorum var. pujupatii	Peru, Chamaya-Bagua, DM.HG.51–711.3	47.3–59.7	5.0–7.1		2.0
Borzicactus paucicostatus forma robustispinus	Peru, Huari, DM.	50.2–61.0	5.0–8.5	9.3–13.5	1.5
Borzicactus weberbaueri var. flammeus—Sample A	Peru, Balsas, *Lau* 109	43.4–70.5	4.3–7.8	12.1–16.4	2.0
Borzicactus weberbaueri var. flammeus—Sample B	Peru, Balsas, DM.HG.51–733.2	60.1–69.2	4.3–7.1	6.4–11.4	2.5
Eomatucana oreodoxa	Peru, near Huari, *Lau* 273	59.7–69.2	4.3–9.3	7.1–11.4	2.0–2.5
Hildewintera aureispina	Bolivia, Prov. Florida, FR.	43.4–50.2			1.5–2.0
Matucana calliantha	Peru, Balsas, DM. 19	59.7–66.4	7.8–12.8	10.7–17.8	2.5
Matucana celendinensis	Peru, Celendin, DM. HG. 51–714.3	46.1–52.9	3.6–5.7	5.0–7.8	2.5
Matucana cereoides	Peru, Pisco Valley, *Lau* 209	65.1–74.6	3.6–5.7	10.0–14.9	2.5
Matucana comacephala Sample A	Peru, Huaytani, DM. HG. 51–751.4	58.3–67.8	5.7–9.3	10.7–15.7	2.0
Matucana comacephala Sample B	Peru, Huaytani, *Lau* 185	59.7–70.5	4.3–7.1	8.5–13.5	2.0
Matucana comacephala Sample C	Peru, Huaytani, *Lau* 185	61.0–69.2	6.4–9.3	8.5–12.8	2.0
Matucana cylindrica Knize nom. nud.	Peru, Rio Fortaleza	62.4–71.9	3.6–5.0	7.1–12.1	2.5
Matucana fruticosa	Peru, San Juan, FR 1307	73.2–86.8	3.6–5.7	8.5–15.6	1.5–2.0
Matucana tuberculosa	Peru, Rio Marañón, DM. HG. 51–705.4	54.3–65.1	5.0–6.4		2.0
Matucana variabilis	Peru, Churin, DM.HG. 51–743.1	61.0–73.2	3.6–5.7	10.7–13.5	2.5
Matucana weberbaueri	Peru, Carrizal, *Lau* 218	54.3–62.4	4.3–7.8	9.3–12.8	2.0
Submatucana aureiflora	Peru, Cajamarca, *Lau* 104	54.2–59.7	3.6–8.5	8.5–12.8	2.5
Submatucana calvescens Sample A	Peru, Angesmarca, DM. 23	63.7–77.3	2.8–7.1	7.8–13.5	2.0
Submatucana calvescens Sample B	Peru, Angesmarca, DM. HG. 51–719.2	70.5–85.4	3.6–7.1	7.1–11.4	2.5
Submatucana currundayensis Sample A	Peru, Cerro Currunday, *Lau* 171	62.4–81.4	3.6–5.7	7.8–12.1	2.5
Submatucana currundayensis Sample B	Peru, Cerro Currunday, DM. 40	66.5–81.4	2.8–5.0	7.8–15.7	2.0–2.5
Submatucana formosa	Peru, Marañón Gorge, *Lau* 105	54.2–63.7	3.6–7.8	7.1–13.5	2.5
Submatucana formosa var. minor	Peru, El Chaqual, *Lau* 226	43.4–52.9	10.0–14.2		1.5
Submatucana intertexta Sample A	Peru, Rio Marañón, DM.	54.2–63.7	5.7–9.3	9.3–12.1	2.5
Submatucana intertexta Sample B	Peru, Rio Marañón, *Lau* 108	48.8–55.6	6.4–5.0	9.3–13.5	2.5
Submatucana intertexta Sample C	Peru, Rio Marañón, *Lau* 108	54.2–67.8	5.0–7.1	9.3–12.8	2.5
Submatucana madisoniorum	Peru, DM. 37	57.0–65.1	6.4–9.0	15.7–20.6	2.5
Submatucana ritteri	Peru, Otuzco, *Lau* 116	62.4–71.9	3.6–7.1	8.5–15.7	2.5
Oroya gibbosa	Peru, Rio Montaro, FR 143A	40.7–48.8			2.5
Oroya neoperuviana	Peru, La Oroya–Tarma, *Lau* 201	42.0–50.2			1.5–2.5
Oroya neoperuviana var. subocculta	Peru, KZ.HG. 51–781.1	46.1–55.6			1.5–2.0
Oroya peruviana	Peru, KZ.HG. 51–773	45.4–53.6			2.5
Oroya peruviana var. conaikensis	Peru, Conaika, *Lau* 203	38.0–42.0			2.0
Oroya subgibbosa Knize nom. nud.	Peru, Jauja–La Oroya, KZ.	40.7–47.5			2.5

