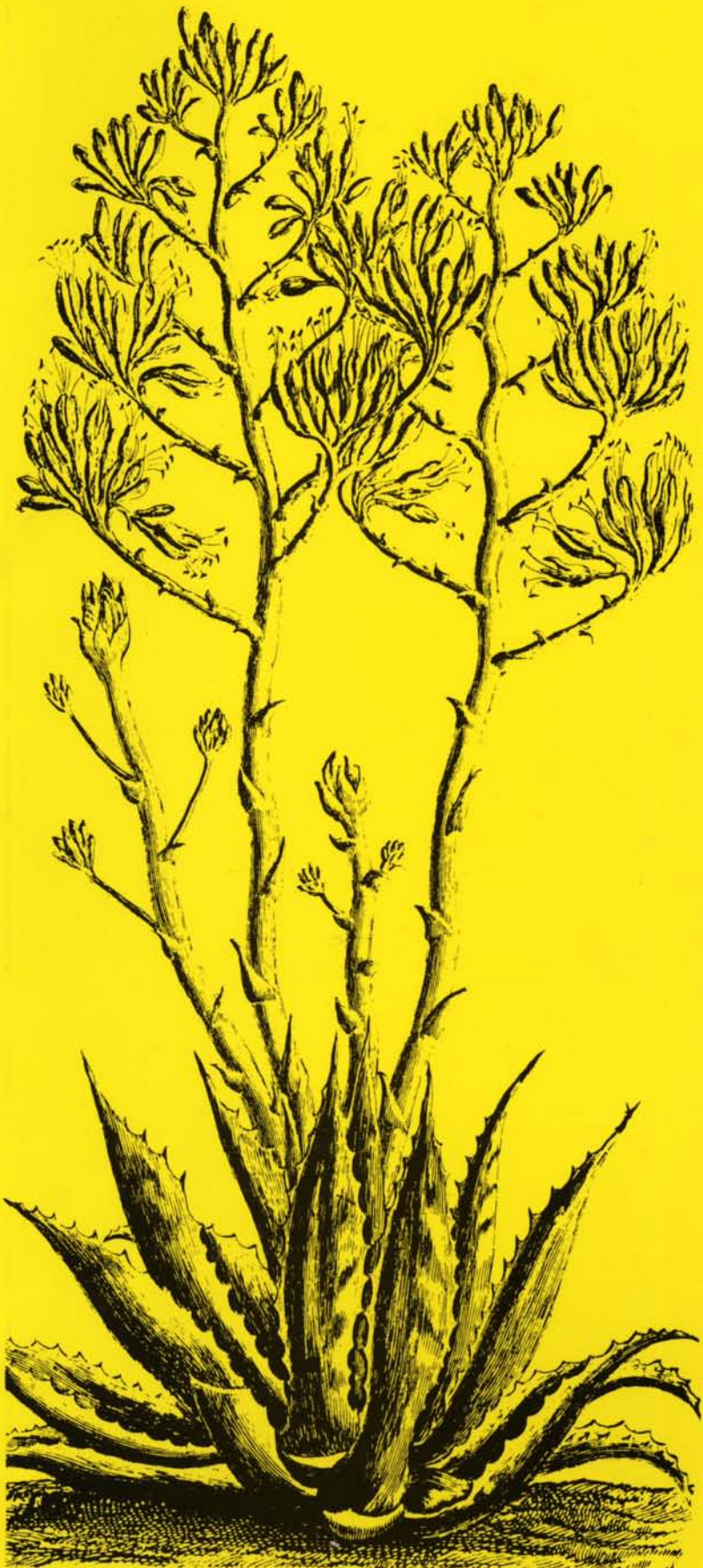


Bradleya

Yearbook of the British
Cactus and Succulent Society



5/1987

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Cactus and Succulent Society

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Contents

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The Duchess of Beaufort's Succulent Plants Gordon D. Rowley	1
A new review of Mammillaria names S-Z David Hunt	17
A revision of the genus Thelocactus B. & R. (Cactaceae) Edward F. Anderson	49
Miscellaneous notes on Stapelieae (Asclepiadaceae) P. V. Bruyans	77
New and unfamiliar names of Cactaceae to be used in the European Garden Flora David Hunt & Nigel Taylor	91
Additional notes on some Ferocactus species Nigel Taylor	95
New names in Rhipsalidinae (Cactaceae) Wilhelm Barthlott	97
More bibliographical data on succulent plant periodicals (1) Urs Eggli	101
More bibliographical data on succulent plant periodicals (2) L. E. Newton	102

The cover design incorporates Richard Bradley's drawing of *Agave americana*, the 'Common American Aloe', from his *Historia Plantarum Succulentarum*: 'The history of succulent plants, containing the Aloes, Ficoids (or Fig-Marygolds), Torch-Thistles, Melon-Thistles, and such others as are not capable of an Hortus Siccus', the work being published in five parts (decades) between 1716 and 1727, in London.

The Duchess of Beaufort's Succulent Plants

Gordon D. Rowley

Summary. An account is given of the succulents depicted in two unpublished folio volumes of water colour paintings of plants cultivated by the Duchess of Beaufort at Badminton during the late 1600s and early 1700s. The history of the plant collections at Badminton is discussed and the succulents illustrated by the Dutch artist Kychicus and by others are identified. Many exotic species are shown to have been introduced to cultivation in Britain earlier than previously recorded.

Zusammenfassung. Die Sukkulente der Herzogin von Beaufort. Die Sukkulente, die im Zeitraum der Jahrhundertwende von 1700 durch die Herzogin von Beaufort in Badminton kultiviert wurden und in zwei unveröffentlichten Bänden mit Aquarellen abgebildet sind, werden vorgestellt. Die Geschichte der Pflanzensammlungen in Badminton wird erläutert und die vom holländischen Künstler Kychicus und anderen illustrierten Pflanzen werden identifiziert. Es wird gezeigt, dass viele exotische Pflanzen in England bereits früher in die Kultur eingeführt worden sind, als bisher angenommen wurde.

Introduction

To most people, mention of Badminton evokes sporting associations: the annual equestrian events that attract thousands to the Duke of Beaufort's flat, expansive acres in his Gloucestershire estate, and the fast-moving indoor game that owes its court size (13.4 × 6.1m) to the proportions of the room there where it was first played in Britain. But Badminton also has a claim to fame of a different sort. At the end of the seventeenth century the first Duchess of Beaufort built up a collection of exotic plants under glass without rival in this country, and pioneered the introduction of many ornamentals, succulents included, that are today a familiar sight on windowsills and in glass-houses. It is the legacy from that brief period of horticultural glory that concerns us here.

Among the many treasures in the large library are two handsomely bound folio volumes containing 178 drawings, the colours as crisp and vivid, it seems, as the day they were painted. Almost all are of plants, some with added insects, some

grouped artistically and made to look part of an elysian landscape, but it is convenient to treat the two volumes separately as they represent the work of different artists (Britten, 1920).

Volume I, measuring 59 × 44cm, has 68 pages and is entirely the work of the Dutch artist variously named as Everhard Kik, Kick, Kikius, Kickius, Kychious, Kychicus or Kytchious. Here the spelling Kychicus will be used following the lead of the popular guide to the collection by Gloria Cottesloe and Doris Hunt (1983). In this book 32 of the pictures have been reproduced, although shortcomings in the accompanying text are one reason for the attempt here to give more accurate identifications. Kychicus made these paintings while staying at Badminton House between 21 July 1703 and 14 July 1705, from living specimens in the Duchess's collection. They are uniformly of high quality, and the only doubts in recognising the species figured arise when immature non-flowering specimens are shown. Many of the pictures include two or more different plants composed artistically to fill the sheet and contrast with one another, so that we find species of very different cultural requirements and flowering seasons keeping company: desert succulents beneath tropical rainforest shrubs, and so forth. Another unusual feature is the inclusion of root systems as well as aerial parts—a rare undertaking by botanical artists.

The second volume of 110 plants, measuring 53 × 40cm, was apparently brought together at a later date as a convenient means of preserving all those other horticultural studies that had accumulated before and after the main work of Kychicus. It includes the products of several artists and is much more variable in quality, including some crude watercolours and copies of published plates. The main contributor is Daniel Frankcom, footman to the Duchess, who expres-



Badminton House, 1985. The room where badminton was first played in England is behind the centre door. (photo: Hunt)



(Above and right: The author in the badminton room, with the Florilegium, 1985. (photo: Hunt)



sed such interest in the work of the artist that Kychicus gave him lessons. But his accomplishments as seen here never rise above the level of the enthusiastic amateur, and do not rival those of his teacher. Lower still on the scale are three watercolours by Henrietta London, daughter of George London, horticultural author and manager of Brompton Park Nursery, from which some of the Badminton plants came. Others, unsigned, could be the work of Adams the gardener, whose efforts to paint flowers in 1701 did not satisfy the exacting standards of the botanist Sherard and led to the commissioning of Kychicus two years later.

Very different are 31 plates representing the life-cycles of various exotic insects and other creatures, mostly associated with sprays of tropical foliage and blooms. Here one immediately recognises the style of Maria Sibylla Merian, and indeed 15 coincide with published plates in her *Metamorphosis Insectorum Surinamensium* of 1703. These may have come from Bradley (see below), but are not originals, although they are very good copies.

Both volumes are provided with an alphabetical index.

The first Duchess and her collections

When J. C. Loudon visited Badminton in the early nineteenth century, he noted that 'the house is an

extensive building, on a French model, erected in 1682; the park is nine miles in circumference, intersected by noble avenues. The gardens were celebrated in the first duke's time; but are at present rather neglected' (Loudon, 1830: p.1075). The great garden of a century earlier with its countless exotics was, alas, no more, and the two books of paintings under consideration here are the best record we have of its former glory. Indeed, they are a unique historical document that proves Badminton to have led the way in introducing novelties until now thought to have arrived much later in cultivation.

Mary Capel, who became the 1st Duchess of Beaufort, was born in 1630, the daughter of Lord Capel. Her first husband, Lord Beauchamp, died in 1659, and she subsequently married Henry Somerset, 3rd Marquess of Worcester, who had inherited Badminton in 1655. He was the great-grandson of Edward Somerset, 4th Earl of Worcester, who had purchased Badminton House, 12 miles north of Bath, as the family home, in 1608. Henry was created Duke of Beaufort in 1682, and made extensive changes at Badminton, enlarging both the house and the surrounding gardens, but it was his wife's influence in gardening that took over with increasing ambition and enterprise over the next forty years. Encouragement to the

culture of exotics came especially from Hans Sloane following his visit to Jamaica, and when the Duchess died in 1715 at the age of 85 it was natural that she should have bequeathed to him her herbarium and catalogue of plants, which fill 12 and 3 volumes respectively in the present Sloane Herbarium and cover the years 1690-1713. Her own correspondence, kept in the archive rooms at Badminton, has been studied by Lady O'Neill (1983), from whom we gain insight into the Duchess's amazingly active life in the pursuit and culture of more and yet more treasures of the stove house. The copious notebooks and records also give us some mental picture of what the collection looked like and how it was managed.

Henry died in 1699, but the Duchess continued managing the gardens and expanding the collection under glass. By 1700 she had about 2000 species of tender exotics and was writing to the celebrated botanist William Sherard to try to persuade him to come to Badminton as tutor companion to Henry, the 16-year-old son of the first Duke who had just succeeded to the title (Tjaden, 1974). Sherard was reluctant and demanded impossible terms, but did eventually come for about 15 months, during which time most of the herbarium specimens were made with the Duchess herself helping with some of the pressing. She had a second garden in Chelsea, adjoining Chelsea Physic Garden (Beaufort Street today), about which less is known, and it is rarely certain from which of the two gardens a particular plant portrait came. The herbarium sheets, now in the British Museum, include excellent specimens of succulents, as can be seen from the aloe and *Opuntia* reproduced in O'Neill (1983).

Worthy of a separate study would be the numerous manuscript lists that survive of the plants grown at Badminton. Three volumes in the Sloane Collection at the British Museum have already been mentioned. Of nine notebooks that I have examined in the Badminton archives, only three were dated, and the most interesting of these was the earliest, in foolscap size, entitled 'Trees, Shrubs and some other out-landish Plants growing at Badminton in the years 1694, 1695 and 1696'. This lists around 600 species in alphabetical order and concludes with an appendix of 68 variegates that has been separately published by Berkeley (1866). That the collection was still flourishing nearly half a century after the death of the first Duchess is apparent from a later notebook of 1762, which includes 21 species of aloe, 10 of ficoids, 4 of cereus, 5 of sedum, 3 cactiform euphorbias and 2 each of *Cotyledon*, *Crassula*, *Opuntia* and *Yucca*.

Orangeries at Badminton

Although the Romans are known to have had special heated structures glazed in mica or later in

glass for the preservation of tender plants, almost nothing survives, and little is known about them. The glasshouse as we know it was effectively invented in the Renaissance period and it came about primarily for one purpose: the culture of citrus fruits and some ornamentals which flourished in Southern Europe but proved frost-tender further north. Glass was an expensive luxury, and available only in small panes, so the first plant houses, orangeries, used as little of it as possible. It so happens that *Citrus* is not demanding of much heat, and tolerates low, directional lighting, so by growing the plants in tubs which were wheeled outdoors in summer the venture proved a success.

However, more and more tropical plants were arriving and inviting attempts at cultivation, and not all took kindly to life in an orangery. Succulents in particular demand maximum light and grow thin elongated shoots lacking flowers if shaded. Their popularity as collectors' plants in the years ahead came only as a result of gradual improvements in glasshouse design, notably in overall glazing and in providing a dry rather than a hot, steamy atmosphere.

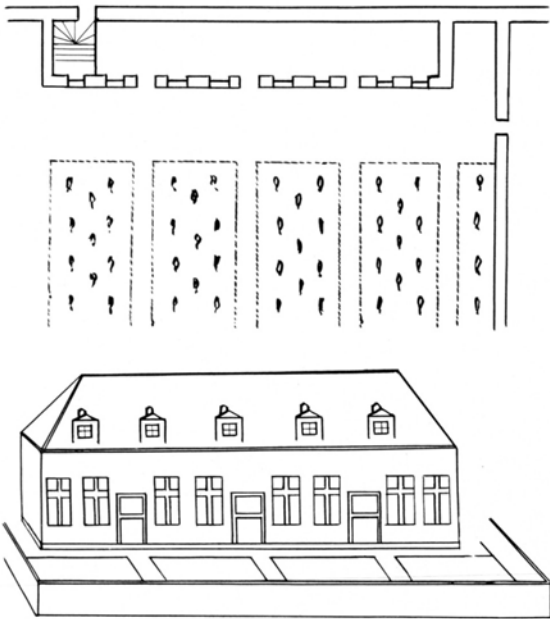
In the Badminton archives there is a detailed map of the house and surrounds as originally laid out that includes the plan of what is referred to as a 'greenhouse' 33m (110ft) in length. Notice the three doorways and eight windows on the south side, and the formal beds laid out in front. In a painting of Badminton House dating from around 1700 and at present hanging in one of the upstairs bedrooms one can make out, in the appropriate place, the same building: an orangery similar in design to those described and figured by Bradley and Miller. In a letter to Hans Sloane quoted by O'Neill (1983) the Duchess gives details of her 'orangree'. It was backed by a 5m (18ft) wall along the north side, and opposite to that were windows and glazed doors, with small windows above in the roof. Two paths ran the length of the house flanking two beds, that adjacent to the wall being planted with shrubs, the other with orange trees. Around and among these were a multitude of exotics, some bedded, some in pots. As no mention is made of separate accommodation for succulents, it is assumed that these had to take their chance among the palms and orchids, ferns and foliage plants. It is not to be wondered at that some of those represented in the paintings show signs of etiolation and are barren, but the fact that so many survived and flowered shows that they must have been managed with some understanding of their special needs. The same letter mentions a length of '220ft': very long for an orangery, and I could find no sign of such a building on the old plans. David Hunt suggests that the measurement perhaps refers to the total length of the path, since it traversed the building twice.



PLATE 1. *Bulbine frutescens* (Volume I, t.3).

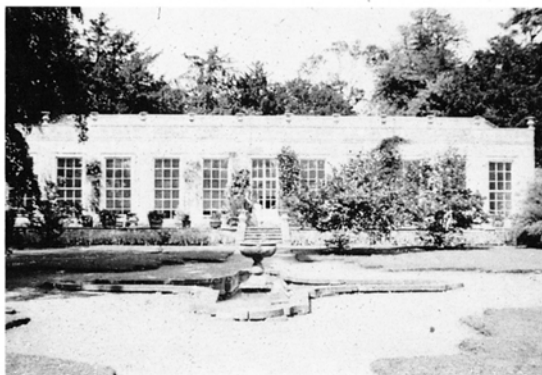


PLATE 2. *Lampranthus coccineus* (centre), *Drosanthemum flavum* (left) and *Glottiphyllum linguiforme* (right) (Volume 1, t. 40).



Plan and sketch of the Badminton orangery, redrawn by the author from a plan and a painting of the house and surrounds contemporary with the first Duchess.

It was a pleasant surprise on visiting Badminton in July 1986 to find that the orangery survives to this day and is regularly used, although not for growing plants. Substantial changes have been made: the original steeply sloping roof has been replaced by one less elevated, and two of the three doorways have been turned into windows to match exactly the other eight, although one can still see the original steps in front of each. Doubtless this was done in an effort to increase the illumination inside. An extension behind the back wall runs the entire length, with a chimney at the east end for the boiler house. The floor is now paved all over with large flagstones, but it did not take much imagination to visualize the two beds as described by the Duchess. Indeed, the stones of the two pathways showed more wear than those covering what



The Badminton orangery, 1985.

(photo: Rowley)

were originally flower beds.

The Badminton archives also contain a large document entitled: 'Elevation and Plan of Orangery, Badminton 1711 (essentially as erected)' by Bateman, and a 'variant elevation' of the same. This has only five windows flanked by a door at either end, and is shorter and broader than the orangery just described. A balustrade runs along the top of the front wall with a large ornate urn on a pedestal at either end. I have not been able to find out more about this, or of any glass-house the Duchess may have had in her Chelsea home.

Richard Bradley as collector for the Duchess

In its heyday, seeds and plants came to Badminton from all over the world under the Duchess's promptings. Travellers, friends and collectors supplied them from South Africa, the Canary Isles and the West and East Indies; others came from botanic gardens in Britain and the Low Countries, and from nurserymen such as George London. Amsterdam was then a prime source of new succulents, and one of the last to seek the patronage of the elderly Duchess was Richard Bradley, then in Holland getting together plants, pictures, and other natural history specimens to offer to wealthy collectors back home (Tjaden, 1973-75). Petiver wrote to the Duchess of Beaufort in May 1714 strongly recommending his friend Bradley as the ideal expert on succulents to seek out and send specimens to Badminton. Aloes, cerei and 'ficoides' (Aizoaceae) were duly dispatched by boat, including 'a new sort of *Fritilaria crassa*', which Peter Bruyns confirms from a sketch in the accompanying letter was *Stapelia pulvinata* Mass. Among the 'other pretty succulent monsters' (Bradley's own epithet) were also coffee plants, seaweeds and offers of Petiver drawings and Sibylla Merian paintings. Although these late arrivals missed being immortalized in the Kychicus paintings, they may well have served as the models for the plates in Bradley's own *History of Succulent Plants* which began to come off the press in 1716. Dried specimens of plants were also sent to the Duchess at Chelsea. Tjaden comments on the 'surprisingly high' prices asked by Bradley for the aloes and other plants, which reflect the great demand for such fashionable rarities at the time. But by 7 Jan. 1715, the Duchess had died, although there seems to have been a time lag before Bradley realised that this source of patronage was no more.

We know from Bradley's own writings that he had seen the Duchess of Beaufort's plants and knew of the paintings that had been made of them. Thus, in his *History of Succulent Plants* under *Opuntia curassavica* (t.4) he writes that: '... the whole Plant seldom exceeds two Foot high in our Climate, where it has not been known to produce

either Flower or Fruit, unless in the Gardens at Badminton, belonging to that incomparable Patroness of Natural Learning, the late Dutchess of Beaufort, by whose excellent Skill of Direction, this Plant was brought to blossom about June . . .'. Under *Eberlanzia spinosa* (t.39) we read: 'I have only seen this Plant in the Garden of the late celebrated Dutchess of Beaufort'. Unfortunately this does not tell us whether he was referring to the garden at Badminton or Chelsea. In a letter of 1714, writing of a new stapeliad (Tjaden, 1973-76), he states: 'The Dutchess of Beaufort has already our most common Sort painted.'

Documenting the paintings

The only previous attempt to list and identify the 178 flower paintings at Badminton dates from 1911-12. They were then on loan to the Royal Botanic Gardens at Kew, where a manuscript list of names was prepared by N. E. Brown and others. This list is currently being revised by Dr. David Hunt and has been of great help in the preparation of the list of succulent plants that follows.

In their present binding, the plates in each volume carry a running number, with sometimes a further, deleted, earlier number that suggests

they have been rearranged over the years. On the page facing each plate in a neat scrolled handwriting is usually to be found a name in English or Latin (polynomial, as we are in the days before Linnaeus), and sometimes additional notes. In Volume 2 this information may appear on the actual painting, in a smaller, more cramped hand. These captions are transcribed here, together with the equivalent modern name for the plants and the recognised date of introduction of each species to cultivation. Whereas we can be certain that the plates of Volume 1 date from 1703-05, the dates of those in Volume 2 are rarely evident. Even so, it is clear that the existence of these paintings made from living specimens growing at Badminton establishes earlier dates of introduction than had been accepted for many species. However, the pursuit is fraught with problems which are summarized below.

Identification of the succulents from their portraits rarely causes problems, and these arise only when flowers are absent and the specimen is obviously juvenile or atypical from lush cultivation. In such circumstances, a reasonable guess, based on what was or could have been around at that time is considered better than no name at all.



Aloe saponaria (Volume I, t.5), drawn by Kychicus.
(photo: Rowley)



Gasteria carinata (Volume II, t.36); an example of the work of Daniel Frankcom.
(photo: Rowley)

Dates of Introduction

There are at least three key dates in the garden history of any plant. The first is that of its discovery in the wild. This is the least likely date to find a place in the record. There follow, not necessarily in this order, the date on which the plant receives a formally published botanical name, and the date on which it is successfully brought live from habitat to cultivation. Sometimes a species receives a name from preserved material many decades before it is seen alive away from the habitat. *Dioscorea macrostachya* Benth. and *Calibanus hookeri* Trel. are examples. In other species the opposite takes place. A plant may become familiar in gardens, often under a false name, long before botanists recognise and christen it officially. *Frailea magnifica* nom.nud. and *Echeveria subrigida* hort. non Rose are two examples of justly popular and widely grown succulents that have still not received validly published names, even at cultivar level.

Any attempts to set a particular year of introduction run up against problems. A 'difficult' or short-lived species may be introduced several times before becoming established in collections. The Mexican *Dioscorea* mentioned above only really gained a footing in collections following its rediscovery in the nineteen-sixties, yet from Loudon's *Gardener's Magazine* of 1839 (p.580) we have irrefutable evidence of the existence of at least two live specimens being exhibited at a show of the Horticultural Society in London, two years before the species received its Latin binomial. It is also true that the longer a species has been known to man, the less likely we are to be able to pin down its exact date of introduction in retrospect. Cactus historians are still undecided over which cacti, if any, were actually brought back from the first voyages to the New World, and probably always will be.

I mention all this as a necessary prelude to the attempt to say which of the Badminton paintings confirms an earlier date of introduction to cultivation than has generally been accepted. The dates listed are mostly taken from the two editions of Aiton's *Hortus Kewensis*, the three of Sweet's *Hortus Britannicus* and Loudon's *Encyclopaedia of Plants*. Taking all this into consideration, it is obvious that the Duchess of Beaufort deserves credit for being the first to grow many species of succulent plants in the British Isles. A. W. Hill, cited by Britten (1920), stated: 'Something like one third of the plants figured are species whose first introduction to living collections has hitherto been believed to have taken place at considerably later date'. This referred to the overall total, succulents and non-succulents. Of the portraits of succulents in Volume 1, the number is nearer two thirds, viz. 30 out of 46 species—a truly remarkable percentage.

Notes on the Badminton paintings

Mention has already been made of the novel features that distinguish Kychicus's work in Volume 1: the grouping of three or more plants, regardless of origin, to form a miniature landscape with a stylised portrayal of the exposed roots as if to allow a glimpse into the unseen world below ground. That he was a good botanical artist cannot be doubted: he examined his subjects minutely and nearly always correctly interpreted details of flower structure and phyllotaxy so dear to taxonomists. Occasionally one sees errors: the two otherwise fine portraits of *Anacampseros* show no sign of the fine white silky hairs at the leaf axils. Perhaps his specimens were kept in water or wrapped in cotton wool—who can say? But, apart from a few tiny reservations, we must be thankful that such a fine body of paintings has survived for getting on for three centuries in such brilliant, unfaded condition, to provide a unique record of one person's pioneering in exotic horticulture.

Two of the pictures in Volume 2 are accompanied by manuscript notes too long to include in the tabulation at the end of this paper. That for *Aloe arborescens*, shown on plate 7, is confused and misleading, and was presumably written from memory long after the painting was made:

'The seed of this Aloe came from the Cape of Good Hope in the year 1701. It was then Sown at Badminton but did not Blow till the year 1707. There was some of them kept in the Stove and some in the Orangaree. The last of which produced Leaves of Seven Foot long. But not offering at any Flowers. Tryal was made to Plant two Roots thereof under a South Wall in the Garden. They were covered with Straw and Glass all the Winter to keep out the Frost.

'June 1707 it produced this Flower The stalks was Three Foot high and four Square. The Flower was 13 Inches long. It grew better than five Inches every day for three days, the next day 3 Inches, the 2 next days 2 Inches each. The Stalk 3 Inches in the . . . Compas. There are Threds comes off the Edges of the Leaves that are Strong enough to Work with: The Leaves themselves dri'd will Tye Bundles up as Ribbon will. Commelin's description of this Plant in Print is very True, but the Flower false. The Root is Thick Weighty and Yellow: out of the Sides of which grows Fibers . . . The Leaf Triangular. The Flowers give an ill Smell.'

These jottings confuse two unrelated species: the African aloe as represented in the painting, and the 'American aloe', *Agave americana*, seen in Plate 99. *Aloe*, but not *Agave*, could indeed bloom at six years from seed under glass, but reference to 'leaves of seven foot long' with strong fibres could only apply to agave. On the other hand, yellow roots are more typical of aloe, and flowers with 'an ill smell' suggest Stapelieae: perhaps a third species also comes into this fable!

Plate 21.1 of *Orbea variegata* has an added note stating correctly that it came from the Cape of Good Hope, and commenting on the many names under which this singular plant was known by various authors. It goes on: 'After it had been at Badminton (in the Stove) at the least Ten years without Blowing, in 1707 it produc'd one Flower, and offer'd at Seed but it did not . . . Ripen.'

One of the finest plates, as well as one of the most interesting, is Kychicus's portrayal of three different states of *Aeonium arboreum* in Volume 1, plate 62. Unlike most species of *Aeonium* which come from the Canary Isles, *A. arboreum* occurs in North Africa and was well known in classical times, when it was introduced to many gardens around the Mediterranean and credited with many uses. Praeger (1932: 159-160) gives an admirable summary of its domestication. A number of mutations have arisen, and Jacobsen (1974: 33) lists five that are still in cultivation: two purple-leaved sports, two variegates (one with white margins, the other with yellow) and a cristate.

Of the two variegates illustrated by Kychicus, that on the left is not uncommon in collections today and corresponds to Jacobsen's 'Albovariegatum', although earlier writers (e.g. Don, 1834) give it botanical status as var. *variegatum*. Miller (1731), listing it as 11. *Sedum majus arborescens foliis elegantissime variegatis tricoloribus* after Boerhaave (1720.I: 285), states that 'The eleventh Sort is a Variety of the tenth [*A. arboreum*] which was accidentally obtain'd in the Gardens of the late Dutchess of Beaufort at Badminton, from a Branch which broke off from one of the plain sort of Houseleek Trees by accident, and being planted in Lime Rubbish afterwards, became beautifully variegated; from which Plant there hath been vast Numbers rais'd, and distributed into many curious Gardens, both at Home and Abroad.' This comment is of interest in proving that, unlike some collectors who hoard for the sake of hoarding, the Duchess shared her treasures around with others. Morison (1699) gives the earliest account of this variegated cultivar, and Bradley (1728) says that it 'has the Leaves finely edged with White, and when the Plant is in Health, are tipp'd with Purple, which I account the finest Plant belonging to a Green-house, and was first introduced by me into Holland.' Several early writers refer to the purple flush on the leaf margins, and Praeger goes so far as to distinguish two cultivars, one with white margins and the other white with a rosy edge. However, my experience of the plant now in cultivation is that the purplish colour comes and goes, just as happens in the parallel example of the white-margined *Agave americana*. Cultural conditions, especially a deficiency of phosphorus, intensify it. I consider, therefore, that there is only one white-margined mutant.

The other variegate on the right of pl.62 with yellow up the centre of the leaf is much less familiar. Indeed, it is known only from this illustration and from a mention in Ray (1704). Ray, citing D. Sherard, says that the two cultivars were both raised in the Badminton glasshouse, one '*foliorum limbo argenteo, medio viridi*', and the other '*fol. limbo viridi, medio aureo*'. From what we now know of the chimaerical nature of variegated plants, this latter was no doubt an unstable chimaera that rapidly reverted to all green—the fate of many potentially desirable novelties. It has never been named and there is no point in doing this here, although there is always the possibility of a watchful grower spotting the same mutation and, perhaps, having greater success in preserving it.

No plate has a stranger or more complex background story than II.10, depicting a fruiting *Mammillaria*, some detached flowers, fruits and seeds, and a stem cross-section showing drops of latex. It is reproduced in colour by Cottesloe & Hunt 1983 as their Pl.18, who misinterpret the cut stem as a *Lithops* flower. The plate is a close copy of Commelin's classic illustration in Hort. Med. Amst. I: t.55, 1697, which is itself taken from a Maria Moninckx painting that has been recently reproduced by Wijnands (1983) as his Pl.36. Comparing the three side by side, one sees that the artist of the Badminton plate invented his own colouring, which is quite different from that of the Moninckx original which he had not seen, and replaced the columnar *Mammillaria* by a painting from life of a smaller globular specimen that also appears in flower in Plate I: 35 by Kychicus.

It is interesting to compare the range of succulents illustrated in the Badminton florilegium with that in Bradley's book of 1716-1727. At least 13 species are common to both: *Aeonium arboreum*, *Agave americana*, *Aloe saponaria*, *Carrianthus ringens*, *Conicosia communis*, *Drosanthemum micans*, *Euphorbia neriifolia*, *Machairophyllum albidum*, *Mammillaria mammillaris*, *Orbea variegata*, *Rhombophyllum dolabrifforme*, *Selenicereus grandiflorus* and *Trichodiadema stellatum*. Several others were probably the same, give or take a bit of taxonomic licence. As regards geographical distribution, the countries of origin are as follows:—

Country of Origin	Badminton Plates	Bradley Plates
Africa, South	37	40
Africa, North	2	1
Canary Isles	1	0
West Indies	4	6
Mexico	2	2
India	1	1
Sri Lanka (Ceylon)	1	0
Europe	4	0

The preponderance of South African succulents is obvious: the favourite 'desert' cacti of the south-west United States and South America were yet unknown, and those from the West Indies gave a very false impression of the cultural needs of the Cactaceae as a whole.

Significance of the Badminton florilegium

Many tributes have been paid to the Badminton garden and to the skill and enthusiasm of the first Duchess in creating and stocking it. The genus *Beaufortia* R.Br., a heather-like Myrtaeous shrub, was named in her honour in 1812. Cowell (1730), in a list of the most celebrated English gardens, placed Badminton second, and we are told that exotic gardening in England was 'first . . . set on foot by the late famous Dutchess of Beaufort, and Dr. Henry Compton . . .'. In addition to the succulents, many other plants scored notable firsts in this country under the Duchess's care. Cowell tells us that she grew guavas nearly 5m (16ft) tall and was the first to get fruits to ripen here.

The eighteenth century was a period of explosive growth for horticulture in England (Henrey, 1975), with new plants flooding in and more and more private persons enriching their gardens while Kew, Chelsea and other botanic gardens also continued to expand. Badminton was among the foremost, and undoubtedly provided an example that was quickly followed by others.

It is a great pity that the Badminton paintings were never published. A unique opportunity was missed to produce a splendid folio that could have stood on the shelf beside those of Martyn (1728, 1730), Dillenius (1732), P. Miller (1760), J. Miller (1777) and others, and heading the series. But we must rejoice that the pictures survive today, unimpaired by the ravages of time, and hope that one day this omission can be put right.

Acknowledgements

This investigation has been made possible by the generous help of Her Grace the present Duchess of Beaufort, who shares with the first Duchess a love of gardens and is at present laying out a new formal garden at Badminton, one bed of which will be devoted to plants grown there before 1715. Further thanks are due for permission to reproduce the accompanying illustrations. Lady Jean O'Neill has been kind enough to read the typescript and make helpful comments. To David Hunt, I am ever grateful for much help and advice, and for suggesting the identities of Cactaceae in the tabulated list. To the Director of the Royal Botanic Gardens, Kew, I owe thanks for copies of the 1912 list of names and other archive material. Peter Mitchell of the Sempervivum Society checked the houseleeks for me, and Will Tjaden, who is working on a parallel study of Dillenius and

Sherard, also co-operated in sending me his unpublished writings. Finally I would like to thank Mrs Ruth Duthie and Richard Bisgrove of the Garden History Society who first drew my attention to the existence of these marvellous old paintings.

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Index to species illustrated

An asterisk indicates an earlier than generally accepted date of introduction

Aeonium arboreum	I.62	* maculata	I.6
cv. innom.	I.62	* verrucosa	I.1
'Albovariegatum'	I.62	sp.	I.35
Agave americana	II.99, 109	*Glottiphyllum difforme	I.39
*Aloe arborescens	I.7; II.7	* linguiforme	I.40
* var. frutescens	I.4	Lampranthus coccineus	I.40
* ferox	I.34	* deltoides	I.35
* pluridens	I.2	*Machairophyllum albidum	I.44
* purpurascens	II.4	Mammillaria mammillaris	I.35; II.10
* saponaria	I.1, 5, 6; II.5, 6	Opuntia compressa	I.44, 45; II.43
* variegata	I.2	tomentosa	II.11
vera	II.40	Orbea variegata	I.39; II.21
*Anacampseros telephiastrum	I.10, 36	Pelargonium gibbosum	II.49
Bulbine frutescens	I.3; II.8	Rhombophyllum dolabriforme	I.42
*Carruanthus ringens	I.42	Ruschia filamentosa	II.14
*Cephalophyllum dubium	I.45	Sansevieria hyacinthoides	I.23
*Cereus repandus	I.23; I.24	* zeylanica	I.2
*Conicosia communis	I.37	*Sceletium anatomicum	I.42
Cotyledon orbiculata	II.108	Sedum acre	I.38
*Delosperma ecklonis	I.39	dasyphyllum	I.41; II.38
*Drosanthemum flavum	I.40	Selenicereus grandiflorus	I.24
* lique	I.36	*Sempervivum montanum	I.57; II.39
micans	II.52	tectorum	II.18
Euphorbia canariensis	I.33	Senecio kleinia	II.100
* caput-medusae	I.34	*Sphalmanthus splendens	I.41
neriifolia	I.67; II.9	*Stenocereus hystrix	II.101
*Furcraea tuberosa	I.6	Trichodiadema barbatum	I.36, 38
*Gasteria carinata	II.36, 38	* densum	I.38
disticha	I.23; II.3	* stellatum	I.44

Tabulation of paintings

Plate	Original Identification	Current Identification	Date of Introduction'
VOLUME I by E. Kychicus, 1703-1705			
1.1	Aloe raised of seed from the Cape of Good Hope	Aloe saponaria Haw.	1727
1.2	—	Aloe saponaria Haw.	1727
1.3	—	Gasteria verrucosa (Miller) Duval	1731
2.1	A Tree Aloe	Aloe pluridens Haw.	Pre-1824
2.2	A fine painted Aloe Aloe Afric. Humilis fol. ex albo & viridi variegato Comm. Quarto printed 1703 Fig. 20	Aloe variegata L.	1720
2.3	—	Sansevieria zeylanica (L.) Willd.	1731
3	Aloe Aquatica fol. iridis	Bulbine frutescens (L.) Willd.	1702
4	Tree Aloe with a turning leaf	Aloe arborescens Miller var. frutescens (Salm-Dyck) Miller	1817
5.1	Three seedling aloes	Aloe saponaria Haw.	1727
5.2	—	Aloe saponaria Haw.	1727
5.3	—	Aloe saponaria Haw.	1727



PLATE 3. *Opuntia compressa* (centre), *Machairophyllum albidum* (left) and *Trichodiadema stellatum* (right) (Volume I, t.44).



PLATE 4. *Aeonium arboreum* and two variegated mutants (Volume I, t.62).

Plate	Original Identification	Current Identification	'Date of Introduction'
6.1	—	<i>Furcraea tuberosa</i> Aiton	1739
6.2	—	<i>Aloe saponaria</i> Haw. seedling	1727
6.3	—	<i>Gasteria maculata</i> (Thunb.) Haw. seedling	Pre-1759
7	—	<i>Aloe arborescens</i> Miller	1731
10.2	Sedum	<i>Anacampseros telephiastrum</i> DC.	1732
23.1	<i>Cereus</i> Amst. 2: 3	<i>Cereus repandus</i> (L.) Miller	1720
23.2	<i>Aloe quiniensis</i> Radice geniculata foliis evridi et atro undulatis variegatis Comm. Amst. fig. 20	<i>Sansevieria hyacinthoides</i> (L.) Druce	1690
23.3	<i>Aloe</i> Afric. triangulo longiss. & angust. flor. luteis foetidis Comm. Amst. 2: t.15	<i>Gasteria disticha</i> (L.) Haw.	1791
24.1	<i>Cereus spinosus</i> Amers. Park. 1628 Herm. 115.	<i>Cereus repandus</i> (L.) Miller	1720
24.2	<i>Cereus minima serpens</i> Amers. Pluk. 150, 6.	<i>Selenicereus grandiflorus</i> (L.) B. & R.	1700
24.3	<i>Arundinacea spinosa</i> Park. 1629	<i>Selenicereus grandiflorus</i> (L.) B. & R.	1700
33	<i>Euphorbium sive Tithymalus aizoides fruticosus canariensis Quadrangularis</i> etc. Comm. Amst. 2: fig. 104	<i>Euphorbia canariensis</i> L.	1697
34.1	<i>Euphorbium Tithymalus</i> Aiz. Afric. simpl. Comm. fig. 7	<i>Euphorbia caput-medusae</i> L.	1731
34.2	<i>Aloe</i> Afric. caul. fol. glauc. caulem Amplect. spinos. Comm. 19	<i>Aloe ferox</i> Miller	1759
34.3	<i>Aloe</i> Africs. caul. fol. glauc. caulem Amplect. Dorso spinos. Comm. 20	<i>Aloe ferox</i> Miller	1759
35.1	<i>Ficoides alsine pusilla</i> Bocc. 48	<i>Lampranthus deltoides</i> (L.) Glen ex Wijnands	1714
35.2	<i>Aloe</i> a seedling	<i>Gasteria</i> sp. seedling	
35.3	<i>Ficoides Melocactus mammillaris glabra</i> Pluk. 291. Herm. 136	<i>Mammillaria mammillaris</i> (L.) Karsten	1690
36.1	<i>Ficoides nodosa rubra</i>	<i>Drosanthemum lique</i> (N.E.Br.) Schwantes	1819
36.2	<i>Portulaca africs. semper-virens flore rubicundo</i> Amst. 2: 89	<i>Anacampseros telephiastrum</i> DC.	1732
36.3	<i>Ficoides</i>	<i>Trichodiadema barbatum</i> (L.) Schwantes	1705 or 1714
37	<i>Ficoides maximus</i> Breyne 80	<i>Conicosia communis</i> N.E.Br.	1714
38.1	<i>Ficoides minor spinosa</i>	<i>Trichodiadema barbatum</i> (L.) Schwantes	1705 or 1714
38.2	<i>Ficoides frutesc. minor spinosa</i>	<i>Trichodiadema densum</i> (Haw.) Schwantes	1732
38.3	<i>Sedum frutescens minus spinosum</i>	<i>Sedum acre</i> L. in fruit	Native
39.1	<i>Fritillaria crassa Promontorii bonae Spei Apocynum humile Aizoides siliquis erectis Africanum</i> Cat. lugd. 52	<i>Orbea variegata</i> (L.) Haw.	1690
39.3	<i>Ficoides sive Chrysanthemum aizoides africanum triangulari folio flore aureo</i> Breyne. t.81	<i>Glottiphyllum difforme</i> (L.) N.E.Br.	1732

Plate	Original Identification	Current Identification	'Date of Introduction'
39.4	<i>Ficoides erecta tereti folia flore albo</i> Herm. 166	<i>Delosperma ecklonis</i> (Salm-Dyck) Schwantes	1854
40.1	<i>Ficoides flore rubro</i>	<i>Lampranthus coccineus</i> (Haw.) N.E.Br.	1696
40.2	<i>Ficoides minima</i>	<i>Drosanthemum flavum</i> (Haw.) Schwantes	1820
40.3	<i>Ficoides</i>	<i>Glottiphyllum linguiforme</i> (L.) N.E.Br.	1714
41.1	<i>Ficoides</i>	<i>Sphalmanthus splendens</i> (L.) L.Bolus	1716
41.4	<i>Sedum minus</i> Hort. Eyst. 397	<i>Sedum dasyphyllum</i> L.	? Native
42.1	<i>Ficoides folio magno flo. pleno albo</i>	<i>Sceletium anatomicum</i> (Haw.) L.Bolus	Pre-1803
42.2	<i>Ficoides</i>	<i>Carruanthus ringens</i> (L.) Boom	1717
42.3	<i>Ficoides</i>	<i>Rhombophyllum dolabriforme</i> (L.) Schwantes	1705
44.1	<i>Ficus Opuntia</i>	<i>Opuntia compressa</i> (Salisb.) Macbride	1596
44.2	<i>Ficoides</i>	<i>Machairophyllum albidum</i> (L.) Schwantes	1714
44.3	<i>Ficoides frutesc. minor spinosa</i>	<i>Trichodiadema stellatum</i> (Miller) Schwantes	1716
45.1	<i>Ficus Opuntia Bauhin</i> vol. 1	<i>Opuntia compressa</i> (Salisb.) Macbride	1596
45.2	<i>Ficoides</i>	<i>Cephalophyllum dubium</i> (Haw.) L.Bolus	1800
57.2	—	<i>Sempervivum montanum</i> L.	1752
62.1	<i>Sedum majus arborescens radicabile</i> Park. 730, 1. Munt. 129	<i>Aeonium arboreum</i> (L.) Webb & Berth.	1640
62.2	—	<i>Aeonium arboreum</i> (L.) Webb. & Berth. 'Albovariegatum'	1699
62.3	—	<i>Aeonium arboreum</i> (L.) Webb & Berth. cv. <i>innom.</i>	1704
67	<i>Tithymalus Indicus arborescens spinosus neriifolia</i> H.M. Ela calli 2: 43 Amst. 1: 13. Pluk. 230, 4.	<i>Euphorbia neriifolia</i> L.	1690

VOLUME II by D. Frankcom, S. Merian and others, undated

3	<i>Aloe Afric. floro rubro foli maculis ab utraq. parte Abdicantib. notato</i> Comm. Amst. v.i. 28	<i>Gasteria disticha</i> (L.) Haw.	1791
4	<i>Aloe succotrina angustifolia spinosa flore purpureo</i>	<i>Aloe purpurascens</i> Haw.	Pre-1789
5	<i>Aloe vera costa spinosa</i> Abr. Munting quarto printed 1681 page 24	<i>Aloe saponaria</i> Haw.	1727
6	<i>Aloe africana caulescens foliis spinosis mainly ab utraq. parte albicantibus notatis</i> Comm. Amst. vi fig. 5	<i>Aloe saponaria</i> Haw. (Syn. <i>A. latifolia</i> Haw.)	1727
7	<i>Aloe afric. Caulescens Folijs Clausis Caulem Amplectentibus</i> Comm. 2: t.15	<i>Aloe arborescens</i> Miller	1731
8	<i>Aloe aquatica fol. iridis</i>	<i>Bulbine frutescens</i> (L.) Willd.	1702
9	—	<i>Euphorbia neriifolia</i> L.	1690

Plate	Original Identification	Current Identification	'Date of Introduction'
10	Echinomelocactus minor Lactescens absque Comento (sic) Cylindricis Strictioribus Paradice of Batavia Pag. 136 Ficoides S. Melocactus mammillaris glabris sulcis carens fructum suum undique fundens Plucknett Table 29th Fig. 1 Ficoides vel ficus americana sphaerica tuberculata lactescens flore albo Fructu rubro pyramidalis Comm. Amst. Vol. 1 Print 55 Pag. 105	Mammillaria mammillaris (L.) Karsten	1690
11	Folium Opuntiaceum Flore et Fructu	Opuntia tomentosa Salm-Dyck	1820
14.2	—	Ruschia filamentosa (L.) L. Bolus	1732
18.1	Sedum majus vulgare similo globulis decidentibus Moris. v.3 p.134 figure 18	Sempervivum tectorum L., white cv. Inflorescences only; remaining plants not succulents	Near-native
21.1	Apocynum humile Aizoides Siliquis Erectis Africanum Horti Academy Lugduno Batavi Catalogus 53	Orbea variegata (L.) Haw.	1690
36	Aloe Blew at Chelsea 1711, the same as that Aloe p.3	Gasteria carinata (Miller) Haw.	1731
38.1	The Pearl Aloe growing at Chelsea	Gasteria carinata (Miller) Haw.	1731
38.2	—	Sedum dasyphyllum L.	? Native
39.2	—	Sempervivum montanum L.	1752
40	Aloe with a green flower	Aloe vera L.	1596
43	Ficus sive Opuntia breeding and feeding the Cochenille. Cochinille sive Fici Indic grana Park. 1490, 3	Opuntia compressa (Salisb.) Macbride	1596
49	Geranium columbinum majus foliis imis longis usque ad Pediculum divisivis Moris. Hist. 2: 511. Pluk. Alm. 167	Pelargonium gibbosum Willd.	1712
52.2	—	Drosanthemum micans (L.) Schwantes	1704
99.1	Aloe mucronato folio americana major Munt. 300. This is that which blew at Hampton Court 1711 and is now in Flower again. Aloe americana sobolifera Cat. Lugd. 17	Agave americana L.	1640
100	Linaria fl. pallido rictu purpureo. C.B.P. Linaria flore albicante Moris. 102.11 Linaria a shrub Pluk. 304, 3.	Senecio kleinia (L.) Less.	1732
101	Cereus peruanus spinosus C.B.P.	Stenocereus hystrix auctt.	1818
108.2	—	Cotyledon orbiculata L. var. orbiculata (Syn. C. decussata Sims)	1819
109	Drawn by Mrs. London	Agave americana L. (abnormal specimen)	1640

A new review of *Mammillaria* names S-Z

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Summary. This is the fifth and final instalment of an annotated list of *Mammillaria* names, continued from Bradleya 4:39-64 (1986). The article concludes with a classified list of recognized species and subordinate taxa.

Zusammenfassung. Dies ist der fünfte und letzte Teil einer kommentierten Liste von *Mammillaria*-namen (Fortsetzung aus Bradleya 4:39-64, 1986). Am Ende des Beitrags wird eine taxonomisch geordnete Aufstellung der anerkannten Arten und der untergeordneten Taxa gegeben.

M. saboae Glass in Cact. Suc. Mex. 11:55, figs. 23-27 (1966). Source: Mexico, SW Chihuahua, near Terrero, 2100m, in soil in depressions of porous volcanic rock, exposed to extremes of temperature, 15 Apr. 1965, Mrs K. Sabo s.n. (MEXU, holotype; POM, OKL, isotypes).

Series LONGIFLORAE. Clustering; individual stems ovoid, 1-2 × 1-2cm, from fleshy roots; tub. small, rounded 2-5 × 5mm, smooth, green; ax. naked. Cent. sp. 0, rarely 1, 2mm, straight (cf. Glass & Foster in CSJA 40:151, 1968); rad. sp. 17-25, 2mm, slender, glassy white, slightly curved, yellowish at the base. Fl. funnel-shaped, to 4cm × 4cm, pink with pale yellow anthers. Fr. sunken in the stem, dried perianth persistent; seeds black, 1mm diam.

I take this to include *M. haudeana* Lau & Wagner (*M. saboae* f. *haudeana* (Lau & Wagner) D. Hunt) from Yecora, Sonora, based on Lau 777, a somewhat larger plant with larger flowers and seeds, and *M. goldii* Glass & Foster (*M. saboae* var. *goldii* (Glass & Foster) Glass & Foster), from Nacozari, Sonora, which usually remains simple and has more numerous spines (35-45), but the above description covers the original form only.

M. saetigera Boed. & Tiegel ex Boed., Mamm. Vergl. Schl., 49 (1933), and in Kakteenk. 1934: 191 (1934), with fig. Source: Mexico, Queretaro, border with San Luis Potosi (Huasteca), near Hacienda Cenca [Conca?], 400-500m, E. Beyer s.n. Type not known to have been preserved.

Series LEUCOCEPHALAE. Apparently simple, depressed globose, c.6-7cm diam.; tub. pyramidal, to 12 × 5-6mm; ax. with white wool and hairlike bristles. Cent. sp. 2, 7-11mm, thick, subulate, white with brown tip; rad. sp. 15-20, to 7mm, the upper shorter, white. Fl. c.2cm, pink with darker midstripe; stigmas 4-5, dark yellow, Fr. slender clavate, 18mm, red; seed yellowish brown.

Evidently one of the *M. hahniana* group, but no authentic material is extant to fix the name precisely. Mottram (Mamm. Index, 80, 1980) has selected the illustration in Kakteenkunde (1934) as lectotype, but it does not seem to show the requisite number of radial spines, nor to match what is seen as '*M. saetigera*' in collections today. Re-collection at Hacienda Cenca, the type locality (perhaps Conca, in the valley of the Rio Santa

Maria between Jalpan and Rio Verde) is needed to clear up the uncertainty.

Craig's *M. saetigera* var. *quadrivalvis* was completely without locality data and may or may not have been relevant.

M. saffordii (B. & R.) Bravo, Las Cact. Mex., 613 (1937); *Neom. saffordii* B. & R., The Cact 4:149, fig. 168 (1923). Source: Mexico, Nuevo Leon, near Icamole, 3 Feb. 1907, W. E. Safford 1250 (US).

Subgen. DOLICHOTHELE. A synonym of *M. carrettii*.

M. saillardii Hort. Rebut (1896) (Craig 345)

M. saint-pieana Backeb. ex Mottram, Mamm. Index, 80 (1980); Backeberg, Descr. Cact. Nov. III: 8 (1963), not valid (ICBN Art. 9.5); see Eggli in Bradleya 3: 102 (1985). Lectotype: Backeberg, Kakteenlexikon, 658, fig. 216 (1966); cf. Mottram, l.c. Source: Mexico, without locality, 'probably collected by Schwarz'.

Series MAMMILLARIA. Not distinguishable from *M. gigantea*.

M. salm-dyckiana Scheer (basonym for *Coryphantha salm-dyckiana*)

M. salmiana [attrib. to Fennel by] C. F. Foerster, Handb. Cact., 254 (1845), name only

M. saltillensis (Poselger) Boed. (*Coryphantha poselgeriana*: Backeb. 3049, 3167)

M. saluciana Schlumb. in Rev. Hort., ser. 4, 5: 404 (1856). Error for *salmiana*; see Schlumberger, l.c., 480.

M. san-angelensis Sanchez-Mejorada in Cact. Suc. Mex. 26:8, fig. 6 (1981); *M. elegans* var. *dealbata* sensu Schumann, *Neomammillaria dealbata* sensu B. & R., The Cact. 4:110 (1923), not *M. dealbata* A. Dietr. Type ('lectotype'): Mexico, Distrito Federal, Pedregal de San Angel, matorral de *Senecio praecox*, 2270m, 9 Jan 1981, M. Panti 486 (MEXU).

Series SUPERTEXTAE. Usually simple, globose to short columnar, 6-12 × 4-7cm; tub. 13:21, conic, with watery sap; ax. slightly woolly at first, later naked. Cent. sp. 1-2, 5-6mm, subulate, whitish, tipped blackish; rad. sp. 18-20, c.5-7mm, acicular, glassy white. Fl. 12-14mm, rose-pink; stigmas yellowish white. Fr. clavate, red; seed curved pyriform, yellowish brown.

A form of *M. haageana* once 'very common in the Valley of Mexico' (B. & R., l.c.) but now reduced to a very few individuals on the Pedregal de San Angel. It was confused with *M. dealbata* by Schumann and by Britton & Rose, and has now been named as a distinct species by Hernando Sanchez-Mejorada. Efforts are being made to propagate the plant from seed, with a view to establishing a viable in situ population.

M. sanguinea Haage f. (*M. spinosissima*: Craig 269)



M. sanluisensis. One of Shurly's own photographs, also reproduced with the original description (1949).

M. sanluisensis Shurly in CSJGB 11:57, with fig. (1949). Source: Mexico, San Luis Potosi, in the northern part of the state, 1800m, rare on steep limestone mountains in good black soil, before 1947. Schwarz s.n. (K, holotype).

Series PROLIFERAE. Clustering from the base, depressed-globose, 5.5×2.5 cm, including the spines; tub. 8:13, cylindrical, 10×5 mm, tapering to 3mm at apex; ax. with 10-12 thin white bristles to 10mm. Cent. sp. 5-8, incl. 1 porrect, 10mm, straight, acicular, white below, red-brown above, later just brown-tipped; rad. sp. 40, 7mm white, threadlike. Fl. 20×15 mm, white, outer segments with narrow red midstripe; stigmas yellow. Fr. ovoid, 5×3 mm, bright red; seeds black.

Not distinguishable from *M. pilispina* J. A. Purpus, though many plants purporting to be *M. sanluisensis* can be found in collections. All these impostors have hooked central spines and are identifiable as a form of *M. leucantha* Boed. (series Stylothelae, and characteristically occurring on volcanic rock, not limestone, by the way).

M. santalarensis Cowper in CSJA 41:248, fig. 1 (1969). Source: Mexico, Chihuahua, Santa Clara Canyon, 15-17.5 miles W of the Ciudad Juarez-Chihuahua highway at km 1757, 10-11 Nov. 1968, Couper 68-947 (UNM, holotype). First collected by Dale Morrill in 1967. 'Plants grow in deep shade in bright green moss on large boulders . . . associated with *Coryphantha compacta*, *Mammillaria gummifera* and an *Echinocereus* in the *E. coccineus* group'.

Series ANCISTRACANTHAE. Apparently conspecific with *M. barbata*, q.v.

M. sartorii J. A. Purpus in MfK 21:50, with fig. (1911). *M. tenampensis* (B. & R.) A. Berger; *Neom. tenampensis* B. & R., The Cact. 4:101, fig. 102 (1923). Source: Mexico, Veracruz, on the rocky walls of the Barranca of Tenampa and Atlyae (?), near 'Zaenapam' [Zacuapam], 800-1000m, 1907, C. A. Purpus. Type not known to have been preserved.

Series POLYEDRAE. Clustering, stems globose to somewhat cylindrical-globose, often 10×8 -9cm tall, rarely to 12cm diam., flat-topped, dark glaucous green; tub. pyramidal, irregularly angled, c. 7-10 \times 10-12mm; ax. with dense white or yellowish

wool and sparse to numerous bristles. Cent. sp. 2-10, very variable, 0-2, porrect, very short (in f. *brevispina*) only 1-2mm, or rarely to 8cm (f. *longispina*), and 2-8 spreading, 2-8mm, dirty white or brownish white with brown tip; rad. sp. 0-12, rudimentary, 1-2mm, bristle-like. Fl. c. 2cm, perianth-segments pale carmine with darker midstripe; stigmas 6, reddish or yellowish. Fr. c. 1.5cm, red; seeds very small, pale brown.

This description includes details from notes I made in the Barranca of Tenampa, 900m, 10 Nov 1973 (see JMS 14:6-8. 1974). Specimens collected on that visit survive at Kew (*H.8567*), and have clustered freely. *M. tenampensis* was separated by Britton & Rose on the basis of having numerous axillary bristles, but this character is inconstant. Bravo, Las Cactaceas de Mexico, 704 (1937), followed by Craig, supposed 'Tenampa' to be a place of this name in the Federal District, but it is the one in Veracruz (cf. Sousa, Las Colecciones de C. A. Purpus en Mexico, Univ. Calif. Publ. Bot. 51:1-36. 1969).

M. sartorii is close to *M. mystax*, but one of the more readily recognizable members of its series.

M. saxatilis Scheer, Bot. Voyage HMS Herald, 286 (1856). Source: Mexico, Chihuahua, near Chihuahua, in crevices of rocks, Potts. No material extant. Very briefly described, and not determinable.

M. scepontocentra Lem. (*Coryphantha pycnantha*: Craig 349)

M. schaeferi Fennel (*M. celsiana*: Craig 278)

M. scheeri Muehlenpfordt in Allg. Gartenz. 13:346 (1845) (*Neolloydia conoidea*: Anderson in Bradleya 4:13. 1986)

M. scheeri Muehlenpfordt, l.c. 15:97 (1847) (*Coryphantha scheeri*: Anderson, l.c.)

M. 'scheideana' Auct. (error for *M. schiedeana*)

M. scheidweileriana Otto ex A. Dietr. in Allg. Gartenz. 9:179 (1841). Source: Mexico, 'erhielt ich aus dem Staat San Luis Potosi' (Ehrenberg in Linnaea 19:344. 1846).

Series STYLOTHELAE. The original application is completely uncertain, and the name best discarded. See JMS 14:8 (1974).

M. schelhasii Pfeiffer in Allg. Gartenz. 6:274 (1838). Source: Mexico, Hidalgo, near Actopan and Ixmiquilpan, between blocks of lava, in small clusters, Ehrenberg (Ehrenberg in Linnaea 19:344, 1846); see also C. F. Foerster, Handb. Cact., 186 (1845).

Series STYLOTHELAE. Subglobose, proliferating from the base; tub. cylindric, 20 × 8mm; ax. with scant white wool. Cent. sp. 3, the lower hooked, 16-17mm, brown, the upper 2 straight, 12mm, slightly more rigid than the radials, reddish, whitish at the base; rad. sp. 16-20, 8-10mm, bristle-like, white, more or less equal. Flowers white, with red filaments.

Despite its early and reasonably clear diagnosis, this name cannot be firmly attached to anything from Hidalgo, and it remains 'insufficiently known'. The name is sometimes misspelt 'schelhasei', which is not unreasonable, since it commemorates a Mr Schelhase, but plants labelled with either spelling usually resemble *M. bocasana*, which is unreasonable, if one looks at the description.

M. schiedeana Ehrenb. in Allg. Gartenz. 6:249 (1838) and in Linnaea 19:344 (1846). Source: Mexico, Hidalgo, Puente de Dios and the Barrancas around Metztlán, at 4000-5000ft, in leaf-mould on limestone, 1837, Ehrenberg (Ehrenberg, l.c. 1846). No authentic material extant.

Series LASIACANTHAE. Clustering, semi-globose, individual heads to 10 × 4cm; tub. cylindric-terete, 6-10 × 3-4mm, tapering to 1mm at tip, dark green; ax. with white woolly hairs longer than the tubercles. Cent. sp. 0; rad. sp. very numerous, 2-5mm, in several series, minutely pubescent, white, yellowish towards the base, golden yellow at the base, the tip usually hairlike. Fl. Aug-Nov, small, 8mm white. Fr. elongate, 12 × 2-3mm, bright carmine red; seeds black.

One of the most prettily-spined species, and varying from golden yellow to almost white. It has been taken to include *M. dumetorum* by Glass & Foster (*M. schiedeana* var. *dumetorum* (J. A. Purpus) Glass & Foster in CSJA 53:143-144, 1981).

M. schieliana Schick in Sukkulentenkunde 3:27, with fig. (1949). Source: based on cultivated specimens of unknown provenance; type not stated to have been preserved.

Series PROLIFERAEE. Not distinguishable from *M. picta*.

M. schlechtendalii Ehrenb. (*Coryphantha clava* var. *schlechtendalii*: Backeb. 3040)

M. schmerwitziana Blanc, name only (Craig 339)

M. schmerwitzii [attrib. to Haage by] Ruempler (Craig 339)

M. schmidtii [attrib. to Sencke by] Ruempler (*M. magnimamma*: Craig 34). Also listed by Krainz, Kat. Staedt. Sukk. Samml. Zuerich, 81 (1967).

M. schmollii (Bravo) Werderm. in Backeberg, Neue Kakteen, 98 (1931); *Neom. schmollii* Bravo in An. Inst. Biol. Mex. 2:123, fig. 12 (1931). Source: Mexico, Oaxaca, near Mitla. Type not stated to have been preserved, and not extant at MEXU.

Series HETEROCHLORAE. Not distinguishable from *M. discolor*. Craig (Mamm. Handb., 290-291, 1945) failed to re-collect the plant near Mitla, and so far as I know *M. discolor* sens. lat. has yet to be recorded from the area. Someone (I do not recall who it was) suggested to me that *M. schmollii* was actually *M. dodsonii*, but this is not credible, *M. schmollii* having been described as simple, to 7cm in diameter, and with yellow flowers.

M. schmuckeri Hort. Schmolli. Referable to *M. kelleriana*, according to Craig, Mamm. Handb., 232 (1945), but plants I saw at the Botanischer Garten, Berlin, in 1985, were akin to *M. parkinsonii*, resembling Schmolli's *M. 'sombretensis'*.

M. schiedeana Anon. in CSJA 10:132 (1938), name only; error for *M. schiedeana*?

M. schochiana Hort. Walton (*M. rhodantha*?): Craig 237

M. schulzeana [attrib. to Boedeker by] A. Berger, as synonym of *M. graessneriana*.

M. schumanniana Auct. (= seq.). According to Mottram, Mamm. Index, 82 (1980), *M. schumannianus* [sic] was a Uhlig catalogue name (1979) for U2851.

M. schumannii Hildm. in MfK 1:125 (Dec. 1891), l.c. '89' [101], name and fig. only (Nov. 1891); *M. venusta* K. Brandegee in Zoe 5:8 (1900); *Bartschella schumannii* (Hildm.) B. & R., The Cact. 4:58, t. 7 fig. 55 (1923). Source (of *M. schumannii*): obtained by Mathsson, of unknown provenance; (of *M. venusta*): Mexico, Baja California, near San Jose del Cabo, 9 Sep 1890, T. S. Brandegee s.n. (UC 110852), 27 Sep 1893, T. S. Brandegee s.n. (UC 110851) and 10 Oct 1899, T. S. Brandegee s.n. (UC 110853), syntypes.

Series ANCISTRACANTHAE. Clustering, individual heads 2-4(-6) × 2-4cm; tub. short and thick; ax. slightly woolly, soon naked. Cent. sp. 1, sometimes 2-4, usually 1 hooked, 10-15mm, stout, pure white to dark brown; rad. sp. 9-15, 6-12mm, thin-accicular. Fl. 3-4cm in diameter, with short tube, rose-pink. Fr. 15-20mm, scarlet, nearly dry, breaking off above the base; seeds black.

I follow the conventional assumption that the plants described by Hildmann and by Mrs Brandegee were one and the same species, although Hildmann's was sterile and of unknown provenance, and no type was preserved.

The species is somewhat anomalous and was placed in a separate genus *Bartschella* by Britton & Rose on account of the flower-size and position, black seeds and circumscissile fruit. There are other Mammillarias with flowers as large, however, and many that have them 'near the top of the plant' and seeds that are black. Very nice illustrations of the fruit-character have recently been provided by R. Wolf (in Mitt. AfM 11(1): 14, 16, 1987). Wolf describes the fruit as 'open at the base and incised above as if someone had cut round it. When the fruit is detached, most of the seeds remain in a little 'nest' in the somewhat deepened axil.'

M. schumannii seems to have no close allies, but may have some affinity with the mainland species *M. boolii*.

M. schwartzii (Boed.) [attrib. to Moran by] F. Buxb. (*M. coahuilensis*; see JMS 14:10, 1974).

M. schwarziiana [attrib. to Boed. by] Backeb. (*Coryphantha schwarziiana*: Backeb. 3502)

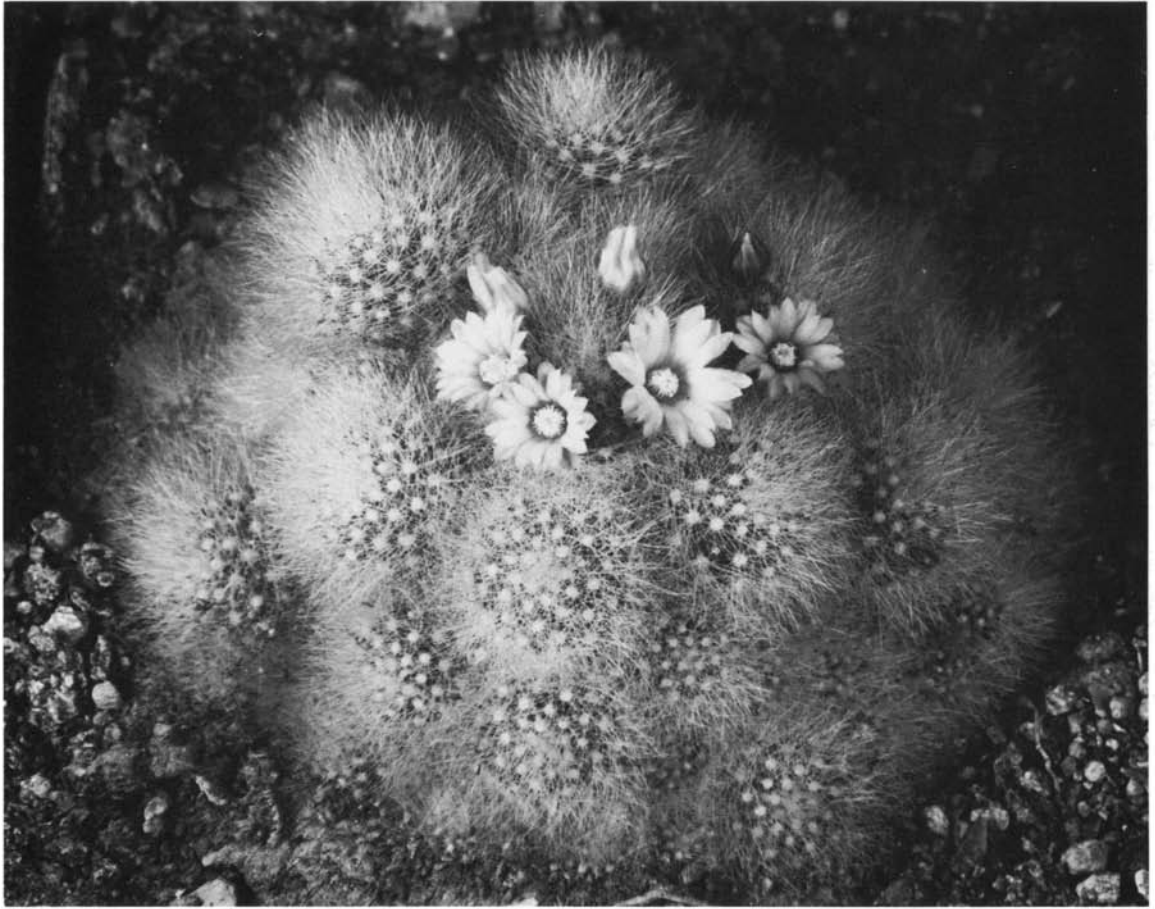
M. schwarzii Shurly in CSJGB 11:17, with fig. (1949). Source: Mexico, Guanajuato, in the north of the state, at c. 1200m, on cliffs in good soil, *F. Schwarz* s.n. (K, holotype).

Series PROLIFERAEE. Clustering, individual heads globose, 3 × 3.5cm, incl. spines; tub. 8:13, nearly cylindric, 7 × 3mm; ax. with few-12 persistent thin white bristles to 5mm. Cent. sp. 8-9, one porrect (straight or occasionally hooked), encircled by the others, 5-6mm, shining white, usually tipped pale red-brown; rad. sp. 35-40, 8mm, little more than hairs, shining white. Fl. 15 × 12mm, perianth-segments white with red midstripe, stigmas 4, pale greenish white. Fr. not described.

A species that intrigues me and has not, so far as I know, ever been recollected. The unanswered questions are: did Schwarz really find it in Guanajuato? What is the provenance (not to say reliability) of the 'seed in circulation in recent years' which 'has given a proportion of seedlings with short red, hooked central spines, and overall spination less dense than that of the normal plant and a rather more rapid growth-rate' (Maddams, Interesting Newer Mammillarias, 20, 1973)? Are the plants with relatively large flowers depicted in the accompanying illustration and by Pilbeam (Mammillaria, A Collector's Guide, 123, 1981) the same as Shurly's original? Is it merely coincidence that *M. glassii* and *M. ascensionis* apparently show a similar (if not greater) variation in flower-size, and occasional hooked centrals? Or are these species related to *M. schwarzii*, and if so, how should they be classified?

