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Contents

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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.

Bradleya 2/1984
pages 1-8

Jacquin and the Stapelieae

G. D. Rowley

Summary. An account is given of the life and literary career of N. J. Jacquin (1727-1817), 'the Linnaeus of Austria', with particular attention to his publications on the Stapelieae (Asclepiadaceae). A portrait of Jacquin and colour reproductions of two of his plates are included.

Stapelia, in the broad sense as conceived by Linnaeus, has a unique place in the history of succulents. In the century following the publication of species Plantarum in 1753—the period often referred to as the golden age of flower-painting—*Stapelia* achieved stardom with two magnificent folio monographs by Masson and Jacquin, with a total of over a hundred hand-coloured plates between them, plus individual paintings by most of the celebrated artists of the day: Redouté*, Bauer, Curtis, Sowerby, Edwards, Fitch and others. *Stapelia* was not just a weird plant with a weird flower to catch the eye of an artist seeking something out of the ordinary. There was something intriguing, mysterious even, about a plant that combined such striking beauty with an often repulsive odour and an attractiveness to blowflies and denizens of death and decay. These qualities are nowhere better caught than in the romantic extravaganzas 'The Maggot-bearing Stapelia' (1801; *S. hirsuta*) and 'Stapelias—dewy, hirsute, bell-shaped' (1812; *Orbea variegata, Stapelia hirsuta* and *Huernia campanulata*) in Thornton's *Temple of Flora*, reproduced as frontispieces to the two editions of White & Sloane's *The Stapelieae* (1933 and 1937).

While artists were busy immortalising stapeliads in their paintings, botanists were no less attracted to them for the bewildering complexity of the floral parts, and a long and wordy battle began even before Linnaeus's time over the apparent absence of free stamens and styles as in other flowers, the number of stamens (5 or 10?), the location of stigmas, the nature and function of the corona and other appendages, and later on the mode of seed-setting. By 1811 so many interpretations had appeared in print that a mere survey of them was enough to fill a book: the 140-page *Genitalia Asclepiadearum Controversa* with which the 84-year-old Baron Jacquin closed a long and fruitful literary career. Enlightenment began with the work of Robert Brown, who brought together various genera in a natural assemblage under his newly founded Family Asclepiadaceae in 1810.

The chronology of Stapelieae in White & Sloane (1937) is so comprehensive that only the briefest summary need be given here. Up to Linnaeus's day only two species were well-known in Europe: *Orbea variegata* and *Stapelia hirsuta*. The former dates from before 1644; the latter from 1696. Two *Carallumas, C. incarnata* and *C. mammillaris*, had been figured by Burmann in 1738 and at least two more from Arabia by Forsskäl later. Thunberg knew seven stapeliads, but the real breakthrough came from Francis Masson's two visits to the Cape in 1772-74 and 1786-96. It was Masson's living material distributed in Europe that really captured Jacquin's imagination and fired his lifelong interest in the Stapelieae.

Jacquin as Botanist and Artist

Nicholas Joseph Jacquin (fig. 1) was born of French parents at Leyden in Holland in 1727. He was educated at Leyden University under Royen and introduced to the joys of botany by L. T. Gronovius, son of the friend and benefactor of Linnaeus, whose Species Plantarum appeared in print just after Jacquin completed his studies in Vienna. An early convert to Linnaeus's revolu-

*White & Sloane overlooked six of the seven fine plates of stapeliads by Redouté in De Candolle's *Historia Plantarum Succulentarum*, five of which are in the rare closing fascicles of 1832 to 1837.

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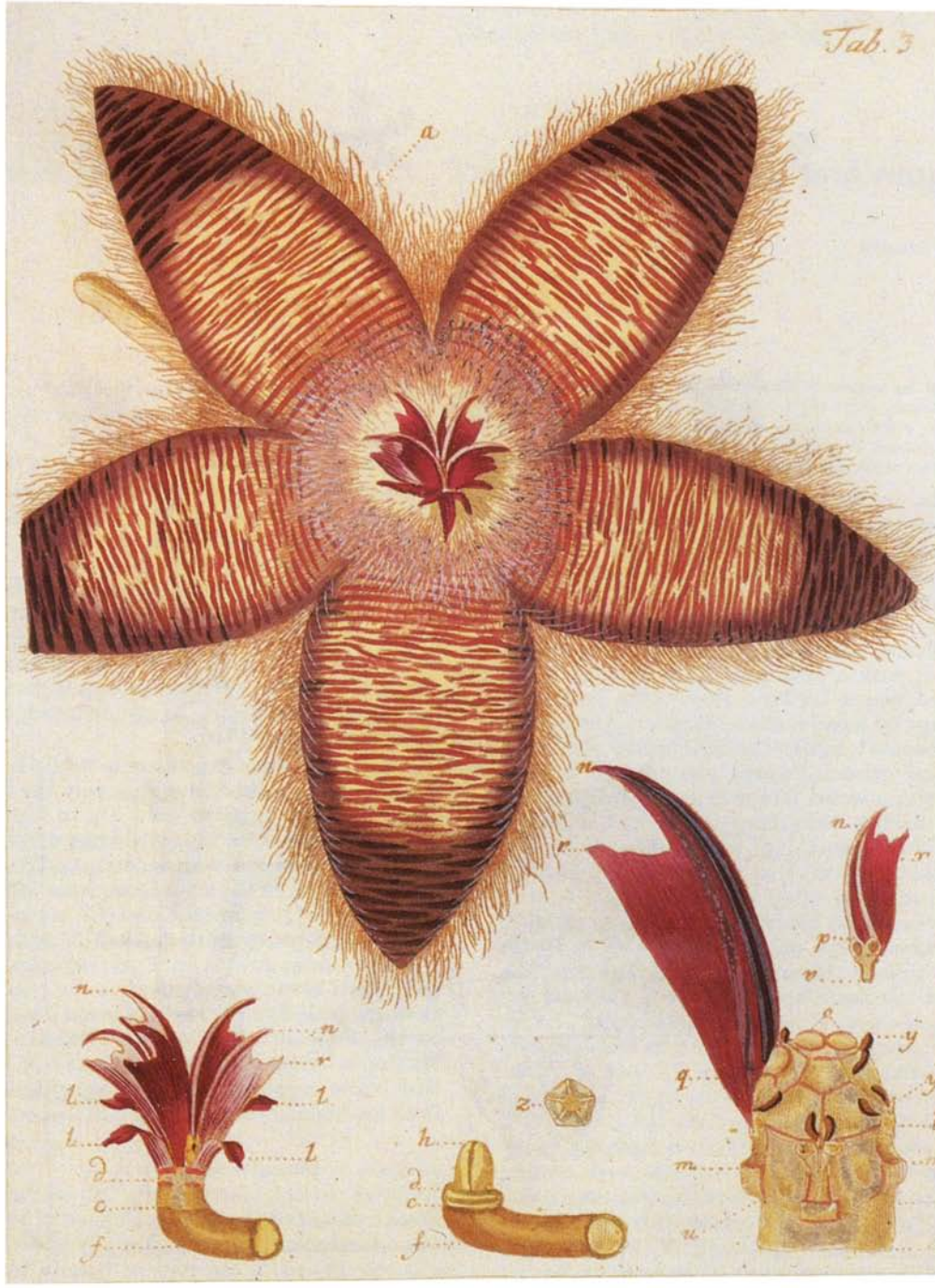

PLATE 1. Reproduction of the plate of *Stapelia hirsuta* in Jacquin's *Miscellanea Austriaca*, Vol. 1 (1778).

Fig. 1. Nicholas Joseph Jacquin (1727-1817).

tionary system and nomenclature, Jacquin frequented the newly-constructed botanical garden at the Imperial Palace at Schönbrunn, where his fervour and insight attracted the attention of the Emperor Francis I. Jacquin was commissioned to make a catalogue of the plants in his garden, and then offered the chance to go abroad and collect plants on behalf of the Emperor. In this way he was enabled to see the flora of the West Indies and, incidentally, to experience a full share of the hardships of travel in those times: his ship was captured, he suffered dysentery, and lost many of his specimens through the ravages of insect pests. This last mishap encouraged him to make paintings of his plants as a record. He was a brilliant artist, and it is for his pictorial

documenting of new species that he is most remembered.

Jacquin returned to Vienna in 1759, published a flora of the local wild plants, and in 1763 spent five years as Professor of Chemistry at Schemnitz near Dresden. But in 1768 he was back in Vienna as Professor of Botany and Chemistry at the University, and also as Director of the botanic gardens there. From now on he began a series of sumptuously illustrated volumes on exotics, as well as on the native Austrian flora, painting some of the pictures himself but, especially in later works, entrusting more to other artists. His patronage extended to a wide circle of naturalists and artists and led to the publication of some of the most exalted and sought-after of all florilegia. 'The plates are jewels and immensely expensive today', wrote Herre (1971), 'Merely to look at them is a pleasure one will never forget'. I fully agree—although you will have to make a trip to one of a few large libraries to share that privilege. Happily the facsimile reissue of his major work on stapeliads in 1982 at last brings a sample before a wider public. Willdenow (1805) lamented that 'His works are unfortunately too expensive', but how could they be cheaper when each plate was coloured in minutest detail by hand, and the edition would inevitably be small?

Jacquin's circle of friends was not limited to scientists and painters: he played the flute and Mozart was among the frequent guests to concerts at his home. His youngest son Gottfried and daughter Franziska had music lessons from Mozart.

Jacquin continued to direct the University gardens up to 1797, when his son Joseph Franz Jacquin took over. But he remained as active as ever during his long retirement, was made a Baron in 1806 and died in his ninetieth year in 1817. His son continued to hold botanical meetings at home as his father had done up to 1837, and died in 1839 at the age of 74.

The Schönbrunn Palace

Tourists visiting Vienna today are sure to be directed two miles to the south-west of the city to see the splendid palace and gardens of Schönbrunn. When I was last there in 1963, the glasshouses contained many succulents, including the original plant of *Fockea crispa* figured by Jacquin around 1801—the oldest pot-plant anywhere in the world. The collection at Schönbrunn dates from 1753 when a Dutch horticulturalist Adriaan Stekhoven was appointed by the Empress Maria Theresa to construct a menagerie, botanical garden and range of glasshouses. Another Dutchman, Richard van der Schot, became head gardener and most of the plants were brought from Holland, so would have included many of the original introductions of succulents from the Cape of Good Hope. As we have already seen, it was at Schönbrunn that Jacquin's abilities as a botanist were first recognised, as he retained a connection with the imperial gardens all his life. Collections of delicate tropical plants, then as now, are vulnerable to a quick demise in a cold climate, and disaster struck in November 1780 when the boilers went out and many rare plants froze. However, the new Emperor Joseph II determined to make good the losses, and sent two young gardeners, Francis Boos and George Scholl to Mauritius and the Western Cape in 1786, where they were highly successful in shipping back large consignments of live plants to Schönbrunn. Many of these were immortalised in pictures in Jacquin's books.

Publications on Stapelieae

An interest in Asclepiadaceae for Jacquin began, he tells us, as early as 1758 when he visited America and subsequently figured *Cynanchum* in his *Selectae Stirpes Americae* in 1763. His first major publication on asclepiads was a 31-page article *Genitalia Asclepiadearum* which he printed along with other articles by himself and J. Sonnauer to make up Vol. 1 of his *Miscellanea Austriaca*—a convenient umbrella-title for a symposium on natural history. This dates from 1778 (or perhaps 1779); a second volume completed the work in 1781 (or 1782?). Among the superb hand-coloured plates are two on Crassulaceae and four on Asclepiadaceae, these last comprising paintings of *Stapelia hirsuta* (Plate 1) and *Orbea variegata* and no less than eighty-four separate flower dissections. The article is mainly concerned with probing the mysteries of floral structure, basing his own work on a careful study of all previous authors. This interest was to persist throughout his long life, and as has already been mentioned his final book in 1810 was an expansion of this early article into a chronological catalogue of 45 different dissertations from Dillenius in 1732 up to 1810, with his own added criticisms and commentary. Ironically, the classic 1810 work of Robert Brown had not then come his way, although it is acknowledged at the end of the monograph in 1819.

Jacquin was inspired to begin his *magnum opus* on stapeliads, the folio *Stapeliarum in hortis vindobonensibus cultarum descriptiones figuris coloratis illustratae* (Descriptions illustrated with coloured figures of stapelias in Viennese gardens) by the influx of new plants and seeds from Boos and Scholl, some of which matched Masson's already published plants, whereas others were new. He makes much reference to Masson's *Stapeliae Novae* of 1796 in his preface. All Jacquin's works on Asclepiadaceae

are in Latin, and many, the stapelia monograph included, appeared in parts. The fourth part came out in 1817 just before he died; his son Franz Joseph Jacquin edited a fifth part to complete the work in 1819. He had been taking an increased interest in the Stapelieae in the last years of his father's life, and in 1816 printed his own small book giving an advance synopsis of the classification of those species covered by the complete monograph. This takes into consideration the segregate genera of R. Brown and Haworth: Jacquin the elder acknowledged only the one Linnaean genus, *Stapelia*. The classification was reprinted, with a few very minor additions to some of the diagnoses, in the final fascicle of the monograph three years later.

A great date enigma

Jacquin's big folio work on Stapelieae, and some of his other serial works, raise problems that generations of bibliographers have yet to solve: when were they published? We know that the *Stapeliarum . . . descriptiones* came out in five parts ('fascicles'), the first apparently in 1806 and the last in 1819. From this final fascicle we have a complete list of the included plates numbered 1 to 64, but arranged systematically and with no clue as to dates or how the fascicles were made up. Close study of the plates reveals subtle differences in the manner of engraving: compare, for instance, the use of stippling on t.29 *Stapelia mutabilis* with the cross-hatching of t.45, *S. revoluta*. Perhaps tests on the paper used might lead to a suggestion of which sheets go together, as has been done for Schubert's symphonic fragments. Of Jacquin's more obvious models, Masson's book came out in fascicles of 10(-11) plates each, De Candolle's *Historia Plantarum Succulentarum* in fascicles of 6(-7). Neither of these patterns fits a book of five fascicles with sixty-four plates. Copies of Jacquin's monograph rarely come up for sale, and no library copy has been traced bound up with wrappers in the fascicles as originally published. An incomplete copy of the work in the library of L. E. Newton, to whom I am grateful for helpful information, contains thirty plates of which at least twenty-one are known to have appeared before 1809 (see below). Absence of Synopsis and Index suggest that this incomplete copy comprises the first (two?) fascicles plus a few plates from later ones.

The quest for exact dates would be of little moment were it not that certain names are published for the first time in the accompanying text, and compete for priority with others for the same plants published independently by other botanists between 1806 and 1819. I searched Hinrichs's 'Verzeichnis neuer Bücher . . .', a bookseller's periodical which helpfully lists other Jacquin works as they appeared in parts, but found only one reference to the folio *Stapeliarum . . .* in Jan.-June 1810 (p.64), and this gave no details, except the price of 60 thalers, which may be compared with 1 thaler for the *Genitalia Ascelpiadearum* of 1811.

The first to turn detective and try to assign dates to individual plates was N. E. Brown in 1890. Haworth and Willdenow, for instance, both listed the Jacquin stapeliads known to them, and from their works published in 1809, 1812 and 1813 Brown was able to give 'before' and 'after' dates to several of Jacquin's species. A good summary of present knowledge is presented in a table in White & Sloane (1937), pp. 93-94: I can trace no more recent information. Stafleu & Cowan (in Taxonomic Literature 2: 413. 1979) accept the dates for the fascicles as: 1. 1806?; 2. Mar. 1809; 3. Mar. 1813; 4. Jan. 1817; 5. Nov. 1819.

Jacquin and Masson compared

It is natural to compare Jacquin's folio with that of Francis Masson, published in four parts in 1796 and comprising forty-one plates. Both show close attention to botanical detail and, as judged by the published printing, there is little to choose between them artistically. Of course, comparison of the original paintings may tell a different story. Jacquin's plates benefit from being larger and including also floral dissections which Masson omits. This adds greatly to their botanical value. But when we come to compare the plants exhibited there is greater difference. Masson scoured the habitats and made his paintings (either himself or employing a local artist) in the country of origin. He was familiar with the variation of species in the wild and selected for illustration those that were most strikingly different. Jacquin studied plants raised from seed or cuttings in Austria and, as N. E. Brown pointed out in 1890, one can sometimes detect a lushness of growth unlikely to be seen in the habitat. Also he was a collector, with a collector's thirst for amassing novelties, even when the differences were small. At least two of his stapelias have been judged by later generations to be hybrids, unknown in the wild. Even one odd fasciated branch sufficed to encourage him to give it a plate to itself and a separate diagnosis. Thus we find that out of the forty-one plates in Masson's book, almost all are accepted as valid species today (allowing for changed generic names), and all but five were new. Of Jacquin's sixty-four plates, these are assignable to thirty-one recognised species, of which five alone are new (including the two hybrids); the remaining novelties are at infraspecific level.

Garside (1942) has pointed out another difference: the geographical origin of the plants figured. Masson includes rare and local species

from a wide range of genera, with representatives of *Caralluma, Hoodia, Pectinaria* and *Trichocaulon.* Jacquin, dependent on his field-collectors, misses out on Karroo and Namaqualand species and has a smaller coverage of genera: *Stapelia* (s. lat.), *Huernia, Duvalia* and *Piaranthus,* many of whose species are widespread.

I do not make the above comparison with any wish to diminish Jacquin's achievement; merely to contrast the attitudes of a pioneer in the field with those of a devoted collector and plantsman in Europe. To have grown and flowered over 60 different Stapelieae in cultivation is a feat that few present-day collectors have matched, bearing in mind how rot-sensitive and short-lived many of the plants can be. Further, we know that Jacquin had many more plants than he was ever able to flower, and eagerly inquired after them when he was too old and ill to go and see them for himself. Some of his plants even bore fruits, as witness the two-horned seed pods seen in some of his plates.

Nineteen species are common to Masson's and Jacquin's folios, and a list of them is given in Table 1. It should be added that two of Jacquin's plates are copies. In order to show the variation of *Stapelia pedunculata* as vividly as possible, he includes four plates of it. No. 60 is an accurate replica of Masson's Plate 21, and No. 63 reproduces Curtis's Bot. Mag. t.793, both with clear acknowledgements of their source.

	Plate numbers	
	JACQUIN	MASSON
S. (Huernia) campanulata	1	6
S. (Huernia) barbata	2	7
S. (Huernia) venusta	7, 64	3
S. (Huernia) reticulata	8	2
S. (Duvalia) caespitosa	11	29
S. (Duvalia) reclinata	14	28
S. (Piaranthus) geminatus	16	25
S. serrulata (Piaranthus decorus)	17	26
S. (Orbea) verrucosa	18	8
S. glanduliflora	21	19
S. divaricata	22	22
S. gemmiflora	24	15
S. vetula	27	16
S. revoluta	44-46	10
S. asterias	47-48	14
S. ambigua	53	12
S. sororia	57	39
S. grandiflora	59	11
S. pedunculata	60	21

Table 1. Species common to Masson's and Jacquin's folios. Generic names follow *Name that Succulent* (Rowley, 1980).

Anthecology

Scanning the hundreds of exquisitely detailed enlargements of floral parts in Jacquin's plates of asclepiads (Plate 2), one naturally wonders how much he really understood of their functioning. In the long hours he must have spent at the microscope with an artist by his side, did he ever question how pollination took place, or even try his hand at inducing it? Or was he merely content to record every detail as he saw it? To answer these questions we must see his work in perspective, relating it to the times in which he lived.

Sexuality in flowers had been firmly established by the pioneer work of Camerarius in 1694 and Kölreuter in 1761-66, but they were ahead of their time, and the enormous implications of their findings were little regarded until the following century. Systematic botany, in the wake of Linnaeus, was all the rage, and Jacquin was one of his most fervent disciples. Linnaeus's use of male and female organs in classification was regarded as daring and even shocking by some.

Jacquin presumably knew the pioneer work *Nature's secrets revealed in the structure and fertilization of flowers* by Sprengel in 1793, but although this marked the birth of anthecology (floral biology) as a science, Sprengel was unaware of the benefits of cross- over self-pollination—a revelation that had to await the coming of Charles Darwin. Jacquin undoubtedly would have liked his plants to set fruit and seeds, and he worked by trial and error to promote them to do so, but the few successes he had seem to have been the result of chance insect visits rather than human intervention. It is evident that he was intent upon achieving self-pollination, and finding a route whereby the anther contents could reach down directly to the ovary without removal —a happening for which there is no evidence as yet. It was not until an Italian, Delpino, in 1865 and a German, Hildebrand, in 1866, independently witnessed insects at work on flowers of asclepiads that the extraordinary transfer of whole pollinia and their insertion like a key into a lock became understood (Müller 1883). This is not the place to give full details: there are good modern accounts by Volk (1951), Reese (1973), Bayer (1978), Barad (1978) and Manders (1979, 1980, 1983). If Jacquin's findings on flower function remain blinkered and sometimes in error, at least the accuracy of his drawings gives them a lasting value to botanists for identification.

Epilogue

Jacquin is best remembered today for his sumptuously illustrated books, admired as much for their rarity and fine artistry as for the botanical content. He was responsible for publishing over 3,000 portraits of plants, some—notably the earliest—painted by himself; the others by a range of artists including such famous names as Ferdinand Bauer. His status as a botanist may be judged by a contemporary reference to him as

PLATE 2. Reproduction of the coloured plate of floral dissections published by Jacquin in his *Genitalia Asclepiadarum Controversa* (1811). *Periploca* (figs. 1-3), *Asclepias spp.* (figs. 4-6) and various stapeliads (figs. 7-15) are shown.

'the Linnaeus of Austria' after the appearance of his textbook on plant identification, which was in use at Vienna University for teaching for half a century. His interest in asclepiads spanned 59 years and ended only with his death. His son notes that even on his deathbed he anxiously asked if any new stapelias were flowering, 'but as if in mourning some still indeterminate and dubious species withheld their blooms in absence of their protector.' No other group of succulents has had a more devoted protector, or been better presented to the world in literature.

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Bradleya 2/1984
pages 9-14

A Cactus-like Euphorbia from Ethiopia

M. G. Gilbert & Susan Carter

Summary. A new species of Euphorbia from southern Ethiopia, *E. gymnocalycioides*, is described. A history of the specimens cited is given, together with topographical details. Its relationship with *E. turbiniformis*, and of both species with section *Euphorbia* of the genus, are discussed. The homology of strange structures in the tubercle axils is suggested.

Euphorbia gymnocalycioides M. Gilbert & S. Carter, **sp. nov.** affinis *E. turbiniformi* Chiov. (quoad *Puccioni & Stefanini* 701) sed planta major, tuberculis prominentibus, 5-9 cymis simplicibus aliquot abortivis in axillibus aggregatis distinguitur. Typus: Ethiopia, *Friis, Vollesen & Mesfin* 2777 (holotypus K, isotypus ETH).

DESCRIPTION. Succulent plant; tap-root 10 cm or more × 1.5 cm at the apex where a few thickened lateral roots spread horizontally; stem reduced to a subspherical fleshy body to c. 6 × 6 cm, dark green and slightly glaucous, with up to 18 well-marked vertical angles, grooved horizontally into prominent tubercles about 5 mm high and 1 cm apart, tessellated around the slightly depressed apex; tubercles crowned by round pale grey weakly horny shields 1-2.5 mm diam., bearing the leaf-scar and occasionally a possible indication on new growth of a pair of rudimentary spines; leaf scale-like, oblong-triangular, 1 mm, very quickly deciduous. Cymes produced in the axils of the tubercles in fairly regular groupings, with 1 central and 1-2 pairs produced progressively on each side, surrounded by 2-6 whitish structures of uncertain homology (see illustrations); peduncle to 7.5 mm, forking once with rays to 1.5 mm; cyathia sessile; bracts deltoid, c. 1.3 × 1.3 mm, margin denticulate; involucres cup-shaped 1.5 × 2.5 mm including the spreading glands; lobes rounded, margin finely denticulate; glands 5, transversely elliptical, 1 mm wide, brown, just touching. Male flowers few, bracteoles linear, simple or with 1-2 teeth. Female flower: stigmas 1 mm, joined in basal one-third, apices spreading, deeply bifid. Capsule (not seen) exserted on a pedicel c. 2.5 mm; seeds not seen.

ETHIOPIA. Sidamo Region, Giacorsa, 7 Aug. 1893, *Ruspoli & Riva* 225 [966] 385 (FT); 60 km from Negele on road to Welensa Ranch, S from road to Melca Guba, 11 May 1982, *Friis, Vollesen & Mesfin* 2777 (K, holo; ETH, iso); ibid., 23 May 1983, *Gilbert, Vollesen & Ensermu* 7730a (K).

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In his description of *Euphorbia turbiniformis*, Chiovenda (1929) cited two specimens, *Stefanini & Puccioni* 701 [755] from near the north-east coast of Somalia, south of Bender Beyla in Bari Region, and *Ruspoli & Riva* 225 [966] 385 from Giacorsa in Sidamo Region of southern Ethiopia. His description, as well as the specific epithet, most nearly match the collection from Somalia which is the one he figured, and which Bally (1966) subsequently chose as the lectotype. It was collected in 1924, but it was not until 1969 that the species was rediscovered by Lavranos (1971) nearly 150 km south-south-west of the type locality, in limestone country near Eil in neighbouring Nugaal Region. Since then it has become one of the most prized, most elusive species amongst the succulent Euphorbias, renowned for its difficulty of cultivation.

Chiovenda described the surface of his *E. turbiniformis* as tessellate-tuberculate, with the tubercles crowned by small round horny shields. This part of his description, and only this part, was clearly obtained from the *Riva* gathering. As Bally pointed out, the body of these plants (there are several on the sheet) are almost spherical, not turbinate, with numerous angles, up to 18 on examination. The plants were collected in 1893, and the specimen has thus been known to science for 90 years, an extremely long time by the standards of East African plants. The sterile collection was discovered during an Italian expedition organised by Prince Ruspoli but lay unnamed for nearly 40 years. After Bally designated the Somali specimen as lectotype of *E. turbiniformis*, Riva's plant was again without a name. It was eventually rediscovered in May 1982 by a Flora of Ethiopia collecting expedition along a new road about 55 km due north of Riva's locality on the opposite slopes of the Dawa Parma River. Unfortunately the living plants which were brought back for cultivation all died, possibly because they were collected during an unusually heavy rainy period. One year later another Flora of Ethiopia

Fig. 1. *E. gymnocalycioides.* In habitat. *Gilbert et al.* 7730a.

expedition revisited the locality and four more plants were taken, all of which have been established in cultivation. One of these subsequently flowered and this account is based primarily on this specimen.

The plants were found at an altitude of 1350 m in an area of rather rich *Acacia-Commiphora* bushland, where they grew in a fairly open area with low outcrops of limestone. They were nearly all growing under low shrublets, mostly *Acanthaceae,* especially *Barleria.* The one exception was a large, much scarred relict, growing in the open. A form of *Euphorbia actinoclada* was frequent in the same type of situation, whilst *E. glochidiata* grew in the most densely bushed areas, as did *Echidnopsis* cf. *planiflora.* An as yet un-named relative of *Euphorbia rubella* was also very locally common.

Rainfall in this area is rather regularly bimodal, with well-defined peaks in April-May and November-December. In cultivation, it may be best to treat this species as a Spring and Autumn grower, with a resting period mid-Summer, a pattern followed by a number of East African succulents. The environment is certainly not as demanding as that of *E. piscidermis* and even more so of *E. turbiniformis* and it does not seem an unreasonable hope that the new species will eventually become established in collections once problems of propagation have been overcome.

That *E. gymnocalycioides* is a species distinct from *E. turbiniformis* is obvious, but nevertheless the two appear to be closely related. As well as reduction to a subspherical body, with numerous vertical series of leaf-scars and inflorescences, details of cyathial structures for the two species are extremely similar. The description, above, of the cyathial bracts, involucre and lobes of the new species, could equally well apply to *E. turbiniformis* which possesses, however, slightly more rounded glands and stigma apices slightly less bifid. These similarities and slight differences can be compared in the accompanying photographs. In addition, both species produce well-exserted capsules. (Unfortunately capsule and seeds have so far not been seen for *E. gymnocalycioides,* but one remnant inflorescence in the type collection bears a capsular pedicel as described). As far as we can tell at the moment, *E. turbiniformis* differs in its inflorescence, by the central cyathium of the cyme often producing three or four lateral cyathia instead of the usual two produced by *E. gymnocalycioides,* as well as the obvious difference of completely suppressed tubercles.