Note: Spinule and punctum density data for *Hildewintera* and *Oroya* were not obtained because the features were too small to count accurately with light microscopy.

The Cactus and Succulent Journal of Great Britain
Volume 43(4) 114-116 (1981)

References to scanning electron microscope photographs of seeds of Cactaceae

compiled by Mary Gregory

Jodrell Laboratory
Royal Botanic Gardens
Kew, Richmond, Surrey

Taxonomists are finding that SEM examination of plant surfaces (especially leaves, seeds and pollen) can provide valuable diagnostic characters. Many new descriptions of species of Cactaceae are accompanied by SEM photos of the seed, and it was thought that a list of references with an index to genera illustrated by SEM seed photos would be useful. Most of these references have been taken from the Jodrell card index to anatomical literature, but I am grateful to Dr W. Barthlott and Dr J. D. Brisson for supplying additional references.

Abbreviations for journals

CSJA: Cactus and Succulent Journal (America).
CSJGB: Cactus and Succulent Journal of Great Britain.
KuaS: Kakteen und andere Sukkulenten.
NCSJ: National Cactus and Succulent Journal.

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3. Barthlott, W. (1975). Zur systematischen Stellung von *Disocactus himantocladus* (Roland-Gosselin) Kimnach (2). KuaS 26: 278–280.
4. Barthlott, W. (1977). Kakteen. Belser: Stuttgart. 212 pp. (Translation by L. Glass, Cacti (1979) Stanley Thornes: Cheltenham. 249 pp.) See Figs. 115–120.
   Seeds of *Mammillaria. Frailea, Blossfeldia, Matucana.*
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   SEM photos of: *Echinocereus, Neobuxbaumia, Mammillaria, Myrtillocactus, Blossfeldia, Coleocephalocereus, Erdisia, Browningia, Ortegocactus, Austrocactus, Thelocactus.*
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Plate 38. *Pereskia, Pelecyphora, Mammillaria, Neoabottia, Browningia, Blossfeldia, Opuntia* (aril).
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Should probably be *Coryphantha*.

Index to Genera

Book Notes

Mariella Pizzetti. *Zauber der Kakteen und anderer Sukkulenten* [Fascination of cacti and other succulents], translated from Italian into German by Mario Bont. Pp. 176, 300 colour plates, 14 line drawings, 2 maps; hardback, 270×225 mm. (10×8¾ in.). Albert Müller Verlag, Rüschlikon-Zürich. Price DM 49 (approx. £12.50).

This large-format, well-produced and very generously illustrated book makes an immediate aesthetic appeal, but its aims are much wider: to explain the nature, nomenclature and cultivation of succulent plants (including an excellent page or two on bowl gardens), and to present a wide range of individual species. The general aspects are covered in the introduction which also provides many habitat pictures worthy of special mention, including the obligatory *Welwitschia mirabilis* as well as a giant *Lobelia* on the slopes of Mount Kenya, and a silvery leaved *Senecio* on the barren slopes of Mauna Loa in Hawaii, while the British heart will warm to our native succulent, *Umbilicus rupestris,* and the delightful full-page view of the Tresco gardens in the Scilly Isles.