M. scleracantha Hort. Monv. (*M. polyedra*?): Craig 23)

*Recently, Lau has described two large-flowered varieties of *M. glassii*. These are: *M. glassii* var. *nominis-dulcis* Lau in CSJA 57(5): 198, with figs. (1985), from Nuevo Leon, S of Dulces Nombres, 23.9°N, 99.3°W, 9000ft, *Lau* 1186A (MEXU, holotype); and *M. glassii* var. *siberiensis* Lau, l.c., from Nuevo Leon, between La Encantada and Siberia, 23.9°N, 99.8°W, 9000-10000ft, *Lau* 1322 (MEXU, holotype).



M. schwarzii

(photo: Martin)

M. scolymoides Scheidw. (basionym for *Coryphantha scolymoides*)

M. scrippsiana (B. & R.) Orcutt, *Cactography*, 8 (1926); *Neom. scrippsiana* B. & R., *The Cact.* 4:84, fig. 78 (1923). Source: Mexico, Jalisco, Barranca of Guadalajara, 28 Sep 1903, *Rose & Painter* 871 (US 399725, holotype).

Series MAMMILLARIA. Globose, becoming short cylindrical, 6cm; tub. bluish green; ax. very woolly at first. Cent. sp. usually 2, a little longer than the radials, brown throughout, slightly divergent; rad. sp. 8-10, slender, pale with reddish tips. Fl. c. 1cm, pinkish, with margins of perianth-segments paler; anthers pinkish; stigmas about 6, recurved, cream.

Reported from the Jalisco-Nayarit border on highway MEX 15 by Glass & Foster (in CSJA 44:199 fig. 195. 1972), *G. & F.* 1463, and said by them to be common in both states. Reported by Reppenhagen (Feldnummernverzeichnis. 1985) from numerous localities in Jalisco and from Santa Rosa, Zacatecas (*Reppenhagen* 972).

The holotype, which I briefly examined in 1969, consists of several tubercles with spines, flowers and photographs. I omitted to measure the flowers, but judging from the illustration cited they must have been appreciably larger than the 1cm described. Details from a plant collected in the Barranca of Guadalajara, on bluffs by highway MEX 41 about 20km N of Guadalajara, 1 Oct 1974, *H.8860*, are incorporated in the précis of Britton & Rose's description given above.

Variants of *M. scrippsiana* are: *M. scrippsiana* var. *autlanensis* Craig & Dawson in CSJA 20:126, figs. 93, 94 (1948), from

Jalisco, SW of Autlan, on cliffs and slopes of igneous hills near the top of the pass on the road to La Resolana, 26 Dec 1946, *Dawson* 4924: Clustering, stems cylindrical to 29 × 8.5cm, cent. sp. 1, 9-12mm; rad. sp. 6, 3-10mm; *M. scrippsiana* var. *rooksbyana* Backeberg in *Cactus* (Paris) no. 30: 132 (1951) (*M. ahucatlensis* Hort.) (Schwarz Cat. 1955?), from Jalisco, without locality, sent by Schwarz: Cent. sp. 4, rad. sp. 12-14; and *M. pseudo-scrippsiana* Backeb., l.c., from Nayarit, near Ahuacatlan: more clustering, paler, with fewer spines and cream-coloured flowers.

M. seegeri Ehrenb. (*M. spinosissima*: Craig 268)

M. seemannii Scheer in Seemann, *Bot. Voy. HMS Herald*, 288 (1856). Source: Mexico, 'probably from Sonora or Durango' (Scheer, l.c.). Briefly described from a sterile specimen, and not identifiable.

M. seideliana Quehl in *MfK* 21:154 (1911), l.c. 26:116 (descr. of fl. and seed), 155 (illustration) (1916). Source: Mexico, Zacatecas, according to Dr Kunze; cult. Hort. Graessner, Perleberg, Germany. No material preserved.

Series STYLOTHELAE. Simple, later clustering; stems globose or shortly cylindrical, the type 7.5 × 4.5cm, seedlings 5 × 5.5cm; tub. cylindrical, 10 × 5mm; ax. with occasional bristly hairs. Cent. sp. 3, the largest 10-15mm, hooked, all varying from white to brown, pubescent at least at first; rad. sp. 18-25, 5-8mm, hair-like, white. Fl. 1.5-2cm, outer segments pale yellow with pink midstripe, inner pale yellow, almost white; stigmas 3-5, yellow. Fr. scarlet, 30 × 4mm; seeds black.

Not positively identifiable. Cultivated plants labelled '*M. seideliana*' are not authentic, and the name is best discarded. Quehl's illustration is reminiscent of *M. moelleriana* or the original *M. boedekeriana*, but the radial spines could hardly be called 'hairlike', and axillary bristles are not usually found in this group. Britton & Rose (The Cact. 4:144, figs. 157a, 158, 1923) depicted two plants, one collected in Zacatecas by Lloyd (Lloyd 54), which looks more like *M. zacatecasensis* Shurly, and one from a photograph supplied by Quehl, presumably a seedling from the type.

M. seidelii [attrib. to Terscheck by] Walpers (referred to *M. scepontocentra* by Labouret; cf. Craig 339)

M. seitziana Mart. ex Pfeiffer, Enum. Cact., 18 (1837); Zuccarini, Pl. Nov. Monac., 716 (1837). Source: Mexico. Originally given as Hidalgo, near Ixmiquilpan and Zimapan, *Karwinski* (Zuccarini, l.c.), but subsequently changed to Oaxaca (Ehrenberg in Linnaea 19:346, 1846). No material extant.

Series POLYEDRAE. Subglobose, 12.5 × 9cm, eventually clustering from the base; tub. conic, scarcely angled, tetragonous at the base, 10 × 7mm, green; young areoles white villose, at length more or less naked; ax. woolly. Spines (5-6, 4 decussate, the upper and lower 12mm, the lateral 8mm, flesh-pink with black tip, and (1-2 close to the uppermost, only 3-4mm, flesh-pink. Fl. in Spring, almost 25 × 12mm, little expanded; outer perianth-segments olivaceous, inner lanceolate, whitish with red midstripe; stamens whitish, anthers yellow; stigmas 6.

The name *M. seitziana* has commonly been attached to forms of *M. compressa* (which is red-flowered) and *M. magnimamma*, both from Hidalgo, one of which is depicted by Craig (Mamm. Handb., fig. 6, 1945). It seems more likely, as Ehrenberg claimed, that the name was originally given to something from Oaxaca. It hardly matters, as the name *M. seitziana* post-dates those of the major contenders from both Hidalgo and Oaxaca.

M. semigloba Hort. Walton (Craig 345)

M. semilonia Ehrenb. ex Haage Cact. Kult., ed. 2 (1900), mention only (Mottram 84) [= seq.?

M. seminolia Auct. in MfK, 47 (1897)

M. sempervivi DC. in Mem. Mus. Hist. Nat. Paris 17:114 (1828). Source: Mexico, probably Hidalgo. Based on living plants collected by T. Coulter (no. 57), not known to have been preserved. Reported by Ehrenberg (Linnaea 19:348, 1846) from near Zimapan.

Series LEUCOCEPHALAE. Simple at first, later clustering, depressed-hemispherical; tub. ovoid-tetragonal, to 10 × 6-7mm; ax. woolly. Cent. sp. 2 (or 4 in var. *tetracantha* DC.), short, to 4mm, brown to blackish at first, later horn-coloured; rad. sp. 2-6, present as small white bristles to 3mm, usually on young stems only. Fl. a little longer than the tubercles; outer segments dingy olive-green, inner dingy white. Fr. clavate, 8mm, red.

A distinctive and well-known species. Reported from Hidalgo by Schumann (near Venados, coll. Mathsson); by Britton & Rose from Barranca Sierra de la Mesa, 1905, *Rose* s.n. (US 2875032); by Glass & Foster (in CSJA 43:74, 1971) near Santuario, etc., and probably widespread in calcareous areas. It is occasionally seen as an epiphyte on trees in the Barranca de Metztilan. Further west, in Queretaro, it intergrades with *M. formosa* by way of *M. pseudocrucigera*, q.v.

M. senckeana, *M. senckei* Hort. (synonyms of *M. seitziana*: Britton & Rose, The Cact. 4:83, 1923; but perhaps only variant spellings of *M. senkii* C. F. Foerster)

M. senilis [attrib. to Lodd. by] Salm-Dyck, Cact. Hort. Dyck. 1849: 8, 82 (1850); *M. senilis* C. F. Foerster, Handb. Cact., 189 (1845), name only; *Mamillopsis senilis* (Salm-Dyck) Britton & Rose, The Cact. 4:19, figs. 19-21 (1923). Source: Mexico, Chihuahua, after 1842, *Potts* (see below). No original material extant.

Subg. MAMILLOPSIS. Clustering, stems globular to cylindrical, to 15 × 10cm; tub. conic, obtuse, 3-4mm; ax. naked (Salm-Dyck) or pubescent and bristly (B. & R.). Cent. sp. 4-6, white, at least the upper and lower hooked, yellow tipped (B. & R.); radial spines

30-40, 2cm, somewhat thinner than the centrals, white. Fl. 6-7 × 5.5-6cm, orange-red; tube straight, c. 4cm × 10mm at base, widening to 15mm in diameter at throat, with broadly rounded scales; limb spreading, segments oblong-obtuse, denticulate; stamens and style exserted 2-2.5cm. Fr. not described.

According to Scheer (in Seemann, Bot. Voy. HMS Herald, 286, 1856), this species was collected by John Potts sometime after 1842 on the tops of mountains near the town of Chihuahua, where during the winter it is covered with snow, and where presumably it reached Salm-Dyck via the London nurserymen Loddiges. Seemann himself reports it from the Sierra Madre, on rocks, and Britton & Rose, l.c., credit him with the first collection, but he did not visit the Sierra Madre Occidental until late in 1849, by which time the plant was already in Salm-Dyck's collection. From his itinerary (l.c., 259), we can infer that Seemann found it between Mazatlan and Durango, but he reports that the plants he collected 'never reached their destination'.

According to Mottram, Mamm. Index, 84 (1980), the original description 'referred to a small-flowered species, perhaps in the *M. spinosissima* group', but Salm-Dyck did not describe the flowers! The first description of the flower of *M. senilis* (incorporated above) appears to be an exemplary one, with three clear drawings, by Schlumberger, in Rev. Hort., ser. 4, 2: 333-335, figs. 2-4 (1853), and there is no mistaking their identity.

The status of *M. diguetii* (F. A. C. Weber) D. Hunt remains in doubt, but it is probably only a form of *M. senilis*.



M. senilis. Reproduction of an engraving accompanying an article by Schlumberger (1853), recording the flowering of this species in cultivation.

M. senkei Craig (error for *M. senkii*)

M. senkii C. F. Foerster, Handb. Cact., 227 (1846) (*M. mystax*: Craig 54)

M. sericata Lem. (*M. schiedeana*: Craig 149)

M. setispina Engelm. ex J. Coulter, pro syn. (= seq.)

M. setispina (J. Coulter) K. Brandegee in Erythra 5: 117 (1897); *Cactus setispinus* J. Coulter in Contr. US Nat. Herb. 3:106 (1894); *Cochemiea setispina* (J. Coulter) Walton, Cact. J. 2:51 (1899). Source: Mexico, Baja California, San Borgia, 1867, *W. M. Gabb* 15 (MO, holotype); San Borgia [Borja] and San Julio Canyon, rocky or gravelly soil, 1889, *Brandegee*.

Subg. COCHEMIEA. Clustering, stems to 30 × 3-6cm; tub. short and broadly conical; ax. woolly. Cent. sp. 1-4, 2-5cm, upper straight, lowest one longest, hooked; rad. sp. 10-12, very

unequal, 10-34mm, slender, flexuous, white with black tips. Fl. described from a withered remnant on the type as only 2cm, but larger in recent collections (reported as 5.4cm by Backeberg, Die Cact. 5: 3540, fig. 3241. 1961). Fr. obovate, 3cm, scarlet; seeds black.

The specimens from San Julio Canyon are from younger parts and show but a single long and hooked central. The San Borgia specimens show mostly 3 or 4 centrals, the lowest one hooked and becoming remarkably long and often variously twisted and curved' (Coulter, l.c.).

In recent years, *M. setispina* has been photographed and re-collected in the neighbourhood of San Borja, and Backeberg's correction of the flower-size confirmed.

M. setosa Pfeiffer (*M. polythete*: Craig 46)

M. severinii Regel & Klein (Craig 339)

M. sheldonii (B. & R.) Boed., Mamm. Vergl. Schl., 30 (1933); Craig, Mamm. Handb., 180-181, fig. 162 (1945). *Neom. sheldonii* B. & R., The Cact. 4: 156, fig. 175 (1923). Source: Mexico, Sonora, near Hermosillo, 1910, *Rose et al.* 12366 (US 635170, holotype). Also collected in Sonora prior to its description by Orcutt and by Charles Sheldon, for whom it is named'.

Series ANCISTRACANTHAE. 'Stems slender-cylindric, about 8cm high; axils of tubercles without setae; radial spines 12 to 15 [but 20-24 in the type], pale with dark tips, the 3 or 4 upper ones darker, a little stouter and 1 or 2 of them subcentral, the true central erect or porrect with upturned hook at end; outer perianth-segments ciliate; inner perianth-segments about 10, broad, acute, light purple with very pale margins; filaments and style light purple; stigmas-lobes 6, green; fruit clavate 2.5 to 3cm, pale scarlet (Britton & Rose, l.c.).

As Craig (Mamm. Handb., 181. 1945) pointed out, the original description does not match the illustration, although Britton & Rose state that the photograph shows *Rose* 12366, which is the type number. My earlier notes on this matter (JMS 14:51. 1974) were misleading, since they gave the spine-count (12-15) from the type description, not from the herbarium sheet. Material on the type sheet (US 635170) actually has 20-24 radials, fewer than in typical *M. milleri* (*M. microcarpa*) but more than in *M. swinglei*. The interpretation of the three species, as generally understood, in terms of reference-points along a geographical progression (Maddams in JMS 10:35, 1970), still seems valid, although the typification of *M. swinglei*, q.v., may raise further problems.



M. sheldonii. Reproduction of Britton & Rose's illustration of *Rose* 12366 (The Cactaceae 4: fig. 175. 1923).

M. shurliana Gates (*M. blossfeldiana* var. *shurliana*).

M. shurlyi F. Buxb. in Krainz, Die Kakt. Lfg. 16 (1961). An illegitimate substitute name for *M. schwarzii* Shurly; see JMS 14:10 (1974).

M. similans Hort. (*Neobesseyia similis*? : Craig 349)

M. similis Engelm. (basonym for *Escobaria missouriensis* var. *similis*)

M. simonis [attrib. to Ehrenb. by] Walton Cat. (Craig 345)

M. simplex Haw., Syn. Pl. Succ., 177 (1812). Haworth's name for *Cactus mammillaris* L., but contrary to modern rules and superseded by *M. mammillaris* (L.) Karsten.

M. simplex [sensu] Torrey & Gray (*Neobesseyia* [i.e. *Escobaria*] *missouriensis*: Craig 349)

M. simpsonii (Engelm.) M. E. Jones (*Pediocactus simpsonii*)

M. sinaloensis (Rose ex Ortega) Mottram, Mamm. Index, 85 (1980), invalid name (*Neom. sinaloensis* Rose ex Ortega, a synonym of *M. mazatlanensis*: Craig 345)

M. sinistrohamata Boed. in MDKG 4:162, with fig. (1932); A. Berger, Kakteen, 296 (1929), name only. Source: Mexico, in the region where the boundaries of Zacatecas, Durango and Coahuila intersect; collected by J. Moeller, of Santa Clara, near San Miguel de Mezquital, Zac., and imported by the firm of F. Haage about 1927. Type presumably not preserved.

Series STYLOTHELAE. Simple, globose, to 4.5 cm diam.; tub. short-cylindric, 8 x 4m; ax. naked. Cent. sp. 4, lowest hooked, to 14mm, others straight, equalling the radials, pale yellow; rad. sp. c. 20, 8-10mm, glabrous, white. Fl. 15mm, outer segments greenish cream with reddish midstripe above, inner greenish cream to cream with soft-green midstripe, stigmas whitish. Fr. small clavate, red; seeds black.

Reported from NE of Zacatecas by Glass & Foster, G. & F. 831, 1973 (cf. CSJA 42:110, figs. 26, 27 (1970), who considered it very close to *M. mercadensis* but with generally more consistently pale yellow spines and flowers lacking the pale pink cast of *M. mercadensis*. They encountered it in relatively flat terrain, amongst grass, whereas *M. mercadensis* was on rocks on hill-sides. There is some doubt in my mind that Glass & Foster had the right plant, but assuming they did, the colour differences they note hardly justify specific rank. As I have reported under *M. mercadensis* (q.v.), forms of that species with yellow and with brown spines can grow together in the same population. In cultivation, yellow-spined examples bore flowers without the pink cast of those with brown spines.

M. slevinii (B. & R.) Boed., Mamm. Vergl. Schl., 44 (1933); *Neom. slevinii* B. & R., The Cact. 4:139, fig. 153 (1923). Source: Mexico, Baja California, Is. San Jose(f), 31 Mar. 1911, *Rose* 16550 (US, holotype); Is. San Francisco, 1921, I. M. Johnston 3943 (US, K).

Series ANCISTRACANTHAE. Simple, cylindric, up to and exceeding 10 x 5-6cm, stem hidden by close-set spines. Young spines pinkish with brown to blackish tips, bleaching white; centrals c. 6, a little longer and stouter than the numerous radials. Fl. c. 2cm diam., outer segments with pinkish midrib, inner white; filaments pinkish; style and stigmas nearly white. Fr. c. 1cm, red; seeds black 'nearly globular, with a projection at base and a large basal hilum'.

Either there is an error in the floral description, or Dr Lau's collection from Is. San Jose (*Lau* 038), which has long purple stigmas (see Pilbeam, Mammillaria, col. pl. (1981)) is misnamed. I am inclined to suspect the former. Long purple stigmas would make *M. slevinii* a close ally, or insular form, of *M. fraileana*, rather than of *M. dioica*, and better sense of the geographical distribution of these species.

M. sneedii [attrib. to (B. & R.) Cory by] Gray Herbarium Card Index (*Escobaria sneedii*)

M. soehlemannii W. Haage & Backeberg in Backeb., Kakteenlexikon, 259 (1966), provisional name. Source: Colombia, Candelaria Desert, 2800m. Briefly described, without latin description or type. Probably referable to *M. colombiana*.

M. solisii (B. & R.) Boed. (*M. nunezii* var. *solisii*)

M. solisioides Backeb. in Cactus (Paris) no. 31, suppl. 3 (Mar. 1952), *fide* Rep. Pl. Succ. 3:10 (1953); l.c. 7(30): 131 (1951), *fide* Backeberg, Die Cact. 5:3434, fig. 3174 (1961); *M. pectinifera* f. *solisioides* Backeb.) Sanchez-Mejorada in Cact. Suc. Mex. 25:65 (1980). Source: Mexico, Puebla, S of Petlalzingo, in humus on low stony hills, in full sun. No material preserved. Motttram (Mamm. Index, 86. 1980) has proposed the fig. cited as lectotype.

Series LASIACANTHAE. Simple, globose to depressed-cylindric, 2-4cm in diameter; tub. short-conic, with watery sap; ax. naked. Cent. sp. 0; rad. sp. c. 25, to 5mm, pectinately radiating and adpressed, white, flexible. Fl. campanulate-funnelshaped, 14mm, yellowish white; style greenish. Fr. scarcely exceeding the tubercles, the withered perianth persistent; seeds 0.8mm, black, faintly pitted, with round basal hilum.

I have not seen the issues of Cactus (Paris) cited, and the particulars above are quoted from 'Die Cactaceae'. A choice plant and very close ally of *M. pectinifera*, such that the two may be local races of a single species, as suggested by Buxbaum (Sukkulantenkunde 5:26. 1954) and Krainz (Die Kakt. Lfg. 12. 1959). Sanchez-Mejorada, who knows these plants in the field, evidently agrees, and has reduced *M. solisioides* to the rank of form. They occupy similar habitats less than 100km apart, and their seeds are virtually identical (and different from those of any other *Mammillaria*, which is a point in favour of excluding them from ser. Lasiacanthae).

M. solitaria [Gillies ex] G. Don (of S American origin, and not a *Mammillaria* sp.)

M. sombreretensis Hort. Schmoll. Plants I have seen under this name were referable to ser. *Leucocephalae*.

M. sonorensis Craig in CSJA 12:155, with figs. (1940), Mamm. Handb., 90, figs. 69-73 (1945). Source: Mexico, Sonora, SE of Alamos, near Guirocoba; collected at various times by Gentry, Lindsay, W. T. Marshall and Craig himself, but who collected the type (US 1791488; see note below) is not stated.

Series MAMMILLARIA. Simple and later clustering, globose, roots fibrous; tub. globular-quadrangular but not sharply angled, 8-15 × 8-18mm, dull bluish green; ax. with wool, typically without bristles. Cent. sp. 1-4, 5-20mm (to 35-45mm in vars. *longispina* and *gentryi*), acicular to subulate, reddish brown; rad. sp. 8-10 (14-15 in var. *longispina*), 1-20mm, upper shortest, slender acicular to acicular, whitish to cream to reddish brown at tip. Flowers 20mm, deep pink; style and stigmas olive green. Fr. scarlet, clavate, 12mm.

I made the following notes from the holotype specimen at Washington in January 1986: Offsetting, 4 × 7cm; tub. c. 10 × 10mm; ax. without bristles. Cent. sp. 2-4, bulbous-based, lowermost longest, to 25mm, with decurved tip. c. 0.6-0.7mm in diameter towards base, uppers nearly straight, c. 15-18mm; rad. sp. c. 12-13, lateral and lowest to 12mm, uppermost 3-4 bristly, 3-4mm. No collector or locality is recorded.

Craig described and illustrated five varieties based on spine-length and tubercle-size, validating the names with Latin descriptions in the *Mammillaria Handbook*, but not citing type material for them, only type localities. For three, Guirocoba (the type locality for the species) was mentioned, but none was allowed more than 10 radial spines. In fact, the only one with up to 4 centrals, as in the holotype (but 14-15 radials) is var. *longispina*, which was not from Guirocoba, but 'Rio Mayo'. I infer therefore, that Craig did not visualise any of the five as 'typical', but more as extremes of a variable species. The holotype must thus be considered to represent a residual var. *sonorensis*, though not



M. pectinifera f. *solisioides*

(photo: Taylor)

necessarily, I suspect, collected at the given type locality.

In my previous notes on *M. sonorensis* (JMS 14:34-35, 1974) I suggested that the Sonoran species of series Mammillaria (then 'Macrothelae'), might form a single complex, excluding *M. johnstonii*, but that two groups based on *M. sonorensis* and *M. standleyi* respectively could be segregated on the number of radial spines and presence/absence of axillary bristles. This idea is now undermined to some extent by the spine-count I have just reported for the type of *M. sonorensis*. But, in any case, having recently made a short visit to Sonora, and seen several of the taxa in nature, I am inclined to reject it out of hand!

M. sororia Meinsh. in Wochenschr. 1: 28 (1858). Source: Mexico, San Luis Potosi, Katorza [Catorce] and Tamaulipas, Jaumave and Santa Barbara, Karwinsky. Described from specimens and seedlings cultivated at Leningrad (St Petersburg).

Series MAMMILLARIA (?). Variable. Adult plants simple, depressed-globose, 5-6.5 × 7.5-10cm, greyish green; tub. large, broadly compressed-conic, polyhedral, rounded-flattened above, keeled below, apex shortly attenuate, c. 12mm overall; ar. woolly at first, later naked; ax. naked. Cent. sp. 1, ascending, stouter and greyer than the radials; rad. sp. 6, upper shorter, 2-4mm, lowermost 8-10mm, whitish or flesh-coloured with blackish base and tip. Flowers large, whitish; outer segments greenish with whitish margins and purplish tip, inner white with greenish purple mid-stripe; stigmas 4, short.

Evidently collected by Karwinsky on his trip to NE Mexico in 1840-43, as was *M. picta*, and described by Meinshausen in the same paper. Meinshausen compared *M. sororia* to *M. subpolyedra*, from which Craig inferred it must have come from Oaxaca and 'might be synonymous with either *M. collinsii* or *M. confusa* var. *centrispina*', despite having given the type locality as Jaumave etc., and reporting the axils as naked! It sounds, on the contrary, as if *M. sororia* might have been of the affinity of *M. meiacantha*. I don't think this occurs near Jaumave, but it might do so in northern San Luis Potosi.

M. spaethiana [attrib. to Schumann in] Spaeth Cat. (*Pediocactus simpsonii*: cf. Britton & Rose, The Cact. 3:91, 1922)

M. speciosa [attrib. to Gillies by] Sweet (1830) (of S American origin, and not a *Mammillaria*)

M. speciosa Vriese (1839) (Craig 340; later homonym of the above)

M. speciosa [attrib. to Boed. in MDKG 2:23(1930) by] Craig (error for *Coryphantha speciosa*)

M. speciosissima Hort. Walton (Craig 345)

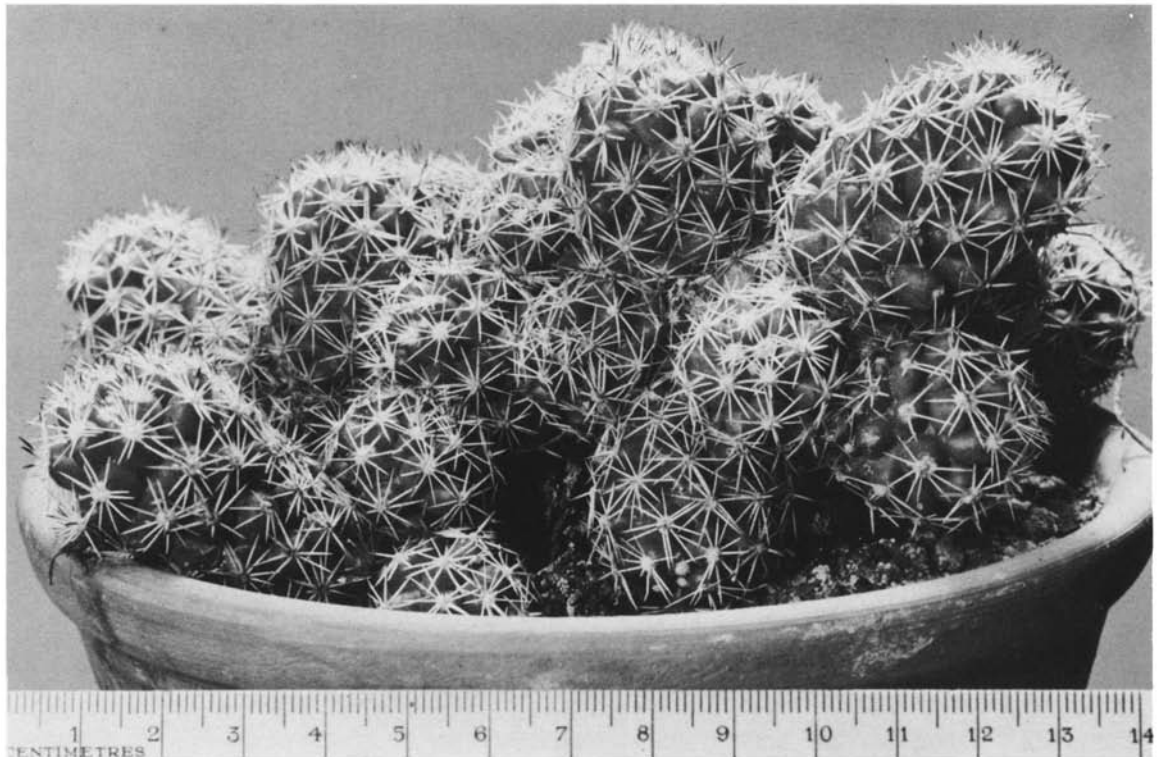
M. spectabilis Muehlenpf. in Allg. Gartenz. 13:346 (1845). Based on cultivated material said to be from Real del Monte, Mexico.

Series HETEROCHLORAE (?). Subglobose, 7.5 × 7.5cm, pale green; ax. woolly at first; tub. short conic, almost 4-angled at base. Spines 6-8, pinkish at first, later white, dark tipped, 4-6 lateral, appressed, one ascending and one descending, the uppermost slightly the longest, 8mm. Flowers pale red.

Though Craig (Mamm. Handb., 136) dismissed the idea, this description seems to fit *M. kewensis* rather accurately, and is earlier by five years.

M. sphacelata Mart. in Nov. Act. Nat. Cur. 16(1):339, t. 25, fig. 1 (1832); Hort. Reg. Monac., 127 (1829), name only. Based on a living plant sent by Karwinsky in the collection at Munich. It died before the description was published and is not known to have been preserved. The plate cited may therefore be taken as the type (Hunt in JMS 14:35, 1974).

Series SPHACELATAE. Clustering and sometimes forming mounds 50cm and more across, the individual stems cylindrical, to 20cm or more; tub. conic, c. 7 × 5-6mm; ax. slightly woolly or naked. Cent. sp. (1-3-4, 4-8mm, straight, ivory or chalky white, tipped or speckled reddish or blackish; rad. sp. (10-11-14(-15), 5-8mm, similar to the centrals. Fl. 15mm, carmine to dark purplish red; stigmas yellowish green. Fr. curved-clavate, scarlet, with persistent perianth; seeds black.



M. sphacelata H.7289, a plant collected in Mexico, Puebla, 5km from Tehuacan, near San Lorenzo, 13 Aug. 1969.

(photo: Zabeau)

The species is common in calcareous areas around Tehuacan, Puebla, where it seems first to have been rediscovered by Haehnel (cf. Quehl in MfK 28:74, with fig. (1918)). The plant figured by Ochoterena, Las Cact. Mex., 142 (1922), was also from the valley of Tehuacan.

Zuccarini (Pl. Nov. Monac., 708. 1837) thought Karwinsky had collected the species, along with others, in Hidalgo, but this was certainly an error, as Ehrenberg pointed out (Linnaea 19:352. 1846). Scheer's report (in Seemann, Bot. Voy. Herald, 286. 1856) of 'a very robust species of *M. sphaelata*' about Guaymas, i.e. in Sonora, was clearly a confusion with *M. inaiæ* or something of that sort.

In the south of its range, towards Zapotitlan de las Salinas and Calipan, *M. sphaelata* intergrades with its close ally *M. viperina*, such that the two names should be regarded as marking the extremes of a single variable species. An example of an intermediate is illustrated in CSJGB 33:64 (1971). Dr Bravo has described a similar intermediate as a variety of *M. sphaelata* or hybrid with *M. viperina* (Cact. Suc. Mex. 11:41. 1966).

M. sphaerica A. Dietr. in Allg. Gartenz. 21:94 (1853). *M. longimamma* var. *sphaerica* (A. Dietr.) K. Brandegee. Source: USA, Texas, near Corpus Christi, near the coast, Poselger. Type not known to have been preserved.

Subgen. DOLICHOTHELE. Clustering and forming low clumps to 50cm wide, individual stems subspherical, 5cm diam.; tub. conic-cylindric, 12-16 × 5-6mm, flabby; ax. slightly woolly. Cent. sp. 1, 3-6mm, yellowish; rad. sp. 12-14, 6-9mm, whitish to pale yellow. Fl. 6-7cm diam., yellow. Fr. 10-15mm, greenish to purplish, with pleasant odour; seeds black.

Benson (in Lundell, Fl. Texas 2(2):274. 1969; Cacti US & Canada, 868, fig. 902. 1982) follows Mrs Brandegee in treating this species as a variety of *M. longimamma*, and (l.c., 1969) records its distribution in Texas in detail, citing 14 herbarium collections. One specimen dating from 1852 survives at Missouri (Texas, Maverick Co., Eagle Pass, Mar. 1852, A. Schott s.n. (MO); cf. Benson, l.c. 965. 1982).

The species also occurs in Mexico, in Tamaulipas, where it was collected by Glass & Foster 15-20 miles south of Ciudad Mier on 25 Feb 1968 (G. & F. 586). I myself found it much further south, at Progreso, north of Victoria, 20 Nov 1973 (H. 8587). Although it is obviously very close to *M. longimamma*, it is disjunct geographically and differs in its smaller tubercles and generally more numerous and glabrous spines.

M. sphaeroidea Salm-Dyck, name only ('*sphaeroides*' Craig 345, Mottram, Mamm. Index, 86). Mentioned under *M. humboldtii*, which is said to differ by having no central spines, but apparently just a typographical error for *M. sphaerotricha*, which was the preceding species listed.

M. sphaerotricha Lem. (*M. candida*: Craig 272)

M. spinaurea Salm-Dyck (Craig 340)

M. spinii [attrib. to Colla by] Salm-Dyck, name only (as synonym of *M. discolor*)

M. spinifuscus Allnut, name only (Craig 345)

M. spinosa G. Don ex Loudon (of S American origin, and not a *Mammillaria*)

M. spinosior Hort. (Schumann, Gesamt. Kakt., 582. 1898)

M. spinosissima Lem., Cact. Aliq. Nov., 4 (1838). Based on a single living plant in the Monville collection.

Series POLYACANTHAE. Columnar, 30 × 6.5cm; tub. ovate-conic, 4-6 × 4mm; ax. slightly woolly. Cent. sp. 12-15, 10-12mm, dark pink, stronger than the radials and somewhat subulate at the base, straight; rad. sp. 20-25, 4-6mm, setaceous, white.

The above is the essence of the original description. Salm-Dyck, Labouret and later authors have all assumed that Lemaire's plant was the same species as a string of forms named by Ehrenberg in 1848-49, although as known today it usually has fewer central spines. No material survives from Lemaire's time, and the earliest geographical reports available (Schumann, Gesamt. Kakt., 534. 1898) are not strictly relevant, since they relate to a) a yellow-spined plant collected long after Lemaire's

time by Mathsson (see under *M. auricoma*) and cited by Schumann (l.c. 538); and b) a plant sent from Real del Monte by Ehrenberg (probably *M. polycentra* Berg). The latter report must certainly be discounted if the modern application of the name is to stand, since neither *M. spinosissima* nor the ser. *Polyacanthae*, of which it is the type species, occur in Hidalgo.

Five plants of *M. spinosissima* as now understood were examined at the Mammillaria Society's meeting on 24 Sep 1964 and found to have a maximum of 8 centrals and 18 radials (JMS 5:5. 1965). The late Mr F. G. Buchenau, quoted by Maddams (JMS 7:65. 1967), claimed to have seen plants matching that described by Lemaire but concluded that few wild plants have anything like as many centrals. Plants seen by Buchenau in Morelos had only 8-9 centrals, with 24-26 radials, according to notes I made at one of his lectures in England.

So *M. spinosissima* is one of those names that have survived by convention rather than factual documentation. The first field-record relevant to the name as now applied appears to be Britton & Rose's from the mountains between Mexico City and Cuernavaca (Britton & Rose, The Cact. 4:118, pl. 12 fig. 2 and figs. 124, 125. 1923). These were described as having brownish to red spines (centrals 7-8, 2cm or more; radials c. 20, to 1cm) and purplish flowers 12mm. The locality for the one depicted in colour (pl. 12, fig. 2) was El Parque, a well-known stopping-off point for botanists on the railway from Mexico City where Rose collected in 1906 (Rose 25594 in US 691384). Another (fig. 125), apparently with paler spines, was collected 'in the mountains' by W. Brockway (El Parque, Brockway 221 in US 2971071).

Not cited or illustrated by Britton & Rose, and of indeterminate spine-colour, is an earlier collection by Pringle from the Sierra de Tepoxtlán, 7500ft., 8 Feb 1899, Pringle 7859 (US 342874). The Sierra de Tepoxtlán is close to El Parque, so all these plants might be regarded as representing a single population. From it, also, would be a yellow-spined plant I collected in 1971 (Hunt 8105, K). Mottram (Mamm. Index, 88. 1980) cites this specimen as *M. spinosissima* var. *flavida* Salm-Dyck.

Craig's concept of the species took in collections made by Lindsay and by himself and Mrs Craig at Taxco, Guerrero, and by Lindsay on the railway between Tehuacan and Oaxaca. Those from Taxco were probably *M. nunezii*. Nothing closely allied to *M. spinosissima* is known between Tehuacan and Oaxaca, unless perhaps *M. duoformis*.

Glass & Foster (in CSJA 43:200, fig. 138. 1971) report *M. spinosissima* var. *sanguinea* (Haage f.) on the cliffs near Pilcaya, Guerrero, growing and intergrading with *M. pilcayensis*. From their fieldnotes, this record applies to G. & F. 1870 & 1869 respectively. They also report *M. spinosissima* in the Barranca de Mal Paso, state of Mexico, 7km S of Ixtapan, G. & F. 1863. It also occurs in a barranca W of Ixtapan, on the way to San Alejo, where I noted it on 9 Oct. 1974 with 7-12 centrals varying from deep red to dull brown (H. 8847). The axils had sparse bristles, and seedlings had some hooked centrals. The type locality of *M. centraliplumosa*, q.v., is not very far distant, to the east.

M. spinosissima Hort. (Craig 350, with a reference to *Echinocactus spinosissimus*, a name listed by Forbes, J. Hort. Tour. 152. 1837). Britton & Rose, The Cact. 4: 118 (1923) devoted a paragraph to their hunch that Forbes's *Echinocactus spinosissimus*, a plant given to him when in Europe in 1835, could have been *M. spinosissima*, already in cultivation though not described till 1838. According to the Americans, Forbes [the Duke of Bedford's gardener] did not have much knowledge of the cacti, which is a bit unfair, since he concluded his excellent 'Journal' with a comprehensive and well-informed annotated list. Anyway, he almost certainly had enough knowledge to know that his *Echinocactus spinosissimus*, which was '14-15-ribbed' was not a *Mammillaria*! Furthermore, Lemaire clearly states that there was only one plant, so Forbes could not have got it from M. Monville even if he had visited him (which he didn't), or from the Cels nursery, which sold many of the plants Lemaire described. (Forbes did visit Cels, on 9 Oct 1835, but records no gifts or purchases).

M. spiraeiformis A. Colla in Rep. Sci. Fis. Med. Piemonte, no. 279, fasc. 15, xi pp. (Aug. 1840). For this reference, which I have not seen, I am indebted to Dr L. E. Newton. It is not in Index Kewensis or other listings.



M. longiflora f. *stampferi* (Reppenhagen 1358).

(photo: Weightman)

M. spirocentra Dinter ('Denter': Craig 345), Alph. Cat. Pl. La Mortola, 27 (1897), name only.

M. splendens Ehrenb. in Allg. Gartenz. 17:242 (1849). Source: Mexico, without locality. Referred by Britton & Rose and later authors to *M. elegans*, but based on plants with white or yellowish axillary wool and spines (centrals 1-4, radials 22-28), and not positively identifiable to ser. *Supertextae*.

M. squarrosa Meinshs. (*M. compressa*: Craig 18)

M. stampferi Reppenhagen in KuaS 30(8): 187 (1979). Source: Mexico. Durango, near El Salto, 2600m, 16 Feb. 1978, *Reppenhagen* 1358 (ZSS). Also collected by Lau (no. 1250). Referred to *M. longiflora*. Treated by me as *M. longiflora* f. *stampferi* (Reppenhagen) D. Hunt in CSJGB 41: 97 (1981).

M. standleyi (B. & R.) Orcutt, *Cactography*, 8 (1926); *Neom. standleyi* B. & R., *The Cact.* 4: 97, fig. 93 (1923). Source: Mexico, Sonora, Sierra de Alamos, 'common in dry stony places above Alamos', 14 Mar. 1910, *Rose, Standley et al.* 12849 (US 635669, holotype). The collection site is recorded on this sheet as Alamos, W of Magdalena.

Series MAMMILLARIA. 'Plants usually solitary, nearly globular, often 10cm in diameter, pale green densely covered with spines; axils of old tubercles containing white bristles, the flowering and fruiting ones filled with dense white wool; radial spines about 16, slightly spreading, white except the dark tips; central spines 4, longer and stouter than the radials, porrect, reddish brown; flowers rather small, about 12mm long, purplish; inner perianth-segments oblong entire; filaments pale, stigma-lobes green; fruit scarlet, 12 to 16mm long; seeds brownish'.

On a brief reconnaissance to Sonora in September 1986, I was able to see for myself some of the milky-sapped mammillarias of that State, and something of the variability which led Mr & Mrs Maddams to 'envisage a search of the foothills . . . revealing a

range of plants having all possible mixtures of the characteristics of *M. sonorensis*, *M. hertrichiana* and *M. standleyi*'.* This variability is certainly very perplexing, but my initial impressions were that it is not a continuous spectrum, and that more than one different species-group is represented. *M. standleyi*, as seen in the hills (600 m.s.m.) above Minas Nuevas, near Alamos, seemed to me particularly distinctive. Non-flowering plants I saw matched those of Britton & Rose: Simple, or offsetting when large (9 × 12cm); tub. obtuse, 8 × 12mm, pale blue-green; ax. with dense wool and c. 5-7 white bristles; cent. sp. 4-5, 5-9mm, white, tipped brown; rad. sp. 13-19, to 7mm, fine, appressed, white or tipped brown (H.9731). Early in 1987, a plant from this site produced purplish red flowers in cultivation at Huntington Botanical Gardens (Trager, in litt.).

The spine-arrangement and clear differentiation of central and radial spines in *M. standleyi*, *M. canelensis* and linking species, are reminiscent of ser. *Leucocephalae* and set these species apart from *M. sonorensis* and its close allies. The latter also tend to have larger tubercles, fewer and stronger spines, less axillary wool and bristles, and larger flowers.

M. staurotypa C. F. Foerster, name only (*M. semperivi*?): Craig 59)

M. stella-aurata Mart. ex Zucc. (*M. elongata*: Craig 141)

M. stella-aurea Auct. (error for *stella-aurata*: Backeberg 3257)

M. stella-de-tacubaya Heese in *Gartenflora* 53:214, fig. 33 (1904); *M. tacubayensis* Fedde in *Just, Bot. Jahresb.* 33(1):443 (1906), substitute name. Source: Mexico, Coahuila, from a ranch near Tacubaya; no specimen is known to have been preserved, and the illustration cited serves as type.

*JMS 10: 76-78 (1970).



M. stella-de-tacubaya. Reproduction of the original illustration (1904).

Series STYLOTHELAE. Simple, 4-5 × 3-4cm, bright green, covered with white spines; tub. 13:21, cylindric, c. 8 × 3-4mm; ar. elliptic, with white wool; ax. sparsely woolly. Cent. sp. 1, 5-6mm, hooked, black; rad. sp. 35-40, 3-5mm, setaceous, interlacing, white. Fl. c. 15mm, reddish white, the outer segments with dark salmon-pink midstripe; stigmas 6, greenish. Fr. 2cm, red, appearing about 1 year after the flowers.

M. gasseriana Boed., which I regard as conspecific (JMS 10:17, 1970), was from San Pedro, near Torreon, Coahuila. The original locality of *M. stella-de-tacubaya* was given as a ranch near Tacubaya, Mexico, taken by Bravo (Las Cact. de Mexico, 708, 1937) to be a place of that name in the Federal District, but now agreed, I think, to be the one in Coahuila only a few miles from San Pedro, the type locality of *M. gasseriana*.

The affinities of *M. stella-de-tacubaya* are arguable. It does not always develop central spines, and is then capable of confusion with *M. magallanii* (ser. Lasiacanthae), another Coahuilan denizen, though the latter should have more radial spines. In fact Craig, who described *M. magallanii*, regarded it as a possible hybrid of *M. lasiacantha*, also present in the area, but did not suggest the identity of the other parent. *M. stella-de-tacubaya* might be a candidate, if, indeed it is a case of hybridization rather than intergradation. A topic for fieldwork!

The unconventional and non-Latin epithet '*stella-de-tacubaya*' is not debarred by the International Code (Hunt, l.c. 18).

M. stellaris Haw. (*M. prolifera*: Craig 274)

M. stellata [attrib. to Haw. by] Index Kewensis (error for *M. stellaris*)

M. stellata (Willd.) Sweet (*M. prolifera*: Craig 274)

M. stenocephala Scheidw. (*M. polythela*: Craig 47)

M. stenogosa Hort. (Mottram 89)

M. stephani [attrib. to Hort. Vindob. by] Walpers, name only (Craig 345)

M. stipitata Scheidw. (*Coryphantha clavata*: Craig 350)

M. straminea Haw. (*M. flavescens*: Craig 67)

M. strobiliformis Engelm. (c. 2 Apr. 1848) (*Neolloydia conoidea*: Craig 350)

M. strobiliformis Muehlenpf. (15 Jan. 1848) (as '*strobiliformis*') (*Coryphantha sulcata*: Craig 350)

M. strobiliformis Scheer ex Salm-Dyck (1950) (*Escobaria strobiliformis* (Poselger) Boedeker)

M. strobiliana Craig (error for *M. strobilina*)

M. strobilina Tiegel in Moeller's Deutsch. Gaertner Zeit. 48:329, 367, with fig. (1933). A freakish form of *M. collinsii* or *M. karwinskiana* (*M. confusa*). See Fittkau in CSJA 42:182 (1970).

M. stueberi C. F. Foerster, Hand. Cact., 517 (1846). Based on a plant raised in Germany and inadequately described. A dubious species thought by Craig to be akin to *M. amoena*.

M. suaveolens Ruempler; name attributed to Poselger by Hort. Rebut (Craig 340; indeterminate)

M. subangularis DC. (*M. compressa*: Craig 18)

M. subcirrhifera C. F. Foerster, name only (*M. compressa*?: Craig 20)

M. subcrocea DC (*M. elongata*: Craig 141)

M. subcurvata A. Dietr. ex Walpers (*M. magnimamma*: Craig 33)

M. subducta Reppenhagen, Feldnummernverzeichnis, 72 (1985), name only (error for *M. laui* f. *subducta*?)

M. subdurispina Backeb. in BFS 1:5 (1949); Die Cact. 5:3438, fig. 3179 (1961). Source: Mexico, 'Queretaro-Guanajuato'.

Series HETEROCHLORAE. Not distinguishable from *M. durispina* and *M. kewensis*, i.e., a form of *M. polythela*. See also Maddams, Interesting Newer Mammillarias, 39 (1973).

M. subechinata Salm-Dyck (*M. echinaria*: Craig 253)

M. suberecta [attrib. to Pfeiffer by] C. F. Foerster, name only (Craig 345)

M. subindurata Krainz, Kat. Staedt. Sukk. Samm. Zuerich, 82 (1967), name only

M. subpolyedra Salm-Dyck, Cat. Hort. Dyck. 1834: 155, 343 (1834). (Uncertain, but possibly synonymous with *M. polyedra*: Craig 23)

M. subpolygona Hort. Haage (as synonym of *M. polygona*: Craig 50)

M. subtetragona A. Dietr. (*M. carnea*: Craig 44)

M. subtilis Backeb. in CSJGB 12:81, with fig. (p.84) (1950). Source: Mexico, San Luis Potosi, about 80km ('metres') N of the [state] capital, in crevices, in half-shade, in good leafy alluvial soil, Schwarz 70. No material preserved.

Series PROLIFERAE. Simple [but 3-headed in the illustration], dwarfish; tub. conic, c. 3mm; ax. with curled bristles. Cent. sp. c. 6-7, c. 10-12mm, nearly bristly, white, yellowish at base, 1 or 2 at the top brownish or reddish; rad. sp. c. 30, hairlike, curled. Fl. funnelform, 10mm, white. Fr. not described.

Very close to, if not a variant of, *M. sanluisensis*, which was described the previous year from material also supplied by Schwarz from northern San Luis Potosi. Both are probably conspecific with *M. pilispina*.

M. subulata Muehlenpf. in Allg. Gartenz. 13:347 (1845) (*Opuntia subulata*)

M. subulifera Ehrenb. in Allg. Gartenz. 17:242 (1849). Source: Mexico, Hidalgo, Santorum ('San Toro'); based on a plant received by Ehrenberg, not extant.

M. sulcata Engelm. (basionym for *Coryphantha sulcata*)

M. sulcimamma Pfeiffer ex Salm-Dyck (*Coryphantha octacantha*: Craig 350)

M. sulco[-]glandulifera Jacobi (*Coryphantha* sp.)

M. sulcolanata Lem. (basonym for *Coryphantha sulcolanata*)

M. sulphurea [attrib. to Sencke by] C. F. Foerster (as synonym of *M. fuscata*)

M. superfina Hort. (perhaps the same as *M. microthele* var. *superfina* Schwarz Cat.: Mottram, 91; the name *M. perbella* 'Superfina' is also in circulation for a form of *M. microthele*)

M. supertexta Mart. ex Pfeiffer, Enum. Cact., 25 (1837); Zuccarini, Pl. Nov. Monac., 706 (1837); Martius, Hort. Reg. Monac., 128 (1828), name only. Source: Mexico, collected by Karwinsky, at San Jose del Oro, Hidalgo, according to Zuccarini, but almost certainly in N Oaxaca or adjacent Puebla. Lectotype: a drawing, catal. no. 116, in the Munich Herbarium; cf. Hunt in CSJGB 39: 98 (1977).

Series SUPERTEXTAE. Simple, subglobose or oblong, the specimen in Hort. Monac. 12.5 × 9.5cm; tub. small, crowded, conic, green; ar. almost naked; ax. lanate, so that the tips of tubercles hardly protrude. Cent. sp. 2, 3mm, white, sometimes tipped black; rad. sp. 16-18, 5mm, white (Pfeiffer, l.c.).

The plant had not flowered, which may explain why Martius did not publish the species with *M. crucigera* and other Karwinsky discoveries in 1832. The description and illustration leave no doubt in my mind that the plant was the same species as Britton & Rose's *M. lanata*, although the latter apparently had no central spines. Dr Lau has collected a variety of plants of this affinity, with and without centrals, in N Oaxaca, some of which were discussed in CSJGB 41:61-66 (1981).

M. surculosa Boed. in MDKG 3:78 (1931). Source: Mexico, Tamaulipas, Miquihuana; discovered by Viereck in 1928 and sent to Boedeker by H. Baum of Rostock, but the type not preserved.

Subg. DOLICHOTHELE. Simple or clustering from stout taproots; tub. to 8 × 4mm; ax. naked. Cent. sp. 1, to 20mm, amber-yellow, somewhat browner near the tip; rad. sp. c. 15, 8-10mm, white. Fl. funnelshaped, 18mm in diameter, sulphur yellow; style and stigmas greenish yellow. Fr. oblong-clavate, to 17mm, greenish brown, the withered perianth persistent; seeds pale brown, curved-pyriform, finely pitted.

Reported by Glass & Foster from San Luis Potosi, between Huizache and Tula, near Presa de Guadalupe, forming mats on a hillside, 28 Feb 1968, G. & F. 653.

One of the most distinctive of Mammillarias, with its characteristic mat-forming habit. The fruit was described by D. G. Houghton (JMS 1(4):12. 1961).

M. swinglei (B. & R.). Boed., Mamm. Vergl. Schl., 33 (1933); Neom. *swinglei* B. & R., The Cact. 4:158 (1923). Source: Mexico, Sonora, vicinity of Guaymas, island in harbour, 10 Mar. 1910, Rose et al. 12568 (US 635832, holotype!); Guaymas, on scorial-covered island in bay, everywhere very common, 14 Apr. 1921, I. M. Johnston 3086 (CAS 81375, US); also collected in 1920 by W. S. W. Kew. Fruit and seeds described from a plant collected by Swingle.

Series ANCISTRACANTHAE. 'Stems cylindrical, 1 to 2dm long, 3-5cm in diameter; axils of tubercles more or less setose; radial spines rather stout for this group, spreading dull white with dark tips; central spines 4, ascending, dark brown or black, the lowest one elongated (1 to 1.5cm long), hooked at apex or sometimes straight; outer perianth-segments greenish or sometimes pinkish; margins somewhat scarious; inner perianth-segments narrowly oblong, nearly white with a brown stripe down center; style pink, twice as long as the pink filaments; stigma-lobes 8, linear, pointed, green; fruit dark red, clavate, 14 to 18mm long; seeds 1mm in diameter, constricted below, black, with a large elliptical basal hilum'.

'Growing with this species (see Rose, No. 12569) were plants with the central spines straight. This may be the plant from Guaymas which Scheer called "a very robust species of *Mammillaria sphaerica*" (B. & R., l.c., 'sphaerica' being a misprint for *sphaerolata*). This straight-spined phase was later described by Craig as *M. inaiae*.

The type specimen of *M. swinglei* consists of the upper portion of a plant and five transverse slices (4cm in diameter), plus frag-

ments in an envelope and a dissected flower. My notes read: tub. 7 × 7mm; ax. with bristles 4-5mm. Cent. sp. 3, 1 hooked, c.17mm, the hook 1.5-2.5mm across, not thickened, 2 straight, 10-12mm; rad. sp. c. 15-16, 5-8mm, bunched laterally. Fl. 18mm, stigmas 4mm, slender.

This species remains something of a mystery to me, and I found nothing with axillary bristles when I visited the Guaymas area (but not the island in the bay) in September 1986. I am now inclined to discount the idea that (in view of the bristles) it could be a stray member of the *M. dioica* group (CSJGB 39:40. 1977), but uncertain if it is simply to be equated with *M. sheldonii* or really something else. The prospect of a boat-trip to Rose's island is a pleasant one, but will have to wait till next time! Britton & Rose evidently thought it was the common species round Guaymas, and Craig's notes and picture for *M. swinglei* (9 of 14 plants examined were bristle-less, and flowers varying from white to pink) leave one wondering how he could separate it from *M. sheldonii*, also said to occur near Guaymas.

On my recent trip, the most distinctive-looking plants of this group were seen at localities near Guasimas, south of Guaymas, growing with *M. bocensis* (at Guaymas they are associated with *M. johnstonii*). With only 7-11 radial spines, the green tubercles of these plants were much more visible, and I did not see any axillary bristles. The plants also tended to be taller (to 25cm). A few were in bud (September), and the largest bud, cut open, revealed purplish pink inner segments and pale green stigmas.

M. tacubayensis Fedde in Just, Bot. Jahresber. 33(1):443 (1906). Illegitimate substitute name for *M. stella-de-tacubaya*.

M. tamayonis Killip ex Schnee in Bol. Acad. Cienc. Fis. Mat. y Nat. Venez. 12 (no. 38): 62 (1949). I have not seen this publication, but believe the species to be referable to *M. columbiana*, or at least the Venezuelan form of that species, *M. hennisii*, on the evidence of two specimens so identified: Venezuela, Edo. Falcon, cardonales, espinares y bosque seco, 37km al S de Coro, alt. 850m; on limestone boulders of slopes in chaparral and deciduous forest, radials greyish white, younger centrals yellow brown, 25 Jan. 1966, Steyermark & Braun 94719 (UC); Lara (Humocaro), without further details, cult. UCBG 50.1203-52 (living plant).

M. tarajensis Hort. Schmolli (*M. hahniana* var. *giseliana*: Craig 111)

M. taylori Hort. A name applied to an undescribed form of *M. beneckeii* from Sinaloa, first collected by Bob Taylor of El Cajon, California. Mottram (Mamm. Index, 92. 1980) attributes *M. taylori* to 'Miquel', but this reference applies to *M. tecta* and *vice versa*.

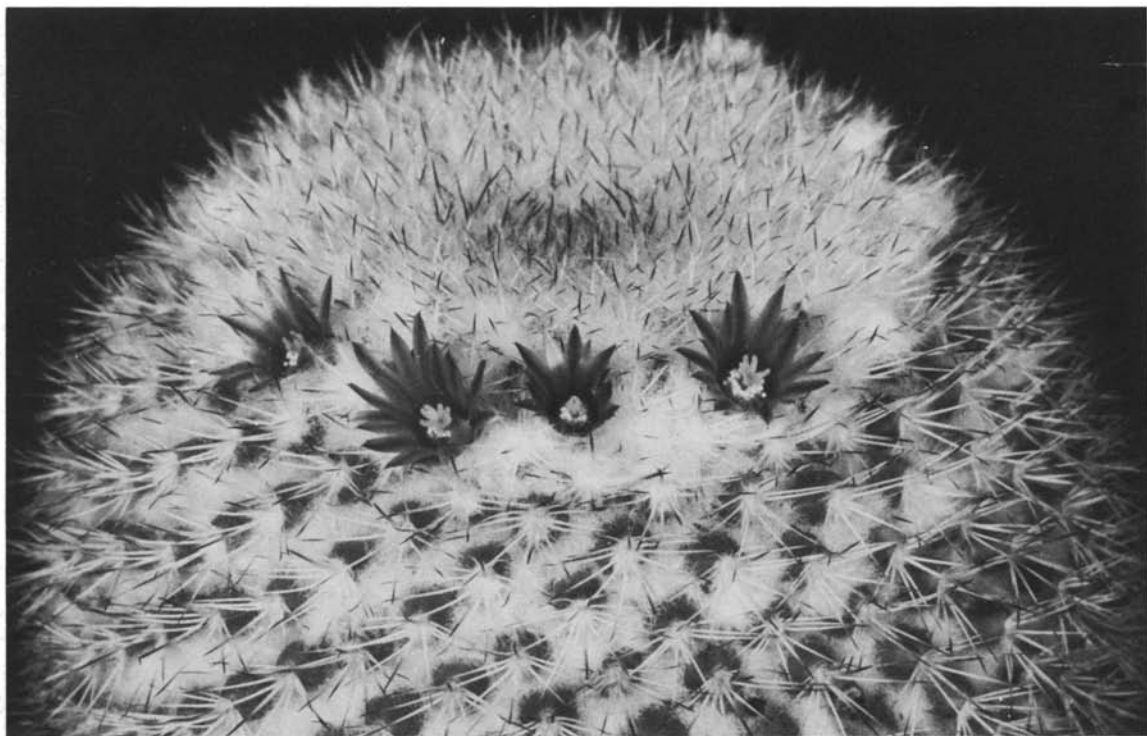
M. tayloriorum Glass & Foster in CSJA 47: 173-176, figs. 1, 2, 4 (caption transposed with fig. 3) (1975). Source: Mexico, Sonora, Isla San Pedro Nolasco, Nov. 1970, G. & F. 2686 (POM, holotype). Named for Bob & Suzanne Taylor of El Cajon, California.

Series MAMMILLARIA. Simple and later clustering, globose, to cylindrical, to 25 × 10-11cm; tub. 13:21, pyramidal, c. 5 × 7mm, pale green; ax. copiously woolly in flowering zone, later with sparse wool and an occasional bristle. Cent. sp. 2-3(-5), similar to the radials; rad. sp. 12, c. 9mm, orange-brown at first, later white with brownish tip. Fl. urceolate, 15mm; outer segments dark cerise with fringed white margins; inner segments entire, with cerise midstripe and white margins; style 10mm, stigmas greenish. Fr. clavate, 9-14 × 6-10mm, red; seeds c. 0.9 × 0.6mm, yellowish brown.

Isla San Pedro Nolasco lies off the coast of Sonora about 30 miles from Guaymas. As with many of the island mammillarias of the Gulf of California, *M. tayloriorum* is woollier than its mainland allies, in this case *M. johnstonii*, which also differs in flower-colour. If anything, *M. tayloriorum* more closely resembles *M. miegiana* and other Sonoran members of series Mammillaria.

M. tecta Miquel in Linnaea 12:12 (1838) (indeterminate member of ser. Supertextae)

M. tegelbergiana Gates ex Lindsay in CSJA 38:196, with figs. (1966); Gates in CSJA 29: 64 (1957), name only; Succ. Jap. 12: 12, with fig. (1959); Backeberg, Die Cact. 5: 3490 (1961), German



M. tayloriorum

(photo: Weightman)

descr. Source: Mexico, Chiapas, highway 190, 16km W of Ocozacoautla, in open areas along the road and in crevices of the limestone rock, 18 May 1953, *Gates & Tegelberg* 113, grown on until 1966 (CAS, holotype; SD, UC, US, MEXU 74917, isotypes).

Series SUPERTEXTAE. Depressed-globose to subcylindric, to 7 × 6cm; tub. conic, 7 × 4mm, light olive green; ax. with white wool at first, no bristles. Cent. sp. 4(-6), 3-7mm, white to straw with dark brown tips; rad. sp. 18-24, 2-4mm, white. Fl. in a circle near top of plant, 13 × 5mm, purplish pink; stigmas 3, small, yellow. Fr. clavate 20 × 4.5mm, red with orange base; seeds golden brown, 1mm.

Members of the *M. supertexta* group are frequent on limestone outcrops in Oaxaca and Chiapas. In Oaxaca, they look only a little different from those of Guerrero and Puebla, but across the isthmus they begin to look a little different, in that the spination tends to be more yellowish or brownish, and the fruits can be more orange-red than purple-red. *M. tegelbergiana* is one of these Chiapas forms, but more easily justifiable as an intergrade between *M. albilanata* and *M. columbiana* than as a separate species.

Further collections: Chiapas, road to El Suspiro, on limestone rocks, Apr. 1964, *Bravo* s.n. (MEXU 61053; also seen by me at this locality, 4 Aug. 1969); highway 190 near Ocozacoautla, km 1030, 25 Mar. 1967, *Bravo* s.n. (MEXU 98508); S of San Felipe, 3km before San Cristobal de las Casas, Sierra Ecatepec, 6 Feb. 1969, *Dodson* s.n. (MEXU 118877).

M. tellii [attrib. to Ehrenb. by] Walton, name only (Craig 345)

M. tenampensis (B. & R.) A. Berger, *Kakteen*, 325 (1929); *Neom. tenampensis* B. & R., *The Cact.* 4:101, fig. 102 (1923). Source: Mexico, Veracruz, Barranca de Tenampa, 1909, C. A. Purpus, flowered at Washington, 1910. The illustration is said to be of the 'type specimen', but this specimen, if preserved, is not amongst the *Mammillaria* types I have examined at Washington.

Series POLYEDRAE. Referred to *M. sartorii*, q.v.

M. tentaculata Otto ex Pfeiffer (*M. fuscata*: Craig 279) *M. tenuis* DC. (*M. elongata* var. *tenuis* (DC.) Schumann: Craig 142)

M. tesopacensis Craig, *Mamm. Handb.*, 104, fig. 86 (1945). Source: Mexico, Sonora, Tesopaco, H. S. Gentry s.n. (var. *tesopacensis*); Movas, c. 15 miles N of Tesopaco, H. S. Gentry s.n. (var. *rubriflora* ('*rubraflora*')); types not stated to have been preserved.

Series MAMMILLARIA. Simple, globose to cylindric, to 18 × 13cm; tub. 13:21, pyramidal-conic, faintly angled below, terete at apex, 10-12 × 7-8mm, bluish green; ax. naked or with scant wool in the flowering area. Cent. sp. 1(-2), 10-12mm, reddish brown at first, black-tipped, later ashy brown; rad. sp. 10-15, 4-7mm, slender acicular, same colour as centrals. Fl. 20 × 20mm; inner segments cream with pink midstripe, sometimes ciliate (var. *tesopacensis*) or deep purple-pink, entire (var. *rubriflora*); stigmas 5, 3mm, light green (var. *tesopacensis*) or 7, bright yellowish green (var. *rubriflora*). Fr. short-clavate, 18 × 10mm, scarlet; seeds 1 × 0.6mm, light brown.

Besides var. *rubriflora*, Craig also listed variants collected by Gentry at Botania (tub. angled, 12mm; cent. sp. 1; rad. sp. 7-12), Movas (a: tub. obscurely 4-sided, 12mm; cent. sp. 1; rad. sp. 11; b: tub. obscurely 4-sided, 8mm; cent. sp. 1; rad. sp. 9) and Rio del Media (tub. terete, 12mm; cent. sp. 1; rad. sp. 11-12). The plants from Movas were presumably not the same as *M. movensis* Craig, l.c. 312, fig. 285, which had 1-4 centrals and axillary bristles, but the author does not comment.

When one looks at Craig's illustration of *M. tesopacensis*, it is hard to credit that the radial spines were only '4-7mm long', and only 9-10 seem to be visible, though '10-15' were called for. Also, some of the tubercles are visibly angled to the tip. On 28 September 1986, about 13 miles N of Tesopaco (i.e. 2 miles from the type locality of var. *rubriflora*), I made the following notes on a longer-spined population referable to *M. tesopacensis* (H.9727): Simple, to 10(-20) × 11(-14)cm; tub. pyramidal-conic, obscurely angled, to 18 × 15mm, glaucous grey-green (green in shaded plants); ax. with sparse wool or naked. Cent. sp. 1, 13-35mm, robust, brown; rad. sp. 9-12, lowest longest, to 2cm, tipped brown. The plants were not in flower. Seedlings (to c. 6cm diam.) in the population were very variable in spination with 9-11 radials, varying in thickness and degree of spreading, and white,

yellowish or dark brown. Also in this locality grew *M. oliviae* vel. aff. and *Echinocereus stoloniferus* (det. N. P. Taylor, from a photograph).

Apart from the longer spines, *H. 9727* seems identifiable as *M. tesopacensis*. But can *M. tesopacensis* be separated from *M. sonorensis*? As a key character, Craig used the angling of the tubercles (not flower-colour, as I wrongly stated in *JMS* 14:62, 1974), which (especially in view of the discrepancy between description and illustration, already noted) is unlikely to be reliable: 'tubercles more or less angled' (in *M. tesopacensis*) compared with 'nearly terete' (in *M. sonorensis*). Angles are certainly visible in the picture of *M. tesopacensis*, right to the tips of some of the tubercles. But the description says 'tubercles . . . very faintly angled below, terete at apex!' And what about Gentry's plant from Rio del Media ('tubercles terete')?

If nothing else is clear, one can at least assert that *Lau 1073*, which was at one time listed as *M. tesopacensis* var. *papasquiarensis* (Lau, Field Numbers of Dr Alfred B. Lau (1983)), has nothing to do with this group. It may be *M. zeyeriana*. The label of a living plant in the Jardín Botánico, UNAM, Mexico, quoted 'Bravo' as the authority for the epithet 'papasquiarensis' and Dr Lau (pers. comm.) believes Dra Bravo has published it (cf. also Stanley in *JMS* 24: 73, 1984), but I have been unable to find the reference.

M. tetracantha [attrib. to Salm-Dyck by] Pfeiffer, Enum. Cact. 18 (1837). Referred to *M. polythele*. Craig (Mamm. Handb. 227, fig. 207, 1945) illustrates as *M. tetracantha* the form described by Scheidweiler as *M. obconella* var. *galeottii*.

M. tetracantha hort. (*M. magnimamma*: Schumann, Gesamt. Kakt. 582, 1898).

M. tetracantha [attrib. to Otto by] C. F. Foerster, Handb. Cact. 214 (1846). Referred with a ? to *M. magnimamma* by Britton & Rose, The Cact. 4:77 (1923); to *M. tetracantha* by Craig, Mamm. Handb. 227 (1945); and treated as a species under *M. sempervivi* by Backeberg, Die Cact. 5: 3161, fig. 2944 (1961).

M. tetracantha Engelm. in Amer. J. Sci., ser. 2, 14:337 (1852); *M. phellosperma* Engelm., Syn. Cact. U.S. 6 (1856), and in Proc. Amer. Acad. 3:262 (1857), illegitimate substitute name. Source: USA, California, San Felipe, 1850, Parry s.n. The type has not been located at MO or ISC, and so the following neotype has been proposed: USA, California, Riverside Co., 0.5 mile above mouth of Whitewater Canyon, at edge of Colorado Desert, 1900m, gravelly soil, Benson 15716 (POM 288535; cf. Benson, Cacti of Arizona, ed. 3, 163, 1969).

Series ANCISTRACANTHAE. Simple or clustering, from tuberous roots, the stems cylindrical or ovoid-cylindrical, to 25 × 3.5-7.5 cm; tub. cylindrical, 8-14 × c. 6mm; ax. with bristles. Cent. sp. 3-4, the upper 2-3 to 14mm, straight or one or more hooked, the lowermost hooked, 18-25mm, stouter; rad. sp. 30-46(-60) in two series, the outer setaceous, c. 6-10mm, white, the inner stouter, longer and dark tipped or purplish. Fl. c. 2.5 × 2.5-3.5cm; perianth-segments lavender, edged white; stigmas creamy white. Fr. cylindrical to clavate, 15-30 × 5-10mm, red, dried perianth not persistent; seeds dome-shaped, 1.5 × 1.2mm, black, pitted and rugose, with large corky appendage 1.5mm.



M. theresae

(photo: Taylor)

A distribution map is given by Benson, *Cacti of the United States and Canada*, 909 (1982). The range of the species extends from California and Arizona into Nevada (Charleston Mts) and Utah (near St George), and it is also reported from Baja California and Sonora (Craig, *Mamm. Handb.*, 197: 1945).

M. tetrandra extends further north than any other *Mammillaria*. For a note on its variation, see Bleck in *JMS* 9:4 (1969). Like *M. schumannii*, it is aberrant from the general run of the hooked-spine species and was made the type of a separate genus (*Phellosperma*) by Britton & Rose. Moran (in *Gentes Herb.* 8: 324. 1953) took a middle course, treating it as a section.

Engelmann changed the epithet 'tetrandra' when he found that the species rarely has as many as 4 hooked centrals, but such changes were outlawed by the laws of nomenclature as long ago as 1867 (Benson, l.c. 969. 1982).

M. texana [attrib. to Poselger by] Young, *Fl. Texas*, 279 (1873) (*M. prolifera* var. *texana* (Engelm.) Borg)

M. texensis hort. (*Neolloydia texensis* B. & R.: Craig 350)

M. texensis Lab. (*M. heyderi* var. *heyderi*: Benson, *Cacti of the United States & Canada*, 966. 1982; not *Neolloydia texensis* B. & R.)