Furthermore, this very remarkable species seems to provide a link between *E. turbiniformis* and section

Euphorbia of the genus (i.e. those succulent-stemmed species with paired spines produced on a horny spine-shield), at least in overall organisation. In a species with such highly modified gross morphology one cannot be sure of relationships, but there are a number of pointers to such a position. The inflorescence details of both species, including the well-exserted capsules, and the many-angled stems, suggest an affinity with a well-defined group of species with similar characteristics, occurring in north-east Africa and predominantly in Somalia. The group includes such species as *E. columnaris* with up to 24 angles on an unbranched stem; *E. phillipsiae* with few branches of 12-14 angles and often much-reduced spines on small spine-shields; *E. mosaica* with 7-8-angled branches and rounded spine-shields bearing spines which can be rudimentary to no more than 1.5 mm long (see illustration); and *E. horwoodii* with its initial spherical body and completely reduced branches, bearing spine-shields with spines often absent. All these species, and especially *E. horwoodii*, indicate a tendency towards the further reduction of body, spines and spine-shields found in *E. gymnocalycioides* and finally in *E. turbiniformis*. The prominent tubercles make the new species look very like a species of cactus, especially *Gymnocalycium*, and hence the specific epithet we have chosen. When they are very young and actively growing, they possess a minute triangular structure at the tip, surrounding the leaf-scar, which must surely represent a vestigial spine-shield and which places this species (and thus also *E. turbiniformis)* within section *Euphorbia*. They are better developed on the *Riva* specimen, from which Chiovenda indicated the presence of minute shields on the tubercle tips.

The new species differs from its relatives by a peculiar group of structures in the axils of the tubercles, some of which are difficult to account for. They consist of an inner cluster of 1-5 'eyes' from which the inflorescences emerge, much as in *E. turbiniformis* (except that in that species the cymes are solitary), surrounded by two or more small white lumps not seen in any other *Euphorbia* species. These form a subopposite pair on either side, with any others rather irregularly placed slightly above. They appear to be covered with a chalk-like deposit and possibly now function as secretory organs, but there has been some debate as to their homologies. The hypothesis most favoured is that each axillary group represents a suppressed lateral branch such as may be observed in the juvenile stages of *E. horwoodii* (Carter, 1978). Thus it is supposed that *E. gymnocalycioides* is derived from an ancestor with a 'medusoid' organisation, i.e. a short thick central stem from which are produced slender, often relatively short-lived, lateral shoots. In

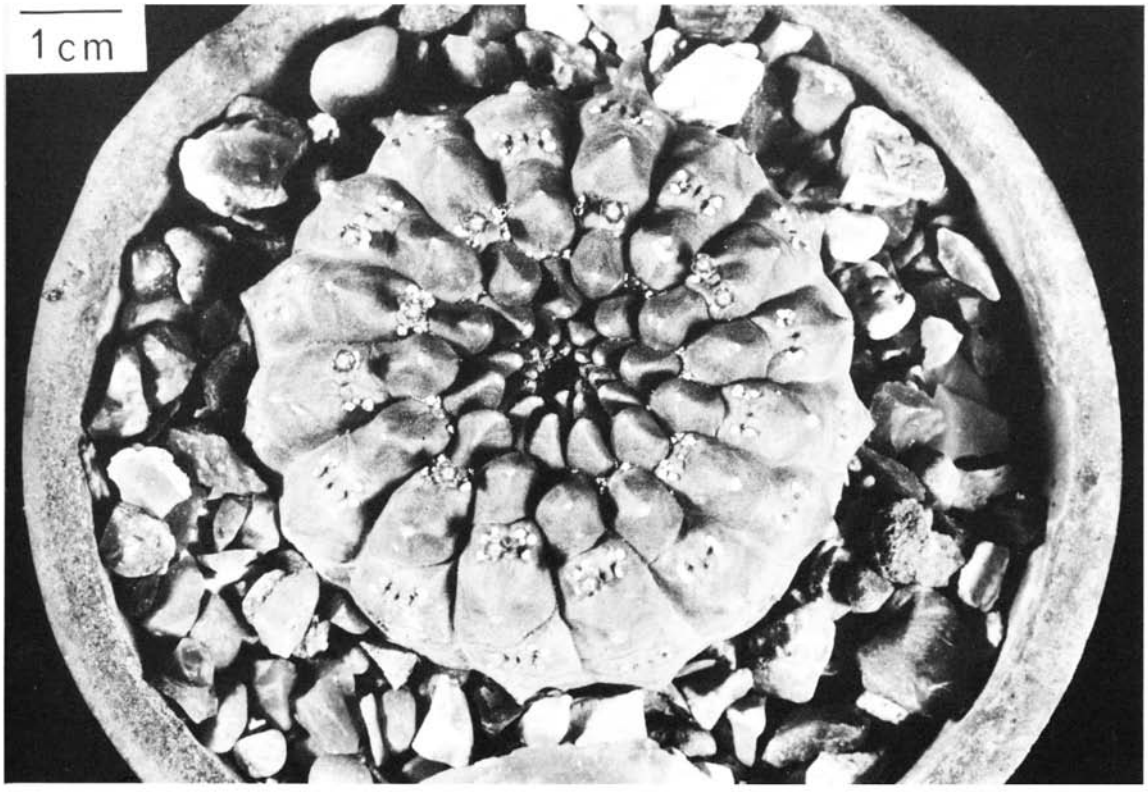

Fig. 2. *E. gymnocalycioides.* A mature plant flowering in cultivation.

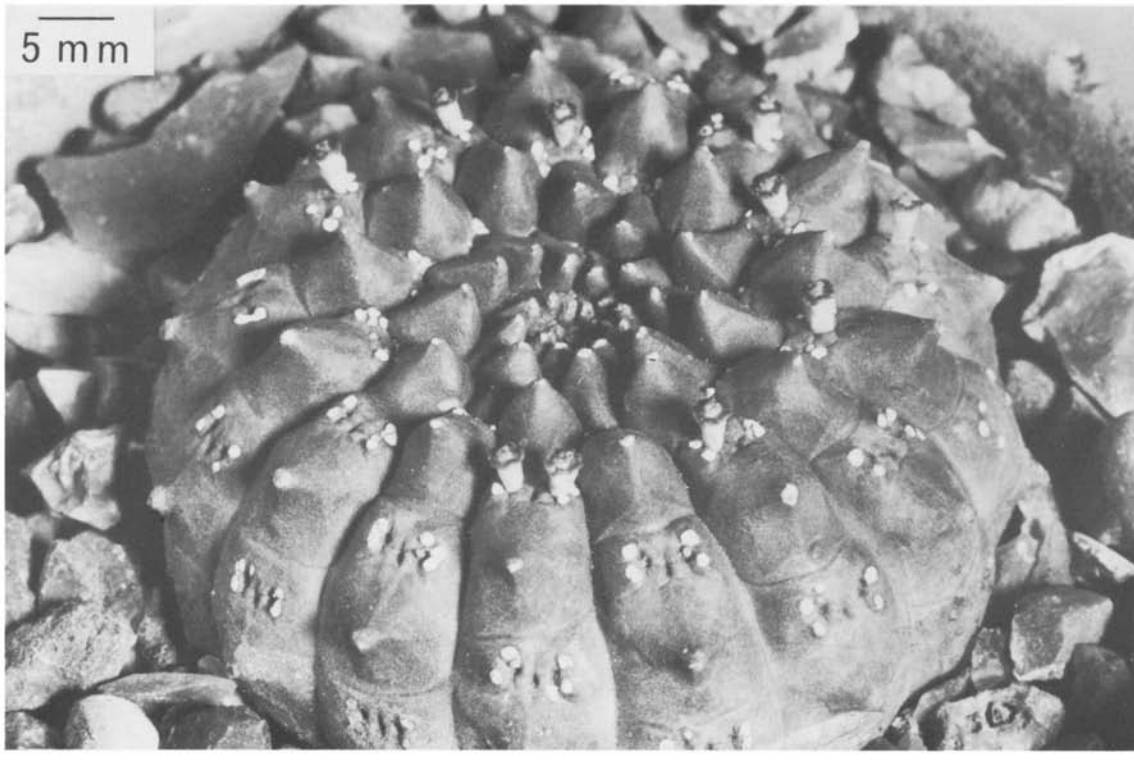

Fig. 3. *E. gymnocalycioides.* Note groups of structures in axils of tubercles.

Fig. 4. *E. gymnocalycioides.* Showing rudimentary spine-shields on tubercle tips and primary cyathia of developing central cymes.

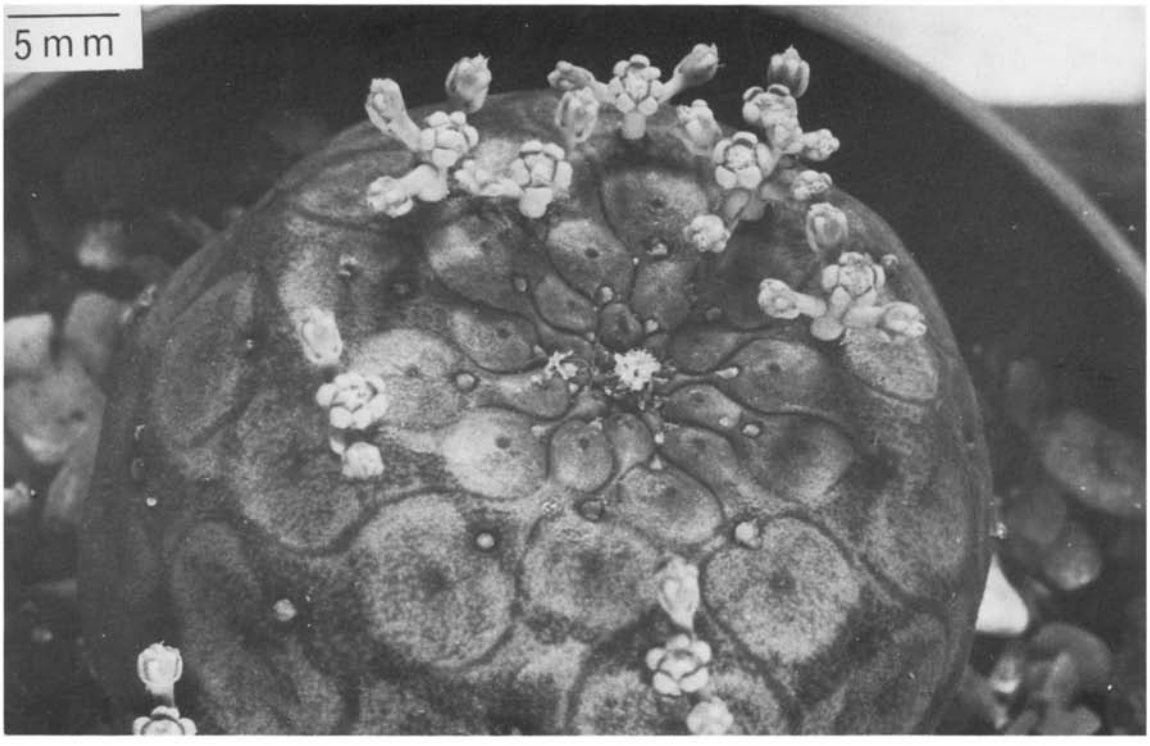

Fig. 5. *E. turbiniformis.* A mature plant flowering in cultivation. Note scars at the apex of suppressed tubercles, with a flowering eye in each axil.

Fig. 6. *E. turbiniformis.* Showing details of well-developed cymes.

Fig. 7. *E. mosaica.* Flowering in habitat, life-size.

E. gymnocalycioides these never elongate, the lower sterile axils of such shoots being represented by the white structures and the upper fertile axils represented by the flowering eyes.

An alternative hypothesis, that the white structures are stipular in origin, does not seem as attractive for two reasons. First, the suggestion that there is a vestigial spine-shield at the tip of the tubercle would be quite incompatible with a further stipular structure at its base. Second, the structures are too irregular in size and position to be modified stipules, which are strictly and regularly paired in section *Euphorbia.* Some Madagascan species, such as *E. didierioides,* do have irregularly arranged stipular spines, but these are distinct in all other respects. The inflorescence characters, also, of the Madagascan species, are quite different.

The establishment of the taxonomic position of the new species emphasizes the isolation of *E. piscidermis,* the other sub-globose *Euphorbia* from north-east Africa, in that it suggests a definite relationship for *E. turbiniformis* which cannot be extended to include *E. piscidermis.* The most likely relatives of that species would seem to be certain geophytic species allied to *E. rubella,* but its morphology is so very highly adapted that the relationship must be distant.

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Bradleya 2/1984
pages 15-18

A new combination in Huernia (Asclepiadaceae)

P. V. Bruyns

Summary. A new combination *Huernia longii* subsp. *echidnopsoides* (Leach) Bruyns is made for what was previously known as *H. pillansii* subsp. *echidnopsoides* Leach. Reasons are put forward to justify this alteration.

Introduction

During a collecting trip to the eastern Cape in 1977, both *Huernia longii* Pillans and *H. pillansii* subsp. *echidnopsoides* Leach were seen in considerable numbers. Both were in flower and it was possible to compare them morphologically, florally and ecologically. As a result it is necessary to reconsider the taxonomic position of the latter in relation to *H. pillansii,* to which it seems to be less closely related than originally considered by its author. A new arrangement is proposed where subsp. *echidnopsoides* is made a subspecies of *H. longii.*

Discussion

Describing *Huernia pillansii* subsp. *echidnopsoides,* Leach (1968) ignores *H. longii* altogether and only compares his new subspecies with subsp. *pillansii* saying that the flowers of his new subspecies 'appear to be identical' to those of subsp. *pillansii.* However, in his review of some Huernias (Leach, 1976) the corolla lobes are given as being more than twice as long as broad and those of subsp. *echidnopsoides* as scarcely longer than broad, a situation that can hardly be described as identical. In this review, however, he discusses the relationship between *H. longii* and *H. pillansii* subsp. *echidnopsoides* in some detail. The differences that he considers of importance can be summarised as follows:

1. *Habitat:* 'Karoo shales, often in fully exposed situations' for subsp. *echidnopsoides;* 'very steep, cliff-like, conglomerate slopes closely intermingled with tufted grasses among shrubs' for *H. longii.*
2. *Stems:* 'the consistently smaller stature, more slender stems with fewer teeth and smaller, spreading (not deflexed) teeth' for *H. longii.*
3. *Flowers:* 'smaller flowers with proportionately wider corolla lobes, shorter papillae' for *H. longii* and the 'quite different . . . inner corona lobes'.

Leach (1976) indicates that he was not able to examine more material of *H. longii* than the type (*Long* 1154) and cultivated parts of this collection. With the finding of this taxon again in the field and the consequent examination of a wider range of material, it has become clear that these distinctions are, for the most part, completely useless. The three points are dealt with separately:

1. *Habitat*

Huernia pillansii subsp. *pillansii* is an element of typical south-western Great Karoo and Little Karoo distribution. This distribution is centred approximately on Ladismith, with the easternmost substantial populations found south of Oudtshoorn (the isolated record of this taxon from near Steytlerville cited by Leach (1968) is atypical and should not be overemphasised). It grows among stones under small xerophytic shrubs (such as *Pteronia* sp., *Relhania* sp. and members of the Mesembryanthemaceae) on flat areas and around the foots of hills. As pointed out by Leach (1968) this habitat is quite different from that of subsp. *echidnopsoides.* However, it is entirely false to claim that those of subsp. *echidnopsoides* and *H. longii* are especially different (particularly so when one has not actually seen both habitats!).

Plants seen in the wild in 1976, 1977 and 1981 of subsp. *echidnopsoides* were growing on small slopes made up of loose broken stones and pebbles dislodged from the surrounding conglomerate cliffs. At the two localities (separated by about 2 km) where the plants were seen the soils were not of 'Karoo shale' derivation at all as claimed by Leach but were of conglomerate origin. The surrounding vegetation consisted of 'transitional fynbos' elements such as *Dodonaea*

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viscosa, Asparagus sp., Elytropappus rhinocerotis and occasional *Restionaceae.*

H. longii was seen in 1977 at two localities separated by about 3 km. At both the plants were growing wedged among pebbles on small flat areas on the otherwise steep conglomerate slopes (of about 45° inclination). Upwards of twenty specimens were counted at the one spot and only a few grew in grass tufts, the majority occurring in or partially in the open.

The vegetation on the slopes themselves consisted mainly of succulents *(Euphorbia polygona, Aloe, Haworthia* and various Crassulas) with occasional larger non-succulent bushes while that surrounding the slopes was the 'transitional fynbos' noted above for subsp. *echidnopsoides.*

The two habitats differ thus mainly in their degree of steepness. Their different appearance—caused by the presence of many succulents in the area where *H. longii* occurs and the relative (but not at all complete) lack of these where subsp. *echidnopsoides* is found—is actually a consequence of this difference in steepness combined with a slight climatic difference caused by the higher surrounding mountains in the latter area.

2. *Stems*

Fig. 1 shows clearly that the stems of *H. longii* and subsp. *echidnopsoides* are not much different in thickness though those of *H. longii* are often thinner than those of the other. It is also commonly the case that vigorous plants of the former have stems longer than those usual for the latter, contrary to the opinion of Leach. As can also be seen in the photograph, the teeth on the tubercles of *H. longii* are often deflexed, again contrary to the opinion of that author.

However, more significant are the similarities between the stems of these two and the differences with those of subsp. *pillansii.* Plants of *H. longii* and subsp. *echidnopsoides* are stoloniferous at least to some extent and it is usual for the outer, exposed stems of a cluster to become subterranean for some of their length and often whole plants consist only of isolated, scattered stems connected by their underground parts.

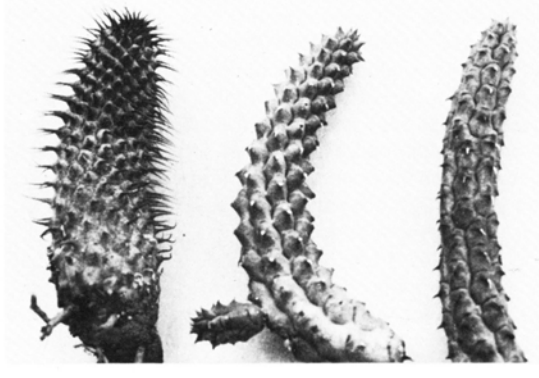

Fig. 1. Stems of the three taxa discussed. From left to right: *H. pillansii,* from a plant of unknown origin, cult. Karoo Botanic Garden, Worcester; *H. longii* subsp. *echidnopsoides,* from *Bruyns* 1838, Patensie; *H. longii* subsp. *longii,* from *Bruyns* 1824, near Uitenhage.

This is, in all likelihood, an adaptation to steep situations where soil erosion is constantly occurring. It is, however, in complete contrast to subsp. *pillansii* which is never stoloniferous however exposed its situation may be.

Stems of subsp. *pillansii* are also different to those of the other two in having upwards of fourteen (and usually sixteen, though White & Sloane (1937) give as many as 20-24) angles, as opposed to the typical 6-9 angles in the other two. Furthermore, the young shoots of subsp. *pillansii* bear soft bristles 5-8 mm long on each tubercle. This bristle is less than 3 mm long in the others and their stems consequently have a tessellate appearance lacking in the other.

3. *Flowers*

As can be seen from the drawings, the corollas of both *H. longii* and subsp. *echidnopsoides* are very similar in shape with the lobes just slightly longer than broad at their base. Observed variation has indicated that they cannot be distinguished on the basis of differences in their corolla lobes. In subsp. *pillansii* the corolla lobes are at least (and mostly more than) twice as long as broad at their base and are not confusable with those of the other two.

As can further be seen, the papillae in the corolla of *H. longii* are variable and some are very similar to those of the other two. This is thus also not a reliable means of distinguishing them.

Leach (1976) points out that the inner corona-lobes of *H. longii* and subsp. *echidnopsoides* are different and this is quite clear from the drawings presented here. Although the outer corona-lobes of both vary considerably (see illustrations), no comparable measure of variation has been observed in the inner corona and this appears indeed to be a reliable means of separating them. At the same time the similarity of the inner coronas of subsp. *pillansii* and subsp. *echidnopsoides* must be mentioned.

Conclusion

More recent collections of *H. longii* and *H. pillansii* subsp. *echidnopsoides* indicate them to occupy equally restricted and specialised niches as succulent elements in 'transitional fynbos' vegetation in the mountainous areas of the south-eastern portion of the Cape Province. This is in contrast to the occurrence of *H. pillansii* subsp. *pillansii* in the Karroid region of the western Cape on the Little and Great Karoos. A closer examination of the similarities and differences between these taxa shows that the only significant point of similarity between subsp. *echidnopsoides* and subsp. *pillansii* is in the shape and orientation of the inner corona lobes. This must be assessed against the vegetative and gross floral similarities between subsp. *echidnopsoides* and *H. longii* discussed above as well as against their mutual ecological and distributional similarity.

Leach (1978) in discussing generic divisions in the *Stapelieae* has stressed the fact that an excessive preoccupation of previous authors with features of the

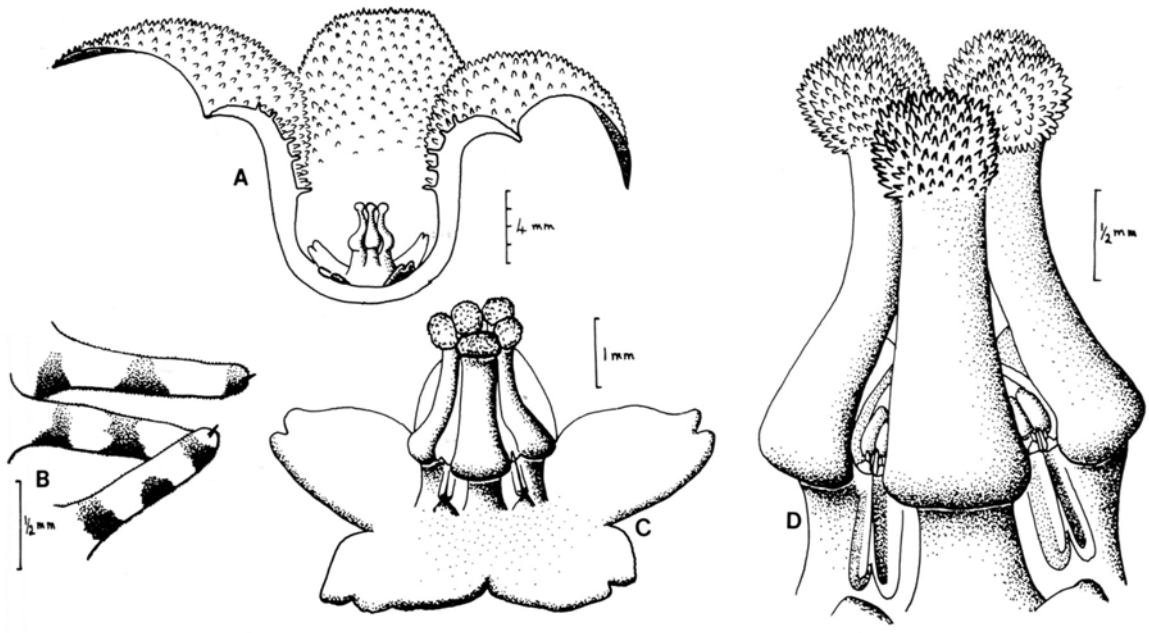

Fig. 2. *H. longii* subsp. *echidnopsoides.* **A,** corolla cut down middle to show corolla tube in section; **B,** papillae found on inner corolla surface; **C,** side view of staminal column; **D,** enlarged side view of upper part of staminal column. **A** from *Karoo Botanic Garden* 199/71, Patensie (NBG); **B-D** from *Bruyns* 1838, near Patensie (NBG).

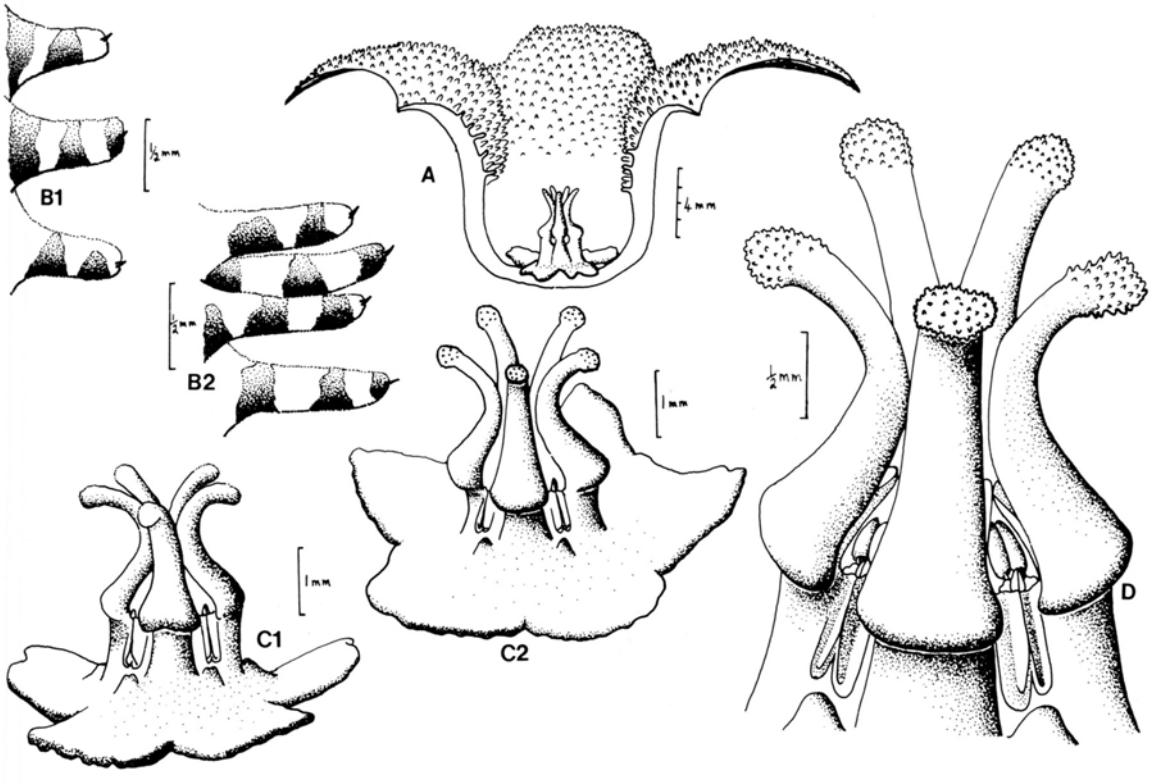

Fig. 3. *H. longii* subsp. *longii.* Dissections as for fig. 2. **A, B1, C1** from *Karoo Botanic Garden* 140/76, north of Uitenhage (NBG); **B2, C2, D** from *Bruyns* 1824, near Uitenhage (NBG). Note the variation in the outer corona lobes between C1 and C2.

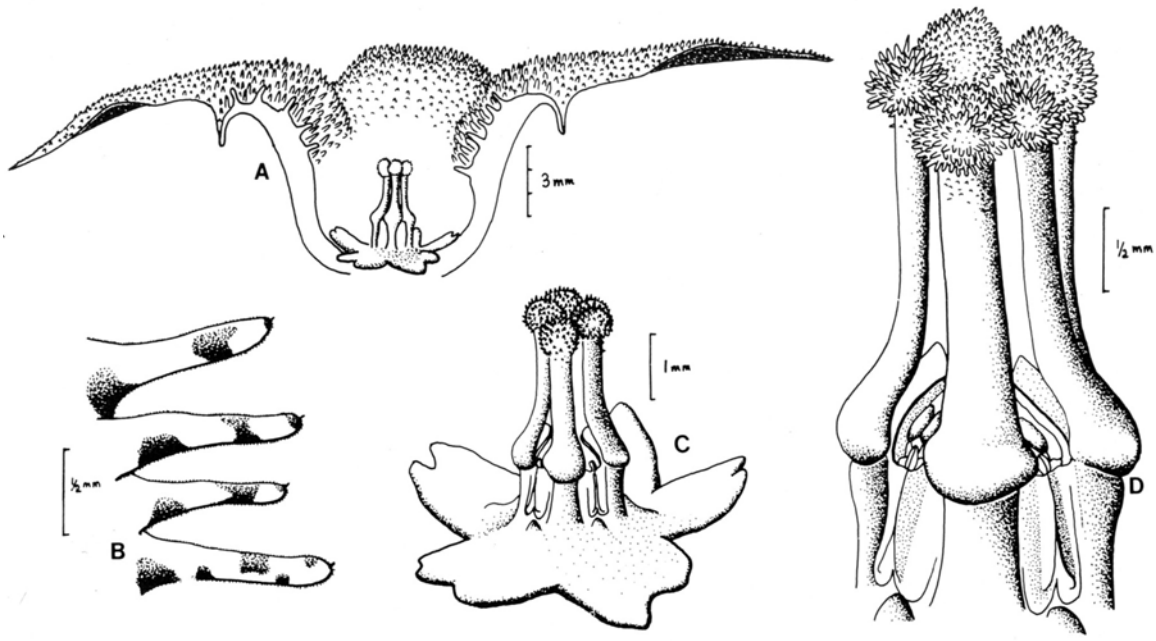

Fig. 4. *H. pillansii.* Dissections as for fig. 2. From a plant of unknown origin, *Städtische Sukkulentensammlung Zürich* 761377 (ZSS).

staminal column, to the almost total exclusion of all else, has led to a very unsatisfactory classification of the group at generic level. A classification of the group at this level is being developed with a view to including a wider range of characters and therefore rectifying this problem. However, at the same time it is imperative that the relationship between species and subspecies be far more accurately assessed and that this assessment should *also* extend beyond the traditional borders of coronal features. In circumscribing this relationship it is essential that as wide a selection of specimens be examined as possible to explore fully the variability exhibited by the taxon concerned and also that its ecological relationship with related taxa be considered.