The main section treats some 200 species in over 90 genera, in alphabetical order, with the Cactaceae well represented among the many other families; the classification is based on Gordon Rowley's Illustrated Encyclopedia (German edition), and the presentation is so simple and effective that no great knowledge of German is demanded: for each plant there is a good colour photograph alongside a concise text naming the relevant family, explaining the current generic name and any older ones, followed by a brief description of the individual species with notes on its homeland, also cultivation and propagation. The work is completed by a glossary of specialist terms as well as a bibliography and index.

Obviously no volume of this size can present all known succulent plants, and no selection will satisfy all tastes: I would replace some Sedums and Kalanchoes by under-represented genera (e.g. *Notocactus*), while certain eccentricities in the text will scarcely trouble the English reader. These are in any event small flaws in a work which does add zest to the succulent literature, and even if the reader does not know German the numerous illustrations could extend his knowledge and will most certainly give very great pleasure, so that this new book deserves a place on that birthday or Christmas list!

LOIS GLASS

Gerhardt Shäfer. The genus *Notocactus.* Kakteen/ Sukkulenten Volume 14, parts 1–4 (complete in one volume). Pp. 124, 25 colour plates and 18 half-tones. Availability: see below.

This account of *Notocactus* (German text) occupies a whole volume of the East German journal and gives a

complete discussion of the genus and its species. Appendices contain a list of field numbers and a bibliography. The photographs are of very good quality, particularly those in colour. Copies are available from Whitestone Gardens Ltd. (see inside back cover) or from Drs. J. C. M. Theunissen, Vierschaarstraat 23, 4751 RR Oud Gastel, Netherlands.

A. W. MACE

Robert T. Clausen. *Variation of Species of Sedum of the Mexican Cordilleran Plateau.* Pp. 27, one half-tone plate. 228×152 mm. Published by the author, P.O. Box 579, Ithaca, New York 14850, U.S.A., price $1.50.

This paper, published as a booklet, contains a variety of information on forty-seven *Sedum* spp. native to the Mexican plateau, including the first descriptions of several new subspecies. It is essential reading for collectors of this group. The author, doyen of *Sedum* specialists and author of the classic '*Sedum of the Trans-Mexican Volcanic Belt*' (1969), requests advance payment by cheque or money order.

Brian Fearn. *Lithops.* National Cactus and Succulent Society Handbook No. 4, Pp. 69, 182×122 mm., 36 half-tones, 2 line drawings. National Cactus and Succulent Society, 19 Crabtree Road, Botley, Oxford OX2 9DU. Price £1.

Rapid dispersal on to many bookshelves and into many pockets seems certain for this concise, fully illustrated and very inexpensive guide to one of the most collected of succulent genera. Very readable introductory chapters covering history, biology and cultivation are followed by Brian Fearn's highly practical identification key (previously published in Jacobsen's Lexicon), brief descriptions of the 35 species recognized each accompanied by a half-tone plate, and a glossary and index.

The booklet is uniform in size and style with previous NCSS Handbooks (in fact it has appeared *after* No. 5 in the series, E. W. Putnam's *Gymnocalycium*). One cannot help feeling that the format is now almost too austere, the typography dated (judging from the uneven lines, the printers' equipment is getting long in the tooth), and the half-tones disappointingly grey and misty. The low price of £1 is commendable but no one these days could object to paying £1.50 or £2 for so much information, especially if it were laid out in a more attractive way. One wonders how much extra it would cost to have all the pictures in colour. The value of colour plates in the identification of *Lithops* would make a full-colour booklet attractive to many potential purchasers at even three to four times the price of this one.

D.H.

The Pimlico Show, 1981

Report by W. F. Maddams

Several criteria may be used to assess a Show; the quantity and quality of the plants, the efficiency of the organization and the general support it commands. On each of these counts the Pimlico Show on 26th September was an unqualified success and this should ensure a continuation of the event. It is particularly pleasing that the 50th Anniversary Show should produce a selection of plants that were both interesting and show-worthy; all too often the small range of plants which are known to be particularly useful for show work dominate the scene. For this reason, in writing this report, I have not attempted an overall coverage but have concentrated on plants which caught my eye for one or more of several reasons.