M. thelocamptos Lehm. (*Coryphantha octacantha?*: Craig 350)

M. theresae Cutak in *CSJA* 39:239 (1967). Source: Mexico, Durango, E slope of Coneto Mts, 0.5 mile below Coneto pass, 27 May 1967, E. & B. Gay 2411 (MO, holotype; MEXU, POM, UC, OKL, isotypes). Discovered by John & Theresa Bock in 1966.

Series LONGIFLORAE. Simple or sparingly clustering, subglobose to cylindrical, to c. 4cm × 10-25mm, from stout taproots; tub. cylindrical, 4-6 × 2-3mm, olive green, sometimes tinged purple; ax. sparsely woolly. Cent. sp. 0; rad. sp. 22-30, 2mm, plumose, translucent white. Flowers funnelshaped, 3.5-4.5 × c. 3cm, with a slender tube c. 2cm × 3mm; pericarpel embedded in stem; outer segments greenish brown, inner violet-purple; anthers deep yellow, stigmas pale yellow. Fr. when dry clavate, c. 10mm; seeds black, c. 0.5mm.

Betty and Ed Gay made several collections in scattered colonies, usually in rock outcroppings, between 1.3 and 17.2 miles (as the road winds) from the junction of the Guatimape-Coneto road with the Durango-Santiago Papasquiaro highway at Guatimape. The elevation is between 7000-7500 feet above sea level (Cutak, l.c.).

The most distinctive of the several dwarf members of series Longiflorae from the Sierra Madre Occidental, and known only from the type locality.

M. thornberi Orcutt in *West Amer. Sci.* 12:162 (1902). Source: USA, Arizona, [Casa Grande,] *Orcutt* 2583. No specimen so numbered is known, and the only preserved material so identified by Orcutt consists of 3 of the distinctive spine-clusters, without locality or collection date, received at Kew on 24 Aug. 1903. For the locality Casa Grande, Benson (*Cacti of the US & Canada*, 967. 1982) quotes a letter from Orcutt to Rose dated 3 Apr. 1922 which survives at the US National Herbarium. Benson has proposed the following neotype: Arizona, Pima Co., 15 miles W of the Silver Bell Mountains [i.e. about 25 miles S of Casa Grande], 1800ft, 2 Feb. 1941, *Benson* 10606 (POM 273934, ARIZ).

Series ANCISTRACANTHAE. Clustering by suckers and lightly attached offsets, stems slender-cylindrical, usually 5-10 × 1.5-2.5cm, tapered at base; tub. 5-9 × 5-9mm; ax. naked. Cent. sp. 1, 9-18mm, hooked, pale to dark reddish brown; rad. sp. 15-20, 5-9mm, white or yellowish, tipped reddish brown. Fl. 15-30 × 15-20mm, purplish pink, with red stigmas 3-5mm long. Fr. 9-15 × 4.5-7.5mm, red; seeds 1mm, black.

Long thought to be the same as *M. fasciculata* Engelm., but this provisional name was based on material from the (middle) Gila River, where *M. thornberi* does not occur. The name *M. fasciculata* is now referred to *Echinocereus fendleri* (Benson, l.c.; Taylor, *The genus Echinocereus*, 51-53. 1985).

The slender stems of *M. thornberi* form 'obscure masses under bushes in remote parts of the desert' (Benson, l.c. 891) and this is also the habit of *M. yaquensis*, which should probably be regarded as conspecific, in Sonora, though 'remote' may not be

quite the word when there is a paved road within a few yards! In September 1986 I saw *M. thornberi* in Arizona near Freeway 19, 15 miles S of Tucson, and *M. yaquensis* in Sonora near highway 15, c. 29 miles S of Guaymas.

M. tiegeliana Backeb., *Die Cact.* 5:3402, fig. 3141 (1961), invalid name (type not designated); *CSJA* 7:21 (1935), named illustration by Schmoll only; Neale, *Cacti and other succulents*, 94 (1935), very brief English descr.; attrib. to Schmoll by Craig, *Mamm. Handb.*, 305 (1945), as synonym of *M. cadereyensis*. Based on cultivated plants of unknown provenance. Mottram, *Mamm. Index*, designated Backeberg's fig. 3141 as the type (lectotype), but did not validate the name, since he called it a synonym of *M. cadereyensis*, and did not specify which of the two rather different plants illustrated should be the type. Both were evidently ser. *Leucocephalae*, but do not match *M. cadereyensis* and are not determinable from the incomplete description.

M. timotensis hort. A plant at the Botanischer Garten Berlin, seen in 1985, resembled *M. columbiana*.

M. toald(oe) [attrib. to Lehmann by] Miquel in *Linnaea* 12:13, with t. 2, fig. 10 (1838); [attrib. to Lehm. by] Pfeiffer, *Enum. Cact.*, 27 (1837), name only, as synonym of *M. geminisipina*.

M. tobuschii W. T. Marshall in *Saguaroland Bull.* [Aug.-Sep. 1952]:78-81 (1952). (Basionym for *Ancistrocactus tobuschii*)

M. tolimanensis Schmoll. *Cat.* 1947 (*M. tolimensis*: Backeb. 3422, 3492)

M. tolimensis Craig, *Mamm. Handb.*, 318, figs. 291, 292 (1945). Source: Mexico, Queretaro, Toliman; based on living material sent by Schmoll, none apparently preserved.

Series MAMMILLARIA. A local variant of *M. compressa*, with which it grows between Bernal and Toliman, Qro.

M. tomentosa Ehrenb. in *Allg. Gartenz.* 17:262 (1849). No source given; no material extant.

Series POLYACANTHAE (?). Cylindrical, 10-12.5 × 6.5-7.5cm; tub. ovoid-conic, 6 × 6mm, yellow green; ax. with white wool and bristles. Cent. sp. 4-6, 1 hooked, downward-pointing, 12-20mm, yellow with red tip, 3-5 straight, 8-10mm; rad. sp. 20-22, upper 4mm, lower 8mm, dull yellow.

Plants labelled *M. tomentosa*, or its supposed synonym *M. flava* Ehrenb. (l.c. 261), both names long regarded as dubious, are still occasionally encountered in collections. A plant in the collection of Mr Maddams, about 1974, was identifiable as *M. spinosissima*, but was pale-spined with the spines longer and weaker than usual, and the centrals barely distinguishable from the radials.

M. tonalensis D. R. Hunt in *CSJGB* 41: 103 (1979), with fig. Source: Mexico, Oaxaca, Puente de Tonalá, steep limestone rocks lightly covered with bushes and with *M. carnea* and *M. dioxanthocentron* var. (?), 17 Oct. 1974, *Reppenhagen* 522; flowered in cult. in Austria, 14 May 1977 (flowers, K); the same locality, *Lau* 1114 (K, holotype).

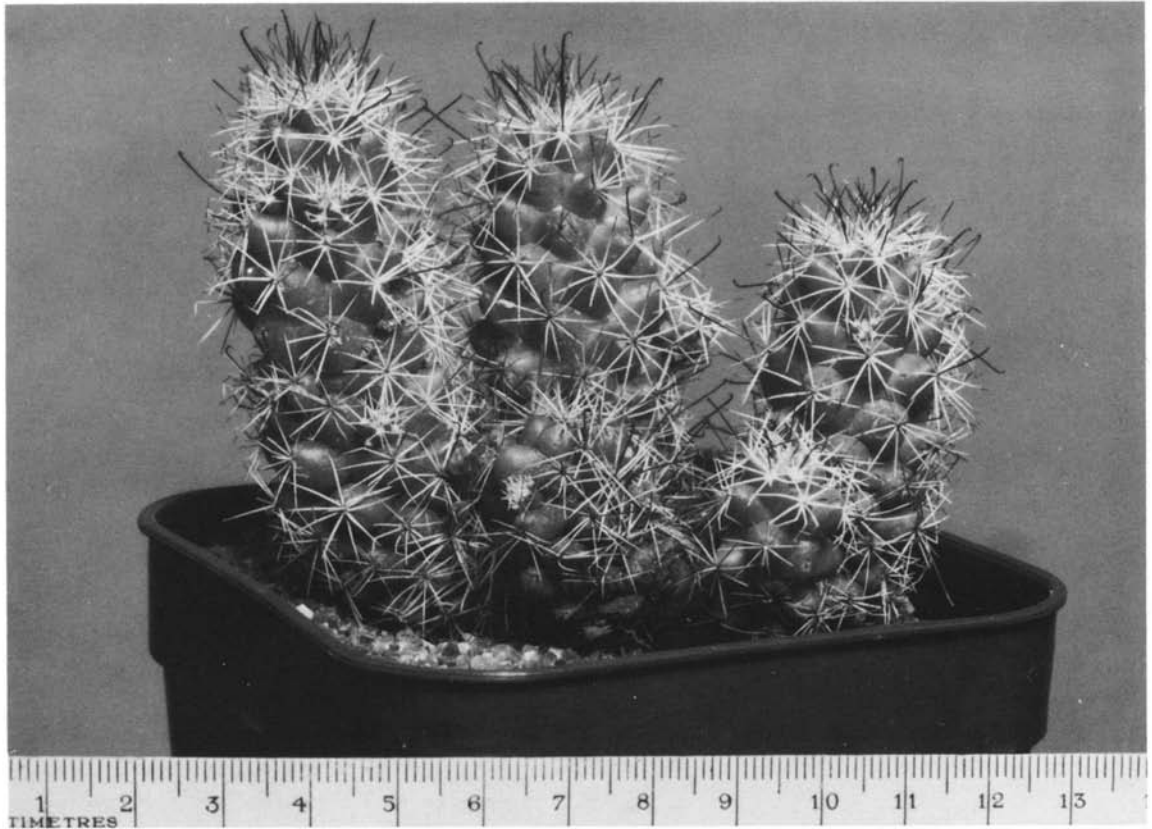
Series SPHACELATAE. Freely clustering and offsetting from fibrous roots, the stems erect or decumbent, slender cylindrical, to 12cm or more × 2-2.5(-3.5)cm diameter; tub. 3:5, shortly and obtusely terete-conic, c. 5(-8) × 8(-12)mm, light green; ax. naked or with slight wool. Cent. sp. 1, to 18 × 0.3mm, hooked (the hook 1.3mm diam.), chestnut-brown at first, becoming almost black; rad. sp. 9-12, to 1cm, acicular, straight, chalky white, the upper tipped chestnut brown. Fl. c. 15 × 10-12mm, outer segments brownish pink, inner carmine with whitish margins, stigmas c. 1mm. Fruit and seed not described.

Known from the type locality only, to the SW of the range of *M. sphacelata*, its most obvious ally, and about 40km from *M. kraehenbuehlii*.

M. tortolensis [attrib. to Hort. Berol. by] Pfeiffer, *Enum. Cact.*, 11 (1837), as synonym of *M. nivosa*.

M. tournefortii Dinter, *Alph. Cat. Pl. La Mortola*, 37 (1897), name only

M. triacantha DC. (*M. compressa*: Craig 18)



M. tonalensis (Lau 1114).

(photo: Zabeau)

M. trichacantha Schumann, Gesamt. Kakt. Nachtr., 133, with fig. (1903). Based on cultivated plants distributed by De Laet.

Series STYLOTHELAE. Simple, globose to shortly columnar; tub. almost 8mm, slightly glaucous green, occasionally red in the axils. Cent. sp. 2, lower hooked, to 12mm, at first reddish, then chestnut brown, upper shorter, finely hairy, white, brown tipped; rad. sp. 15-18, the lowest longest, to 8mm, all finely hairy, glassy, white, yellowish at base. Fl. 12-15 × 15mm, perianth-segments yellowish, margins and underside pale rose. Fr. almost 1cm, pale red; seeds 1mm, black.

This species has been the subject of confusion since the original description, where the Latin says simply 'flowers red' but the German 'yellowish, the segments with pale rose margins and underside'. Assuming the latter (being more detailed) to be more likely to be correct, various writers have suggested that the plant may have been *M. nana*. Against this is the much lower radial spine count, and in view of the completely uncertain origin of *M. trichacantha* it is a name best discarded.

M. tricolor hort. (*M. discolor*: Watling in JMS 1(8):7. 1961)

M. trigoniana Hort. Rebut (Craig 345)

M. trigoniana Dams in MfK 20 (1904) ('similar to *M. rhodantha*')

M. trochartii Vaupel (error for *trohartii*: Backeb. 3411)

M. trohartii Hildm. ex Schumann, Gesamt. Kakt., 586 (1898) (*M. phymatothele*: Craig)

M. tuberculata Engelm. in Emory, Rep. U.S. & Mex. Bound. Survey, Cact., 7 (1859) (error for *tuberculosa*: Engelmann, l.c. 74).

M. tuberculata [attrib. to Hort. by] Craig (*Escobaria tuberculosa*: Craig 350)

M. tuberculosa Engelm. (basonym for *Escobaria tuberculosa*)

M. turbinata Hooker in Curtis's Bot. Mag. t. 3984 (1843) (*Strombocactus disciformis*)

M. turbinata B. Maddams in JMS 20:55 (1980), name only ('like *M. ocamponis*')

M. uberiformis Zucc. ex Pfeiffer, Enum. Cact., 34 (1837); Zuccarini, Pl. Nov. Monac. fasc. 3, 710 (1837). Discussed under *M. longimamma*, q.v.

M. uberimamma [attrib. to Monv. by] Lab. (*M. crocidata*: Craig 37)

M. uhdeana Salm-Dyck, name only (*M. spinosissima*: Craig 269)

M. umbrina Ehrenb. in Allg. Gartenz. 17:287 (1849). Source: Mexico; based on a plant sent to Ehrenberg of unknown source. The original plant, which had hooked spines, was probably referable to ser. Polyacanthae but its exact identity cannot be determined. The plant seen in collections in modern times as '*M. umbrina*' is not correctly named (as Craig, Mamm. Handb., 191 (1945) pointed out), although it is referable to ser. Polyacanthae. It resembles *M. ernestii* and *M. virginis*.

M. uncinata Zucc. ex Pfeiffer, Enum. Cact., 34 (1837); Zuccarini, Pl. Nov. Monac. fasc. 3, 715 (1837). Source: Mexico, Hidalgo, near Pachuca, *Karwinsky*. Raised from seed, according to Zuccarini, but the type not known to have been preserved. Ehrenberg, in Linnaea 19:348 (1846), reported it from the Cerro Ventoso, near Mineral del Monte, at 8500ft, and lower down, 8000ft; in meadows near Pachuca, 7500ft, and near Singuiluca(n).

Series MAMMILLARIA. Simple or clustering, globose to sub-clavate or depressed, individual heads usually 6-10 × 8-10cm;

tub. obtuse-conic, somewhat angled, 8-10 × 8-12mm, dark bluish green; ar. and ax. woolly at first, soon naked. Cent. sp. 1, 7-10mm, hooked, with occasionally a second almost hooked, pinkish grey to dark purplish brown, tipped darker; rad. sp. 3-6, to 5-6mm, rigid, subequal, the upper shorter, pinkish to greyish white, darker-tipped. Fl. c. 1.5-2 × 1.5cm, white with brownish red midstripe (Zuccarini; 'small, pink': Pfeiffer). Fr. clavate 1-2cm × 4-6mm, purplish red.

One of the most readily distinguished and widely distributed species, well-known on the central Mexican plateau and recorded as far north as Chihuahua (Coulter in Contr. US Nat. Herb. 3:99. 1893). It occurs with *M. magnimamma* and other species of ser. Mammillaria but hybrids have not been reported (though I have seen intermediate-looking plants in Hidalgo). Further south, it occurs with *M. mystax* in Puebla (between Esperanza and Tehuacan, SE of Morelos Canada, 2350m, 5 Oct 1974, H. 8818). A flat-topped plant from Mitla, Oaxaca, distributed by Mr Reppenhagen (Reppenhagen 705, old numbering) which he told me had developed hooked spines in cultivation, may also prove to be this species.

Although *M. uncinata* appears to be the only member of the sect. Mammillaria with truly hooked spines, other species can sometimes have one or more centrals almost hooked. I have seen herbarium specimens (labelled *M. uncinata*) from Guanajuato and Zacatecas which looked suspiciously like hooked-spine forms of *M. gigantea* and *M. gummifera*. One of these (*Bravo* s.n. in MEXU 60588), may correspond with *Glass & Foster* 1944 (CSJA 57: 68, fig. 71. 1985), described as 'a very puzzling and variable species with affinities to *M. pettersoni* [sic], *M. gummifera* and even *M. uncinata*! It becomes very large; 1(-2) central spine(s) up to 1.5 inches long, black or white (sometimes yellow or orangey) sometimes incurved over the apex, particularly in young plants'. Conversely, I have voiced a suspicion that *M. uncinata* may not always have hooked spines, and that *M. lloydii* (q.v.) might be a straight-spined counterpart.

M. unguispina Hort. (*Epithelantha micromeris* var. *unguispina*: Backeb. 2915)

M. unicornis [attrib. to Boed., ZfS 205 (1928) by] Craig, Mamm. Handb., 350 (1945) (error for *Coryphantha unicornis* Boed.)

M. unihamata Boed. in Kakteenk. 1937:40, with fig. (1937). Source: Mexico, Nuevo Leon, Ascension, Ritter. Type presumably not preserved.

Series STYLOTHELAE. Simple, or occasionally sprouting at the base, elongate-globose, deep shiny green; tub. 8:13, conic, c. 7 × 3mm; ax. naked. Cent. sp. 1, very rarely 2, 10-12mm, porrect, hooked, smooth, rusty brown; rad. sp. 16-20, c. 6mm, smooth, thinly acicular, glassy white, faintly yellowish at base. Fl. and fr. not described by Boedeker; seed globose, black.

Placed next to *M. carrettii* by Boedeker and put into synonymy with it by Craig. This is certainly wrong, as pointed out by Buxbaum (in Sukkulentenkunde 5:19. 1954) on the basis of seed characters. From the description and illustration, it seems more likely that *M. unihamata* is allied to, if not the same as, *M. weingartiana*, which was also collected by Ritter near Ascension and was described by Boedeker in 1932. This has been disputed by S. C. Woolcock and by W. F. Maddams (in JMS 26:53. 1986), on the basis that the spination and habit of plants in cultivation as *M. unihamata* do not tally with the description of *M. weingartiana*, q.v.

M. uniseta Quehl (insufficiently known: Craig 341)

M. urbaniana Vaupel (*Escobaria cubensis*)

M. utahensis Hildm. Cat. (synonym of *M. radiosa*: Schumann, Gesamt. Kakt. 481. 1898)

M. vagaspina Craig, Mamm. Handb., 62, fig. 44 (1945). Source: Mexico, Queretaro [Guanajuato?], Tierra Blanca, Schmoll. Type presumably not preserved.

Series MAMMILLARIA. Simple (or clustering), to 8.5cm in diameter; tub. pyramidal, more or less angled and keeled, 13 × 8-11mm, dull dark greyish green; ax. with white wool. Cent. sp. 2, very irregular, 6-60mm, divergent, lower longer, very tortuous, somewhat angled, chalky brown; rad. sp. 2-5, the upper 2 usually

deciduous, 1-10mm, acicular, chalky brownish white. Fl. 10mm in diameter, pink. Fr. curved clavate, 11 × 4mm, red.

At most a race of *M. magnimamma*. The key difference by which the two were separated, namely the presence of central spines in *M. vagaspina*, seems entirely spurious, but plants from the central plateau region do differ in various respects from that on the pedregal of Mexico City, illustrated by Britton & Rose and Craig (fig. 17) as *M. magnimamma*.

M. valdeziana (Moeller) Kelsey & Dayton (*Neolloydia valdeziana*)

M. valida F. A. C. Weber (1898) (*M. melanocentra*: Craig 64)

M. valida J. A. Purpus (1911) (*Coryphantha poselgeriana*: Craig 350)

M. vandermaelen Craig, Mamm. Handb., 338 (1945), name only, based on a misunderstanding; see *M. rosea*

M. variabilis Reppenhagen in KuaS 36(10):206-207, with fig. (1985). Source: Mexico, Guanajuato, Absylon, 1550m, 29 Aug. 1978, Reppenhagen 1393 (K, spirit coll. no. 24062.16, holotype?). When I visited Mr Reppenhagen in 1985, he gave me sterile living material of several of his collections, including Reppenhagen 1393, for preservation as holotypes, but no material of 'Herbarium Reppenhagen 20', the cited holotype of *M. variabilis*, has been received.

Series STYLOTHELAE. Variable. Freely clustering, stems globose at first, later oblong, 2-8 × 2-4cm; tub. thick-conic, 8-9 × 4-5mm, dark green; ax. naked. Cent. sp. 4-9, 7-10mm, the lowest longest, hooked, all smooth, yellow at base, glassy white to red-brown or dark brown above; rad. sp. 14-19, 6-10mm, stiffly bristly, glassy white. Fl. 12-16 × 12-16mm, whitish, yellowish or pink. Fr. ripening up to 14 months after flowering, ovoid or clavate, 5-10 × 2-4mm, transparent white to carmine pink; seeds black, 0.8-1mm.

My first impression of this plant was that it was *M. erythrosperma*, recalling especially Britton & Rose's *M. multiformis*. Reppenhagen himself compares it with another of his novelties, *M. limonensis* Repp. (in KuaS 36(3):44-46, with figs. 1985) from Jalisco, El Limon, 2 Mar. 1980, Reppenhagen 1620 (K, holotype), which has more cylindrical stems and axillary bristles.

M. variamamma Ehrenb. (insufficiently known: Craig 341)

M. varieaculeata F. G. Buchenau in Cact. Suc. Mex. 11:79, figs. 39, 40 (1966). Source: Mexico, Puebla, S of Chilac, between rocks on a steep hill in open sun or under trees, loamy, stony soil, pH 8; type said to have been deposited at MEXU, but not found there in 1969.

Series POLYEDRAE (?). Clustering, offsetting or rarely dividing dichotomously; stems globose to cylindrical, to 13 × 9cm; tub. pyramidal, 5-6 × 4-6mm, green to dark green; ax. bristles 10-25, 4-8mm, white. Cent. sp. 1-5, 4-5 in young plants, later 2-3, finally 1-2, in young pl. 4-12mm, acicular, light brown, later mostly 5-10mm but to 45mm in the same head and cluster, strongly acicular to subulate, at first dark or reddish brown, paler later; rad. sp. 17-20(-24), 4-8mm, white, yellow-brown and later dark brown at base. Fl. 17-18mm, red; stigmas 5, light green. Fr. clavate, 15-20mm, scarlet-red, the dried perianth persistent; seeds pale brown.

Also reported from Tilapa, *Glass & Foster* 1382. An interesting plant, apparently allied to *M. mystax* but with some points of resemblance to ser. Superstextae.

M. varicolor (Tiegel) Weniger, Cacti of the Southwest, 138 (1972), invalid name (*Escobaria varicolor*)

M. variimamma Haage (variant spelling of *M. variamamma*: Backeb. 3491)

M. vaupeliana [attrib. to Boed., ZfS, 206 (1928) by] Craig (error for *Coryphantha vaupeliana*)

M. vaupelii Tiegel in Moellers Deutsch. Gaertner-Zeit. 48:412, with fig. (1933). Source: Mexico, Oaxaca, without locality. Type presumably not preserved.

Series SUPERSTEXTAE. Simple, depressed-globose; ax. with lax, almost bristly wool. Cent. sp. 2, the lower 15mm, the upper

10mm, stout, coffee-brown; rad. sp. 16, 5-6mm, glassy white. Fl. not described by Tiegel. Fr. 15mm, carmine red; seed yellowish brown.

At most a form of *M. haageana*, described from a young, rather heavily spined specimen. The var. *flavispina* Neale, Cacti and other Succulents, 94 (1935), never validly published, may be referable to *M. tegelbergiana*, q.v.

M. velthuisiana [attrib. to Hort. Mueller, Marrakesch, by] Backeb., Die Cact. 5: 3496, fig. 3213 (1961). Seen by Backeberg in Thiemann's collection at Bremen, and thought by him to be perhaps a hybrid: 'broad-globose species with milky sap; ax. with bristles; spines white or the central brown-tipped, and in the form with longer central spines these at first dark brown further down; fl. unknown.' Pilbeam in JMS 7:48 (1967) grew plants under this name from seed distributed by the Mammillaria Society in 1964 and later (Mammillaria, a Collector's Guide, 136, 1981) identified them as *M. petterssonii*, but Backeberg's picture shows plants referable to ser. *Leucocephalae*. The name has never been validly published.

M. venusta K. Brandegee (*M. schumannii*)

M. verhaertiana Boed. in MfK 22:125, with fig. (1912). Source: Mexico, without locality; imported to Germany by De Laet.

Series ANCISTRACANTHAE. Simple, short-cylindric; ax. with wool and white bristles. Cent. sp. 4 or 6, 12mm, the lowermost hooked, yellowish white, tipped yellowish brown; rad. sp. 20 and more (Craig:15-20), yellowish white, tipped slightly yellowish brown. Fl. 2cm, outer segments yellowish white with olive-green midstripe, inner more white; filaments short, pale pink (Craig: orange-yellow); stigmas 8-9, pink, thick.

Insufficiently known. The original plant (though compared with *M. spinosissima* by Boedeker) was fairly obviously one of the Baja Californian species, and was reported by Craig from Los Angeles Bay, i.e. the Bahía de Los Angeles on the E coast, together with an illustration of a plant collected there by Lindsay (Craig, Mamm. Handb., 160, fig. 141, 1945) which is probably the same as *M. angelensis* Craig. There is no assurance that this identification is correct, however, particularly as Craig altered the radial spine-count and stigma colour. Boedeker's own illustration resembles *M. phitauiana*, from the mainland further south, but the typification of *M. verhaertiana* is so imperfect that it should not be allowed to displace this name either.

M. versicolor Scheidw. (*M. magnimamma*: Craig 33)

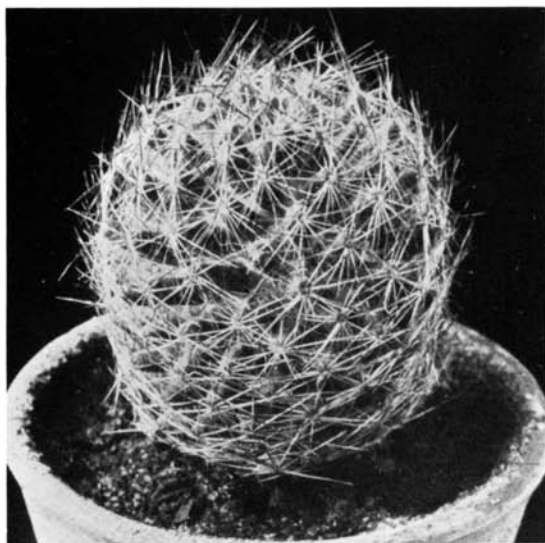
M. vetula Mart. in Nov. Act. Nat. Cur. 16(1): 338, t. 24 (1832); Hort. Reg. Monac., 128 (1829), name only. Source: Mexico, Hidalgo, San Jose del Oro, 11,000ft, often covered with snow and ice, *Karwinsky* (Zuccarini, Pl. Nov. Monac. fasc. 3, 704, 1837). No material is known to have been preserved, and the plate cited may be taken as the lectotype.

Series PROLIFERAE. Clustering, stems globose to shortly cylindric; tub. bluntly conic, c. 8mm; ax. with slight wool or naked. Cent. sp. 1-2, c. 1cm, reddish brown; rad. sp. at first 25-30, eventually to 50, white. Fl. c. 15mm, lemon yellow; stigmas 5, white. Fr. and seed not described.

Ehrenberg (in Linnaea 19:343, 1846) wrote that the species grew amongst limestone rocks in the region of La Encarnacion. This is a village close to San Jose del Oro and is the type locality of *M. magneticola* Meyran which differs only in the more numerous centrals (4-7). Ehrenberg's further notes on the species are quoted in full in Bradleya 3:73 (1985). It still occurs there, and Felipe Otero showed me white- and brown-spined forms at about 2200m (7150ft), in November 1973 (*H.* 8534). When hanging from rocks, the stems reached 40 × 4cm, but with green tubercles in the youngest 2.5cm only; tub. cylindric or terete-cylindric, 10 × 7mm. Cent. sp. 5-9, to 13mm, indistinctly differentiated from the radials, mid-brown, especially on young plants or plants in shade, or chalky white with 3mm brown tip; rad. sp. 25-40, 8-12mm, white or chalky white. Fl. 17mm, lemon yellow, outer segments with reddish midstripe; stigmas 1.5mm, orange-yellow.

M. vetula is most closely allied to *M. gracilis*, which occurs in drier and somewhat lower areas to the south and west.

M. vicina [attrib. to Brandegee in] Manchester Coll. Cacti, 48 (1908), name only



M. viereckii. Reproduction of Boedeker's original illustration (1927).

M. viereckii Boed. in ZfS 3:23, with fig. (1927). Source: Mexico, Tamaulipas, near Nogales, Feb. 1925, *Viereck*. Type not known to have been preserved.

Series PROLIFERAE. Discussed under *M. picta*, q.v. A distinctive form in cultivation is *Lau* 1063, from Aramberri, Nuevo Leon.

M. viescens De Herdt Cat. (Mottram 97)

M. villa-lerdo [name attrib. to Haage f. by] Britton & Rose (error for *villa laredo*)

M. villa laredo Haage f., name only (Backeb. 3496)

M. villifera [attrib. to Otto by] Pfeiffer (*M. polyedra*: Craig 21)

M. villosa [attrib. to Fennel by] C. F. Foerster, name only

M. viperina J. A. Purpus in MfK 22:148 (1912) & l.c. 23: 21, with fig. (1913). Source: Mexico, Puebla, Tehuacan valley, by the Rio de Zapotitlan, 1908, *C. A. Purpus*; extending to San Luis Tultitlan in the Sierra Mixteca. Type not known to have been preserved.

Series SPHACELATAE. Clustering, with elongate, decumbent, cylindric stems usually 1.5-2cm in diameter; tub. short cylindric or globose, to 5 × 3mm; ax. with slight wool and sometimes fine white bristles. Spines numerous, to 5mm, fine, variable in colour from white to half-white and half-brown, to blackish brown. Fl. red. Fr. cylindric-clavate, red; seeds black.

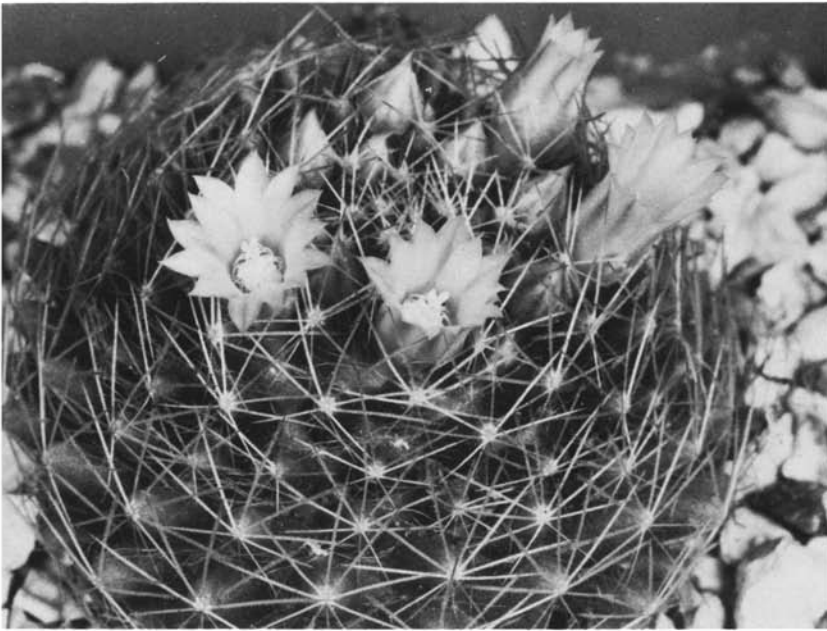
To be regarded as an extreme form of *M. sphacelata*, q.v. Craig's description of the seed as 'light tan', etc. is incorrect.

M. virens Scheidw. (*M. karwinskiana*: Craig 26)

M. virentis [attrib. to Salm-Dyck by] Craig, Mamm. Handb., 345 (1945) (genitive case of *virens* Scheidw.)

M. virginis Fittkau & Kladiwa in Krainz, Die Kakteen, Lfg. 46/47, with figs. (1 Jun. 1971). Source: Mexico, Guerrero, near Ancon, c. 1800-2100m, on limestone and occasionally epiphytic in shade or half-shade in light oakwoods, on humic, acid, loamy soils with much leaf-litter and a rich epiphytic flora. Type: *Fittkau* HF 1512.70 (ZSS).

Series POLYACANTHAE. Stem cylindric, rarely branching from the base, to 25 × 8cm, with milky sap during the rainy season; tub. conic-cylindric, 8-10 × 4-5mm; ax. naked or white-woolly. Cent. sp. 2-8, 4-12mm, reddish brown, the lowermost sometimes hooked; rad. sp. 15-21, 2-7mm, white with dark tip. Fl. April-June, campanulate, 12-14mm, outer segments 7 × 2mm, brownish red with pink or white margins, inner 8 × 2.2mm,



M. viereckii (Lau 1063)
(photo: Weightman)

with violet midstripe and paler margins. Fr. oblong-clavate, 20-26mm, olive-green, salmon-pink below; seeds brown.

Said to be akin to *M. umbrina* Ehrenb., this is one of several forms of the *M. spinosissima* complex described by Fittkau. Owing perhaps to the strongly dissected topography of the region where the group occurs, many local variants have arisen, and as more are documented the pattern looks increasingly reticulate. Apart from the small flowers, which were described as having a reduced perianth and may have been somewhat freakish, there seems little to distinguish *M. virginis* from *M. spinosissima* itself.

M. viridescens Hort. (Craig 345)

M. viridiflora (B. & R.) Boed., Mamm. Vergl. Schl., 36 (1933); *Neom. viridiflora* B. & R., The Cact. 4:153 (1923). Source: USA. Arizona, on Superior-Miami Highway, near Boundary Monument, between Pinal and Gila Counties, 4700ft, 5 Jul. 1922, *Orcutt* 608 (US 1821085, holotype); near Tula Spring, S of Aravaipa, June 1922, *Ruth C. Ross* 14 (US 2557460, paratype).

Series ANCISTRACANTHAE. Stem simple or sometimes clustering, globose to short-oblong, 5-10 × 5-7.5cm, obscured by spines; tub. terete, c. 4.5 × 4.5mm; ax. naked. Cent. sp. 1(-4), 1.5-3cm, 1 or more hooked, reddish brown; rad. sp. 20-30, 10-12mm (Benson: 14-24, 8-10.5mm), bristle-like, white or pale brown, with brown tip. Fl. narrowly campanulate, 1.5cm (Benson: 20-38 × 15-34mm), greenish or tinged pink. Fr. globose to ovoid, 10-22 × 4.5-13mm, green to dull purplish, juicy; seeds 1-1.5mm, black or dark brown.

Regarded as a variant of *M. wilcoxii* by Craig, but now believed to be a distinct species, taking in *M. orestera* Benson. See Zimmerman & Zimmerman in CSJA 49:23-34, 51-62 (1977) and Benson, Cacti of the United States & Canada, 894-896, pl. 191 & figs. 929-932 (1982). Britton & Rose's description is expanded, above, with data from Benson's. Benson also gives notes on the plant's ecology and distribution.

M. viridis Salm-Dyck (*M. praelii*: Craig 30)

M. viridula Ehrenb. (insufficiently known: Craig 342)

M. vivida Hort. (*M. erythrosperma*?: Craig 345)

M. vivipara (Nutt.) Haw. (*Escobaria vivipara*)

M. vizcainae, *M. vizcayechensis* Koehres seedlist, 1983 (fide R. Zahra, in litt.)



M. viperina at Zapotitlan de las Salinas, Puebla.

(photo: Gates)

M. voburnensis Scheer in Hooker, London J. Bot. 4:136 (1845). Source: Guatemala, without locality; received and grown at Kew from the Duke of Bedford's collection at Woburn. Type not known to have been preserved (not at K).

Series POLYEDRAE. Clustering, the individual stems cylindrical; tub. short, subovate, angled above, rounded below, dark green and red toward apex; ax. with wool and bristles. Cent. sp. 1-2, 12mm, rigid, straight, subulate, brown at first, then ivory, brown-speckled; rad. sp. to 9, subequal the lower 4 a little longer, ivory-white.

The spelling 'voburnensis' adopted by some authors is incorrect. The original initial 'v' was certainly intentional and not a typographical error as claimed by Craig. There is no 'w' in classical Latin.

The species was rediscovered, according to Britton & Rose (The Cact. 4: 100, 1923), by W. R. Maxon in 1905 and by F. Eichlam in 1908, at Rancho San Agustín and other localities near Guatemala City, and re-described as *M. chapinensis* Eichlam & Quehl in MfK 19:1-5 (1909). The name was said to allude to 'the natives of Guatemala (El Chapin, La Chapina)'. Close allies include *M. eichlamii* (Honduras) and *M. collinsii* (Mexico, Oaxaca).

M. vogtheriana [attrib. to Werderm. & Boed. in MDKG 4:32 (1932) by] Craig (error for *Coryphantha vogtheriana*)

M. vonwyssii Gray Card Index (error for *vonwyssiana*)

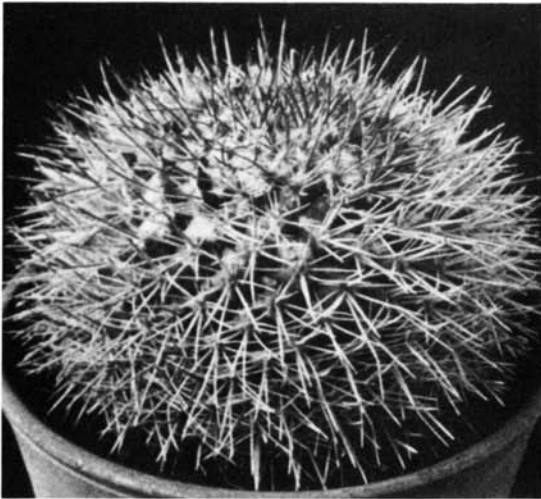
M. vonwyssiana Krainz in Schweiz. Gart. [1945-6]: 170, with figs. (1945 or 1946). Based on a plant grown from seed collected by Ritter and supplied by Winter (ZSS 712, holotype).

Series LEUCOCEPHALAE. Simple, to 6 × 8cm, glaucous green; tub. conic, 6-8mm, with milky sap; ax. naked at first, later woolly. Cent. sp. 2(-4), 3-5mm, yellowish, black-tipped; rad. sp. 18-20, 3-6mm, glassy white. Fl. c. 2cm, carmine red with darker midstripe; stigmas pale carmine. Fr. 2cm, red; seeds pale brown.

Persisting in cultivation, according to Pilbeam (Mammillaria, a Collector's Guide, 138, 1981), but not yet identified with any naturally occurring species.

M. vulpina Ehrenb. (*M. spinosissima*: Craig 268)

M. wagneriana Boed. in MDKG 4:199, with figs. (1932). Source: Mexico, Zacatecas, near San Miguel del Mezquital. Based on two plants, one shorter-, the other longer-spined, received by Boedeker from H. Wagner of Ludwigsburg and from Herr Ross of Krozingen respectively, and originating from J. Moeller (who lived near San Miguel del Mezquital). No authentic material is known to be extant.



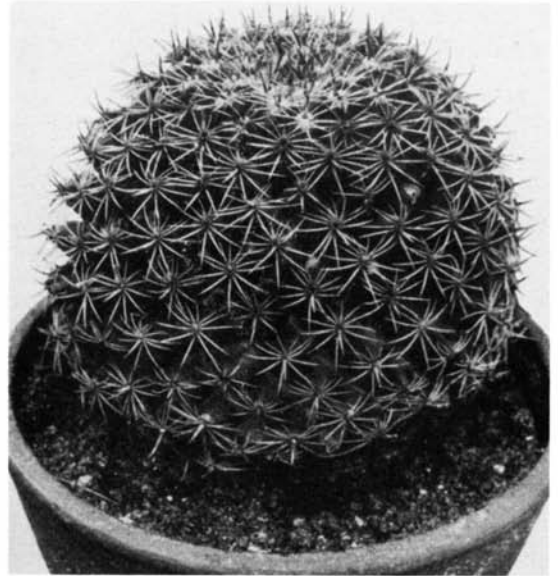
M. wagneriana. Reproduction of Boedeker's original illustration (1932).

Series MAMMILLARIA. Simple, depressed-globose, 6 × 10cm; tub. quadrangular, shortly pyramidal, c. 7mm; ax. densely white woolly, without bristles. Cent. sp. 2-4, variable, either straight, 2cm, or tortuous, 4-5cm, reddish horn-coloured; rad. sp. 9-10, unequal, the upper 2-3 c. 5-7mm, the lateral 10-14mm and the lower 15-21mm, all whitish horn-coloured, tipped brown. Fl. 1.5cm diam., inner segments dirty white with pale pink midvein and apex; stigmas 5-6, pale yellowish green. Fr. clavate, red; seeds brown.

Craig treated *M. wagneriana* as a synonym of *M. obscura* Hildmann, but the latter name is of uncertain application. Glass & Foster (in CSJA 57: 221, 1985) imply that they regard *M. wagneriana* as close to, perhaps not separable from, *M. gummifera*, though this is hardly supported by the original illustrations which depict something more akin to *M. zeyeriana* (at least as understood today). Extensive fieldwork in N Zacatecas and E Durango will be needed before the native species of ser. Mammillaria can be properly delimited.

M. waltheri(i) Boed. in ZfS 3:72, with fig. (1927). Source: Mexico, Coahuila, S of Viesca.

Series MAMMILLARIA. A form of *M. heyderi*, to judge from the description and illustration.



M. waltheri. Reproduction of Boedeker's original illustration (1927).

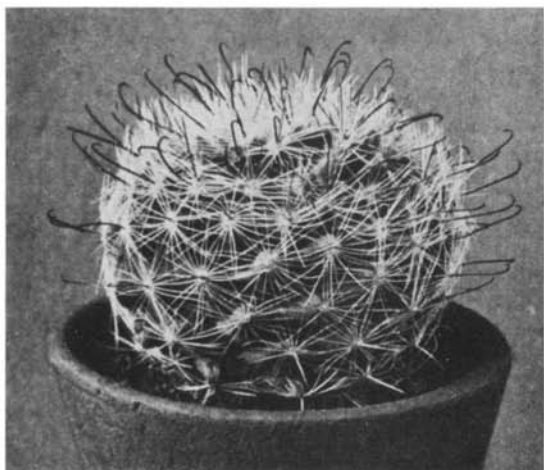
M. waltonii Walton in Cact. J. 1:29 (1898) (*M. parkinsonii*: Craig 121)

M. webbiana Lem. Implied by Ehrenberg (in Linnaea 19:348, 1846) to be very similar to *M. crocidata*. Both were presumably forms of *M. polythele* or possibly *M. magnimamma*.

M. wegneri Ehrenb. in Bot. Zeit. 1:738 (27 Oct. 1843) and in Allg. Gartenz. 11:395 (17 Dec. 1843) (as '*wegenerii*'). Source: Mexico, Oaxaca (Ehrenberg in Linnaea 19:346, 1846). Incompletely described; seeds brown. No material extant.

M. weingartiana Boed. in MDKG 4:219, with fig. (1932). Source: Mexico, Nuevo Leon, near Ascension, received from Ritter in 1931 and from Graessner in 1932. Type presumably not preserved.

Series STYLOTHELAE. Simple or clustering, stems globose, 4-5cm diam.; tub. slender-conic, c. 8 × 3mm; ax. naked. Cent. sp. at first 1, to 12mm, hooked tawny, later 2-3 shorter straight centrals also developed; rad. sp. 20-25, 6-8mm, white, glabrous. Fl. 10mm, inner segments pale greenish yellow with pinkish



M. weingartiana. Reproduction of Boedeker's original illustration (1932).

brown midstripe, fringed; stigmas 3-5, white or pale pink. Fr. small, clavate, red; seeds black.

Apparently conspecific is *M. unihamata*, described by Boedeker a few years later, also from Ritter material from Ascension, but with 16-20 radial spines. The smooth spines and tuberous stem-base are distinctive.

Seeds distributed as *M. unihamata* by the Mammillaria Society in 1972 were collected 20 miles N of La Escondida (Maddams in JMS 12:14, 1972), evidently near the type locality, since Ascension is c. 20 miles N of La Escondida! A plant I examined (about 1974) in Mr Maddams's collection from the same source (but not raised from seed) had 1 central and only 12-13 radials. Two others, source not known, had 17-18 radials, and one of them 2 hooked centrals at some areoles.

M. werdermanniana Hort. Schmolli (*M. hahniana* var. *werdermanniana* Schmolli ex Craig, Mamm. Handb., 112, 1945)

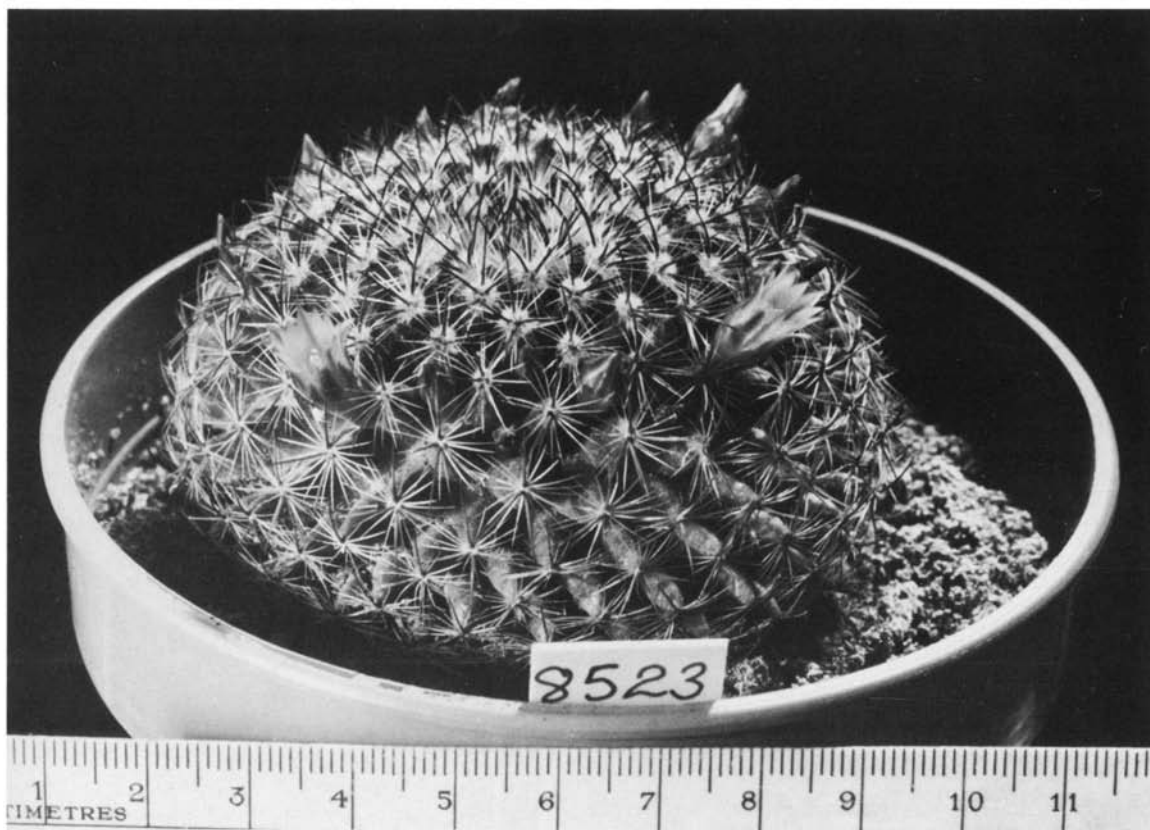
M. werdermannii Boed. [attrib. to Boed. in MDKG 1:155 (1929) by] Craig (error for *Coryphantha werdermannii*)

M. werdermannii [attrib. to H. Weiss in Kakteenk. 3:18 (1934), name only, by] Craig, Mamm. Handb., 345 (1945), but the reference seems to be incorrect.

M. wiesingeri Boed. in Kakteenk. [2]:204, with fig. (1933). Source: Mexico, Hidalgo, near Metzquititlan, 2000m, amongst obsidian rocks; found by *Wiesinger* and transmitted to Boedeker via C. Halbinger. No material preserved.

Series HETEROCHLORAE. Simple, depressed-globose, the original plant 4 × 8cm, with thick roots; tub. slender-pyramidal, c. 10 × 3-4mm; ax. naked or with occasional bristles. Cent. sp. 4(-6), 5-6mm, red-brown; rad. sp. c. 20, 5-6mm, glassy white. Fl. c. 12 × 10mm, carmine red, the style pink with 5 short, white stigmas. Fr. slender-clavate, 1cm, carmine red; seeds yellowish brown.

One of the best typified of Boedeker's species, in view of the exact and unusual type locality (see Hunt in JMS 15:13, 1975). It is intermediate between *M. rhodantha* and *M. discolor* and may be conspecific with *M. erectacantha* C. F. Foerster, q.v.



M. wiesingeri H.8523, specimen raised from seed collected at the type locality. The flowers are larger than indicated in the original description, measuring 2cm overall. (photo: Harwood)

M. wilcoxii Toumey ex Schumann, Gesamt. Kakt., 545 (1898). Source: 'The description was drawn up from an imperfect specimen which came from Orcutt', collected by Toumey, probably in Arizona. Neotype: USA, Arizona, Cochise Co., several miles SW of Benson, desert grassland, 4500ft, 22 Feb. 1976, D. A. & A. D. Zimmerman 2788, fl. in cultivation, fr. from same plants (POM 322896). Synonym: *M. meridiorosei* Castetter, Pierce & Schwerin in CSJA 50:177 (1978).

Series ANCISTRACANTHAE. Simple, depressed, short-cylindric, c. 5cm diam., pale green; tub. 5:8, rather lax. conic, 5-6mm, obliquely truncate; ax. naked. Cent. sp. 1, hooked, brown, paler below; rad. sp. 14-16, thinly subulate, white, the medial longest, to 10mm. (Schumann's description).

Comprehensively studied in the field by D. A. Zimmerman & A. D. Zimmerman (in CSJA 49:23-34, 51-62, 1977). It differs from *M. wrightii* (var. *wrightii*) in having statistically fewer central spines (av. 1.6, compared with 2.3), and more radials (12-30, av. 20, compared with 8-20, av. 13), somewhat smaller flowers (av. 3.5 × 2.9cm, compared with 4.5 × 3.5cm), and smaller fruits (6-15mm diam., compared with 12.5-26mm), and it occurs at lower elevation (1050-1500m, in desert grassland, whereas *M. wrightii* occurs at 1500-2400m in various floristic associations; cf. Benson, Cacti of the United States & Canada, 902, 1982). *M. wrightii* is a plant of central New Mexico and adjacent Arizona, whilst *M. wilcoxii* occurs in SW New Mexico, S Arizona, N Sonora and adjacent Chihuahua (see distribution map, Zimmerman & Zimmerman, l.c. 59).

Zimmerman & Zimmerman conclude that *M. wilcoxii* merits varietal status only, and are followed by Benson. It is, however, a geographical (not a horticultural) variety, and would probably be treated by European botanists (and many Americans) as a subspecies. Since the distribution area does not apparently overlap with that of *M. wrightii*, and the two taxa are now so clearly circumscribed (along with *M. viridiflora*), students of Mammillaria may find it simpler to treat all three equally, as species.

M. meridiorosei Castetter, Pierce & Schwerin was a superfluous redescription of *M. wilcoxii*. The authors claimed that *M. wilcoxii* had been misinterpreted by the Zimmermans and Benson, and that the 'true' *M. wilcoxii* was actually what Britton & Rose had called *M. viridiflora*. Being the earlier name, *M. wilcoxii* would displace *M. viridiflora*, and *M. meridiorosei* would be the new name for *M. wilcoxii* sensu Benson. A lengthy paper by Castetter, Pierce & Schwerin in support of this recipe for confusion was rejected by the Cactus & Succulent Journal (US), but later published, unrefereed, in the Journal of the Mammillaria Society (JMS 19:44-54, 58-64, 72-78, 1979, JMS 20:2-5, 1980). They treated the topic as if it were a matter of taxonomic judgment, but their case was lost from the outset on a technicality of nomenclatural procedure: they proposed to reject Benson's neotype, and proposed instead that a Toumey collection from Bowie, Arizona, dated 20 Dec. 1896 (US 535383), should be the 'lectotype' of the name *M. wilcoxii*. This is inadmissible, since Schumann, who published and validated Toumey's manuscript name, did not see the Toumey specimen himself.

When this was pointed out (Hunt in JMS 20:60-61, 1980), Pierce & Schwerin continued to insist that Toumey was the publishing author, claiming that Schumann and later Orcutt had ascribed the description to him. But they did not; only the name. There is no reason to suppose that Schumann's reference to '*Mamillaria Wilcoxii* Toumey msc. bei Orcutt' means Toumey had given Orcutt more than the name.

It would have been open to Castetter et al. to argue for rejection of Benson's choice of neotype on taxonomic grounds, and they could even have suggested one of the Toumey specimens as the new neotype. But Zimmerman & Zimmerman (l.c. 61) regarded all the Toumey material as 'too poorly preserved and/or of insufficient material for positive identification. All lack adequately preserved flowers [disputed by Castetter, Pierce & Schwerin, l.c. 19:58] and were collected in regions of known or probable distributional overlap between two different taxa'.

M. wildiana Otto ex Pfeiffer (*M. wildii*: Craig 152)

M. wildii A. Dietrich in Allg. Gartenz. 4:137 (1836). Source: Mexico, without locality. Received at Berlin, according to Otto (l.c. 138), from the Hanover Reise-Verein and from Mr Zepnick,

horticulturist at Frankfurt, and named for Mr Wild, medical inspector at Kassel, 'long famous amongst plant-lovers for his magnificent gardens and his manifold contributions to the culture especially of alpine plants'. Type not extant.

Series STYLOTHELAE. Clustering, with terete, obtuse tub. to 10 × 4-6mm; ax. with long hairs. Cent. sp. 4, 8-10mm, one hooked and 3 erect, pale yellow, later dirty brown; rad. sp. 9, 6-8mm, bristly, white. Fl. 8-10mm, excluding the pericarpel; outer segments whitish with brownish red midstripe, inner transparent white; stigmas 5, yellowish-greenish. Fr. obconic, brownish red [mature?].

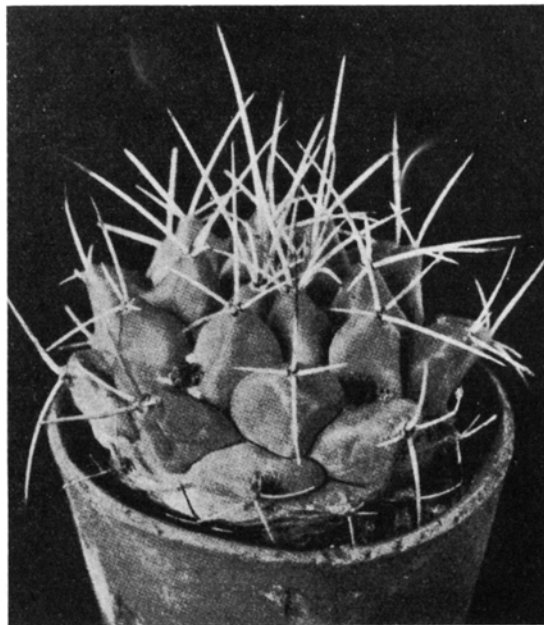
Familiar in cultivation, and common around the barranca of the Rio Grande east of Metztilan, whence it was reported (as *M. wildiana*) by Ehrenberg (in Linnaea 19:344, 1846; cf. Bradleya 3:73, 1985) 'at 5000-6000ft [1500-1800m] on lava debris and basalt scree, or occasionally growing on *Prosopis* and *Acacia* trees'. Hemsley (Biol. Centr. Amer., 527, 1879) thought the 'Rio Grande' mentioned by Ehrenberg to be in Oaxaca, but it was certainly the one that rises near Tulancingo and flows through the great Barranca.

M. williamsii (Lem. ex Salm-Dyck) J. Coulter (*Lophophora williamsii*)

M. winkleri C. F. Foerster (*Coryphantha pycnantha*: Craig 350)

M. winterae Boed. in MDKG 1:119, with fig. (1929) (as '*winteriae*'; spelling to be corrected in accordance with ICBN, Art. 73). Source: Mexico, Nuevo Leon, near Monterrey, widespread in hot situations on various soil types. Sent by F. Ritter from Saltillo, at whose instigation Boedeker named the species after Ritter's sister Hildegard.

Series MAMMILLARIA. Simple, depressed-globose, to 20-30cm diam.; tub. quadrangular, to 15 × 15-25mm; ax. naked at first, later rather densely white-woolly, without bristles. Spines 4, the upper and lower to 30mm, the lateral to 15mm, all stout-accicular, straight or somewhat curved, pale grey or faintly reddish, brownish-tipped. Fl. c. 3 × 2.5cm, outer segments brownish red with broad yellowish white margins, inner yellowish white with whitish margins and pale sulphur-yellow midstripe; stigmas 5-9, greenish yellow. Fr. clavate, pale red; seeds pale red-brown.



M. winterae. Reproduction of Boedeker's original illustration (1929).

According to Glass & Foster (in CSJA 42:265, fig. 65, 1970), *M. winterae* is characteristic of the mountains SE of Saltillo, the type locality of *M. zahniiana*, described by Boedeker in the same paper, and so they infer that somehow the type localities got switched. Or else, I suggest, *M. zahniiana*, q.v., is not really distinct.

M. wissmannii Hildm. ex Schumann (basonym for *Neobesseyia wissmannii*; but probably based on a mixture of *Coryphantha sulcata* and *Escobaria missouriensis*)

M. witurna Hort. (Craig 345)

M. woburnensis Muehlenpf. in Allg. Gartenz. 14:372 (1846) and many later authors. An alternative but incorrect spelling for *M. woburnensis* Scheer, q.v.

M. woodsii Craig in CSJA 15:33, with fig. (1943) and Mamm. Handb., 113-114, fig. 95 (1945). Source: Mexico, Guanajuato, Hacienda de Tarajeas, *Schmoll* s.n. (US 1791490). The specimen is very poor indeed; just a husk.

Series LEUCOCEPHALAE. Simple, flattened globular to clavate, 5 × 8cm; tub. 13:21, angled and keeled below, nearly rounded at apex, 7 × 6-7mm, dull grass-green; ax. with dense wool in flowering zone and numerous white hair-like bristles to 25mm. Cent. sp. 2 (or 4), lowermost to 16mm, upper 4-5mm, dull chalky purplish pink with black tip; rad. sp. 25-30, 4-8mm, hair-like, tortuous, white. Fl. March-April, 10-12 × 12-15mm, pink. Fr. clavate, 15 × 6mm, deep pink; seeds dull brown.

Not specifically distinct from *M. hahniana* and *M. mendeliana*, but one of a range of forms from the same geographical area which link the two extremes.

M. wrightii Engelm. & Bigelow in Rep. Pacific Railr. 4:27 (1856); Engelm., Syn. Cact. US, 6 (1856) and in Proc. Amer. Acad.

3:262 (1857); and in Emory, Rep. US & Mex. Bound. Survey, Cactaceae, 7, t.8 (1859). Specimens cited by Engelmann & Bigelow (1856): USA, [New Mexico,] high plains near the Gallinas, [Bigelow]; [San Miguel Co.,] hills and rocky places near Anton Chico, on the Pecos, 25 Sep. 1853, [Bigelow]; Mexico, Chihuahua, Santa Rita del Cobre Mts, near Lake Santa Maria, *Wright* and *Bigelow* 'in boundary collections'. Localities cited by Engelmann (1856, 1857): 'New Mexico, on the Pecos and near the Copper Mines'. Specimens cited by Engelmann (1859): New Mexico, [Grant Co.,] near the Copper mines, [Aug. 1851,] *Wright*; [Texas,] near El Paso, *Parry*; and [New Mexico,] on the upper Pecos, east of Santa Fe, *Bigelow*.

Series ANCISTRACANTHAE. Simple, globose or depressed-globose, 3.5-7.5cm diam.; tub. terete, 10-12mm; ax. naked. Cent. sp. 1-3, hooked, dark-coloured, not much longer than the radials; rad. sp. to 12, 8-12mm, whitish, the upper 3-5 a little stronger, dark-tipped. Fl. 'fully' 2.5 × 2.5cm, perianth-segments narrow, acuminate, bright purple. Fr. large, nearly 2.5cm, purplish, withered perianth persisting; seeds 1.4mm, black, scrobiculate, with small narrow hilum.

For convenience and clarity, I have dealt with *M. wilcoxii* Toumey ex Schumann separately, although Zimmerman & Zimmerman (in CSJA 49:23-34, 51-62, 1977), followed by Benson (Cacti of the United States & Canada, 901-905, 1982), treat it as a variety within *M. wrightii*.

As a taxonomic entity, *M. wrightii* sensu stricto, or *M. wrightii* var. *wrightii*, is distinctive, with its large, bright purple flowers and large globular or obovoid fruits, as described by Engelmann. If there is a problem, it is the nomenclatural one of typification. According to Zimmerman & Zimmerman (in CSJA 49:29, 57, 1977) and to Benson (Cacti of the United States & Canada, 968, 1982), the lectotype is the one designated by Coulter (in Contr. US Nat. Herb. 3:101, 1894): USA, New Mexico, Copper Mines,



M. wrightii f. *wolfii* (Lau & Schreier 1042).

(photo: Schreier)

Aug 1851, Wright s.n. (MO 2016409), consisting of 'a few spine clusters and a barely decipherable handwritten description' (Zimmerman & Zimmerman, l.c. 57). I agree, on the contrary, with Britton & Rose, The Cact. 4:152 (1923), who did not mention Coulter's paper, but cited the Bigelow specimen (US 1821086) as the 'type' of *M. wrightii*. The reason is that Engelmann & Bigelow specifically cited this one as the one which provided the description and illustration of the flower, fruit and seed (Engelmann & Bigelow, l.c.): 'Flowers and fruit were unknown until specimens from the Pecos flowered in Washington. From these the following description was drawn . . .'. The text concludes by citing Bigelow's own collections from 'High Plains near the Gallinas' and 'Hills and rocky places near Anton Chico, on the Pecos, 25 Sept. 1853' and concluding 'Santa Rita del Cobre Mts, near Lake Maria, Chihuahua. Wright and Bigelow, in boundary collections'. Clearly, therefore, the 1853 Bigelow specimen was the type of at least the flower and fruit, and since these are the most diagnostic features of the taxon, must surely be treated as the holotype?

This point is an important one, since it could be argued that Coulter's choice of a lectotype was unnecessary or at least inappropriate. The current interpretation of *M. wrightii* might then be in doubt.

Apart from this, the long history of controversy surrounding *M. wrightii*, *M. wilcoxii* and *M. viridiflora* seems to have been largely resolved by the very thorough work of Zimmerman & Zimmerman (in CSJA 49: 23-34, 51-62, 1977). The subsequent description of *M. meridiorsei* Castetter, Pierce & Schwerin, ruffled the waters again, but was based on incorrect premises regarding the publication and typification of *M. wilcoxii*, q.v.

M. wrightii f. *wolfii* D. R. Hunt in CSJGB 41:97 (1979). Source: Mexico, Chihuahua, near Sta Clara Canyon, Menonite settlement, 6 Mar 1974, Lau & Schreier in Lau 1042 (K). A white-flowered form known only from the type collector. It should probably be referred to *M. wrightii* var. *wilcoxii*.

M. wuthenauiana Backeb. in Beitr. Sukk.-Kunde Pflege [1941]: 5 (1941), without Latin diagn., and in Feddes Repert. 51:64 (1942); Stachlige Wildnis, 368 (1942); Die Cact. 5:3444, fig. 3186 (1961). Source: Mexico, Morelos, Tixtla, to Guerrero, Taxco. Without details of collector. Type not preserved.

Series POLYACANTHAE. Simple, later clustering, stems to 12cm or more \times c. 8cm; ax. with bristles. Cent. sp. 4, to 1.8cm, reddish brown straight, or the longest longest, hooked; rad. sp. 28-29, very thin, glassy white, fl. carmine red.

Not distinguishable from *M. nunezii*.

M. xaltiangensis Sanchez-Mejorada in An. Inst. Biol. Mex. 44, Bot. ser. (1):30, with figs. (1975). Source: Mexico, Guerrero, mun. Acapulco, 1km N of Xaltianguis, growing on sandy granite hills on the right-hand bank of the Rio Xaltianguis, beside the Mexico-Acapulco highway, 500m, in low pasture at the edge of deciduous woodland with *Quercus*, *Ficus*, *Spondias*, *Peniocereus fosterianus* and *Hylocereus undatus*, in flower, Aug 1970, Sanchez-Mejorada 70-0802, cult. Mexico City, mature fruit produced in Oct 1971 (MEXU, holotype).

Series POLYACANTHAE. Simple or clustering somewhat, stem cylindrical, to 20 \times 7-8cm, with milky sap in the stem but not the tubercles; tub. slightly 4-angled, 8 \times 6mm; ax. in flowering zone with sparse wool and a few white bristles 8-12mm. Cent. sp. 4, unequal, the upper 7-8mm, the lowest 8-12mm, occasionally hooked, at first purplish or yellowish brown, reddish tipped, later whitish; rad. sp. 16-20, 5-6mm, translucent white. Fl. small, 12mm, outer segments greenish cream below, pale reddish above with creamy margins, inner pale pinkish below, very light green above; stigmas pale greenish cream. Fr. clavate, 18-20mm, pale green at base, dark green and later yellow above; seeds brown.

The most southerly of ser. Polyacanthae yet described, with distinctive flowers (unaccountably mis-reported by me (in JMS 15:51, 1975) as 'pinkish purple'). Reppenhagen has subsequently collected the species at Xaltianguis, Repp. 753 and also reports it from Tierra Colorada, Repp. 1261. Other more distant collections which are conspecific are Lau 1155, from Michoacan, near Aguillilla, and Taylor 304, from between Playa Azul and Arteaga, Mich., at 750m. These have small, pale yellowish flowers with the outer segments dull reddish outside below, and the withered perianth does not persist on the fruit.

M. xanthina (B. & R.) Boed., Mamm. Vergl. Schl., 47 (1933); *Neom. xanthina* B. & R., The Cact. 4:164, fig. 184 (1923). Source: Mexico, allegedly collected in Durango, near Monte Mercado, A. Groeschner, comm. 1922, B. P. Reko 4401 (US 1820182, holotype).

Series MAMMILLARIA. Depressed-globose, the type 7 \times 8-9cm, dull bluish green; tub. broader than long; ax. woolly at first. Cent. sp. 2, brownish, stouter and a little longer than the radials; rad. sp. 10-12, to 4mm, white. Fl. pale lemon yellow.

A mystery plant, nothing like it being known from Durango. Glass & Foster (in CSJA 42: 109, fig. 20, 1971) 'combed' the Monte Mercado area and only found *M. gummifera* (G. & F. 1983). The plant looks to have been more like *M. marksiana* or one of the *M. standleyi*-*M. canelensis* complex, and an error in the source data must be suspected.

M. xanthispina Hort. Walton (Craig 345)

M. xanthotricha Scheidw. (*M. mystax*: Craig 54)

M. yaquensis Craig, Mamm. Handb., 320, fig. 293 (1945); Krainz, Die Kakteen. Lfg. 3 (15 Jan 1957), description and illustration of flower. Source: Mexico, Sonora, Rio Yaqui, flat lowlands a few miles from Fort Pithaya, July 1937, Craig & Hilton; 1940, Lindsay. Type deposited at DS. Floral description based on an imported plant in coll. W. Andreae.

Series ANCISTRACANTHAE. Clustering freely, joints very easily detached, to 7 \times 1.5cm; tub. short conic, 3 \times 5mm; ax. faintly woolly. Cent. sp. 7mm, hooked, reddish brown; rad. sp. 18, 5-6mm, smooth, cream, tipped light brown. Fl. 2 \times 2cm, inner segments whitish pink with pink midstripe; stigmas 6, 5-7mm, purple-red. fr. elongate-globular to short clavate, 9 \times 5mm, scarlet; seeds black.

Very closely allied to *M. thornberi*, of which it is probably a southern geographical variety or subspecies. It has been re-collected by Glass & Foster south of Guaymas, under shrubs and mesquite, 15 Apr 1972, G. & F. 2068 (cf. CSJA 57:151, fig. 7, 1985), and I also saw it at their locality on 27 Sep 1986, when I made the following notes: Freely clustering and fragile (offsets c. 20 \times 12mm detach very easily); tub. 3 \times 4mm. Cent. sp. 1, 7mm, hooked, dark reddish brown; rad. sp. 18-19, to 6mm, subequal, minutely pubescent, white, brown-tipped.

M. yucatanensis (B. & R.) Orcutt, Cactography, 8 (1926); *Neom. yucatanensis* B. & R., The Cact. 4:114, fig. 119 (1923). Source: Mexico, Yucatan, Progreso, rare on landward side of marshes, 1921, G. F. Gaumer 24367 (US 1821095, holotype); previously collected at the same locality in 1918, Gaumer 23939 (US 1946072).