In the present case consideration should also be given to the fact that, as pointed out by Cowling (1982), the eastern Cape is a region entertaining a high level of endemism among succulent plants. Cowling indicates that this is in contrast to the position among species which are neither succulents nor 'typical Cape genera' where it was shown by Gibbs Russel & Robinson (1981) that the proportion of endemism was low. A high proportion of endemics is indicative of a 'lengthy history' of the group in the area (Cowling, l.c.) and it is therefore reasonable to assume that the two eastern taxa under consideration here have evolved independently of subsp. *pillansii* for a considerable period of time.

It is therefore clear that the isolated similarity of the inner coronas of subsp. *pillansii* and subsp. *echidnopsoides* must be relegated to second place so as to put subsp. *echidnopsoides* and *H. longii* closer together taxonomically. At the same time it is considered that the differences extant are too small to warrant the raising of all three of the taxa under discussion to specific rank. Thus we have:

H. longii subsp. **longii**
H. longii Pillans in J. S. Afr. Bot 5: 65 (1939).
Type: Cape, Uitenhage district, *Long* 1154 (BOL).

H. longii subsp. **echidnopsoides** (Leach) Bruyns **comb. nov.**
H. pillansii subsp. *echidnopsoides* Leach in J. S. Afr. Bot. 34: 140 (1968).
Type: Cape, eastern end of the Baviaanskloof, *Leach & Bayliss* 13612 (K!, PRE).

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Bradleya 2/1984
pages 19-38

A review of Ferocactus Britton & Rose

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Summary. A systematic treatment of *Ferocactus* Britton & Rose *sensu stricto* is presented. Following guidelines outlined in an earlier paper (Taylor & Clark, 1983) the species comprising subg. *Ferocactus* are arranged in two sections and four informal groups. In total 23 species and 20 heterotypic infraspecific taxa are included, with their authorities, places of publication, types, essential synonyms and distributional data. Brief diagnostic descriptions are provided to supplement the key to species and to enable identification of infraspecific taxa. References to good published illustrations are cited as an additional aid to recognition.

Introduction

Besides being an important component of the floras of Mexico and the south-western United States, *Ferocactus* is a well-known and popular genus in horticulture and Botanic Gardens. Even without flowers many species are attractive to the eye, and some can reach impressive proportions under glasshouse culture and may flower as well. Up to the present there has been no published account of the genus available to aid the collector or botanist to identify and classify his plants, the works of Britton & Rose (1922) and Backeberg (1961) being either too out-of-date, or all but useless for this purpose. A detailed study of the genus was undertaken more than 30 years ago by George Lindsay, but his doctoral thesis, completed in 1955, has never been effectively published. Some of Lindsay's work did appear, however, in the *Vegetation and Flora of the Sonoran Desert* (F. Shreve & I. L. Wiggins, 1964) but his valuable notes and many photographs have largely remained available to only a few well-informed enquirers (via University Microfilms, Ann Arbor, Michigan, who have generated copies of his thesis on demand). The present study draws heavily upon Lindsay's work, though in the 29 years since its completion certain aspects have become out-of-date. In the meantime we have discovered the value of the Scanning Electron Microscope, which has greatly aided the understanding of relationships in *Ferocactus* through the study of seed testa morphology (Taylor & Clark, 1983).

In central northern and southern Mexico, where half the species of *Ferocactus* are to be found, there are few problems in the delimitation of taxa, and my treatment broadly follows that of Lindsay (1955b). However, in north-west Mexico, and in particular in the Baja Peninsula, the representatives of sect. *Ferocactus* are, it seems, still actively evolving, and consequently more difficult to distinguish. Here I have taken a broader view of the species and have referred some of the weaker segregates to infraspecific ranks within the circumscriptions of their immediate allies. As far as Baja California is concerned, there is of course a ready-made Flora to use for identification purposes (Wiggins, 1980). Unfortunately this mighty tome is unreliable, and at least that part dealing with the Cactaceae should be consulted with considerable caution. The range and flowering times of a number of the Ferocacti dealt with therein appear to have been hopelessly transposed.

In the notes which follow references cited only by date and page will be found in the Bibliography provided. Dimensions are given with length first followed by diameter (connected by a multiplication sign), single unqualified measurements referring to length. Field collections of the author are at K.

Key to species

1. Stems highly branched, forming large clusters or mounds >2 m diam.; stems <25 cm diam., with 8-13 ribs; spines >13 per areole; seeds with tabular testa-cells, not pitted (south-east Puebla to north Oaxaca) 2
1. Stem solitary or, if clustered, then either stems, ribs, spines or seeds not as above 3
   2. Flowers and fruits red; stem ribs (11-)13 1. **F. flavovirens**
   2. Flowers and fruits yellow; stem ribs 8 12. **F. robustus**
3. Spines 1-10 per areole, straight or slightly curved, none strongly flattened above or recurved to hooked at apex 4
3. Spines >10 per areole or at least one strongly flattened and/or recurved to hooked at apex, or stem ribs 13-16 and spiralled 15

4. Seeds smooth or with reticulate markings, but not pitted 5
4. Seeds pitted 8
5. Spines 1-6(-8), ± equal, to 2.5(-5.5) cm long; stems 15-50 (-60) cm diam. 6
5. Spines usually >7, unequal, the central longer, 3-10 cm; stems to 25(-30) cm diam. 7
6. Stem glaucous; seeds very smooth (east Mexico) 3. **F. glaucescens**
6. Stem dark green; seeds with a reticulate pattern of raised testa-cell margins (west Mexico: Sinaloa) 5. **F. schwarzii**
7. Areoles well separated on the ribs, 2-4 cm apart; stems often clustered; stigmas 10-14 (east Mexico) 2. **F. echidne**
7. Areoles c. 1 cm apart or ± confluent on the ribs; stem solitary; stigmas c. 7 (south-west Mexico) 4. **F. reppenhagenii**
8. Fruit red to purple, indehiscent, and/or very juicy and deliquescent; ribs acute; stem not exceeding 1.2 m high 9
8. Fruit yellow (red in 21b) or dehiscing by a basal pore; ribs obtuse or acute; stem 30 cm-4 m high 12
9. Flowers yellow; seed c. 1 mm 10
9. Flowers red to purplish-pink; seed c. 1.8-2 mm 11
10. Stem ribs 13-18; spines 6-7 per areole; seed elongate, curved (Michoacan) 6. **F. lindsayi**
10. Stem ribs 20-40; spines usually >7 per areole; seed ± isodiametric (north cent. Mexico) 8. **F. histrix**
11. Stem globular to cylindric, 30-120 cm high; flower 6-7 cm long 7. **F. haematacanthus**
11. Stem depressed-globose, disc-shaped, to c. 10 cm high; flower 3-4 cm long 9. **F. macrodiscus**
12. Central spine 1 per areole, conspicuous; seeds c. 2-3 mm 13
12. Central spines 4 or not distinct from radials; seeds 1.5-2 mm 14
13. Flower to 4.5 cm long; stem to 1 m high (south-west Chihuahua, south-east Sonora & north Sinaloa) 21. **F. pottsii**
13. Flower 6-7.5 cm long; stem to 2.5 m high (south Arizona to north Sinaloa, mainland Baja California Sur) 23. **F. emoryi**
14. Stem ribs c. 13-20; spines usually red, some ± flattened or angled, hairlike whitish spines often present; stems often in clumps (cent. northern Mexico) 20. **F. pilosus**
14. Stem ribs 25-35; spines clear yellow, rarely reddish-brown, terete, all of one type; stem solitary (islands on west side of Gulf of California) 22. **F. diguetii**
15. Scales on receptacle-tube and fruit with long narrowly attenuate apices (Cent. north & south Mexico) 10. **F. latispinus**
15. Scales not as above 16
16. Fruit pinkish-red and indehiscent, and/or very juicy, deliquescent, releasing the seeds in fluid 17
16. Fruit yellow or dehiscing by a basal pore when fully ripe 19
17. Spines straight or curved but not hooked at apex; flower 3-4 cm, short-tubed 18
17. At least one spine per areole hooked at apex; flower 6-10 cm, with a long tube 11. **F. hamatacanthus**
18. Flowers purplish-pink to red, tepals with paler margins; seeds to 2 mm 9. **F. macrodiscus**
18. Flowers yellow; seeds c. 1 mm 8. **F. histrix**
19. Radial spines 7-9 per areole, terete, only slightly thinner than the solitary terete or laterally compressed central 23. **F. emoryi**
19. Radial spines >9 or at least some much thinner than the one or more centrals 20
20. Perianth-segments remaining ± erect at anthesis; flowers to 2.5 cm diam.; stems often clustering, to 3 m high; principal spines 6-12, none curved or hooked at apex, often accompanied by very fine hairlike radials (cent. north Mexico) 20. **F. pilosus**
20. Perianth-segments spreading; flowers 3.5-6 cm diam., stems rarely clustering; spines not as above or centrals and radials intergrading (north-west Mexico & USA) 21
21. Flowers violet-purple to lilac (west coast of Baja California, Bahia Sebastian Viscaino to c. 31°N) 18. **F. fordii**
21. Flowers green, yellow, orange or red 22
22. Spines clearly differentiated into stout dark coloured centrals plus upper and lower radials, and finer whitish laterally directed radials, or the latter absent and seeds with tabular testa-cells 23
22. Spines in each areole intergrading in size and colour; seeds with concave testa-cells 25
23. Largest of the upward and downward directed central spines equally flattened and similar, curved but not normally hooked at apex, or fruits to 7.5 cm long; flowers red (Baja California, 28-31°N) 14. **F. gracilis**
23. Largest central spine more flattened than the others or otherwise dissimilar, often strongly recurved or hooked; flowers red to yellow; fruits to 6 cm long. 24
24. Seeds (see cited illustrations) with tabular, finely verrucose, ± isodiametric testa-cells, the raised anticlinal walls at the margin of each cell not prominent (south-west USA, Chihuahua, Sonora, north Sinaloa & west Durango) 19. **F. wislizeni**
24. Seeds with tabular to concave, coarsely verrucose testa-cells, the verrucae few and separate, the raised cell margins prominent or the cells oblong (Baja California, from 29°N to the Cape). 13. **F. peninsulae**
25. Flowers greenish; spines to 5 cm long; seed c. 1.5 mm (north-west Baja California west of the Sierras San Pedro Martir & Juarez, USA near San Diego) 15. **F. viridescens**
25. Flowers yellow, orange or reddish, or green but with other colours in the same population; spines to 5-17 cm long; seeds c. 2-3 mm. 26
26. Central and radial spines ± equal in number (10), the former mostly porrect, to 5 cm long, twisted flattened and fairly uniform, or flowers orange to red with 4-5 mm wide inner perianth-segments (west Baja California, below Punta Abreojos to Isla Cedros) 17. **F. chrysacanthus**
26. Central spines fewer than radials and 4 of the former much larger than the others, to 7-17 cm long, or cent.sp. ± adpressed or not differentiated from rad.sp.; inner perianth-segments 7-11 mm wide (east & north-east Baja California Norte & north-west Sonora, south-west USA) (see also 19c from Isla Tiburon, Gulf of California) 16. **F. cylindraceus**

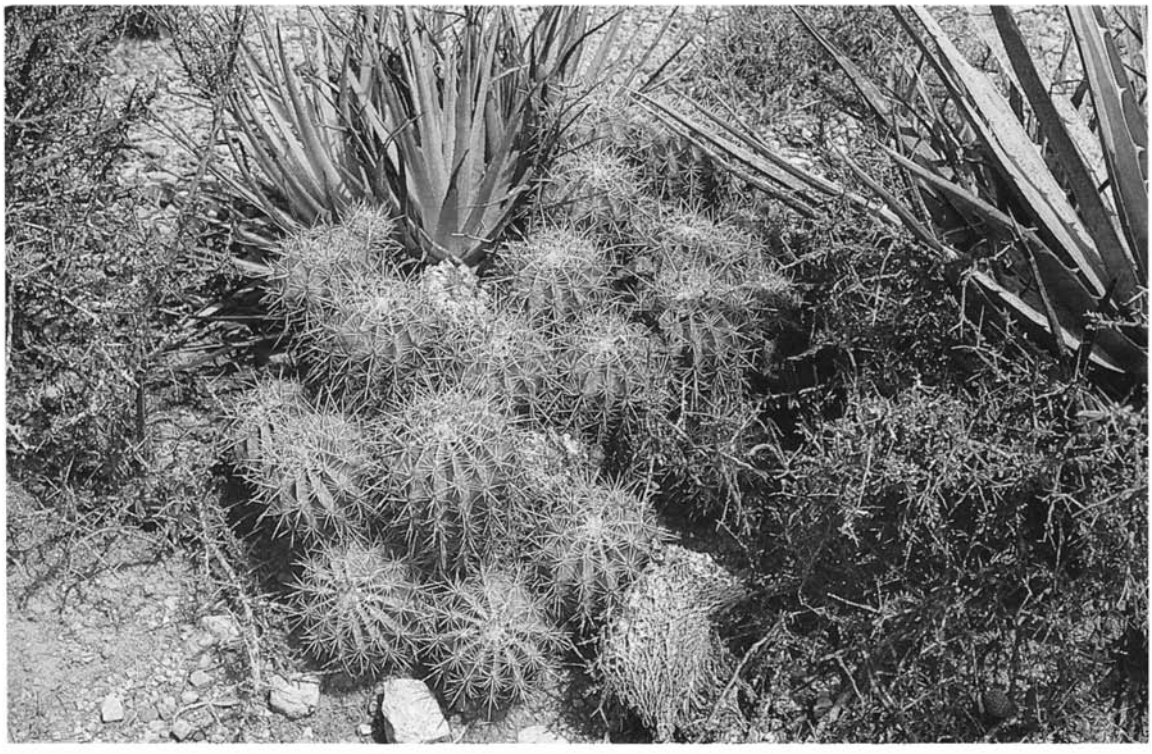
Section **Bisnaga** (Orcutt) N. P. Taylor & J. Y. Clark in Bradleya 1: 6 (1983); *Bisnaga* Orcutt, Cactography, 1 (1926) pro genus. Type: *Echinocactus cornigerus* DC (=*F. latispinus* (Haw.) Britton & Rose).

Seeds with an abrupt, sharp edge to the hilum-micropylar rim, mostly very smooth and shiny, seldom exceeding 2mm. Fruit when ripe with a *juicy interior, indehiscent* or bursting irregularly near apex, often red or purplish.

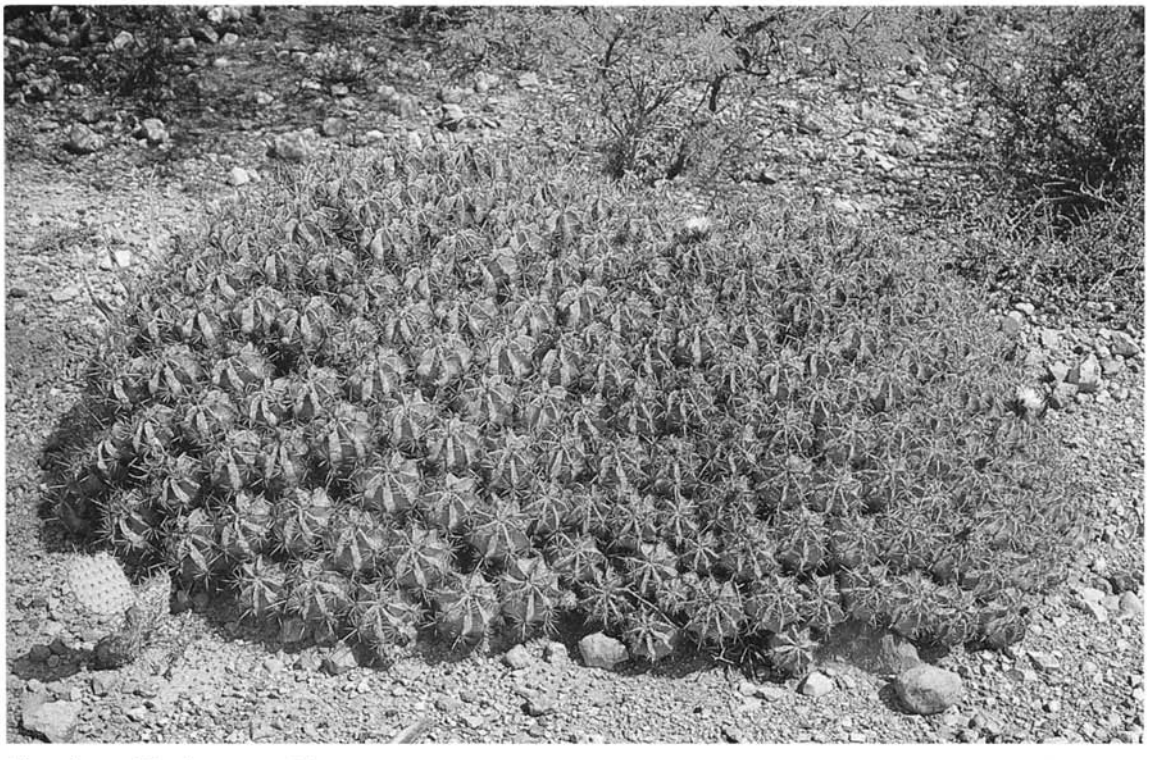
F. GLAUCESCENS GROUP (Taylor & Clark, 1983) (Nos. 1-5) Stems caespitose or solitary; spines ± terete, straight at apex. Seeds with tabular testa-cells or with only the cell margins slightly raised, not 'pitted'.

1. **F. flavovirens** (Scheidw.) Britton & Rose, Cact. 3: 138, t. 13.1 (1922); Hirao (1979): fig. 47; Kraehenbuehl in Kakt. and. Sukk. 34(2): 40-41, with figs. (1983); *Echinocactus flavovirens* Scheidw. in Allg. Gartenz. 9: 50 (1841); *Bisnaga flavovirens* (Scheidw.) Orcutt (1926); type of *Ferocactus* subg. *Pennisquama* F. Buxb. in Beitr. Biol. Pflanzen 41: 143-156 (1965) and in Krainz, Die Kakteen, Lfg 31-32, with figs. (1965). Type: living material from Tehuacan, Puebla, c. 1830 m, possibly collected by Karwinsky between 1828 and 1832 (apparently not preserved). Neotype (Lindsay, 1955b): Mexico, Puebla, road to Zapotitlan de Salinas, 9 km from Tehuacan, c. 1830 m, *Lindsay* 2596 (DS).

Caespitose, forming mounds of more than 2 m diam.; stems to 30-40 × 20 cm, light green; ribs (11-)13; areoles widely



F. flavovirens at the neotype locality near Tehuacan, Puebla. *(photo: Hunt)*



A large clump of *F. robustus* near Tehuacan. *(photo: Hunt)*

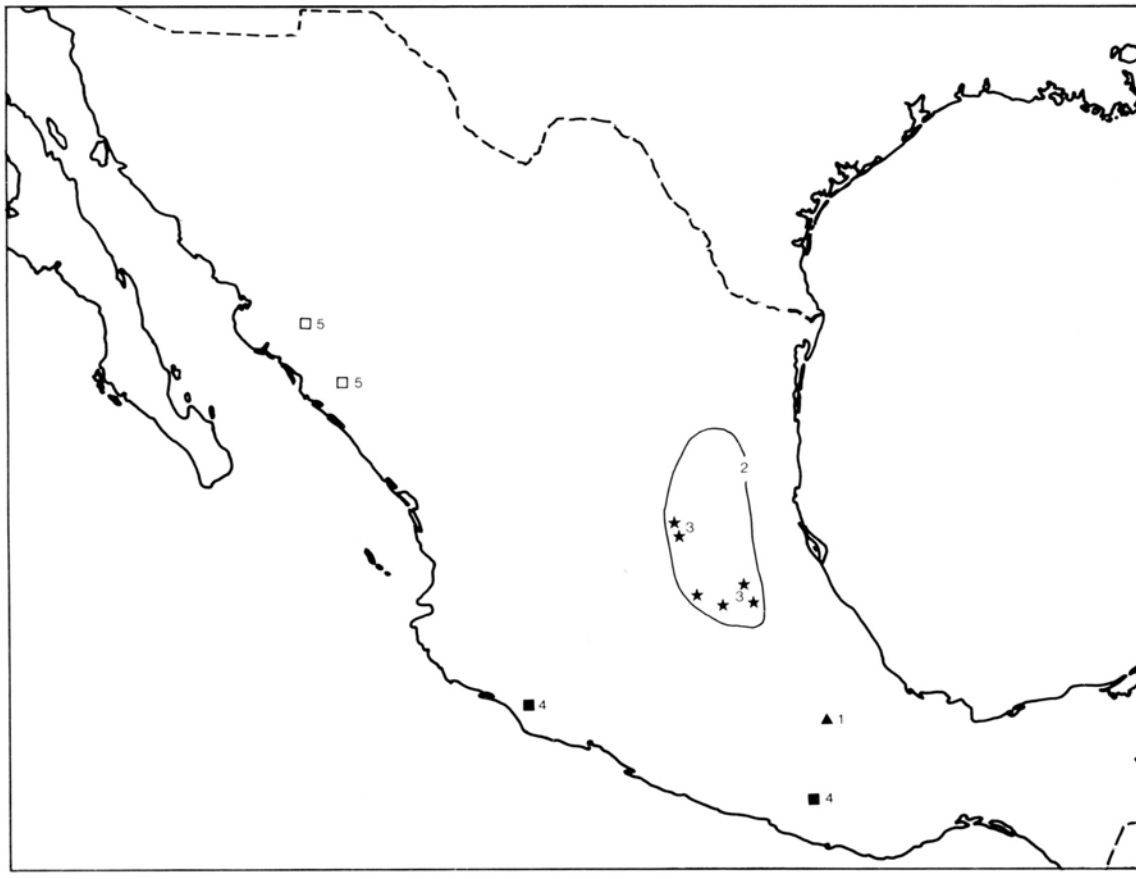
spaced; rad.sp. 12-20, light brown to grey, uppermost sometimes lighter coloured and bristle-like; cent.sp. 4-6, light brown, longest to 8 cm. Fl. (see Buxbaum in Krainz, l.c.) c. 3.5 cm, red, arising from the youngest areoles at the centre of the stem apex, immersed in wool; perianth-segments linear-lanceolate, only 2-3 mm wide; style and 13-15 stigmas yellowish. Fr. ellipsoid, nearly 3 × 2 cm, red, clothed with long, brown, ciliate-aristate scales, pulp red; seed (see Bradleya 1: 13, fig. 21) narrowly ovoid, c. 1 mm, dark brown. Range: south-east Puebla to northernmost Oaxaca, on limestone.

Although it was first collected early in the last century, *F. flavovirens* has only recently become better known. The studies of Buxbaum (1965) have drawn attention to its unusual flowers, which are superficially like those of *Echinocactus grusonii*, but red (see Hirao and Kraehenbuehl refs. for good colour illustrations). They may have more in common with the flowers of *F. latispinus:* both have very narrow, aristate, densely imbricate receptacle scales, though in terms of seed and vegetative morphology the species can hardly be closely related. In these other characters *F. flavovirens* fits conveniently into the F. GLAUCESCENS GROUP, where it has the least specialized habit and, like the similarly caespitose *F. robustus* (sect. *Ferocactus*), can be interpreted as a possible link to a hypothetical shrubby, cereoid ancestor.

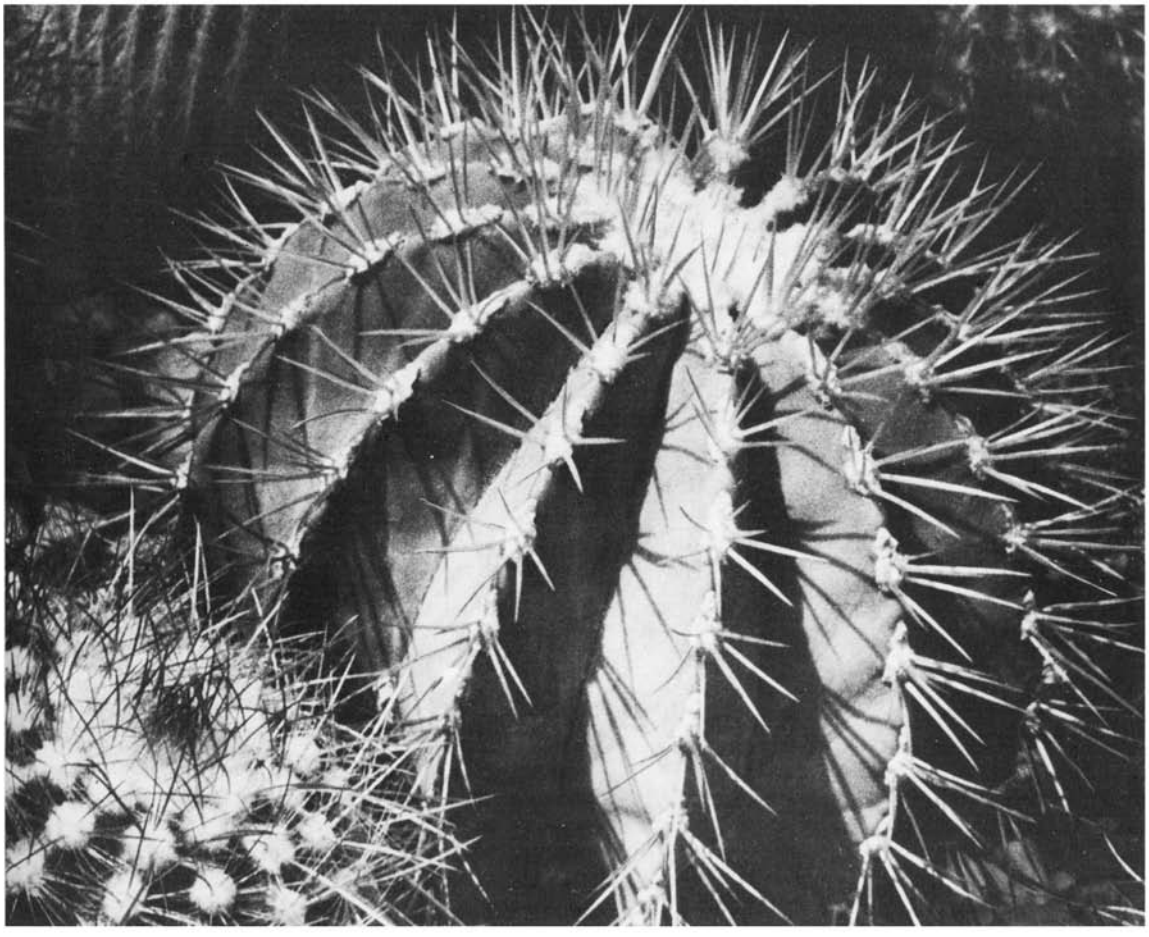
2. **F. echidne** (DC) Britton & Rose, Cact. 3: 136 (1922); Sanchez.-Mej. in Cact. Suc. Mex. 10: 66, 72, figs. 42A & B, 43A & B (1965); Hirao (1979): fig. 39; *Echinocactus echidne* DC, Coll. mem. 8: 19, t. 11 (1834). Type: living material sent to De Candolle in 1828 by *Thomas Coulter*, probably from the environs of Zimapan, Hidalgo (cf. McVaugh in J. Wash. Acad. Sci. 33: 65-69. 1943); the De Candolle illustration (t.11) can serve as lectotype. Syn. *E. victoriensis* Rose in Contrib. US. Nat. Herb. 12: 291 (1909); *F. echidne* var. *victoriensis* (Rose) G. Lindsay (1955a): 168, fig. 159 (upper right); *F. victoriensis* (Rose) Backeb. (1961). Type: Tamaulipas, vicinity of Cd. Victoria, c. 320 m, 1907, *Palmer* 267 (US). Syn. *E. rafaelensis* J. Purpus in Monatsschr. Kakteenk. 22: 163 (1912), ibid. 23: fig. opposite p. 34 (1913); *F. rafaelensis* (J. Purpus) Borg (1937). Type: San Luis Potosi, Minas de San Rafael (nr Buenavista, south of Los Cerritos), 1910, *C. Purpus* (probably not preserved, but see illustration, loc. cit.). Syn. (?) *'F. rhodanthus'* F. Schwarz; Hirao (1979): fig. 41.