Of recent years there has been something of a change in the entries in the premier class, that for six cacti. The really large plants have tended to be superseded by mature but smaller specimens from the less common genera and the trend was evident on this occasion. Mr. Worrall's first-prize entry included lovely plants of *Melocactus bahiensis* complete with cephalium, a vigorous-looking *Ariocarpus retusus* and a plant labelled *Lophophora decipiens* with three of the largest heads I can recall for specimens of this genus. Mr. Byles's second-prize entry included worthy plants of *Melocactus azureus* and *Echinocactus horizonthalonius* and I have a strong suspicion that the former species will be seen increasingly in the future.

It was pleasing that the class for three plants from Mammillaria, Coryphantha or Thelocactus groups produced a significant number of representatives from the second or third of these. However, it was a member of the first group in its broader sense that took the honours, a vigorous specimen of *M. (Cochemiea) poselgeri* that was selected as the 'Best Cactus' in the show. The choice, dwarf Mammillarias were well-represented in the class for six in 4½-inch pots. They included clumps of *M. saboae* f. *haudeana* and *M. goldii*, M. *carmenae* with three heads, *M. zephyranthoides* outgrowing its pot and *M. glassii* resplendent with many scarlet fruits. By contrast the entries in the class for one Mammillaria, although very sound, contained nothing of especial note.

I was rather intrigued by the fact that the plants which took first and second prizes for one Astrophytum, very worthily, were clearly hybrids. The first had a lot of *A. myriostigma* in its ancestry but derived its quite marked spines from elsewhere, while the second was somewhere near *A. ornatum*. The readiness with which seed is set in cultivation will, I suspect, lead to an increasing number of such plants and it must be admitted that they are very attractive. Among the Gymnocalyciums, *G. leeanum* and *G. hybopleurum* stood out as, in the negative sense, did the substantial absence of *Weingartia* species.

Once again, choice miniature 'Echinocactanae' in gratifying numbers appeared in the restricted pot-size class. I should be more than happy to provide a home for Mr. Read's three-headed *Ariocarpus agavoides,* Mr. Worrall's *Blossfeldia minima* or either of the *Ariocarpus scapharostrus* in other entries. I have the same sentiments over the lovely plant of *Echinocereus brandegei,* with scarlet spines on the new growth of its ten stems; I must confess I should have given it preference over the five-headed *E. knippelianus* that won the class. The six inch pot-size restriction for cacti provides an opening for choice material of intermediate size and I was not disappointed, the highlights being *Discocactus nigrisaetosus, Obregonia denegrii* and a lovely *Mammillaria nivosa* on which the golden spines stood out against the abundant axillary wool.

The classes for succulents produced one of the best sets of entries for some years, with the classes for Mesembryanthemaceae being particularly good. The judges had a difficult task in the class for three Euphorbias, coming down in favour of Mr. Worrall's entry which included a flawless *E. obesa,* but Mrs. Ellis's three miniatures, *E. decaryi, E. primulifolia* and *E. jansenvillensis* were much admired. A fine *Hoodia gibbosa* romped home a clear winner in the contest for the best stapeliad and must have been a contender for 'Best Other Succulent'. This honour went, however, to a large plant of *Caralluma hesperidum* from the same stable, that of Mr. Sutton, entered in the class for one succulent, which was also graced by *Pectinaria saxatilis, Pachypodium brevicaule* and a small specimen of *Pachycormus discolor* in flower, a rare treat.