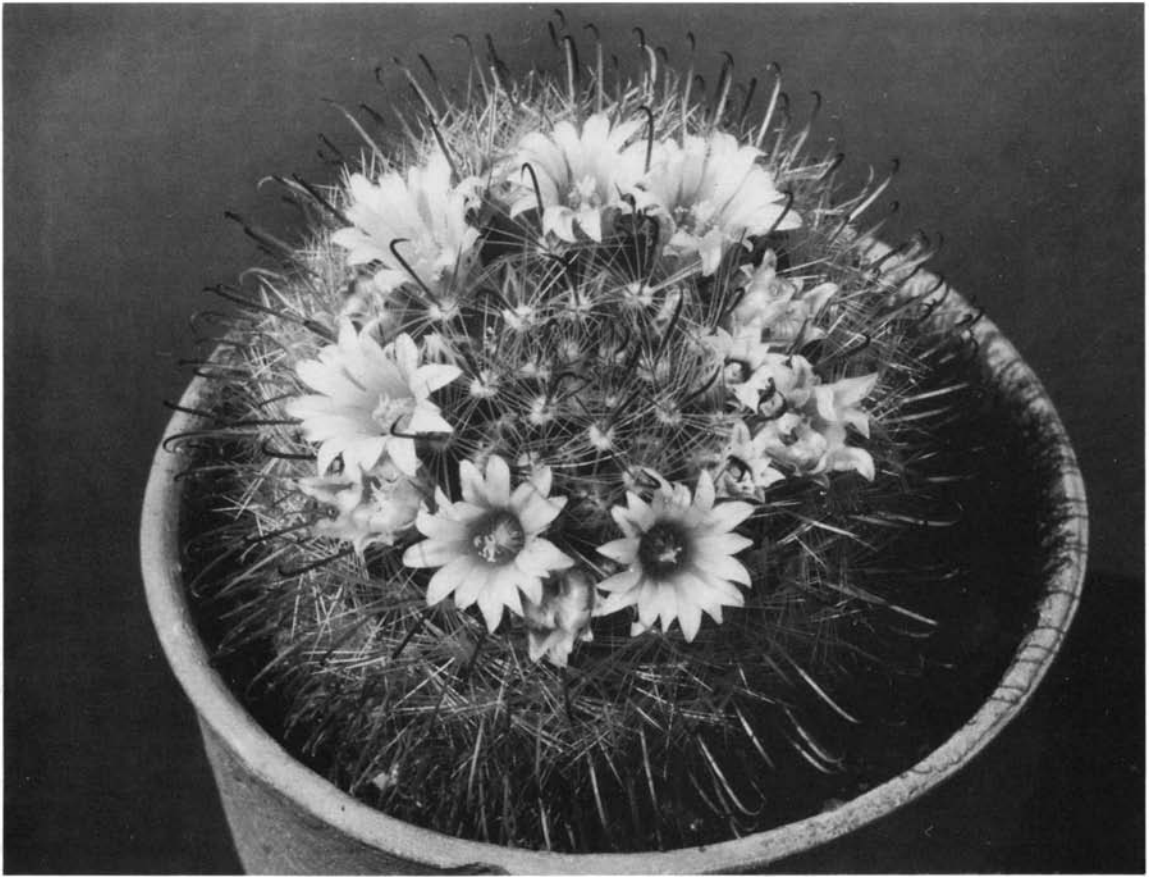
Series SUPERTEXTAE. Clustering; stems erect, cylindrical, 10-15 \times 3-6cm, 'not milky'; tub. conic; ax. woolly, not setose. Cent. sp. 4(-5), 6-8mm, much stouter than the radials, yellowish brown; rad. sp. c. 20, white. Fl. very small, pink. Fr. oblong, bright red.

Probably not distinct as a species from *M. colombiana*. Not re-collected for many years, and evidently very rare or perhaps extinct.

M. zacatecasensis Shurly in CSJGB 22:51, with fig. (1960). Source: Mexico, Zacatecas, without further locality. Based on cultivated plants received by Shurly in 1954. Neotype (see below): cult. Shurly, preserved 1961 (K).

Series STYLOTHELAE. Simple, globose, 6-7cm diam., with fibrous roots; tub. terete, 6 \times 3mm; ax. naked. Cent. sp. 3-4, lowest hooked, 15mm, upper 2-3 straight, 10mm, all smooth, pale yellow below, pale red above; rad. sp. 20-24, 7-8mm, yellow. Fl. 14mm diam., perianth-segments white with pink midstripe; stigmas greenish white. Fr. clavate, red; seeds black, with corky hilum.

Shurly sent one of his plants to Kew for preservation, but not in flower. Apparently it was grown on in hopes of obtaining flowers for preservation (or in ignorance of its intended purpose), but it disappeared from the collection and was missing when I began working at Kew in 1961 and checked his types. At my request he sent another plant which was duly preserved as a neotype. The lost holotype may have been the plant depicted in the illustration (Shurly, l.c. 58).



M. zacatecasensis. One of Shurly's original photographs, also reproduced with the original description (1960).

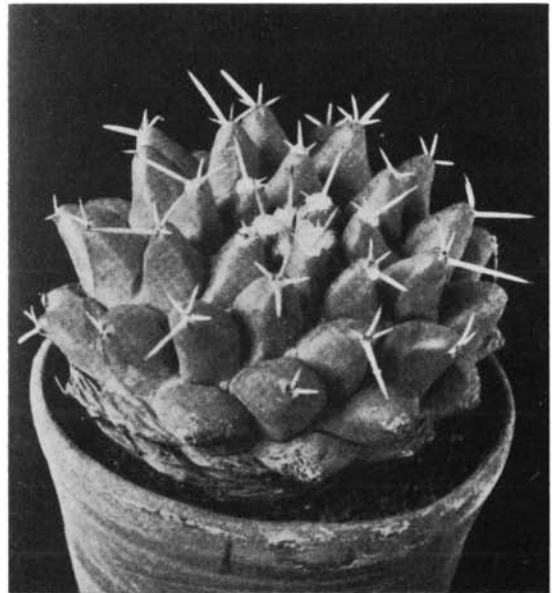
The species occurs in the mountains adjacent to the city of Zacatecas, where it has been re-collected on a number of occasions and also distributed by Abbey Garden, as AbG. 33 (Glass & Foster in CSJA 42:142. 1970). I found it myself above Zacatecas, on hilltops at 2400m, 30 Sep 1974, Hunt 8808, cult. Kew (K). It is closely allied to *M. jaliscana* and may not be specifically distinct.

M. zahniana Boed. in MDKG 1:120, with fig. (1929). Source: Mexico, Nuevo Leon, near Saltillo, 1600-2500m, in gravelly soil, shrinking almost into the ground in winter, 1927, Elmar Ritter; sent to Boedeker first by Garteninspektor Zahn of Erlangen and then by F. Ritter from Saltillo. Type not preserved.

Series MAMMILLARIA. Simple, depressed-globose, to 6 × 10cm; tub. 8:13, pyramidal, tetragonal, 2 × 2cm, dark leaf-green; ax. with sparse wool. Spines 4, straight, subulate, horny white, tipped blackish, the lowest 15mm, the uppers 8mm. Fl. 20 × 25mm; outer perianth-segments pale greenish yellow with white margins and red midstripe, inner sulphur yellow to darker yellow with pale margins; stigmas 8-10, 4mm, pale green.

Only distinguished from *M. winterae*, which was described in the same paper, by the shorter subulate spines and 'pure yellow' flowers. On this basis, *M. zahniana* can hardly be accepted as a distinct species, especially as Glass & Foster claim to have found only *M. winterae* in the mountains SE of Saltillo (G. & F. 2248; cf. CSJA 42:265, fig. 65. 1970). But Glass & Foster suspected the type localities might have been switched inadvertently, and later (ined.) reported 'true' *M. zahniana* from near Montemorelos, in Nuevo Leon, some 80km SE of Monterrey (G. & F. 3269).

Another plant which invites comparison with *M. winterae* and *M. zahniana* is Lau 1069 from Aramberri, Nuevo Leon. The similarity may be only superficial, as this is a clustering plant with



M. zahniana. Reproduction of Boedeker's original illustration (1929).

smaller heads. The flowers are yellow, however, with the outer segments a muddy brown.

M. zanthotricha B. & R. (error for *xanthotricha*)

M. zapilotensis Craig, Mamm. Handb., 132, fig. 114 (1945); *M. guereronis* var. *zapilotensis* (Craig) Backeb. in CSJA 23:152 (1951). Source: Mexico, Guerrero, Zapilote [Zopilote] Canyon, near Rio Balsas, June 1942, Craig. Type not stated to have been preserved.

Series POLYACANTHAE. The hooked-spine phase of *M. guereronis*, q.v., with which it grows.

M. zegschwitzii Terscheck (Craig 342)

M. zeilmanniana Boed. in MDKG 3:227, with fig. (1931). Source: Mexico, Guanajuato, near San Miguel Allende, amongst rock in leaf-mould, *E. Georgi*. Sent to Boedeker in 1931; type not preserved.

Series STYLOTHELAE. Simple or clustering, to 6 × 4.5cm; tub. subcylindric; ax. naked. Cent. sp. 4, the upper 3 straight, the lowest hooked, slightly longer, all reddish brown; rad. sp. c. 15-18, finely bristly, pubescent, white. Fl. to 2cm, pinkish violet or purple, stigmas yellowish. Fr. small, whitish green to pale pink; seeds black.

Now one of the best-known of the small, hooked-spine species in cultivation, having been mass-produced for sale in garden-centres and supermarkets, but not, to my knowledge, ever rediscovered in nature, like *M. bombycina*. Some doubt must attach to the veracity of the source data. It flowers very freely when only 1-2 years old from seed, but is apparently self-sterile, and fruits are rarely seen. Pilbeam (in JMS 5:11. 1965) and N. P. Taylor (ined.) have confirmed the pale fruit-colour recorded by Boedeker, obtaining small pale pink or white fruits c. 7 × 4mm by cross-pollinating their plants. This pale fruit-colour is also characteristic of *M. berkiana* Lau*, a recently described species from Jalisco, and of *M. guillauminiana* from Durango. These three species, all with relatively small pink or reddish flowers, seem to form a small subgroup in series Stylothelae, and the distribution of *M. berkiana* and *M. guillauminiana* suggests to me that *M. zeilmanniana* might also have hailed from the Sierra Madre Occidental, rather than Guanajuato.

M. zephyranthiflora [attrib. to Hort. Schelhase by] Pfeiffer in Pfeiffer & Otto, Abb. Besch. Cact. 2: t. 8 (1846). Error for *M. zephyranthoides*.

M. zephyranthoides Scheidw. in Allg. Gartenz. 9:41 (1841). Source: Mexico, Oaxaca, in the cold region, 7000ft [2150m], *Galeotti*. Collected by Galeotti in the summer of 1836, according to Ehrenberg (in Linnaea 19:343. 1846), and then by Ehrenberg himself 'in 1837 on the high plateaux near Tizayuca and sent to Kassel' (cf. Bradleya 3:73. 1985). Type not known to have been preserved.

Series ANCISTRACANTHAE. Simple, the type 3.6 × 2.5cm, with tub. 6mm, but reaching 8 × 15cm with tub. 25mm in cultivation; ax. naked. Cent. sp. 1, short or up to 14mm, hooked, white or yellowish to red-brown; rad. sp. 12-18, 8-10mm, very slender, white. Fl. near apex, 4cm diam., perianth-segments white with pink midstripe. Fr. red, ovoid; seeds black.

One of the most interesting and perhaps ancient species in the genus. It occurs sporadically in calcareous areas in S Mexico, being known not only from Oaxaca and Hidalgo, but also Puebla and Queretaro, and one of the very few mammillarias found both north and south of the trans-Mexican volcanic belt.

The southern form is generally smaller and more weakly

***M. berkiana** Lau in KuaS 37(2):30-33 (1986). Source: Mexico, Jalisco, Sierra Huichol, San Andres Cohamiata, 2000m, on granite rocks, in humus or moss, *Lau* 1245 (ZSS AA 18-41, holotype).

Series STYLOTHELAE. Clustering, stems globose, 4-6cm, with fibrous roots; tub. cylindric, 4-5 × 3mm; ax. naked. Cent. sp. 5-8, 2-4 hooked, 10mm, the rest straight, 4-5mm, dark red, white at base; rad. sp. 35-38, upper 4 mm, lower 6mm, rigid smooth, white. Fl. campanulate, 10mm diam., dark purple. Fr. clavate or cylindric, 8mm, whitish to pink; seeds black.

spined than that from Queretaro, which has been distributed by Schmoll under the catalogue name *M. zephyranthoides* var. *queretaroensis* (ZSS, seed coll. no. 1027).

The closest relative of *M. zephyranthoides* appears to be *M. heidiae* Krainz, from Puebla, and Luethy (in KuaS 38(1):11. 1987), reports that hybrids intermediate in flower-colour have been produced between them. Luethy reduces *M. heidiae* to a variety of *M. zephyranthoides*, and speculates on Buxbaumian lines about the phylogeny and chorology of this and other hypothetically ancient species, adopting the proposal of Kuhn & Hofmann (in Informationsbrief ZAG Mamm. 5(3):41-42. 1979) that these should be removed from ser. Ancistracanthae to ser. Zephyranthoides Kuhn & Hofmann.

M. zepnickii Ehrenb. (Craig 342)

M. zeyeriana Haage f. ex Schumann, Gesamt. Kakt. 574 (1898). Source: Mexico, without locality. Type not extant.

Series MAMMILLARIA. Simple, hemispheric or subpyramidal, attenuate above, to 10cm diam., pale glaucous green; tub. 13:21, conic, lightly angled and obliquely truncate, 10-12mm; ax. naked. Cent. sp. 4, the lower 3 subradial, to 15mm, from the lower part of the areole, the uppermost 2cm, curved, chestnut-brown; rad. sp. 10, only from the upper part of the areole, spreading, straight, white. Fl. and fr. not described by Schumann.

The lower centrals should probably be counted as radials, to conform with the usual disposition in species of this affinity. Boedeker (Mamm. Vergl., Schl. 51. 1933) gave the source as NE Durango, and Craig (Mamm. Handb., 108. 1945) reported it from Viesca, Coahuila. Glass & Foster (in CSJA 42:231. 1970, 56:153. 1984, and 57:224. 1985) also report it from the latter area, allying it to *M. grusonii*, but regarding it as distinct. Both names are untypified, and neotypification would be desirable if the names are to be maintained. But this should not be until the species of ser. Mammillaria in Coahuila, Durango and Zacatecas are better understood.

M. zoderi Hort. Listed by Schumann, Gesamt. Kakt., 582 (1898) as a garden name for a form of *M. magnimamma*.

M. zapilotensis [attrib. to Craig by] Backeb., Die Cact. 5:3108 (1961), correction of '*zapilotensis*'

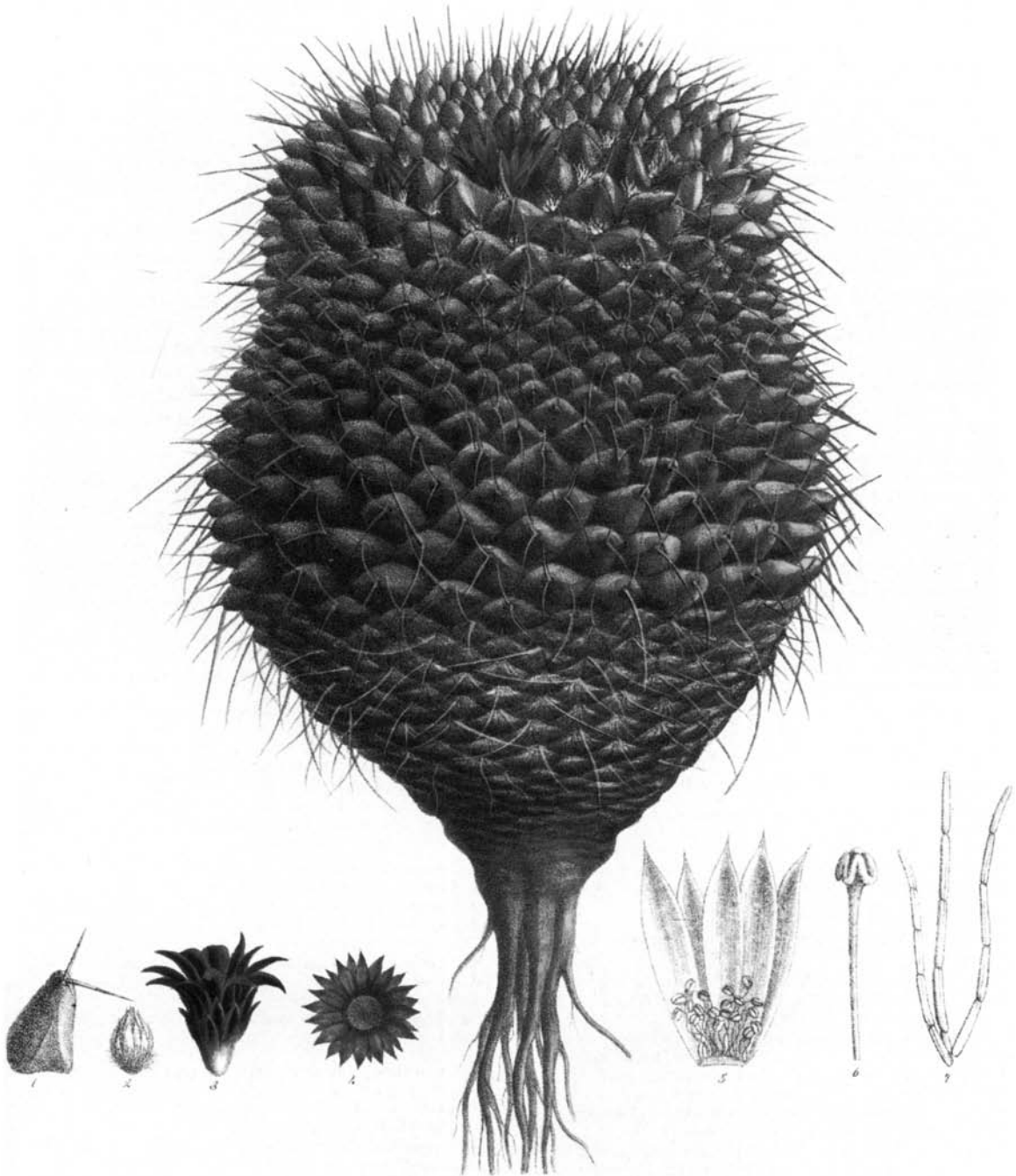
M. zucariniiana Mart. in Nov. Act. Nat. Cur. 16(1):331, t. 20 (1832). Source: Mexico, *Karwinsky*. Reported by Pfeiffer, Enum. Cact., 20 (1837) from Hidalgo, Ixmiquilpan, but this may be unreliable. Ehrenberg did not list the species in his 'Beitrag'.

Series MAMMILLARIA. Simple, cylindric, the type c. 20 cm; tub. depressed conic, acute, indistinctly angled, 8-10 × 12-14mm, dark and glaucous green; ax. woolly in flowering zone. Cent. sp. 2, upper c. 25mm, lower somewhat longer, whitish, tipped purple, at first, later ashy grey; rad. sp. 3-4, small, 2-6mm, often deciduous, white. Fl. more campanulate than in *M. polythele*. 25mm, rose-purple; stigmas 4-5, yellow.

Britton & Rose (The Cact. 4:90, fig. 83. 1923) identified plants from San Luis Potosi (Alvarez, May 1905, *Palmer* 590) as this species, but this must be discounted as the spination and tubercles are different and, anyway, Karwinsky had not been as far north by 1832. (*Palmer* 590 was evidently the false *M. orcuttii* collected by others at Alvarez.) A more plausible identification for *M. zucariniiana* was suggested to me by Felipe Otero, involving a plant of the *M. magnimamma* group which occurs in the mountains between Zimapan and Encarnacion. This seems to agree closely with the original and a point circumstantially in its favour is that *M. vetula*, which grows nearby, was described by Martius in the same paper. However, the possibility that *M. macracantha* DC., described a few years earlier from a Coulter specimen, might also have been the same species, cannot be discounted. Seed of Otero's plant, from him and from *Hunt* 8536, was distributed by the Mammillaria Society as *M. zucariniiana* around 1974.

M. zucariniiana Hort. non Mart. (*M. macracantha*: Ruempler in Foerster, Handb. Cact., ed. 2, 377. 1885)

M. zucarini [attrib. to Ruempler by] Britton & Rose, The Cact. 4:80 (1923) (error for *zucariniiana*)



Mammillaria zuccariniana. Mart.

M. zuccariniana. Reproduction of Martius's original plate (1832).

ADDENDA

M. aurihamata and **M. bocensis** (names given in the 'Review' in italic type). Both of these are recognized and should be in bold type.

M. bambusiphila Reppenhagen in Mitt. AfM 10(5):161-166 (1986); *M. bambusiphila* var. *parva* Reppenhagen, l.c., 167-171 (1986). Source: Mexico, Michoacan, near Huascana or Huacana, 800m, Reppenhagen 748 (K, holotype of var. *bambusiphila*; see below); near Coalcoman, 1100m, Reppenhagen 663 (K, holotype of var. *parva*). The type material of both varieties (received at Kew in October 1986) is poor. That of var. *bambusiphila* was a living but diseased plant with withered fruits. That of var. *parva* consisted of three dead, sterile stem-husks. All have been filed as boxed material.

Series POLYACANTHAE. Further local forms of the affinity of *M. meyranii*. Rationalization of species-limits in this series must await competent taxonomic study.

M. bertrandii (or *M. bertrandiana*) was a catalogue name used by Schmoll (Backeberg, Die Cact. 5: 3492. 1961). According to Backeberg (l.c.) and Maddams (pers. comm.), the plant in question was of the *M. magnimamma* group.

M. bocensis. See above.

M. crebrispina DC. A plant bearing this name at the Berlin-Dahlem botanic garden in 1985 was *M. magnimamma* sens. lat.

M. duwei Rogozinski & P. J. Braun in KuaS 36(8): 158-164, with figs. (1985). Type: *Duwe & Rogozinski* 1 (KOELN). See *M. nana* (Bradleya 4:39. 1986)

M. glassii var. *nominis-dulcis* Lau in CSJA 57(5):198, with figs. (1985). Type: *Lau* 1186A (MEXU); *M. glassii* var. *siberiensis* Lau, l.c. Type: *Lau* 1332 (MEXU). See *M. schwarzii*.

M. kleiniorum Appenzeller in Mitt. AfM 10(6):197-203 (1986). Source: Mexico, Michoacan, Iquiplan, 20 Apr. 1984, *Klein* 190a (ZSS AA 50-200, holotype).

Series STYLOTHELAE. Said to be close to *M. jaliscana* and *M. zacatecasensis*, but differentiated by the stem-shape (to 13cm diam.) and larger flowers (2 × 2cm).

M. limonensis Reppenhagen in KuaS 36(3):44-46, with figs. (1985). Source: Mexico, Jalisco, El Limon, 2 Mar. 1980, Reppenhagen 1620 (K). See *M. variabilis*.

M. paradensis Hort. (cf. W. Maddams in JMS 20:56. 1980)

Numerous *nomina nuda* from Reppenhagen's Feldnummernverzeichnis 1959-1984 (Arbeitskr. Mamm., Sonderheft, 1985) have been listed by Woolcock in JMS 26:46-48 (1986). Validation of these names is expected in Reppenhagen's forthcoming monograph.

JOURNAL ACRONYMS

The following acronyms have been used in the alphabetical list in place of more conventional abbreviations:

BfK	[Backeberg,] Blätter für Kakteenforschung
CSJA	Cactus and Succulent Journal of the Cactus and Succulent Society of America
CSJGB	The Cactus and Succulent Journal of Great Britain
JDKG	Jahrbuch der Deutsche Kakteen-Gesellschaft
JMS	The Journal of the Mammillaria Society
KuaS	Kakteen und andere Sukkulente
MDKG	Monatsschrift der Deutsche Kakteen-Gesellschaft
MfK	Monatsschrift für Kakteenkunde
NCSJ	The National Cactus and Succulent Journal
ZfS	Zeitschrift für Sukkulentekunde

AUTHORITIES FOR SYNONYMY

As noted in the Introduction (Bradleya 1: 105), names long regarded as synonyms or unidentifiable are not annotated but (usually!) followed by a page reference in round brackets () to Craig's 'Mammillaria Handbook' (1945) or Backeberg's 'Die Cactaceae', vol. 5 (1961) & 6 (1962), e.g. '(Craig 323)', '(Backeb. 3261)', to indicate that the synonymy given is taken from one of these authors (although it very often goes back much further). Synonymy given without such a reference has been checked by

me, or is my own opinion. (The convention of using square brackets [] for spelling errors etc., also proposed in the Introduction (l.c.), has not been used very consistently, I'm afraid.)

Acknowledgments

This work, which is mainly one of bibliography, would not have been possible for me without the facilities of the Library of the Royal Botanic Gardens, Kew. For permission to reproduce various original and reprinted illustrations I am indebted to the Director and Trustees of the Royal Botanic Gardens, and to photographers Mark Eban, Ed Greenwood, Tudor Harwood, Margaret Martin, John Pilbeam, Kurt Schreiber, Nigel Taylor, Bill Weightman and Ron Zabeau. Nigel Taylor has also risked eye-strain with his diligent reading of the proofs, and made many helpful suggestions. My thanks, too, to the members of the Mammillaria Society, and its editor, Bill Maddams, who motivated and published the first version of this 'Review'; and to the members of the British Cactus and Succulent Society, who have subscribed to 'Bradleya' and made possible the publication of a new version.

Appendix

CLASSIFIED LIST AND INDEX OF RECOGNIZED TAXA

To conclude this 'Review', I am providing a summary of the species and subordinate taxa I currently recognize, arranged in the groups to which I have assigned them in the alphabetical list. The framework of subgenera, sections and series remains as given in my previous published list (Hunt in CSJGB 43: 41-48. 1981) and does not take account of subsequent developments, apart from the change in name of series Macrothelae to series Mammillaria (made from the letter 'D' onwards). Other necessary nomenclatural changes, and several significant taxonomic improvements that now seem possible, will be made in future publications.

As a general rule, the species-names printed in bold type in the alphabetical 'Review' have been those I recognized and numbered as species in my 1981 list. The main discrepancies are indicated below. The order of species also remains largely unchanged, except that I have moved *M. heidiae* from subg. Dolichothele to ser. Ancistracanthae and rearranged ser. Mammillaria (Macrothelae) to group all the northern and eastern species before the western.

Discrepancies between 1981 and 1987 lists

1. Additional numbered species (4)

M. hutchisoniana. 'Probably conspecific with *M. goodridgii* ... but the confused history of *M. goodridgii* argues against using that name for the mainland forms' (Bradleya 2: 92).

M. berkiana and **M. guillauminiana**. Probably closely allied to *M. zeilmanniana*, but recognized pending rediscovery of the latter in the wild.

M. perezdelarosae. Perhaps allied to *M. bombycina*, but recognized pending rediscovery of *M. bombycina*.

2. Species now treated as subordinate taxa (8)

M. albicans and *M. angelensis*. The status of these two taxa remains uncertain; they are listed provisionally under *M. dioica*.

M. canelensis. Referred to *M. standleyi*.

M. craigii (name given in bold type in the 'Review'). Now referred to *M. sonorensis*.

M. magallanii. Status uncertain; referred to *M. lasiacantha*.

M. sinistrohamata. Referred to *M. mercadensis*.

M. solisioides. Referred to *M. pectinifera* f. *solisioides*.

M. variegata. Referred to *M. mystax*.

3. Additional subordinate taxa (species names only)

M. hernandezii. Subordinate to *M. napina*.

M. leucocentra. Subordinate to *M. geminispina*.

4. Change of name

M. microcarpa. Preferred name is now *M. milleri*.

CLASSIFIED LIST

Genus **Mammillaria**

M. subgenus Mammilloidya

Type species: *M. candida*

1. *M. candida*

M. subgenus Oehmea

Type species: *M. beneckeii*

2. *M. beneckeii (M. nelsonii)*
M. colonensis
M. guienolensis

M. subgenus Dolichothele

Type species: *M. longimamma*

3. *M. longimamma*
 var. *longimamma*
 var. *uberiformis*
 4. *M. sphaerica*
 5. *M. melaleuca*
 6. *M. baumii*
 7. *M. carretii*
 8. *M. surculosa*

M. subgenus Cochemiea

Type species: *M. halei*

9. *M. pondii*
M. maritima
M. setispina
 10. *M. halei*
 11. *M. poselgeri*

M. subgenus Mamilloopsis

Type species: *M. senilis*

12. *M. senilis*
 var. *senilis*
 var. *diguettii*

M. subgenus Mammillaria

Section **Hydrochylus**

Series I. **Longiflorae**

Type species: *M. longiflora*

13. *M. longiflora*
 f. *longiflora*
 f. *stampferi*
 14. *M. saboae*
 var. *saboae*
 f. *saboae*
 f. *haudeana*
 var. *goldii*
 15. *M. theresae*
 16. *M. napina*
M. hernandezii
 17. *M. deherdtiana*
 var. *deherdtiana*
 var. *dodsonii*

Series II. **Ancistracanthae**

Lectotype species: *M. dioica*

18. *M. tetrancistra*
 19. *M. guelzowiana*
 20. *M. wrightii*
 var. *wrightii*
 f. *wrightii*
 f. *wolfii*
 var. *wilcoxii (M. meridiorosei)*
 21. *M. viridiflora (M. chavezii, M. orestera)*
 22. *M. barbata*
M. garessii
M. morricallii
M. santaclarensis
 23. *M. zephyranthoides*
 24. *M. heidiaea*

25. *M. mainiae*
 26. *M. thornberi*
 27. *M. yaquensis*
 28. *M. fraileana*
M. slevinii
 29. *M. occidentalis*
 30. *M. mazatlanensis*
M. patonii
 31. *M. sheldonii*
M. alamensis
M. gueldemanniana
(M. guirocobensis)
 32. *M. milleri (M. microcarpa, nom. prov.)*
 33. *M. grahamii*
M. oliviae
 34. *M. insularis*
 35. *M. boolii*
 36. *M. schumannii*
 37. *M. blossfeldiana*
M. shurliana
 38. *M. goodridgii*
 39. *M. hutchisoniana*
(M. bullardiana)
M. louisiae
 40. *M. swinglei*
M. inaiiae
 41. *M. multidigitata*
 42. *M. capensis*
 43. *M. armillata*
M. cerralboa
 44. *M. phitauiana*
 45. *M. dioica*
M. angelensis
M. estebanensis
M. albicans
 46. *M. neopalmeri*

Series III. **Stylothelae**

Type species: *M. wildii*

47. *M. fittkaui*
 48. *M. zeilmanniana*
 49. *M. guillauminiana*
 50. *M. berkiana*
 51. *M. bombycina*
 52. *M. perezdelarosa*
 53. *M. moelleriana*
M. cowperae
 54. *M. pennispinosa*
 var. *pennispinosa*
 var. *nazasensis*
 55. *M. mercadensis*
M. sinistrohamata
 56. *M. jaliscana*
M. kleiniorum
 57. *M. zacatecasensis*
 58. *M. rettigiana*
M. flavihamata
M. gilensis
M. posseltiana
 59. *M. weingartiana*
M. unihamata
 60. *M. stella-de-tacubaya*
M. gasseriana
 61. *M. mathildae*
 62. *M. erythrosperma*
M. multiformis
M. limonensis
M. variabilis
 63. *M. bocasana*
M. longicoma (M. knebeliana?)

64. *M. aurihamata (M. aureoviridis?, M. erectohamata?)*

65. *M. leucantha*
M. sanluisensis Hort. non Shurly
 66. *M. nana (M. eschanzieri?)*
 67. *M. pygmaea*
M. pubispina
 68. *M. painteri*
 69. *M. wildii (M. glochidiata?, M. schelhasei?)*
M. calleana
 70. *M. oteroi*
 71. *M. glassii*
 var. *ascensionis*
 var. *nominis-dulcis*
 var. *siberiensis*

Series IV. **Proliferae**

Type species: *M. prolifera*

72. *M. schwarzii*
 73. *M. prolifera*
 var. *prolifera*
 var. *arachnoidea*
 var. *haitiensis*
 var. *texana (M. multiceps, M. granulata?)*
 74. *M. pilispina*
M. sanluisensis Shurly
(M. subtilis)
 75. *M. albicoma*
 76. *M. picta*
M. anniana
M. aurisaeta
M. viereckii
 77. *M. vetula*
 78. *M. gracilis*

Series V. **Lasiacanthae**

Type species: *M. lasiacantha*

79. *M. lasiacantha*
M. denudata
M. egregia
M. lengdobleriana
M. magallanii
M. roseocentra?
 80. *M. plumosa*
 81. *M. carmenae*
 82. *M. schiedeana*
 var. *schiedeana*
 var. *dumetorum*
 83. *M. humboldtii*
 84. *M. laui*
 f. *laui*
 f. *dasyacantha*
 f. *subducta*
 85. *M. lenta*
 86. *M. aureilana*
 87. *M. herrerae*
 var. *herrerae*
 var. *albiflora*
 88. *M. pectinifera*
 f. *pectinifera*
 f. *solisoides*

Series VI. **Sphacelatae**

Type species: *M. sphacelata*

89. *M. kraehenbuehlii*
 90. *M. sphacelata*
 var. *sphacelata*
 var. *viperina*
 91. *M. tonalensis*

Series VII. **Leptocladodae**

Type species: *M. elongata*

92. *M. pottsi*
93. *M. elongata*
 M. echinaria
94. *M. microhelia*
 M. microheliopsis
95. *M. densispina*
 M. mieheana

Series VIII. **Decipientes**

Type species: *M. decipiens*

96. *M. decipiens*
 M. albescens
 M. camptotricha

Section **Subhydrochylus**

Type species: *M. guerreronis*

Series IX. **Heterochlorae**

Lectotype species: *M. discolor*

97. *M. rhodantha*
 M. aureiceps
 M. calacantha
 M. fera-rubra
 M. mollendorffiana
 M. mundtii Hort.
 M. pringlei
98. *M. polythele*
 M. durispina
 M. kewensis
 M. obconella
99. *M. wiesingeri*
 M. erectacantha Hort.
100. *M. discolor*
 M. esperanzaensis
 M. schmollii

Series X. **Polyacanthae**

Type species: *M. spinosissima*

101. *M. backebergiana*
 M. ernestii
102. *M. meyranii*
 M. bambusiphila
103. *M. matudae*
104. *M. spinosissima*
 M. auricoma
 M. centraliolumosa
 M. gasterantha
 M. pilcayensis
 M. virginis
 M. tomentosa?
105. *M. nunezii*
 M. bella
 M. hubertmulleri
106. *M. guerreronis*
107. *M. reko*
 var. *reko*
 var. *aureispina*
 var. *leptacantha*
 M. pseudoreko?
108. *M. duiformis*
 M. erythrocalix
 M. rossiana
 M. hamata?
109. *M. magnifica*
110. *M. xaltianguiensis*
111. *M. eriacantha*

Series XI. **Supertextae**

Type species: *M. supertexta*

112. *M. haageana*
 var. *haageana*
 M. collina (*M. elegans* Hort.)
 M. conspicua
 M. san-angelensis

- M. vaupelii*
 var. *schmollii*
113. *M. supertexta* (*M. lanata*,
 M. martinezii)
114. *M. crucigera*
115. *M. huitzilopochtli*
116. *M. dixanthocentron*
 M. flavicentra
117. *M. albilanata*
 M. fuauxiana
 M. reppenhausenii
 M. tegelbergiana
 M. halbingeri?
118. *M. columbiana*
 M. ruestii
 M. yucatanensis

Section **Mammillaria** (*Galactochylus*)

Series XII. **Leucocephalae**

Type species: *M. parkinsonii*

119. *M. geminispina*
 M. leucocentra
120. *M. perbella*
 M. cadereytensis
 M. infernillensis
 M. queretaria
 M. rosensis?
 M. vonwyssiana?
121. *M. hahniana*
 M. bravoae
 M. mendeliana
 M. woodsii
 M. saetigera?
122. *M. klissingiana*
 M. brauneana
123. *M. muehlenpfordtii*
124. *M. parkinsonii*
 M. auriareolis
125. *M. chionocephala*
 M. rittriana
 M. caerulea
126. *M. formosa*
 M. microthele
127. *M. sempervivi*
 M. pseudocrucigera

Series XIII. **Mammillaria** (*Macrothelae*)

Type species: *M. mammillaris*

128. *M. mammillaris*
 M. pseudosimplex?
129. *M. nivosa*
 M. ekmanii?
130. *M. heyderi*
 M. gaumeri
 M. gummifera
 M. hemisphaerica (*M. applanata*)
 M. macedougali
 M. meiacantha
 M. sororia?
131. *M. grusonii*
 M. pachycylindrica
132. *M. zeyeriana*
 M. wagneriana?
133. *M. coahuilensis*
 M. albiarmata
134. *M. uncinata*
 M. lloydii?
135. *M. melanocentra*
136. *M. rubrograndis*
137. *M. petterssonii*
 M. obscura?
138. *M. gigantea*
 M. hamiltonhoytea
 M. ocotillensis

139. *M. winterae*
 M. zahniana
140. *M. rosealba*
141. *M. magnimamma*
 M. bucareliensis
 M. macracantha?
 M. vagaspina
 M. zuccariniana
142. *M. compressa*
 M. esseriana?
 M. conopsea
143. *M. scrippsiana*
 M. pseudoscrippsiana
144. *M. standleyi*
 M. auricantha
 M. auritricha
 M. bellacantha
 M. canelensis
 M. floresii
 M. laneusumma
 M. mayensis
 M. montensis
 M. xanthina?
145. *M. hertrichiana*
146. *M. miegiana*
147. *M. tayloriorum*
148. *M. sonorensis*
 M. bellisiana
 M. craigii
 M. movensis
 M. tesopacensis
149. *M. bocensis*
 M. neoschwarzeana
 M. rubida
 M. ortegae?
150. *M. johnstonii*
151. *M. lindsayi*
152. *M. marksiana*
153. *M. brandegeei*
 M. gabbii
 M. lewisiana
 M. glareosa (*M. dawsonei*)
154. *M. peninsularis*
155. *M. baxteriana*
156. *M. petrophila*
 M. arida
 M. gatesii
 M. marshalliana
 M. pacifica
157. *M. evermanniana*

Series XIV. **Polyedrae**

Type species: *M. polyedra*

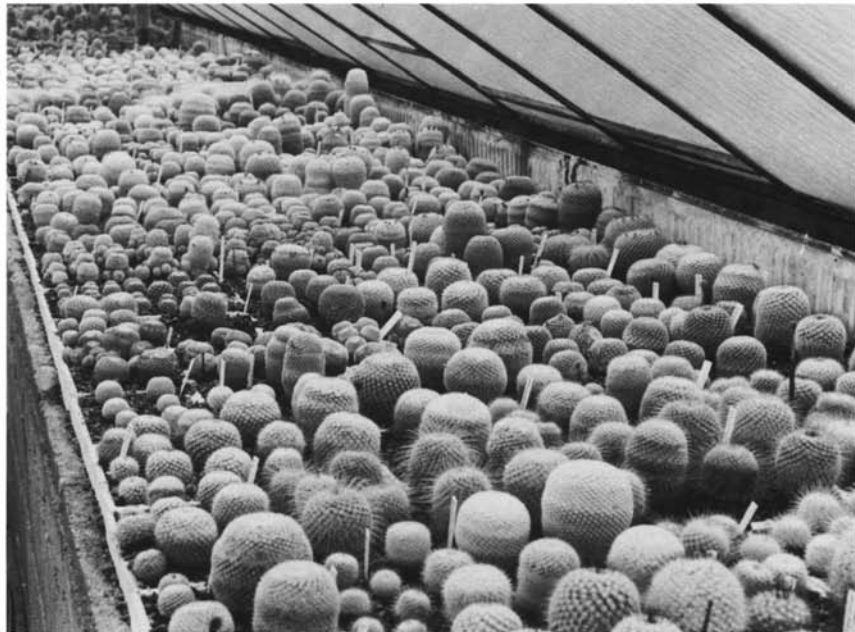
158. *M. knippeliana*
159. *M. karwinskiana* (*M. confusa*,
 M. conzattii)
 M. multiset?
 M. nejapensis
 M. neomystax
 M. praelii?
160. *M. voburnensis*
 M. beiselii
 M. collinsii
 M. eichlamii
161. *M. polyedra*
162. *M. carnea*
 M. orcuttii?
163. *M. sartorii* (*M. tenampensis*)
 M. echinops?
164. *M. mystax*
 M. casoi
 M. crispiseta
 M. huajuapensis
 M. mixtecensis
 M. varieaculeata

INDEX TO CLASSIFIED LIST

Recognized species are in roman type, subordinate taxa and synonyms in italic. Varietal and forma epithets are only included for those subordinate taxa which have no name at specific rank, or where the correct infraspecific epithet differs from the correct epithet at specific rank.

<i>alamensis</i>	31	<i>conspicua</i>	112	grusonii	131	mammillaris	128
<i>albescens</i>	96	<i>conzattii</i>	159	<i>gueldemanniana</i>	31	<i>maritima</i>	9
<i>albiarmata</i>	133	<i>cowperae</i>	53	guelzowiana	19	marksiana	152
<i>albicans</i>	45	<i>craigii</i>	148	guerreronis	106	<i>marshalliana</i>	156
albicoma	75	<i>crispiseta</i>	164	<i>guiengolensis</i>	2	<i>martinezii</i>	113
<i>albiflora</i>	87	crucigera	114	guillauminiana	49	mathildae	61
albilanata	117			<i>gummifera</i>	130	matudae	103
<i>angelensis</i>	45	<i>dawsonii</i>	153			<i>mayensis</i>	144
<i>anniana</i>	76	deciapiens	96	haageana	112	mazatlanensis	30
<i>applanata</i>	130	deherdtiana	17	<i>haageana</i> var. <i>schmollii</i>	136	<i>meiacantha</i>	130
<i>arida</i>	156	densispina	95	hahniana	121	melaleuca	5
armillata	43	<i>denudata</i>	79	<i>halbingeri</i>	117	melanocentra	135
<i>ascensionis</i>	71	<i>diguetii</i>	12	halei	10	<i>mendeliana</i>	121
<i>aureiceps</i>	97	dioica	45	<i>hamata</i>	108	mercadensis	55
aureilanata	86	dicolor	100	<i>hamiltonhoytea</i>	138	meyranii	102
<i>aureoviridis</i>	64	dixanthocentron	116	<i>haudeana</i>	14	<i>microcarpa</i>	32
<i>auriariolis</i>	124	<i>dodsonii</i>	17	heidiae	24	microhelia	94
<i>auricantha</i>	144	<i>dumetorum</i>	81	<i>hemisphaerica</i>	130	<i>microheliopsis</i>	94
<i>auricoma</i>	104	duoformis	108	<i>hernandezii</i>	16	<i>microthele</i>	126
aurihamata	64	<i>durispina</i>	98	herrerae	87	miegiana	146
<i>aurisaeta</i>	76			hertrichiana	145	<i>mieheana</i>	95
<i>auritricha</i>	144	<i>echinaria</i>	93	heyderi	130	milleri	32
		<i>echinops</i>	163	<i>hoffmanniana</i>	98	<i>mixtecensis</i>	164
backebergiana	101	<i>egregia</i>	79	<i>huajuapensis</i>	164	moelleriana	53
<i>bambusiphila</i>	102	<i>eichlamii</i>	160	<i>hubertmulleri</i>	105	<i>mollendorffiana</i>	97
barbata	22	<i>ekmanii</i>	129	huitzilopochtli	115	<i>montensis</i>	144
baumii	6	<i>elegans</i> Hort.	112	humboldtii	83	<i>morralii</i>	22
baxteriana	155	elongata	93	hutchisoniana	39	<i>movensis</i>	148
<i>beisei</i>	160	<i>erectacantha</i>	99			muehlenpfordtii	123
<i>bella</i>	105	<i>erectohamata</i>	64	<i>inaiae</i>	40	<i>multiceps</i>	73
<i>bellacantha</i>	144	eriocantha	111	<i>infernilensis</i>	120	multidigitata	41
<i>bellisiana</i>	148	<i>ernestii</i>	101	insularis	34	<i>multiformis</i>	62
benecke	2	<i>erythrocalix</i>	108			<i>multiseta</i>	159
berkiana	50	erythrosperma	62	jaliscana	56	<i>mundtii</i>	97
blossfeldiana	37	<i>eschanzieri</i>	66	johnstonii	150	mystax	164
bocasana	63	<i>esperanzaensis</i>	100			nana	66
bocensis	149	<i>esseriana</i>	142	karwinskiana	159	napina	16
bombycina	51	<i>estebanensis</i>	45	<i>kewensis</i>	98	<i>nejapensis</i>	159
boolii	35	evermanniana	157	<i>kleiniorum</i>	56	<i>nelsonii</i>	2
brandegeei	153			klissingiana	122	<i>neomystax</i>	159
<i>brauneana</i>	122	<i>fera-rubra</i>	97	<i>knebeliana</i>	63	neopalmeri	46
<i>bravoae</i>	121	fittkau	47	knippeliana	158	<i>neoschwarzearna</i>	149
<i>bucareliensis</i>	141	<i>flavicentra</i>	116	kraehenbuehlii	89	nivosa	129
<i>bullardiana</i>	39	<i>flavihamata</i>	58			nunezii	105
		<i>floresii</i>	144	<i>lanata</i>	113		
<i>cadereyensis</i>	120	formosa	126	<i>laneusumma</i>	144	<i>obconella</i>	98
<i>caerulea</i>	125	fraileana	28	lasiacantha	79	<i>obscura</i>	137
<i>calacantha</i>	97	<i>fuaxiana</i>	117	loui	84	occidentalis	29
<i>calleana</i>	69			<i>loui</i> f. <i>dasyacantha</i>	84	<i>ocotillensis</i>	138
<i>camptotricha</i>	96	<i>gabbii</i>	153	<i>loui</i> f. <i>subducta</i>	84	<i>orcuttii</i>	162
candida	1	<i>garensii</i>	22	<i>lengdobleriana</i>	79	<i>ortegae</i>	149
<i>canelensis</i>	144	<i>gasseriana</i>	60	lenta	85	oteroi	70
capensis	42	<i>gasterantha</i>	104	leucantha	65		
carmenae	81	<i>gatesii</i>	156	<i>leucocentra</i>	119	<i>pachycylindrica</i>	131
carnea	162	<i>gaumeri</i>	130	<i>lewisia</i>	153	<i>pacifica</i>	156
carretii	7	geminispina	119	<i>limonensis</i>	62	painteri	68
<i>caso</i>	164	gigantea	138	lindsayi	151	parkinsonii	124
<i>centralplumosa</i>	104	<i>gilensis</i>	58	<i>lloydii</i>	134	<i>patonii</i>	30
<i>cerralboa</i>	43	<i>glareosa</i>	153	<i>longicoma</i>	63	pectinifera	88
<i>chavezii</i>	21	glassii	71	longiflora	13	peninsularis	154
chionocephala	122	<i>glassii</i> var.		longimamma	3	pennispinosa	54
coahuilensis	133	<i>nominis-dulcis</i>	71	<i>louisiae</i>	39	<i>pennispinosa</i> var.	
<i>collina</i>	112	<i>glassii</i> var. <i>siberiensis</i>	71			<i>nazasensis</i>	54
<i>collinsii</i>	160	<i>glochidiata</i>	69	<i>macdougalii</i>	130	perbella	120
<i>colonensis</i>	2	<i>goldii</i>	14	<i>macracantha</i>	141	perezdelarosae	52
columbiana	118	goodridgii	38	<i>magallanii</i>	79	petrophila	155
compressa	142	gracilis	78	magnifica	109	petterssonii	137
<i>confusa</i>	159	grahamii	33	magnimamma	141	phitauiana	44
<i>conopsea</i>	142	<i>granulata</i>	73	mainiae	25		

<i>picta</i>	76	<i>reppenhagenii</i>	117	<i>solisioides</i>	88	<i>vaupelii</i>	112
<i>pilcayensis</i>	104	<i>rettigiana</i>	58	<i>sonorensis</i>	148	<i>vetula</i>	77
<i>pilisplina</i>	74	<i>rhodantha</i>	97	<i>sororia</i>	130	<i>viereckii</i>	76
<i>plumosa</i>	80	<i>ritteriana</i>	125	<i>sphacelata</i>	90	<i>viperina</i>	90
<i>polyedra</i>	161	<i>rosensis</i>	120	<i>sphaerica</i>	4	<i>virginis</i>	104
<i>polythele</i>	98	<i>roseoalba</i>	140	<i>spinosissima</i>	104	<i>viridiflora</i>	21
<i>pondii</i>	9	<i>roseocentra</i>	79	<i>stampferi</i>	13	<i>voburnensis</i>	160
<i>poselgeri</i>	11	<i>rossiana</i>	108	<i>standleyi</i>	144	<i>vonwyssiana</i>	120
<i>posseltiana</i>	58	<i>rubida</i>	149	<i>stella-de-tacubaya</i>	60		
<i>pottsii</i>	92	<i>rubrograndis</i>	136	<i>subtilis</i>	74	<i>wagneriana</i>	132
<i>praelii</i>	159	<i>ruetii</i>	118	<i>supertexta</i>	113	<i>weingartiana</i>	59
<i>pringlei</i>	97	<i>saboeae</i>	14	<i>surculosa</i>	8	<i>wiesingeri</i>	99
<i>prolifera</i>	73	<i>saetigera</i>	121	<i>swinglei</i>	40	<i>wilcoxii</i>	20
<i>prolifera</i> var.		<i>san-angelensis</i>	112			<i>wildii</i>	69
<i>arachnoidea</i>	73	<i>sanluisensis</i> Hort.	65	<i>tayloriorum</i>	147	<i>winterae</i>	139
<i>prolifera</i> var.		<i>sanluisensis</i> Shurly	74	<i>tegelbergiana</i>	117	<i>woodsii</i>	121
<i>haitiensis</i>	73	<i>santaclarensis</i>	22	<i>tenampensis</i>	163	<i>wrightii</i>	20
<i>prolifera</i> var. <i>texana</i>	73	<i>sartorii</i>	163	<i>tesopacensis</i>	148	<i>wrightii</i> f. <i>wolfii</i>	20
<i>pseudocrucigera</i>	127	<i>schelhasei</i>	69	<i>tetrancistra</i>	18		
<i>pseudorekoi</i>	107	<i>schiedeana</i>	82	<i>theresae</i>	15	<i>xaltiangueusis</i>	109
<i>pseudoscrippsiana</i>	143	<i>schmollii</i>	100	<i>thornberi</i>	26	<i>xanthina</i>	144
<i>pseudosimplex</i>	128	<i>schumannii</i>	36	<i>tomentosa</i>	104		
<i>pubispina</i>	67	<i>schwarzii</i>	72	<i>tonalensis</i>	91	<i>yaquensis</i>	27
<i>pygmaea</i>	67	<i>scrippsiana</i>	143			<i>yucatanensis</i>	117
		<i>sempervivi</i>	127	<i>uberiformis</i>	3		
<i>queretarica</i>	120	<i>senilis</i>	12	<i>uncinata</i>	134	<i>zacatecasensis</i>	57
		<i>setispina</i>	9	<i>unihamata</i>	59	<i>zahniana</i>	139
<i>rekoi</i>	107	<i>sheldonii</i>	31			<i>zeilmanniana</i>	48
<i>rekoi</i> var. <i>aureispina</i>	107	<i>shurliana</i>	37	<i>vagaspina</i>	141	<i>zephyranthoides</i>	23
<i>rekoi</i> var.		<i>sinistrohamata</i>	55	<i>variabilis</i>	62	<i>zeyeriana</i>	132
<i>leptacantha</i>	107	<i>slevinii</i>	28	<i>varieaculeata</i>	164	<i>zuccariniana</i>	141



'... I give up on *elegans*—please, no more *elegans*!'

(JMS 9: 7, 1969)

A revision of the genus *Thelocactus* B. & R. (Cactaceae)

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Summary. *Thelocactus bicolor* and *T. hexaedrophorus* are compared to *Ferocactus hamatacanthus* and *Hamatocactus setispinus* in 19 characters. *H. setispinus* has a greater similarity to *T. bicolor* than to the other 2 species and is placed in *Thelocactus* as *T. setispinus* (comb. nov.). The following characteristics of *Thelocactus* are discussed: ribs and tubercles, areoles, spines and extrafloral nectaries, epidermis, outer cell layers, druses and crystals, flowers, pollen, fruits, and seeds. Ecological characteristics, such as distribution, soils, habitat characteristics, sympatry, and associated plants, are described. The relationships and general features of each species are considered. In the section on formal taxonomy *Thelocactus* is redefined to include *T. setispinus*, *T. bicolor*, *T. leucacanthus*, *T. macdowellii*, *T. tulensis*, *T. hastifer*, *T. conothelos*, *T. heterochromus*, *T. hexaedrophorus*, *T. lausseri*, and *T. rinconensis*.

Zusammenfassung. Eine Revision der Gattung *Thelocactus* B. & R. (Cactaceae). *Thelocactus bicolor* und *T. hexaedrophorus* werden aufgrund von 19 Merkmalen mit *Ferocactus hamatacanthus* und *Hamatocactus setispinus* verglichen. *H. setispinus* zeigt eine grössere Ähnlichkeit zu *T. bicolor* als die beiden anderen Arten und wird deshalb als *T. setispinus* (comb. nov.) in die Gattung *Thelocactus* gestellt. Die folgenden Eigenschaften von *Thelocactus* werden diskutiert: Rippen und Warzen, Areolen, Bedornung und extraflorale Nektarien, Epidermis, äussere Zellschichten, Drusen und Kristalle, Blüten, Pollen, Früchte, und Samen. Oekologische Merkmale wie Verbreitung, Bodentypen, Standort-eigenschaften, Sympatrie, und vergesellschaftete Pflanzen, werden beschrieben. Für jede Art werden die verwandtschaftlichen Beziehungen und generellen Merkmale angegeben. Die Gattung *Thelocactus* wird formell emendiert und umfasst nun *T. setispinus*, *T. bicolor*, *T. leucacanthus*, *T. macdowellii*, *T. tulensis*, *T. hastifer*, *T. conothelos*, *T. heterochromus*, *T. hexaedrophorus*, *T. lausseri*, und *T. rinconensis*.

Introduction

Thelocactus was proposed by Britton and Rose (1922, 1923) as a major group in their subtribe 'Coryphanthanae', but there has been considerable confusion about the boundaries of this genus ever since it was erected. This paper is based upon nearly 25 years of research on species within the general boundaries of the genus as proposed by Britton and Rose over 50 years ago. An earlier paper (Anderson and Ralston, 1978) described

many of the characters of the genus and proposed that the species of *Gymnocactus* be included in *Thelocactus*. However, a more recent paper (Anderson, 1986) revised the earlier conclusions regarding *Gymnocactus* and included its species in the newly-defined genus *Neolloydia*. This paper now deals with those species that have commonly been included in the genus *Thelocactus*, as well as the type species of *Hamatocactus*, *H. setispinus*.

The circumscription of *Thelocactus* is difficult at best. Some members have little specialization, whereas others have numerous specialized structures. Most species are also highly variable, particularly with regard to the most evident features, such as body shape (tubercles, ribs, etc.), spination, and flower colour. Numerous intermediate forms also exist, not only among populations of species, but also between species and even between *Thelocactus* and related genera. The delimitation of the genus is thus exceedingly difficult because almost all its basic characters are inconsistent in those species commonly accepted as belonging within the genus, or they are found in other closely related genera. The 'Gymnocactus' group is a good case in point. Anderson and Ralston's paper (1978) argued that it should be included in *Thelocactus*. However, subsequent studies of other 'Coryphanthanae' suggested somewhat different generic boundaries. Thus, *Neolloydia* has been redefined (Anderson, 1986) to include the species of *Gymnocactus* as well as those of *Normanbokea* and *Turbinicarpus*. Early in the study of *Neolloydia* serious consideration was given to making *Thelocactus* a larger, more inclusive genus containing *Neolloydia*, *Gymnocactus*, *Normanbokea*, and *Turbinicarpus*. This attempt led to considerable frustration as few consistent, clear characters could be found to delimit the group. For practical purposes, as well as sound taxonomic ones, the idea was abandoned. However, *Thelocactus* clearly is closely related to *Neolloydia*; it is also evident that it consists of several loosely related species and species groups having relationships to other genera in the Tribe Cactaeae sensu F. Buxbaum (1974).

Accepted for publication 20 January 1987.

Several interesting evolutionary and developmental trends occur in such *Thelocactus* characters as extrafloral nectaries, seeds, the nature of the epidermis and hypodermis, pollen, fruits, and ribs developing into tubercles. Even neoteny occurs within the genus, though it is not so evident as in *Neolloydia*.

More than 50 taxa at the specific and infraspecific levels have been included in this genus at one time or another; this has led to considerable taxonomic and nomenclatural confusion when attempting to deal with these often poorly defined groups. As is also common in all groups of cacti, almost no type material has been preserved, and in many cases type localities are unknown. Therefore, typification is clearly essential to understanding the nomenclature of this poorly defined genus as some proposed taxa are unable to be determined without reference to a specific specimen or illustration.

Materials and methods

Field work was done in Texas and Mexico on 11 field trips during the years 1957-86. In several cases cited localities have been purposely vague for conservation reasons. Herbarium specimens of field-collected material were deposited in US, WCW, POM, HNT, ZSS, and K. Plants were grown in the Whitman College greenhouse in order to secure reproductive structures and tissues for laboratory study, and were then donated to HNT and ZSS as part of their permanent living collections. Anatomical studies with the light microscope used the usual paraffin embedding procedure; materials were sectioned at 15-32 μ m and stained in safranin and fast green dyes (Johansen, 1940; Anderson & Ralston, 1978). Crystals were studied with a polarizing attachment. Analysis of pollen, seeds, spines, epidermis, and outer cell layers under the Scanning Electron Microscope was performed primarily at the Battelle Pacific Northwest Laboratories using JEOL JSM-U3 and JSM-25SIII microscopes and at Whitman College on a JEOL T-300 SEM. Stem materials were free-hand sectioned, killed and fixed in a McDowell-Trump fixative (McDowell, 1978), dehydrated in an acetone series, and critical point dried with Freon TF or carbon dioxide using a procedure developed by R. Adey (Anderson & Skillman, 1984). They were then either sputter coated with gold-palladium or coated with carbon and gold in a rotary evaporator. Soils were analysed with a Simplex soil testing kit and a Beckman Zeromatic pH meter.

Herbarium specimens were borrowed from MO, POM, RSA, US, TEX, NY, and SRSC. Other specimens were examined on visits to GH, K, MEXU, BM, Z, UNM, and ZSS. Voucher specimens are preserved in the Whitman College Herbarium (WCW). All cited specimens have been seen by the author unless stated otherwise.

The relationship of *Hamatocactus setispinus* to *Thelocactus*

It has been suggested by several workers on the Cactaceae that *Hamatocactus setispinus* is not closely related to *Echinocactus hamatacanthus*, which Knuth (1935) placed in *Hamatocactus*; this was accepted by Backeberg (1961) and others. More recently Taylor &

Clark (1983: 4) and Taylor (1984) investigated the relationship of *E. hamatacanthus* and placed it in *Ferocactus*. In this paper a comparison is made of *H. setispinus*, *F. hamatacanthus*, *T. bicolor*, and *T. hexaedrophorus*. A total of 30 characters have been studied, the same ones used in the *Neolloydia* investigation (Anderson, 1986). However, only 19 show variation within the 4 species. Unfortunately, the data do not produce a clear answer to the question of where *H. setispinus* should be placed. Table 1 summarizes the 19 characters. *Hamatocactus setispinus* and *F. hamatacanthus* are similar in 7 characters (ribs, hooked spines, flower colour, absence of druses and crystals, seed diameter, indehiscent fruits, and extrafloral nectaries). However, they differ in 12 characters (flower diameter, bicoloured flowers, wavy epidermis, seed shape, testa type, testa texture, hilum location, fruit length, fruit colour at maturity, pollen diameter, pollen shape, and pollen aperture number). Taylor (1984) reported bicoloured flowers and pinkish-red fruits in var. *hamatacanthus*, but I have observed only yellow flowers and greenish-magenta fruits.

The greatest similarity appears to be between *H. setispinus* and *T. bicolor*. Ten of the 19 characters are alike between the 2 species: presence of ribs, bicoloured flowers, pollen diameter, pollen shape, pollen aperture number (Figs. 1-2), exine type, seed shape, testa type, hilum location, and extrafloral nectaries (Figs. 3-4). However, many of these are either seed or pollen characters. The 9 characters by which they differ are hooked central spines, flower diameter, flower colour, epidermis margin, presence of druses, testa texture, fruit length, fruit colour, and fruit dehiscence.

The type species of *Thelocactus* is *T. hexaedrophorus*, a taxon more typical of the other species of *Thelocactus* than is *T. bicolor*. When *T. hexaedrophorus* is compared to *H. setispinus*, only 4 of the 19 characters are similar: flower diameter, seed shape, testa type (usually), and hilum location. Three of the similar characters therefore are of the seeds.

Several previous studies (Buxbaum, 1950-53; Anderson and Boke, 1969; Leuenberger, 1974; Barthlott and Voit, 1979; Bregman and Bouman, 1983; Taylor and Clark, 1983; Barthlott, 1984; Anderson, 1986) have emphasized the evolutionary importance of seeds. The mussel-shaped (*miesmuschelformige* of Barthlott & Voit, 1979) seed having a 'lateral' hilum, such as in *F. hamatacanthus* (Fig. 5), is thought to be in a different evolutionary line than the pyriform seeds with a 'basal' hilum, such as in *Thelocactus* and *H. setispinus* (Figs. 6-7) (Bregman and Bouman, 1983; Anderson, 1986). Although one must be aware of ecological modifications of characters, most evidence indicates that seed characters tend to be relatively conservative and less affected by environmental factors. It appears unlikely that the same genus would have two evolutionarily distinct types of seeds. Although they all have hooked spines, similar fruits, and similar appearance, the major differences of both seeds and pollen, apparently conservative structures with regard to evolutionary change, lead me to con-

Table 1. Comparison of *Thelocactus hexaedrophorus*, *T. bicolor*, *Hamatocactus setispinus* and *Ferocactus hamatacanthus*.

Character	<i>T. hexaedrophorus</i>	<i>T. bicolor</i>	<i>H. setispinus</i>	<i>F. hamatacanthus</i>
Ribs well developed	—	+	+	+
Central spines hooked	—	—	+	+
Flower diam. (cm)	4-5.5	5-8	4-5.5	6.5-10
Flower colour	white	magenta	yellow	yellow
Flower throat dark	—	+	+	—
Pollen diam. (μ m)	42-44	45-65	50-60	40-44
Pollen shape	sph-elong	sph	sph	elong
Pollen aperture no.	3	6-12	6-12	3
Epidermis w/wavy margin	—	—	+	—
Druses, crystals, etc.	+	+	—	—
Seed diam. (mm)	1.4-1.6	1.3-1.5	0.9-1.2	0.9-1.1
Seed shape	pyr	pyr	pyr	mus
Testa type	tess	ver	ver	pitted
Testa texture	sm-wart	var	rug	smooth
Hilum	basal	basal	basal	lateral
Fruit length (mm)	8-10	10-17	10-13	25-30
Fruit colour	green-magenta	green	red	green-magenta
Fruit dehiscent	+	+	—	—
Extrafloral nectaries	—	+	+	+

Key: + = present, — = absent; pollen shape: sph=spheroidal, elong=elongate; seed shape: pyr=pyriform, mus=mussel-shaped; testa type: tess=tessellate, ver=verrucose; testa texture: sm-wart=smooth-warty, var=variable, rug=rugose, w=cell wall.

clude that *H. setispinus* does not belong with the other species that have been included in *Hamatocactus*.

Pollen and seeds are similar in *H. setispinus* and *T. bicolor* (Figs. 1-2, 6-7). However, they differ with regard to the two traditionally important characters of spines (hooked vs. straight) and fruits (dehiscent vs. indehiscent) (Figs. 8-9). On the other hand, both have bicoloured flowers and well-developed ribs, two other easily-observed morphological characters.

The few common characters between *H. setispinus* and *T. hexaedrophorus* make the inclusion of the former species in *Thelocactus* a real problem; it simply makes the definition of the genus more difficult because several historically significant characters, such as straight spines and basally dehiscent fruits, can no longer be used. On the other hand, *H. setispinus* does have the same type of seed and most pollen characters are similar. Perhaps one's immediate inclination would be to reject the possibility that *H. setispinus* might belong in a newly and more broadly defined *Thelocactus*. However, an examination of the differences and similarities of *T. bicolor* with most of the other species of the genus shows it to be different in 10 of the 19 characters in Table 1, such as the nature of the flowers, some seed characters (testa texture, for example), and the presence of well-developed ribs. It would be inappropriate to separate *T. bicolor* from the genus for both historical and practical reasons.

There seem to be two possible decisions based on current data as to the disposition of *H. setispinus*, assuming that it is not related to the other species that have been placed in *Hamatocactus*. The first is to recognize *Hamatocactus*, which would be monotypic unless *T. bicolor* were removed from *Thelocactus* and also placed in it. In my opinion this makes the probable relationships among these species and species groups even more confusing. The second possible action would be to

include *H. setispinus* in a more broadly defined genus *Thelocactus*. This would recognize the apparent close relationship of this species with *T. bicolor* and the fact that the genus is a basic group having lines of evolution in several directions. *Thelocactus* would therefore be defined primarily on the basis of seed and pollen characters, a distinct geographic range and habitat, and some vegetative features (development of ribs and/or podaria, habit of growth, etc.). I feel it is important to recognize the close relationship of *H. setispinus* and *T. bicolor* without the ensuing problems of recognizing a separate genus. I therefore conclude that the former species should be included in a newly-defined genus *Thelocactus* as *T. setispinus*. This decision agrees with that of the I.O.S. Working Party report (1986) on the genera of Cactaceae.

Characteristics of *Thelocactus*

Some of the following characters were discussed by Anderson and Ralston (1978), but it is necessary to summarize them briefly in this paper so that the characters used in Table 1 can be better understood and evaluated.

Ribs and tubercles. The genus varies greatly with regard to these two characters. Britton and Rose (1922a) described their new genus as tuberculate. However, these structures vary from small and conical in species such as *T. hastifer* and *T. leucacanthus* (Plates I & II) to large and rounded in *T. heterochromus* and *T. hexaedrophorus* (Figs. 10 & 24 & Plate II). Likewise, ribs vary from strongly developed in such species as *T. bicolor*, *T. hastifer*, and *T. setispinus* (Fig. 9 & Plates I & II) to virtually or completely absent in *T. conothelos*, *T. tulensis* var. *buekii*, *T. rinconensis*, and *T. macdowellii* (Plates I-III).

Areoles. Buxbaum (1950-53) placed considerable emphasis on the presence or absence of an areolar groove. However, Anderson (1962) showed great variation within the genus *Ariocarpus* with regard to the com-

plete absence of a groove to the presence of very extensive ones. Species of *Thelocactus* do not develop grooves extending to the base of the tubercle (Fig. 10); therefore, the areoles are never truly dimorphic. The most accurate description of the areoles of *Thelocactus* is that they are round to elongate, sometimes developing a short groove or furrow.

Spines and Extrafloral nectaries. Schill, Barthlott, and Ehler (1973) wrote an important paper on cactus spines. It appears that the spines of *Thelocactus* do not demonstrate any significant taxonomic or evolutionary trends. Buxbaum (1950-53), Boke (1961), and Gibson and Nobel (1986) noted that extrafloral nectaries are homologous to spines and commented on some of the genera that possess them. Mauseth (1982) discussed their development and ultrastructure in *Ancistrocactus scheeri*, and Pickett and Clark (1979) described the ecological aspects of such nectaries in *Opuntia acanthocarpa*. No taxonomic studies of the cacti have involved a systematic analysis of them. Extrafloral nectaries are

present in *Ferocactus*, *Sclerocactus* (sensu lato), *Coryphantha*, and some species of *Thelocactus*. It appears that this character is a good one at the specific level, being both consistent and easy to recognize most of the year (Figs. 3-4). It is therefore used in the key to the species and included in the species descriptions. It is possible that the nectary may be a relatively primitive character of the Cactaceae, being present in *Opuntia*. It is also present in *Coryphantha*. Any evolutionary trends within *Thelocactus* are difficult to see; however, *T. leucacanthus*, which seems to have many primitive features and is the most southern in its distribution, does have extrafloral nectaries.