Stem solitary or caespitose, flattened-globose to cylindric, to 35(-80) × 20(-30) cm, dull to grey-green; ribs 13-21; areoles well separated; rad. sp. 7-9, shorter than the solitary 5-10 cm central. Fl. 2-4.5 × 3-3.5 cm, yellow, rarely red; stigmas 10-14. Fr. globular to ovoid, 2 × 1.5 cm, light green, white, tinged pink or red; seed (see Bradleya 1: 13, figs. 23 & 24) 1-1.75 mm, dark red to black, very smooth. Range: Hidalgo, Queretaro, Guanajuato, San Luis Potosi, south-east Nuevo Leon (*Meyer & Rogers* 2945) and south Tamaulipas, c. 300-1860 m, on basic soils.

A wide-ranging and variable species represented by a number of distinctive forms in habitat. The northernmost of these has been recognized as var. *victoriensis* by Lindsay (*loc. cit.*) but this is difficult to justify on the characters given by him. The species needs further field study throughout its range. It is closely related to the following (q.v.), but has different spination.



Map 1. Distribution of *Ferocactus* section *Bisnaga:* F. GLAUCESCENS GROUP. Numbers correspond to species as numbered in the systematic account. Maps prepared by Ruth Taylor.



F. glaucescens *(photo: Broogh)*

3. **F. glaucescens** (DC) Britton & Rose, Cact. 3: 137 (1922); Backeb. (1961): Abb. 2598; Sanchez-Mej. in Cact. Suc. Mex. 10: 66, 72, figs. 38, 42D & 43D (1965); G. Unger in Kakt. and. Sukk. 29(8): 187 (1978); D. Herbel, Alles ueber Kakteen, 166 (1978); Rauh (1979): farbt. 4.8; Hirao (1979): fig. 37; Cullman et al., Kakteen, 174 (1984); *Echinocactus glaucescens* DC in Mem. Mus. Hist. Nat. Paris 17: 115 (1829). Type: living material sent to De Candolle in 1828 by *Thomas Coulter*, probably from the environs of Zimapan, Hidalgo (cf. McVaugh in J. Wash. Acad. Sci. 33: 65-69. 1943). Neotype (Lindsay, 1955b): Hidalgo, 8 km south of Jacala, on limestone boulders and outcrops, 1525 m, *Lindsay* 2611 (DS). Syn. *E. pfeifferi* Zucc. ex Pfeiffer, Enum. Cact. 58 (1837). The type of *E. pfeifferi* was collected by *Karwinsky* at Toliman, Hidalgo; Britton & Rose mistakenly cite this locality for the type of *E. glaucescens*.

Stem solitary or caespitose, globular to cylindric, to 45(-70) × 50(-60) cm, usually quite glaucous; ribs 11-34(-44); areoles approximate; spines 4-7(-8), ± equal, to 2.5(-3.5) cm, central 0-1. Fl. 2-4.5 × 2.5-3.5 cm, yellow; stigmas 8-14, cream. Fr. globular or ovoid, 1.5-2.5 × 2 cm, whitish or yellowish tinged red, with yellow scales; seed (see Bradleya 1: 13, fig. 22) to 1.5 mm, dark brown to almost black, very smooth. Range: Hidalgo, Queretaro & San Luis Potosi, on limestone, usually below 1500 m.

Similar to no. 5, but differing in the glaucous, often caespitose, stem and smoother seeds. Sometimes confused with no. 2, but readily distinguished by the closely placed areoles bearing spines of nearly uniform length.

4. **F. reppenhagenii** G. Unger in Kakt. and. Sukk. 25: 50-54, with figs. (1974); Hirao (1979): fig. 45 (juvenile plant). Type: Michoacan (exact locality not disclosed), *Reppenhagen* (ZSS).

Stem solitary, depressed-globose, columnar to 80 cm in age, 9-24 cm diam.; ribs 12-18, edge rounded; areoles confluent on old plants; rad.sp. (6-)7-9(-11), to 4 cm; cent.sp. 1, 2.8-8 cm. Fl. 2-3 × 2-3 cm, yellow to orange; stigmas 7. Fr. ovoid, 1.5-2.2 × 0.8-1.7 cm, bright to dark red; seed (see Bradleya 1: 14, fig. 25) to 2.3 mm, reddish-brown to black, very smooth. Range: Colima & Michoacan; Oaxaca (*fide* Lau, 1983); south-east and south-west facing slopes, 1900-2500 m.

Juvenile plants suggest a close affinity with the next species, but the adults retain their round-edged ribs and long spines.

5. **F. schwarzii** G. Lindsay in Cact. Succ. J. (US) 27: 70-72, with figs. (1955); Krainz, Die Kakteen, Lfg 33 (1966); Hirao (1979): fig. 43; Riha & Subik (1981): 49, fig. 36. Type: north Sinaloa, between El Rancho del Padre and Rio Sinaloa, 1940, *Schwarz* (DS 371145).

Stem solitary, globose, broadly elliptical or obovoid, to 80 × 50 cm, though mature at 10 cm diam., deep green; ribs 13-19, acute, rounded in youth; areoles ± confluent; spines (0-)1-4(-5), more numerous in youth, 0.5-5.5 cm. Fl. to 5 × 4 cm, yellow; style and 12-20 stigmas yellow. Fr. (known only from dried material) c. 1.5 × 1.2 cm; seed (see Bradleya 1: 14, fig. 26) 1.5 mm, black, raised testa-cell margins prominent. Range: cent. & northern Sinaloa.

F. LATISPINUS GROUP (*F. recurvus* Group—see Taylor & Clark, 1983) (Nos. 6-11). Stems solitary, sometimes very large; central spines often flattened dorsi-ventrally, straight or curved, or recurved to hooked at apex. Seeds with tabular-concave ('pitted') testa-cells.

6. **F. lindsayi** H. Bravo-H. in Cact. Suc. Mex. 11: 9-12, with figs. (1966); Cact. Succ. J. (US) 45: 104, figs. 3 & 4 (1973). Type: Michoacan, between Presa del Infiernillo and Playa Azul, nr Apatzingan, 1965, *H. Bravo-Hollis* (MEXU).

Stem globose to short-cylindric, to 60 × 40 cm, glaucous-green; ribs 13-18; areoles 6-10 mm apart; rad.sp. 5-6, 2.5-3 cm; cent.sp. 1, 4.5 cm, terete, straight. Fl. 5 × 3-4 cm, yellow; style and 12 stigmas yellow. Fr. ovoid, c. 1.5 cm; seed (see Bradleya 1: 14, fig. 27) to 1 mm, elongate, curved, dark brown to black. Range: Michoacan, basin of Rio Balsas, south-east of Apatzingan.

At present a little-known species but seemingly distinctive.

7. **F. haematacanthus** (Salm-Dyck) H. Bravo-H. ex Backeb. & F. Knuth, Kaktus-ABC, 352 (1935); Sanchez-Mej. in Cact. Suc. Mex. 9: 41 (1964), ibid. 11: 31-40, 51-52, figs. 16-19 (1966); Hirao (1979): fig. 42; Kakt. and. Sukk. 31: 14-16 (1980); *Echinocactus electracanthus* (var.) *haematacanthus* Salm-Dyck ('haemata-cantha'), Cact. Hort. Dyck 1849, 150 (1850); *E. haematacanthus* (Salm-Dyck) Monv. ex F. A. C. Weber in Bois, Dict. hort. 1: 466 (1896). Based only on Salm-Dyck's brief and unsatisfactory diagnosis, there being no known contemporary illustrations, nor provenance details of the type. Rediscovered and well characterized by Weber, loc. cit., and soon after collected by Purpus (Esperanza), but not known to Britton & Rose. Neotype: Puebla-Veracruz border, road between Tehuacan and Cumbres de Acultzingo, 1966, *Sanchez-Mejorada* 10786 (MEXU).

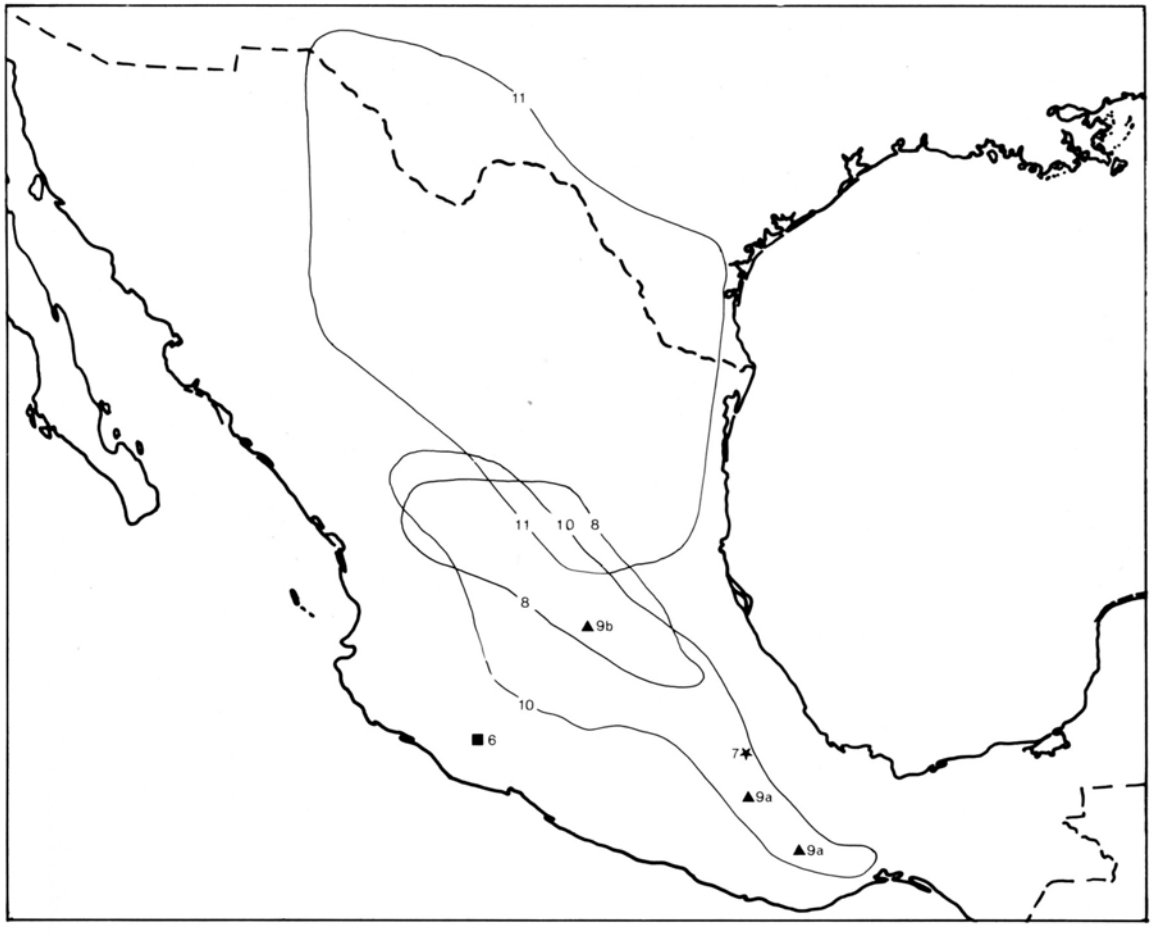
Stem globose to cylindrical, 30-120 × 26-36 cm, green, or glaucous when young; ribs 13-27; areoles confluent at maturity; rad.sp. 6(-7), 2.5-3.5 cm; cent.sp. 4, 4-8 cm, blood-red like the radials. Fl. 6-7 × 5.8-6.8 cm, purplish-pink; style whitish-yellow with 9-10 intense yellow stigmas. Fr. ovoid, 2.2-3.5 × 1.4-2.7 cm; seed (see Bradleya 1: 15, fig. 29) c. 1.8 mm, black. Range: Esperanza; Barrancas of Acultzingo & Maltrata (Puebla/Veracruz), 2200-2500 m.

Very closely allied to the following but with a larger purplish flower and larger, black seeds. The name is misapplied by Backeberg (1961) to *F. pilosus (F. stainesii* var. *haematacanthus* (Salm-Dyck) Backeb.).

8. **F. histrix** (DC) G. Lindsay in Cact. Succ. J. (US) 27: 171-173, fig. 159 (upper left and lower right) (1955); Backeb. (1961): Abb. 2595-2597, 2599; Sanchez-Mej. in Cact. Suc. Mex. 10: 66, 72, figs. 36, 37, 42C & 43C (1965); Hirao (1979): fig. 38; Riha & Subik (1981): 48, fig. 35; Castillo Sanchez in Cact. Suc. Mex. 28: 3-12, fig. 3 (1983); *Echinocactus histrix* DC in Mem. Mus. Hist. Nat. Paris 17: 115 (1829). Type: living material sent to De Candolle in 1828 by *Thomas Coulter* (no. 43), probably from the environs of Zimapan, Hidalgo (cf. McVaugh in J. Wash. Acad. Sci. 33: 65-69. 1943). Lindsay, loc. cit., draws attention to a watercolour illustration annotated as *Echinocactus histrix* by De Candolle; this can serve as lectotype (G). Syn. *F. melocactiformis* Britton & Rose (1922): 138-139; (?) *E. melocactiformis* DC, Prodr. 3: 462 (1828) and loc. cit. supra, t. 10 (1829)—an older name than *E. histrix* but of less certain application, cf. Lindsay, l.c.; *Bisnaga electracantha* Orcutt (1926); (?) *E. electracanthus* Lemaire, Cact. Aliq. Nov. 24 (1838); '*F. electracanthus*' hort.

Stem depressed-globose to short-cylindric, to 110 × 80 cm, but dimensions often less than 60 cm; ribs 20-40 or more; areoles almost confluent; rad.sp. 6-9; cent.sp. 1-4, uppermost

F. schwarzii *(photo: Chapman)*



Map 2. Distribution of *Ferocactus* section *Bisnaga:* F. LATISPINUS GROUP.

2-3 to 3.5 cm, lowermost to 9 cm, porrect and often slightly downcurved. Fl. 2-3.5 × 2.5-3.5 cm, yellow; stigmas 6-16. Fr. 2-3 cm, sometimes bursting at apex and releasing seeds in fluid; seed (see Bradleya 1: 15, fig. 30) to 1 mm, dark brown. Range: south-east Durango, Zacatecas, Aguascalientes, east Jalisco, San Luis Potosi, north Guanajuato, Queretaro and Hidalgo; 1200-2600 m, calcifuge.

A valuable account of this species' ecology is given by Castillo Sanchez, *l.c.* Lindsay (1955b) records *F. histrix* from Esperanza, Puebla (*Purpus* 5358, 5497) but these collections belong to the closely related *F. haematacanthus.*

9. **F. macrodiscus** (C. Martius) Britton & Rose, Cact. 3: 139 (1922); Meyran in Cact. Suc. Mex. 11: 92, fig. 49 (1966); Glass & Foster in Cact. Succ. J. (US) 44: 96, fig. 168 (1972); G. Unger in Kakt. and. Sukk. 29: 65-66, figs. 1, 2 & 5 (1978); Rauh (1979): t. 23.5; Hirao (1979): fig. 33; *Echinocactus macrodiscus* C. Martius in Nov. Act. Nat. Cur. 16: 341, t. 26 (1832); Guerke & Vaupel, Bluehende Kakt. 3: t. 134 (1912). Type: living material sent to Martius between 1828 and 1832 by *Karwinsky,* probably from Oaxaca (cf. McVaugh in Contrib. Univ. Mich. Herb. 14: 141-144. 1980). The original of the Martius illustration (t. 26) can serve as lectotype (M). Syn. *E. macrodiscus* (var.) *multiflorus* R. Meyer in Monatsschr. Kakteenk. 24: 150, with figs. (1914).

9a. var. **macrodiscus**

Stem disc-shaped, to 10 × 30-40 cm, deep seated, sometimes ± level with the ground and hidden, blue-green, with a strong contractile taproot; ribs 13-35; areoles in notches, distinct; rad.sp. 6-8, c. 2-3 cm, mostly recurved; cent.sp. 4, to 3.5 cm, cruciform. Fl. 3-4 × 3-4 cm, perianth-segments purplish-pink with white margins; style red with 10-12 yellow stigmas. Fr. ± globular, to 4 × 3 cm; seed (see Bradleya 1: 14, fig. 28) to 2 mm, dark brown. Range: north & central Oaxaca, in open pine/oak woodland in grass, 1700-2500 m.

9b. var. (unnamed, Guanajuato); Lindsay (1955b): 107, 109; Meyran, loc. cit., 91, fig. 48 (1966); Glass & Foster, loc. cit., fig. 169 (1972), ibid. 54: 116, fig. 2 (1982); G. Unger, loc. cit., figs. 3 & 4 (1978); Hirao (1979): fig. 32. Differs from var. *macrodiscus:*

Ribs fewer and more pronounced; areoles widely spaced; spines very stout, not recurved. [Fl. (see Glass & Foster, l.c. 1982), fruit and seed very similar to the above.] Range: Guanajuato, nr San Miguel de Allende and between San Luis de la Paz and Xichu; (?) Queretaro (*fide* Weber in Bois, Dict. hort. 1: 467. 1896); (?) San Luis Potosi (*fide* Schumann, Gesamtb. Kakt. 349. 1898).

This disjunct variety warrants formal recognition. Contrary to popular belief it seems reasonably certain that the type of this species originated from southern Mexico (probably Oaxaca) and not from San Luis Potosi (where its presence is yet to be confirmed). It is possible that the oft-quoted, early records from SLP are the result of confusion with *F. histrix.*

F. macrodiscus is a plant of specialized habit, its northern variety bearing a strong superficial resemblance to *Echinocactus (Homalocephala) texensis.* They are not closely related, however: the seeds and flowers differ considerably, though it

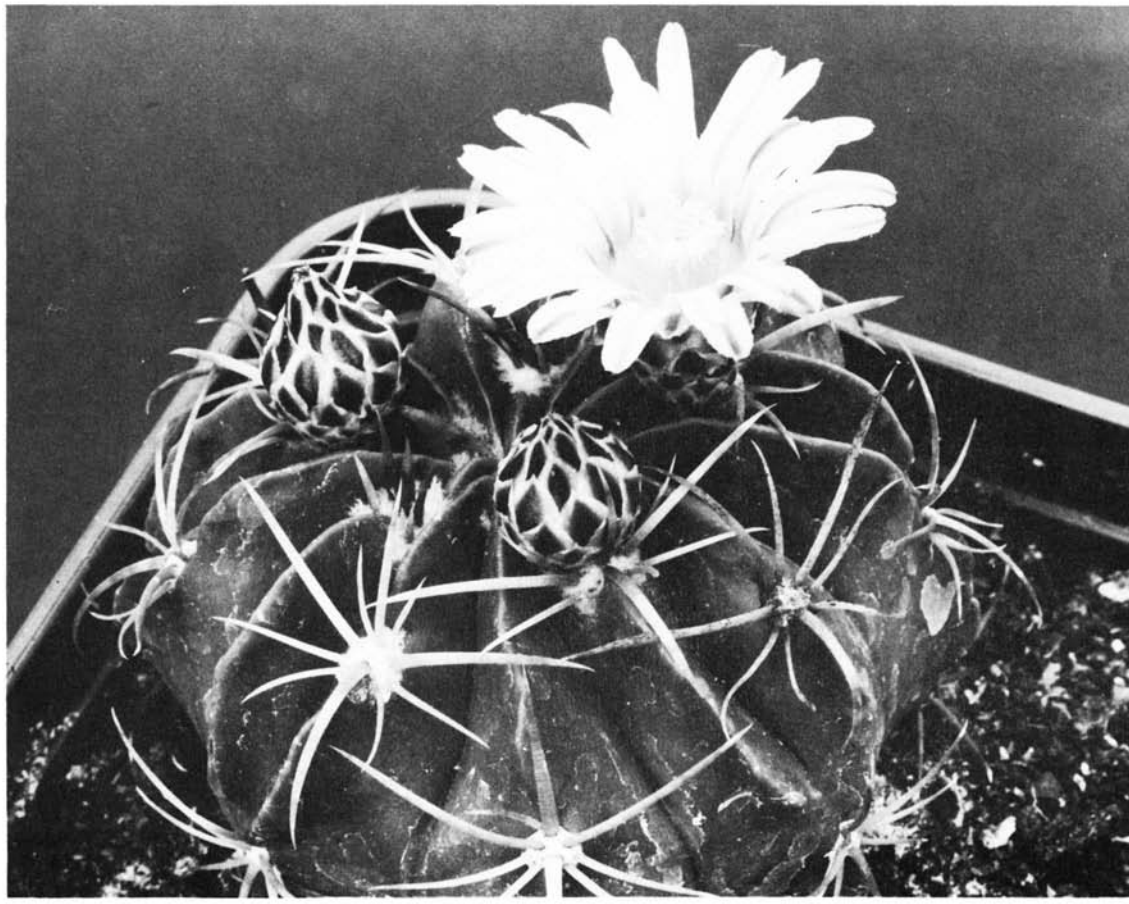
remains to be seen whether *E. texensis* is congeneric (it has a *Bisnaga*-like fruit). Young plants of *F. macrodiscus* and *F. latispinus* resemble one another, but the flower morphology of the latter distinguishes it immediately.

10. **F. latispinus** (Haw.) Britton & Rose, Cact. 3: 143 (excl. tt. 13.2 & 16.3) (1922); Borg, Cacti, t. 34a (1937); H. Bravo-H., Cact. de Mex. fig. 226 (1937); C. Glass in Cact. Succ. J. (US) 40: 161, fig. 5 (below) (1968); Rauh (1979): t. 4.5 & farbt. 4.7; Hirao (1979): figs. 34 & 34-1; Riha & Subik (1981): 50, figs. 37 & 38; Kraehenbuehl in Kakt. and. Sukk. 34: 162-163 (1983); Cullmann et al., Kakteen, 175 (1984); *Cactus latispinus* Haw. in Phil. Mag. 63: 41 (1824). Based on a plant brought to England from Mexico by a Mr Bullock (apparently not preserved). Neotype (Lindsay, 1955b): San Luis Potosi, 13.6 km east of city of San Luis Potosi, *Lindsay* 2583 (DS). Syn. *Echinocactus cornigerus* DC, Prodr. 3: 461 (1828), in Mem. Mus. Hist. Nat. Paris 17: 36, t. 7 (1829) and Coll. mem. 8: t. 10 (1834); *Bisnaga cornigera* (DC) Orcutt (1926).

10a. var. **latispinus**
Stem depressed-globose or flattened, to 30 × 40 cm; at maturity ribs c. 21; rad.sp. 9-15, varying from dark and stout, to fine, acicular, white; cent.sp. 4, the 3 uppermost ascending, to 4 cm, straight, flattened, the lowermost usually descending, to 5 cm and 0.9 cm wide, curved to hooked at apex, strongly annulate. Fl. (in summer) c. 4 × 4 cm, purplish-pink or yellow, scales of receptacle-tube narrowed to an attenuate apex, to 1 cm; stigmas c. 16, yellow. Fr. ovoid, to 2.5 × 1.8 cm; seed (see Bradleya 1: 15, fig. 31) c. 1.5 mm, dark brown. Range: south-east Durango, Zacatecas, Aguascalientes, west San Luis Potosi, east Jalisco, Guanajuato, Queretaro, Hidalgo, State of Mexico & Puebla; Michoacan (*fide* D. Gold in Cact. Suc. Mex. 14: 5-6. 1969); grassy plains and rocky hillsides at ±2000 m.

10b. var. **spiralis** (Karw. ex Pfeiffer) N. P. Taylor **comb. nov.**: *Echinocactus spiralis* Karw. ex Pfeiffer, Enum. Cact. 60 (1837) and in Nov. Act. Nat. Cur. 19(1): t. 16, fig. 4 (1839); *E. recurvus* var. *spiralis* (Karw. ex Pfeiffer) Schumann, Gesamtb. Kakt. 348 (1898). Type: seedlings raised in Germany from seeds collected in south Mexico by *Karwinsky* in 1828. Neotype: Pfeiffer, loc. cit., t. 16, fig. 4 (1839). Syn. (?) *Cactus recurvus* P. Miller, Gard. dict. ed.8 (1768) (*C. nobilis* L, Mant. Pl. 243. 1771; *F. nobilis* Britton & Rose 1922); *F. recurvus* Borg, Cacti, 231 (1937); G. Lindsay (1955a): 173, fig. 160; C. Glass, loc.cit. fig. 5 (centre) (1968); Rauh (1979): t. 79.4; Hirao (1979): fig. 35; *F. latispinus* sensu Britton & Rose (1922): quoad tt. 13.2 & 16.3; et sensu Backeb. (1961) quoad Abb. 2583; non *Cactus latispinus* Haw. The name *Cactus recurvus* P. Miller is abandoned here for lack of typification. No type material appears to be extant and the brief original description could apply equally well to var. *latispinus*. Arbitrary neotypification of *C. recurvus*, so as to maintain the usage established by Lindsay, loc.cit., has been considered, but the present solution has the greater merit of preserving the more familiar name *F. latispinus* for the species as a whole. Differs from var. *latispinus:*

Stem globose to short-cylindric, to 40(-100) × 35 cm; ribs 13-16, often spiralled; rad.sp. 5-7, uniformly stout; lowermost



F. macrodiscus var. *macrodiscus* *(photo: Weightman)*

cent.sp. to 6 cm and 0.7 cm wide. Fl. (in winter) to 5 × 2.5 cm, perianth-segments whitish with pink to purplish midstripes or bases. Fr. cylindric, 5-8 × 2 cm; seed c. 1.25 mm. Range: south Puebla to south Oaxaca, 1640-2440 m.

Intergrades with var. *latispinus* in Puebla (Lindsay, 1955b) and replaces it further south.

10c. var. **greenwoodii** (C. Glass) N. P. Taylor **comb nov.**: *Ferocactus recurvus* var. *greenwoodii* C. Glass in Cact. Succ. J. (US) 40: 160, figs. 1-4, 5 (upper) (1968); Hirao (1979): fig. 36. Type: Oaxaca, Nejapa Valley, Highway 190, Km 637, Oct. 1967, *C. Glass* 817-3 (POM). Like var. *spiralis* but differing:

Stem subglobose, to 10 × 16 cm; spines terete, of ± equal thickness. Fl. (in October) to 6 × 3 cm, yellow. Fr. globose, to 2.5 × 2.5 cm. Range: south-east Oaxaca, between Tehuantepec and Oaxaca city on limestone.

The densely imbricate and very narrow scales on the receptacle-tube of *F. latispinus* immediately distinguish it from other species in the F. LATISPINUS GROUP and suggest that it is somewhat isolated.

11. **F. hamatacanthus** (Muehlenpf.) Britton & Rose, Cact. 3: 144, t. 16.1 (1922); Hirao (1979): fig. 51; L. Benson (1982): 706, 708 (map), 950, figs. 746 & 747, colour pl. 124; *Echinocactus hamatacanthus* Muehlenpf. ('hamatocanthus') in Allg. Gartenz. 14: 371 (1846); Weniger, Cacti of the Southwest, 84, t. 23 (1970); *Bisnaga hamatacantha* (Muehlenpf.) Orcutt (1926); *Hamatocactus hamatacanthus* (Muehlenpf.) F. Knuth (1935); Backeb. (1961): Abb. 2606 & 2607; type of *Ferocactus* subg. *Hamatacanthus* H. Bravo-H. in Cact. Suc. Mex. 21: 66 (1976). Type: a living plant, ex Mexico, in the collection of Fennel at Cassel. Neotype: Coahuila, Saltillo, 1880, *Palmer* 374(K). Syn. *Echinocactus longihamatus* Galeotti in Pfeiffer, Abbild. Beschr. Cact. 2: t. 16 (1848); Engelm. (1859): 22, tt. 21-24; *F. hamatacanthus* var. *crassispinus* (Engelm.) L. Benson (1974); *E. longihamatus* var. *crassispinus* Engelm. (1856); *Brittonia davisii* C. A. Armstrong in Cact. J. (GB)2: 64 (1934).