Haworthias dominated the class for two Liliaceae and, not surprisingly, John Pilbeam emerged the winner, with *H. pygmaea* and *H. comptoniana,* but given the choice of one plant only I should have opted for *H. picta* in Mr. Sutton's second prize group. Although diminutive, it stood out, not least because of its delicate white-speckled leaves. Aloes were not entirely absent, the best being *A. kniphofioides* and *A. myriacantha.* It was a contest between the small and the large in the class for three succulents, with the former, Mr. Worrall's *Pachypodium brevicaule, Anacampseros papyracea* and *Haworthia truncata* emerging the winner. Nevertheless, Mrs. Edmonds's larger plants, *Pachypodium saundersii* with seven stems up to 18 inches tall, *P. succulentum* and *Euphorbia stellata* also caught the eye.

There is ample scope in the choice of six South African succulents and Mr. Hooker took advantage of this to win the Pryke-Howard Cup with species from the genera *Haworthia, Lithops, Decabelone, Anacampseros, Euphorbia* and *Trichocaulon.* Mr. Bent's entry contained the little-known *Pelargonium sericeum.* I cannot recall seeing a better set of Conophytums, one in which the diversity of body-form and flower-colour was clearly displayed. My favourite was Mr. Tribble's *C. pageae* with its fat, round green heads. The entries in the class for six stemless mesembryanthemums were also very good with Mr. Bowdery, winner of the Denton Medal, having particularly fine specimens of *Cheiridopsis pillansii, Conophytum wettsteinii* and *Gibbaeum dispar.* The Lithops were on a somewhat lower plane, with *L. dorotheae* standing out because of its superb colouring and markings.

Among the remaining classes, Mrs. Edmonds again demonstrated her prowess at raising from seed, her other succulents being particularly good, and in her appreciation of what is required in the 18 inch-square group. The other entry in the latter class, from Mr. Worrall, contained fine plants from the genera *Melocactus, Discocactus* and *Uebelmannia,* and a cristate *Pachypodium lamerei,* but it lacked decorative effect. The two intermediate classes provide a stepping-stone between novice status and the open classes; the winner of both, Mr. Tribble, will certainly make his mark if he continues to exhibit. He had splendid plants of *Oreocereus celsianus, Coryphantha elephantidens, Lobivia peclardiana, Crassula mesembryanthemoides* and *Trichodiadema bulbosum.* Last but certainly not least, the winning entry for three other succulents for novices included a good plant of *Euphorbia primulifolia.* The overall standard here was good and this augurs well for the future.

Show Draw Prize-winners

1st: D. J. Irwin, London SE19; **2nd:** P. de Carteret, Guernsey, C.I.; **3rd:** D. Salmon, Hollingbourne, Kent; **4th:** Mrs. Brill, Collier Row, Essex; **5th:** Mrs. Dyson, Barnet, Herts.; **6th:** Dr. P. Brandham, Kew Gardens, Surrey.

Wanted (alive): Lophophoras

Member Mr. L. J. Batchelor asks if any fellow members can help him in his search for the rare Lophophoras? He already has the ordinary *L. williamsii* and var. *decipiens,* also *L. echinata* var. *diffusa,* but would be grateful for any assistance in finding plants of the other species and varieties. If you can help, please write to Mr. Batchelor at 43 Chester Road, Seven Kings, Ilford, Essex IG3 8PT.

Nursery List

Nurserymen and others who regularly offer plants or seeds for sale are listed below as a service to members, but this does NOT imply the Society's approval or recommendation of plants or other goods offered.

North & South Yorkshire

Cruck Cottage Cacti (Dorothy & Ronald Wood), Cliff Road, Wrelton, Pickering, North Yorkshire YO18 8PJ. Tel. no. Pickering (0751) 72042. Open daily except Sat. morning. No lists. Nursery in garden setting.

Whitestone Gardens Ltd., The Cactus Houses, Sutton-under-Whitestonecliffe, Thirsk, North Yorkshire YO7 2PZ. Tel. no. Sutton (08456) 467. Open daylight hours every day throughout the year. Send 4×8p stamps (UK) or 3 international postal reply coupons for list. Everything for the cactophile; plants, seeds, books, sundries; substantial stocks and extensive collection on view.