Epidermis. Considerable taxonomic significance has been given to various characters of the epidermis (Anderson and Boke, 1969; Boke and Anderson, 1970; Eggli, 1984; Anderson and Skillman, 1984). Gasson (1981) established the parameters of variation patterns within the Cactaceae. Epidermal margins vary widely in the genus. Some, as in *T. tulensis*, have more or less straight

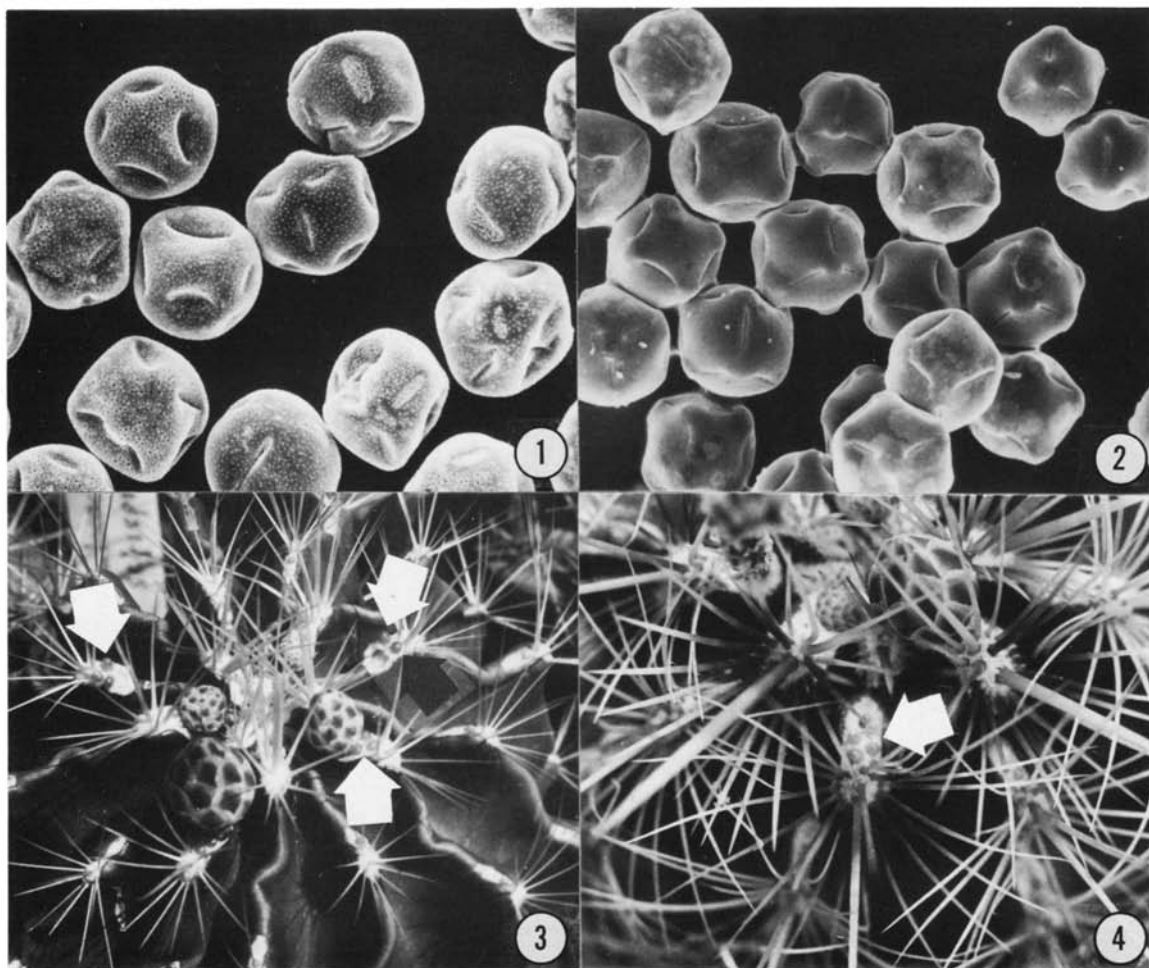


Fig. 1, pollen of *T. setispinus* (R. O. Albert in 1981)($\times 290$). Fig. 2, pollen of *T. bicolor* (E. F. Anderson 5090)($\times 260$). Fig. 3, extrafloral nectaries (arrows) of *T. setispinus* (R. O. Albert in 1981). Fig. 4, extrafloral nectaries (arrow) of *T. bicolor* (E. F. Anderson 5115).

walls and a polygonal shape (Fig. 11), while others, such as *T. setispinus*, *T. leucacanthus*, and *T. conothelos*, have wavy margins (Figs. 12-13). Still others, as in *T. rinconensis* and *T. hexaedrophorus*, are papillate (Fig. 14).

Gasson (1981) also reported that the Cactaceae consistently have paracytic stomatal subsidiary cells (Fig. 13). However, he did note that an additional cyclocytic ring was evident in *T. leucacanthus* and that the stomata are

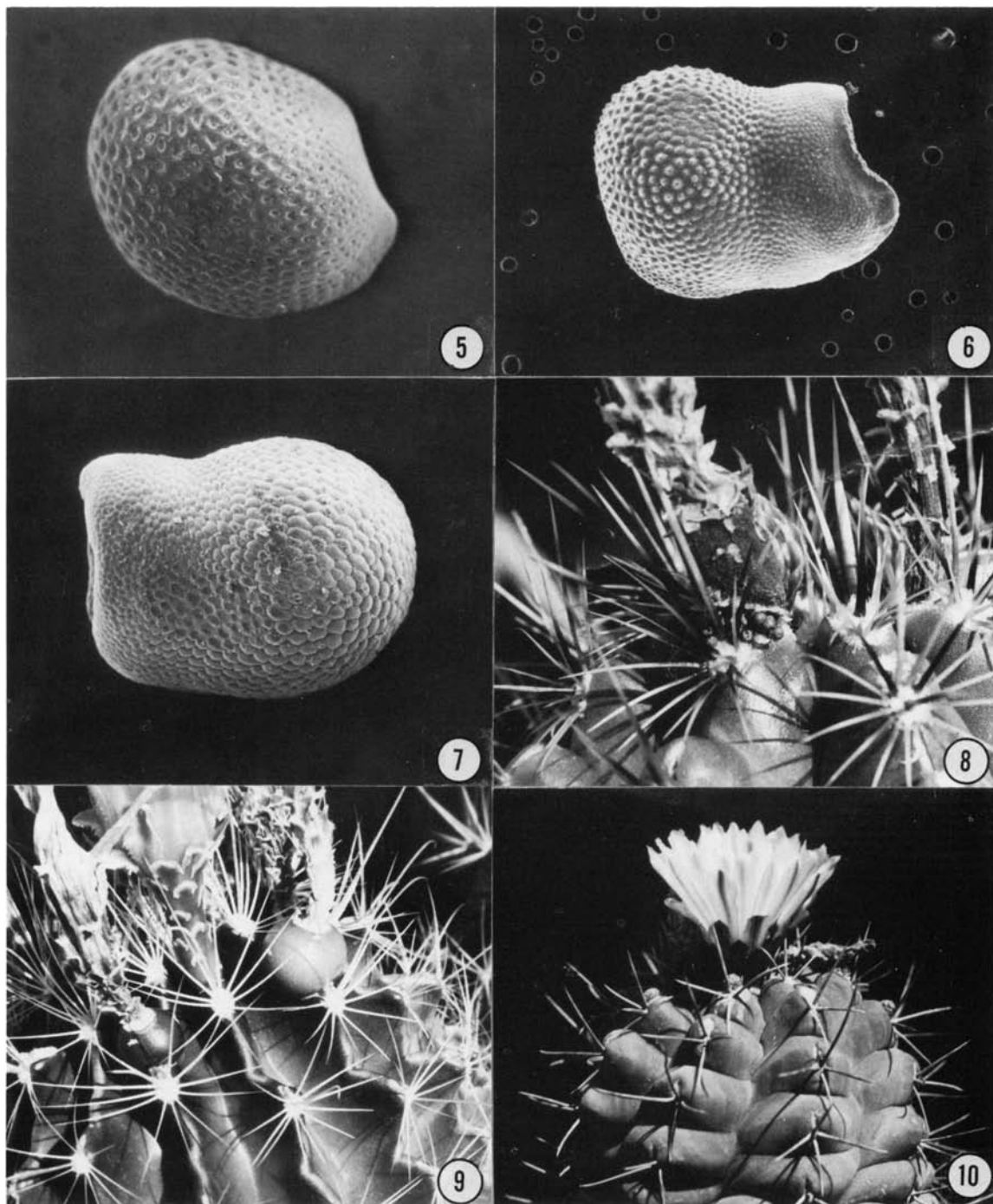


Fig. 5, seed of *Ferocactus hamatacanthus* (S. Brack 393)($\times 40$). Fig. 6, seed of *Thelocactus bicolor* (E. F. Anderson 1251)($\times 26$). Fig. 7, seed of *T. setispinus* (S. Brack 858)($\times 40$). Fig. 8, fruit of *T. bicolor* (E. F. Anderson 1243). Fig. 9, fruits of *T. setispinus* (R. O. Albert in 1981). Fig. 10, *T. hexaedrophorus* (E. F. Anderson 1722) showing partially developed areolar groove and flower without floral tube.

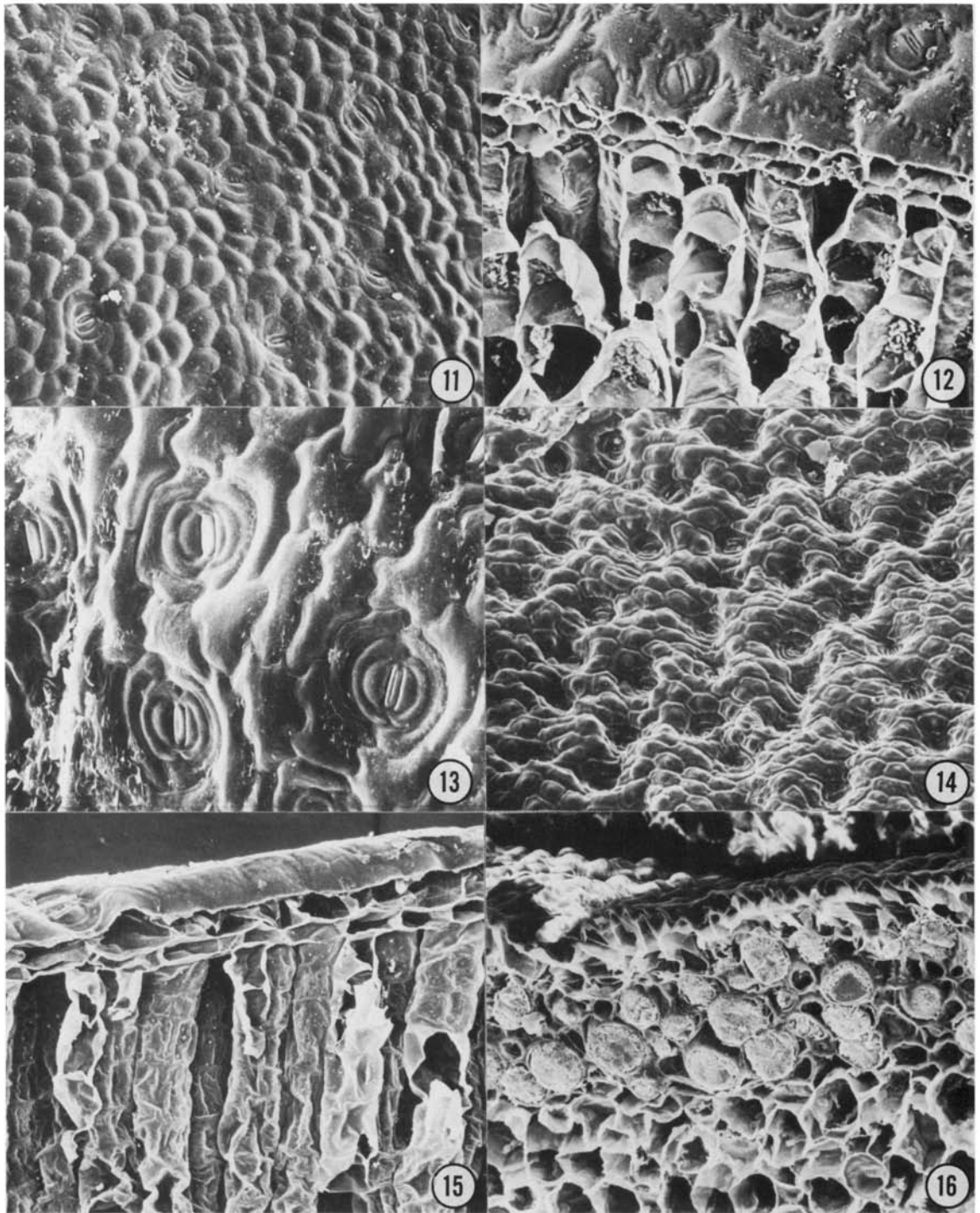


Fig. 11, epidermis of *T. tulensis* (E. F. Anderson 1734)($\times 90$). Fig. 12, epidermis and outer cell layers of *T. setispinus* (R. O. Albert in 1981)($\times 130$). Fig. 13, epidermis with paracytic stomata of *T. leucacanthus* (E. F. Anderson 3195)($\times 175$). Fig. 14, epidermis having papillate cells and sunken stomata of *T. hexaedrophorus* (E. F. Anderson 3198)($\times 90$). Fig. 15, outer cell layers of *T. bicolor* (E. F. Anderson 5132)($\times 130$). Fig. 16, outer cell layers of *T. rinconensis* (E. F. Anderson 3187) showing several-layered hypodermis and druses ($\times 175$).

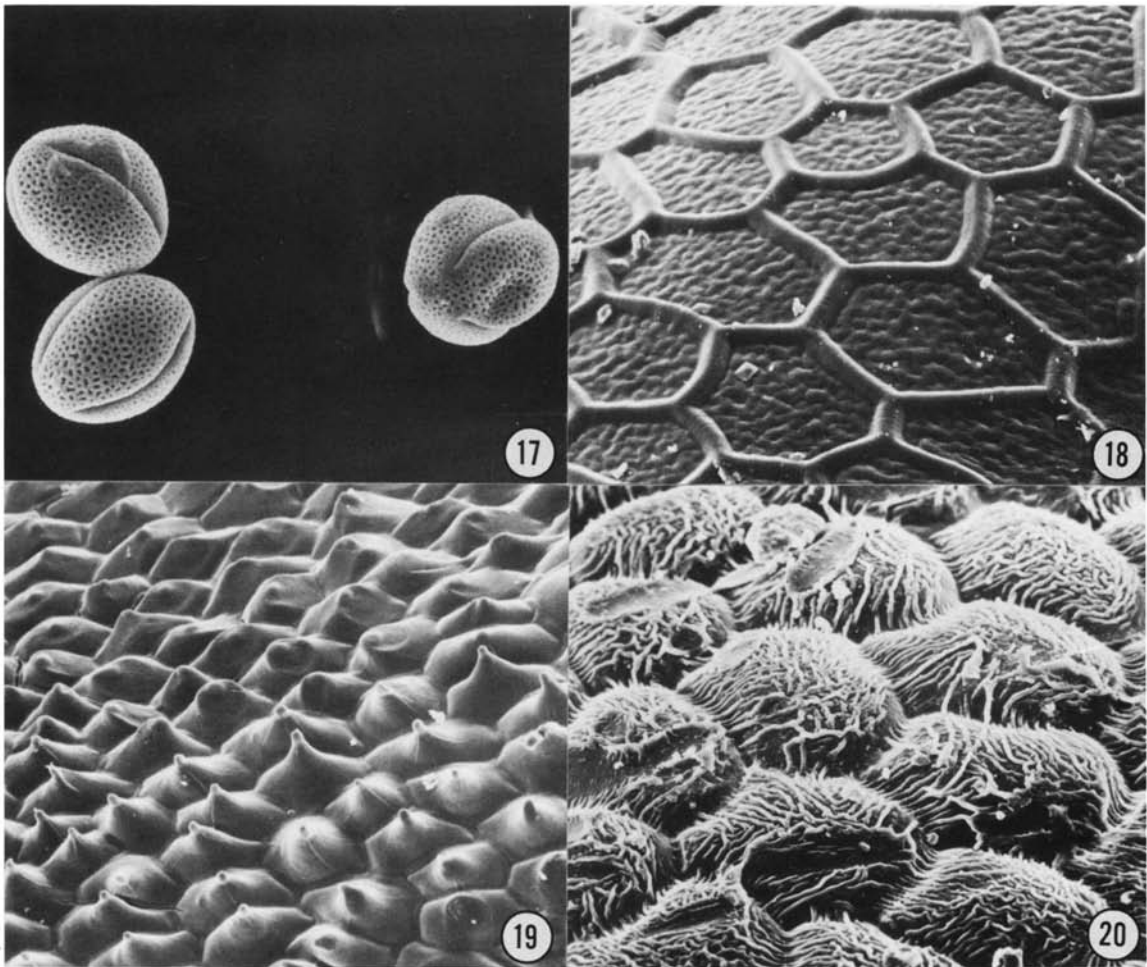


Fig. 17, pollen of *T. rinconensis* (E. F. Anderson 3190)($\times 400$). Fig. 18, tessellate testa with a smooth texture of *T. leucacanthus* (E. F. Anderson 3195)($\times 400$). Fig. 19, verrucose testa with a warty texture of *T. conothenos* (E. F. Anderson 1715)($\times 600$). Fig. 20, verrucose testa with a rugose texture of *T. setispinus* (S. Brack 858)($\times 400$).

sunken in *T. hexaedrophorus* (Fig. 14). Gasson (1981) also reported that the genus has relatively thick cuticle ($3.5\text{--}7\mu\text{m}$). It appears that characters of the epidermis can be of value in circumscribing species but not of such distinctness to be of value in delimiting *Thelocactus* from other closely related genera.

Outer cell layers. This anatomical region has provided a number of taxonomically important characters and their general structure has been discussed by Gasson (1981), Mauseth (1984), and Gibson & Nobel (1986). Anderson and Boke (1969) found the outer cell layers to be of value in their study of *Pelecypora*, as did Anderson and Skillman (1984) of *Aztekium* and *Strombocactus*. However, Anderson (1962, 1986) also showed that characters of the outer cell layers are not necessarily consistent within a single genus. Anderson and Ralston (1978) reported earlier that species of *Thelocactus* showed variation in their outer cell layers. Species of the genus all have one epidermal layer (Figs. 15-16). The

hypodermis is also of one layer (Figs. 12, 15) in all but one species, *T. rinconensis*, which has 2-3 layers (Fig. 16). *T. setispinus*, though different in epidermal surface outline, has only one hypodermal layer like most of the other species of *Thelocactus*.

Druses and crystals. All species of *Thelocactus*, except for *T. setispinus*, have druses and crystals in the hypodermis and cortex (Fig. 16).

Flowers. These are highly variable within the genus, both with regard to size and colour. However, all flowers of *Thelocactus* have an ovary with scales, a more or less funnel-form shape, and a poorly developed floral tube (Fig. 10) except in *T. conothenos*. Flower variations probably are due to ecological factors related to pollination, a subject that has not yet been studied extensively in the cacti. Floral characters, although varying considerably within the genus, still have taxonomic value in providing features for use in descriptions and keys.

Pollen. Pollen has been found to be of considerable

systematic significance, especially since publication of a major survey of pollen in the family by Leuenberger (1976a, 1976b). Several specific taxonomic studies have also successfully incorporated pollen characters (Anderson and Stone, 1971; Anderson and Skillman, 1984; Anderson, 1986). Two basic pollen types are found in *Thelocactus*: a spherical, polycolpate type (Figs. 1-2) in such species as *T. bicolor*, *T. setispinus*, and *T. macdowellii*; and spherical to somewhat elongate grains that are mostly tricolpate, which are found in the other species of the genus (Fig. 17). Pollen diameter has a range of 45-65 μ m within the genus and an exine type that is consistently reticulate.

Fruits. The fruit of *Thelocactus* has been described as typically globose to elongate-globose, dehiscent basally, and with a persistent perianth (Glass and Foster, 1977; Benson, 1982; Anderson and Ralston, 1978) (Fig. 8). Most descriptions also state that the fruits are dry and greenish to whitish at maturity. The major exception to these well-known descriptions is the fruit of *T. setispinus*, which is fleshy, indehiscent, and bright red at maturity (Fig. 9). It is likely this fruit is an adaptation for animal, probably bird, dispersal. Both pollination and dispersal syndromes seem to be genetically plastic and variations can arise quickly and easily, often within species or species groups.

Seeds. As stated earlier, seeds, apparently in contrast to flowers and fruits, tend to be conservative in their rates of evolutionary change. Bregman and Bouman (1983) have proposed several evolutionary types of seeds in the Cactaceae; it is unlikely that more than one type would be present in the same genus. The seeds of *Thelocactus* are characterized as pyriform and possessing a large 'basal' hilum (Figs. 6-7). Buxbaum (1950-53) also noted that seeds of this genus have a distinct hilum-micropylar rim. The surface of the seed can be either tessellate (checkered) (Fig. 18) or verrucose (warty) (Figs. 19-20). The texture of the testa is quite variable, from virtually smooth (Fig. 18) to warty (Fig. 19) to rugose (wrinkled) (Fig. 20). *Thelocactus* seeds vary from 0.5-1.7mm in diameter and 1-2.3mm long.

Ecology of *Thelocactus*

Little has been reported in the literature concerning various ecological factors of *Thelocactus*, such as distribution, vegetation types, soils, sympatry, habitat characteristics, and associated plants. Although most field time was spent searching for and observing plants, a number of ecological observations were made. Though incomplete, the following is a presentation of some of the data obtained thus far.

Distribution. *Thelocactus* has a latitudinal distribution of more than 1,200 kilometers, from approximately 20° to 32° North Latitude. Generally, it is found in the Big Bend region of Texas, eastward and southeastward through the Rio Grande Plains region (Correll & Johnston, 1970), also called the Tamaulipan Brushlands or Thorn Shrub, to the Gulf of Mexico. It occurs south of the Rio Grande onto the high central plateau of northern and north-central Mexico lying east of the Sierra Madre

Occidental and, except for two taxa, west of the Sierra Madre Oriental. Most of this region would be described as the Chihuahuan Desert (Shreve, 1942; Shelford, 1963; Henrickson & Straw, 1976; Brown, 1982) or the Matorral Xerófilo (Rzedowski, 1978) (Fig. 21). One of the two exceptional taxa, *T. bicolor* var. *schwarzii*, occurs east of the Sierra Madre Oriental in the Tamaulipan Brushland or Thorn Shrub (Fig. 22). The other, *T. setispinus*, is found in the Rio Grande Plains region and then southward into the Tamaulipan Brushland (Fig. 21).

Thelocactus is also found in savannah and grasslands at the higher, more southern and western extremes of its range, referred to by Rzedowski (1978) as Pastizal.

There is considerable variation in both topography and vegetation within this vast region of more than 800,000 square kilometers; this has led some workers (Muller, 1947; Rzedowski, 1965, 1978) to create subdivisions. However, the general term 'Chihuahuan Desert-scrub' of Brown (1982) or simply 'Chihuahuan Desert' would encompass most of the region of northern and north-central Mexico where *Thelocactus* occurs.

Soils. Soil samples were collected and analysed from 13 sites throughout the range of *Thelocactus*. Most habitats consist of Cretaceous limestone and derived soils, which vary in texture from fine shale to sandstone. These rocks and soils have a basic pH (7.2-8.5) and can be best characterized as having >150 ppm Ca, about 6 ppm Mg, and strong carbonates. Some sites had considerable K, but little P was present anywhere. All sites tested negatively for Fe, Cl, SO₄, Mn, and Al. The taxon which is found in the most distinct soil is *T. bicolor* var. *flavidispinus*, a variety that is restricted to strongly siliceous Caballos Novaculite in Brewster County, Texas.

Habitat characteristics. Twenty sites (Fig. 21) throughout the range of *Thelocactus* were analysed with regard to elevation, average precipitation, high temperature averages, low temperature averages, and the Modified Index of Aridity, using data from Soto Mora & Jáuregui O. (1965). *Thelocactus* occurs from nearly sea level (12 metres) to 2300 metres elevation. Precipitation varies throughout its extensive range from 156.9 to 847.2mm annually. High temperatures range from 29.1° to 37.8° Celsius, while low temperatures vary from 1.7° to 14.2° Celsius. *Thelocactus* generally occurs in frost-free zones; however, freezing temperatures occasionally damage plants in the north and at higher elevations. The Modified Index of Aridity (I), which is an indication of the relationships of temperature and precipitation, was studied throughout the range of *Thelocactus*. Its habitats exhibit a wide range of 'I' readings, from 44.1 to 251, with an average of 101.53. The lowest 'I' reading is along the Gulf of Mexico at low elevation, whereas the highest is in the relatively low, hot interior of northern Mexico in the state of Coahuila. In general, the 'I' readings decrease southward, in part due to increasing elevation.

Sympatry. An analysis was made of the species of *Thelocactus* growing sympatrically. This is based on personal field observations, recorded data in field notes (Glass & Foster, unpubl.), and herbarium sheets. The

following species have been found to be sympatric:

<i>bicolor/setispinus</i>	Rio Grande City, TX
<i>bicolor/rinconensis</i>	Near Saltillo, Coah.
<i>bicolor/tulensis</i>	El Huizachejct., S.L.P.
<i>bicolor/conothelos</i>	Near La Bonita, S.L.P.
<i>bicolor/macdowellii</i>	Near Saltillo, Coah.
<i>bicolor/hexaedrophorus</i>	El Refugio, N.L.
<i>hexaedrophorus/conothelos</i>	East of Matehuala, S.L.P.
<i>conothelos/tulensis</i>	North of Dr. Arroyo, N.L.
<i>hastifer/leucacanthus</i>	Near Vista Hermosa, Qto.
<i>tulensis/hexaedrophorus</i>	El Refugio, N.L.

Associated plants. Dominant perennial plants which are associated with *Theolocactus* were observed and recorded on the field trips in Texas and Mexico. The Glass & Foster field notes (unpubl.) were also consulted. Two species have not been observed in the field: *T. heterochromus* and *T. lausseri*. A list of over 100 plants associated with the species of *Theolocactus* in habitat is available from the author upon request.

Characteristics and relationships of *Theolocactus* species

Theolocactus leucacanthus appears to be the species with the largest number of primitive characters. It is the most southern of the species (Fig. 22), is frequently caespitose, has ribs rather than well-developed tubercles, possesses extrafloral nectaries, and has a relatively simple pyriform seed. It varies considerably throughout its range with regard to both spination and flower colour.

Theolocactus bicolor is unique in many characters when compared with the other species of *Theolocactus*, varying considerably in spination and growth form; it is the most widespread in its distribution (Fig. 22). There are several discontinuous populations, two of which can be defined as varieties, in large part due to the wide geographic separation and different vegetational zone of one variety (var. *schwarzii*), and distinct edaphic factors of the other (var. *flavidispinus*). One of the most enigmatic populations, formally recognized by some as var. *schottii*, exists in the Big Bend region of Texas and perhaps also to the south in Chihuahua and Coahuila, Mexico. However, this remote region is poorly known and nearly inaccessible. It seems likely that intermediate forms between the typical *T. bicolor* in Coahuila and the Big Bend form may occur in this area. Another population that has been formally recognized as var. *bolaensis* occurs in western Coahuila within the general range of the highly variable var. *bicolor*. This localized population near Sierra Bola is not geographically or edaphically isolated, even though individuals often appear distinct from the more typical members of this species because of their more elongate growth form and more dense, lighter-coloured spines. However, there seems to be little justification for recognizing this population as a distinct variety, especially when it is not geographically separated. *Theolocactus bicolor* is most closely related to *T. setispinus*, which is discussed in another section of this paper.

Theolocactus setispinus does not occur west of the Sierra Madre Oriental or in the Chihuahuan Desert. Rather, it is found in the Thorn Shrub of southeastern

Texas and the Tamaulipan Brushland of northeastern Mexico (Fig. 21). It seems to replace *T. bicolor* to the north and east of its wide range, apparently tolerating more shade, greater moisture, and greater temperature extremes. Its similarities to *T. bicolor* are discussed in an earlier section of this paper.

Theolocactus hexaedrophorus is one of the most southern species of the genus, occurring at relatively high elevations (1,500-2,300m) south of, the twenty-third parallel in the states of San Luis Potosí and Zacatecas (Fig. 21). Both varieties frequently are found in dark, rocky soil of limestone origin in areas with little vegetation. They are often in the Pastizal (grassland or savanna) with *Prosopis* as the main associated woody plant (Rzedowski, 1978), but they also occur in fairly typical Chihuahuan Desertscrub in the region of Miquihuana, for example.

Theolocactus heterochromus appears to be intermediate to *T. bicolor* and *T. hexaedrophorus*, as shown in such characters as spination, body form, and seeds. The geographic distribution of *T. heterochromus*, though the most western of any species of *Theolocactus*, nonetheless can be described as intermediate in location between the ranges of *T. bicolor* and *T. hexaedrophorus* (Fig. 25).

Theolocactus tulensis is a significant and highly variable species which includes three fairly distinct geographical varieties: var. *tulensis*, var. *buekii*, and var. *matudae*. These varieties have a north-south geographical distribution along the western edge of the Sierra Madre Oriental and onto the adjoining flatter Chihuahuan Desert (Fig. 23). The most southern variety is var. *tulensis*, with var. *buekii* occurring immediately to the north. *Theolocactus tulensis* var. *matudae* is found farther north in Nuevo León and suggests a relationship to *T. rinconensis*. Those populations in the more northern areas tend to have a greater development of tubercles and a corresponding loss of ribs. This species, which has definite affinities to *T. leucacanthus*, also seems to be related to *T. hexaedrophorus*.

Theolocactus rinconensis is centred in Coahuila, mainly around Saltillo and westward (Fig. 25). This species has an internal anatomy similar to some of the species of *Neolloydia* and distinct from the other species of *Theolocactus* (Anderson and Ralston, 1978; Anderson, 1986). The most remarkable feature of *T. rinconensis* is the highly variable spination, a feature that has led to the description of several species and varieties. Ralston (unpubl.) analyzed the spination of a sample of 28 plants from various locations within the 110 kilometer east-west range of this species. He found considerable variation: 3-8 spines per areole, 1-4 central spines, 1-5 radial spines, both rough (scaly) and smooth, and lengths of 15-112mm. However, the most important observation was that there was a complete, intergrading series with no clear discontinuities from one population to another. Certain trends were seen, such as the shorter spines (<60mm) tended to be smooth, whereas the longer ones were rough; plants with rough spines tended to have 3-4 central spines but varied in radials from 1-5; plants with smooth spines tended to have 1-2 central spines and 1-2

radial spines; and the more western populations tended to have the longer spines. However, the basic structure of the vegetative body is the same throughout the range of the group. It is impossible to delineate varieties—or species—on the basis of spination, which has provided the primary features used by previous workers because one can find a complete series of spine characters throughout the range of this group. It simply is not practical to delimit separate species or even varieties within this group because of the geographic proximities and overlapping of spine characters from one population to another. A taxonomic variety should be geographically isolated from another; this clearly is not the case within this group.

Thelocactus conothelos seems to be somewhat separate from the other species and groups of *Thelocactus*. Perhaps *T. hastifer* is an intermediate form between this species and *T. leucacanthus*. *Thelocactus conothelos* has flowers with well developed receptacular tubes and tubercles are fairly well developed. Sometimes extrafloral nectaries are present. It has a central range within the overall distribution of *Thelocactus* (Fig. 25).

Thelocactus macdowellii is an enigma. Glass and Foster (1977) feel it is related to *T. conothelos*, but testa characters are like those of *T. leucacanthus* and *T. hexaedrophorus*, and the flower tube is much shorter than that of *T. conothelos*. The following characters suggest it may be a link to *Neolloydia*, particularly to those species formerly included in *Gymnocactus*: flowers having only a few scales on the ovary, dense spination, smaller body size, and a more northern distribution. It occurs in Coahuila near Saltillo (Fig. 23).

Thelocactus hastifer may lie between *T. leucacanthus* and *T. conothelos*, having simple tessellate seeds, extrafloral nectaries, and a tendency to be columnar (a characteristic of some populations of the latter). *T. hastifer* may also be related to *T. bicolor*, which sometimes becomes columnar and which has extrafloral nectaries. It is found in the state of Querétaro (Fig. 23).

Thelocactus lausseri is reported by Riha and Busek (1986) as occurring in Coahuila (Fig. 25) and as possibly related to *T. conothelos* because of spine similarities. However, the seed testa textures of these two taxa differ. In fact, the seeds of *T. lausseri* are most similar to those of *T. setispinus* and several species of *Neolloydia* (Anderson, 1986). *Thelocactus lausseri* is provisionally included in the genus pending further study.

SYSTEMATIC TREATMENT

Thelocactus Britton & Rose in Bull. Torrey Bot. Club 49:251 (Aug. 1922). Type: *Echinocactus hexaedrophorus* Lemaire.

Hamatocactus Britton & Rose, Cact. 3:104 (Oct. 1922). Type: *H. setispinus*.

Thelomastus Frič in Kreuzinger, Verzeichniss, 10 (1935), *nom. inval.*

DESCRIPTION. *Stem* single or clustering, depressed-globose, globose, elongate, cylindrical, to columnar, 2-20cm diam., 3-25cm high. *Ribs* distinct or indistinct, 7-20, vertical or spiralling. *Tubercles* present and very evident in all but one species, rounded to conical. *Areoles* round to elongate, sometimes with a partially developed groove, bearing white to yellowish trichomes, borne on the apices of the tubercles, with or without extrafloral nectaries. *Spines* highly variable, 0-30, tending to be persistent. *Central spines* usually present, 0-5, 5-60mm long, mostly erect, straight or in one species hooked. *Radial spines* 0-25, 3-35(-60!)mm long, usually radiating, straight, mostly subulate. *Flowers* arising from the apices of young tubercles, variable in colour, 2-8cm diam. *Ovary* in anthesis covered with scales. *Fruits* green to bright red and mostly dry at maturity, dehiscing by a basal pore except in one species, with scales, round to somewhat elongate, with a persistent perianth. *Seeds* black, pyriform, verrucose (warty) or tessellate (with polygonal ridges), with a large basal hilum, 1-2.3mm long, 0.5-1.7mm diam.

DISTRIBUTION. Plants of this genus are found mostly in limestone soils of the Chihuahuan Desert, dry scrublands or thorn shrub, succulent shrub forest, desert grasslands, and savanna of Texas and Mexico, from nearly sea level to more than 2,200m elevation. The range is from 20° to 32° north latitude and 97°30' to 105°40' west longitude.

KEY TO THE SPECIES OF THELOCACTUS

1. Central spines not hooked; tubercles present; fruits not red and fleshy at maturity, dehiscing by a basal pore 2
- Central spines hooked; tubercles absent; fruits red and fleshy at maturity, not dehiscing by a basal pore 1. ***T. setispinus***
2. Flowers mainly of one colour, not with a dark throat 3
- Flowers mainly of two or three colours, with a dark throat 2. ***T. bicolor***
3. Stem usually clustering 4
- Stem usually single 6
4. Extrafloral nectaries* present; flowers yellow, violet, or carmine red 3. ***T. leucacanthus***
- Extrafloral nectaries absent; flowers magenta or white 5
5. Flowers magenta; ribs indistinct; radial spines 15-25, white 4. ***T. macdowellii***
- Flowers white or nearly so; ribs distinct; radial spines 5-12, brownish-red becoming grey 5. ***T. tulensis***
6. Plants becoming distinctly columnar 6. ***T. hastifer***
- Plants not becoming distinctly columnar 7
7. Radial spines 10-25 8
- Radial spines less than 10 10
8. Flowers white with dark midveins or variable in colour; spines not densely covering the plant, not distinctly white when young; central spines usually >25mm long 9
- Flowers always magenta; spines densely covering the plant, distinctly white when young; central spines usually <25mm long 4. ***T. macdowellii***
9. Radial spines 10-23, 5-20mm long; central spines 1-4, 10-55mm long, 1-2mm diam.; perianth-segments variable in colour (Nuevo Leon, Tamaulipas and San Luis Potosi) 7. ***T. conothelos***

*see Figs. 3-4.

- Radial spines 20-22(-25), 18-20(-28)mm long; central spines 4, 60mm long, 2.5mm diam.; perianth-segments white with dark midveins (Coahuila) 8. **T. lausseri**
10. Flowers large, >5.5cm diam. 11
Flowers small, <5.5cm diam. 12
11. Tubercles rounded; ribs distinct; central spines 1(-3) 9. **T. heterochromus**
Tubercles conical; ribs indistinct; central spines 3-7 5. **T. tulensis**
12. Tubercles rounded, 13-26mm broad; stems green to olive-green (Nuevo Leon, Tamaulipas, San Luis Potosi and Zacatecas) 10. **T. hexaedrophorus**
Tubercles conical or at least more or less pointed, 7-15mm broad; stems blue-green, yellowish-green, to purplish-green (absent from San Luis Potosi and Zacatecas) 11. **T. rinconensis**

1. **T. setispinus** (Engelm.) E. F. Anderson **comb. nov.**
Echinocactus setispinus Engelm. in Boston J. Nat. Hist. 5:246 (1845). *Hamatocactus setispinus* (Engelm.) B. & R., Cact. 3:104 (1922). *Ferocactus setispinus* (Engelm.) L. Benson in Cact. Succ. J. (US) 41:128 (1969). Lectotype (Benson, loc. cit.): Colorado River, 1844, Lindheimer (MO).
Cactus bicolor Teran & Berlandier, Mem. Comis. Limites, 1 (1832). *Hamatocactus bicolor* (Teran & Berlandier) I. M. Johnston in Contr. Gray Herb. II, 70:88 (1924).
Echinocactus muehlenpfordtii Fennel in Allg. Gartenz. 15:65 (1847). Britton and Rose (1922b) believed this taxon was the same as *T. setispinus*. However, the description does not confirm this positively. No illustration accompanied the description.

Echinocactus hamatus Muehlenpf. in Allg. Gartenz. 16:18 (1848). *Echinocactus setispinus* [var.] *hamatus* (Muehlenpf.) Engelm. in Boston J. Nat. Hist. 6:201 (1850). *Hamatocactus setispinus* var. *hamatus* (Muehlenpf.) Borg, Cacti, 218 (1937). The type locality is stated only as Texas. It seems fairly certain that this refers to *T. setispinus*, though no illustration accompanied the description.

Echinocactus setispinus [var.] *setaceus* Engelm. in Boston J. Nat. Hist. 6:201 (1850). *Hamatocactus setispinus* var. *setaceus* (Engelm.) W. T. Marshall in Cact. Succ. J. (US) 16:80 (1940). Engelmann commented that this was a smaller, more northern form having more and thinner spines.

Echinocactus setispinus var. *cachetianus* Labouret, Monogr. Cact. 203 (1853). *Hamatocactus setispinus* var. *cachetianus* (Labouret) F. Knuth in Backeb. & F. Knuth, Kaktus-ABC, 353 (1935). This variety was proposed on the basis of a larger flower and slight differences in the vegetative body, including the spines.

Echinocactus setispinus var. *mierensis* Schumann, Gesamtb. Kakt. 340 (1898). Schumann established this variety on the basis of somewhat different spination than on the typical variety.

Echinocactus setispinus var. *orcuttii* Schumann, Gesamtb. Kakt. 340 (1898). As with the variety above, this one was based on variations in spination.

Britton and Rose (1922b) also refer the following species to the synonymy of *T. setispinus*: *Echinopsis nodosa* Linke, *Echinocactus nodosus* Hemsley, and *E. hamulosus* Regel. It is not possible to determine positively what plants were being described in these cases.

DESCRIPTION. *Stem* single, rarely clustering, 7-12cm high, 5-9cm diam., globose to elongate-globose, yellow-green to blue-green. *Ribs* very evident, 12-15, sinuous and narrow, 1-2mm wide, 14-18mm high. *Tubercles* absent. *Areoles* 5-9mm long, 2-3mm broad, typically 20mm apart, with extrafloral nectaries. *Central spines* 1, yellowish-white to reddish with a light-coloured tip, 16-27mm long, 0.5-1mm diam., erect, hooked, round in cross section. *Radial spines* whitish to reddish-white, 9-17, 9-24mm long, 0.5-0.75mm diam., radiating, straight, acicular.

Flowers 3-4.2cm diam., 3.8-5.2cm long. *Outer perianth parts* dark green with brownish-white margins, ovate, 4-8mm long, 3-6mm broad, rounded and reddish apically, ciliate marginally. *Inner perianth parts* yellow, deep red at base, ovate, 20-25mm long, 6-7mm broad, acuminate apically, marginally entire. *Filaments* reddish to whitish, 10-15mm long. *Anthers* light yellow, 24-26mm long, 1mm diam. *Stigmas* 7-9, 5-6mm long, light yellow to white. *Ovary* in anthesis scaly. *Fruits* red, fleshy at maturity, with scales, indehiscent, round, 11-15mm long, 10-14mm diam. *Seeds* 1.3-1.7mm long, 0.5-0.8mm diam., verrucose.

DISTRIBUTION (Fig. 21). The northernmost species of the genus, occurring in thorn shrubland in southern Texas and the north-eastern Mexican states of Coahuila, Nuevo León, and Tamaulipas along the coastal lowlands and inward along the Rio Grande to the Pecos River, from 23°10' to 29°55' N, and from 97°10' to 101°40' W, at elevations from sea level to 550 m.

SPECIMENS EXAMINED. TEXAS. Without locality, 1895, *J. W. Toumey* s.n. (US). Eastern Texas, 1872, *E. Hall* s.n. (US). Bexar Co.: San Antonio, 1907, *C. R. Ball* s.n. (US). Kinney Co.: Fort Clark, *E. A. Mearns* 4048 (US). San Saba Co.: San Saba, 1915, *B. R. Russell* s.n. (US). Medina Co.: Hondo, *J. D. Mitchell* s.n. (US). Val Verde Co.: Pecos High Bridge, *J. R. Moorhead* 4100 (US). Starr Co.: Falferrias, 1907, *F. L. Lewton & R. M. Meade* s.n. (US). Maverick Co.: Los Alamos Ranch, 7 miles from Eagle Pass, 1905, *R. W. Anderson* s.n. (US). Jim Wells Co.: Alice, 1981, *R. O. Albert* s.n. (US, WCW). Webb Co.: 4mi. east of Laredo, *E. F. Anderson* 5035 (WCW); Laredo, 1909, *B. MacKinsin* s.n. (US). Cameron Co.: Brownsville, 1905, *F. L. Lewton* s.n. (US); Brownsville, 1909, *F. C. Pratt* (US); Brownsville, 1920, *R. Runyon* s.n. (US); 7mi. east of Brownsville, 1905, *F. L. Lewton* s.n. (US); Three Islands near Brownsville, 1921, *R. D. Camp* s.n. (US). Nueces Co.: Along Corpus Christi Bay, *A. Heller* 1532 (US). MEXICO. Tamaulipas: 35km southeast of Santa Teresa [on hy. 101], *F. G. Medrano* 112 (MEXU). It is also reported as coming from near Llera (S Tamaulipas) by Robert Haas (pers. comm. to N. P. Taylor in 1981).

2. **T. bicolor** (Galeotti ex Pfeiffer) Britton & Rose in Bull. Torrey Bot. Club 49:251 (1922).

Echinocactus bicolor Galeotti ex Pfeiffer, Abbild. Besch. Cact. 2:pl. 25 (1848). *Ferocactus bicolor* (Galeotti ex Pfeiffer) N. P. Taylor in Cact. Succ. J. Gr. Brit. 41:30 (1979). The type locality was stated only as Mexico and there is no known type specimen. However, McVaugh (1978) reports that Galeotti probably collected it in the vicinity of San Luis Potosi. The illustration (Plate 25) which accompanied the original description must serve as the lectotype.

Echinocactus rhodophthalmus Hooker in Bot. Mag. 76:pl. 4486 (1850). The illustration shows clearly that this is the same as *T. bicolor*.

Echinocactus rhodophthalmus var. *ellipticus* Hooker in Bot. Mag. 78:pl. 4634 (1852). *Echinocactus ellipticus* (Hooker) Lemaire in Jard. Fleur. 3:pl. 270 (1853). The illustrations show that this proposed taxon is the same as *T. bicolor*.

Echinocactus bicolor var. *schottii* Engelm., Syn. Cact. U.S. 21 (1856). *Echinocactus schottii* (Engelm.) Small, Fl. Southeast U.S. 814 (1903). *Thelocactus bicolor schottii* Davis ex Backeb., Cact. 5:2809 (1961), *nom. inval.* *Thelocactus bicolor* var. *schottii* (Engelm.) Krainz, Die Kakteen, Lfg. 18 (Oct. 1961). Benson (1982) has designated the following specimen as the lectotype: Mexico, 'Cretaceous hills near Mier,' 1853, *Schott*, F 42661. I did not examine this specimen but did study the photograph of a specimen collected on the Rio Bravo by Schott in 1853 and given the same name (NY).

Echinocactus bolaensis Runge ('*bolansii*') in Gartenflora 38:106 (1889). *Echinocactus bicolor* var. *bolansii* (Runge) Schumann, Gesamtb. Kakt. 303-304 (1898). *Thelocactus bicolor* var. *bolansii* (Runge) A. Berger, Kakteen, 256 (1929). *Ferocactus bicolor* var. *bolaensis* (Runge) N. P. Taylor in Cact. Succ. J. Gr. Brit. 41:30 (1979). No type locality was listed nor was a type specimen designated. An excellent illustration accompanied the description, however; it should serve as the lectotype. Schumann (1898) stated that the plant came from Sierra Bola in Coahuila.

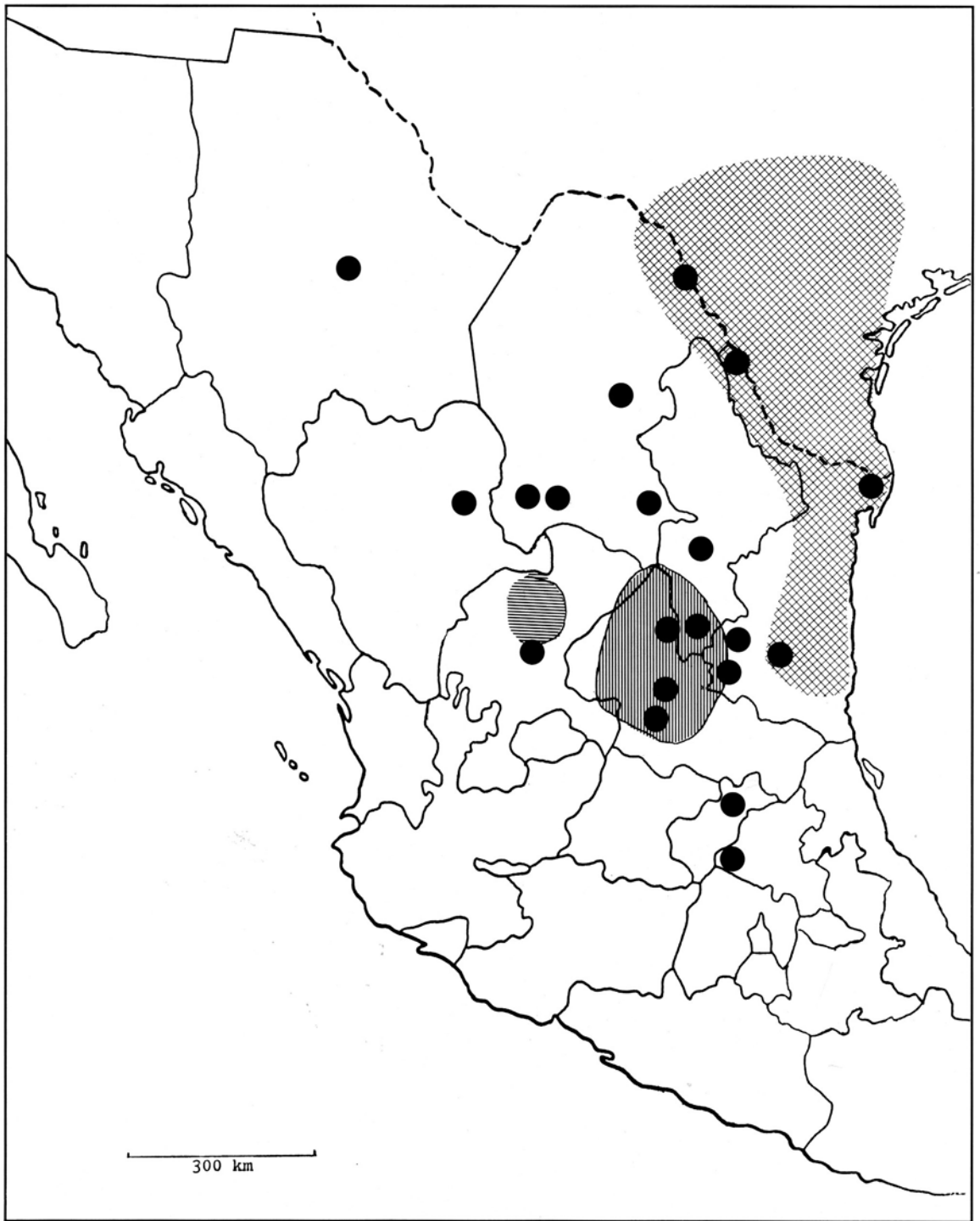


Fig. 21. Twenty habitat sites for ecological studies (spots) and distribution of *T. setispinus* (cross hatching) and of *T. hexaedrophorus* var. *hexaedrophorus* (vertical lines) and var. *lloydii* (horizontal lines).

Echinocactus bicolor var. *tricolor* Schumann, Gesamtb. Kakt. 303 (1898).

Echinocactus wagnerianus A. Berger, Kakteen, 256 (1929). *Thelocactus wagnerianus* A. Berger, Kakteen, 346 (1929). Both names were proposed at the same time. *Thelocactus bicolor* var. *wagnerianus* (A. Berger) Krainz, Die Kakteen, Lfg. 18 (October 1961). The type locality is known only as eastern Mexico. It appears that there are insufficient characters to accept this as a separate variety of *T. bicolor*.

Thelocactus bicolor var. *texensis* Backeb., Die Cact. 6:3872 (1962), *nom. inval.* (see Eggli, 1985).

Part of the problem concerning the epithets *pottsii* and *heterochromus* is discussed under *T. heterochromus*. However, the problem of var. *pottsii* Salm-Dyck, Cact. Hort. Dyck. 173 (1850) needs to be dealt with here, as Salm-Dyck considered it to be a variety of *E. bicolor* Galeotti ex Pfeiffer, including it under the description of that species. Unfortunately, the description is quite short and not specific enough for one to be sure of what plant he was describing. No type locality or illustration were included. It seems evident that Salm-Dyck did not consider this variety to be the same as what he later described as the species *E. pottsii*. If he had, he certainly would have commented on its relationship to *E. bicolor* and would have referred to his earlier publication. Rather, in his description of *E. pottsii* he commented that it was related to *E. californicus* and *E. electracanthus*. Salm-Dyck's variety has often been confused with *E. pottsii* in the literature as workers clearly have been uncertain what the plant was. Very different illustrations of the variety appeared in Backeberg (1961: 2810), Bravo-H. (1937: Fig. 247), and van Oosten (1940: 58-59). This varietal epithet cannot be clearly identified with any population of *Thelocactus bicolor* and it does not appear to be *T. heterochromus*.

DESCRIPTION. *Stem* usually single but sometimes clustering, 1.5-38cm high, 2-18cm diam., globose to elongate, green to yellowish-green. *Ribs* usually vertical, 8-13. *Tubercles* 6-12mm long, 5-30mm broad, 3-18mm high. *Areoles* 3-6mm long, 3-6mm broad, often with a furrow, typically 6-10mm apart, with extrafloral nectaries. *Central spines* 0-5, 14-33mm long, 0.75-1.5mm diam., entirely yellowish-white or reddish-purple with a white or yellowish-white tip, spreading or erect, straight, acicular. *Radial spines* 8-17, 10-27(-45!)mm long, 0.5-1mm diam., reddish-purple in the basal third with the rest yellowish-white or entirely yellowish-white, spreading radially or erect, straight or sometimes curved, acicular though sometimes the uppermost one flattened and much longer. *Flowers* 4-8cm diam., 3.5-6.2cm long. *Outer perianth parts* greenish-brown to magenta with white to pale purple or pink margins, ovate to elongate, 7-32mm long, 4-11mm broad, acute apically, marginally entire or ciliate. *Inner perianth parts* light magenta above, sometimes fading to white and then always becoming very dark below, with a brownish midvein, elongate to ovate, 30-50mm long, 5-12mm broad, aristate apically, marginally entire. *Filaments* white, 6-10mm long. *Anthers* yellow, 1-1.5mm long. *Style* white, 12-20mm long, 1-2mm diam. *Stigmas* 7-13, 2-6mm long, red, yellow or orangish. *Ovary* in anthesis scaly. *Fruits* yellowish-brown or greenish-brown, dry at maturity, dehiscing by a basal pore, with scales, ovate, 7-17mm long, 6-12mm diam. *Seeds* 1.2-2.5mm long, 1.1-1.5mm diam., verrucose.

DISTRIBUTION (Fig. 22). The most widespread species of the genus, occurring widely throughout the Chihuahuan Desert and Tamaulipan Thorn Shrub, from 22°10' to 30°10' N, and from 97°30' to 104°50' W, at elevations from sea level to 2000 m. Found on limestone soil and Caballos Novaculite.

KEY TO THE VARIETIES OF *T. BICOLOR*

1. Central spines present; flowers bi-, rarely tricolored 2
Central spines usually absent; flowers tricolored (restricted to thorn-shrub in S Tamaulipas) 2a. var. **schwarzii**
2. Plants 10-38cm high (not restricted to Caballos Novaculite soils in Brewster Co., Texas) 2b. var. **bicolor**
Plants 1.5-4.5cm high (restricted to Caballos Novaculite soils in Brewster Co., Texas) 2c. var. **flavidispinus**

2a. var. **schwarzii** (Backeb.) E. F. Anderson **comb. nov.**

Thelocactus schwarzii Backeb. in Cact. Succ. J. Gr. Brit. 12:81 (1950). *Ferocactus bicolor* var. *schwarzii* (Backeb.) N. P. Taylor in Cact. Succ. J. Gr. Brit. 41:30 (1979). The type locality was stated as Tamaulipas, under bushes in heavy soil. No type specimen has been located and it is doubtful whether one was preserved. Therefore, the photograph on p. 84 accompanying Backeberg's description must serve as the lectotype.

DESCRIPTION. *Stems* up to 9cm diam., often caespitose. *Central spines* usually absent except in older plants, then single and erect. *Radial spines* 13-14, yellowish becoming grey, spreading horizontally, the uppermost one up to 27mm long, flattened, and curved upward. *Flowers* 5-7cm diam., 4-5cm long.

DISTRIBUTION (Fig. 22). Located in the Tamaulipan Thorn Shrub in the region south of Llera, Tamaulipas, from 23°10' to 23°25' N, and from 99°50' to 100°5' W, at elevations of about 150 m.

SPECIMENS EXAMINED. MEXICO. Tamaulipas: Carretera 81 entre Llera y González, 7 June 1986, E. F. Anderson in H. Sanchez-Mejorada 3700 (MEXU).

2b. var. **bicolor**

DESCRIPTION. *Stem* single or clustering, 5-38cm high, 5-14cm diam., globose to elongate-globose, green to yellowish-green. *Ribs* 8-13, either vertical or spiralling. *Tubercles* 6-11mm long, 12-30mm broad, 13-18mm high, rectangular in outline. *Areoles* 3-5mm long, 3-6mm broad. *Central spines* 1-4, 15-33(-75)mm long, 0.75-1.5mm diam., reddish-purple with a yellowish-white tip or yellowish-white throughout, sometimes keeled, one more or less erect, flattened and much longer (up to 75mm), with the others spreading. *Radial spines* 8-15(-17), 10-24mm long, reddish-purple in the basal third with the rest yellowish-white or yellowish-white throughout, spreading radially. *Flowers* 3.8-8cm diam., 4-8cm long.

DISTRIBUTION (Fig. 22). Widely distributed throughout the Chihuahuan Desert of the Big Bend region of Texas and of northern Mexico, and the Tamaulipan Thorn Shrub along both sides of the Rio Grande to the Gulf coast, from 22°10' to 29°20' N, and from 97°40' to 106°5' W, and at elevations from sea level to 2000 meters.

SPECIMENS EXAMINED. TEXAS. Brewster Co.: Old Ore Road in Big Bend National Park, D. O. Kolle & J. F. Weedon 56 (SRSC); Black Hill near Nine Point Mesa, J. F. Weedon 408 (SRSC); Left-hand, Shut-up, Solitario, J. F. Weedon 80 (SRSC); River Road west of Castolon in Big Bend National Park, D. O. Kolle & B. H. Warnock 63 (SRSC); 16mi. east of Marathon, D. S. Correll & D. C. Wasshausen 27797 (TEX); Lajitas, 1955, N. H. Boker s.n. (POM); 1.1mi. west of Lajitas, 1978, S. Brack s.n. (UNM); 4mi. west of Lajitas, D. Weniger 133 (UNM); Terlingua Ranch, E. F. Anderson 5132 (WCW). Presidio Co.: Smith Ranch, J. F. Weedon 89 (SRSC); Rio Bravo, H. W. Schott 853 (NY). Starr Co.: Rio Grande City, E. U. Clover 1880 (TEX); just east of Roma, L. Benson 16537 (POM); 8mi northwest of Rio Grande City, 1958, R. O. Albert s.n. (POM). MEXICO. Coahuila: Saltillo, E. Palmer 104 (NY), 379 (NY, K), 436 (US), 503 (NY, US), 435 (US); Choyo Grande, E. Palmer 04.505 (US); Villa Real, C. A. Purpus 10.331 (US); Sierra del Puebla north of Saltillo, E. Palmer 04.209, 04.424, 04.492 (US); Cerro del Pueblo, W. E. Safford 1287 (US); 8km west of Saltillo, E. F. Anderson 1852 (US, WCW); KM8 west of Saltillo, E. F. Anderson 3211 (US, WCW); on road to General Cepeda, E. F. Anderson 1243 (WCW); 10.7mi. east of Saltillo, E. F. Anderson 1847 (WCW); 15mi. northeast of Saltillo, G. L. Webster & E. Aguirre P. 2935 (TEX); 21km east of Saltillo, E. F. Anderson 1251 (US, WCW); 20mi. east of Saltillo, F. A. Barkley, G. L. Webster, & C. M. Rowell Jr. 7251A (TEX); 1km south of Marte, M. C. Johnston, T. L. Wendt, & F. Chiang 10522 (TEX); Sierra del Venado, F. Chiang, T. Wendt, & M. C. Johnston 9478 (TEX); 4km south of Las Margaritas, M. C. Johnston, T. L. Wendt, & F. Chiang 9521A (TEX); Parras, W. E. Safford 1339 (US); Soledad, J. N. Rose, J. H. Painter, & J. S. Rose 8340 (US, NY). Cerro de la Bola, 1957, J. Cowper s.n. (POM); 3km east of Cerro Bola, E. F. Anderson 3191 (US, WCW). Nuevo Leon: Grutas Garcia, 1957, H. Bravo H. s.n. (MEXU). Chihuahua: vicinity of Chihuahua, E.

Palmer 71 (US, NY); Chihuahua, 1891, W. H. Evans s.n. (US); rocky hills near Chihuahua, C. G. Pringle 73 (NY); Santa Eulalia Mts., 1908, E. Palmer s.n. (US); Santa Eulalia Mts., J. N. Rose 11677 (US); between Jimenez & Camargo, F. Chiang, T. Wendt, & M. C. Johnston 8315D (TEX). Zacatecas: locality unknown, F. E. Lloyd 45 (US); Valle de El Rodeo, noroeste de Zacatecas, 1972, R. Sanchez S. s.n. (MEXU); Concepción del Oro, [no date], H. Bravo H. s.n. (MEXU). San Luis Potosí: El Huizache junction, E. F. Anderson 1859 (WCW). Durango: Tepehuanes, E. Palmer 42 (NY, US).

2c. var. **flavidispinus** Backeb. in Beitr. Sukk.-Kunde Pflege 1941:6 (1941).

Thelocactus flavidispinus (Backeb.) Backeb. in Cact. Succ. J. (US) 23:150 (1951). *Ferocactus bicolor* var. *flavidispinus* (Backeb.) N. P. Taylor in Cact. Succ. J. Gr. Brit. 41:30 (1979). The type locality is stated only as Texas and there was no designation of a type specimen. A good photograph accompanied the description and should serve as the lectotype.

DESCRIPTION *Stem* single, 1.5-4.5cm high, 2-7cm diam, globose to subglobose, green. *Ribs* present but poorly defined. *Tubercles* 7-11mm long, 5-8mm broad, 3-5mm high. *Areoles* 3-6mm diam. *Spines* dense and covering the entire plant. *Central spines* usually 3, 15-24mm long, 0.5-1mm diam., yellowish-white, erect, straight. *Radial spines* 12-17, 10-15mm long, yellowish-white, spreading radially, more or less straight, somewhat subulate, the uppermost one much longer (38-45mm) and flatter than the others. *Flowers* 4-5cm diam., 3.5-4cm long. *Outer perianth parts* greenish-brown with whitish-pink margins.

DISTRIBUTION (Fig. 22). Restricted to Caballos Novaculite outcrops in modified Chihuahuan Desert vegetation of Brewster Co., Texas, from 29°50' to 30°10' N, and from 102° to 103°30' W, at elevations of 1200 to 1330 m.

SPECIMENS EXAMINED. TEXAS. Brewster Co.: about 15mi. south of Marathon, 1955, N. H. Boke s.n. (POM); 1mi. south of Marathon, L. Benson & D. S. Correll 16483 (POM); 12mi. east of Marathon, D. Weniger 101, 102 (UNM); 4mi. south of Marathon, D. Weniger 115, 116 (UNM); west side of East Bourland Mt., J. F. & T. J. Weedon 192 (SRSC); below Marathon, M. B. Gurney HR (POM); 1.5mi. south of Marathon, D. S. Correll, H. S. Gentry, & C. Hanson 29704, 29705 (TEX); 3.3mi. south of Marathon, E. F. Anderson 4910 (US, WCW); 3mi. south of Marathon, B. H. Warnock 11041 (SRSC); 5mi. south of Marathon, B. H. Warnock 8480 (SRSC, TEX); 5mi. south of Marathon, E. F. Anderson 3212 (WCW); 5.6km south of Marathon, E. F. Anderson 5090 (WCW); 6-10mi. south of Marathon, B. H. Warnock 471006 (SRSC); 15mi. south of Marathon, 1955, N. H. Boke s.n. (POM); 26.9km south of Marathon, E. F. Anderson 5136 (WCW); Marathon region, B. H. Warnock 11059 (SRSC); south and east of Marathon, B. H. Warnock 11063 (SRSC).

3. **T. leucacanthus** (Zucc. ex Pfeiffer) Britton & Rose, Cact. 4:8 (1923).

Echinocactus leucacanthus Zucc. ex Pfeiffer, Enum. Cact. 66 (1837). *Ferocactus leucacanthus* (Zucc. ex Pfeiffer) N. P. Taylor in Cact. Succ. J. Gr. Brit. 41:90 (1979). The type locality was stated as near Zimapán, Mexico, and the specimen apparently came from a collection of Karwinski. No type specimen is known to exist. The same year (1837) Zuccarini again described this species in *Abhandlung der Mathematisch-Physikalischen Classe der Koniglich Bayerischen Akademie der Wissenschaften (München)* but referred to the Pfeiffer publication which had appeared in February. An excellent illustration appeared in the later article and almost certainly is the same material upon which the description in Pfeiffer was based. Subsequently, it was also printed by Pfeiffer and Otto in their *Abbildung und Beschreibung Blühender Cacteen* (1:pl. 14) of 1843. As these illustrations are of the same plants upon which the original description was based, I feel it is appropriate to designate the earlier one, though it exists in a relatively rare journal, as the lectotype: Abh. Bayer. Akad. Wiss. München 2:Tab. II (1837).

Cereus tuberosus Pfeiffer, Enum. Cact. 102 (1837). *Echinocactus tuberosus* (Pfeiffer) Salm-Dyck ex Foerster, Handb.

Cact. 287 (1846). *Echinocactus leucacanthus* var. *tuberosus* (Pfeiffer) Foerster, Handb. Cact. 287 (1846).

Cereus maelenii Pfeiffer in Allg. Gartenz. 5:378 (1837). *Echinocactus maelenii* (Pfeiffer) Salm-Dyck, Cact. Hort. Dyck. 18 (1842). *Mammillaria maelenii* (Pfeiffer) Salm-Dyck, Cact. Hort. Dyck. 14 (1845). *Echinocactus maelenii* Hemsley ('*maelenii*'), Biol. Centr. Amer. Bot. 1:534 (1880). Pfeiffer noted in the description that this taxon was closely related to *E. leucacanthus* Zucc.

Echinocactus porrectus Lemaire, Cact. Aliq. Nov. 17 (1838). *Thelocactus porrectus* (Lemaire) F. Knuth in Backeb. and F. Knuth, Kaktus-ABC, 361 (1935). *Thelocactus leucacanthus* var. *porrectus* (Lemaire) Backeb., Die Cact. 5:2818 (1961). No illustration accompanied the description and the type locality was listed only as Mexico. Britton and Rose (1923), Backeberg (1961), and others have all considered it the same species as *T. leucacanthus*.

Echinocactus subporrectus Lemaire, Cact. Aliq. Nov. 25 (1838). *Echinocactus tuberosus* var. *subporrectus* (Lemaire) Foerster, Handb. Cact. 523 (1846). Lemaire commented only that it was closely related to *E. porrectus*, which he described in the same publication. There was no illustration and no type locality was stated.

Echinocactus ehrenbergii Pfeiffer in Allg. Gartenz. 6:275 (1838). *Thelocactus ehrenbergii* (Pfeiffer) F. Knuth in Backeb. and F. Knuth, Kaktus-ABC, 359 (1935). No illustration appeared with the description, nor was a type locality mentioned on that page. However, Pfeiffer stated in the foreword that Ehrenberg had sent the plants from Mineral Del Monte, Mexico. He also mentions in the description that these plants stand next to *E. porrectus*. It seems evident that this is a synonym of *T. leucacanthus*.

Echinocactus theloideus Salm-Dyck in Allg. Gartenz. 18:396 (1850). No illustration was published and he stated only that it came from Mexico. However, he commented that the specimens arrived at the garden under the name of *E. ehrenbergii*. All workers have subsequently felt that this taxon is the same as *T. leucacanthus*.

Echinocactus leucacanthus var. *crassior* Salm-Dyck, Cact. Hort. Dyck. 35 (1850). Almost nothing is known of this taxon but it has been considered simply a synonym.

Thelocactus leucacanthus var. *schmollii* Werderm. in Blüh. Kakt. and Sukk. Pfl. 3:Taf. 160 (1939). Werdermann did not know where the plant had been collected by Schmoll in Mexico. No type specimen apparently exists, but an excellent colour photograph accompanied the description; this must serve as the lectotype.

Thelocactus sanchezmejoradai Meyrán in Cact. Suc. Mex. 3:77 (1958). *Thelocactus leucacanthus* var. *sanchezmejoradai* (Meyrán) Backeb., Die Cact. 5:2817 (1961). Type: UNAM. Type locality: 15km east of Cadereyta des Montes, Querétaro.

DESCRIPTION *Stem* commonly clustering and forming clumps up to 80cm across, 4.5-15cm high, 2.5-5cm diam., globose to globose-cylindrical, yellowish-green. *Ribs* 7-14, vertical to spiral. *Tubercles* conical but rounded apically, 5-8mm long, 10-14mm broad, 8-11mm high. *Areoles* 6mm long, 3mm broad, typically 4-6mm apart, with extrafloral nectaries. *Central spine* sometimes present, 0-1, 9-50mm long, 1mm diam., yellowish-white to nearly black, erect, straight, acicular. *Radial spines* 6-20, 5-7mm long, 0.5-0.75mm diam., yellowish-white sometimes becoming reddish or greyish, radiating, straight to somewhat recurved, somewhat subulate. *Flowers* 2-4.5cm diam., 2.5-5.2cm long. *Outer perianth parts* dark green with greenish-brown margins, ovate, 7-16mm long, 4-7mm broad, pointed apically, ciliate marginally. *Inner perianth parts* yellow to violet to carmine red, ovate to elliptical, 22-30mm long, 6-8mm broad, aristate apically, marginally entire. *Filaments* yellowish-green, 4-11mm long. *Anthers* yellow, 0.5-1mm long. *Style* light magenta, 7-13mm long. *Stigmas* 5-6, 2-3mm long. *Ovary* in anthesis scaly. *Fruit* dark green to yellowish-green, dry at maturity, dehiscing by a basal pore, 6-9mm long, 6-8mm diam. *Seeds* 1.4-2mm long, 1-1.8mm diam., tessellate.

DISTRIBUTION (Fig. 22). The southernmost species of the genus, occurring on limestone soils in succulent shrub forest in the

Mexican states of Hidalgo and Querétaro, from 20°10' to 20°55' N, and from 99°10' to 100° W, at elevations from 1200 to 1900 m.