11a. var. **hamatacanthus**

Stem solitary, rarely caespitose, hemispheric to cylindric, to 60 × 30 cm; ribs 12-17, rounded, strongly tuberculate; rad.sp. 8-20, 1.5-4(-8) cm; cent.sp. 4-8, to 8 cm, terete or somewhat flattened, recurved to hooked at apex, rather stiff, sometimes twisted. Fl. funnel-shaped with a pronounced tube, 6-10 × 6.5-7.5 cm, yellow, often red in the throat; stigmas 11-14, yellow. Fr. ovoid to oblong, to 5 × 2.5 cm, pinkish-red; seed (see Bradleya 1: 15, fig. 32) to 1.6 mm, black. Range: south-east New Mexico, west & south Texas & cent. north Mexico (west side of Sierra Madre Oriental to north(?) and south Chihuahua & east Durango, south to San Luis Potosi); chiefly in the Chihuahuan Desert, 10-1500 m.

11b. var. **sinuatus** (A. Dietr.) L. Benson in Cact. Succ. J. (US) 41: 128 (1969); *Echinocactus sinuatus* A. Dietr. in Allg. Gartenz. 19: 345 (1851); Weniger, l.c. 82-83, t. 23 (1970); *Hamatocactus sinuatus* (A. Dietr.) Orcutt (1926); G. Unger in Kakt. and. Sukk. 31: 289-291, with figs. (1981). Type: cultivated plants collected in Texas by *Poselger* (apparently none preserved). Neotype (Benson, loc. cit.): 'Western Texas, probably on the Pecos or San Pedro', 1852, *C. Wright* (MO). Differs from the above:

Stem to 30 × 20 cm (but mature when much smaller); ribs c. 13, narrow, more acute, well-defined; rad.sp. 8-12, at least some markedly flattened; cent.sp. 4, lowermost strongly flattened and ± flexuous. Fl. entirely yellow; stigmas 8-10. Fr. to 2.5 cm, sometimes globose, dark greenish to dark brownish-red; seed c. 1 mm. Range: south-east Texas (east of Devil's River) and north-east Mexico, east side of Sierra Madre Oriental in Tamaulipas and Nuevo Leon; brushlands, mostly at low elevations. Other illustrations: Britton & Rose (1922): fig. 152; Hirao (1979): fig. 50; Rauh (1979): t. 81.5 (as '*Hamatocactus setispinus*').

A rather distinctive variety, but intergrading with the above.

This species is sometimes confused with *F. setispinus* (Engelm.) L. Benson (subg. *Ancistrocactus*), but has pitted seeds (placing it in subg. *Ferocactus*) and a larger, juicy or deliquescent fruit. Amongst the species of sect. *Bisnaga* it has the most northerly distribution, and will flower when very young. It seems to be the most highly derived in its characters and is perhaps a product of neoteny, the mature stems having the rounded, tuberculate ribs characteristic of the seedling phase in other species.

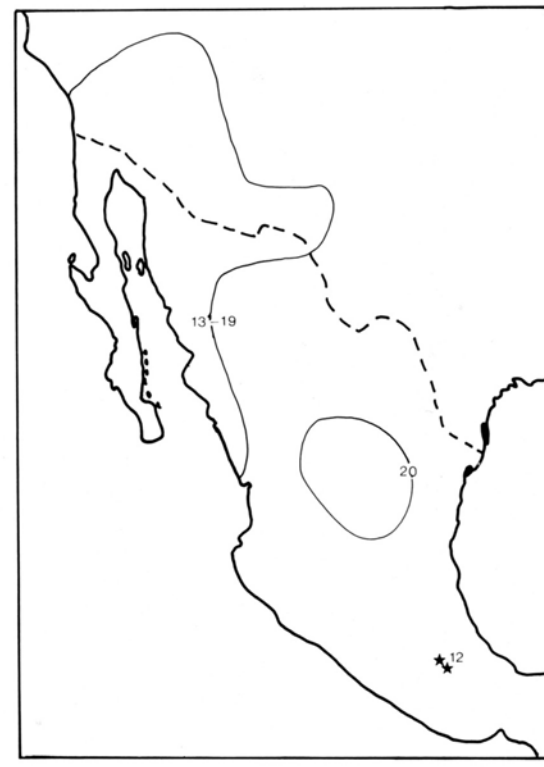
Section **Ferocactus**

Seeds with a broad hilum-micropylar rim, dull, less often shiny. Fruit wall fleshy at maturity, yellow (or tinged with red, or pinkish-crimson, in nos. 14, 15, 18 and 21), *interior becoming dry, dehiscent via a basal pore* formed as the ripe fruit becomes detached from the plant.

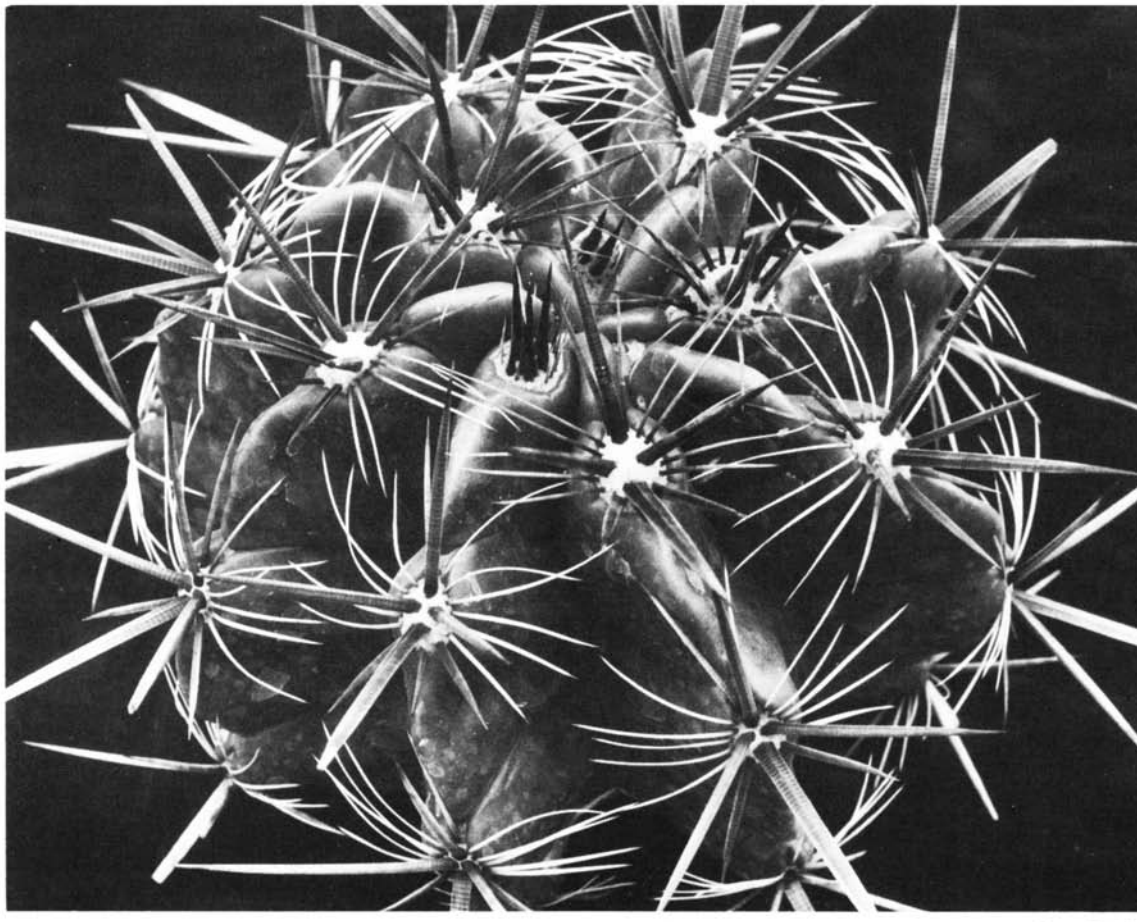
F. ROBUSTUS GROUP (Taylor & Clark, 1983) (Nos. 12-20)

Spines many (>10) per areole and varying between (or well differentiated into) very fine and rather stout. Seeds with slightly to prominently raised testa-cell margins or with shallowly concave testa-cells.

12. **F. robustus** (Pfeiffer) Britton & Rose, Cact. 3: 135, fig. 143 (1922); Krainz, Die Kakteen, Lfg 30, with figs. (1965); Rauh (1979): t. 79.7; Hirao (1979): figs. 48 & 48-1; Kraehenbuehl in Kakt. and. Sukk. 33: 170-171, with figs (1982); *Echinocactus robustus* Pfeiffer, Enum. Cact. 61 (1837) and in Nov. Act. Nat. Cur. 19(1): t. 16, fig. 3 (1839); '*E. robustus*' Otto in Allg. Gartenz. 1: 364 (1833), nom. nud. Type: Puebla ('Oaxaca'), Tehuacan, 1828, *Karwinsky* (fruit & seeds only; probably not preserved). Neotype (Lindsay, 1955b): nr Tehuacan, Zapotitlan de Salinas, 1951, *Lindsay* 2058 (DS).



Map 3. Distribution of *Ferocactus* section *Ferocactus:* F. ROBUSTUS GROUP.



F. robustus (see also page 21) *(photo: Tribble)*

Stem caespitose, forming large hemispherical clusters to 1 × 5 m; ribs c. 8, acute, with widely spaced areoles; rad.sp. 10-14; cent.sp. 4-7, to 6 cm, much stouter, straight or somewhat curved, angled or flattened. Fl. 3-4 × 3-4 cm, yellow; stigmas 10, red. Fr. 2-3 × 2 cm (yellow); seed (see Bradleya 1: 8, fig. 1) 1.5 mm, periclinal walls of testa-cells verrucose. Range: south-east Puebla, mostly level ground, on limestone.

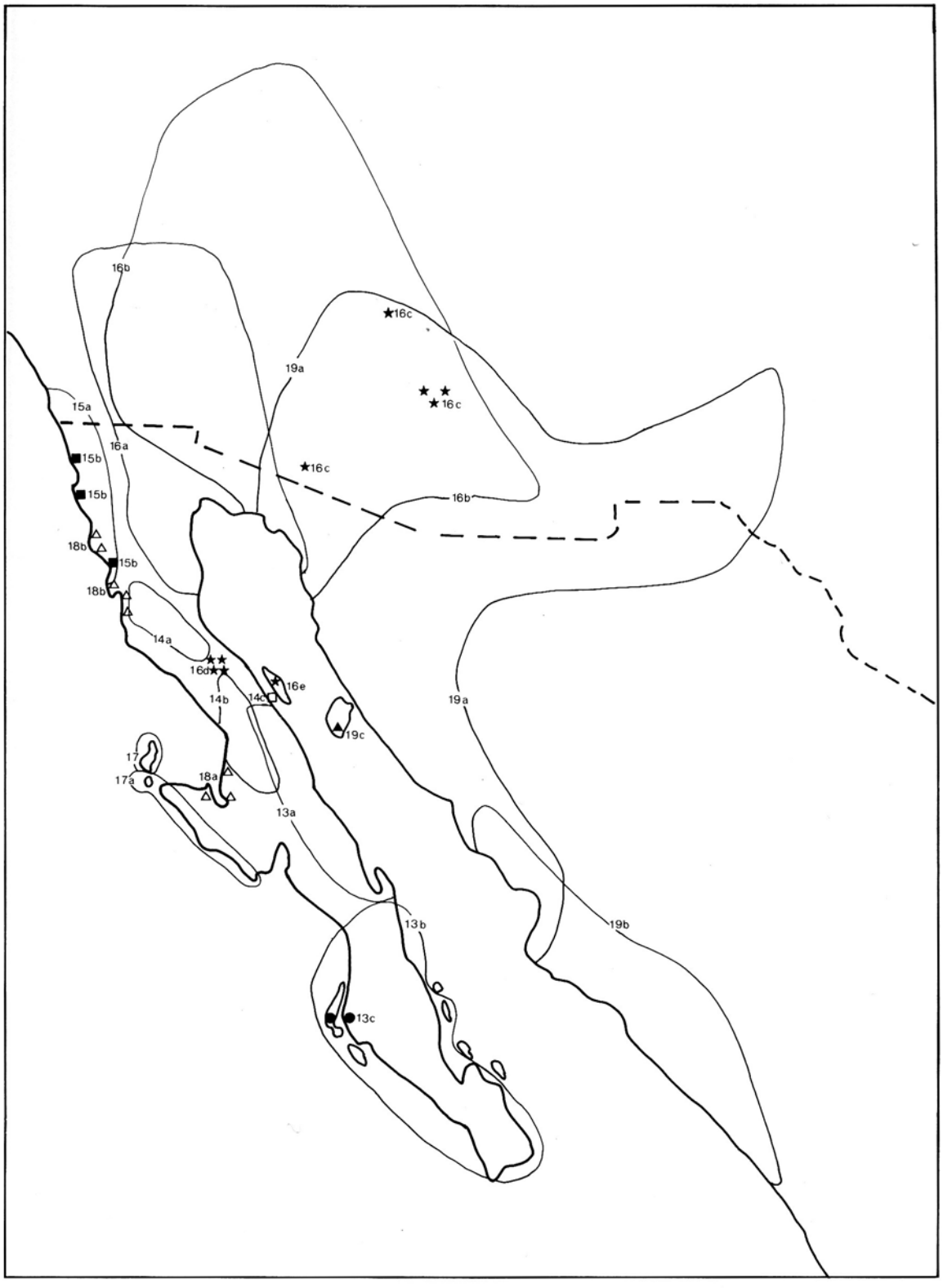
Now isolated from its allies in Baja California and at first sight with little or no obvious morphological connexion, *F. robustus* must nevertheless belong with them when characters of its seed and fruit are considered. It seems to be an unspecialized survivor from earlier times, before sect. *Ferocactus* exploded into north-west Mexico. Its few-ribbed, highly branched stems have a cereoid character and point, perhaps, to the origin of the genus. It is especially interesting that the apparently least specialized member of sect. *Bisnaga (F. flavovirens)* is restricted to much the same small area in south Mexico as *F. robustus*, and that this region should also be the home of various of the least derived Pachycereeae (see Gibson & Horak, Ann. Missouri Bot. Gard. 65: 1050. 1978).

13. **F. peninsulae** (F. A. C. Weber) Britton & Rose, Cact. 3: 133, fig. 140 (1922); Cact. Succ. J. Gr. Brit. 41: 112 (colour plate) (1979); *Echinocactus peninsulae* F. A. C. Weber in Bull. Mus. Hist. Nat. Paris 1: 320 (1895), ibid. 4: 101 (tab.), 102-103 (1898); Engelm. in J. Coulter, Contrib. US. Nat. Herb. 3: 361 (1896). Based on plants observed and photographed at c. 27°N in east Baja California by *L. Diguet* in 1894 (apparently no plant material was preserved).

The following is cited as 'type' in Engelmann's account (Coulter, l.c.): 'Lower California' [vicinity of Mulege], 1867, *W. M. Gabb* 11 (MO). Weber and Engelmann (who died in 1884) corresponded concerning this species, but it is not known whether Weber examined Gabb's material prior to publishing *E. peninsulae.* If he did, then Gabb's collection can be taken as the lectotype; if not, then it should be regarded as the neotype. Syn. *F. horridus* Britton & Rose, Cact. 3: 128 (1922)—a form with long cent.sp.

13a. var. **peninsulae**
Stem solitary unless damaged, clavate, ovoid or tapering towards apex from near base, to 2.5 m × 50 cm, but often not exceeding 70 cm in height, dark blue-green; ribs 12-20, acute, sinuses deep; slender, whitish rad.sp. 6-13; stouter, darker cent. & lower rad. sp. 7-9, 1 central flattened, downwardly directed, hooked at apex, to c. 7(-15) cm (longest in young plants), remainder ± terete and straight. Fl. (summer-autumn) 5-6 cm, perianth-segments yellow with broad orange to red midstripes; stigmas c. 16-20. Fr. ± globular, to 3.5 cm; seed (see Bradleya 1: 8, fig. 3) c. 2 mm, dark brown to black, periclinal walls of testa-cells verrucose. Range: central & east Baja California, from Bahia de los Angeles and west of San Borja, south to Bahia Concepcion (and perhaps further); usually in rocky places; Viscaino & Central Gulf Coast Deserts.

13b. var. **townsendianus** (Britton & Rose) N. P. Taylor **stat. nov.**: *Ferocactus townsendianus* Britton & Rose, Cact. 3: 127, fig. 133 (1922). Type: Baja California Sur (east coast), Isla San



Map 4. Distribution of *Ferocactus* section *Ferocactus:* F. ROBUSTUS GROUP, omitting *F. robustus* and *F. pilosus* (see Map 3).

Jose, 15 March 1911, *Rose* 16570 (US). Differs from var. *peninsulae:*

Stem smaller, very rarely to 1 m, globose, conical or occasionally cylindric, very variable in shape and size; ribs c. 13-16; spination similar but more variable, the slender, whitish rad.sp. 0-16; centrals sometimes straight or cent. & lower rad.sp. reduced to only 5. Fr. c. 2.5 × 2 cm; seed (see Bradleya 1: 8, fig. 2) 1.2-2 mm. Range: south Baja California, from Cabo San Lucas to c. 26°N, Isla San Jose; Islas Santa Margarita & Magdalena (*fide* Lindsay, 1955b).

This variety appears to replace var. *peninsulae* in south Baja. The distinction between them is primarily one of size, especially in respect of the stems, spines and fruits. However, the situation is complicated in the region where the change from one to the other occurs (south of Mulege to south of San Javier) due to the presence of *F. emoryi* var. *rectispinus*, which hybridizes with both, producing all manner of intermediates. It appears that certain of these (which superficially resemble var. *peninsulae*, but are probably hybrids of var. *townsendianus* and *F. emoryi*) may have wrongly given the impression that var. *peninsulae* ranges south into the Sierra de la Giganta and yet remains distinct from var. *townsendianus* there. In this region it is, in fact, not easy to locate specimens of either taxon that can definitely be said to be free of the introgressive influence of *F. emoryi* var. *rectispinus*. The northernmost locality where seemingly pure var. *townsendianus* was encountered by the author in 1983, is in mountains to the south-west of San Javier (*N. P. Taylor* 59). On the west coast Lindsay (1955b) records it further north, at San Gregorio. Reasonably typical var. *peninsulae* is common at about 27°N on the east coast, but the identity of some plants found further south, e.g. in the arroyo behind Playa Santispac, Bahia Concepcion (*N. P. Taylor* 84), is less certain. These seem rather small for var. *peninsulae* and may be closer to var. *townsendianus*.

In the south-west of the Cape region, at the southern tip of Baja, var. *townsendianus* (the only *Ferocactus* in this region) shows considerable variability. In particular spination and seed size seem to be rather plastic, and deserve further investigation. The seeds are remarkably like those of *F. robustus* from Puebla.

13c. var. **santa-maria** (Britton & Rose) N. P. Taylor **comb. nov.**: *Ferocactus santa-maria* Britton & Rose, Cact. 3: 131 (1922); *F. townsendianus* var. *santa-maria* (Britton & Rose) G. Lindsay in Cact. Succ. J. (US) 27: 170-171, fig. 158 (1955). Type: Baja California Sur (west coast), Isla Magdalena, Bahia Santa Maria, 18 May 1913, *Rose* 16279 (US). Differs from var. *townsendianus:*

Stems commonly globose; ribs thick, sometimes conspicuously tuberculate; areoles and spines often much larger, centrals to 11 cm and/or much stouter. Fl. (in spring) yellow or orange. Fr. to 5 × 4 cm; seed (see Bradleya 1: 16, fig. 36) 2 mm, proportionately broader, the periclinal testa-cell walls nearly isodiametric. Range: south-west Baja California, west edge of Llano de la Magdalena near San Carlos (*N. P. Taylor* 64) and on Isla Magdalena.

This taxon seems distinct for its larger fruits and seeds. It flowers in spring, before var. *townsendianus*, and is often represented by smaller individuals, while its areoles and spines seem disproportionately large. It is one of a number of cactus taxa endemic to the western edge of the Magdalena region of south-west Baja California.

A further taxon has been treated as a variety of this species by Lindsay (1955a), viz. *F. viscainensis* H. Gates. This plant is considered under the next species.

As noted by Lindsay (1955b), *F. peninsulae* bears a strong resemblance to *F. wislizeni*, especially the form from across the Gulf of California, in Sonora and Sinaloa, formerly known as *F. herrerae*. However, examination of their seeds (see Bradleya 1: 8-9) suggests that they are no more closely related than are the other taxa treated here.

14. **F. gracilis** H. Gates in Cact. Succ. J. (US) 4: 323-324, with fig. (1933); Lindsay (1965): fig. 61. Type: Baja California Norte, hills west of Misión San Fernando, 25 July 1932, *H. E. Gates* 22 (DS).

14a. var. **gracilis**

Stem solitary unless damaged, to 3 m × 30 cm, globose then clavate-cylindric, more rarely tapering towards apex; ribs c. 16-24, somewhat tuberculate; slender whitish rad.sp. c. 8-12; stouter upper and lower rad.sp. and cent.sp. c. 9-12, red with yellow tips, the largest to 7 cm, flattened, downwardly directed and ± curved at apex, one upwardly directed central also flattened. Fl. (in summer) 4 × 3.5 cm, red; stigmas 9-14. Fr. oblong-cylindric, 2.5-4 cm, yellow, sometimes tinged reddish; seed (see Bradleya 1: 10, 16, figs. 9, 33 & 34) 1.75-2.25 mm, black, testa-cell periclinal walls concave, not verrucose. Range: cent.-north Baja California, from the Sierra San Miguel (Arroyo Socorro) to the vicinity of Jaraguay (south of Catavina); Viscaino Desert on granite-based substrate.

14b. var. **coloratus** (H. Gates) G. Lindsay in Cact. Succ. J. (US) 27: 169 (1955); *F. coloratus* H. Gates in ibid. 4: 344, with fig. (1933). Type: Baja California Norte, 'south-west of Aguaje San Andreas', 28°50′N, 114°10′W, *H. E. Gates* 160 (DS 207823). Syn. *F. viscainensis* H. Gates, loc. cit. 324-325, with figs. (1933); *F. peninsulae* var. *viscainensis* (H. Gates) G. Lindsay, loc. cit. 169-170, fig. 157 (1955), and in Cact. Suc. Mex. 10(4): fig. 56 (1965). Type: B.C.N., Mesquital, 22 July 1932, *H. E. Gates* 43 (DS 207824). Differs from the above:

Stem to 2 m, generally stouter; spination very variable, but often exposing more of the stem; rad.sp. ranging from twisted and hairlike to stiffly acicular, often fewer, sometimes 0; cent.sp. very broad or narrow, lowermost slightly to rather strongly curved at apex (grey in the coastal population at Miller's Landing), sometimes cent.sp. reduced to 5 or 3. Fl. (in spring) 5 cm, red or perianth-segments with yellow margins. Range: south Baja California Norte, from c. El Crucero (south of Laguna Chapala) to vicinity of El Arco (28°N), west to the coast at Miller's Landing; Viscaino Desert in sand or on granite.

This variety is very variable, probably through gene exchange with *F. peninsulae*, with which it grows in the central part of the peninsula, e.g. between Rosarito and San Borja, and between Pozo Aleman and Rancho La Union. Their flowering periods appear to differ: var. *coloratus* flowers in spring (April to June), *F. peninsulae* in late summer, though some overlap is to be expected. Lindsay's referal of *F. viscainensis* to *F. peninsulae*, largely on account of similarities in their spination, ignores its closer relationship with *F. gracilis*, especially in its fruit and seeds. The extreme in the west, represented by Gates's *F. coloratus*, can be linked through various intermediates to extreme '*viscainensis*' specimens, which predominate further east, and in the south near the 28th parallel. Var. *coloratus* flowers earlier than var. *gracilis* and appears to be isolated from the latter, at least in the centre of the peninsula, due to the occurrence of *F. cylindraceus* var. *tortulispinus*, which completely replaces *F. gracilis* in the Laguna Chapala Seca region.

To be considered here:

14c. **F. gatesii** G. Lindsay in Cact. Succ. J. (US) 27: 150-151, figs. 146 & 147 (1955). Type: B.C.N., island in the Isla Smith group, north side of Bahia de los Angeles, 28° 59½′N, 113°32½′W, 10 May 1952, *R. Moran* 4103 (DS). Differs from the above:

Stem to 1.5 m; ribs 30-32. Fl. to 6 cm. Fr. to 7.5 cm; seed (see Bradleya 1: 8, fig. 4) to 2.5 mm. Range: islands in Los Angeles Bay (east-cent. Baja California).

Probably only a disjunct variety of *F. gracilis*. The seeds scarcely differ from those in certain populations of var. *gracilis*.

15. **F. viridescens** (Torrey & A. Gray) Britton & Rose, Cact. 3: 140, t. 14.1 & fig. 148 (1922); Lindsay (1965): fig. 50; Hirao (1979): fig. 19; L. Benson (1982): 703-705, figs. 742-745; *Echinocactus viridescens* Torrey & A. Gray, Fl. N. Amer. 1: 554 (1840). Type: USA, California, arid hills nr. San Diego, 1835,

Nuttall (BM). Syn. *E. orcuttii* Engelm. apud Orcutt in West Amer. Sci. 2:46 (1886); *F. orcuttii* (Engelm.) Britton & Rose (1922): 134-135. Type: Baja California Norte, Valle de las Palmas, 1883, *Orcutt* (MO). Syn. (?) *E. californicus* Labouret, Monogr. Cact. 199 (1853)—a poorly typified name.

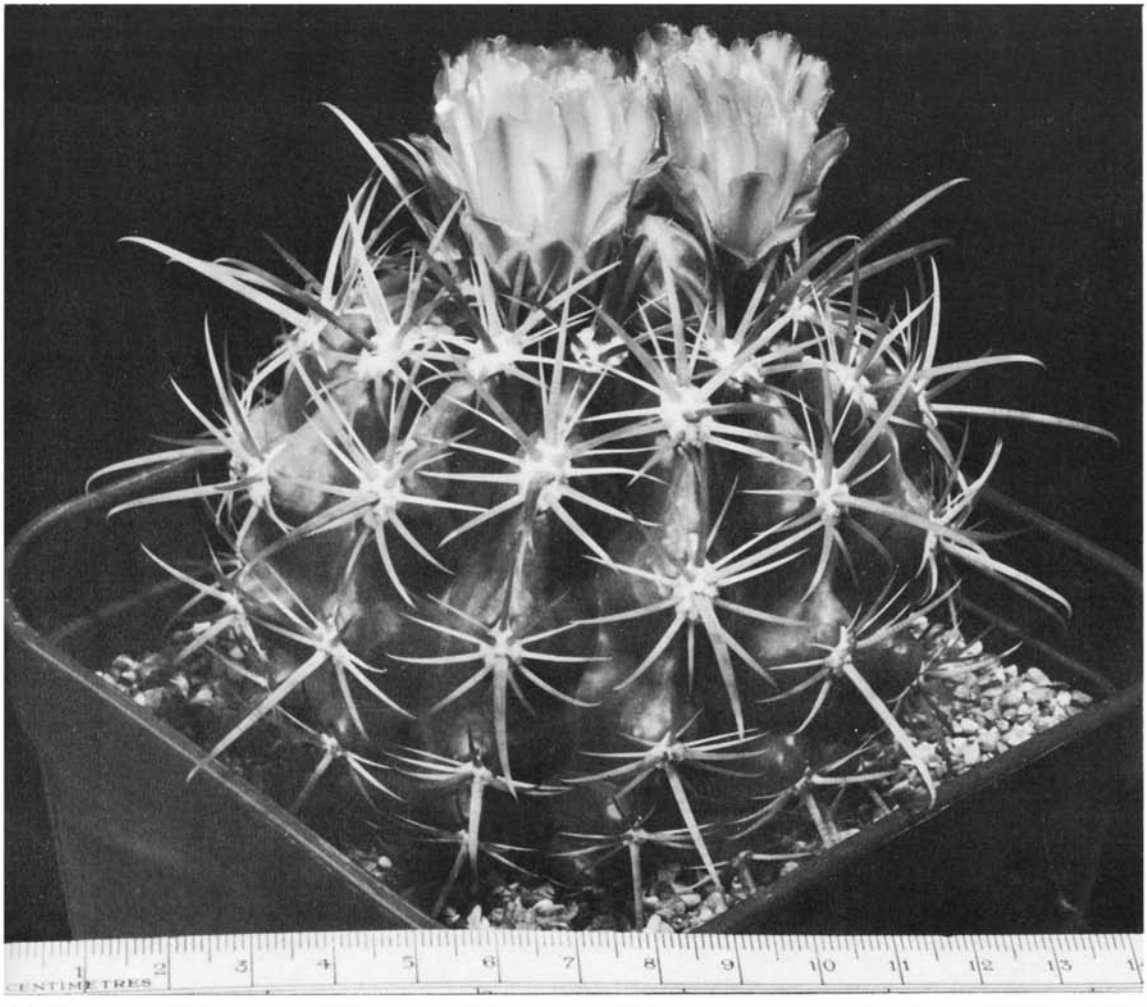
15a. var. **viridescens**

Stem solitary or occasionally caespitose, commonly to 30 × 30 cm, but in certain inland populations to 1.3 m × 40 cm, depressed globose to cylindric; ribs 13-25(-30), obtuse and somewhat tuberculate; rad.sp. to c. 19, some slender and bristle-like, others stouter and intergrading with the centrals; cent.sp. 4-9, somewhat curved but not hooked, the largest upper and lower spines flattened (as in *F. gracilis*), to 5 mm wide, grey, yellowish or reddish. Fl. (in spring) to 5 × 6 cm, greenish, perianth-segments sometimes with a darker, reddish midstripe; style yellow; stigmas c. 15. Fr. to 3.5 × 2.5 cm, yellow when ripe; seed (see Bradleya 1: 11, fig. 16) 1.5 mm, black. Range: south-west California (USA) near San Diego, and north-west Baja California, to the vicinity of San Quintin; rocky hillsides near the coast and in Chaparral inland; 10-400 m.