Oak Dene Nurseries, 10 Back Lane West, Royston, Barnsley, Yorkshire S71 4SB. Tel. no. Royston (022670) 2253. Open every day, April–Sept. 9–6, Oct.–March 10–4 (closed for lunch 12.30–1.30). S.A.E. for list. Seed, plants, books and sundries.

Merseyside & Lancashire

Jim Bolton, Southview, 39 Altcar Road, Formby, Liverpool L37 8DR. Tel. no. Formby (07048) 73187. Open all day Sundays, advisable to telephone for weekday visits. Large selection of seedlings, etc., all at reasonable prices. No list.

Harry Mays, Woodsleigh, Moss Lane, St. Michaels on Wyre, Preston PR3 0TY tel. no. St Michaels (09958) 295. Surplus seedlings for sale to visitors only. Prior 'phone call essential.

North Wales

Jolly's (G. A. & M. A. Coombes), Glanrafon, Talsarnau, Gwynedd LL47 6YD. Tel. Penrhyndeudraeth (076674) 643. Open any time by appointment. No orders by post; no list. Warm welcome to holidaymakers—we are in the Snowdonia National Park.

Derbyshire

Abbey Brook Cactus Nursery, Old Hackney Lane, Matlock, Derbyshire. Tel. no. Matlock (0629) 55360. Open every afternoon 2–6 except Tuesday (closed all day). List free on request, stamp appreciated. Mail order catalogue illustrated in colour lists over 1700 species of nursery-grown cacti and other succulent plants.

South Humberside & Lincolnshire

Southfield Nurseries (B. Goodey), Louth Road, Holton-le-Clay, Grimsby, South Humberside DN36 5HL. Tel. no. Grimsby (0472) 822157. Open daily 10-5 (closed for lunch 12.30-1.30). Send stamp for list. Seed-grown cacti, Lithops, succulents.

Jumanery Cacti (June & Tom Jenkins), St. Catherine's Lodge, Cranesgate Road,Whaplode St. Catherine, Nr. Spalding, Lincs PE12 6SR. Tel. no. Holbeach St. Johns (040634) 373. Open 9–5 Sunday–Friday, closed Saturday. S.A.E. for list.

Norfolk

Richard & Wendy Edginton, The Vines, 2 Green Man Lane, Kirstead, Norwich, Norfolk NR15 1EP. Tel. no. Brooke (0508) 58113. Open most mornings and weekends. S.A.E. for list. Seedling cactus plants 35p upwards.

Barleyfield Succulent Plant Nursery (Victor & Heather Graham), Southburgh, Thetford, Norfolk. Tel. no. Dereham (0362) 820457. Nearly always open, but telephone call appreciated. S.A.E. for list. 'Other' succulents, handmade plant pots. (0362) 820457. Stamp for list. Open Sundays only. Best to 'phone for directions. Very large selection of succulents including some cacti.

Warwickshire

Rod & Ken Preston Mafham, 2 Willoughby Close, Kings Coughton, Alcester, Warwickshire, tel. no. Stratford (0789) 762938, invite members to see their collection at weekends or during school holidays—please 'phone first. Surplus seedlings.

Gloucestershire

W. G. Geissler, 1 Lyefield Road, Charlton Kings, Cheltenham GL53 8BA. Tel. no. Cheltenham (0242) 517846. Open weekends and evenings, No list, no orders by post, but visitors very welcome in Cotswold country.

P. Strong, Green Mead, Green Lane, Chedworth, Cheltenham GL54 4AR. Tel. no. Fossebridge (028572) 581. Surplus seed-raised plants.

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Hertfordshire

R. F. S. & B. R. Dale, Thurnlea, 14 Buttondene Crescent, Old Nazeing Road, Broxbourne, Herts EN10 6RH. Tel. no. Hoddesdon 63234. Open almost any time but write or 'phone. No list. Full range B.E.F. pots, labels, top dressing, etc.

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The Cactus Place (David & Barbara Brewerton), 33 Bridge Avenue, Upminster, Essex RM14 2LX. Tel. no. Upminster 29911. No list. Open 9 till dusk, but 'phone first. Large and medium sized specimens.

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