SPECIMENS EXAMINED. MEXICO. Hidalgo: Zimapán, *H. Bravo H.* 3373 (MEXU); near Ixmiquilpan, *J. N. Rose* 05.1133 (NY, US); near Ixmiquilpan, *J. N. Rose & J. H. Painter* 8916, 8986 (US);

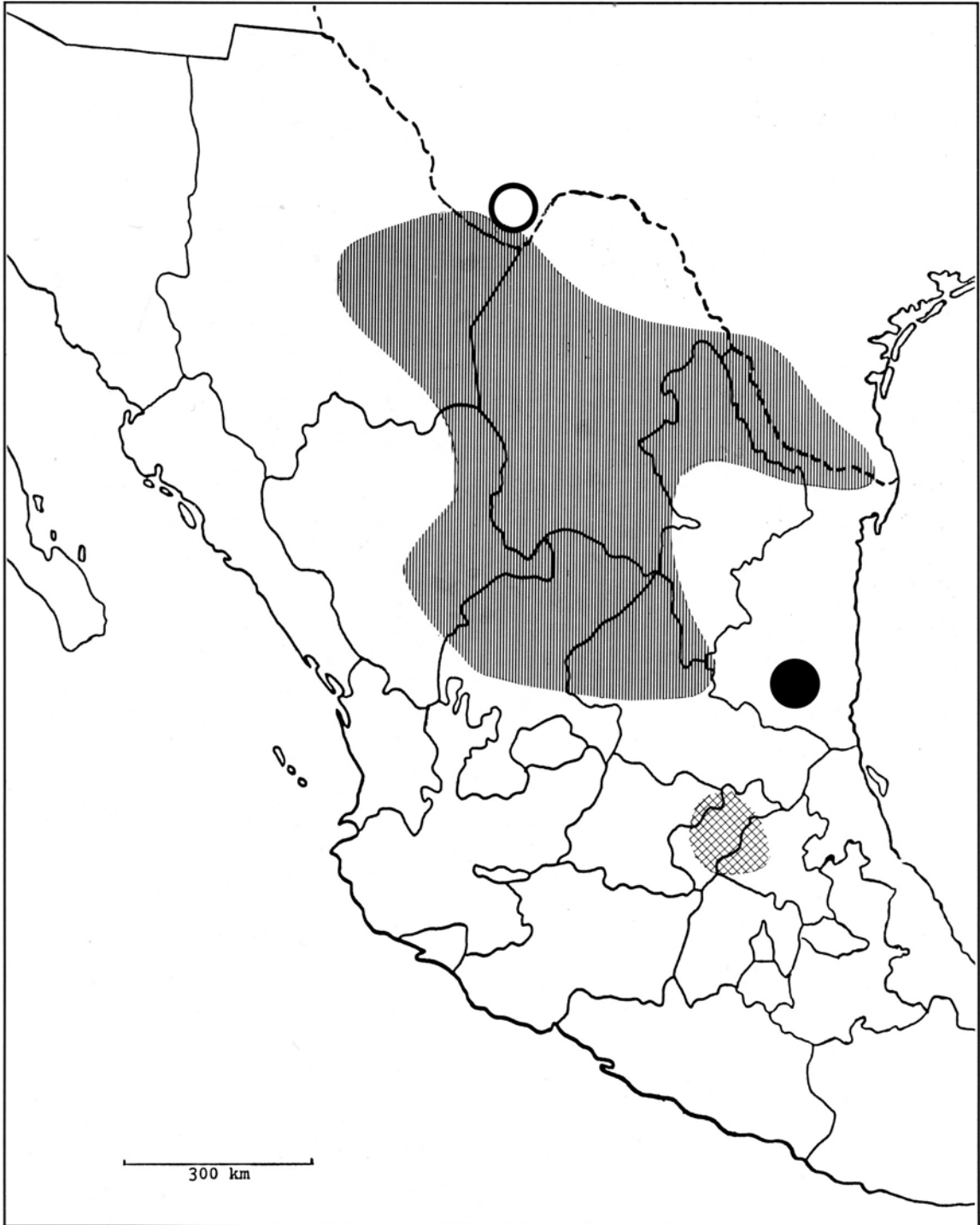


Fig. 22. Distribution of *T. bicolor* var. *bicolor* (vertical lines), var. *flavidispinus* (hollow circle), and var. *schwarzii* (solid circle); and of *T. leucacanthus* (cross hatched).

north of junction of highways 45 and 80, A. C. & L. C. Gibson 2629 (RSA); near Huichapan, E. F. Anderson 3193 (WCW); entre Huichapan y Tecozantla, L. Scheinvar 3023D (MEXU). Querétaro: between Jalpan and Cadereyta, E. F. Anderson 4962 (US, WCW); between San Juan del Rio and Cadereyta, J. N. Rose & J. H. Painter 05.1227 (US); 19km north of Cadereyta, E. F. Anderson 3194 (US, WCW); 15km north of Vizarrón, E. F. Anderson 3195 (US, WCW).

4. **T. macdowellii** (Rebut ex Quehl) C. Glass in Cact. Suc. Mex. 14:4 (1969).

Echinocactus macdowellii Rebut ex Quehl ('Mc. Dowellii') in Monatsschr. Kakt.-Kunde 4: 133-134 (1894). *Echinomastus macdowellii* (Rebut ex Quehl) B. & R., Cact. 3:151 (1922). *Neolloydia macdowellii* (Rebut ex Quehl) H. E. Moore in Baileya 19:166 (1975). *Thecactus conothelos* var. *macdowellii* Glass & Foster ('*macdowellii*') in Cact. Succ. J. (US) 49:220 (1977). No type specimen was preserved nor a type locality stated in Quehl's original description. Britton and Rose (1922b) reported that according to McDowell it came from Nuevo León near the border of Coahuila. Several illustrations appeared in various cactus publications around the turn of the century but it is impossible to directly connect them with the original material described by Quehl. The photograph in Britton and Rose (1922b) is from a photograph obtained by Rose from Quehl in 1912. Unfortunately, there is no proof it is of the plant used 18 years earlier for the original description. As none of these illustrations qualify for use as a lectotype, the following specimen is proposed as the neotype: "33km northeast of Saltillo, Coahuila on hy. 40 to Monterrey," 22 July 1972, Edward F. Anderson 3182 (US 3047870). The ICBN recommends (Art. 73.C) that Scottish prefixes (ie. Mc, Mac) be united with the family name as "mac-". Therefore, this epithet should be spelled *macdowellii*.

DESCRIPTION. *Stem* single or caespitose, 4-9.5cm high, 4.5-12cm diam., globose to elongate, green to pale green. *Ribs* indistinct. *Tubercles* present, more or less conical, 4-5mm long, 5-6mm broad, 3-4mm high. *Areoles* 5-6mm long, 2-3mm wide, typically 5mm apart, without extrafloral nectaries. *Spines* densely covering the plant. *Central spines* 2-3(-4), 11-25 (rarely to 50)mm long, 0.5-1mm diam., white to greyish-white, radiating, straight. *Radial spines* 15-25, 8-12 (rarely to 20)mm long, 0.5-1mm diam., white becoming brownish-grey with age, radiating, straight, acicular. *Flowers* 3.5-5cm diam., 4-4.5cm long. *Outer perianth parts* dark magenta with the margins lighter, ovate, 15-21mm long, 7-8mm broad, with rounded apices and entire margins. *Inner perianth parts* magenta, elongate-ovate, 30-37mm long, 4-5mm broad, apices pointed to rounded, margins entire. *Filaments* yellowish, 9-12mm long. *Anthers* yellow. *Style* magenta. *Stigmas* 4-6, 5-7mm long, yellow. *Ovary* in anthesis with only a few membranous scales. *Fruits* brown, dry at maturity, dehiscent by a basal pore, 1-1.3cm long, 0.7-1.2cm diam. *Seeds* 2mm long, 1mm diam., tessellate.

DISTRIBUTION (Fig. 23). Found only on limestone soil of the Chihuahuan Desert in the Mexican states of Coahuila and Nuevo León, from 25°30' to 25°45' N, and from 100°40' to 101° W, at an elevation of about 1500 m.

SPECIMENS EXAMINED. MEXICO. Location unknown: A. V. Fric 23.319 (US). Coahuila: 33km northeast of Saltillo, E. F. Anderson 3182 (US, WCW); between Saltillo and Monterrey, C. Glass & R. Foster 608 (POM).

5. **T. tulensis** (Poselger) Britton & Rose, Cact. 4:11 (1923).

Echinocactus tulensis Poselger in Allg. Gartenz. 21:125 (1853). The type locality was stated as Tula, which most certainly is the town in the Mexican state of Tamaulipas. No illustration accompanied the description and apparently there were none drawn from the original material. As no possible lectotype material exists, the following specimen is designated as the neotype: "At KM14 on highway 101 between Tula and the junction at hy. 80 in Tamaulipas," 30 July 1979, Edward F. Anderson 3202 (US).

? *Thelocactus kranzianus* Oehme in Beitr. Sukk.-Kunde Pflege

1940:1 (1940). The type locality was stated only as Mexico. No type specimen is known, but two illustrations accompanied the original description. The second photograph should serve as the lectotype. Oehme stated that this species differed from *T. tulensis* because of longer spines, larger flowers, and tubercle shape. Glass and Foster (1977) and others have commented on the variability of populations of *T. tulensis*. Probably the material upon which Oehme based his new species is a variation of *T. tulensis*. In fact, he stated that it was imported into Europe under the name of *Echinocactus tulensis*. There is a definite possibility this could be var. *matudae* but information is too scanty to be able to tell.

DESCRIPTION. *Stem* solitary or caespitose, 2.5-25cm high, 6-18cm diam. *Ribs* present or absent. *Tubercles* highly variable in shape and size, 10-30mm long, 12-24mm broad, 8-25mm high. *Areoles* 2-9mm long, 2-6mm wide, with a partially developed groove, typically 12-35mm apart, without extrafloral nectaries. *Spines* evenly distributed on the stem. *Central spines* 1-7, 15-55 (-80)mm long, 1-2mm diam. *Radial spines* 5-12, 7-15mm long, 1-1.5mm diam., brownish-red becoming grey with age, radiating to somewhat ascending, straight, acicular. *Flowers* 3.5-8cm diam., 2.5-5cm long. *Outer perianth parts* ovate to spatulate, ciliate marginally. *Inner perianth parts* elongate to linear, mucronate or acuminate apically, marginally entire. *Filaments* pale yellow to purplish-pink or white. *Anthers* yellow. *Style* lavender to pink or white. *Stigmas* 6-8, yellow or white, 3-5mm long. *Ovary* in anthesis scaly. *Fruits* green to greenish-magenta to whitish-brown, dehiscent by a basal pore, 11-18mm long, 7-10mm diam. *Seeds* 1.6-2.7mm long, 0.6-1.7mm diam., tessellate.

DISTRIBUTION (Fig. 23). Occurring on limestone soils of the eastern Chihuahuan Desert of Nuevo León, Tamaulipas, and San Luis Potosí, from 22°15' to 25° N, and from 99°30' to 100°55' W, at elevations from 750 to 1400 m.

KEY TO THE VARIETIES OF *T. TULENSIS*

1. Flowers magenta or purplish-pink; ribs absent; tubercles 15-30mm long, pointed or conical (Nuevo León) 2
Flowers white; ribs present; tubercles 10-12mm long, rounded (San Luis Potosí, Tamaulipas) 5a. var. **tulensis**
2. Flowers 3.5-4.5cm diam.; central spines 1-4; radial spines 4-5(-8) 5b. var. **buekii**
Flowers 7.5-8cm diam.; central spines 3-7; radial spines 7-12 5c. var. **matudae**

5a. var. **tulensis**

DESCRIPTION. *Stem* solitary or frequently caespitose, 10-25cm high, 6-8cm diam., globose to elongate-globose, deep green to paler green. *Ribs* distinct and vertical. *Tubercles* round or somewhat pyramidal, 10-12mm long, 12-17mm broad, 8-10mm high. *Areoles* 5-7mm long, 3-5mm wide, with a partially developed groove, typically 12-15mm apart. *Central spines* 1-4 but with 1 (occasionally more) usually becoming dominant and very long, 30-40(-80)mm long, brownish-red to whitish, the main one pointing upward and the others spreading, straight to twisted, flattened, ridged. *Radial spines* 5-12, 7-15mm long, radiating, straight, acicular. *Flowers* 3.5-4.2cm diam., 2.5-3.3cm long. *Outer perianth parts* magenta with whitish margins, broadly ovate, 8-10mm long, 3-4mm broad, pointed apically. *Inner perianth parts* white with rose-pink midveins, elongate to linear-ovate, 20-27mm long, 3-4mm broad, acuminate apically. *Filaments* white. *Style* pink, 7-9mm long. *Stigmas* white. *Fruits* 12-17mm long, 7-9mm diam. *Seeds* 1.8-2.2mm long, 0.6-1.7mm diam.

DISTRIBUTION (Fig. 23). The most southern and widespread variety, occurring in Tamaulipas and San Luis Potosí, from 22°15' to 23°55' N, and from 99°30' to 100°55' W, at elevations from 1100 to 1400 m.

SPECIMENS EXAMINED. MEXICO. Tamaulipas: 10km north of junction of highways 80 and 101, E. F. Anderson 1734 (US, WCW); at KM14 on hy. 101 between Tula and the junction, E. F. Anderson 3202 (US, WCW); Tula, E. F. Anderson 1188 (WCW); near Tula, J. Cowper 2078 (POM). San Luis Potosí: 14.5 miles north of Matehuala, E. F. Anderson 1219 (US, WCW). It has also

been observed near El Huizache junction. The following specimen appears to be intermediate between var. *tulensis* and var. *buekii*: Tamaulipas: 6km al norte de La Perdida, de Miquihuana, 1976, F. Guevara F. s.n. (MEXU).

5b. var. **buekii** (Klein) E. F. Anderson **comb. nov.**
Echinocactus buekii Klein ('*buekii*') in Gartenflora 8:257 (1859).
Thelocactus buekii (Klein) B. & R., Cact. 4:8 (1923). The origin of the material described was stated only as Mexico. There is no

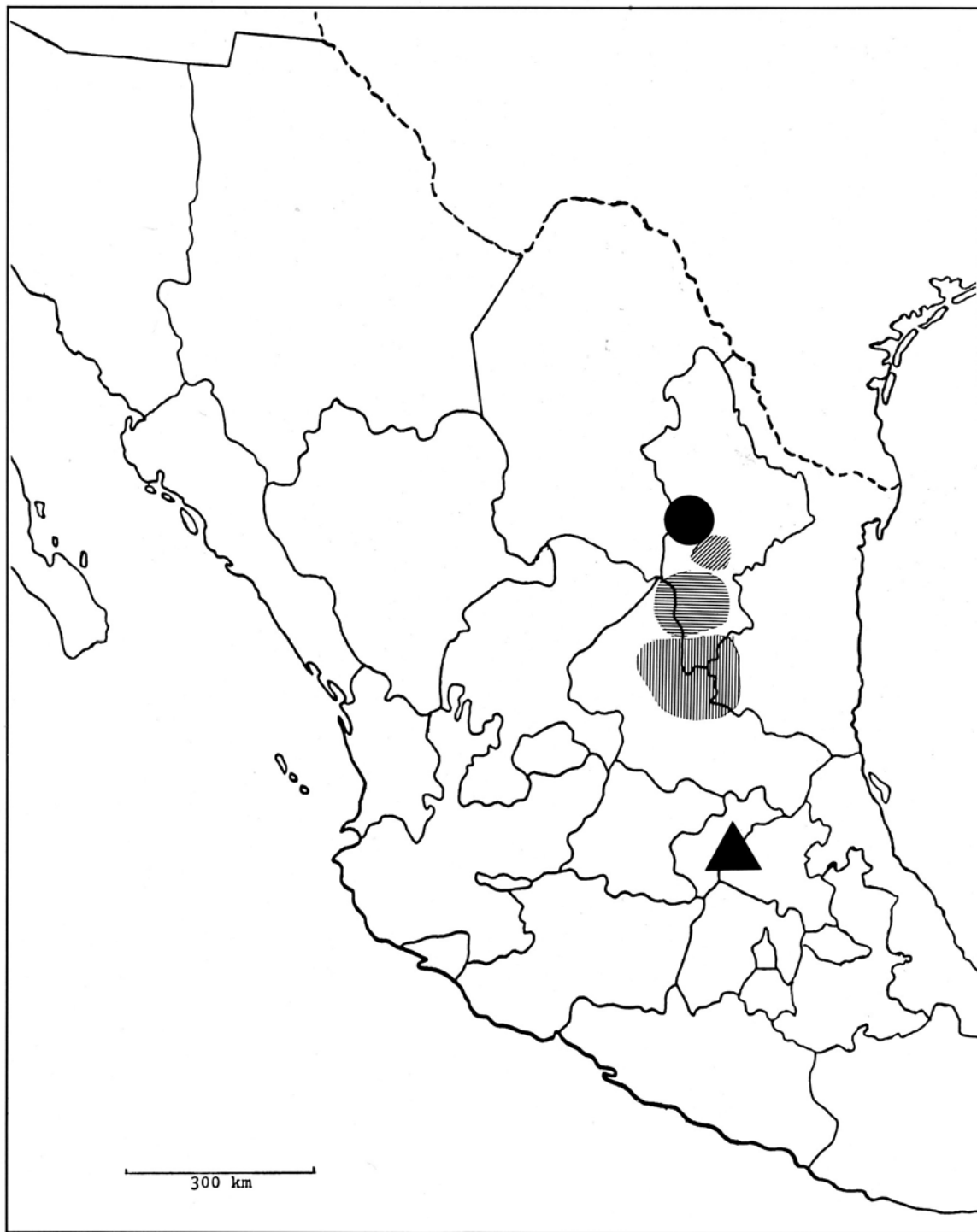


Fig. 23. Distribution of *T. tulensis* var. *tulensis* (vertical lines), var. *buekii* (horizontal lines), and var. *matudae* (diagonal lines); of *T. macdowellii* (circle); and of *T. hastifer* (triangle).

known type specimen, but a good illustration accompanied the original description. This illustration (Gartenflora 8:257. 1859) is therefore designated as the lectotype. The specific epithet was written *buekii* in the title of the description. However, it was spelled *buekii* in the accompanying illustration (Taf. 266). Later Britton and Rose (1923) adopted the spelling "*buekii*", though noting that it had been spelled two ways in the Klein publication. They further commented that the plant 'probably' had been named for Dr. Johannes Nicolaus Bück. Thus, the original spelling by Klein might simply have been the result of the omission of the umlaut from the proper name when it was converted to the specific epithet. If that were the case, the epithet "*buekii*" used by Britton and Rose omitted the letter "c". I have concluded that the epithet *buekii* is the correct one for the following reasons: 1) probably it was named in honour of either Heinrich Wilhelm Buek (1796-1879) or Johannes Nicolas Buek (1779-1856), both of whom were contemporaries of Klein; 2) the plant is referred to in two different places in the index of the journal as *E. buekii*; and 3) nearly everyone has followed the spelling *buekii*. It is therefore quite likely that an unfortunate typographic error was made in the title of the article naming the new species.

DESCRIPTION. *Stem* solitary, 2.5-6cm high, 7-18cm diam., globose to subglobose, yellowish-green often becoming purplish-green or even brown. *Ribs* poorly developed or absent. *Tubercles* more or less pointed, angled, tending to be elongate towards the plant apex, 18-24mm long, 11-25mm broad, 12-24mm high. *Areoles* 5-9mm long, 2-6mm wide, having a 2-3:1 length:width ratio, typically 15-25mm apart. *Central spines* usually present, 1-4, 15-55mm long, often becoming very long, reddish to grey, straight to slightly curved, erect, acicular. *Radial spines* much shorter than the centrals, 4-5 (rarely to 8), 6-18(-25)mm long, 1-1.5mm diam., spreading or radiating. *Flowers* 3.5-4.5cm diam., 3.5-4cm long. *Outer perianth parts* greenish-brown with whitish margins, ovate, 10-22mm long, 5-8mm broad, with pointed or ciliate-rounded apices, ciliate margins. *Inner perianth parts* magenta, elongate to ovate, 25-30mm long, 5-6mm broad, mucronate apically. *Filaments* white. *Style* lavender to white, 1.5-2mm long, 1mm diam. *Stigmas* yellow. *Fruits* 12-18mm long, 7-10mm diam. *Seeds* 1.8-2.3mm long, 0.5-1.7mm diam.

DISTRIBUTION (Fig. 23). The centrally located variety of the species, occurring in Nuevo León, from 23°55' to 24°15' N, and from 99°50' to 100°50' W, at elevations from 1200 to 1800 m.

SPECIMENS EXAMINED. MEXICO. Nuevo León: 88km north of Dr. Arroyo, E. F. Anderson 3206 (US, WCW); near Aramberri, E. F. Anderson 3209 (WCW); from Linares in the direction of San Roberto, P. Chewa 209 (MEXU).

5c. var. **matudae** (Sanchez-Mej. & A. Lau) E. F. Anderson **comb. nov.**

Thelocactus matudae Sanchez-Mej. & A. Lau in Cact. Suc. Mex. 23:51-52 (1978). Type: Nuevo Leon, near Rayones, [without date,] A. Lau *Rubens* s.n. (MEXU 227752).

DESCRIPTION. *Stem* single, 8-14cm high, 10-15cm diam., globose, greenish-yellow with tips often becoming purplish. *Ribs* indistinct. *Tubercles* highly variable, usually conical but somewhat angular in cross section, broadly keeled and sometimes becoming rib-like, 15-30mm long, 20mm broad, 15-25mm high. *Areoles* 2-7mm long, 2-4mm wide, sometimes forming a furrow, typically 28-35mm apart. *Central spines* 3-7 (usually 3-4), 25-45(-78)mm long, reddish-brown to greyish, erect, straight, subulate. *Radial spines* 7-12, 14-25mm long, radiate but somewhat ascending. *Flowers* 7.5-8cm diam., 5cm long. *Outer perianth parts* light green with purplish midvein, spatulate, apices acute, margins ciliate. *Inner perianth parts* purplish-pink with a darker midvein, linear, 35mm long, 5mm broad, acuminate apically. *Filaments* pale yellow to purplish-pink, 12mm long. *Style* pale purplish pink, 20mm long, 1.5mm diam. *Stigmas* yellow. *Fruits* round to ellipsoid, deep green, 11-15mm long, 7-9mm diam., with scales having membranous borders. *Seeds* 1.6-2.7mm long, 1.2-1.6mm diam.

DISTRIBUTION (Fig. 23). The northernmost variety of the species, apparently restricted to the Valley of Rayones, Nuevo León, at 25° N, and 100°5' W, at elevations from 800 to 1000 m.

SPECIMENS EXAMINED. MEXICO. Nuevo León: entre Rayones y Galeana, 9 June 1986, E. F. Anderson in H. Sanchez-Mejorada 3725 (MEXU); near Rayones, A. Lau *Rubens* s.n. (MEXU).

6. **T. hastifer** (Werderm. & Boedeker) F. Knuth in Backeb. & F. Knuth, Kaktus-ABC, 360 (1935).

Echinocactus hastifer Werderm. & Boedeker in Notizbl. Bot. Gart. Mus. Berlin-Dahlem 11:274 (1931). *Ferocactus hastifer* (Werderm. & Boedeker) N. P. Taylor in Cact. Succ. J. Gr. Brit. 41:90 (1979). Miraculously, the type specimen survived the destruction of World War II and still exists in Berlin (Leuenberger, 1979). Type: not seen (B).

DESCRIPTION. *Stem* usually single, 10-30cm high, 2.5-5cm diam., long cylindrical, yellowish-green, without a distinctly woolly crown. *Ribs* 12-18, vertical or spiralling slightly. *Tubercles* elongate vertically, 10-13mm long, 4-5mm broad, 4-6mm high. *Areoles* 4-5mm diam., typically 7-8mm apart, with or without extrafloral nectaries. *Central spines* 4-5, with a very long central and dominant one, 10-14(-26)mm long, 0.5mm diam., white to yellowish-brown, the centre one becoming dark brown with age, erect with the others radiating slightly, straight, acicular. *Radial spines* 20-25, 12-15mm long, white becoming darker with age, radiating, straight, slightly subulate. *Flowers* 3.5-5cm diam., 2.5-3cm long. *Outer perianth parts* light magenta with dark magenta midveins, broadly ovate, 10-13mm long, 5-7mm broad, with rounded apices and entire margins. *Inner perianth segments* magenta, elongate-ovate, 20-24mm long, 4-6mm broad, with pointed apices and entire margins. *Filaments* white, 6-8mm long. *Anthers* yellow. *Style* whitish-magenta, 7-9mm long, 2mm diam. *Stigmas* 5-7, 2mm long. *Fruits* greenish-purple, dry at maturity, dehiscent by a basal pore, 8-14mm long, 7-11mm diam. *Seeds* 1.7-2.1mm long, 0.5-1.1mm diam.

DISTRIBUTION (Fig. 23). Occurring on limestone soil in thorn or microphyllous shrubland in the Mexican state of Querétaro, from 20°30' to 21° N, and from 99°30' to 99°45' W, at elevations from 1800 to 2000 m.

SPECIMENS EXAMINED. MEXICO. Locality unknown, W. Wagner in 1962 (WCW). Querétaro: en Camino a Vista Hermosa, 31 May 1986, E. F. Anderson in H. Sanchez-Mejorada 3604 (MEXU); loc. cit., 20 April 1986, U. Guzman 456 (MEXU).

7. **T. conothelos** (Regel & Klein) Backeb. & F. Knuth, Kaktus-ABC, 385 (1935).

Echinocactus conothelos Regel & Klein, Ind. Sem. Hort. Petrop. 1860:48 (1860). *Gymnocactus conothelos* (Regel & Klein) Backeb., Die Cact. 5:2859 (1961). Regel and Klein stated that the original specimen was collected by Karwinski near Tancuicillos and Jaumave in Mexico. No type specimen is known nor did an illustration accompany the original description. Neither is there an illustration in any other publication that might be attributed to the original material. Therefore, the following specimen is designated as the neotype: "1 mile southwest of La Perdida, Tamaulipas," 22 January 1961, Edward F. Anderson 1725 (POM). If Latin grammar is followed strictly, the specific epithet should be *conothele*. However, the original name does not have to be changed as proposed by Glass and Foster (1972) (see ICBN, Art. 73).

Echinocactus saussieri F. A. C. Weber in Bois, Dict. hort. 468 (1896). *Thelocactus saussieri* (F. A. C. Weber) A. Berger, Kakteen, 257 (1929). *Gymnocactus saussieri* (F. A. C. Weber) Backeb. in Cact. Succ. J. (US) 23:151 (1951). The type locality was stated to be Matehuala. No illustration appeared with the original description and none can be attributed to the original material. The following specimen is designated as the neotype: "At KM31 east of Matehuala, San Luis Potosi, 31 July 1972, Edward F. Anderson 3204 (US). There has been considerable discussion in the literature about the relationship of *T. conothelos* and *T. saussieri*, but my observations in the field, as well as those of others (Kladiwa and Fittkau, 1971; Glass and Foster, 1972; Baborak, 1978) suggest that there is but a single, highly variable species.

DESCRIPTION. *Stem* usually single but occasionally clustering, 6-24(-45)cm high, 7-17cm diam., globose to cylindrical, green to



PLATE I. Top row: Left, *T. setispinus*, R.O. Albert in 1981 (photo: Anderson); centre, *T. bicolor* var. *bicolor*, the form previously known as var. *bolaensis* (Fröhlich); right, *T. bicolor* var. *schwarzii* in habitat (Taylor). Middle row: Left, *T. leucacanthus*, E.F. Anderson 4962 (Anderson); right, *T. conothelos* var. *conothelos* (Ruoff). Bottom row: Left, *T. leucacanthus* (Ruoff); centre, *T. macdowellii*, E.F. Anderson 3182 (Anderson); right, *T. conothelos* var. *aurantiacus* (Fröhlich).

yellowish-green. *Ribs* indistinct and usually spiralling. *Tubercles* large, deltoid to elliptical, 8-24mm long, 4-18mm broad, 4-16mm high. *Areoles* 3-8mm long, 1.5-5mm wide, with a short furrow, usually without extrafloral nectaries, typically 10-30mm apart. *Central spines* 1-4, 10-55mm long, 1-2mm diam., becoming long and very dominant with age, reddish or reddish-white becoming greyish-brown, sometimes becoming shredded, erect to somewhat spreading, straight, acicular. *Radial spines* 10-23, 5-20mm long, 1mm diam., radiate, whitish to greyish-brown, acicular to terete, straight. *Flowers* 3-4cm diam., 3-5cm long. *Outer perianth parts* brownish-purple to orange, ovate, 14-17mm long, 7-9mm broad, mucronate apically, ciliate marginally. *Inner perianth parts* purple to magenta, white, yellow or orange, 20-27mm long, 4-8mm broad, mucronate apically, ciliate marginally. *Filaments* 5-13mm long, white. *Anthers* yellow-orange. *Style* white to yellow-orange, 25-27mm long. *Stigmas* 5-6, 2mm long. *Ovary* in anthesis naked below but with heavy scales above. *Fruits* dry at maturity, dehiscent by a basal pore, 10-14mm long, 6-9mm diam. *Seeds* 1.5-2.1mm long, 1.2-1.5mm diam., verrucose.

DISTRIBUTION (Fig. 25). Occurring on limestone soils in the easternmost Chihuahuan Desert and into thorn shrubland and pine forest in the states of Nuevo León, Tamaulipas, and San Luis Potosí, from 23° to 24°15' N, and from 99°30' to 102° W, at elevations from 1000 to 2100 metres.

KEY TO THE VARIETIES OF *T. CONOTHELOS*

1. Radial spines 10-16, 8-12mm long; flowers magenta to white (Tamaulipas, San Luis Potosí, Nuevo León) 7a. var. **conothelos**
 Radial spines 17-23, 10-30mm long; flowers pinkish-purple to yellow or yellowish-orange 2
2. Flowers pinkish-purple; central spines creamy white becoming shredded with age, upper ones 30-50mm long (Ascension, Nuevo León) 7b. var. **argenteus**
 Flowers yellow to yellowish-orange; central spines orangish to greyish-brown, upper ones 17-35mm long (Aramberri, Nuevo León) 7c. var. **aurantiacus**

7a. var. **conothelos**

DESCRIPTION *Stem* solitary or occasionally clustering, globose, 6-24(-45)cm high, 7-18cm diam. *Tubercles* not obscured by spines. *Central spines* 1-4 (usually 4), 13-55mm long, erect to somewhat spreading. *Radial spines* 10-16, 8-12mm long, white and somewhat glassy, straight to somewhat curved or twisted. *Flowers* magenta, purple, or white.

DISTRIBUTION (Fig. 25). Occurring in thorn shrub and Chihuahuan Desert in the states of Nuevo León, Tamaulipas, and San Luis Potosí, from 23° to 24°5' N, and from 99°30' to 102° W, at elevations of 1500 to 1800 m.

SPECIMENS EXAMINED. MEXICO. Tamaulipas: Tula, 1972, *L. Kladiwa* s.n. (ZSS); 1 mile east of La Peña, *E. F. Anderson* 1715 (POM); 1 mile southwest of La Perdida, *E. F. Anderson* 1725 (POM). San Luis Potosí: at KM31 east of Matehuala, *E. F. Anderson* 3204 (US, WCW); Loma Bonita, Matehuala, *H. Sanchez-Mejorada* 2105 (MEXU). Nuevo León: cerca de Dr. Arroyo, 1958, *H. Bravo H.* s.n. (MEXU); KM34 al norte de Matehuala en carretera 57, 15 June 1986, *E. F. Anderson* in *H. Sanchez-Mejorada* 3839 (MEXU).

7b. var. **argenteus** Glass & Foster in *Cact. Succ. J. (US)* 44:48 (1972). Type: 'About 7 miles west of Ascension, 12 February 1971', *Glass & Foster* 3176 (ZSS).

This variety is based on material from near Ascension, Nuevo León, differing 'from the type principally by its greater spine count, the distinctive nature and colour of the spines, and by its isolated range.' I feel that these are sufficient differences to justify the recognition of the population as a formal variety, especially when considering the geographical isolation.

DESCRIPTION *Stem* solitary, globose to depressed-globose to somewhat columnar, 8-18cm high, 13cm diam. *Tubercles* mostly obscured by spines. *Central spines* 4, 30-50mm long, shredding, porrect. *Radial spines* 20, 13-30mm long, glassy, silvery greyish-white, stiff. *Flowers* pinkish purple.

DISTRIBUTION (Fig. 25). Restricted to pine forest in the area near La Ascension, Nuevo León, at 24°10' N, and 99°58' W, at an elevation of 2100 m.

SPECIMENS EXAMINED. MEXICO. Nuevo León: 10.5km west of La Ascension, *E. F. Anderson* 3210 (US, WCW); About 7 miles W of Ascension, 12 Feb. 1971, *Glass & Foster* 3176 (ZSS).

7c. var. **aurantiacus** Glass and Foster in *Cact. Succ. J. (US)* 44:48-50 (1972). Type: 'About 9 miles east of La Escondida, 12 February 1971', *Glass & Foster* 3183 (ZSS).

This variety also comes from Nuevo León, but just northwest of the town of Aramberri. It differs from the typical members of the species by flower colour, a greater number of radial spines, central spines of different colour and shape, and its isolation in the Aramberri Valley. I feel these characters are sufficient to distinguish this population as a separate variety.

DESCRIPTION *Stem* solitary, globose to somewhat columnar, 10cm high, 11cm diam. *Tubercles* mostly obscured by spines. *Central spines* 4, 20-35mm long, porrect to slightly recurved. *Radial spines* 17-23, 10-20mm long, glassy white with yellowish base, stiff. *Flowers* bright yellow to orangish-yellow.

DISTRIBUTION (Fig. 25). Restricted to a small, isolated area of the Chihuahuan Desert near Aramberri, Nuevo León, from 24° to 24°10' N, and from 99°45' to 99°55' W, at elevations from 1000 to 1200 m.

SPECIMENS EXAMINED. MEXICO. Nuevo León: About 9 miles east of La Escondida, 12 Feb. 1971, *Glass & Foster* 3183 (ZSS); northwest of Aramberri, 31 July 1972, *E. F. Anderson* 3208 (US, WCW)—this locality was again visited in 1986 and all plants at lower elevations had been collected. A few specimens remain in higher, less accessible places.

8. **T. lausseri** J. Riha & J. Busek in *Kakt. and Sukk.* 37(8):162-164 (1986). Type: Sierra de las Ovejas, Coahuila, Mexico, *A. Lausser* s.n. (PR 377518).

DESCRIPTION *Stem* single, globose to short elongate, 7-10cm high, 5-8.5cm diam., grey-green. *Ribs* 8-10, slightly spiralling. *Tubercles* somewhat round, 7-9mm broad, 8-12mm high. *Areoles* round, 5-6mm diam., without extrafloral nectaries. *Central spines* 4(-6), 60-105mm long, 2.5mm diam., red to reddish-yellow to whitish-yellow to whitish-grey, erect, somewhat curved, rounded. *Radial spines* 20-22(-25), 18-20(-28)mm long, 1mm diam., silver-white to rarely yellowish, not erect, rounded. *Flowers* 3.6cm diam., 3.6cm long. *Outer perianth parts* whitish with a darker midvein, ovate. *Inner perianth parts* whitish to light rose with a darker midvein, up to 25mm long and 3mm wide, smooth marginally, pointed apically. *Filaments* rose to white. *Anthers* yellow. *Style* yellow to whitish, 16mm long. *Stigmas* 5-8, yellowish. *Ovary* in anthesis scaly. *Fruit* dehiscent basally, with scales, 12-14mm long, 7mm diam. *Seeds* 2mm long, 1mm diam., verrucose.

DISTRIBUTION (Fig. 25). Occurring on limestone soils in the Chihuahuan Desert in the state of Coahuila, from the Sierra de las Ovejas near Cuatro Ciénegas.

9. **T. heterochromus** (F. A. C. Weber) van Oosten in *Kakteenkunde* 1940:58 (1940).

Echinocactus heterochromus F. A. C. Weber in *Bois, Dict. hort.* 466 (1896). *Ferocactus heterochromus* (F. A. C. Weber) N. P. Taylor in *Cact. Succ. J. Brit.* 41:90 (1979). Weber stated that the type locality was of the northeast of Mexico in Coahuila. No type specimen was preserved and no illustration accompanied the description. Unfortunately, no illustration of this species appeared for many years; however, those that were published by van Oosten (1940) and others fit the original description very well. As no original material, or illustration based upon it, exists, it is necessary to designate the following specimen as the neotype: 'Durango, 3.5km al Oeste de la Soledad', *R. D. Worthington* 10902 (TEX).

Britton and Rose (1923) believed that an earlier name for this taxon was *Echinocactus pottsii* Salm-Dyck in *Allg. Gartenz.* 18:394 (1850). However, van Oosten (1940) and more recently

Glass and Foster (1977) questioned whether this was the same plant that Weber had described as *E. heterochromus*. Salm-Dyck stated that the type locality was Chihuahua but did not include an illustration. Van Oosten (1940) presented a photograph of a plant that he believed was Salm-Dyck's *E. pottsii*, and which met the description. Clearly, it is not the same as *E. heterochromus*; in fact, Taylor (1984) refers it unhesitatingly to *Ferocactus*.

DESCRIPTION. *Stem* single, 4-7cm high, 6-15cm diam., globose to depressed-globose, green to bluish-green. *Ribs* 7-11. *Tubercles* rounded on top, 17-20mm long, 25-30mm broad, 13-17mm high. *Areoles* elongate, extending about half the length of the tubercle or more, 4-7mm long, 3-5mm broad, very evident, yellowish, typically 16-20mm apart, without extrafloral nectaries. *Spines* present on all areoles and relatively short. *Central spines* 1(-4), 20-30mm long, 1.5-2mm diam., reddish-yellow becoming darker with age, pointing downward, slightly curved, somewhat subulate. *Radial spines* 6-9, 16-28mm long, 1.5-2.5mm broad, white to reddish-yellow becoming reddish-black with age, radiating, more or less straight but the uppermost one distinctly recurved, subulate. *Flowers* 5.5-10cm diam., 4.5-5.5cm long. *Outer perianth parts* magenta with whitish-magenta margins, oblong, 15-22mm long, 7-11mm broad, pointed apically, ciliate marginally. *Inner perianth parts* magenta becoming very dark at the base, oblong, 25-31mm long, 6-12mm broad, mucronate apically, marginally entire. *Filaments* yellow, 8-13mm long. *Anthers* yellow, 0.5mm long. *Style* whitish-yellow, 23-26mm long, 1.5-2mm diam. *Stigmas* 6-9, 3-5mm long. *Ovary* in anthesis covered with heavy scales. *Fruits* somewhat globose-elongate, slightly fleshy at maturity, dehiscent by a basal pore, with scales, 23-30mm long, 15-17mm diam. *Seeds* 1.6-2.2mm long, 1-1.5mm diam., distinctly verrucose but also slightly tessellate.

DISTRIBUTION (Fig. 25). Usually occurring on hill tops in limestone soil along the western edge of the Chihuahuan Desert in the states of Chihuahua, Durango, and possibly Zacatecas, from 25°10' to 28°40' N, and from 104° to 106°10' W, at elevations of 1200 to 1400 m.

SPECIMENS EXAMINED. MEXICO. Chihuahua: vicinity of Chihuahua, *E. Palmer* 71 (K); from Parral, 1969, *H. W. Fittkau* s.n. (ZSS); rocky hills near Chihuahua, *C. G. Pringle* 73 (K); cerca de Parral, 1960, *H. Bravo* H. s.n. (MEXU). Durango: 3.5km al Oeste de La Soledad, *R. Corral* D. 202 and *R. D. Worthington* 10902 (TEX). Zacatecas (?): vicinity of Fresno [Fresnillo ?], *E. Palmer* 150 (US).

10. **hexaedrophorus** (Lemaire) Britton & Rose in Bull. Torrey Bot. Club 49:251 (1922).

Echinocactus hexaedrophorus Lemaire, Cact. Gen. Nov. Sp. 27 (1839). The type locality was stated as Tampico. However, this clearly is impossible and probably refers to the Mexican port from which the plant was shipped to Europe. No illustration accompanied the description but one appeared two years later in Lemaire's *Iconographie descriptive des Cactees* (Part I, plate 2) (1841). Probably this is the same plant upon which Lemaire based his original description, as he stated that the plant had been collected in Mexico by Galeotti and introduced into the European collection of M. van der Maelen in 1838. Another illustration of the species appeared in *Curtis' Botanical Magazine* (73:tab. 4311) in 1847; clearly it is the same species as illustrated by Lemaire. Because of the absence of proof that the Lemaire illustration of 1841 is based on the same material used in making the original description, it can serve only as the neotype. Therefore, Plate 2 in Lemaire, *Iconographie descriptive des Cactees* (1841) is designated as the neotype (Fig. 24). Probably the plants were collected in the area of San Luis Potosí.

Echinocactus fossulatus Scheidw. in Allg. Gartenz. 9:49 (1841). *Echinocactus hexaedrophorus* var. *fossulatus* (Scheidw.) Salm-Dyck ex Labouret, Monogr. Cact. 251 (1853). *Thelocactus fossulatus* (Scheidw.) B. & R., Cact. 4:10 (1923). Scheidweiler stated the type locality as San Luis Potosí, Mexico, and one of the new cacti from the collection of M. van der Maelen, which is the same source from which Lemaire obtained the plant that he described as *E. hexaedrophorus*. However, Scheidweiler did not include an illustration with the original description. The

first illustration appeared in Pfeiffer & Otto, *Abbildung und Beschreibung Blühender Cacteen* (Vol. 2, plate 13, 1847). It is impossible to know if it is based on the same material as was the original description; however, it can serve as the neotype. There seems to be no justification for recognizing this as a separate species or variety.

Echinocactus hexaedrophorus [var.] *subcostatus* Salm-Dyck, Cact. Hort. Dyck. 1849, 34 (1850).

Echinocactus hexaedrophorus [var.] *roseus* Lemaire ex Labouret, Monogr. Cact. 251 (1853).

Echinocactus hexaedrophorus var. *major* Quehl in Monatsschr. Kakt.-Kunde 4:29 (1894).

Echinocactus hexaedrophorus var. *labouretiana* Schumann, Gesamtb. Kakt. 438 (1898); *Echinocactus labouretianus* Cels Cat. nom. nud.

Echinocactus hexaedrophorus var. *decipiens* A. Berger, Kakteen, 253 (1929).

Echinocactus droegeanus Hildm. ex Schumann, Gesamtb. Kakt. 438 (1898). *Echinocactus hexaedrophorus* var. *droegeanus* (Hildm. ex Schumann) R. Meyer in Monatsschr. Kakt.-Kunde 27:40 (1917). Perhaps *Echinocactus drageanus* Moerdt in Rev. Hort. 67:186 (1895) refers to the same taxon; however, the description is too incomplete to tell. Britton and Rose (1922b) believed it probably was the same.

DESCRIPTION. *Stem* single, rarely clustering, 3-7.5cm high, 8-15cm diam., globose to flattened to sometimes depressed globose, green to deep olive green. *Ribs* indistinct, often spiraling. *Tubercles* large, sometimes somewhat compressed apically, rounded, deltoid, or hemispherical, 8-20mm long, 13-26mm broad, 8-12mm high. *Areoles* on top of the tubercle and with a distinct groove, 4-13mm long, 0.5-4mm broad, elliptical, 3-5 times longer than wide, typically 12-28mm apart, without extrafloral nectaries. *Spines* often difficult to distinguish as centrals or radials. *Central spines* 0-3, 15-25mm long, 1.5-2mm diam., reddish to reddish-white or brownish, more or less erect, straight, acicular to subulate. *Radial spines* 4-8, 5-35mm long, 1-1.5mm diam., reddish to brownish to greyish-white, erect to spreading, straight, mostly acicular. *Flowers* 3.3-5.5cm diam., 2.7-3.5cm long. *Outer perianth parts* deep magenta to brownish-magenta but with lighter margins, ovate, 8-22mm long, 3-8mm broad, apically pointed or rounded, margins ciliate to membranous. *Inner perianth parts* white with magenta or pink midveins or completely white, elongate-elliptical, 22-31mm long, 3-7mm broad, apices rounded or pointed, margins entire. *Filaments* white, 3-15mm long. *Anthers* yellow, 1-1.5mm long. *Style* yellow or white, 7-14mm long. *Stigmas* 5-10, 3-7mm long. *Ovary* in anthesis covered with scales. *Fruits* green-magenta becoming yellowish-brown, dry at maturity, dehiscent by a basal pore, with scales, ovoid, 7-11mm long, 8-12mm diam. *Seeds* 1.5-2mm long, 1.2-1.5mm diam., tessellate.

DISTRIBUTION (Fig. 21). Occurring widely on limestone soils in the Chihuahuan Desert, savannah (pastizal), and grasslands in San Luis Potosí, Zacatecas, Tamaulipas, and Nuevo León, from 21°50' to 24°25' N, and from 99°45' to 103°10' W, at elevations from 1100 to 2300 m.

KEY TO THE VARIETIES OF *T. HEXAEDROPHORUS*

Central spines 0-1, 15-18mm long; radial spines 4-6; flowers 4-5.5cm diam. 10a. var. **hexaedrophorus**
Central spines 1-3, 20-25mm long; radial spines 6-8; flowers 3.3-3.6cm diam. 10b. var. **lloydii**

10a. var. **hexaedrophorus**

DESCRIPTION. *Stem* 4.5-7.5cm high, 8-15cm diam., green. *Tubercles* rounded or hemispherical, 8-20mm long, 13-26(-40)mm broad, 6-12mm high. *Areoles* 4-13mm long, 0.5-3mm broad. *Central spines* 0-1, 15-18mm long, reddish. *Radial spines* 4-6, 5-35mm long, reddish to greyish-white. *Flowers* 4-5.5cm diam. *Outer perianth parts* deep magenta, 8-22mm long, 4-8mm broad, apically rounded, ciliate marginally. *Inner perianth parts* with pink midveins, 22-31mm long, 3-7mm broad. *Style* white, 7-12mm long.

DISTRIBUTION (Fig. 21). Occurring widely, mostly in Chihuahuan Desert in the states of San Luis Potosí, Tamaulipas, and



PLATE II. Top row: *T. lausseri* in habitat and flowering in cultivation (photos: Busek). Second row: *T. hastifer* in habitat (Taylor) and flowering in cultivation (Anderson). Third row: Left, *T. hexaedrophorus* in habitat W of San Luis Potosí, SLP, a form tending towards var. *lloydii* (Taylor); right, *T. hexaedrophorus* var. *hexaedrophorus* (Fröhlich). Bottom row: Left, *T. rinconensis* in bud near Saltillo, Coahuila (Taylor); right, *T. tulensis* var. *matudae* (Fröhlich).

Nuevo León, from 21°45' to 24°15' N, and from 99°5' to 101°45' W, and at elevations from 1100 to slightly higher than 2000 m.

SPECIMENS EXAMINED. MEXICO. Without locality: 1926, A. Berger s.n. (NY); 1917, E. Wagner s.n. (NY). San Luis Potosí: without locality, E. Palmer 04.368, 05.478 (US); 16km east of San Luis Potosí, E. F. Anderson 1201 (WCW); 19km north of San Luis Potosí, E. F. Anderson 1668 (US, WCW); at KM30 north of San Luis Potosí, E. F. Anderson 3198 (US, WCW); 30 miles southeast of San Luis Potosí, J. Couper 2100 (POM); 5km

south of Ventura, E. F. Anderson 1208 (WCW); 2km on road to Salinas, E. F. Anderson 5001 (US, WCW); Minas de San Rafael, C. A. Purpus 15 (NY, US); 5.5km south of Villa Juarez, E. F. Anderson 4955 (US, WCW); 27km south of El Huizache junction, E. F. Anderson 1861 (WCW); 28km north of Matehuala, E. F. Anderson 1225 (WCW). Tamaulipas: 2km southeast of Las Perdidas, E. F. Anderson 1722 (US, POM, WCW). Nuevo León: KM34 al norte de Matehuala en carretera 57, 15 June 1986, E. F. Anderson in H. Sanchez-Mejorada 3837 (MEXU); 29km este de Matehuala, H. Sanchez-Mejorada 2111 (MEXU); 8km east of Dr.

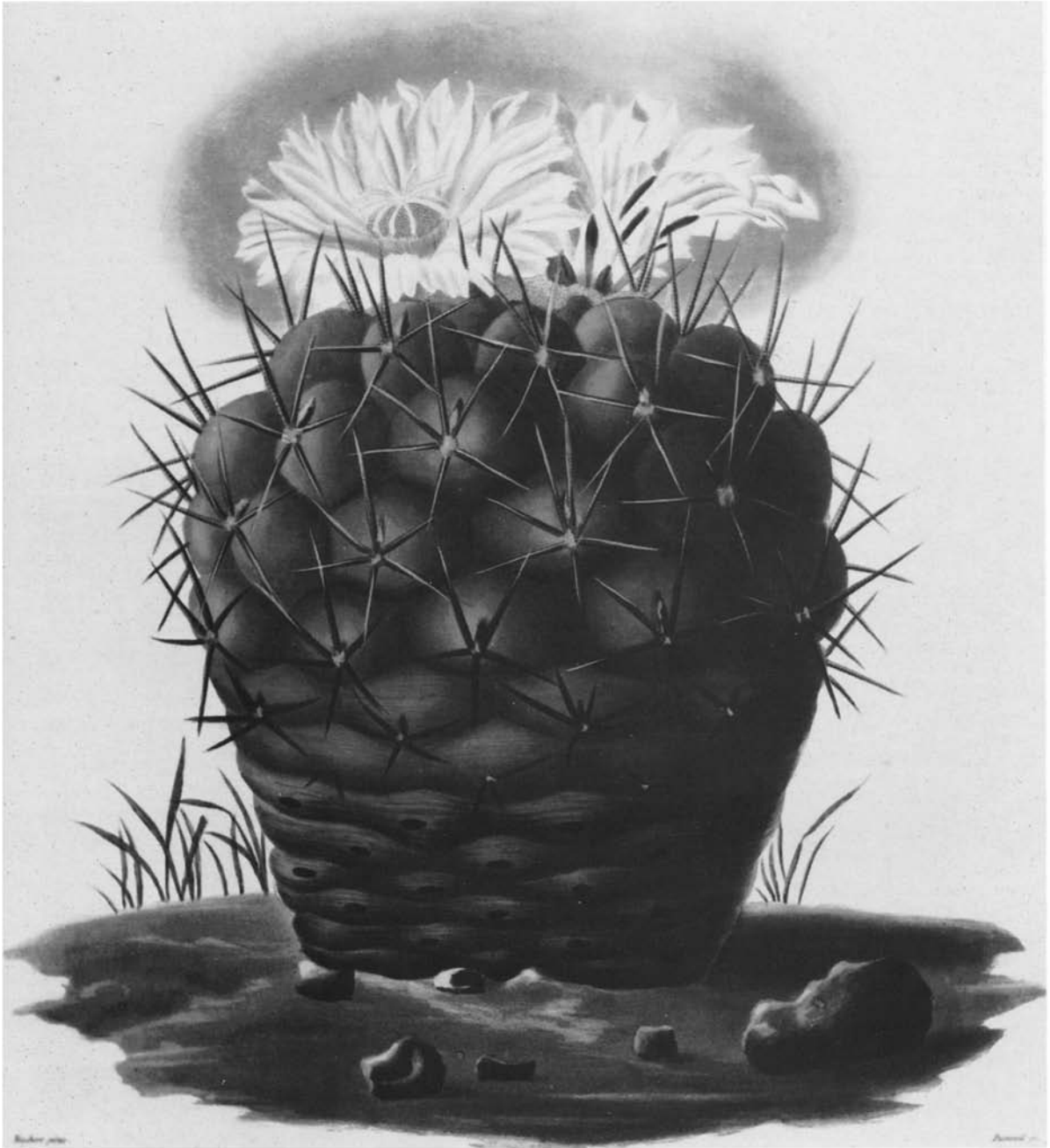


Fig. 24. Illustration of *T. hexaedrophorus* in C. Lemaire, *Iconographie descriptive des Cactees*, Plate 2 (Dec. 1841), here designated as the neotype of *Echinocactus hexaedrophorus* Lem.

Arroyo, *E. F. Anderson* 1730 (US, POM, WCW). Coahuila: K84, carretera Saltillo—Concepción del Oro, *H. Bravo* H. 57 (MEXU).

10b. var. **lloydii** (Britton & Rose) Kladiwa & Fittkau in Krainz, *Die Kakteen*, Lfg. 61 (Jan. 1975).
Thelocactus lloydii B. & R., *Cact.* 4:11 (1923). Type: Mexico, Zacatecas, *F. E. Lloyd* 33 (US).

DESCRIPTION. *Stem* 3-6cm high, 8-12cm diam., deep olive green. *Tubercles* deltoid-shaped, 15-20mm long, 13-18(-40!)mm wide, 6-9mm high. *Areoles* 10-12mm long, 2-4mm wide. *Central spines* 1-3, 20-25mm long, 1.5-2mm diam., reddish-white to brownish. *Radial spines* 6-8, 15-22mm long, reddish-white to brownish. *Flowers* 3.3-3.6cm diam. *Outer perianth parts* brownish-magenta, 9-12mm long, 3-4mm broad, with somewhat pointed apices and membranous margins. *Inner perianth parts* white with magenta midveins, 24-30mm long, 5-7mm broad. *Style* yellow, 12-14mm long.

DISTRIBUTION (Fig. 21). Restricted to high elevation savannah and grassland in the state of Zacatecas, from 22°50' to 24°10' N, and from 102°30' to 103°20' W, and at elevations from 2200 to 2300 m.

SPECIMENS EXAMINED. MEXICO. Zacatecas: northern Zacatecas, *F. E. Lloyd* 33 (US, NY); 2.5km north of Fresnillo, *E. F. Anderson* 3192 (US, WCW); KM62 between Fresnillo and Torreon, *E. F. Anderson* 5003 (US, WCW).

11. **T. rinconensis** (Poselger) Britton & Rose, *Cact.* 4:7 (1923).
Echinocactus rinconensis Poselger in *Allg. Gartenz.* 23:18 (1855); Schumann ('*rinconadensis*'), *Gesamtb. Kakt.* 433 (1898). The type locality was stated as near La Rinconada in Mexico. Unfortunately, there are many places in the Chihuahuan Desert that go by that name (Henrickson and Straw, 1976). However, plants meeting the description are found in Coahuila near Saltillo and along the highway towards Monterrey, Nuevo León. Just east of the border and along the highway is a town called Rinconada. As no illustration or original material exists, the following specimen is designated the neotype: 'About 20km northeast of Saltillo,' 22 July 1972, *Edward F. Anderson* 3180 (US).

Echinocactus phymatobelos Poselger ex Ruempler in Foerster, *Handb. Cact.*, ed. 2, 602 (1885). *Thelocactus phymatobelos* (Poselger ex Ruempler) B. & R. ('*phymatobele*'), *Cact.* 4:8 (1923). *Thelocactus rinconensis* var. *phymatobelos* (Poselger ex Ruempler) Glass & Foster in *Cact. Succ. J. (US)* 49:246 (1977). Britton and Rose changed the spelling of the epithet, but this is not sanctioned by ICBN. No specimen was preserved, no illustration was made, and the type locality was unknown to Ruempler. He stated only that the specimen was found in the cactus collection of the late Dr. Poselger. It is unclear what the plant might have been, especially since the description stated that it had only two spines. One of the most widely copied illustrations appeared in Schumann (1903); however, each tubercle has more than two spines. Plants which best seem to fit the original description occur near Saltillo. The following specimen is proposed as the neotype: '2.3km south of Puente Chorro no. 1 on hy. 57 to Matehuala,' 23 July 1972, *Edward F. Anderson* 3183 (US).

Echinocactus nidulans Quehl in *Monatsschr. Kakt.-Kunde* 21:119 (1911). *Thelocactus nidulans* (Quehl) B. & R., *Cact.* 4:9 (1923). *Thelocactus lophothele* var. *nidulans* (Quehl) Kladiwa & Fittkau in Krainz, *Die Kakteen*, Lfg. 61 (Jan. 1975). *Thelocactus rinconensis* var. *nidulans* (Quehl) Glass & Foster in *Cact. Succ. J. (US)* 49:245 (1977). No type locality was stated, but the type still exists in Berlin (Leuenberger, 1979). Type: not seen (B).

? *Echinocactus lophothele* Salm-Dyck in *Allg. Gartenz.* 18:395 (1850). *Thelocactus lophothele* (Salm-Dyck) B. & R. in *Bull. Torrey Bot. Club* 49:251 (1922). Salm-Dyck stated that Potts had collected the plant in Chihuahua in 1850. No illustration appeared with the description; in fact, no illustration of any quality appeared for more than 50 years. The plant that has been called *T. lophothele* occurs in Coahuila, not Chihuahua. Glass and Foster (1977) felt that this epithet should not be used because of the uncertain status of the taxon. I agree with

this conclusion, for both the lack of an illustration and the incorrect locality for a *Thelocactus* that meets this description make it impossible to correctly delineate the taxon Salm-Dyck described.

DESCRIPTION. *Stem* single, 4-15cm high, 8-20cm diam., globose to flattened-globose to depressed-globose, blue-green often tinged with purple. *Ribs* usually indistinct but sometimes numbering up to 31. *Tubercles* distinctly conical, angled, often elongate towards the apex and flattened on top, 12-27mm long, 7-15mm broad, 8-15mm high. *Areoles* round to elongate, 3-10mm long, 1-5mm wide, typically 2-4cm apart, without extrafloral nectaries. *Spines* usually present but highly variable and sometimes totally absent. *Central spines* 0-4, 40-60mm long, 1.5-2mm diam., reddish-purple becoming greyish-white and sometimes scaly with age, erect, straight, acicular. *Radial spines* 0-5, 3-35 (-50!)mm long, 1-1.5mm diam., reddish or reddish-yellow becoming grey with age, erect to radiating, straight, acicular. *Flowers* 2.7-3cm diam., 3-4cm long. *Outer perianth parts* white with magenta midveins, ovate to oblong to elliptical, 5-23mm long, 4-6mm broad, mucronate apically, entire to partly ciliate margins. *Inner perianth parts* white to light pink with a darker midvein to yellowish to sometimes magenta, oblong to linear, 18-30mm long, 4-6mm broad, apices mucronate, margins entire. *Filaments* white, 6-8mm long. *Anthems* yellow, 1mm long. *Style* white, 4-8mm long. *Stigmas* 6-12, 3-4mm long. *Ovary* in anthesis covered with scales. *Fruits* greenish-yellow, slightly fleshy at maturity, dehiscent by a basal pore, with scales, 7-13mm long, 7-9mm diam. *Seeds* 1.7-2mm long, 0.5-1mm diam., tessellate.

DISTRIBUTION (Fig. 25). Occurring on limestone soils in the Chihuahuan Desert of northern Mexico in the states of Coahuila and Nuevo León, from 25°20' to 26°30' N, and from 100°45' to 102°15' W, at elevations from 1200 to 1900 m.

SPECIMENS EXAMINED. MEXICO. Coahuila: location unknown, *C. F. Moeller* 14 (US); Puente Chorro no. 1 on hy. 57 south of Saltillo, *E. F. Anderson* 1235 (POM), 1075, 1854 (WCW); 4km northwest of Arteaga, *E. F. Anderson* 3187 (US, WCW); 12.7mi. east of Saltillo, *E. F. Anderson* 1849 (WCW); 20km northeast of Saltillo, *E. F. Anderson* 3180 (US, WCW); 10km south of Saltillo, 1969, *L. Kladiwa* s.n. (ZSS); 17km south of Saltillo, *E. F. Anderson* 3183 (US, WCW); on road to Estación Marte, *E. F. Anderson* 3190 (US, WCW); 36km west of Saltillo, *E. F. Anderson* 3188 (US, WCW). Glass and Foster (unpubl.) also report collecting it near San Felipe, northwest of Monterrey, Nuevo León.

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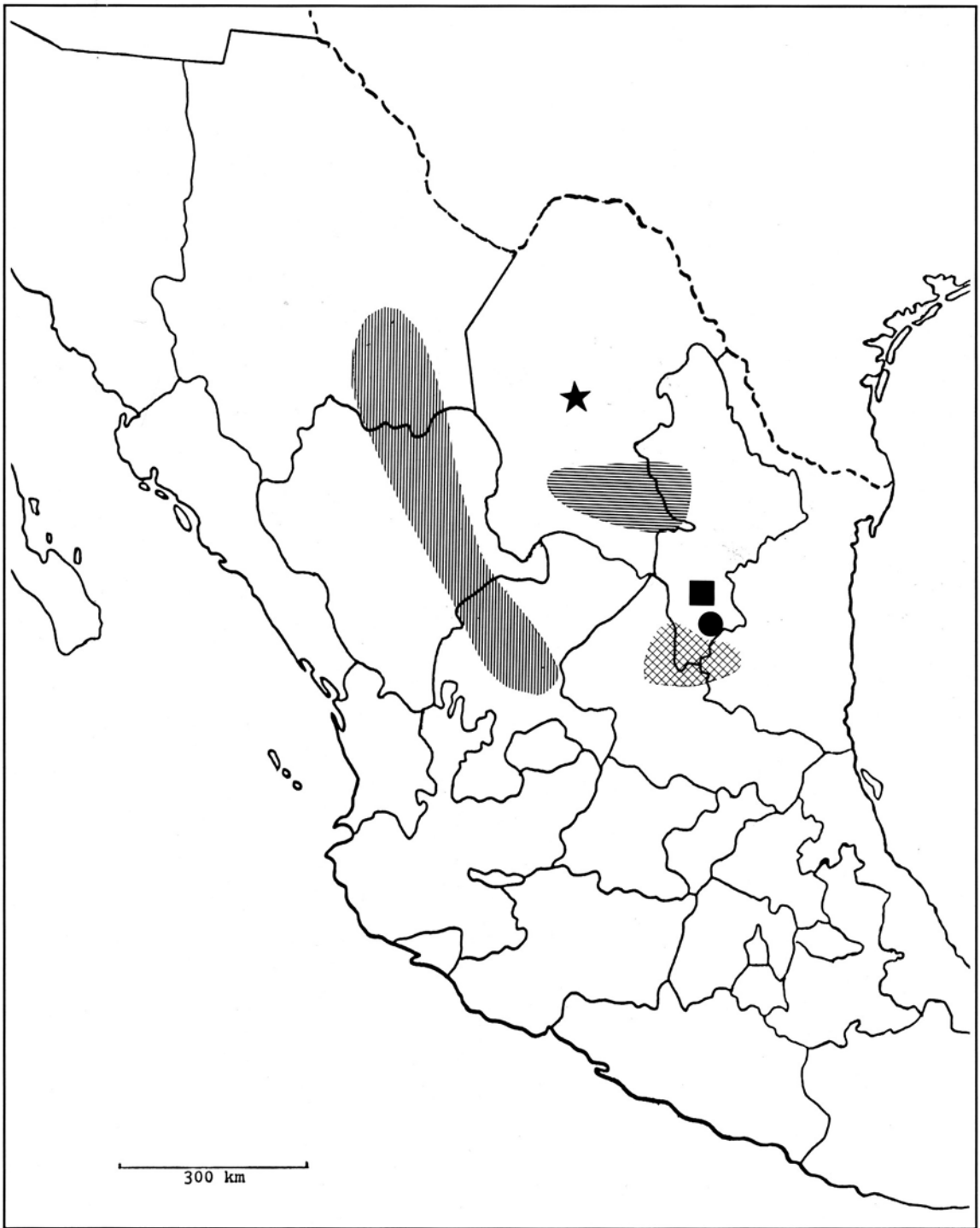


Fig. 25. Distribution of *T. conothelos* var. *conothelos* (cross hatched), var. *argenteus* (square), and var. *aurantiacus* (circle); of *T. lausseri* (star), of *T. heterochromus* (vertical lines), and of *T. rinconensis* (horizontal lines).

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PLATE III. *T. tulensis* var. *buekii* (photo: Mottram).

SOTO MORA, C. & JAUREGUI O., E. (1965), *Isotermas Extremas e Índice de Aridez en la Republica Mexicana*. Univ. Nac. Auton. México, México, D.F.
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Index to binomials and infraspecific epithets

The numbers correspond to those of the species and varieties in the systematic treatment. Accepted names are in bold type face.

<i>Cactus bicolor</i>	1
<i>Cereus maelenii</i>	3
<i>tuberosus</i>	3
<i>Echinocactus</i>	
<i>bicolor</i>	2
var. <i>bolaensis</i>	2
var. <i>schotti</i>	2
var. <i>tricolor</i>	2
<i>bolaensis</i> (<i>bolansis</i>)	2
<i>buekii</i>	5b
<i>conothelos</i>	7
<i>droegeanus</i>	10
<i>ehrenbergii</i>	3
<i>ellipticus</i>	2
<i>fossulatus</i>	10
<i>hamatus</i>	1
<i>hamulosus</i>	1
<i>hastifer</i>	6
<i>heterochromus</i>	9
<i>hexaedrophorus</i>	10
var. <i>decipiens</i>	10
var. <i>drageanus</i>	10
var. <i>droegeanus</i>	10
var. <i>fossulatus</i>	10
var. <i>labouretiana</i>	10
var. <i>major</i>	10
[var.] <i>roseus</i>	10
[var.] <i>subcostatus</i>	10
<i>labouretianus</i>	10
<i>leucacanthus</i>	3
var. <i>crassior</i>	3
var. <i>tuberosus</i>	3
<i>lophothele</i>	11
<i>macdowellii</i>	4
<i>maelenii</i>	3
<i>muehlenpfordtii</i>	1
<i>nidulans</i>	11
<i>nodosus</i>	1
<i>phymatothelos</i>	11
<i>porrectus</i>	3
<i>pottsii</i>	= <i>Ferocactus pottsii</i>
<i>rhodophthalmus</i>	2
var. <i>ellipticus</i>	2
<i>rinconensis</i>	11
<i>saussieri</i>	7
<i>schottii</i>	2
<i>setispinus</i>	1
var. <i>cachetianus</i>	1
[var.] <i>hamatus</i>	1
var. <i>mierensis</i>	1
var. <i>orcuttii</i>	1
[var.] <i>setaceus</i>	1
var. <i>setaceus</i>	1
<i>subporrectus</i>	3
<i>theloideus</i>	3
<i>tuberosus</i>	3
var. <i>subporrectus</i>	3
<i>tulensis</i>	5
<i>wagnerianus</i>	2
<i>Echinomastus macdowellii</i>	4
<i>Echinopsis nodosa</i>	1

<i>Ferocactus bicolor</i>	2
var. <i>bolaensis</i>	2
var. <i>flavidispinus</i>	2c
var. <i>schwarzii</i>	2a
<i>hastifer</i>	6
<i>heterochromus</i>	9
<i>leucacanthus</i>	3
<i>setispinus</i>	1
<i>Gymnocactus conothelos</i>	7
<i>saussieri</i>	7
<i>Hamatocactus bicolor</i>	1
var. <i>hamatacanthus</i>	= <i>Ferocactus hamatacanthus</i>
<i>setispinus</i>	1
var. <i>cachetianus</i>	1
var. <i>hamatus</i>	1
<i>Mammillaria maelenii</i>	3
<i>Neolloydia macdowellii</i>	4
Thelocactus bicolor	2
var. bicolor	2b
var. <i>bolaensis</i>	2
var. flavidispinus	2c
var. <i>pottsii</i>	2
var. <i>schottii</i>	2
var. schwarzii	2a
var. <i>texensis</i>	2
var. <i>wagnerianus</i>	2
<i>buekii</i>	5b
conothelos	7
var. argenteus	7b
var. aurantiacus	7c
var. conothelos	7a
var. <i>macdowellii</i>	4
<i>ehrenbergii</i>	3
<i>flavidispinus</i>	2c
<i>fossulatus</i>	10
hastifer	6
heterochromus	9
hexaedrophorus	10
var. hexaedrophorus	10a
var. lloydii	10b
<i>krainzianus</i>	5
lauseri	8
leucacanthus	3
var. <i>porrectus</i>	3
var. <i>sanchezmejoradai</i>	3
var. <i>schmollii</i>	3
<i>lloydii</i>	10b
<i>lophothele</i>	11
var. <i>nidulans</i>	11
macdowellii	4
<i>matudae</i>	5c
<i>nidulans</i>	11
<i>phymatothelos</i> (<i>phymatothele</i>)	11
<i>porrectus</i>	3
rinconensis	11
var. <i>nidulans</i>	11
var. <i>phymatothelos</i>	11
var. <i>sanchezmejoradai</i> (<i>sanchezmejoradai</i>)	3
<i>saussieri</i>	7
<i>schwarzii</i>	2a
setispinus	1
tulensis	5
var. buekii	5b
var. matudae	5c
var. tulensis	5a
<i>wagnerianus</i>	2

Miscellaneous notes on Stapelieae (Asclepiadaceae)

P. V. Bruyns

Summary. An historical and ecological survey of the stapeliads native to Europe is presented, and each illustrated. The circumscription of the Arabian *Caralluma hexagona* is discussed and its limits expanded to include *C. shadhbana* and *C. foulcheri-delbosicii* as synonyms. A description, illustrations and distributional data are given.

Zusammenfassung. Vermischte Bemerkungen zu einigen Stapelieae (Asclepiadaceae). Für die in Europa heimischen Taxa der Stapelieae wird ein historischer und ökologischer Ueberblick gegeben, und alle Taxa werden abgebildet. Das Konzept der arabischen *Caralluma hexagona* wird diskutiert und die Beschreibung wird so erweitert, dass *C. shadhbana* und *C. foulcheri-delbosicii* als Synonyme betrachtet werden müssen. Die Beschreibung wird durch Abbildungen und Informationen zur Verbreitung ergänzt.

5. THE STAPELIADS OF EUROPE*

The first stapeliad known to European scientists was *Orbea variegata* which was brought back in 1639 from the Cape of Good Hope by the Dutch collector Justus Heurnius. A number of other species turned up prior to 1825 in southern Africa, Arabia and India but it seemed that such plants did not occur anywhere near the European continent. It was therefore with some surprise that the botanical community of Europe greeted Giovanni

*This is a continuation of the series 'Miscellaneous notes on Ceropegieae' begun in Bradleya 4 (1986). There I employed the term Ceropegieae for the combined tribes Ceropegieae and Stapelieae of the Asclepiadaceae. These two tribes, unlike the others in the family, are separated on the basis of the presence of angled stems with each leaf borne on a raised tubercle in the Stapelieae as opposed to the lack of either of these features in the Ceropegieae. Among the Stapelieae the genus *Freerea* Dalz. transgresses the first character, having essentially rounded, irregularly tuberculate stems, and many species of *Ceropegia* are known to have both angled stems and tubercles bearing the leaves (for example *C. stapeliiformis* Haw., *C. armandii* Rauh). For these reasons these two tribes are regarded as one, but it has been pointed out by Sundell (in Taxon 29: 260-263. 1980) that the name Stapelieae was validated before Ceropegieae and is therefore the correct name for the expanded tribe comprising them both.

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Gussone's discovery in 1828 of *Stapelia europaea* on the small island of Lampedusa about 160km south of Sicily in the Mediterranean. Since then two other species, *Caralluma munbyana* and *C. burchardii*, have been found near the southern limits of the continent. This paper gives an historical and ecological survey of these three European stapeliads. Taxonomic matters such as their generic position (they probably all belong to the genus *Desmidorchis* Ehrenb. as resurrected by Gilbert and Raynal, 1980) are not dealt with.