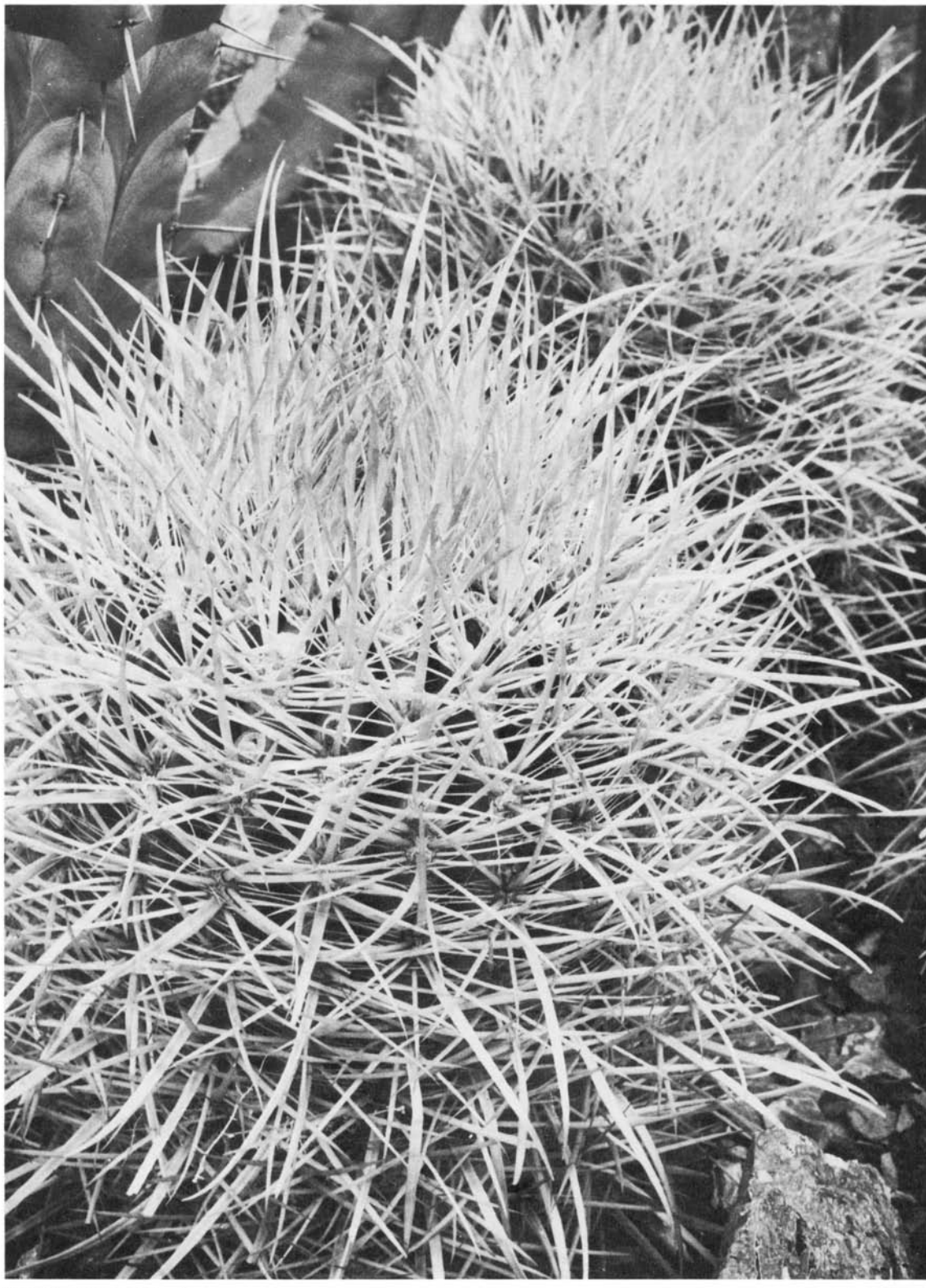
15b. var. **littoralis** G. Lindsay in Cact. Succ. J. (US) 36: 8-10, with figs. (1964); Hirao (1979): fig. 20. Type: Baja California Norte, sea coast bluffs at Puerto Santo Tomas, 31°33'N, 116°41'W, 15 May 1960, *R. Moran* 8277 (SD). Differs from the above:

Stem to 30 × 18 cm; ribs 21-34, rather narrow; spines to 33 per areole, very densely arranged, not flattened. Fl. 3 × 2.5 cm, perianth-segments more numerous; style red. Fr. globular, c. 1.5 cm diam., sometimes red. Range: coastal bluffs between Punta Salsipuedes and Misión Santo Domingo (west coast of Baja Norte).

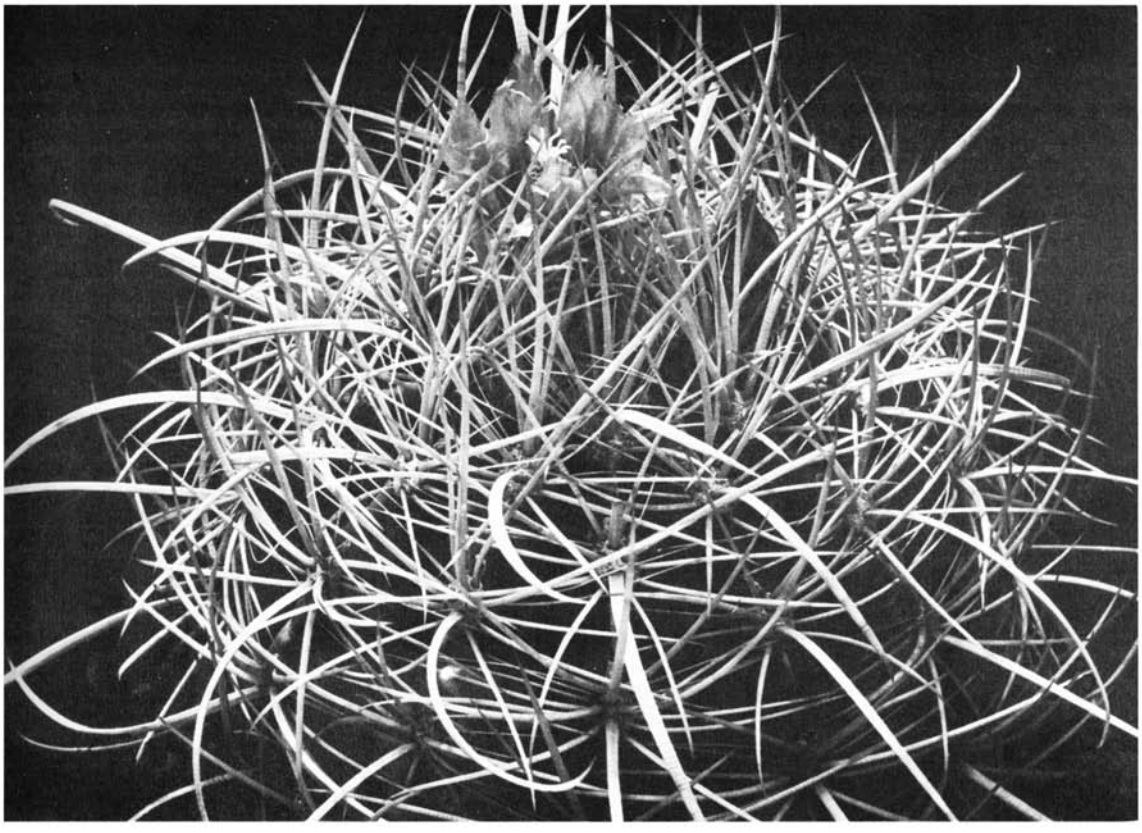
This species is closely related to *F. gracilis* var. *gracilis*, which it replaces north of the Viscaino Desert, in the winter rainfall zone of north-west Baja. Though it is normally thought of as a low-growing plant, *F. viridescens* can become cylindrical and has been recorded reaching a height of 1.3 m. Large forms are found away from the coast, in valleys draining the west side of the Sierra Juarez. In two of these (Rio San Carlos & Rio Santo Tomas) Lindsay (1955b) records that the cylindrical plants resemble *F. cylindraceus ('F acanthodes')*. This is an interesting observation since there can be little doubt that these two are closely related, differing primarily in quantitative characters.



F. viridescens var. *viridescens* *(photo: Zabeau)*



F. viridescens var. *littoralis* *(photo: Broogh)*



F. cylindraceus *(photo: Broogh)*

16. **F. cylindraceus** (Engelm.) Orcutt, Cactography, 5 (1926); *Echinocactus viridescens* (var.) *cylindraceus* Engelm. in Amer. J. Sci. ser. 2, 14: 338 (1852); *E. cylindraceus* (Engelm.) Engelm., Syn. cact. US. 19 (1856) and Cact. Mex. Bound. t. 30 (1859). **Type**: USA, California, San Diego Co., San Felipe, c. 33°N, 1849/1850, *Parry* (MO). Syn. *F. rostii* Britton & Rose (1922): 146-147, fig. 153b; *F. acanthodes* sensu Britton & Rose (1922): 129-131, t. 15, figs. 134-137, et auctt. mult.; L. Benson (1982): 686-687, figs. 719-722, colour pl. 118; (?) non *Echinocactus acanthodes* Lemaire, Cact. Gen. Nov. Sp. 106 (1839)—see Taylor (1979): 91-92.

16a. var. **cylindraceus**
Stem solitary, rarely branching or only when damaged, eventually cylindric or somewhat barrel-shaped, to 3 m × 40(-50) cm; ribs 18-30, tuberculate; spination extremely variable in size, colour and form; rad.sp. c. 15-25, from fine, hairlike to stout and intergrading with centrals; cent.sp. 4-7, terete or 2 or more flattened, straight, curved or twisted, the lowermost largest, to 17 cm, often curved, sometimes hooked at apex. Fl. (in spring) 3-6 × 4-6 cm, green, yellow or tinged with red; stamen filaments yellow to pink; stigmas c. 18. Fr. 3-4 × 1.5-2 cm; seeds (see Bradleya 1: 11, fig. 13) 2-3 mm. Range: Mexico, Baja California Norte, east of Sierra Juarez, and north-west Sonora; USA, south California & south-west Arizona; Colorado Desert at 60-600 m.

16b. var. **lecontei** (Engelm.) H. Bravo-H. in Cact. Suc. Mex. 25: 65 (1980); *Echinocactus lecontei* Engelm., Syn. cact. US. 18 (1856) and Cact. Mex. Bound. t. 27 (1859); *F. lecontei* (Engelm.) Britton & Rose (1922); *F. acanthodes* var. *lecontei* (Engelm.) G. Lindsay (1955a); L. Benson (1982): 687-692, figs. 723-725, colour pl. 117 & 120. Lectotype (Benson, l.c. 949): USA, Arizona, Bill Williams Fork of the Colorado River, 1854, *Bigelow* (MO). Differs from the above:

Cent.sp. to only 7 cm, more adpressed, less twisted, never hooked. Seed (see Bradleya 1: 11, fig. 15) to 2 mm. Range: Mexico, north Sonora; USA, south California, south Nevada, south-west Utah & Arizona (except the north-east); Mojavean, Sonoran & Colorado Deserts at 300-1500 m.

16c. var. **eastwoodiae** (L. Benson) N. P. Taylor **comb. nov.**: *F. acanthodes* var. *eastwoodiae* L. Benson, Cacti of Arizona, ed. 3, 26 (1969); Cact. US & Can. 692, figs. 726 & 727, colour pl. 119 & 121 (1982); *F. eastwoodiae* (L. Benson) L. Benson (1982): 969. Type: USA, Arizona, Pinal Co., mts. above Queen Creek, 3200', 20 April 1966, *L. Benson* 16618 (POM 311312). Differs from the above varieties:

Rad.sp. 12-14, uniformly stout; lowermost cent.sp. 7.5-8.1 cm, like the others bright yellow. Range: Arizona in east Yavapai, west Pima, Pinal & Gila Counties; Sonoran Desert at 390-1140 m.

16d. var. **tortulispinus** (H. Gates) H. Bravo-H. ('tortulospinus'), l.c. (1980); *F. tortulospinus* H. Gates in Cact. Succ. J. (US) 4: 343, with fig. (1933); *F. acanthodes* var. *tortulospinus* (H. Gates) G. Lindsay (1955a): 168-169. Type: Mexico, Baja California Norte, 10 miles north of Laguna Chapala Seca, 29°39'N, 114°40'W, 24 July 1932, *H. E. Gates* 161 (DS 207825). Differs from var. *cylindraceus:*

Stem shorter, commonly not exceeding 70 cm but exceptional

specimens to 2 m; spines orange-red (or reddish-grey where the influence of *F. gracilis* occurs). Fl. slightly smaller, clear yellow, scales on receptacle-tube narrower and more pointed. Range: east Baja California Norte, between El Crucero and Cerro Juan, east to Calamajue and Las Arrastras de Arriola; east margin of Viscaino Desert on various rock types.

This disjunct variety is very similar to var. *cylindraceus* and is maintained here more for reasons of geography than morphological difference. It is of greater range than hitherto stated and far more variable than originally supposed. The twisted central spines, given as its distinguishing feature by Gates and Lindsay, are not a constant feature, and it will grow to 2 m tall in favourable sites. It interrupts the range of *F. gracilis* in central Baja and introgression with *F. gracilis* var. *coloratus*, which flowers at the same time (April/May), seems to have occurred where they meet near El Crucero. There, plants with spination exactly like var. *coloratus*, bearing the yellow flowers of var. *tortulispinus*, are not uncommon (e.g. *N. P. Taylor* 103). Further north, near Calamajue, there is a spectacular population in the canyon south of the site of the destroyed misión; thousands of bright orange-spined plants are dotted all over the dark green schist of the canyon walls.

To be considered here is:

16e. **F. johnstonianus** Britton & Rose, Cact. 4: 287 (1923); G. Lindsay (1965): fig. 47; A. Lau in Cact. Succ. J. (US) 53: 221-222, figs. 2-4 (1981). Type: Baja California Norte, wash behind lagoon on east side of Angel de la Guardia Island, 2 May 1921, *I. M. Johnston* 3394 (US). Differs from the above taxa:

Spines 22-25, ± uniform, not differentiated into radials and centrals. Range: east and south-west parts of Isla Angel de la Guardia.

Probably only a disjunct, island variety of *F. cylindraceus*.

F. cylindraceus is closely related to *F. viridescens* and it is doubtful whether there are any absolute differences between them. The larger forms of the latter from inland localities in north-west Baja should be carefully compared with this species.

17. **F. chrysacanthus** (Orcutt) Britton & Rose, Cact. 3: 127 (1922); G. Lindsay (1965): fig. 53; Hirao (1979): figs. 18 & 18-1 (young plants); *Echinocactus chrysacanthus* Orcutt, Rev. Cact. 1: 56 (1899). Type: Baja California Norte, Cedros island, 1894, (?) *L. M. Ford* (not preserved). Neotype (Lindsay, 1955b): Cedros island, arroyo behind village at south-east side of island, *Lindsay* 559 (DS).

Stem solitary, rarely caespitose, to 1 m × 30 cm; ribs c. 21, tuberculate; spines to 22 or more, c. 10 central, curved and twisted, to c. 5 cm, yellow, rarely red, grey at moister higher localities. Fl. (in June) 4.5 × 4 cm, yellow or orange; perianth-segments with red midstripes; stigmas c. 11, pink. Fr. oblong-cylindric, 3 × 1.5 cm, yellow; seed (see Bradleya 1: 10, fig. 11) to 2.5 mm, testa-cell periclinal walls oblong (not isodiametric). Range: Islas Cedros & San Benito; coastal scrub near sea level, to 500 m amongst pines.

To be considered here is:

17a. **F. fordii** var. **grandiflorus** G. Lindsay in Cact. Succ. J. (US) 27: 164-165, fig. 154 (1955). Type: Baja California Sur, west coast, San Bartolome Bay, 28 April 1948, *Lindsay* 556(DS). Differs from the above:

Fl. to 6 cm, orange or red. (Fr. & seed not described.) Range: west coast of north Baja Sur, from below Punta Abreojos to Punta Eugenio and Isla Natividad.

A little-known plant from a somewhat inaccessbile region. Illustrations of the type raise the question of why this taxon was referred to *F. fordii* rather than *F. chrysacanthus*. Its appearance, stated flower colour and geographical location argue for its placement here.

18. **F. fordii** (Orcutt) Britton & Rose, Cact. 3: 126, quoad fig. 132 (1922); *Echinocactus fordii* Orcutt, Rev. Cact. 2: 81 (1900); Schumann, Bluehende Kakt. 1: t. 11 (1903). Type: Baja California Norte, west coast 'Lagoon Head' (Morro Santo Domingo), *Orcutt* (US 1821079).

18a. var. **fordii**

Stems normally solitary, ± globose, to 25 cm diam.; ribs to c. 21, tuberculate; rad.sp. c. 15, to 3 cm; cent.sp. 4-7, lowermost to 7 cm, hooked at apex and sometimes twisted, grey. Fl. (poorly known, but see Schumann, l.c.) Fr.; seed ? Range: coastal sand dunes around Bahia de Sebastian Viscaino.

This plant is poorly known at present for lack of study at the type locality. A dead adult plant and seedlings of what appears to be the true *F. fordii* were encountered near Guerrero Negro, on the dunes near Laguna Ojo de Liebre (Scammon's Lagoon) in 1983 (*Supthut* in *N. P. Taylor* 43 & 43A). The seedlings are in cultivation in Switzerland and the UK in the hope that flowers, fruits and seeds may be produced and the above description amplified. The plants, with their rather long central spines, are quite reminiscent of the plate in Schumann, l.c., which may depict a plant from the original collection. The commonly cultivated '*F. fordii*' is described below:

18b. var. (unnamed; west Baja, 30-31°N); Hirao (1979): fig. 22.

Like the above but lowermost cent.sp. to c. 4 cm, less conspicuous. (Fl. c. 4 cm, purple; stigmas 9-11. Fr. oblong, 3-4 cm, yellow to red; seed (see Bradleya 1: 10, fig. 10) to 2.5 × 2.2 mm). Range: coast of north-west Baja between San Antonio del Mar and El Rosario, and Isla San Martin; littoral sand dunes and grassy mesas.

This plant may be found to require a name once the disjunct type locality form of the species has been studied properly. It is very common in collections (identified as *F. fordii*) being one of the easiest species in subg. *Ferocactus* to flower in cultivation.

F. fordii is very close to *F. chrysacanthus* and is, perhaps, not specifically distinct. It may be distinguished by its purplish flowers.

19. **F. wislizeni** (Engelm.) Britton & Rose, Cact. 3: 127-128, tt. 1 & 12.2, fig. 131a (1922); Hirao (1979): fig. 29; L. Benson (1982): 693-698, figs. 728-736, colour pl. 122; *Echinocactus wislizeni* Engelm. in Wislizenus, Mem. Tour North. Mex. 96, in adnot. (1848) and Cact. Mex. Bound. tt. 25 & 26 (1859). Type: USA, south New Mexico, nr 'Donana', 1846, *Wislizenus* (MO). Syn. '*E. emoryi*' Engelm. in Emory, Milit. Reconn. App. 2, 157, fig. 5 (1848), nom. prov., non Engelm. (1856); *E. arizonicus* Kunze in Monatsschr. Kakteenk. 19: 149 (1909); *F. arizonicus* (Kunze) Orcutt (1922); *E. wislizeni* var. *phoeniceus* Kunze in Torreya 13: 75 (1913); *F. phoeniceus* (Kunze) Orcutt (1926); *E. falconeri* Orcutt in West. Amer. Sci. 12: 162 (1902); *F. falconeri* (Orcutt) Orcutt (1926); *E. hertrichii* Weinberg ('hertichii') in Desert 1: 40 (1929).

19a. var. **wislizeni**

Stem normally solitary, barrel-shaped to columnar, tapering towards apex, to 1.6(-3) m × 80 cm; ribs 20-30, scarcely tuberculate; rad.sp. c. 12-20, bristle-like to acicular, whitish; cent.sp. 4(-8), lowermost to 10 cm, flattened, hooked or straight, uppermost 3 ± terete. Fl. (mainly in summer) to 5-7.5 × 4.5-6 cm, yellow-orange to red; stigmas c. 20. Fr. ovoid, to 5 × 3 cm; seed (see Bradleya 1: 9, fig. 6) to 2.5 mm, testa-cell periclinal walls tabular with verrucose surface. Range: USA, westernmost Texas, south New Mexico, cent. & south Arizona; north-west Mexico, north-west Chihuahua, north & west Sonora and north-west Sinaloa; 300-1600 m.

In the southern part of its range it intergrades with the following:

19b. var. **herrerae** (J. G. Ortega) N. P. Taylor **stat. nov.**: *F. herrerae* J. G. Ortega ('Ferrocactus') in Mexico Forestal 5: 53, 55, figs. 1-4 (1927); Hirao (1979): fig. 26; Rauh (1979): t. 79.3. Type: Mexico, plants collected between Mazatlan, Ahome and Sianori (states of Sinaloa, Sonora & Durango) at up to 1200 m.s.m., *J. G. Ortega* (MEXU). Differs from the above:

Stem to 2 m × 45 cm; ribs 13, often spiralled; spination varying considerably with age of plant, but rad.sp. ± absent on larger stems and principal cent.sp. not flattened, straight. Fr. to 6 cm; seed (see Bradleya 1: 9, fig. 5) to 2.25 mm. Range: south

Sonora, north Sinaloa & west Durango; coastal plains and western slopes of Sierra Madre Occidental to 1200 m.

19c. var. **tiburonensis** G. Lindsay in Cact. Succ. J. (US) 27: 166-167, fig. 155 (1955). Type: Mexico, Gulf of California (Sonora), south-east corner of Tiburon Island, 30 April 1952, *Lindsay* 2229 (DS). Differs from var. *wislizeni:*

Stem to 1 m × 35 cm; rad.sp. subulate, not bristle-like. Fl. (early spring) yellow. Seed with periclinal testa-cell walls somewhat concave, not verrucose or verrucae fused together (see Bradleya 1: 9, fig. 7). Range: Isla Tiburon, Gulf of California.

A rather distinct variety, which may provide a tenuous link to certain members of the *F. robustus* group in Baja (e.g. *F. cylindraceus*). Considered a distinct species by Backeberg (1961).

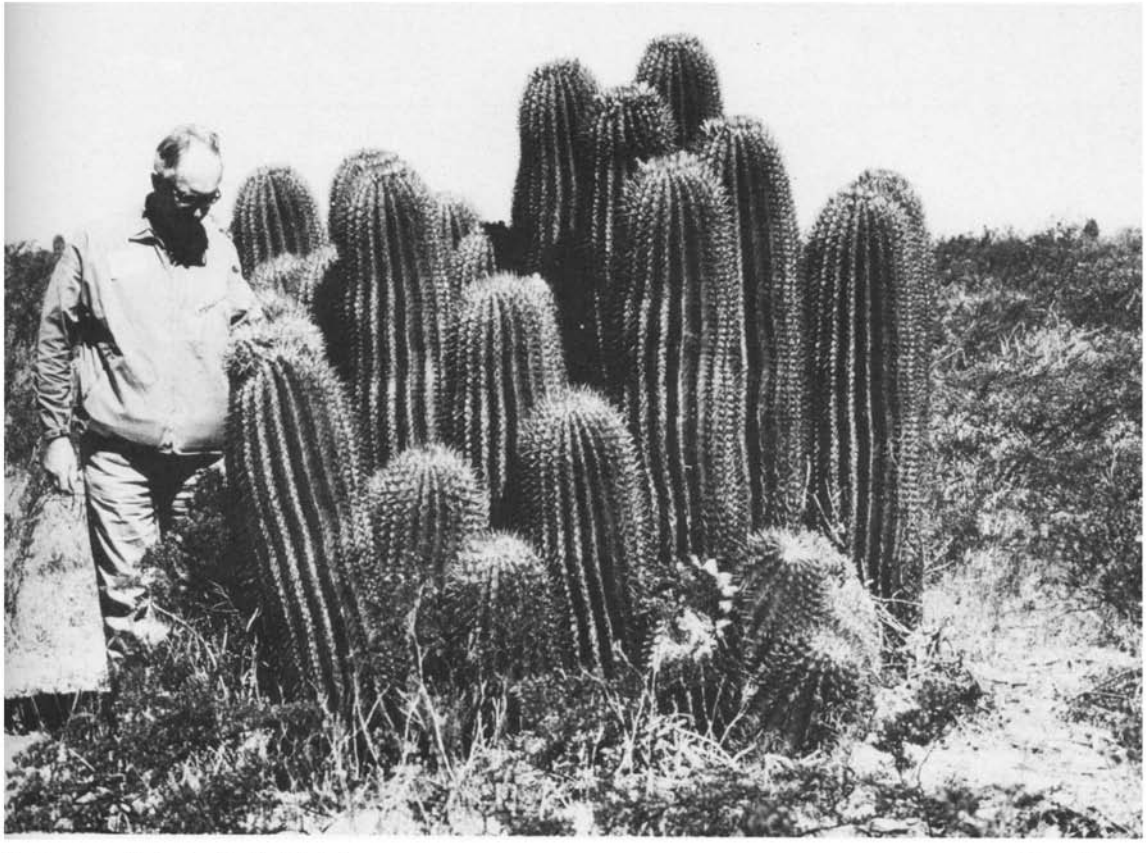
On seed characters the species is perhaps not so close to *F. peninsulae* as gross morphology seems to suggest, though they have probably recently diverged from a common ancestor.

It should be noted that the epithet *wislizeni*, the genitive form of Wislizenus, is correct as spelt here (the form used by Engelmann); it should not end in *'ii'* as in Benson (1982), etc. (see ICBN, 1983, Rec. 73C.2).