Discussion

The continent of Europe is well-provided for with rain and mostly this is distributed evenly throughout the year. It also lies within the temperate zone and has been subjected to periods of extreme cold in recent geological history. None of these factors is conducive to the development of a rich succulent flora nor are they encouraging to the Asclepiadaceae, a family primarily of subtropical to tropical distribution. On the mainland the family is poorly represented by seventeen species of the genera *Caralluma* (2), *Cynanchum* (1), *Cionura* (1), *Periploca* (2) and *Vincetoxicum* (11) and the succulent members only reach the tip of the continent where they have a small foothold in the south-eastern corner of the Iberian Peninsula. A few additional asclepiads are added to the count when some of the islands 'annexed' to Europe are considered and this brings *Caralluma europaea* from the island of Lampedusa (Italy) and *C. burchardii* from the eastern Canary Islands (Spain) into consideration.

The tiny island of Lampedusa is far closer to the Tunisian and Libyan coasts than it is to mainland Italy and consequently its vegetation bears a marked resemblance to that on the adjacent coast of Africa. *Caralluma europaea* is well-known along the coast of Tunisia and Libya and its appearance on Lampedusa is not surprising. In a similar way the eastern Canary Islands have a vegetation bearing a strong relationship to the 'Succulent Sub-Mediterranean shrubland' of the Mediterranean/Sahara regional transition zone (White, 1983)



Top row: Left, *Caralluma burchardii*, La Oliva, Fuerteventura, *Bruyns* 2383; Right, *C. europaea*, Lampedusa, Italy, *Bruyns* 2396. Second row: Left, *C. europaea*, Almeria, Spain, *Bruyns* 2399; Right, *C. europaea*, Mazarrón, Spain, *Bruyns* 2405. Third row: Left, *C. europaea*, *Bruyns* 2405; Right, *C. munbyana*, Caravaca, Spain, *Bruyns* 2400. Bottom row: *C. hexagona*, North Yemen, near Manakhah, *Lavranos* 13120, two different clones growing at Städtische Sukkulentensammlung, Zürich, from ISI 1191.

and the *Caralluma* provides a further example of a species common to the Moroccan coast and these islands.

On mainland Europe *C. europaea* and *C. munbyana* both occur in the area characterised by Rikli (1946) as 'Litoral Steppe'. This vegetation type, unique in Europe but bearing some relation to that in the northernmost part of Africa, is found in an area of exceptional dryness in the European context, receiving only 150-300mm of rain annually. This rain falls almost entirely in winter and the summer months are dry and hot, the heat being increased by hot winds blowing northwards from the Sahara. These relatively harsh climatic conditions combined with a generally shallow-soiled, rocky terrain give the vegetation a markedly xerophytic character and succulents are frequent (Rikli, l.c.).

Investigations by F. Alcaraz and my own collections have shown that the distribution of the two *Carallumas* fills out nearly the entire area given by Rikli as covered by this vegetation. The only exception is that they do not advance as far inland as Albacete, although *C. munbyana* occurs within the Province of Albacete near Hellín, 120km from the coast. Plants of both species are particularly found in association with the grass *Stipa gigantea* which Rikli takes as characteristic of a certain formation within the Litoral Steppe (the 'Halfaformation'). This grass occurs on both sides of the Mediterranean but no information is available as to whether the same association with the *Carallumas* occurs in north Africa.

None of these *Carallumas* is endemic to Europe and both occur on the adjacent coast of Africa. Since the temperatures on the Iberian Peninsula were lower by an

average of 6°C during the last ice age (Dennell, 1983: 98) it is reasonable to assume that this area was then uninhabitable for stapeliads so that they moved into this part of Spain subsequently. The distribution of *C. europaea* from Morocco to Israel suggests that it has occurred on the southern shore of the Mediterranean for a very long time so that it could easily have spread to Europe with the retreat of low temperatures. However, despite claims to the contrary (White & Sloane, 1937), the herbarium records indicate *C. munbyana* to be restricted to the vicinity of Oran in Algeria so that today it appears to be commoner in Spain than in north Africa. This provides evidence that it may have arisen in Spain and moved across to north Africa. However, this implies it to be a recently evolved species which seems improbable and it is more reasonable to assume that it, too, has moved into Europe from the north African coastal area and that it is either very much more widespread in Africa than records indicate or that it has suffered a decline in this area. The claim that both these species have 'jumped' the 200km of sea separating Africa and the Iberian Peninsula is made more reasonable when it is considered that most asclepiads are ideally suited for dispersal by wind since each seed is light and flat and has a large coma of fine hairs attached to it. The powerful winds (Levante) which blow off the Sahara and across the Mediterranean would easily transport them along with the other dust that they bring. In addition it is unlikely that their sudden transportation to new areas would have left them without a pollinator. Both species have dark-coloured flowers emitting a strong dung-like odour so that they are almost certainly myophilous



Map 1. Distribution of the European species of *Caralluma*. The stippled area in Spain indicates the part shown in more detail in Map 2.

(Vogel, 1954). Flies of all sizes are very common in semi-arid areas and since it does not appear that the relatively flat-flowered Stapelieae are as highly pollinator-specific as some of the tubular-flowered ones, it is likely that pollination would occur in a newly colonized area.

A further remarkable fact is that the populations in Spain advance beyond the 38°N parallel. Of all members of the Stapelieae, they therefore occur furthest from the equator.

Caralluma burchardii N. E. Brown in Bull. Misc. Inf. Kew 1913(3): 121 (1913).

Unlike the other two species, *C. burchardii* does not occur on the European continent itself and is found only in the desertic eastern islands of the Canary Archipelago. Here it inhabits Fuerteventura and Lanzarote as well as the islets of Lobos and Graciosa. In 1912 Oscar Burchard, an amateur botanist living at Orotava on Tenerife, discovered the first specimens near La Oliva on the northern end of Fuerteventura and Eric R. Sventenius appears to have recorded it first from Lanzarote. Recently it has been recorded from a dry valley on Gran

Canaria (D. Bramwell, pers. comm. 1982) which is another island where suitably arid conditions exist in parts.

On Fuerteventura the greatest concentrations are around the volcanic mountain of Arena just north of La Oliva. Here plants grow in an enormous volcanic slag-field stretching over many square kilometres and this is the largest, most prolific stapeliad population that I have ever seen. In fact it has achieved weed status in the area and even infests *Opuntia* plantations inside the town of La Oliva. Individual plants are enormous: stems may be up to 50cm tall (though more usually they are 15-30cm long) and 2.5cm thick, forming clusters up to 60cm in diameter. However, as these slag-fields are characterised by pockets of soil filling up the spaces between the stones, the plants are mostly much smaller in stature, spreading extensively but shallowly by underground runners. Thus specimens up to 3m in diameter are encountered but they consist of only a few, widely-scattered stems joined under the soil surface. These slag-fields were previously used to grow a species of *Opuntia* for the production of cochineal and as a consequence the vegetation of the area consists mainly of two species of

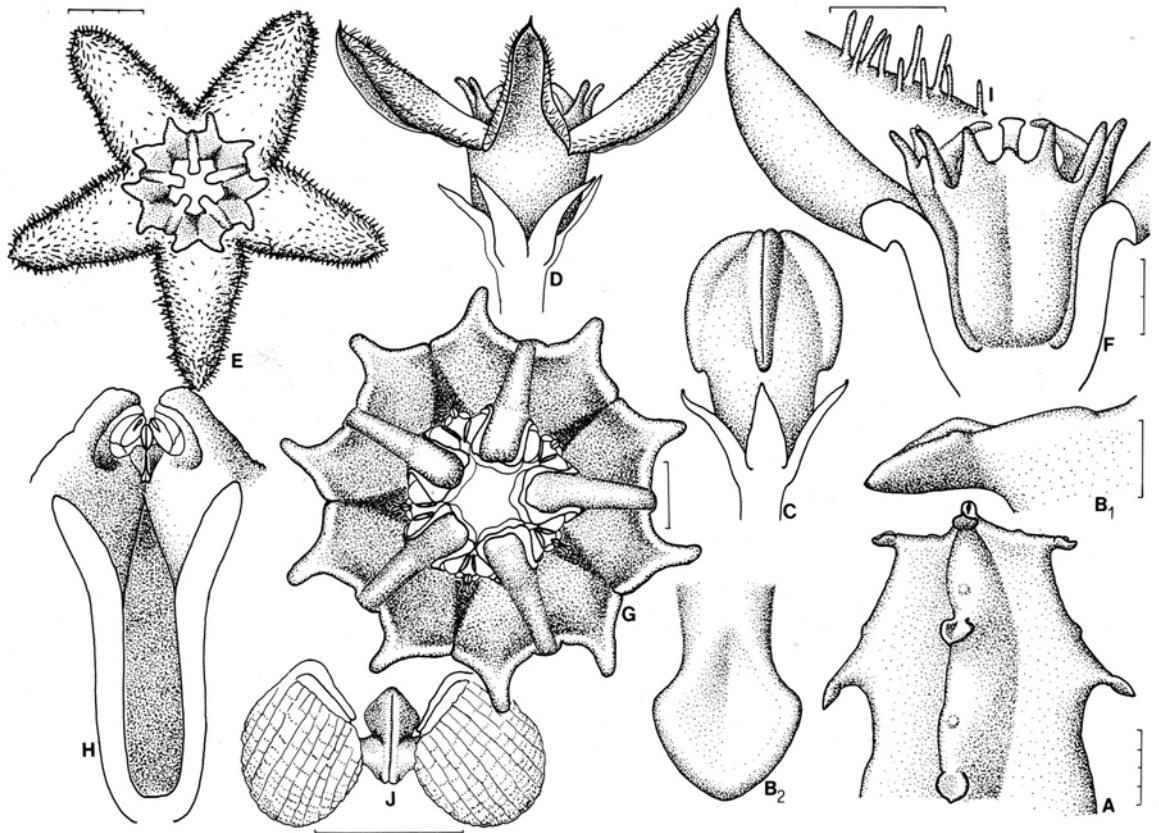


Fig. 1. *Caralluma burchardii* N. E. Brown. A, side view of small piece of stem (scale 4mm); B₁, side view of leaf (scale 1mm as for B₂, H); B₂, face view of leaf; C, bud; D, side view of corolla; E, face view of corolla (scale 3mm as for C, D); F, side view of staminal column with corolla-tube dissected (scale 2mm); G, face view of staminal column (scale 1mm); H, side view of dissected staminal column showing deep nectarial orifice; I, hairs on upper surface of corolla (scale 1mm); J, pollinarium (scale ½mm). All drawn from *Bruyns* 2383, La Oliva, Fuerteventura, Canary Islands (K).

Opuntia, *Agave americana*, the *Caralluma*, *Kleinia neriifolia*, *Euphorbia obtusifolia*, *Asparagus*, *Launaea arborescens* and various lichens. Similar patches of vegetation are found scattered all over the island except in the south in the sandy parts of Jandia and they mostly occur in similar slag-ash heaps around volcanic cones (Burchard, 1929). Other concentrations are on Lobos, Graciosa and Lanzarote (Kunkel, 1970, 1971). *Caralluma burchardii* is also recorded from Morocco (Maire, 1923) and plants from there are reputedly different. The few photographs extant do not show significant differences in the flowers and since a substantial amount of the sand found on the eastern Canaries is brought over from the Sahara by the harmattan winds it is highly likely that the seeds of *C. burchardii* would have come over in this way too. It is therefore reasonable for the island populations to resemble closely those from the mainland.

As with *C. europaea*, *C. burchardii* has no close relatives in Africa despite the reputed occurrence of three other stapeliads—*C. hesperidum*, *C. europaea* and *C. munbyana*—in Morocco.

In contrast to the situation in *C. europaea*, the above-ground portions of *C. burchardii* do not branch. It appears that it is only a few axillary buds beneath the soil that are active and each of these sends out a runner just beneath the soil surface. The underground stems are always much thinner than the above-ground parts and are nearly cylindrical (i.e. lacking angles) but possess the same rudimentary leaves which persist for some time. On breaking out through the soil the new shoot becomes erect, thicker and lengthens rapidly. It is 4-angled but usually much thinner than the older stems. The stem lengthens slightly after the terminal inflorescences are produced but the main growth activity is in thickening. According to Burchard (1929) one can gauge the age of a stem by the number of times it has increased in length as the angles on growth produced after an inflorescence are out of phase with previous angles.

The flowers of *Caralluma burchardii* have a number of interesting features. One of these is the thick, cylindrical, translucent hairs on the upper surface of the corolla which are most plentiful towards the margins of the lobes. A more unusual feature is in the corolla-tube. In most species with a corolla-tube of some length the column is located in the base of the tube and does not protrude from its mouth. However, here the column has a correspondingly long stipe which places the coronas outside the tube giving the flower the appearance of lacking a tube. This arrangement is otherwise known only in *Brachystelma delicatum* (Bruyns, 1982), *B. discoideum*, *Caralluma quadrangula* and *C. cicatricosa*. As with all these species there is a very deep nectarial orifice behind each outer corona-lobe which reaches down to the base of the column. The anther wings at its mouth are very small.

Both this species and *C. europaea* appear to prefer growing in a rather moist atmosphere. This is despite the sensitivity of *C. europaea* to excessive moisture in the soil, though the same is not true of *C. burchardii*

which is very tolerant of a wet soil. Both species have been grown in a glasshouse otherwise housing orchids and bromeliads and thrived in this environment. On the other hand *C. munbyana* slowly died off in this place but flourished in a south-facing window of my room where the atmosphere was drier. This, it would seem, is correlated with the fact that the latter grows away from the sea where the air is always drier while the other two occur mostly near the coast and may derive benefit from aerial humidity.

Caralluma europaea (Guss.) N. E. Brown in Gard. Chron. Ser. 3, 12: 369 (1892).

Stapelia europaea Gussone in Suppl. Fl. Sic. Prodr.: 65 (1832).

This species is well-known in collections but most of the material is either of unknown origin or from the Middle East. Enquiries as to who had seen or collected it in recent years produced no positive answers and so it appeared to be rare in the wild in Europe.

In fact nothing could be further from the truth and it is relatively plentiful, albeit in restricted areas in remote and out-of-the-way places. Such a spot is the type locality, Lampedusa.

Caralluma europaea is plentiful on the little island of Lampedusa and still occurs just behind the town based around the harbour. The island consists of a low limestone massif sloping slightly downwards from north to south with cliffs up to 100m high on the northern side. Except for a few introduced *Pinus halipensis* in the middle the vegetation consists mainly of very short, scented bushes of Labiatae, Thymelaeaceae and Compositae and *Sarcopoterium spinosum* (Rosaceae). The *Caralluma* is commoner towards the southern side where it either grows inside small bushes or in the open among stones and the mounds of large bulbs of *Urginea*. A few plants were even growing in crevices on small cliffs. As with most of the other vegetation it does not venture close to the sea and the lowest belt consists exclusively of a cushion-forming *Limonium* amongst which the *Caralluma* is not found.

Although *C. europaea* is recorded from the nearby island of Linosa (Heywood & Markgraf, 1972), this appears to be an error. This diminutive island is of volcanic origin and though a *Periploca*, *Euphorbia dendroides* and various other succulents abound, it did not appear to harbour any *Carallumas* and seems an unlikely habitat for them.

In Spain it is found along the coast from Cartagena in the east to Almeria in the west. Around Almeria it grows on the limestone hills forming the coastal 'plain', a region of low hills and terraces making up the flood plain of the Rio Andarax. A little further east at Cabo de Gata it grows on sandstone hillsides and appears to inhabit this type of terrain from here at least as far east as Aguilas. The two habitats could scarcely be more contrasting: the limestone ridges bear a vegetation consisting of many tiny, highly scented herbs such as *Thymus* and *Helianthemum* as well as the liliaceous geophyte *Androcym-*

bium gramineum in great numbers and the *Caralluma* occurs either in these bushes or among lumps of limestone in the open on flattish places; the sandstone slopes are covered with colonies of the dwarf palm *Chamaerops humilis*, the large clump-forming grass *Stipa gigantea* and *Launaea*, and it is either in these or in the plentiful piles of loose stones that they grow, forming substantial clumps with stems up to 30cm long. Further east around Mazarrón it is to be seen in large numbers on dolomite slopes. Here it is commonest near the summits of these ridges where it grows under and among loose stones or in bushes. Around Cartagena it is rare and occurs once more on sandstone but this time in very exposed spots with *Sedum sediforme* and scarcely any other vegetation. However, *C. europaea* is not restricted to this coastal strip. It occurs in the low hills to the north of Totana over 30km from the sea where it grows on dolomite in short macchia consisting mainly of *Cistus*, *Rosmarinus* and other Labiates, *Asparagus*, *Pinus halipensis*, *Juniperus oxycedrus*, particularly where the same

Sedum sediforme occurs in quantities. It is also known (F. Alcaraz, pers. comm., 1985) to occur in the Segura basin at least as far north as Ulea, 60km from the coast and may even extend slightly further up, the only restrictions on its distribution in this area appearing to be altitude (it does not venture above 300m) and the presence of shales.

In the more general context this species grows in Morocco, Tunisia, Algeria, Libya, Egypt, Israel and Jordan. Shaw (1980) mentions that it occurs in Portugal too but this is not substantiated by any records and the increasing rainfall encountered as one proceeds westwards makes it unlikely to grow anywhere on the Iberian Peninsula west of the Sierra Nevada.

At Totana and particularly at Mazarrón considerable numbers of plants were flowering in December 1982 which showed that the range of colour variation is more considerable than expected. There is also a great deal of variation in the size of the corolla, even on one plant, as the flowers rapidly decrease in size with the advance of

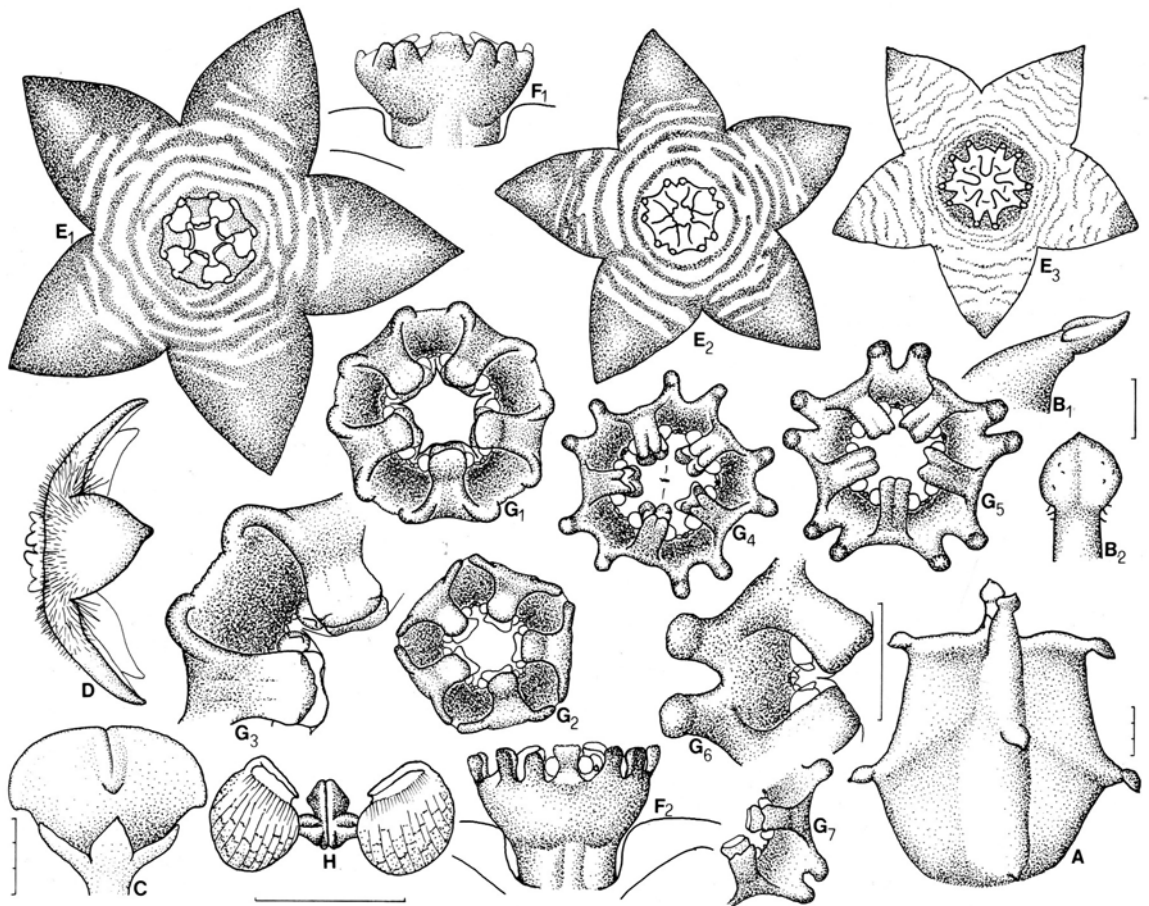


Fig. 2. *Caralluma europaea* (Guss.) N. E. Brown. A, side view of piece of stem (scale 3mm); B₁, side view of leaf (scale 1mm as for B₂, F, G₁, G₂, G₄, G₅, G₇); B₂, face view of leaf; C, bud (scale 3mm as for D, E); D, side view of corolla; E, face view of corolla; F, side view of staminal column (scale G₃ = G₆, 1mm); H, pollinarium (scale 1/2mm). Drawn from: A, B, C, D, E₁, F₁, G₁-G₃, H, *Bruyns* 2396, Lampedusa, Italy (K); E₂, F₂, G₄, *Bruyns* 2399, Almeria, Spain (K); E₃, G₅, G₆, *Bruyns* 2405, east of Mazarrón, Spain (K); G₇, *Bruyns* 2403, Totana, Spain (K).

the flowering season, the largest being those that are first to open. The degree to which the corolla-lobes are reflexed and the density of hairs on the face of the corolla are also subject to enormous variation within a single population. The flowers themselves are dark purple-brown or reddish, variously mottled with yellow and, like most stapeliads with dark-coloured flowers, they produce an unpleasant, dung-like odour. This smell is strong and can be detected readily up to 10cm away from a cluster of flowers despite each flower being less than 1.5cm in diameter.

Plants of *Caralluma europaea* are variably soboliferous. At all localities seen this was very much dependent on the nature of the soil and how much the plants were exposed. Places with many smaller rocks, often loose, where the vegetation became scanty gave rise to the most soboliferous specimens which is clearly a protection against soil erosion. Underground shoots may be up to 30cm long but at least small ones are present on virtually all plants and it seems to have a natural tendency to spread beneath the soil surface, leading to curious results when plants grow in little pockets in otherwise solid rock. The underground parts are white, much narrower than the rest and have no angles, though they bear white rudimentary leaves which are persistent.

The affinities of *C. europaea* are not clear. An apparently obvious relative is *C. hexagona* Lavranos from Arabia but this species has very different leaves and a unique corona structure. To the south of where *C. europaea* occurs is a long stretch of true desert in which stapeliads do not occur and the nearest species to the south and west are *C. hesperidum*, *C. venenata* and *C. decaisneana* of the quite different 'ango' group, *C. dalzielii* of the 'true Carallumas' and *C. acutangula*, none of which bears any close relation to the Mediterranean species.

The history of *C. europaea* is rather complicated. White & Sloane (1937) cite a number of publications but do not appear to have consulted them as much of their data on its history is wrong. The first record was made by Schousboe (1800), a Dane who made a journey to Morocco between 1790 and 1793. He discovered it on the island in the harbour of the town of Mogadore and thought that his plants represented *Stapelia quadrangula* Forsskäl. In Europe it was initially recorded by Philip Barker Webb. He mentions (Webb, 1838) that he first saw it 'in saline places at Cape Gata and at Almeria' (Hooker, 1858) in 1826 after being told of it by Mariano Lagasca y Seguro. La Gasca, as he is generally known, was professor and director of the botanical garden at Madrid until forced to flee to Gibraltar in 1822 after which he made his way to London, which is probably where Webb met him and obtained this information. It is therefore certain that it was known to La Gasca before 1822 and he may have discovered it even prior to Schousboe, though this remains unconfirmed. In 1828 Gussone found his *Stapelia europaea* on Lampedusa (Caruel, 1883) which he described in 1832. Later, he published a further discussion with a figure of his collection (Gussone, 1839).

The next figure in its history is Johann C. Mikan, who had heard of Gussone's discovery from Prof. Tenore before April 1829 and went to fetch himself a piece in 1830. He scrounged a scrap of Gussone's collection from a pot in the royal private garden at Bocca near Palermo and took it back with him to Prague. It thrived and he was able to give some to the 'Privatgarten Sr. Majestät des Kaisers an der Hofburg zu Wien' where Jacquin the younger saw it and from where some reached Lindley in London. Mikan had his material figured twice and the second of these, made in 1833, forms the plate accompanying his article of 1835. Here he erected a new genus *Apteranthes* for it, describing it as *A. gussoneana* as he was unable to determine whether Gussone had yet published his discovery. His generic distinctions of 'rotate corolla, corona simple, five lobes incumbent on the anthers' etc. must have seemed adequate to have distinguished it from the few members of *Stapelia* available to him for examination, but Brown (1892) seems to have had no hesitation in placing it in *Caralluma*. In the same year as Mikan's paper appeared, Lindley (1835) published the name *Stapelia gussoneana* Jacq. f. ex Lindl. almost certainly based on the material communicated by Mikan.

The taxonomic history of the Spanish forms is also remarkably confused. Webb, who first recorded these plants, considered that they were conspecific with Gussone's but, although his account (Webb, 1838) appeared some years after Gussone's, he referred to it as *Stapelia gussoneana* and was evidently unaware of Gussone's work on it. Boissier (1839) and various others agreed with Webb on its classification but used Mikan's name. Its distribution was extended to around Mazarrón first by Guirao and later by Jiménez Munuera shortly before 1909. Jiménez was much surprised by the confusion surrounding the genera *Boucerosia* and *Apteranthes* but he confused the picture himself by calling his material *Boucerosia munbyana* var. *hispanica* (De Coincy) Jiménez & Ibáñez (Jiménez, 1909), which not only created an unnecessary new combination but was also the wrong name for the plant, though Font Quer (1924) explains that this was caused by the conditions of the material that he saw.

During the botanical exploration of the Almeria region in 1921, Enric Gros was given the task of recollecting the *Caralluma* at Cabo de Gata. This he did and some of this material was planted in the garden of the Museum of Natural Sciences at Barcelona where it flowered in the same year (Font Quer, 1924). On this occasion Font Quer was surprised 'to see that this accursed asclepiad had equally deceived both Webb, who had discovered it at the beginning of the 19th century, and Pau and Jiménez, who spoke of it 100 years later'. He concluded that it was neither *S. europaea* Guss. nor *B. hispanica* De Coincy and communicated the name *Caralluma confusa* Font Quer nom. nud. to Pau who mentioned this in his notes on the collections of Gros (Pau, 1922). This name was never validly published and Font Quer decided anyway that varietal status was all that these plants deserved since, 'apart from the characteristic of the outer corona

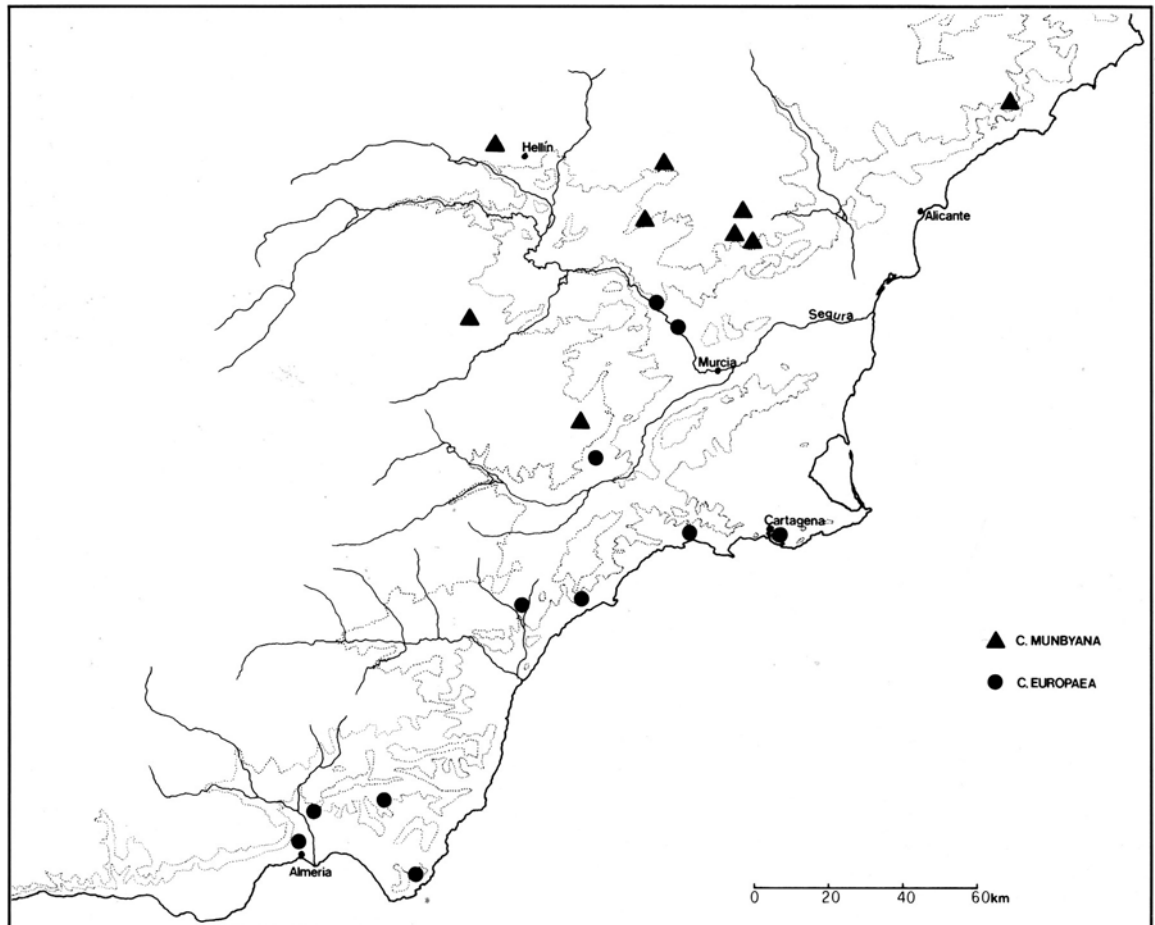
the other small differences are scarcely of importance: the corolla can reach 17mm and is not so deeply divided as in *C. europaea*, the flowers are very shortly pedicelled and only very slightly smelly' (Font Quer, 1924). He seems to have been entirely successful in evading further confusion by recognising that the only distinction from *C. europaea* lies in the shape of the outer corona. Webb's plant and probably most of the westerly-distributed forms have each tooth of the outer corona-lobes attenuated and thickened at its apex on the upper surface into a round knob while in the Italian material (and possibly that from Libya) the outer corona is reduced to two bumps between the backs of adjacent inner corona-lobes. White & Sloane (1937:229) mixed this up entirely when they stated that Mikan had established *Apteranthes* on the basis of the 'little terminal knobs of the outer corona-lobes' which they considered Webb's plants did not possess and the same confusion occurs in Heywood & Markgraf (1972). As detailed above, Mikan separated his genus from *Stapelia* with a series of characters one of which was the lack of an outer corona

and both his and Gussone's figures show that White & Sloane were wrong.

Caralluma munbyana (Decaisne ex Munby) N. E. Brown in Gard. Chron. Ser. 3, 12: 370 (1892).
Boucerosia munbyana Decaisne ex Munby, Fl. Alg. 25 (1847).

Caralluma munbyana is very little-known and even White & Sloane (1937) do not appear to have been able to obtain any living plants or even photographs of it. Munby (1847), however, records it as 'very abundant' around Oran in Algeria. There is a painting of a flowering specimen from Algeria at Kew but this has never been published and the first published photograph of it is that of E. Lamb (1957), though Munby (l.c.) and Durieu (1849) include sketches of its flowers. The sketches here are not the first made from European material, Auguste De Coigny having published a series of drawings of his 1890 collection (De Coigny, 1901).

In Spain *C. munbyana* is not rare but seems to be restricted to various patches between 500 and 800m in



Map 2. Distribution of *C. munbyana* (▲) and *C. europaea* (●) in south-east Spain. Based on records in MU and own observations. Dotted lines indicate 200m and 500m contours.

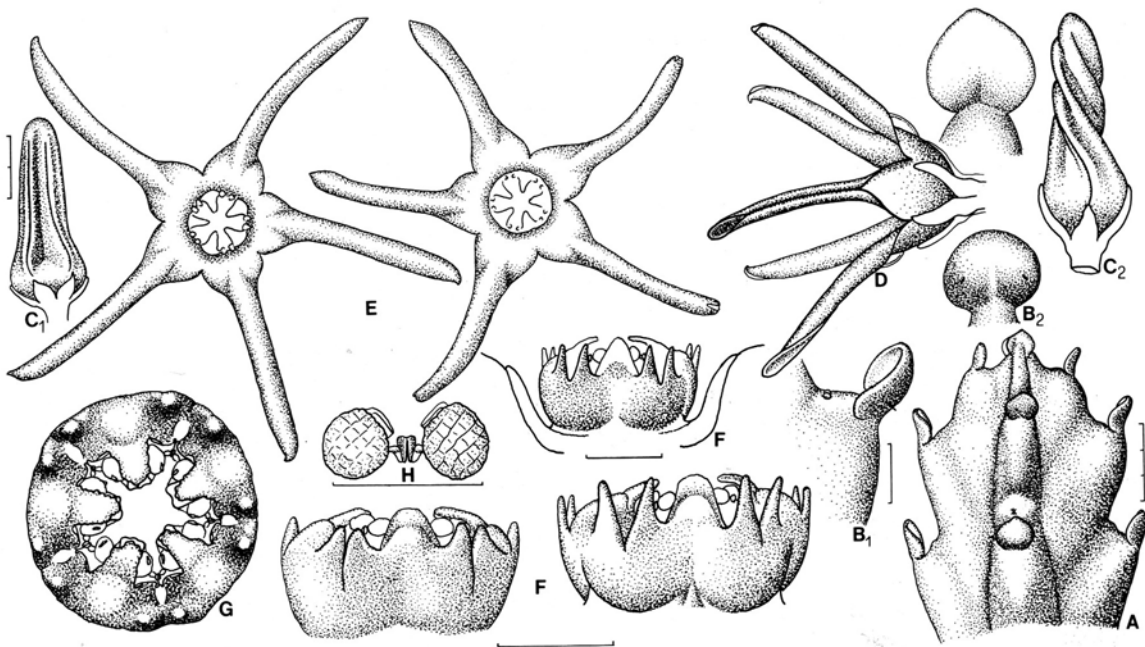


Fig. 3. *Caralluma munbyana* (Decaisne ex Munby) N. E. Brown. A, side view of tip of piece of stem (scale 3mm); B₁, side view of leaf (scale 1mm as for B₂); B₂, rear view of leaf; C, bud (scale 2mm as for D, E); D, side view of corolla; E, face view of corolla; F, side view of staminal column (scales 1mm, G as in lower scale); G, face view of staminal column; H, pollinarium (scale ½mm). Drawn from: A, B, C₂, *Bruyns* 2404 (K), Jumilla, provincia de Murcia; remainder *Bruyns* 2400, Caravaca, provincia de Murcia, Spain.

the basin of the Rio Segura and to a few spots at the same altitude north-east of Alicante, all of which fall into the semi-arid 'Litoral Steppe' as demarcated by Rikli (1946). It is extremely plentiful on a particular hillside near Caravaca (whether this is De Coincy's type locality 'Calor de Mina' is not certain) but is very localised there. Many other scattered populations are now known between Abanilla and Pinoso, around Jumilla and as far inland as north-west of Hellín where I recently saw some enormous colonies. It has also been recorded from near Villajoyosa, north-east of Alicante, and the plants occur here less than 15km from the sea but at the usual altitude and in a typical habitat.

Plants are found on south-facing slopes, which are hotter and drier than average, and occur only on dolomite. At Caravaca they grow in a particularly exposed place with a spiny legume, grasses, small plants of *Juniperus oxycedrus*, *Quercus ilex* and three species of *Sedum* (*S. anglicum*, *S. dasyphyllum*, *S. sediforme*). Here, as north-east of Alicante, the plants were either tightly wedged into crevices among larger rocks or occurred in level gravel patches made up of quantities of smaller stones. In such spots dense clusters of stems, generally only protruding 2 or 3cm from among the gravel (and resembling the dolomite stones quite remarkably both in colour and shape) are all that is visible. The major portion of the highly soboliferous plant is contorted among the stones under the surface and is sometimes revealed as a white, worm-like mass on the removal of some of the larger surface rocks.

In the higher areas (for example around Hellín, Jumilla and Pinoso) it occurs on steeper slopes with a denser vegetation dominated by *Stipa gigantea* and *Rosmarinus* with the occasional *Pinus halipensis* and *Juniperus sabina*, so that specimens may sometimes be found among pine needles, but most commonly they grow very well hidden inside the *Stipa* tussocks which are the dominant feature of many of these slopes. The same three species of *Sedum* were usually present as well as the tiny *Hypericum ericoides*. The locality near Villajoyosa contained all of these plants too but was notable for the presence of two species of *Erica* (one of them *E. multiflora*) and large quantities of the dwarf *Quercus ilex* and *Chamaerops humilis*.

Outside Spain *C. munbyana* occurs in Algeria along the north-west coast and is reputed to grow in Morocco (White & Sloane, 1937) but I have been unable to locate any herbarium records to confirm this. It is not known from anywhere else.

This species is much smaller than either of the other two, with stems rarely exceeding 1.5cm diameter and mostly less than 8cm tall. Owing to its extreme soboliferous habit—individual stems may reach an underground length of more than 30cm—it is difficult to assess the extent of individual specimens. The stems are considerably more rounded than in the others, with smaller angles bearing prominent leaves which are virtually circular and less succulent than usual. As the illustrations show, the flowers are entirely different. They bear no hairs on the corolla face (which is only finely papillate)

and possess long corolla-lobes whose narrowness is increased by the folding back of the margins. The corolla-tube is sufficiently deep that the column is just contained within it.

The flowers of *Caralluma munbyana* bear some resemblance to those of *C. tuberculata* from Arabia and Pakistan. There are, however, many differences: the thicker, erect, papillate-hairy leaves, much larger, rugulose and partly papillate corolla as well as the much larger staminal column in *C. tuberculata*. In addition *C. tuberculata* forms densely-packed clumps mostly with only a single, central rooted stem.

The only date that Munby gives is on a specimen in the Kew Herbarium, which flowered in Oran in September, 1844. However, when he discovered it remains uncertain. He first went fortuitously to Algeria in 1839 but actually settled near Oran in 1844 (Hooker, 1876). Decaisne (1844) mentions *C. munbyana* under *Apteranthes gussoneana* and as these two men were well acquainted, it is probable that Munby told him of the discovery by letter so that he found it for the first time during or just before 1844. De Coincy discovered it at Caravaca in Spain on the 3rd of June, 1890. He found only fruiting material and published a description of this in 1893 under *Apteranthes gussoneana*. He doubted the accuracy of this determination but, despite careful cultivation, was unable to persuade the plants to flower. Giving some to a neighbouring gardener solved this problem and when they flowered he immediately realised he was dealing with a quite different plant and published it as *Boucerosia munbyana* var. *hispanica* (De Coincy, 1898). He also obtained material from Oran in Algeria of the var. *munbyana* from a Mr. Doumergue and when this flowered he decided to describe the Spanish material as *B. hispanica* (De Coincy, 1899). The figure dating from 1901 also appeared under this name. The differences he gave for his plants: shorter and closer-together outer corona-lobes, shinier stems with less prominent ribs, smaller, sessile and very obtuse leaves and hooked ends to the follicles, are very insignificant and there seems no point in regarding the Spanish taxon as distinct from *C. munbyana* in Algeria.

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I particularly wish to thank Dr F. Alcaraz Ariza of Murcia for much information on the distribution of the Carallumas in south-east Spain and Dr D. Bramwell for his assistance on the Canary Islands. I am also very grateful to Dr I. Mendoza of Zürich for translating Font Quer (1924) from the Catalan for me and to Dr C. Lambrick of Oxford for her helpful criticisms of the manuscript.

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6. A NOTE ON CARALLUMA HEXAGONA

LAVRANOS

A considerable amount of material of many Arabian stapeliads has been brought back to Europe in recent years by a number of collectors and botanists. Some of this has proved rather difficult to identify and this is particularly true of that from Saudi Arabia which does not fit well into the concepts of the species described from North Yemen and further south. Similarly, collections from Oman, though similar to taxa described from the Hadramawt and further west in the Yemen Arab Republic (North Yemen), differ sufficiently that doubt as to their identity exists. A study of published names in some of these groups reveals considerable confusion and vagueness and the position of *C. hexagona* is a case in point where a re-evaluation seems justified.

Here three species have been described: *C. hexagona* from near Al Madhan, South Yemen, with a variety *septentrionalis* from near Sana'a in North Yemen; *C. foulcheri-delbosicii* from the Hadramawt, South Yemen, with var. *greenbergiana* from near Mukayras, South Yemen; *C. shadhbana* near Manakhah, North Yemen and var. *barhana* from 50km west of Ta'izz in North Yemen.

Lavranos (l.c. infra, 1967) explains the differences between the first two species: *C. hexagona* has '4-angled, sturdy, usually creeping stems and fairly large flowers' whereas in *C. foulcheri-delbosicii* 'the stems are less robust, generally ascending in habit, almost invariably 4-angled and the flowers are rather small, with relatively deep corolla-tube and ascending corolla- and outer corona-lobes.' In Lavranos (l.c. infra, 1977) the differences between *C. shadhbana* and *C. hexagona* are outlined and in the former the stems are more slender and 4-angled while the flowers are dark purple in colour with ovate-deltoid corolla-lobes, longer than broad. *C. hexagona* is said to have usually 6-angled stems, larger cream- and dark brown-spotted flowers with deltoid corolla-lobes usually broader than long. *C. foulcheri-delbosicii* is not mentioned in this account.

When one begins to examine the available material, however, one finds things very much more involved than this. Material grown from cuttings under the number ISI 1191 (ZSS) and originating from the type locality of *C. shadhbana* var. *shadhbana* is found often to have flowers with purple-brown dots on a yellow-green background. Specimens from Saudi Arabia, which otherwise conform reasonably to *C. shadhbana* are found to have corolla-lobes as broad as long or broader, and this is readily seen to be entirely dependent on the extent to which the margins are reflexed rather than on any difference in the shape of the lobes (Fig. 4 E4 and Fig. 5 E1). Thus it becomes clear that neither the colour of the

flowers nor the shape of the corolla-lobes is sufficient to distinguish *C. hexagona* and *C. shadhbana* reliably. In the two photographs of *C. hexagona* var. *septentrionalis* in Lavranos & Newton (l.c. infra) both 4- and 6-angled stems can be distinguished. Preserved material referable to *C. hexagona* (particularly on account of the large flower) from North Yemen had 4-angled stems as well. This character, which is anyway well-known to be unreliable in certain groups, is therefore here of little use in separating these taxa.

As far as the separation of *C. hexagona* and *C. foulcheri-delbosicii* is concerned, Figures 4 and 5 show that in fact all these taxa have a corolla-tube of some depth and that this invariably contains the staminal column up to at least the middle of the outer corona-lobes. A few collections exist of *C. hexagona* with the corolla-tube at least twice as deep as the column is tall—apparently referable to var. *septentrionalis* (deduced from the illustration and description as no type specimen has been located)—but this is variable within a single population where both flat and campanulate flowers will sometimes be found (A. G. Miller, pers. comm., 1985). It seems advisable, therefore, to abandon this character too as a means of distinguishing these species.

Caralluma hexagona and its allies are all plants of exceptionally rocky habitats, usually growing in shallow soil in crevices between large stones or in rock outcrops. *Caralluma europaea* is a further species occupying a similar niche in many areas around the Mediterranean Sea. In this species a similar variation in thickness and length of stems, size and colour of the corolla and depth of the corolla-tube to that between the three species discussed here has been observed in a number of extensive populations, particularly in Israel (Bruyns, in press). It appears that there is inherently a large range of variation in many of the features of these plants and it is possible that this is brought about by highly localized modifications of the very harsh environment in which they occur.

Caralluma hexagona is a close relative of some of the taller, more erect, shrub-forming members of *Caralluma* in Arabia such as *C. awdeliana* (Defl.) A. Berger, *C. petraea* Lavranos and *C. arabica* N.E. Br. and does not seem to be especially closely allied to *C. europaea*, which has a similar mat-forming habit. As in the southern African genus *Quaqua*, one finds that a group of species with mostly upright stems rooting mainly by a central stem (compare *Q. mammillaris* (L.) Bruyns with *C. awdeliana*) also has procumbent allies which form large, freely-rooting mats (e.g. *Q. armata* (N.E. Br.) Bruyns and *C. hexagona*). The relationship of *C. hexagona* is firstly to be seen in the rudimentary leaves and tubercles: here (Fig. 4A), as in *C. awdeliana*, the leaf is borne initially erect on a small tubercle whose upper surface then grows far more than the lower, pushing the leaf into a downward-pointing position at the base of a long, narrow tubercle. It is these narrow tubercles which give the angles of the stems their distinctive, sinuate appearance. Secondly the outer corona-lobes are similar to those in *C. awdeliana*, differing mainly in being much

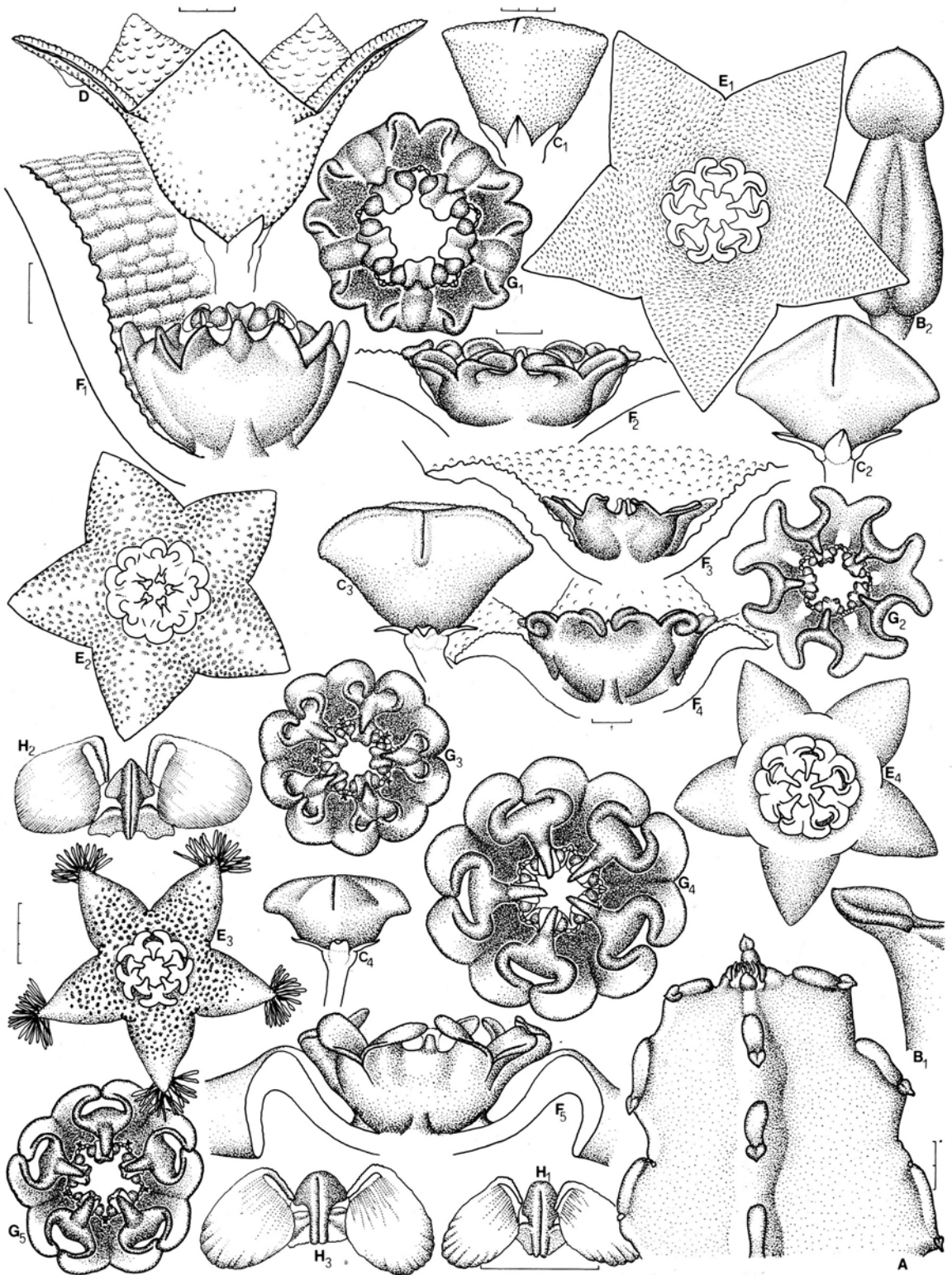


Fig. 4. *Caralluma hexagona* Lavranos. A, side view of small piece of stem (scale 2mm); B₁, side view of leaf (scale 1mm as for

B₂, F₁, G₁); B₂, face view of leaf; C, bud (C₁ scale 3mm, as for C₂, C₃, E₂); D, side view of corolla (scale 2mm as for E₁, F₃); E, face

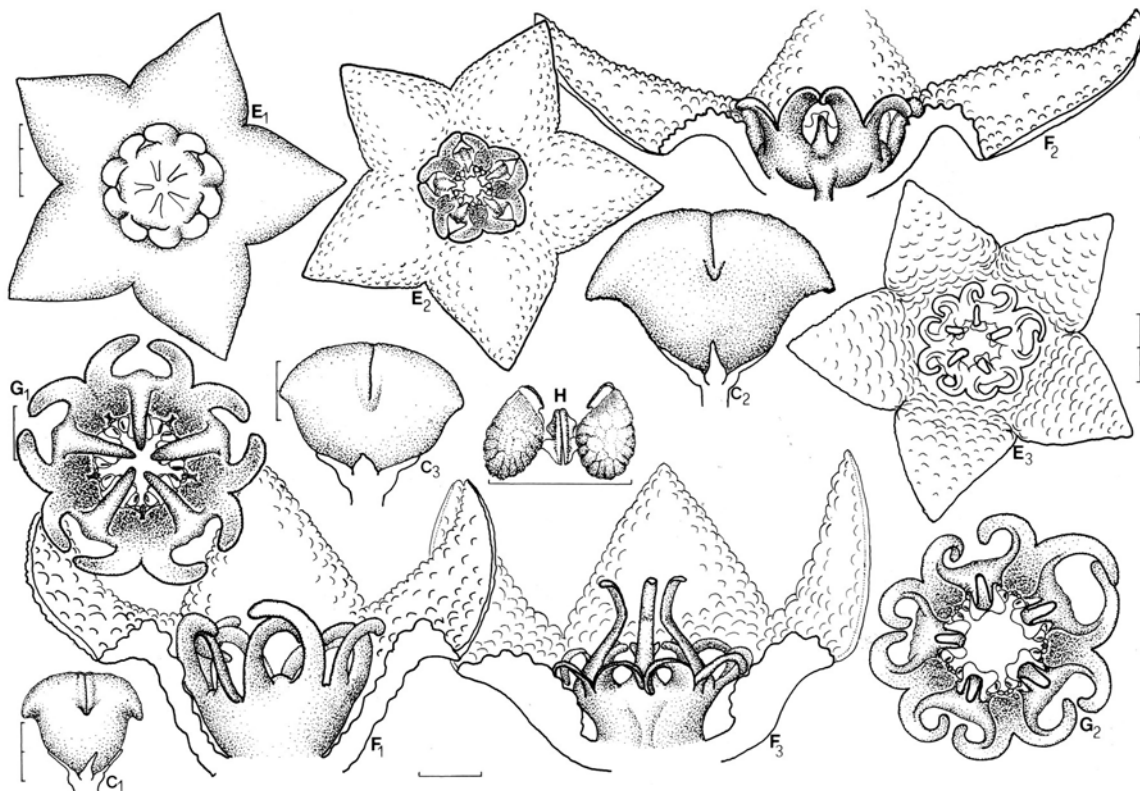


Fig. 5. *Caralluma hexagona* Lavranos (letters as designated in Fig. 4). E₁ from *Collenette* 3405 showing entirely different shape to that in Fig. 4 E₄ but from same plant. C₂, E₂, F₂ from *Noltee* 069. Corolla pale greenish-white with few dark papillae, outer corona-lobes increasing in length towards that found in most plants from South Yemen. G₁ from *Lavranos* 1943, type of *C. foulcheri-delboscii*. C₁, F₁ from *Rauh & Lavranos* 2804, type of var. *greenbergiana* with very small flowers. C₃, E₃, F₃, G₂, H from *Miller* 6213. Plant also with very small flowers differing from the above mainly in the very long inner corona-lobes and the rather shorter outer corona-horns.

broader. They share with all the above-mentioned relatives (as well as a few others) the peculiarity of being dorsoventrally flattened more or less in the direction of a radius of the column, rather than perpendicular to it as in *C. europaea* and *C. adenensis* (Defl.) N.E. Br.

view of corolla (E₃ scale 3mm, as for C₄, E₄); F, side view of staminal column showing dissected corolla-tube (F₂ scale 1mm as for G₄, F₅, G₅, F₄ scale 1mm as for G₂, G₃); G, face view of staminal column; H, pollinarium (scales as for H₁, 1/2mm). A from *Noltee* 069 (see also Fig. 5). C₁, D, F₁ and G₁ from *Miller & Long* 3399. In this population both flat and campanulate flowers were found but that illustrated here corresponds to *C. hexagona* var. *septentrionalis*. H₁ from *Wood* 2772, a further collection with very deep corolla-tube and large flower. E₁, C₂ and F₂ from *Miller & Long* 3491. Plants with very large flower typical of *C. hexagona* var. *hexagona*. C₃, F₃ and G₂ from *Lavranos* 1829, the type of var. *hexagona* and also with very large flowers. E₂, F₄, G₃, H₂ from *Noltee* 206C, from the vicinity of the type locality of *C. shadhbana* var. *barhana* but with a different shape to the corolla. E₃, G₅ from seed grown from *Lavranos* 13120, from the type locality of *C. shadhbana* var. *shadhbana*. Plants here showing very slight development of annulus and with purple-brown dots on yellow-green background (as in var. *barhana*) changing to pale-green towards tips of lobes. B, C₄, E₄, F₅, G₄ (see also Fig. 5), *Collenette* 3405. Uniformly dark purple flower with shape of corolla-lobes and colour as in var. *shadhbana* but showing well-developed annulus as in var. *barhana*. H₃ from *Collenette* 2706.

An unusual phenomenon in almost all live collections of this species is the different greyish colour of the inner surface of the outer corona-lobes. It appears that this is caused by the secretion of nectar (?) on this surface which rapidly dries out to form a thin, crystalline deposit. This, coupled presumably with the evil, dung-like odour of the flowers and the clavate cilia (rapidly drying out and flattening) that are often present on the margins towards the end of the corolla-lobes, acts as an attractant for the pollinators of these flowers.

Caralluma hexagona Lavranos in J. S. Afr. Bot. 29: 105 (1963). Type: South Yemen, 3 miles south of Al Madhan, 2250m, 17 Aug. 1962, *Lavranos* 1829 (K!).

C. hexagona var. *septentrionalis* Lavranos & Newton in Cact. Succ. J. (US) 51(5): 234 (1979). Type: North Yemen, about 15km north of Sana'a, 2300m, 2 Sept. 1977, *Lavranos & Newton* 15724 (No specimen deposited).

C. foulcheri-delboscii Lavranos in J. S. Afr. Bot. 30(1): 21 (1964). Type: South Yemen, southern slopes of Kor Seiban, Hadramawt, 1900m, 22 Aug. 1962, *Lavranos* 1943 (K!).

C. foulcheri-delboscii var. *greenbergiana* Lavranos in Cact. Succ. J. (US) 39(1): 6 (1967). Type: South Yemen, near Mukayras, 2100m, 3 March 1964, *Rauh & Lavranos* 2804(K!).

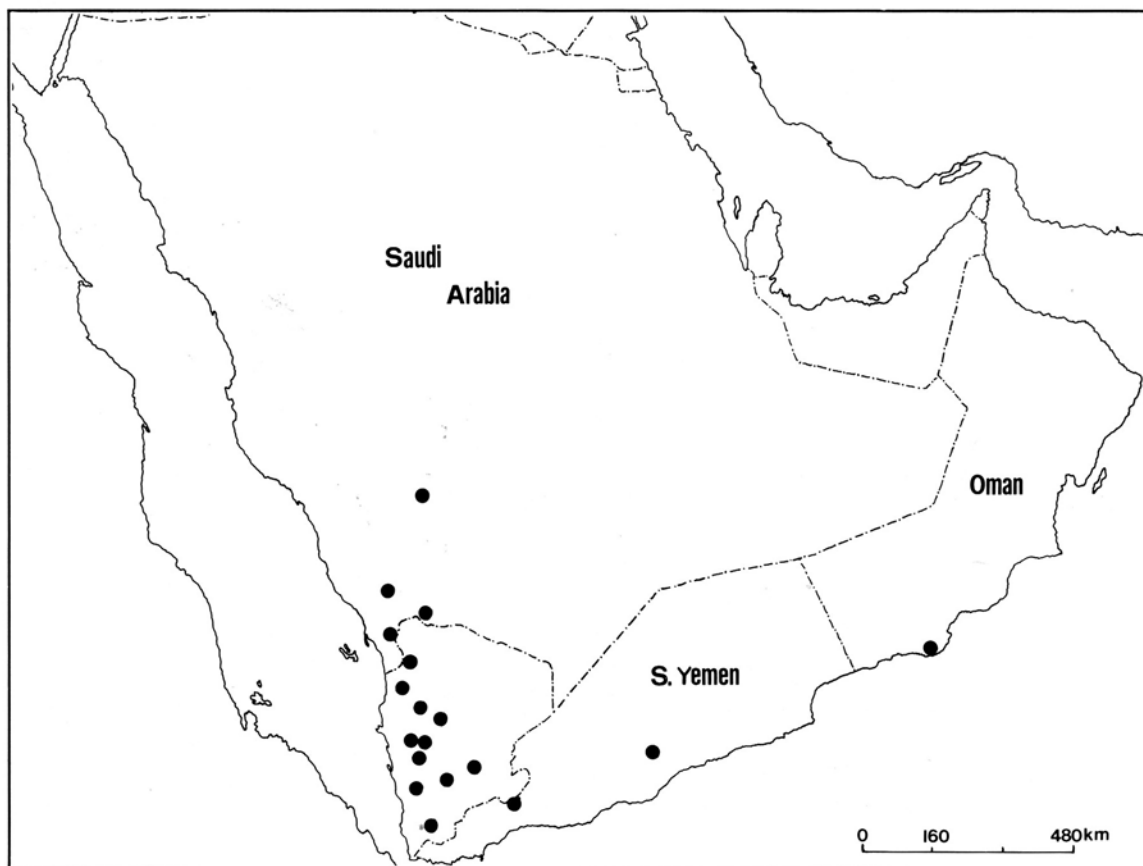
C. shadhbana Lavranos in Flow. Pl. Afr. 44(3): t.1743 (1977); *Collenette* in Flowers Saudi Arabia: 57 (1985). Type: North Yemen, gorge of Wadi Shadh, west of Manakhah, 30 March 1974, *Lavranos* 11341 (FI, PRE).

C. shadhbana var. *barhana* Lavranos & Newton, l.c. 235 (1979); Colletette, l.c. 57 (1985). Type: North Yemen, 50km west of Ta'izz on road to Mockha, 500m, 21 Sept. 1977, *Lavranos & Newton* 15924 (K!).

DESCRIPTION. *Stems* glabrous, brown-green to glaucous-green, ascending, 12-20mm thick, 10-100mm long, 4- to 6-angled, angles compressed, divided into elongated tubercles bearing small, deltoid, rapidly caducuous leaves near base. *Inflorescence* bearing 3-10 flowers in clusters near apex of stems, opening simultaneously. *Pedice* 4-10mm long, glabrous, terete, up to 1.5mm diam. *Sepals* ovate-deltoid to deltoid, green, 1.2-3mm long, 1mm broad at base. *Corolla* rotate to campanulate, 12-22mm diam., exterior greenish-white with few red to brown to purple-brown, wart-like spots concentrated on lobes, interior uniform purple-brown to green to creamy-white, covered densely with broad, red-brown, convex to shortly columnar papillae sometimes becoming confluent towards apex of lobes, finely setulose over entire surface but without hairs except for a cluster of dark-purple to red-brown cilia (2-3mm long) sometimes along margin of lobes at tips; *tube* 2-5mm long, cupular to campanulate; *lobes* ovate to ovate-deltoid or deltoid, ascending to slightly recurved, 4-8mm broad at base, 4-8mm long. *Corona* cupular, 4mm diam., dark purple-red-brown; *outer lobes* forming pocket containing anther wings, deeply bifid, dorsiventrally-flattened, slightly channelled above, limb diverging then recurved; *inner lobes* subulate, ascending, closely incumbent on anthers, usually horizontal but sometimes becoming erect over stigmatic surface.

DISTRIBUTION. SAUDI ARABIA. Bishah, 5500', *Colletette* 3405 (K, ZSS); Wadi al Uss, on road to Rijal, 4000', rocky hillside under

Acacias, stems 4-5-angled, 19 Aug. 1983, *Colletette* 4471 (K, E); 75km north-west of Najran, 6200', in vertical crevice in limestone outcrop, 26 April 1979, *Colletette* 1450 (K); Jebel Fayfa, north-east of Jizan, 5000', at base of shrubs on rocky hillside, Sept. 1982, *Colletette* 3944 (E); l.c., 16 Sept. 1983, *Colletette* 4641 (E). Without locality: collected 14 April 1981, *Colletette* 2703, 2706, 2707 (K). NORTH YEMEN. On rocks in open *Acacia* scrub in Wadi Liyah, Khawlan As Sham, 700m, 1 Nov. 1979, *Wood* 3046 (K); Near Muharraq, at eastern end of Tihama by rocks, 500m, 30 May 1980, *Wood* 3274 (K); 8km west of Hajjah, 960m, 28 March 1981, *Miller & Long* 3282 (E); by sandstone rock near Khalaqah in Naham, 2300m, 11 May 1979, *Wood* 2772 (K); Wadi Dahr, north-west of Sana'a, 2500m, amongst sandstone rocks on cliffs south of wadi, 7 May 1975, *Wood* 110/75 (K); l.c., 2300m, in sandstone cliffs, 3 May 1978, *Wood* 2349 (K); Jebel Milhan, on scrubby bank at 700m, 10 Sept. 1976, *Wood* 1201 (K); 10km east of Sana'a, 2200m, 3 Apr. 1981, *Miller & Long* 3399 (E); Wadi Shadhb near Manakhah, steep slopes of gorge amongst rocks, *Lavranos* 13120 (ZSS); *Lavranos & Newton* 15898 (K); Jebel Raymah, between Gabl and Suq ar Ribat, 800-1700m, 1 Sept. 1977, *Wood* 1914 (K); about 15km east of Rada', 2100m, on stony sandstone hills, *Wood* 2753 (K); between Sumarah Pass and Ibb, 1750m, *Noltee* 069, 072, 085 (K); Jebel Ras, north-east of Hays, 1450m, 8 Apr. 1981, *Miller & Long* 3491 (E); near Ta'izz, 1300m, 29 Aug. 1977, *Wood* 1876 (K); Al Barh, on rocky hill, 21 Sept. 1977, *Lavranos & Newton* 15924 (K); *Noltee* 206C (K). SOUTH YEMEN. 3 miles south of Al Madhan, near Mukayras, 2250m, 17 Aug. 1962, *Lavranos* 1829 (K); near Mukayras, 2100m, 3 March 1964, *Rauh & Lavranos* 2804 (K); southern slopes of Kor Seiban, Hadramawt, 1900m, 22 Aug. 1962 (K). OMAN. In crack in cliff at base of Jebel Semhan, east of Salalah, 500m, 20 Sept. 1984, *Miller* 6213 (E).



Map 3. The known distribution of *Caralluma hexagona* drawn up from the data listed above.

New and unfamiliar names of Cactaceae to be used in the European Garden Flora

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Summary. A background is given to the account of the Cactaceae compiled by the authors for European Garden Flora, volume 3 (in press). This is followed by notes on the treatment of particular genera, including 54 new combinations.

Zusammenfassung. Neue und ungewohnte Namen für Cactaceae zur Benutzung in der 'European Garden Flora'. Zur Behandlung der Cactaceae durch die Autoren für die 'European Garden Flora', Band 3 (im Druck) werden begleitende Bemerkungen gemacht. Zusätzliche Informationen zu einigen Gattungen umfassen auch 54 Neukombinationen.

Background to the EGF account

The European Garden Flora, a major publishing project sponsored by the Royal Horticultural Society and published by Cambridge University Press, 'attempts to provide a scientifically accurate and up-to-date means for the identification of plants cultivated for amenity in Europe . . . and to provide what are currently thought to be their correct names, together with sufficient synonymy to make sense of catalogues and other horticultural works . . . The Flora attempts to cover all those species that are likely to be found in general collections (i.e. excluding botanic gardens and specialist collections) in Europe' (Introduction to EGF Vol. II, pp. 1-2, 1984). The procedure to be followed by contributors in selecting species for inclusion includes (i) accounting for all names in a 'Commercial List' compiled at the Royal Botanic Garden, Edinburgh in 1978 from all available European nursery catalogues; (ii) considering species included in several works on the flora of gardens, including 11 'Basic Reference Works'; and (iii) drawing on the personal experience of contributors, family editors, advisers and other experts.

The 'Commercial List' contained 'well over 12,000' specific names in total. Of these, 884 were of Cactaceae, making it the largest single family, on paper, to be covered (Rosaceae: 830; Compositae: 743; Ericaceae: 690; Liliaceae: 577; Scrophulariaceae: 345; Orchidaceae: 338).

Contributors are also expected to account for names of further species recognized in the 'Basic Reference

Works', other than plants rarely cultivated in Europe. Of the 'Basic Reference Works', only the following six include cacti: Bailey's *Manual of Cultivated Plants* (1949), *Hortus Third* (1976), Boom's *Flora Cultuur Gewassen* (vol. 3, 1968), *The Royal Horticultural Society's Dictionary of Gardening* (edn 2, 1956 and revised Supplement, 1969), Parey's *Blumengärtnerei* (edn 2, 1958-61) and Zander's *Handwörterbuch der Pflanzennamen* (edn 12, 1980).

The problem of what species should be included in EGF has been a particularly thorny one in this family, highlighted by the observation that *Hortus Third*, with over 1000 species, is actually more comprehensive than a recent semi-popular specialist handbook on cacti, Cullmann's *Kakteen*, edn 5 (1984), which has only about 750. Moreover, the 'Commercial List' includes a very large number of 'species' based on single introductions by commercial collectors which are likely to prove ephemeral either as taxa of that rank, or in nursery lists, or both. In our judgment, only c.200 of the names on the Commercial List, even allowing for some noteworthy omissions, represent species 'likely to be found in general collections', i.e. well-established in horticulture and generally available. A proposal that the EGF account should be restricted to these species was unacceptable to the editors, however, despite the declared scope of the work, and it was agreed, instead, that as a general rule at least one species of each clearly recognizable group within each genus (other than those rarely found in cultivation) should be keyed and described, and brief descriptions of related taxa appended. On this basis (and without conscious plagiarism!) we have ended up with the same overall total as Cullmann et al., i.e. about 750 species fully treated or briefly described.

In the absence of any other complete treatment of the family to specific level since the monographs of Schumann (1897-99) and Britton & Rose (1919-23), and with the advent of many hundreds if not thousands of novelties, principally from South America, horticulturists have had to rely heavily in recent decades on handbooks

by amateurs and commercial collectors, where the number of genera accepted has grown uncritically to between 150 and 250. With the European Garden Flora and other major projects in prospect, the International Organization for Succulent Plant Study (IOS, a Commission of the International Union of Biological Sciences, IUBS) set up a Working Party in 1984 to seek a consensus of botanical opinion on the problem of generic classification in Cactaceae. The preliminary report of this IOS group (Hunt & Taylor, eds., in *Bradleya* 4: 65-78. 1986) contains a draft list admitting only 86 genera, and this has been closely (but not invariably) followed for the EGF treatment. The non-acceptance of many genera proposed by such authors as Backeberg, Buxbaum and Ritter, unfortunately but inevitably necessitates publication of a quantity of new names before the relevant genera have been properly revised; nevertheless, it seems a lesser evil to publish these names than to perpetuate the unorthodox, unworkable and often conflicting systems that have held sway for half a century in the wake of Britton & Rose.

We would like to take this opportunity to thank various specialists who have co-authored or helped with several of the EGF generic treatments: Ted Anderson, Wilhelm Barthlott, John Donald, Roger Ferryman, Fred Kattermann, James Iliff, Roberto Kiesling, Beat Leuenberger, Bill Maddams, Roy Mottram, Gordon Rowley and Geoff Swales. We must stress, on their behalf, that they do not necessarily agree with the generic or specific limits we have eventually adopted, and that responsibility for factual errors is entirely ours.