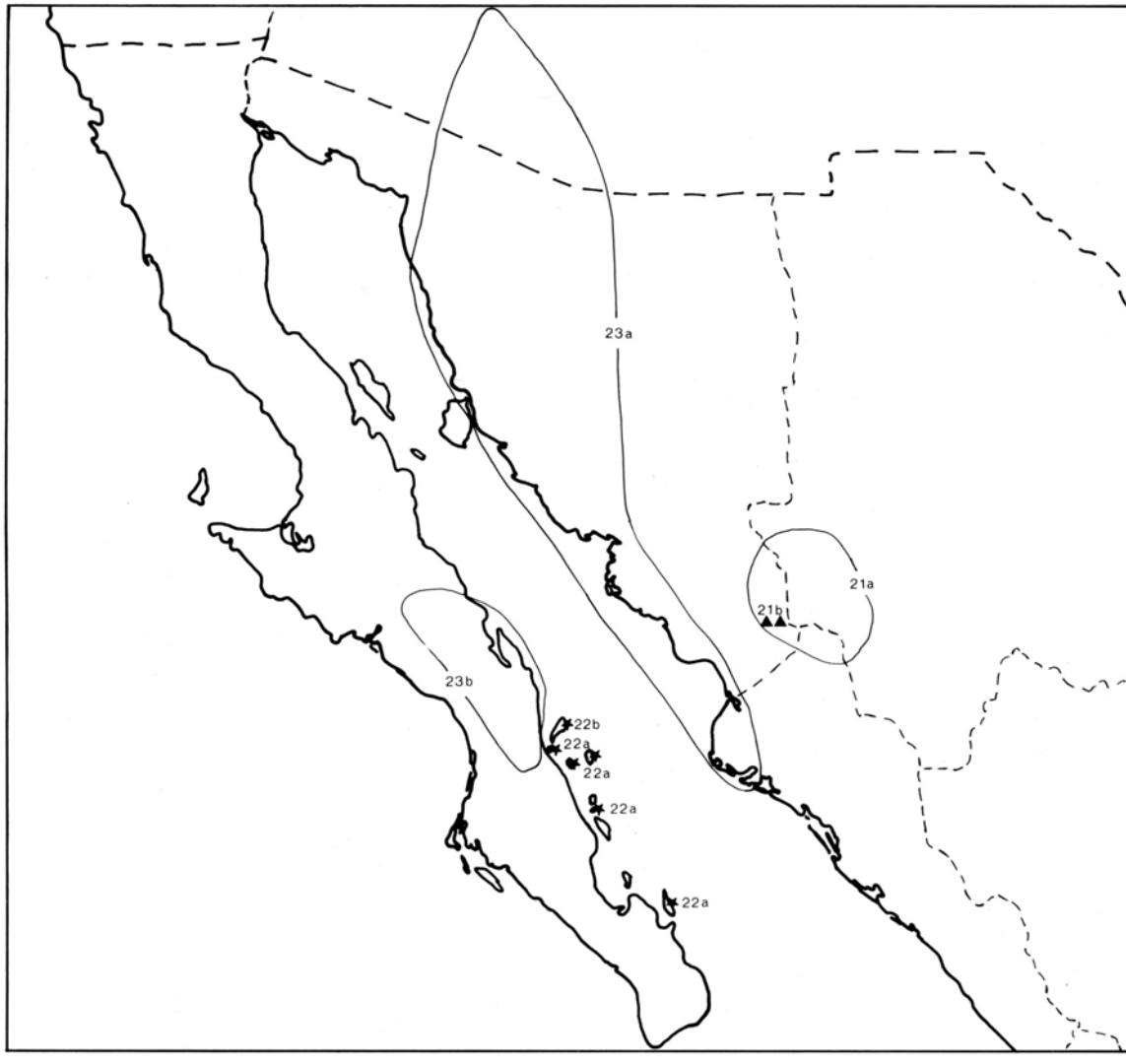
20. **F. pilosus** (Galeotti ex Salm-Dyck) Werderm. in Fedde Rep. spec. nov., Sonder-Beih. C, Lfg 18: t. 72 (1933); G. Lindsay (1955a): 174-175, fig. 161; *Echinocactus pilosus* Galeotti ex Salm-Dyck, Cact. Hort. Dyck. 1849, 148 (1850). Type: cult. Hort. Dyck. 1849; original collection from Mexico, (?) *Galeotti* (not preserved). Neotype (Lindsay, 1955b): San Luis Potosi, 69 miles east of city of SLP on road to Antiguo Morelas, 4700′, *Lindsay* 2588 (DS). Syn. *E. pilosus* (var.) *stainesii* Salm-Dyck ('steinesii'), op. cit. 149 (1850); *'E. stainesii'* Audot in Rev. Hort. 6(10): 248 (1845), nom. inval. (ICBN Art. 34.1(c) & 34.3); *F. stainesii* (Salm-Dyck) Britton & Rose (1922): 124; Backeb. (1961): Abb. 2563-2569; E. & B. Lamb, Ill. Ref. Cact. Succ. 5: tt. 331 & 332 (1978); Hirao (1979): fig. 31; Riha & Subik (1981): 51, fig. 39; Cullmann *et al*, Kakteen, 175 (1984) (excellent colour illustration); *F. pringlei* (J. Coulter) Britton & Rose (1922): 125-126, t. 11.1, figs. 129-131; *E. pilosus* (var.) *pringlei* J. Coulter (1896); *F. stainesii* var. *haematacanthus sensu* Backeb. (1961): 2700, Abb. 2566, non *Echinocactus electracanthus* (var.) *haematacanthus* Salm-Dyck (1850). NB. As pointed out by Lindsay (1955a) the epithet *stainesii* was not validated at specific rank until 1922 and must therefore give way to *Echinocactus pilosus* Salm-Dyck (1850).

Stem solitary or forming a massive clump, to 3 m × 50 cm; ribs 13-20, acute in young plants but more shallow and rounded in large adults; areoles approximate on mature stems; rad.sp. reduced to numerous whitish bristles or 0; central (principal) spines 6-12, to 5 cm, subulate, stout, usually red, ± straight. Fl. to 4 × 2.5 cm, yellow to red, perianth-segments remaining ± erect; stigmas c. 15. Fr. ovoid, yellow, 3-4 cm; seed (see Bradleya 1: 9, fig. 8) c. 1.75 mm, testa-cell periclinal walls deeply concave. Range: cent. north Mexico, San Luis Potosi, Zacatecas, Durango, south Nuevo Leon & south Coahuila; (?) south-west Tamaulipas; Chihuahuan Desert at 1450-2100 m.

A geographically isolated member of the F. ROBUSTUS GROUP which, however, shows a clear relationship with *F. gracilis* from Baja California (although convergence can never be ruled out!). Its caespitose tendencies and spination are also a reminder of the relictual, south Mexican *F. robustus*, but its seeds are very different.



F. pilosus near Huizache, San Luis Potosi. *(photo: Tjaden)*



Map 5. Distribution of *Ferocactus* section *Ferocactus:* F. POTTSII GROUP.

F. POTTSII GROUP (Taylor & Clark, 1983) (Nos. 21-23)
Spines to 10 per areole, of ± uniform thickness, not greatly flattened, mostly straight. Seeds with tabular-concave periclinal testa-cell walls.

21. **F. pottsii** (Salm-Dyck) Backeb., Die Cact. 5: 2738, Abb. 2600 (1961); G. Unger in Kakt. and. Sukk. 22: 184-187, figs. 1-4 (1971); Glass & Foster in Cact. Succ. J. (US) 56: 62-63, figs. 5 & 7 (1984); *Echinocactus pottsii* Salm-Dyck, Allg. Gartenz. 18: 395 (1850); Schumann, Gesamtb. Kakt. 327-328, fig. 57 (1898). Type: a living plant in Hort. Dyck., sent from Mexico in 1850 by *Potts* (not preserved). Neotype: Mexico, Sonora, Guirocoba Ranch, 50 km east of Alamos, 20 April 1940, *Bool & Lindsay* (DS) (type of *F. alamosanus* var. *platygonus* G. Lindsay). Syn. *F. alamosanus* var. *platygonus* G. Lindsay in Cact. Succ. J. (US) 14: 139, with figs. (1942); '*F. guirocobensis*' F. Schwarz, nom. nud., cf. Hirao (1979): fig. 46 (excellent colour illustration).

21a. var. **pottsii**
Stem solitary, to 1 m × 50 cm, globular to short-cylindric; ribs 13-25, rather broad and obtuse; areoles distinct; rad.sp. 3-8, to 4.5 cm; cent.sp. 1, to 7.5 cm, straight (sometimes hooked in seedlings?). Fl. to 4.5 × 3.5 cm, yellow; stamens yellow or red; stigmas c. 12. Fr. to 4 × 3 cm, yellow; seed (see Bradleya 1: 12, fig. 17) to 3.2 mm. Range: south-west Chihuahua, south-east Sonora & north Sinaloa; arid subtropical thorn forest or higher in the pine belt.

21b. var. **alamosanus** (Britton & Rose) G. Unger, l.c. 187 (1971); *Echinocactus alamosanus* Britton & Rose in Contrib. US. Nat. Herb. 16: 239, t. 66 (1913); *F. alamosanus* (B. & R.) Britton & Rose (1922): 137, fig. 145; G. Lyons in Cact. Succ. J. (US) 40: 138-139, figs. 1 & 2 (1969); Glass & Foster, l.c. 62 (1984). Type: Sonora, high up in the canyons of Alamos Mt, 18 March 1910, *Rose et al.* 12850 (US) . Differs from the above:
Stem solitary or sometimes caespitose, to 30 cm; ribs much narrower, acute; spination much denser, giving the stem a yellow appearance. Fl.(?) Fr. 'much smaller' (Glass & Foster, l.c.) red; seed (?). Range: south Sonora, Alamos Mt and canyons at Guirocoba Ranch, mostly on high vertical rocks.

22. **F. diguetii** (F. A. C. Weber) Britton & Rose, Cact. 3: 131-132, t. 11.2 & 12.3 (1922); G. Lindsay (1955a): fig. 156 (right) and (1965): figs. 46 & 63; G. Rowley, Ill. Encycl. Succ. 21,

fig. 2.1 (1978) (excellent colour plate); Hirao (1979): fig. 23 (young plant); *Echinocactus diguetii* F. A. C. Weber in Bull. Mus. Hist. Nat. Paris 4: 100, 99, fig. 1 (1898). Type: Mexico, Gulf of California, photographs and plant remains (the latter apparently no longer extant) collected by *L. Diguet* on Isla Santa Catalina; photograph published by Weber, l.c.

22a. var. **diguetii**
Stem solitary, eventually massive, to 4 m × 60 cm (Wiggins, 1980, claims 5 × c. 1 m); ribs 25-35, becoming sinuate in age; spines 4-8 (to 10 in juveniles), to 5 cm, clear yellow or reddish-brown. Fl. 4 × 4 cm, red; stigmas 12. Fr. (when dry) 3 × 2 cm; seed (see Bradleya 1: 12, fig. 20) 1.5-2 mm, glossy brown. Range: Islands in the Gulf of California off the east coast of Baja Sur, including Santa Catalina, Monserrate, Dansante, San Diego & Cerralvo; (?) Isla Coronados near Loreto (perhaps now extinct).

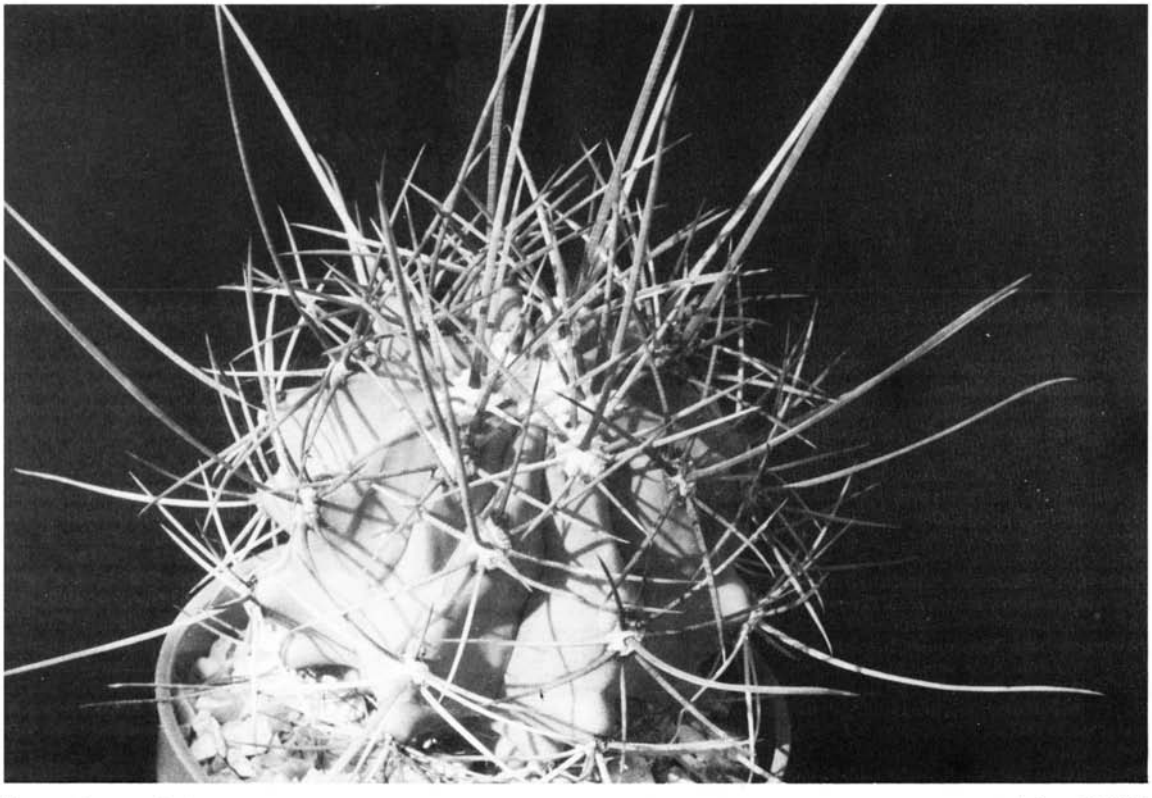
22b. var. **carmenensis** G. Lindsay in Cact. Succ. J. (US) 27: 167-168, fig. 156 (left) (1955). Type: Mexico, Gulf of California, east coast of Baja Sur, Isla Carmen, Balandera Bay, *Lindsay* 2204 (DS). Differs from the above:
Stem to only 1 m × 40 cm; globular and heavier spined while young. Range: Isla Carmen, rare.

F. diguetii is unquestionably the largest species in the genus. It is closely related to the following and they are very similar as young plants.

23. **F. emoryi** (Engelm.) Orcutt, Cactography, 5 (1926); Backeb. (1961): 2717-2719, Abb. 2581-2582; E. & B. Lamb, Ill. Ref. Cact. Succ. 5: t. 330 (1978); Hirao (1979): fig. 30; *Echinocactus emoryi* Engelm., Syn. cact. US. 19 (1856); Engelm. & Bigelow, Descr. cact. 31, t. 3, fig. 3 (1856); Schumann, Gesamtb. Kakt. 345-346 (1898). Neotype: Engelm. & Bigelow, l.c. t. 3, fig. 3 (1856). Syn. *F. covillei* Britton & Rose (1922): 132-133, figs. 138 & 139; L. Benson (1982): 699-703, figs. 737-741, colour plate 123. In an earlier paper (Taylor, 1979) I took the view that the name *F. emoryi* Orcutt (1926), based on *Echinocactus emoryi sensu* Engelm. (1856, 1859) et Engelm. & Bigelow (1856) *non E. emoryi* Engelm. (1848), could not be used for *F. covillei* B. & R. (1922) as the latter had priority. However, I had overlooked the fact that the names published by Engelmann in Emory, Milit. Reconn. (1848), are provisional (cf. ICBN Art. 34.1 (b)) and therefore invalid. This means that Orcutt's *F. emoryi* can be treated as a combination for *E. emoryi* Engelm. (1856), rather than a *nom. nov.*, and has priority from the earlier date (1856), making *F. covillei* its synonym. The choice of neotype indicated above is made in view of the possibility that *E. emoryi* Engelm. (1856) may be antedated by *E. emoryi* Engelm. & Bigelow (1856), in which case the illustration cited will represent the lectotype. The dates of both these publications do not appear to have been precisely determined at present.

23a. var. **emoryi**
Stem solitary unless injured, to 2.5 × 1 m, but often only 1.5 m × 60 cm, globular to cylindric, light to glaucous-green; ribs 15-30 or more, with pronounced tubercles in youth; rad.sp. 7-8(-9); cent.sp. 1, 4-10 cm, straight, curved or hooked at apex, very stout. Fl. c. 7.5 × 5-7 cm, red or yellow; stigmas c. 18. Fr. narrowly obovoid, to 5 × 3 cm; seed (see Bradleya 1: 12, fig. 19) 2-2.5 mm. Range: USA, in south-west Arizona; north-west Mexico, Sonora to north Sinaloa (Topolobampo); sea level to 900 m.

23b. var. **rectispinus** (Engelm.) N. P. Taylor **comb. nov.**: *Echinocactus emoryi* (var.) *rectispinus* Engelm. in Coulter, Contrib. US. Nat. Herb. 3: 362 (1896); *F. rectispinus* (Engelm.) Britton & Rose (1922): 134, t. 14.2, fig. 142 (1922); G. Lindsay



F. emoryi var. *rectispinus* *(photo: Tribble)*

(1965): fig. 57; Rauh (1979): t. 79.5 / 6. Type: Mexico, Baja California Sur, nr Mulege, 1867, *W. M. Gabb* 12 (MO). Differs from the above:

Stem to 1.5(-2) m × 45 cm; ribs c. 21; cent.sp. to 25 cm, straight. Fl. 6 cm, yellow. Fr. globular to ovoid, to 3.5 × 2.5 cm; seed to 2 mm. Range: north Baja California Sur, from the vicinity of San Ignacio to south of Loreto; volcanic rocks from sea level to nearly 1600 m.

This variety shares its range with *F. peninsulae*, which likewise flowers in late summer. Considerable introgression of the two species seems to be taking place wherever they meet on the volcanic rocks, to which *F. emoryi* var. *rectispinus* appears to be restricted. In the three populations of this taxon encountered in 1983 (at the extremes and centre of its range) there was in each case much evidence of influence from *F. peninsulae*. Elsewhere, the presence (or former presence) of var. *rectispinus* was evident from the occurrence of abnormally spined individuals in *F. peninsulae* populations. On the volcanic mesa a few kilometers east of San Ignacio can be found a fine example of a large hybrid swarm involving these two taxa. Almost every intermediate was visible *(N. P. Taylor* 89, 90, 91, 92, 93, 94, 95, 96). It is not known whether this introgression is a recent phenomenon, or how widespread it really is, since the mountains where var. *rectispinus* grows are fairly inaccessible. It is possible that pure var. *rectispinus* will be found more plentiful at higher elevations, where *F. peninsulae* is less frequent.

While *F. diguetii* is the most imposing *Ferocactus* in terms of sheer size, *F. emoryi* var. *rectispinus* has the most remarkable spination amongst the North American echinocacti, with a straight, rigid central spine to 25 cm in length. Alas this armament is only poorly developed in cultivation.

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Index to specific epithets

Bradleya 2/1984
pages 39-64

The Cactaceae of Plumier's Botanicum Americanum

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Summary. A commentary is provided in tabular form on 24 taxa of Cactaceae enumerated by Plumier in his manuscript 'Botanicum Americanum', together with half-size reproductions of copies at Kew of 21 of his drawings. Early names for Plumier taxa whose identity or status requires confirmation could affect the currently accepted names of species in several genera.

Introduction

The French missionary, explorer and botanist Charles Plumier (1646-1704) who travelled in the West Indies in 1689, 1693 and 1695 made c. 6000 drawings which are preserved at the Muséum d'Histoire Naturelle at Paris (Stafleu & Cowan, 1983). His principal work was a manuscript entitled '*Botanicon americanum seu historia plantarum in Americanis insulis nascentium*' in eight volumes, with 1219 plates. This remarkable *magnum opus* has never been published but several sets of copies of some of the drawings were made, the best known being one of 508 drawings now in the library of the University of Groningen, Holland, which was used by Johannes Burman (1707-1779) as the basis of his *Plantarum americanarum fasciculus*, published in ten parts between 1755 and 1760 and containing 262 plates.

The British Museum (Natural History) and the Royal Botanic Gardens, Kew, also possess copies of the drawings. The collection at Kew consists of 551 uncoloured drawings, bound in four volumes numbered 2-5, and accompanied by a single volume (vol. 1) containing transcripts of some of Plumier's relevant descriptions (here the title is *Botanicum Americanum...*).

The drawings at Kew are an amalgamation of two (or more) sets, since many of those on cartridge-type paper in volumes 2, 3 and 5 are duplicated by tracings in volume 4. The tracings differ significantly in matters of detail from the indirect copies and were evidently made on a different occasion.

Here I am concerned solely with the drawings and descriptions of cacti, of which 23 are described in the text-volume at Kew, and 23 are represented by drawings. There is a drawing relating to all but one of the descriptions and one drawing for which there is no separate description (see taxa nos. 3 and 7 in the Table). Taxa nos. 14, 16 and 19 occupy two, and no. 13 three, pages of drawings, so that there are 28 pages of drawings in all, plus four duplicates among the tracings.

A list of the cacti included in the original drawings at Paris, sent to me by Dr. Alicia Lourteig, mentions the same 24 taxa, and so I assume the Kew set is complete, apart from the one missing drawing and the description of another.

Burman reproduced all or parts of the drawings relating to 16 of Plumier's descriptions, combining two copies on one plate on four occasions and publishing a net total of 12 plates (tt. 191-201).

The identification of the species described and depicted by Plumier has engaged numerous botanists, including Linnaeus, Lamarck, De Candolle, Haworth, Britton & Rose and Urban.

Plumier's West Indian herbarium is believed to have been lost at sea (Urban, 1920) and in the absence of preserved material, the drawings serve as types of several names proposed by Lamarck, De Candolle and Haworth. The remainder are of almost equally great historical interest, and in several cases identification is still an open question.

On the following pages, the 24 taxa are listed as nos. 1-24 in the order they appear in Plumier's manuscript, with references to the original pagination (P), that of the Kew copy (K) and Burman's version (B), together with the modern interpretation and my own comments. There then follow half-size reproductions of 21 drawings in the Kew copy. These appear by permission of the Director, Royal Botanic Gardens, Kew.

To decide the correct name of several of Plumier's taxa will be the task of a monographer (e.g. *Cephalocereus*, no. 21; *Harrisia*, nos. 16 and 18; *Selenicereus*, no. 8). Recollection of other taxa at Plumier's stated locality is desirable to confirm or establish a plausible

identification (*Mammillaria*, no. 6; *'Cereus plumieri'*, no. 12; *Dendrocereus*, no. 13; *Opuntia*, no. 23). The suggestions advanced here concerning the identity of nos. 13, 16 and 18 urgently require verification, since current names for the taxa concerned are liable to be displaced. This also applies in the most problematical case of all, *Stenocereus*, no. 17, where the Lamarck name *Cactus fimbriatus* must be considered a possible contender as basionym of a name to replace *S. hystrix* (Haw.) F. Buxb., *Cactus hystrix* Haw. now being regarded by some authorities as having been based on a *Melocactus*.

Acknowledgments

I am indebted to Professor R. A. Howard, Dr. B. E. Leuenberger, Dr. A. Lourteig and Mr. N. P. Taylor for their valuable comments on the original draft of this paper, and to the Photography Department, Royal Botanic Gardens, Kew, for reproductions of the copies of Plumier drawings.

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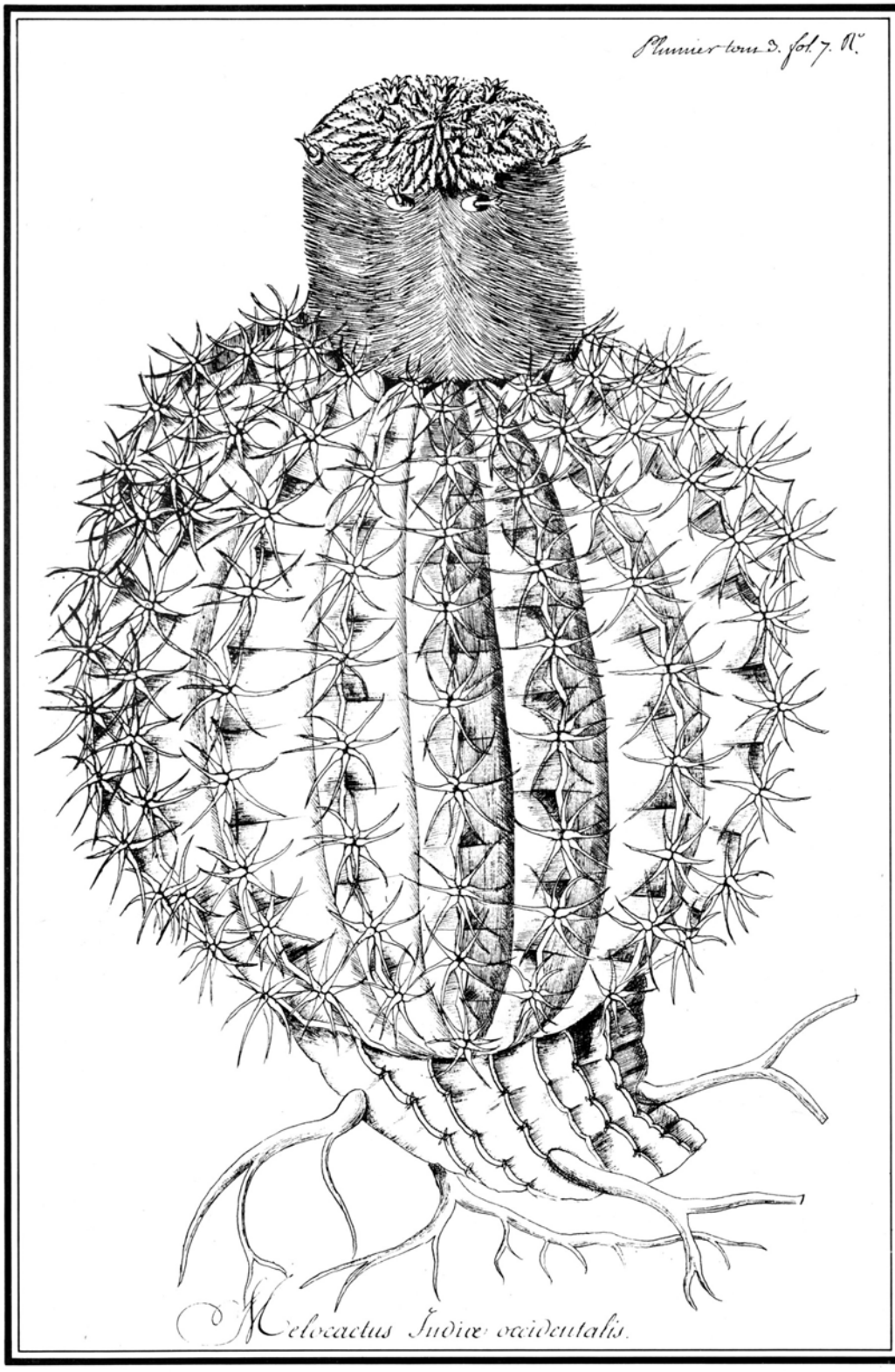
	Plumier's ms. phrase-name, and binomials based on his drawings	Plumier drawing no., References to Kew copy and Burman's Pl. Amer.	Modern identification and comments by D. R. Hunt
1.	Pereskia aculeata, flore albo, fructu flavescente	P2: 132 K126, 3: 35 (4: 69)	**Pereskia aculeata** P. Miller
2.	Melocactus Indiae occidentalis (St. Kitts)	P3: 7 K144, 3: 45	**Melocactus intortus** (P. Miller) Urban As Britton & Rose (The Cactaceae 3: 231. 1922) observed, the type of *Cactus intortus* Miller was from Antigua. Unfortunately Urban mis-applied the name to the plant from Hispaniola, for which the correct name is *M. lemairei* (Monv. ex Lem.) Miq. ex Lem.
3.	Melocactus Indiae occidentalis fere conicus et striatus (St. Kitts)	P3: 8 K —, 3: 44	**Melocactus intortus** (P. Miller) Urban
4.	Melocactus purpureus, striis in spiram contortis (Haiti: Port à Piment) *Echinocactus intortus* var. *purpureus* DC. Prodr. 3: 462 (1828) *Melocactus intortus* (P. Miller) Urban in Feddes Repert. Sp. Nov. 16: 35 (1919). (N.B. Urban in Feddes Repert. Sp. Nov. Beih. 5: 134. 1920 cites Plumier's ms. 3, t. 8, after the phrase name)	P3: 9 K145, 3: 43 (4: 64)	**Melocactus lemairei** (Monv. ex Lem.) Miq. ex Lem.
5.	Melocactus lanuginosus et tuberosus, purpureis aculeis munitus (Grenadines: Canouan Is,)	P3: 10 K146, 3: 41	**Mammillaria mammillaris** (L.) Karsten Recently recollected on Canouan Is. by R. A. Howard
6.	Melocactus minimus, lanuginosus et tuberosus (Haiti: Cul de Sac) *Cactus glomeratus* Lamarck, Encyl. 1: 537 (1783) *Mammillaria glomerata* (Lam.) DC., Prodr. 3: 459 (1828)	P3: 11 K147, 3: 42 B194, t. 20, f.1	Perhaps **Mammillaria prolifera** (P. Miller) Haw., despite the discrepancy in flower colour; cf. Hunt in J. Mamm. Soc. 4: 53-54 (1964).