Apart from two new *Rebutia* combinations by John Donald, the new names proposed below are published by whichever of us (Hunt or Taylor) has been responsible for compiling the EGF account of the genus concerned. The order of genera and species (except in *Rebutia*) is alphabetical.

APOROCACTUS Lemaire

There seems little evidence that this Mexican genus has more than two recognizable species, one with strongly zygomorphic purplish pink flowers (*A. flagelliformis* (L.) Lemaire) and one with almost regular scarlet flowers. The correct name of the latter species appears to be *A. martianus* (Zuccarini) Lemaire, of which *A. conzattii* Britton & Rose is a synonym. Notes on this genus will be given in another paper (D.H.).

ARROJADOA Britton & Rose

Arrojadoa polyantha (Werdermann) D. Hunt **comb. nov.** Basionym: *Cephalocereus polyanthus* Werdermann in Feddes Repert. Sonder-Beih. C., t. 44 (1932) & Bras. Säulenakt., 114 (1933); syn. *Micranthocereus polyanthus* (Werdermann) Backeberg.

CLEISTOCACTUS Lemaire

Cleistocactus acanthurus (Vaupel) D. Hunt **comb. nov.** Basionym: *Cereus acanthurus* Vaupel in Engler, Bot. Jahrb. 50, Beibl. 111: 13 (1913); syn. *Borzicactus acanthurus* (Vaupel) Britton & Rose.

The IOS Working Party assigned *Cereus acanthurus* Vaupel, the type of *Loxanthocereus* Backeberg, to *Haageocereus*, largely on the basis of staminal insertion. The overall similarity of the bright red, zygomorphic flowers, is, however, towards *Cleistocactus*.

C. aureispinus (Ritter) D. Hunt **comb. nov.** Basionym: *Wintertia aureispina* Ritter in Kakt. and. Sukk. 13: 4 (1962); syn. *Hildewintertia aureispina* (Ritter) Ritter; *Winteroocereus aureispinus* (Ritter) Backeberg.

C. fieldianus (Britton & Rose) D. Hunt **comb. nov.** Basionym: *Borzicactus fieldianus* Britton & Rose, The Cactaceae 4: 278 (1923).

C. samaipatanus (Cardenas) D. Hunt **comb. nov.** Basionym: *Bolivocereus samaipatanus* Cardenas in Cact. Succ. J. (US) 23: 91 (1951); syn. *Borzicactus samaipatanus* (Cardenas) Kimmach.

COPIAPOA Britton & Rose

Copiapoa cinerea var. **gigantea** (Backeberg) N. P. Taylor **comb. nov.** Basionym: *C. gigantea* Backeberg in Jahrb. Deutsche Kakt.-Ges. 1:104 (1936); syn. *C. cinerea* var. *haseltoniana* (Backeberg) N. P. Taylor in Cact. Succ. J. Gr. Brit. 43: 53 (1981); *C. gigantea* var. *haseltoniana* (Backeberg) F. Ritter, Kakteen in Südamerika 3: 1101 (1980); change of epithet necessitated by alteration to autonym rules (Art. 57.3, ICBN, 1983).

ECHINOPSIS Zuccarini

Echinopsis candicans (Gillies ex Salm-Dyck) F. A. C. Weber ex D. Hunt **comb. nov.** Basionym: *Cereus candicans* Gillies ex Salm-Dyck, Cact. Hort. Dyck. 335 (1834); *Echinopsis candicans* F. A. C. Weber in Bois, Dict. Hort. 1: 471 (1896), pro syn.; *Trichocereus candicans* (Gillies ex Salm-Dyck) Britton & Rose.

E. schieliana (Backeberg) D. Hunt **comb. nov.** Basionym: *Lobivia schieliana* Backeberg, Descr. Cact. Nov. [1]: 30 (1957).

E. tegeleriana (Backeberg) D. Hunt **comb. nov.** Basionym: *Lobivia tegeleriana* Backeberg in Jahrb. Deutsche Kakt.-Ges. 1: 82 (1935/6).

E. thionantha (Spegazzini) D. Hunt **comb. nov.** Basionym: *Echinocactus thionanthus* Spegazzini in Anal. Mus. Nac. Buenos Aires 11: 499 (1905); syn. *Acanthocalycium thionanthum* (Spegazzini) Backeberg.

Acanthocalycium Backeberg was referred to *Echinopsis* by the IOS Working Party, with a comment by Donald that it is 'dimorphic, part of it possibly *Echinopsis*, the rest *Neoporteria* (*Pyrrhocactus*)'. This certainly seems true with respect to *A. thionanthum*, which has a distinct staminal throat circle and can be accommodated without difficulty in *Echinopsis*, and to *A. andreaeanum* (Backeberg) Donald, which does not have the throat circle and seems better placed in *Neoporteria* subg. *Pyrrhocactus*. The type species, *A. spiniflorum* (Schumann) Backeberg, which also has no throat circle, is more equivocal. Until it is better understood, we retain it in *Echinopsis*, where it was placed by Berger.

HAAGEOCEREUS Backeberg

Haageocereus weberbaueri (Schumann ex Vaupel) D. Hunt **comb. nov.** Basionym: *Cereus weberbaueri* Schumann ex Vaupel in Engler, Bot. Jahrb. 50, Beibl. 111: 22 (1913); syn. *Weberbauerocereus weberbaueri* (Schumann ex Vaupel) Backeberg.

HARRISIA Britton

Harrisia tetracantha (Labouret) D. Hunt **comb. nov.** Basionym: *Cereus tetracanthus* Labouret in Rev. Hort. ser. 4, 4: 25 (1855); syn. *Eriocereus tetracanthus* (Labouret) Riccobono in Boll. R. Orto. Bot. Palermo 8: 244 (1909) (as '*E. tephacanthus*'); *Roseocereus tetracanthus* (Labouret) Backeberg (as '*R. tephacanthus*'). Not *Cereus tephacanthus* (Link & Otto) Steudel, Nom. Bot. ed. 2, 1: 336 (1840).

Rümppler, Schumann, and Weber, followed by Riccobono, Backeberg and others, all treated Labouret's epithet 'tetracanthus' as a typographical error, and 'corrected' it to 'tephracanthus' (ashy spined), but the case for so doing is debatable. The description certainly calls for eight spines, not four, and the colour notes are distinctive: 'huit aiguillons bruns, noirs à la pointe, se couvrant avec le temps comme une poussière impalpable griscendré, et persistants dans leur couleur à la base et

à la pointe seulement.' So far so good; but then the small print (i.e. page 26; always read the small print!) says: 'En comparant les aréoles depuis le sommet de la plante jusqu'à sa base, on observe que le nombre des séries d'aiguillons s'est successivement augmenté jusqu'à quatre'. The epithet 'tetracanthus' evidently did not mean four-spined, but might have been intended, perhaps, to mean 'with the spines in 4 series'.

If, on the contrary, 'tetracanthus' was a typographical error, Labouret (who contributed another article in the same volume) did not bother to correct it later (the index to the volume has 'tetracanthus', which solves nothing!). And there is a further objection to 'tetracanthus': it would be a homonym of *Cereus tephrocanthus*, attributed to Link & Otto by Steudel, which, under the Rules (cf. Art. 32.4), could be considered to be a validly published new combination by Steudel, based on *Echinocactus tephrocanthus* Link & Otto (despite the fact that Steudel also listed *E. tephrocanthus* Link & Otto as an alternative accepted name).

In the circumstances, and in whatever genus the species is classified, it seems the proper course to re-adopt the original epithet.

NEOPORTERIA Britton & Rose

Neoporteria horrida (Remy ex Gay) D. Hunt **comb. nov.** Basionym: *Echinocactus horridus* Remy ex Gay, Flora Chilena, 15 (1847); syn. *Horridocactus horridus* (Remy ex Gay) Backeberg; *Pyrrhocactus horridus* (Remy ex Gay) Backeberg.

OPUNTIA Miller

Opuntia articulata (Pfeiffer) D. Hunt **comb. nov.** Basionym: *Cereus articulatus* Pfeiffer, Enum. Cact., 103 (1837); *O. articulata* Otto in Allg. Gartenz. 1: 367 (1833), nomen nudum; Pfeiffer, l.c., pro syn.

OREOCEREUS (A. Berger) Riccobono

Oreocereus hempelianus (Guerke) D. Hunt **comb. nov.** Basionym: *Echinopsis hempelianus* Guerke in Monatsschr. Kakt. 16: 94 (1906); syn. *Arequipa hempeliana* (Guerke) Oehme.

PACHYCEREUS (A. Berger) Britton & Rose

Pachycereus militaris (Audot) D. Hunt **comb. nov.** Basionym: *Cereus militaris* Audot in Rev. Hort. ser. 2: 4: 307 (1845); syn. *Backebergia militaris* (Audot) Sanchez-Mejorada.

P. schottii (Engelmann) D. Hunt **comb. nov.** Basionym: *Cereus schottii* Engelmann, Syn. Cact. U.S., 32 (1856) [preprint of Proc. Amer. Acad. 3: 288 (1857)]; syn. *Lophocereus schottii* (Engelmann) Britton & Rose.

PARODIA Spegazzini

Parodia allosiphon (Marchesi) N. P. Taylor **comb. nov.** Basionym: *Notocactus allosiphon* Marchesi in Bol. Soc. Argent. Bot. 14: 246 (1972).

P. buiningii (F. Buxbaum) N. P. Taylor **comb. nov.** Basionym: *Notocactus buiningii* F. Buxbaum in Kakt. and. Sukk. 19: 229 (1968).

P. caespitosa (Spegazzini) N. P. Taylor **comb. nov.** Basionym: *Echinocactus caespitosus* Spegazzini in Anal. Mus. Nac. Buenos Aires ser. 3, 4: 495 (1905).

P. concinna (Monville) N. P. Taylor **comb. nov.** Basionym: *Echinocactus concinnus* Monville in Hort. Univ. 1: 222 (1839).

P. crassigibba (F. Ritter) N. P. Taylor **comb. nov.** Basionym: *Notocactus crassigibbus* F. Ritter in Succulenta 49(7): 108 (1970); syn. *N. uebelmannianus* Buining in Kakt. and. Sukk. 19: 175 (1968); not *Parodia uebelmanniana* F. Ritter in Kakteen in Südamerika 2: 425 (1980).

P. erinacea (Haworth) N. P. Taylor **comb. nov.** Basionym: *Cactus erinaceus* Haworth, Syn. Pl. Succ. Suppl. 74 (1819).

P. herteri (Werdermann) N. P. Taylor **comb. nov.** Basionym: *Echinocactus herteri* Werdermann in Rev. Sudamer. Bot. 3: 143 (1936).

P. horstii (F. Ritter) N. P. Taylor **comb. nov.** Basionym:

Notocactus horstii F. Ritter in Succulenta 45: 3 (1966).

P. liliputana (Werdermann) N. P. Taylor **comb. nov.** Basionym: *Blossfeldia liliputana* Werdermann in Kakteenkunde (1937): 162 (1937).

P. mammulosa (Lemaire) N. P. Taylor **comb. nov.** Basionym: *Echinocactus mammulosus* Lemaire, Cact. Aliq. Nov. 40 (1838).

P. mueller-melchersii (Backeberg) N. P. Taylor **comb. nov.** Basionym: *Notocactus mueller-melchersii* Fric ex Backeberg in Backeberg & F. Knuth, Kaktus-ABC, 415 (1935).

P. neohorstii (Theunissen) N. P. Taylor **comb. nov.** Basionym: *Notocactus neohorstii* Theunissen in Succulenta 60(6): 142 (1981); syn. *Wigginsia horstii* F. Ritter, Kakteen in Südamerika 1: 199 (1979); not *Notocactus horstii* F. Ritter (1966), nec *P. horstii* (F. Ritter) N. P. Taylor.

P. ottonis (Lehmann) N. P. Taylor **comb. nov.** Basionym: *Cactus ottonis* Lehmann, Ind. Sem. Hort. Hamburg, 16 (1827).

P. ottonis var. **tortuosa** (Link & Otto) N. P. Taylor **comb. nov.** Basionym: *Echinocactus tortuosus* Link & Otto, Icon. Pl. Rar. 29 (1828); syn. *E. ottonis* var. *tortuosus* (Link & Otto) Hort. F. A. Haage, Special Offer (Catalogue), 9 (1897), first published in an earlier undated catalogue; *Cactus linkii* Lehmann.

P. rutilans (Daeniker & Krainz) N. P. Taylor **comb. nov.** Basionym: *Notocactus rutilans* Daeniker & Krainz in Sukkulantenkunde (Jahrb. Schweiz. Kakt.-Ges.) 2: 19 (1948).

P. scopa (Sprengel) N. P. Taylor **comb. nov.** Basionym: *Cactus scopa* Sprengel, Syst. 2: 494 (1825).

P. succinea (F. Ritter) N. P. Taylor **comb. nov.** Basionym: *Notocactus succineus* F. Ritter ('sucineus') in Succulenta 49: 109 (1970).

P. werdermanniana (Herter) N. P. Taylor **comb. nov.** Basionym: *Notocactus werdermannianus* Herter in Rev. Sudamer. Bot. 7: 75 (1942).

PENIOCEREUS (A. Berger) Britton & Rose

Peniocereus serpentinus (Lagasca & Rodrigues) N. P. Taylor **comb. nov.** Basionym: *Cactus serpentinus* Lagasca & Rodrigues in Anal. Cienc. Nat. Madrid 4: 261 (1801).

REBUTIA Schumann

Pending a plausible phylogenetic interpretation of the *Echinopsis* group as a whole, the account for the European Garden Flora adopts the interim expedient of recognizing *Rebutia* as a genus, and of recognizing it in the broad sense current before the rise and popularity of *Sulcorebutia* Backeberg. Two new combinations from *Sulcorebutia* necessitated for EGF are made below by John Donald, who has kindly put his knowledge and extensive living collection of the group at our disposal, and who has further contributions on the group in preparation:

R. cylindrica (Donald & A. Lau) Donald* **comb. nov.** Basionym: *Sulcorebutia cylindrica* Donald & A. Lau in Ashingtonia 1(5): 56 (1974)

R. mentosa (F. Ritter) Donald **comb. nov.** Basionym: *Sulcorebutia mentosa* F. Ritter in Succulenta 43: 102 (1964).

The status of the putative genus *Weingartia* Werdermann is also problematical. It has two disparate elements, one of which (the variable *W. neocumingii* Backeberg) links it with *Sulcorebutia*, and the other (the type species, *W. fidaiana* (Backeberg) Werdermann, and its close allies) more equivocally with *Echinopsis sensu lato*. Lacking sufficient evidence to separate the two elements, and in view of the popular association of *Weingartia* and *Sulcorebutia*, the IOS Working Party's decision to include *Weingartia* under *Rebutia* seems the most satisfactory (or least unsatisfactory) short-term solution. Three new combinations are required for the EGF account:

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Rebutia fidaiana (Backeberg) D. Hunt **comb. nov.** Basionym: *Echinocactus fidaianus* Backeberg in *Kakteenfreund* 2: 117 (1933); syn. *Weingartia fidaiana* (Backeberg) Werdermann.

R. neocumingii (Backeberg) D. Hunt **comb. nov.** Basionym: *Weingartia neocumingii* Backeberg in *Kakt. and. Sukk.* 1(2): 2 (1950); *Echinocactus cumingii* Regel & Klein non Hopffer.

R. neumanniana (Werdermann) D. Hunt **comb. nov.** Basionym: *Weingartia neumanniana* Werdermann in *Kakteenkunde* [1937]: 21 (1937); syn. *Echinocactus neumannianus* Backeberg in *Kakteenfreund* 2: 90 (1933), not *E. neumannianus* [sic] Cels ex Labouret, *Monogr. Cact.*, 245 (1853) (*E. neumannianus* auctt. mult.).

Although they differ by one letter, *Echinocactus neumannianus* is a homonym of *E. neumannianus* Cels ex Labouret (Art. 64.2) and thus illegitimate. The epithet can be adopted in other combinations, however (Art. 67.1, note 2; Art. 72, ex. 2), and *Weingartia neumanniana* Werdermann is treated as a *nomen novum* with priority from 1937.

Another problematical case is that of the following species, usually assigned to *Lobivia* Britton & Rose, and confused by Backeberg with *Echinopsis densispina* Werdermann (*E. kuehnrichii* (Fric) H. Friedrich & Glaetzle). For the EGF it is treated under *Rebutia*, and a note is needed on the spelling of the specific epithet:

R. famatinensis (Spegazzini) Spegazzini in *An. Soc. Cient. Arg.* 96: 72 (1923) (as 'famatinensis'); *Echinocactus famatinensis* Speg. in *ibid.* 92: 118 (1920); *Lobivia famatinensis* (Spegazzini) Britton & Rose.

Spegazzini's spelling 'famatinensis', which may have been deliberate (since he did not alter it when making the combination in *Rebutia*), and appears to have been universally followed, nevertheless seems to be an orthographic error, since the type locality was Famatina. I have therefore used the spelling 'famatinensis' (D.H.).

SCLEROCACTUS Britton & Rose

Sclerocactus erectocentrus (J. Coulter) N. P. Taylor **comb. nov.** Basionym: *Echinocactus erectocentrus* J. Coulter in *Contrib. U.S. Nat. Herb.* 3: 376 (1896).

S. intertextus (Engelmann) N. P. Taylor **comb. nov.** Basionym: *Echinocactus intertextus* Engelmann, *Syn. Cact. U.S.*, 21 (1856).

S. intertextus var. **dasyacanthus** (Engelmann) N. P. Taylor **comb. nov.** Basionym: *Echinocactus intertextus* var. *dasyacanthus* Engelmann, *Syn. Cact. U.S.*, 21 (1856).

S. johnsonii (Engelmann) N. P. Taylor **comb. nov.** Basionym: *Echinocactus johnsonii* Engelmann in S. Watson in King, *U.S. Geol. Expl.* 40th Par. Botany, 117 (1871).

S. mariposensis (Hester) N. P. Taylor **comb. nov.** Basionym: *Echinomastus mariposensis* Hester in *Desert Pl. Life* 17: 59 (1845).

S. papyracanthus (Engelmann) N. P. Taylor **comb. nov.** Basionym: *Mammillaria papyracantha* Engelmann in *Mem. Amer. Acad. ser.* 2, 4: 49 (1849).

S. scheeri (Salm-Dyck) N. P. Taylor **comb. nov.** Basionym: *Echinocactus scheeri* Salm-Dyck, *Cact. Hort. Dyck.* 1849, 155 (1850).

S. uncinatus (Galeotti) N. P. Taylor **comb. nov.** Basionym: *Echinocactus uncinatus* Galeotti in Pfeiffer & Otto, *Abbild. Besch. Cact.* 2: t. 18 (1848).

S. uncinatus var. **crassihamatus** (F. A. C. Weber) N. P. Taylor **comb. et stat. nov.** Basionym: *Echinocactus crassihamatus* F. A. C. Weber in Bois, *Dict. Hort.* 1: 468 (1896); syn. *Ferocactus crassihamatus* (F. A. C. Weber) Britton & Rose, *Cact.* 3: 144 (1922).

S. uncinatus var. **wrightii** (Engelmann) N. P. Taylor **comb. nov.** Basionym: *Echinocactus uncinatus* var. *wrightii* Engelmann, *Syn. Cact. U.S.*, 16 (1856).

S. unguispinus (Engelmann) N. P. Taylor **comb. nov.** Basionym: *Echinocactus unguispinus* Engelmann in Wislizenus, *Mem. Tour North. Mexico*, 111 (1848).

S. unguispinus var. **durangensis** (Runge) N. P. Taylor **comb. nov.** Basionym: *Echinocactus durangensis* Runge in *Hamb. Gartenz.* 46: 231 (1890); syn. *Echinomastus unguispinus* var. *durangensis* (Runge) H. Bravo in *Cact. Suc. Mex.* 25: 65 (1980).

S. warnockii (L. Benson) N. P. Taylor **comb. nov.** Basionym: *Neolloydia warnockii* L. Benson in *Cact. Succ. J. (US)* 41: 186 (1969).

WEBEROCEREUS Britton & Rose

Mr Roy Mottram has pointed out that four combinations proposed by Hunt (in *Kew Magazine* 2(4):341. 1885) had already been made by other authors, as follows: *Weberocereus bradei* (Britton & Rose) G. Rowley in *Rep. Pl. Succ.* 23:10 (1974); *W. glaber* (Eichlam) G. Rowley in *Nat. Cact. Succ. J.* 37(2):46 (1982); *W. imitans* (Kimmach & Hutchison) F. Buxbaum in *Succulenta* 57(6):125 (1978); *W. tonduzii* (F. A. C. Weber) G. Rowley, l.c. (1982). Only the last of these species is treated in the European Garden Flora (D.H.).

Additional notes on some *Ferocactus* species

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Summary. Brief notes, supplementing and emending the author's 'Review of *Ferocactus*' (1984), are presented for 7 species, based on recent field studies. *F. lindsayi* is reclassified in *F. sect. Ferocactus*, *F. POTTSII* Group.

Zusammenfassung. Einige kurze Bemerkungen zu 7 Arten der Gattung *Ferocactus* werden gegeben. Sie ergänzen und erweitern den Beitrag 'Review of *Ferocactus*' (1984) der Autors und ergaben sich aus neueren Felduntersuchungen. *F. lindsayi* wird in die Sektion *Ferocactus*, *F. POTTSII*-Gruppe, umgestellt.

Introduction

When I compiled my 'Review of *Ferocactus*' (Bradleya 2: 19-38, 1984) I had not had the benefit of studying the 'mainland species' in the field, though I had managed to visit the peninsula of Baja California where most of the taxonomically difficult species are found. During the period May-July 1986 I was able to undertake more than eight weeks of field study in northeastern, central and southern Mexico and was fortunate to encounter most of the *Ferocactus* species that occur there. The brief notes which follow are organized according to the numbered sequence in my earlier Review.

1. *F. flavovirens* (Scheidw.) Britton & Rose

Cultivated specimens of this species invariably lack the nectar-secreting 'gland-spines' typical of the genus. The areoles on specimens studied in the valley of Tehuacan, Puebla, occasionally displayed typical gland-spines but these appeared to be non-functional in most cases. In view of the unspecialised nature of this species, whose seeds and habit suggest it is close to the ancestral stock of sect. *Bisnaga*, it is interesting to speculate whether the poor development of gland-spines may be yet another indicator of its basal phylogenetic position. The development of these glands, on the upper side of the areole, seems to be an apomorphic feature restricted to the North American globular cacti (Cactaceae sensu Buxbaum) within the subfamily Cactoideae. In the field, rib number in *F. flavovirens* ranges from 11 to 15.

2. *F. echidne* (DC) Britton & Rose

This species is very variable in habit and spination. It can form large clumps of stems on occasion and one specimen observed in a gully north of Vizarron, Queretaro, had sprawling branches more than 100 × 30cm.

6. *F. lindsayi* H. Bravo-H.

This previously little-known species is misplaced in sect. *Bisnaga*. Its minute, elongate seeds are difficult to interpret in terms of the form of the hilum-micropylar rim, and thus my earlier opinion of its affinity relied on the description of its fruit gleaned from the literature (Taylor in Bradleya 1: 5, 1983). Upon seeing it in the wild (Michoacan, Cuenca del Balsas, Hwy 37, Paso de Chivo, 250-300m, 19 July 1986, N. P. Taylor 313) I was immediately impressed by its resemblance to the species of sect. *Ferocactus*, *F. POTTSII* Group, especially *F. emoryi* and *F. pottsii*, and having located a plant in fruit this relationship was confirmed: they have a dry interior and basal pore (see illustration). The fruits are bright red, whereas yellow is more common in sect. *Ferocactus*, but it is interesting to note that Glass & Foster describe the fruits of *F. pottsii* var. *alamosanus* as red also. Where I observed it, *Ferocactus lindsayi* inhabits bare rocky cliffs, the same habitat as recorded for var. *alamosanus*, but its spination is closer to that of var. *pottsii* and the straight-spined, southern form of *F. emoryi* var. *emoryi* (*F. covillei*). Its tiny boomerang-shaped seeds, however, leave no doubts as to its distinctness as a species.

The occurrence of a member of the *F. POTTSII* Group in Michoacan means that all four species-groups in *Ferocactus* are represented in southern Mexico, the centre from which the numerous species of northern Mexico are assumed to have radiated and then evolved by a process of allopatric speciation.

9. *F. macrodiscus* (C. Martius) Britton & Rose

The northern variety of this species from Guanajuato will shortly be named by Dr Jorge Meyran (Cact. Suc.

Mex., in press). It is disturbing to note that it appears to have vanished from one of its former localities, presumably, as a result of over-collection.

10. **F. latispinus** (Haw.) Britton & Rose

The southern var. *spiralis* is perhaps the least derived member of the *F. LATISPINUS* Group in terms of habit. In the valley of Tehuacan, at an altitude of only 1400m, its few-ribbed stems become elongate and quite cereoid in appearance. Here it is sympatric with *F. flavovirens*, the least specialized species in sect. *Bisnaga*. Further south, in the state of Oaxaca, var. *spiralis* can be found at much higher elevations (to 2440m) and is then low-growing with globose or depressed stems. These forms should not be confused with the globose var. *greenwoodii*, which occurs between the city of Oaxaca and Tehuantepec at lower altitudes (i.e. \pm 1400m) and has globose fruits (clavate-cylindric in var. *spiralis*). At one locality SE of Oaxaca city there is evidence of introgression between *F. macrodiscus* and var. *spiralis*.

11. **F. hamatacanthus** (Muehlenpf.) Britton & Rose

Weniger (Cacti of the Southwest, 84, 1970) claims that flowers of the typical plant (var. *hamatacanthus* in my Review) are sometimes red in the throat. However, this is not borne out by my encounters with this taxon in the

states of San Luis Potosi, Tamaulipas, Nuevo Leon and Durango, where its flowers are plain yellow only.

20. **F. pilosus** (Galeotti ex Salm-Dyck) Werderm.

The fruits of *F. pilosus*, as observed at localities in the states of San Luis Potosi, Tamaulipas and Nuevo Leon, do not open by means of a basal pore. Furthermore, the fruit interior remains quite fleshy at maturity and the exterior is frequently tinged with red. These features appear to contradict its placement in sect. *Ferocactus*, but its overwhelming similarity to *F. gracilis*—seeds included—confirm this classification. Unfortunately, as in the case of *F. lindsayi*, *F. pilosus* will not key out easily in my Review, since the fruit data are now seen to be misrepresented there.

For this species Gottfried Unger (Kakt. and. Sukk. 37: 44-45, 1986) has recently attempted to resurrect the long-overlooked *Echinocactus piliferus* Lem. ex Ehrenb. (1848), which antedates *E. pilosus* Galeotti ex Salm-Dyck (1850). This exhumation may be justifiable on grounds of priority, but in order to protect the better known *F. pilosus* it is preferable to reject *F. piliferus* (Lem. ex Ehrenb.) G. Unger as an inadequately typified name. Unger makes no attempt to provide a neotype—an essential prerequisite for the certain application of names based only on descriptions.



Fruits of *Ferocactus lindsayi* (N. P. Taylor 313)

(photo: Taylor)

New names in Rhipsalidinae (Cactaceae)

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Summary. The classification to be used in forthcoming treatments of *Rhipsalis* and allied genera (Cactaceae subtribe Rhipsalidinae Britton & Rose) is briefly explained, and 26 new names proposed.

Zusammenfassung. Im Hinblick auf die anstehende Bearbeitung von *Rhipsalis* und verwandter Gattungen (Cactaceae subtribus Rhipsalidinae Britton & Rose) wird deren Gattungs- und Untergattungs-Umgrenzung kurz umschrieben und 26 neue Namen vorgeschlagen.

Introduction

After extensive discussion, a Working Party of the International Organization for Succulent Plant Study (IOS), of which the author was a member, recently recommended the acceptance of five genera in the *Rhipsalis* group (Hunt, D. R. & Taylor, N. P., eds., in *Bradleya* 4: 65-78 (1986), Group II), with the reservation that two of the genera, *Lepismium* and *Pfeiffera*, might be combined but for the confusion likely to arise from the amplification of *Lepismium* (the older name) in a sense very different from that proposed by Backeberg (*Die Cactaceae* 2: 682-697. 1959). Enquiries were subsequently made concerning the possibility of conserving the name *Pfeiffera*, but it is understood that a proposal to this end would be unlikely to succeed and that the priority rule would have to take its course. Even so, the author feels that the taxonomic grounds for combining the two genera must override nomenclatural considerations and the *Pfeiffera-Lepismium* merger should go ahead.

The nomenclatural changes necessitated by the IOS Working Party's report and by the author's decision to amplify *Lepismium* are made below so that the new names will be available for use in a treatment of the Cactaceae for Kubitzki et al., *The Families and Genera of Vascular Plants*, and in detailed treatments of *Rhipsalis* and allied genera which are in preparation.

The proposed framework of genera and subgenera in the Rhipsalidinae is based on morphological (vegetative and floral) and micromorphological investigations (predominantly SEM studies of seedcoats and epidermises)

carried out by the author and others between 1971 and 1986. In addition, papers on the systematics of the family as a whole, notably the survey of pollen-morphology by B. E. Leuenberger (*Diss. Bot.* vol. 31, Vaduz 1976), the various publications on individual species and genera by M. Kimnach (in *Cact. Succ. J. (US)*, vols. 28-57. 1956-1985) and the recently published survey of the Rhipsalidinae by S. A. Volgin (in *Feddes Repert.* 97: 553-564. 1986) have been fully considered.

The four genera recognized here form a natural group and are probably not closely related to the other epiphytic genera of Cactaceae; there is evidence that the great resemblance with some Hylocereinae (notably the genus *Pseudorhipsalis*) is a result of convergent adaptation to the same epiphytic habitat. No hybrids between the genera (or even the subgenera) accepted here are known. On the basis of seed-morphology, and various other characters, the Rhipsalidinae seem to have had a common origin with the South American tribe Notocactaceae F. Buxb. (resembling most closely the genus *Corryocactus*).

The character-basis and possible phylogenetic relationships of the component genera and subgenera of the Rhipsalidinae are summarized in the following key. The scheme will be justified in more detail in future papers devoted to the individual genera.

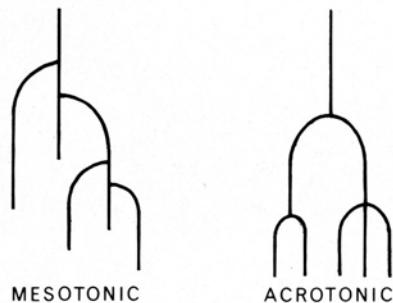


Fig. 1. Branching patterns in Rhipsalidinae.

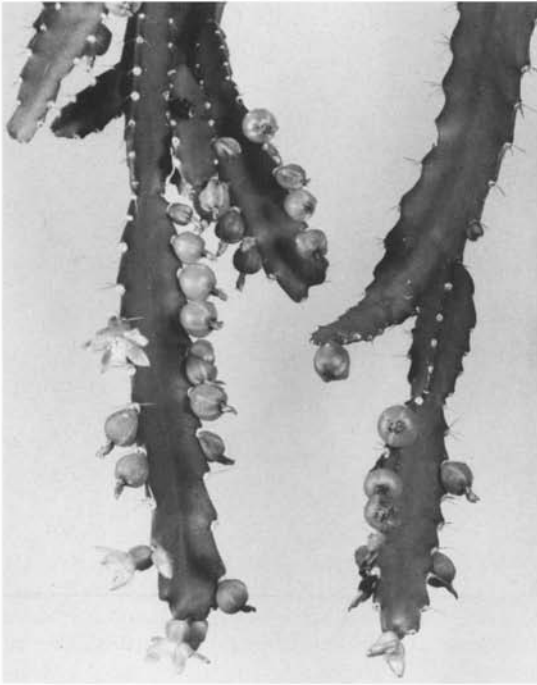


Fig. 2. *Lepismium* (subg. *Acanthorhopsalis*) *monacanthum*. Spiny areoles, basitonic to mesotonic branching pattern, angled pericarp.



Fig. 4. *Lepismium* (subg. *Lepismium*) *houletianum*. Serrate platycladia, angled pericarp, dark red to almost black fruits.

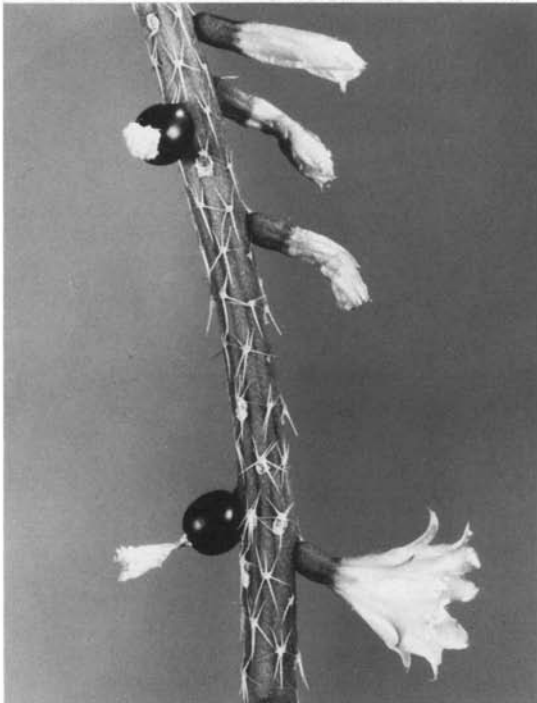


Fig. 3. *Lepismium* (subg. *Ophiorhopsalis*) *aculeatum*. Spiny areoles, slightly angled pericarp. Dark red to almost black fruits occur in several species of *Lepismium* (see also *Lepismium houletianum* fig. 4), but this intense fruit colour is absent in *Rhipsalis*.

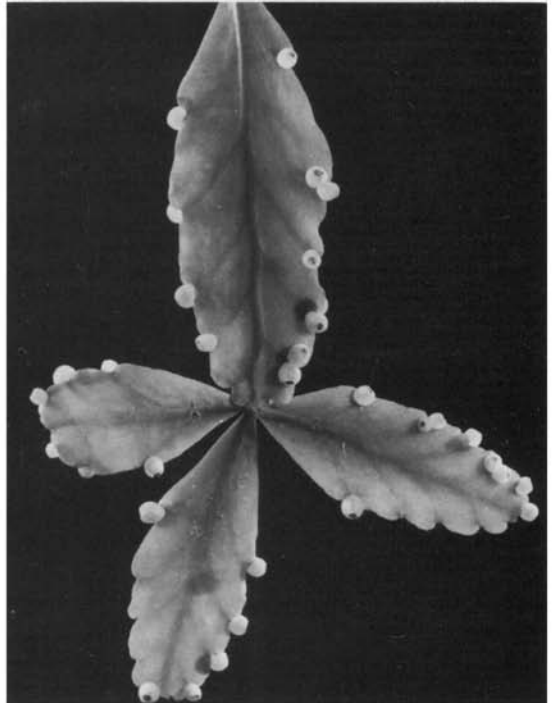


Fig. 5. *Rhipsalis* (subg. *Phyllarthrorhopsalis*) *occidentalis*. Crenate stems, terete pericarp, acrotonic branching.

Key to genera of Rhipsalidinae

1a. Branching system mesotonic; pericarpel tuberculate and spiniferous or angled, rarely almost terete; spines often hard; scale-leaves often clearly visible (centre of diversity Bolivia and Argentina, a few spp. extending NE into Brazil)

Lepismium

1b. Branching system acrotonic, very rarely mesotonic; pericarpel usually terete and naked (bristly in some spp. of *Rhipsalis* subg. *Erythrorhipsalis*; angled in 2 spp. of *Hatiora* and 3 spp. of *Schlumbergera*); spines absent or, if present, soft (centre of diversity E Brazil, a few spp. extending throughout trop. America, Africa, Madagascar and Ceylon) 2

2a. At least some of the stem-segments longer than 5cm; flowers more or less whitish, never intensely coloured; tips of stem-segments without a clearly defined composite areole (except *Rhipsalis clavata*)

Rhipsalis

2b. All stem-segments less than 5cm; flowers intense yellow, pink or red (except white forms of *Schlumbergera* spp.); tips of stem-segments with a composite areole (except neotenic taxa and individuals) 3

3a. Flowers actinomorphic; tube shorter than 5mm **Hatiora**

3b. Flowers mostly zygomorphic; tube longer than 8mm

Schlumbergera

LEPISIUM Pfeiffer (1835)

(incl. *Acanthorhipsalis*, *Lymanbensonia*, *Pfeiffera*, *Rhipsalis* p.p.)

In the amplified sense adopted here, the genus comprises 14 species, mostly in Bolivia and Argentina, a few species extending NE into Brazil.

Lepismium subg. **Lepismium**. Type: *L. cruciforme* (Vellozo) Miquel. Synonym: *Rhipsalis* subg. *Phyllorhipsalis* Schumann emend. F. Buxb.

L. houlettianum (Lemaire) Barthlott **comb. nov.** Basionym: *Rhipsalis houlettiana* Lemaire in Ill. Hort. 5: misc. 64 (1858).

L. houlettianum var. **regnellii** (Lindberg) Barthlott **comb. et stat. nov.** Basionym: *Rhipsalis regnellii* Lindberg in Gartenflora (Berlin) 39: 121 (1890).

L. lorentzianum (Grisebach) Barthlott **comb. nov.** Basionym: *Rhipsalis lorentziana* Grisebach in Abh. Ges. Wiss. Goettingen 24: 139 (1879).

L. warmingianum (Schumann) Barthlott **comb. nov.** Basionym: *Rhipsalis warmingiana* Schumann in C. Martius, Fl. Bras. 4(2): 291 (1890).

Lepismium subg. **Acanthorhipsalis** (Schumann) Barthlott **comb. nov.** Basionym: *Rhipsalis* subg. *Acanthorhipsalis* Schumann, Gesamtb. Kakt., 615 (1898).

L. monacanthum (Grisebach) Barthlott **comb. nov.** Basionym: *Rhipsalis monacantha* Grisebach in Abh. Ges. Wiss. Goettingen 24: 140 (1879).

L. incachacatum (Cardenas) Barthlott **comb. nov.** Basionym: *Rhipsalis incachacana* Cardenas in Cactus (Paris) 6 (34): 125 (1952).

L. paranganiense (Cardenas) Barthlott **comb. nov.** Basionym: *Acanthorhipsalis paranganiense* Cardenas in Cactus (Paris) 6 (34): 126 (1952).

L. crenatum (Britton) Barthlott **comb. nov.** Basionym: *Hariota crenata* Britton in Bull. Torrey Bot. Club 18: 35 (1891).

L. brevispinum Barthlott **sp. nov.** Synonym: *Acanthorhipsalis brevispinum* Ritter, Kakteen in Suedamerika 4: 1260 (1981), nom. inval. (Art. 37). Type: Ritter, loc. cit. 1529, Abb. 1114 (cf. Art. 32.2).

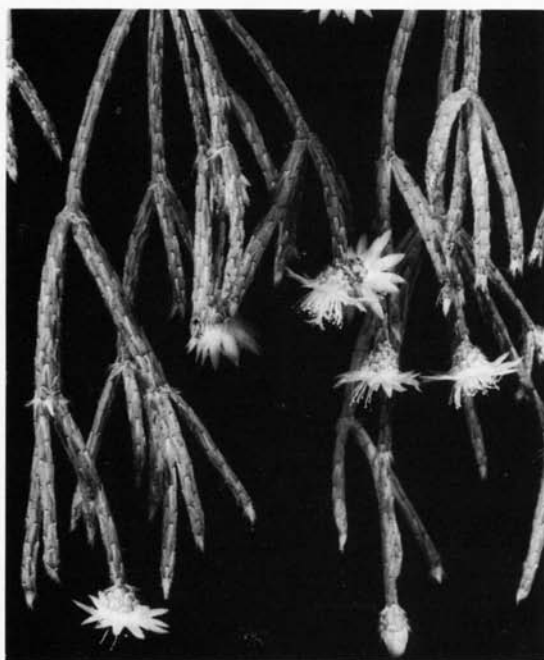


Fig. 6. *Rhipsalis* (subg. *Erythrorhipsalis*) *pilocarpa*. Acrotonic branching, subterminal campanulate flowers (characteristic for this subgenus).

Lepismium subg. **Lymanbensonia** (Kimmach) Barthlott **stat. nov.** Basionym: *Lymanbensonia* Kimmach in Cact. Succ. J. (US) 56: 101 (1984).

L. micranthum (Vaupel) Barthlott **comb. nov.** Basionym: *Cereus micranthus* Vaupel in Engler, Bot. Jahrb. 50 (2/3), Beibl. 111: 19 (1913). Not *Rhipsalis micrantha* (Kunth) DC.

Lepismium subg. **Ophiorhipsalis** (Schumann) Barthlott **comb. nov.** Basionym: *Rhipsalis* subg. *Ophiorhipsalis* Schumann, Gesamtb. Kakt., 615 (1898).

L. lumbricoides (Lemaire) Barthlott **comb. nov.** Basionym: *Cereus lumbricoides* Lemaire, Cact. Gen. Nov. Sp., 60 (1839).

L. aculeatum (F. A. C. Weber) Barthlott **comb. nov.** Basionym: *Rhipsalis aculeata* F. A. C. Weber in Rev. Hort. 64: 428 (1892).

Lepismium subg. **Pfeiffera** (Salm-Dyck) Barthlott **stat. nov.** Basionym: *Pfeiffera* Salm-Dyck, Cact. Hort. Dyck. 1844, 40 (1845).

L. ianthothele (Monville) Barthlott **comb. nov.** Basionym: *Cereus ianthothele* Monville, Hort. Univ. 1: 218 (1839).

L. miyagawae (Barthlott & Rauh) Barthlott **comb. nov.** Basionym: *Pfeiffera miyagawae* Barthlott & Rauh in Cact. Succ. J. (US) 59: 63 (1987).

RHIPHALIS Gaertner (1788)

Rhipsalis subg. **Rhipsalis**

This subgenus comprises about 35 terete-, angular- and phylloid-stemmed species, all with more or less sunken areoles, e.g. *R. baccifera* (J. Miller) Stearn, *R. floccosa* Salm-Dyck, *R. paradoxa* Salm-Dyck and *R. pentaptera* Pfeiffer. The following new names are required for a proposed treatment of the genus as it occurs in the Old World:

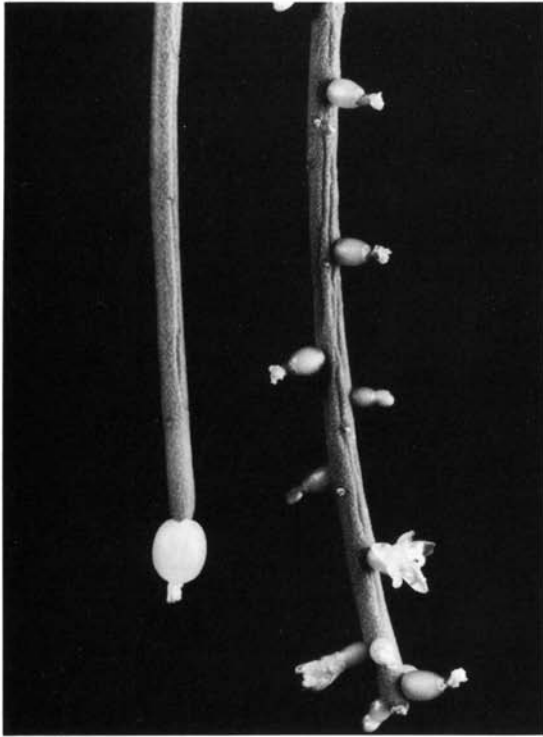


Fig. 7. *Rhipsalis* (subg. *Rhipsalis*) *baccifera* ssp. *mauritiana*. A plant from Ceylon. Note the completely terete pericarp and fruit.

R. baccifera (J. Miller) Stearn subsp. ***erythrocarpa*** (Schumann) Barthlott **stat. nov.** Basionym: *R. erythrocarpa* Schumann in Engler, Die Pflanzenwelt Ost-Afrikas und der Nachbargebiete, Teil C, 282 (1895).

R. baccifera subsp. ***mauritiana*** (De Candolle) Barthlott **comb. nov.** Basionym: *R. cassythae* [var.] *mauritiana* De Candolle, Prodr. 3: 476 (1828).

R. baccifera subsp. ***horrida*** (Baker) Barthlott **stat. nov.** Basionym: *R. horrida* Baker in J. Linn. Soc. Bot. 21: 347 (1884).

R. subg. ***Phyllarthrorhipsalis*** F. Buxbaum (1970)
Comprises about 8 phylloid-stemmed species such as *R. rhombea* (Salm-Dyck) Pfeiffer, *R. pachyptera* Pfeiffer and *R. crispata* (Haworth) Pfeiffer. The group is linked with subg. *Rhipsalis* by intermediate species, like *R. micrantha* (Kunth) DC., and probably does not deserve subgeneric rank.

R. subg. ***Erythrorhipsalis*** A. Berger (1920)
Comprises about seven terete-stemmed species with bell-shaped flowers, such as *R. pilocarpa* Loeffgren, *R. cereuscula* Haworth, *R. clavata* F. A. C. Weber, *R. burchellii* Britton & Rose and *R. mesembryanthoides* Haworth ('*R. mesembryanthemoides*' auct.). The group does not appear closely related to subg. *Rhipsalis*, but has connections with *Lepismium* subg. *Ophiorhipsalis* on the one hand and *Hatiara* on the other.

HATIARA Britton & Rose (1915)
(incl. *Epiphyllopsis* Backeberg & F. Knuth, *Pseudozygocactus* Backeberg, *Rhipsalidopsis* Britton & Rose)

Hatiara subg. ***Hatiara***
Includes only two species, the polymorphic *H. salicornioides* (Haworth) Britton & Rose and:



Fig. 8. *Hatiara* (subg. *Rhipsalidopsis*) *epiphylloides*. The extremely rare (and most difficult to cultivate) "Yellow Easter Cactus" with terminal composite areole which permits strictly acrotonic branching only.

H. herminiae (Campos-Porto & Castellanos) Backeb. ex Barthlott **comb. nov.** Basionym: *Hariota herminiae* Campos-Porto & Castellanos in Rodriguesia 5 (14): 353 (1941); *Hatiara herminiae* Backeb., Die Cactaceae 2: 710 (1959), nom. inval. (Art. 33.2).

H. subg. ***Rhipsalidopsis*** (Britton & Rose) Barthlott **stat. nov.** Basionym: *Rhipsalidopsis* Britton & Rose, The Cactaceae 4: 209 (1923).

Includes *H. epiphylloides* (Campos-Porto & Werdermann) F. Buxbaum, and the following two species and their hybrid:

H. gaertneri (Regel) Barthlott **comb. nov.** Basionym: *Epiphyllum russellianum* var. *gaertneri* Regel in Gartenflora 33: 323 (1884).

H. rosea (Lagerheim) Barthlott **comb. nov.** Basionym: *Rhipsalis rosea* Lagerheim in Svensk Bot. Tidskr. 6: 717 (1912).

H. × ***graeseri*** (Werdermann) Barthlott **comb. nov.** Basionym: *Rhipsalidopsis graeseri* Werdermann in Kakteenkunde 3: 10 (1939). (*H. gaertneri* × *H. rosea*).

SCHLUMBERGERA Lemaire (1858)
(incl. *Epiphyllanthus* A. Berger, *Zygocactus* Schumann)
Contains five closely related species restricted to SE Brazil and various interspecific hybrids.

Acknowledgements

The author is grateful to David Hunt, Beat Leuenberger and Nigel Taylor for taxonomic and nomenclatural advice in connection with the proposals presented in this paper.

More bibliographical data on succulent plant periodicals (1)

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Summary. Bibliographical details of an additional 23 serial publications devoted to succulents are given, supplementing an earlier list (Eggli, 1985).

Zusammenfassung. Als Erweiterung einer früher publizierten Liste sukkulenter Zeitschriften (Eggli, 1985) werden bibliographische Angaben für 23 weitere Periodica gemacht.

Introduction

Thanks to the cooperation of numerous readers of my first 'Bibliography of Succulent Plant Periodicals' (Eggli, 1985) and especially through the generous help of M. Kroenlein, Monaco, it is now possible to publish a supplementary list of mostly local periodicals, etc. The format follows that used in the main list and the reader is referred to that for an explanation of abbreviations, etc. The abbreviations, as well as those of new entries in the following contribution by L. E. Newton (1987), are in line with those of the original list and can (and should) be used to refer unequivocally to a periodical in citations.

It is quite obvious that many specialized periodicals—new or old—yet remain to be "discovered". It is the hope of the present author that a more complete listing should be possible with the help of all friends of succulent plants—any contributions will be gratefully acknowledged, especially if a photocopy of some relevant title pages could be provided for reference purposes.

References

- EGGLI, U. (1985). A Bibliography of Succulent Plant Periodicals. In *Bradleya* 3: 103-119.
 NEWTON, L. E. (1987). More bibliographical data on succulent plant periodicals (2). In *Bradleya* 5: 102-104.

Supplementary List

- A-1. **Beaver Tale.** The Beaver Tale. Journal of the Cactus and Succulent Society of Southern Nevada. Fl. 1985 (see *CSSA Newslett.* 1985, p. 88).

- A-2. **Cact. Corner News.** Cactus Corner News. Newsletter of the Fresno Cactus and Succulent Society. Fresno (USA: CA): ed. S. Haffner. Preliminary issue no. 0 [sic!] 1983, 1(1984)+, monthly.

- A-3. **Cact. Succ. Pl. Acclimat.** Cactus, Succulentes et Plantes d'Acclimatacion. Reze (F): Association des Amateurs des Plantes de Serres et d'Acclimatacion. 1(1986)+, bimonthly. Preceded by *Cactus (Bruxelles)*.

- A-4. **Cact. Vetpl. (Wijnegem).** Cactussen en Vetplanten. Tijdschrift van de Belgische Vereniging voor Liefhebbers van Cactussen en andere Vetplanten. Wijnegem (B): ed. E. van Hoofstadt. 1(1984)+, bimonthly.

- A-5. **Communique.** Newsletter of the San Gabriel Valley Cactus and Succulent Society. Fl. 1985 (see *CSSA Newslett.* 1985, p. 90). Volumes numbered but partly not dated or vice versa.

- A-6. **Epi News.** San Diego (USA): San Diego Epiphyllum Society. 1(1977)+, monthly.

- A-7. **Hoya Nieuwsbrief.** See Addendum in Eggli (1985: 119).

- A-8. **J. Echeveria Soc.** Journal of the Echeveria Society. Coxcatlan (Mexico): ed. F. Otero. 2(1986)+, intended to be published quarterly. Preceded by *Newslett. Echeveria Soc.*

- A-9. **Kakt. Agaven Liebhaber.** Kakteen und Agaven für den Liebhaber. Südheiderstedt (BRD): Kakteenversand Metzger. A single issue 1986 seen, intended to be published monthly. Consisting primarily of the seed and plant list of the editing firm.

- A-10. **Kaktus-Rundbrief.** Orientierungsblatt der "Kakteenfreunde Bern". Bern (CH). No. 1(1986 [publ. Dec. 1985])+ (contains only branch affairs of the Bern branch of the Swiss Cactus Society).

- A-11. **Kaktuszkedvelok Lapja.** Debrecen (HU): Kossuth Lajos Tudományegyetem Botanikus Kertjének. 1(1971)+ ?.

- A-12. **Mesemb Study Group Bull.** Mesemb Study Group Bulletin. Brighton (GB): ed. S. Mace. 1(1986)+, quarterly.

- A-13. **Mitt. Ges. österreich. Kakt.-Freunde.** Mitteilungen der Gesellschaft österreichischer Kakteenfreunde. Wien (A). Fl. 1:4(1937). ZSS.

- A-14. **Mittelstachel.** Der Mittelstachel. Würzburg (BRD): Ortsgruppe Würzburg der DKG, ed. F. Schröter. 1(1983/84), 2(1984/85), 3(1985), 5(1985/86), published irregularly.

- A-15. **Newslett. Echeveria Soc.** Newsletter of the Echeveria Society. Coxcatlan (Mexico): ed. F. Otero. 1(1985[1985/86]), 3 issues. Followed by *J. Echeveria Soc.*

A-16. **Newslett. Palomar Cact. Succ. Soc.** Newsletter of the Palomar Cactus and Succulent Society. ? (USA). Fl. 1985 (see CSSA Newslett. 1985, p. 86).

A-17. **Newslett. Wisconsin Cact. Succ. Soc.** Newsletter of the Wisconsin Cactus and Succulent Society. ? (USA). Fl. 1985 (see CSSA Newslett. 1985, p. 86).

A-18. **Notocactus.** Div. loc. (BRD, NL). A total of 5 issues published since 1978 by various members of Internoto, featuring name lists, translations, reprints etc. Not a periodical in the strict sense.

A-19. **Notokaktus.** Arbeitsmaterial der Zentralen Arbeitsgemeinschaft Notokakteen. ? (DDR). Fl. 1984 (see Kakt./Sukk. 1985, p. 66d).

A-20. **Sempervivum Year Book.** Burgess Hill (GB): Sempervivum Society, ed. P. Mitchell. 1974+. Published irregularly

1974, 1975, 1977 (titled 'Year Book, Sempervivum Society'), 1978, 1979/80 (publ. 1981), 1978+ titled 'The Sempervivum Society Yearbook'. Ceased ?

A-21. **Succeltje.** 't Succeltje. Gouda (NL): Succulenta afd. Gouda. 1(1976)+, each vol. with 10, 11 or 12 issues.

A-22. **Toronto Cact. Succ. Club Newslett.** Toronto Cactus and Succulent Club Newsletter. Toronto (Canada). Fl. 1983+ (1983 published with 8 issues).

A-23. **Transplant.** The Transplant. Newsletter of the Central Arkansas Cactus and Succulent Society. ? (USA). Fl. 1985 (see CSSA Newslett. 1985, p. 85).

A-24. **Vjesnik.** Društvo Prijatelja Cvijeca i Zelenila Zagreb, Sekcija Kaktusara. Zagreb (YU). Fl. 2(1978)+ ?. [Translated title: Newsletter, Association of the Friends of Plants and Flowers of Zagreb, Cactus Section.]

Bradleya 5/1987

pages 102-104

More bibliographical data on succulent plant periodicals (2)

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Summary. Additional information, supplementing Eggli's 'A Bibliography of Succulent Plant Periodicals', is supplied from material in the author's private library.

Zusammenfassung. Aufgrund von Material in der privaten Bibliothek des Autors werden als Ergänzung zur Bibliographie sukkulenter Zeitschriften von Eggli zusätzliche Angaben gemacht.

Introduction

The information presented here is supplementary to Urs Eggli's recent bibliography of succulent plant periodicals (Eggli, 1985). Most of the following data, have been checked from the publications concerned. In some cases the data are taken only from the brief entries on my library index cards and are incomplete, because with

shortage of space at my home base in England I have been obliged to send most of my library away for storage. Entries for which the index card has incomplete data and the periodical is away in storage are indicated with 'not to hand' in the notes that follow. Some smaller items, and some correspondence with editors on publication dates, are also not immediately available because they are in boxes of unsorted papers arising from my move from Ghana in 1984. As it seems unlikely that I shall have access to my stored and unsorted library materials for some years the available information is presented without further delay to enlarge on the data published by Eggli.

Accepted for publication 15 December 1986.

Additional notes for periodicals listed by Eggli

The number at the start of each entry is the main entry number in Eggli's list, with cross-references in parenthesis.

12. **Auckland Branch Newsletter.** Probably monthly. I have only two issues: vol. 2 no. 9 and vol. 3 no. 11. Neither has any indication of the year. Both refer to 'this month's meeting', and so presumably the Newsletter was issued monthly.

29. **Bulletin of the African Succulent Plant Society.** 1966-1977. Publication ceased in 1977 with vol. 12. 1(1966/7)-9(1974/5) bimonthly; 10(1975/6) 5 issues; 11(1976/7) 4 issues; 12(1977) 1 issue.

44? (210,296). **Natal Cact. Succ. Club J. Natal Cactus and Succulent Club Journal.** 1957-1965. This title is correct and appears on every issue; the word "Bulletin" does not appear on any issue. Only five issues appeared, as follows: vol. 1 no. 1(1957); vol. 2 no. 1(1958); vol. 3 no. 1(1962); no volume, part number or date, issued July 1963; no volume, part number or date (but Editorial dated 2 Aug. 1965), issued Oct. 1965.

76. **Cactus Capital Chatter.** Publication suspended after vol. 14 no. 3 (1978), and resumed with vol. 15 no. 1 in 1982.

81. **Cactus Chronicle.** (Hamilton, New Zealand.) I have only one issue. It has no volume or part number, but it is dated September 1962.

100. **Cactus Points.** 1955-1966. From Vol. 1 to vol. 2 no. 10 (Aug. 1957) entitled *The Cactus Club Bulletin*. Last issue appeared Jan. 1966.

101. **Cactus Romand.** 1967-1968. Sociétés Romandes des Cactéophiles, Switzerland. Only 3 parts issued, numbered consecutively: no. 1 (Dec. 1967); 2 (Apr. 1968); 3 (Dec. 1968).

102. **Cactus Sticker.** 1971-1976. Monthly, except July & August, from Feb. 1971; publication ceased in 1976.

105. **Cactus and Succulent Bulletin.** 1968+ Proceedings of the Australian National Convention of Cactus & Succulent Societies. Later called Australasian Convention, to include New Zealand societies. Issued every 2 years, each issue published by the organisation hosting the Convention. 1-Adelaide; 2-Melbourne; 3-Sydney; 4-Brisbane; 5-Perth; 6-Adelaide. Last recd. no. 6 (1978).

111 (2). **Affiliate Reporter.** 1965-1982. (Continued as *CSSA Newsletter*.) Bimonthly, from Jan. 1965. My set not to hand, so am unable to check when changed to monthly.

143 (314). **Crawley Branch Newsletter.** Monthly, from 1966.

145,456. **Csili Kaktuszgyűjtő Szakkör.** 1964+ Magyar Kaktusz-gyűjtők Országos Egyesülete, Budapest. 1(1964) +, monthly, but sometimes 2 or 3 issues appeared together as double or triple numbers. The title *Tájékoztatója* was introduced later, and might have been a separate publication that eventually merged with Csili. On later issues both titles appear together on the covers. Last recd 1981. My set (lacks vols. 1-2) not to hand for further details.

171. **Friciana.** Last recd no. 51—not dated but probably 1976 as no. 50 was 1975.

205. **Journal of the Cactus and Succulent Society of South Australia.** 1967+ My set starts with four issues in 1967. Last recd Apr. 1983. Still published?

230. **Kaktusy.** 1972+ Astrophytum Club of Alma-Ata, U.S.S.R. More than 1 volume. I have a set from 1972 to 1979. Still published?

245. **Kakteen-Rundschau.** 1969-1973. Bimonthly. Early issues entitled *Lübecker Kakteen-Zeitschrift*.

248. **Kakti U Sukkulenti Ohra.** No. 1 (1963) entitled *Sukkulenti*. Words "of Malta" dropped from Society's name in 1979 in

accordance with new Maltese legislation. Last recd no. 26 (1984).

249. **Kambroo.** 1976+ Bimonthly from Feb. 1976.

249. **Kambroo—International Edition.** 1979-1980. Separate from *Kambroo*, and issued with it to subscribers outside R.S.A.

251. **Kettering Kaktus.** Vol. 1 (1965) was produced in a limited edn of 4 copies, passed around amongst Branch members.

259. **Newsletter,** London Branch, NCSS. I have June 1949-Nov. 1950, and 1956-1967, but not to hand for further details.

260 (80). **Los Angeles Cactus Chronicle.** 1952+ My set starts with vol. 1(1952), monthly. The earlier date might refer to an earlier series.

272. **Mancunian Cactivities.** 1965-1966? Quarterly from Oct. 1965. I have vol. 1 nos. 1-4. Probably no further issues.

292, 293. **Neale's Photographic Reference Plates.** 1949+ Issued with the *Monthly Notes* from the start of the 2nd. year of the Notes. 4 plates each month 1949-1952; 2 plates each month 1953+.

305. **News Review.** My record card states 'Quarterly from Feb. 1963'; my subscription started with vol. 3 no. 5 (Feb. 1972) but I was unable to obtain the earlier issues. From vol. 9 no. 1 (May 1986), the name changed to *Dinteranthus*.

306. **Illawarra Cactus & Succulent Society News Letter.** 1973-1975. Illawarra Cact. Succ. Soc., N.S.W., Australia. Vol. 1 nos. 1-7, quarterly from Sept. 1973. From no. 8 continued as *Illawarra Cactus & Succulent Journal*. (See below.)

321. **Godalming Branch Newsletter.** 1957- Monthly from July 1957, quarterly from 1982. Name changed to *Guildford & Godalming Branch Newsletter* in 1974. After no. 295 (Dec. 1982) new series of consecutive numbers started (1—Jan. 1983).

368. **Opuntia Pad.** Bimonthly from Oct. 1972, 6 issues per vol. Last recd vol. 3 no. 1.

371. **Overseas Newsletter from the Exotic Collection.** Irregular from Apr. 1967. Numbered consecutively to no. 5 (1968), then numbered within each year, except 1978. 1967:nos.1-3; 1968:4-5; 1969:1-2; 1970:1-3; 1971:1-2; 1972:1-5; 1973-1975:1-4 each year; 1976:1-5; 1977:1-4; 1978:Mar.,Nov. Last recd 1978:Nov.

373. **Pectinifera Zpravodaj.** J. Elsner & J. Egide, Hradek Kraleve, CSSR. I have the following 7 issues, numbered consecutively: 1 (Sept. 1973), 2 (Dec. 1973), 3 (Mar. 1974), 4 (June 1974), 5 (Oct. 1974), 6 (Apr. 1975), 7 (July 1985).

379. **Poole and East Dorset Branch Journal.** 1967-1975. Ceased publication with vol. 9 no. 1 (dated Jan.-May 1975).

380. **Portsmouth and District Branch Newsletter.** My set starts from Sept. 1969, and there were probably earlier issues.

421. **Southern Spine.** 1959-1979. The first issue was entitled *The Southern News*. Publication ceased with vol. 19 (1977-9). Several double issues appeared in later volumes and vol. 19 comprised: no. 1 (Aug. 1977), 2 (Sep.-Oct. 1977), 3 (Nov. 1977-Jan. 1978), 4 (Feb.-Mar. 1978), 5 (to May 1979).

422. **Spasmodic Monthly.** 1965-1972. Dated, but no volume or part numbers. Monthly, Jan. 1965-Aug. 1972, (except for Apr., May 1968, Apr., May, Jul., Sep.-Dec. 1969, Jun. 1970, Feb., Jun., Sep. 1971, May-Jul. 1972.)

425. **Spine.** The early volumes were also quarterly, but with a gap of 4 years between Vol. 1, no. 4 and Vol. 2 (gap filled by *Bulletin*, cf. Eggli, no. 33).

445. **Succ. Japon.** Succulentarium Japonia. Note correct name.

449. **Succulent Plant Trust Newsletter.** Nos. 1 (July 1962) to 44 (Nov. 1977) entitled *The Succulent Plant Institute Newsletter*.

478. **Zonemag.** 1970+ Bimonthly from June 1970.

Periodicals not listed by Eggli

Entry numbers continue sequence in Eggli (1987).

- A-25. **Amer. Cact. Month Club (Bull.)**. American Cactus of the Month Club (Bulletin). American Cactus of the Month Club, Altadena, Calif., U.S.A. 19..? Bimonthly; no volume or part numbers. I have a set from 1980 to 1982. Still published?
- A-26. **Asclepiad Soc. Newslett.** Asclepiad Society Newsletter. The Asclepiad Society, Collinston, Louisiana, U.S.A. 1974-1975. Monthly from Nov. 1974, to Oct. 1975, numbered 1-12. As far as I remember this is a complete set; if there were later issues they are in boxes of unsorted papers. I have correspondence with the Editor confirming the end of publication, but not to hand.
- A-27. **Birmingham Branch News.** Birmingham Branch, National Cact. Succ. Soc., U.K. 1976+ One issue 1976, then 2 issues p.a. from 1977, numbered consecutively.
- A-28. **Bull. (Central Cact. Agency)**. Bulletin. Central Cactus Agency, Wellingborough, U.K. 1963-1964. Monthly, from Sep. 1963 to Aug. 1964. Issues dated, no volumation.
- A-29. **Cact. Succ. Newslett.** Cactus and Succulent Newsletter. Cact. Succ. Soc. of South Australia, Adelaide. 1964+ Monthly, from July 1964. Vol. 1 nos. 1-16 (1964-1965); vol. 2 nos. 1-12 (1966); thereafter dated but no volume or part numbers. Last recd Apr. 1983.
- A-30. **Cact. Succ. Rev.** Cactus and Succulent Review. Vancouver, Canada. 1986+ Bimonthly, from Aug. 1986.
- A-31. **Cact. Succ. Soc. Malta Mag.** Cactus and Succulent Society of Malta Magazine. Cact. Succ. Soc. Malta. 1955-19..? Quarterly from Dec. 1955. I have nothing later than vol. 1 no. 5 (Dec. 1956).
- A-32. **Cactus Club Bulletin.** See no. 100 above.
- A-33. **Cardiff Branch Newslett.** Cardiff Branch Newsletter. Cardiff Branch, National Cact. Succ. Soc., U.K. 1(1973)+, quarterly. Last recd vol. 4, no. 2 (Jul. 1977). Still published?
- A-33. **Chit Chat (Johannesburg)**. Chit Chat. Plant Rescue Society, Johannesburg, R.S.A. 1970+ Numbered consecutively. Several issues a year, but irregular. Last recd no. 63 (Feb. 1977).
- A-34. **Coastal Bend Cact. Succ. Soc. Bull.** Coastal Bend Cactus and Succulent Society Bulletin. Coastal Bend Cact. Succ. Soc., Corpus Christi, U.S.A. 1970-1983. Monthly. Included in *Star to Star* (a monthly periodical comprising regular bulletins submitted by a number of local hobby groups) from Apr. 1970 to Sep. 1983.
- A-35. **East London Succ. Cact. Soc. Mag.** East London Succulent and Cacti Society Magazine. East London Succulent & Cacti Society, R.S.A. 1968+ Numbered consecutively. Twice yearly until 1979 (nos. 1-23); 1 issue 1980 (24); 2 issues 1981 (25,26); 1 issue 1982 (27); 1 issue 1984 (no number or date), no further issues recd. Still published?
- A-36. **Dinteranthus.** See no. 305 above.
- A-37. **Fearn Herb. Bull.** Fearn Herbarium Bulletin. Abbey Brook Cactus Nursery, Sheffield, U.K. 1961. No. 1 (Oct. 1961)—as far as I am aware there were no further issues. (In spite of the title, this is only a trade list.)

A-38. **Guildford & Godalming Branch Newsletter.** See no. 321 above.

A-39. **Illawarra Cact. Succ. J.** Illawarra Cactus & Succulent Journal. Illawarra Cact. & Succ. Soc. N.S.W., Australia. 1975+ Quarterly from Sept. 1975 (vol. 1 no. 8). Vol. 1 nos. 1-7 entitled *Illawarra Cactus & Succulent Society News Letter* (see no. 306 above).

A-40. **Long Beach Cact. Club. (Bull.)**. Long Beach Cactus Club (Bulletin). Long Beach Cactus Club, U.S.A. 19..? Apparently monthly. I have only 3 issues for 1969.

A-41. **Lübecker Kakteen-Zeitschrift.** See no. 245 above.

A-42. **Newslett. Cact. Succ. Soc. Austral. Capital Territ.** Newsletter, Cactus and Succulent Society of the A.C.T. Cact. Succ. Soc. of the Australian Capital Territory. 1973+ Monthly from Apr. 1973 (vol. 1, no. 1); some issues dated but without volume or part numbers. I have only six issues in vol. 1.

A-43. **Newslett. Hutt Valley Branch.** Newsletter of the Hutt Valley Branch. Hutt Valley Branch, Cact. Succ. Soc. New Zealand. 1955+ Monthly. I have nothing later than vol. 7 no. 8 (Sept. 1961).

A-44. **Saboten To Tanikushokubutsu.** Japan-Cactus Planning Press, Fukusima. 1978+ Quarterly from Spring 1978. Only 3 issues recd.

A-45. **Sempervivum Fanc. Assoc. Newslett.** Sempervivum Fanciers Association Newsletter. Sempervivum Fanciers Association, Randolph, Mass., U.S.A. 1(1975) +, quarterly.

A-46. **South West Essex Branch Newslett.** South West Essex Branch Newsletter. S.W. Essex Branch, National Cact. Succ. Soc., U.K. 19..?-1952. Monthly. Ceased publication when Branch dissolved in Dec. 1952.

A-47. **Southampton District Branch Newslett.** Southampton and District Branch Newsletter. Southampton & Distr. Branch, National Cact. Succ. Soc., U.K. 19..? I have only Oct. 1965-May 1966, but not to hand for further details.

A-48. **Southern News.** See no. 421 above.

A-49. **Succulent Plant Institute Newsletter.** See no. 449 above.

A-50. **Wellington Cact. News and Views.** Wellington Cactus News and Views. Wellington Branch, Cact. Succ. Soc. New Zealand. 1959+ Monthly. Numbered consecutively. Last recd no. 39 (Nov. 1962). Still published?

A-51. **Zone 6 News.** Zone 6 Branches, National Cact. Succ. Soc., U.K. 1974+ Twice yearly from June 1974 to 1980, annually from 1981, numbered consecutively. Last recd no. 16 (1982). Still published?

References

EGGLI, U. (1985). A Bibliography of Succulent Plant Periodicals. In *Bradleya* 3:103-119.

_____ (1987). More bibliographical data on succulent plant periodicals (1). In *Bradleya* 5: 101-102.

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