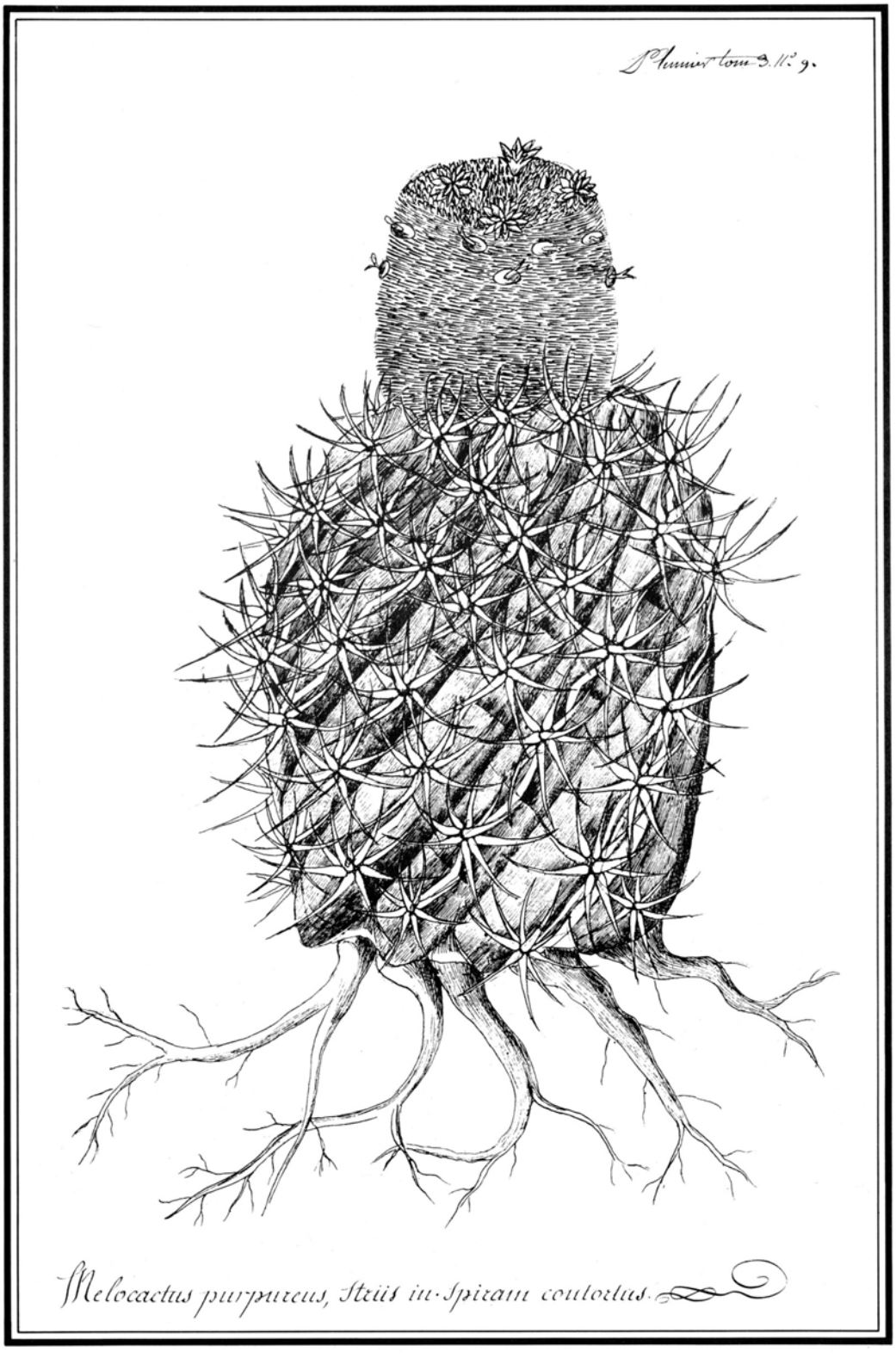
7. Melocactus, ex pluribus globulis Opuntia modo nascentibus constatus (Haiti) *Cactus moniliformis* L., Sp. Pl. 468 (1753)	P3: 11a K148 B191, t. 198	**Opuntia moniliformis** (L.) Haw. ex Steudel
8. Melocactus repens pentagonus flore albo fructu rubro (Haiti)	P3: 12 K149, 3: 39 (4, 67)	**Selenicereus urbanianus** (Guerke ex Weingart) Britton & Rose, if distinct from **S. grandiflorus** (L.) B. &. R. *S. urbanianus* was described as usually 4-5-ribbed, whereas *S. grandiflorus* is typically 7-8-ribbed.
9. Melocactus tetragonus repens fructu rubro (Grenadines: Union Is.) *Cereus quadrangularis* Haworth, Syn. Pl. Succ. 191 (1812) et Phil. Mag. 7: 117 (1830); DC., Prodr. 3: 468 (1828); Urban, Symb. Antill. 8: 462 (1920)	P3: 13 K150, 3: 40 B191, t. 199, f. 1	**Acanthocereus pentagonus** (L.) Britton & Rose
10. Melocactus repens trigonus flore albo fructu coccineo (Lesser Antilles) *Cactus triangularis* L., Sp. Pl. 468 (1753) *Cereus triangularis* (L.) Haw., Syn. Pl. Succ. 180 (1812); DC., Prodr. 3: 468 (1928); Urban, Symb. Antill. 8: 460 (1920)	P3: 14 K151, 3: 38 B193, t. 200, f. 1	**Hylocereus triangularis** (L.) Britton & Rose
11. Melocactus trigonus alius repens ex Insula St. Crucis (St. Croix) *Cereus trigonus* Haw., Syn. Pl. Succ. 181 (1812)	P3: 15 K152, 3: 47 B193, t. 200, f. 2	**Hylocereus trigonus** (Haworth) Safford
12. Melocactus alius trigonus repens fructu e violaceo coccineo (Bequia) **Cereus plumieri** Gosselin, Bull. Soc. Bot. France 54:668 (1907).	P3: 16 K153, 3: 57 B192, t. 199, f. 2	Not known today and not *Cereus* sensu stricto; tentatively referred to *Hylocereus napoleonis* (Graham) B. & R. by Britton & Rose, The Cact. 2: 191 (1920), in spite of the bristly fruit.
13. Melocactus arborescens trigonus undulosus aculeis validis munitus (Haiti: Port de Paix, Le Moustique) *Cactus pitajaya* Jacquin var. ß, Lamarck, Encycl. 1: 539 (1783) *Cereus undulosus* DC., Prodr. 3: 467 (1828); Urban, Symb. Antill. 8: 462 (1920)	P3: 17, 18, 19 K154, 3: 58, 59, 61 (4: 65) B187, t. 194	**Dendrocereus undulosus** (DC.) B. & R. in J. New York Bot. Gard. 26: 220 (1925). Recollected about 1925 in the original locality by W. Buch of Port-au-Prince and said by Britton & Rose to have 'much longer and more slender' flowers than the Cuban *D. nudiflorus* (Engelm.) B. & R. Recently reported from near Bayajibe by C. Fleming (Cact. Succ. J. Amer. 56: 126, figs. 8, 9. 1984). If, as seems likely, *D. undulosus* and *D. nudiflorus* are conspecific, the name *D. undulosus* has priority. As a genus, *Dendrocereus* seems doubtfully distinct from *Acanthocereus;* it is to the latter genus as *Neoabbottia* is to *Leptocereus.*

14. Melocactus seu Opuntia arborescens tetragona flore exalbido (Haiti: Cul de Sac) *Cactus paniculatus* Lamarck, Encycl. 1: 540 (1783) *Cereus paniculatus* (Lam.) DC., Prodr. 3: 466 (1828); Urban, Symb. Antill. 8: 462 (1920)	P3: 20, 21 K155, 3: 60, 62 (4: 66) B186, t. 192	**Neoabbottia paniculata** (Lamarck) Britton & Rose
15. Opuntia arbor excelsa, cereiformis, flore albo (Haiti: Port de Paix) *Cactus polygonus* Lamarck, Encyl. 1: 539 (1783) *Cereus polygonus* (Lam.) DC., Prodr. 3: 466 (1928)	P3: 22 K156, 3: 56 B189, t. 196	**Cephalocereus polygonus** (Lamarck) Britton & Rose
16. Melocactus cereiformis spinosissimus ramosissimus fructu aureo tuberoso (Haiti: Cul de Sac, Léogane) *Cactus divaricatus* Lamarck, Encycl. 1: 540 (1783) *Cereus divaricatus* (Lam.) DC., Prodr. 3: 466 (1828)	P3: 23, 24 K157, 3: 54, 55 B187, t. 193	Though Britton & Rose, The Cact. 2: 151 (1920), remark under *Harrisia nashii* Britton that *C. divaricatus* 'cannot be certainly associated with any known cactus', it seems to me the same as *H. nashii* (see also no. 18). Lamarck's epithet has priority. Britton & Rose may have been influenced by the curious 'flowers' in the drawing. Plumier says, however, that he nowhere saw the flowers, so what is shown may be an attempt to 'reconstruct' them from the floral remains on the immature fruits. The habit of the plant, number of ribs, and yellow-orange tuberculate fruits are consistent with identification as *Harrisia*.
17. Opuntia monoclonos cereiformis amplo flore roseo fimbriato (Haiti: La Bande du Sud) *Cactus fimbriatus* Lamarck, Encycl. 1: 539 (1783), excl. fig. Burm. *Cereus fimbriatus* (Lam.) DC., Prodr. 3: 464 (1828), excl. fig. Burm.; Urban, Symb. Antill. 8: 461 (1920), excl. fig. Burm. et syn. Haw. *Cereus grandispinus* Haw. in Phil. Mag. 7: 113 (1830); *Pilocereus grandispinus* (Haw.) Lem. in Rev. Hort. [1862]: 427 (1862).	P3: 25 K158, 3: 46 B188, t. 195, f. 2	Presumably either *Stenocereus hystrix* (Haworth) F. Buxb. or *S. griseus* (Haworth) F. Buxb. In some respects the description favours the latter species but it is not native to Haiti. Owing to Lamarck's mis-citation of Burman's reproduction of the Plumier illustration as 'fig. 1' instead of 'fig. 2', subsequent references have confused this and the next species. If, as I assume, the type of *Cactus fimbriatus* Lam. is the Plumier original, not the Burman copy, then *C. fimbriatus* is the earliest name for one or other species of *Stenocereus*. This is significant in view of the probability that *Cactus hystrix* Haworth was not a species of *Stenocereus*, and that '*S. hystrix*' must be renamed.

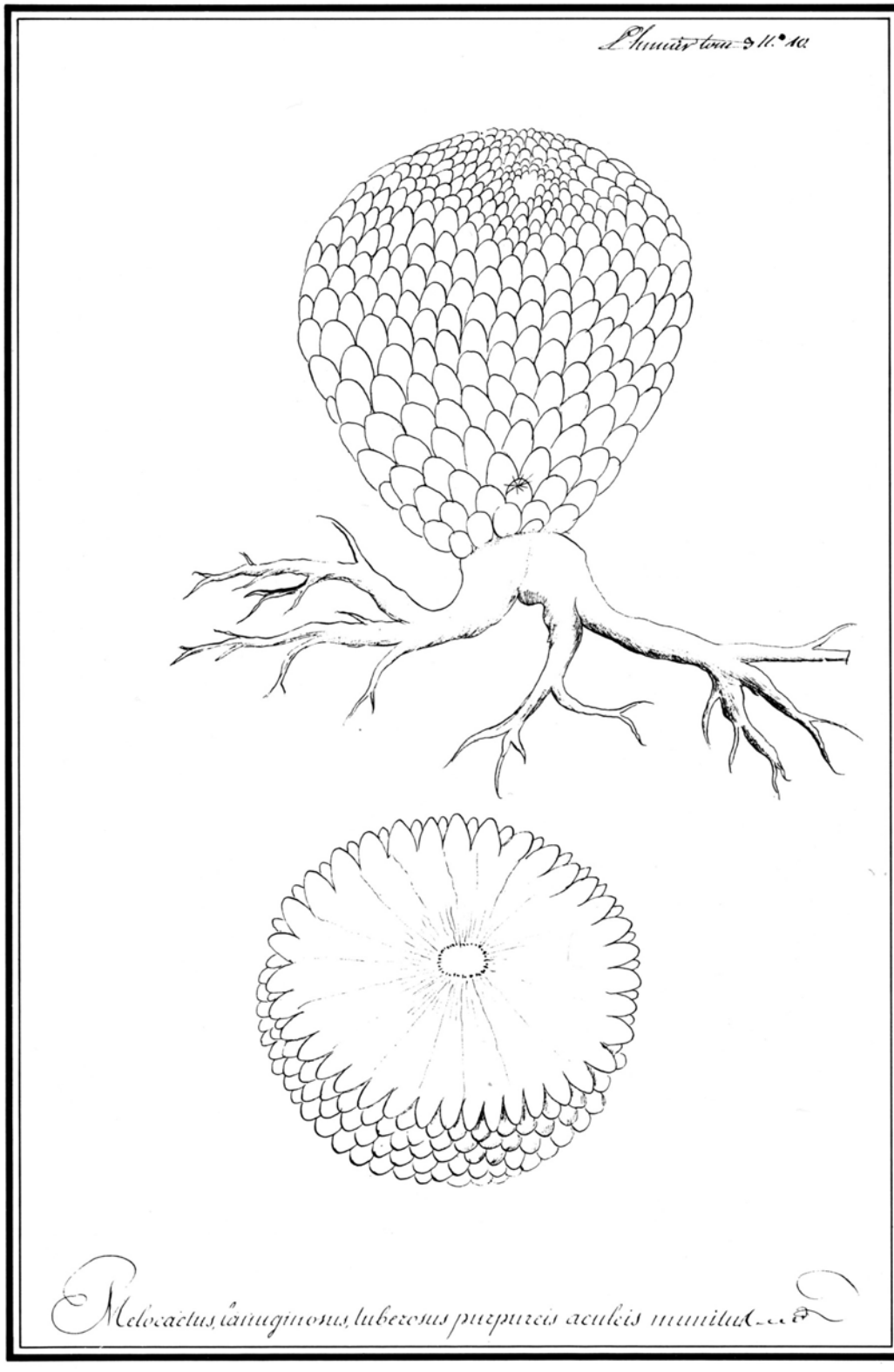
18. Melocactus arborescens folio striato spinosissimo fructu oblongo subluteo (Haiti: Cul de Sac) *Cereus serruliflorus* Haworth in Phil. Mag. 7: 113 (1830) [*Cereus fimbriatus* DC., Prodr. 3: 464 (1828); Urban, Symb. Antill. 8: 461 (1920), quoad fig. Burm., etc.]	P3: 26 K159, 3: 53 B188, t. 195, f. 1	**Harrisia nashii** Britton (but see note to 16). Note that the drawings on the upper right and lower left represent a flower-bud and section of the flower-bud, although the artist may have mistaken them for a fruit, drawing the stamens and anthers as if they were ovules and funicles.
19. Opuntia arbor excelsa foliis reticulatis, flore flavescente (Haiti: Port à Piment; St Thomas)	P3: 27, 28 K160, 3: 51, 52	**Opuntia moniliformis** (L.) Haworth ex Steudel The plant observed on St Thomas would be referable to **O. rubescens** Salm-Dyck ex De Candolle, if distinguishable; cf. Britton & Rose, The Cact. 1: 208 (1919).
20. Opuntia arborescens spinosissima foliis portulacae cordatis (Haiti: Le Fond du Parisien; Cul de Sac) *Cactus portulacifolius* L., Sp. Pl. 469 (1753); Lamarck, Encycl. 1: 543 (1783)	P3: 29 K161, 3: 34 B190, t. 197, f. 1	**Pereskia portulacifolia** (L.) DC.
21. Melocactus monoclonos, fructu atropurpureo, cereiformis (Lesser Antilles) *Cereus monoclonos* DC., Prodr. 3: 464 (1828) **Cephalocereus monoclonos** (DC.) Britton & Rose in Contr. US. Nat. Herb. 12: 418 (1909); Urban, Symb. Antill. 8: 463 (1920)	P3: 30 K162, 3: 36 B185, t. 191	Perhaps conspecific with **Cephalocereus royenii** (L.) Britton & Rose (though not thought so by B. & R. themselves), or with *Cephalocereus nobilis* (Haw.) B. &. R., which may also be referable to *C. royenii.*
22. Opuntia major, validissimis spinis munita (Per omnes insulas Americanas)	P3: 44 K165, 3: 37	**Opuntia dillenii** (Ker-Gawler) Haworth, presumably
23. Opuntia minima repens spinis tenuissimis et aduncis (Haiti)	P3: 45 K166, 3: 50	**Opuntia taylori** Britton & Rose, perhaps
24. Opuntia minima flagelliformis (Haiti)	P3: 46 K167, 3: 48 B190, t. 197, f. 2	**Rhipsalis baccifera** (J. Miller) W. T. Stearn



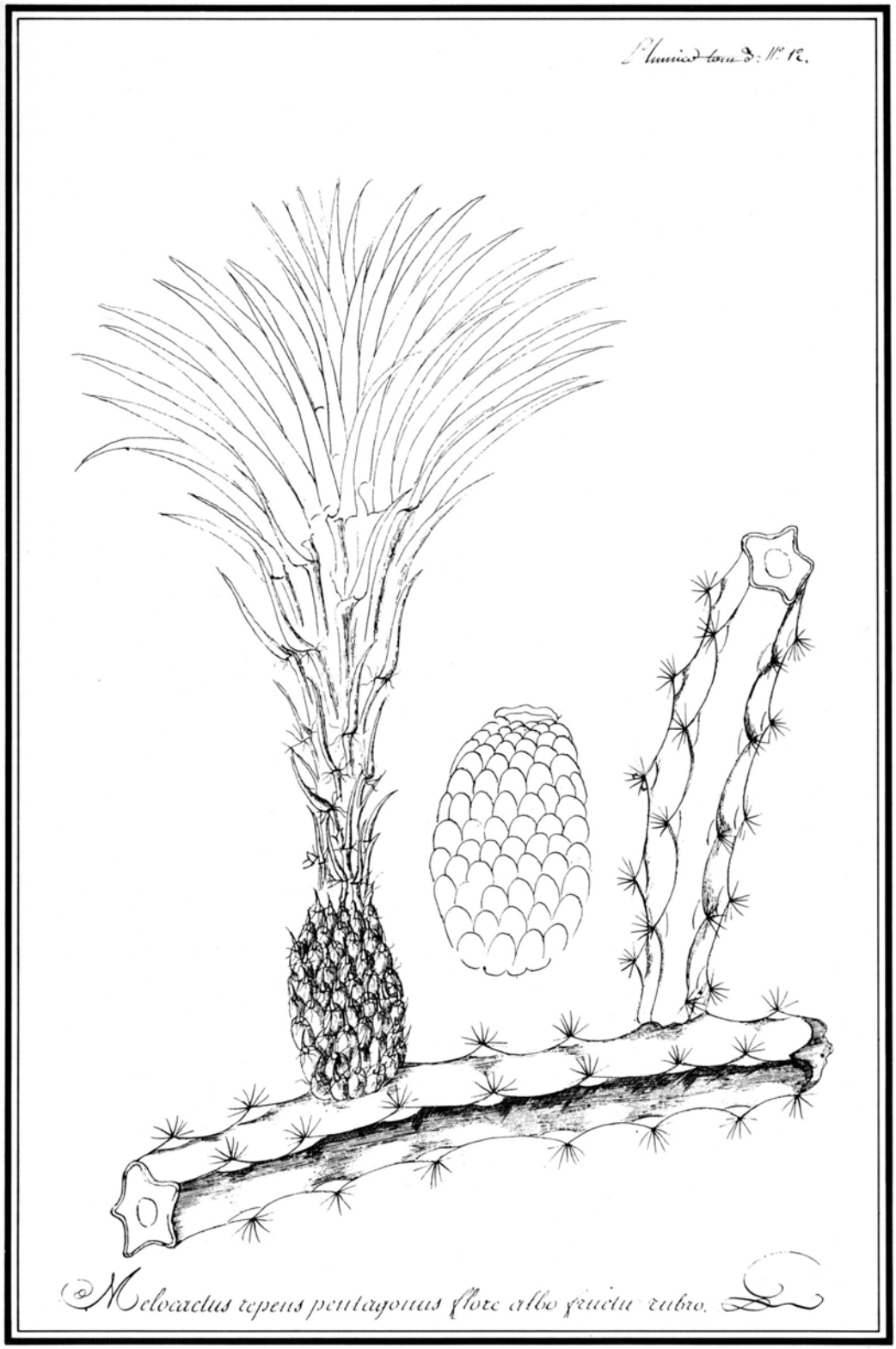
2. Melocactus Indiae occidentalis Plumier 3:7



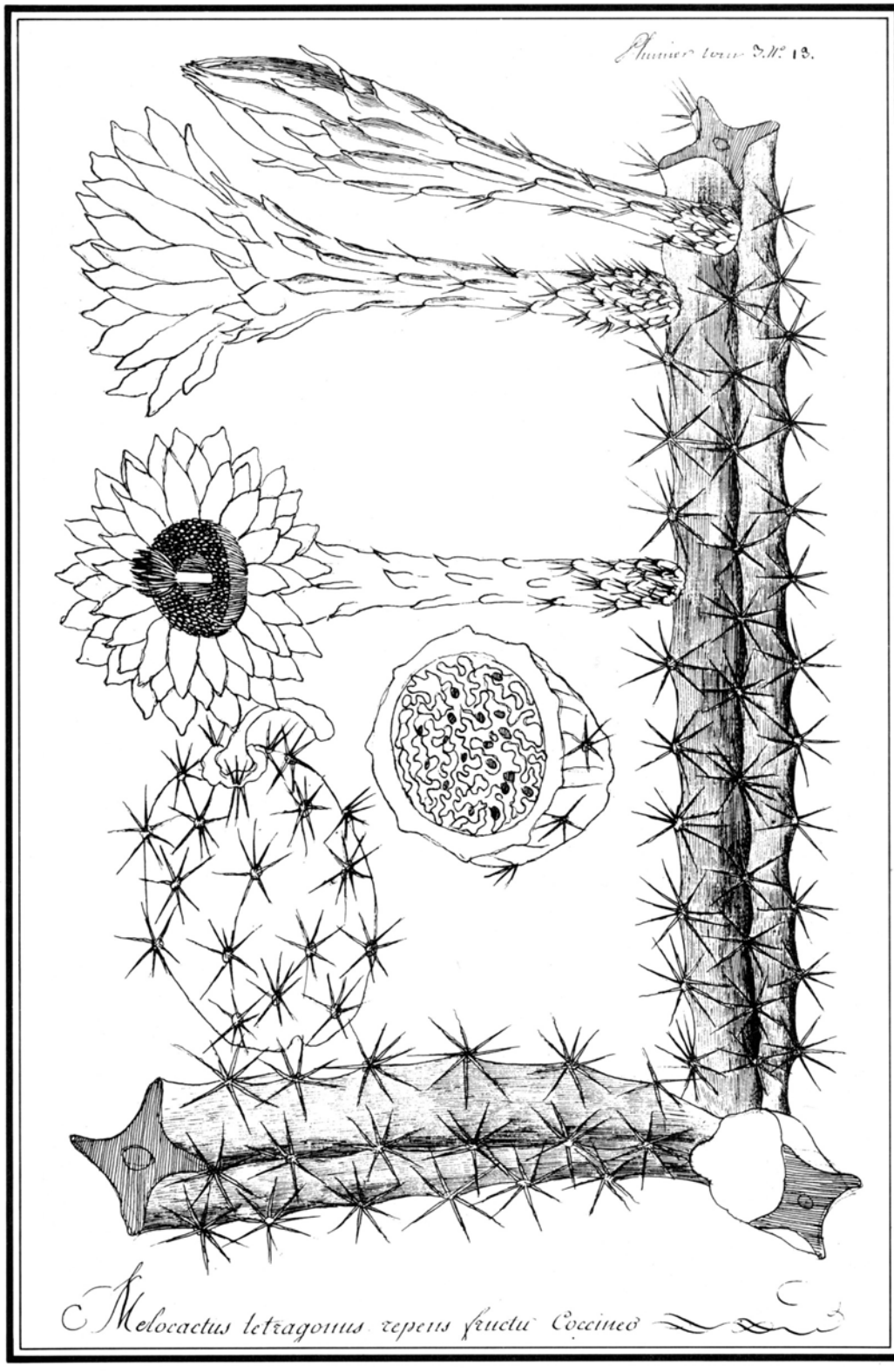
4. Melocactus purpureus, striis in spiram contortis Plumier 3:9



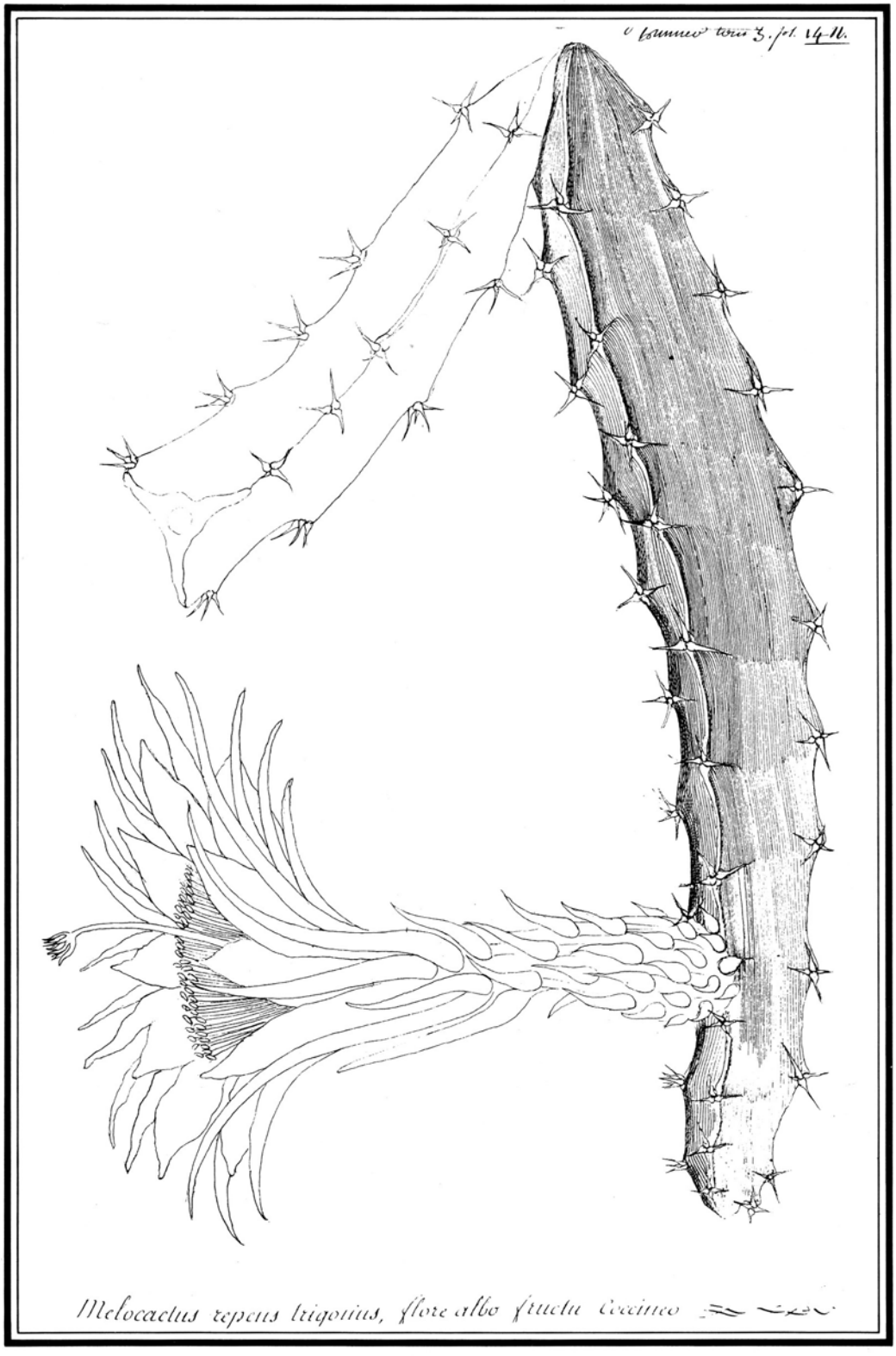
5. Melocactus lanuginosus [et] tuberosus purpureis aculeis munitus Plumier 3:10



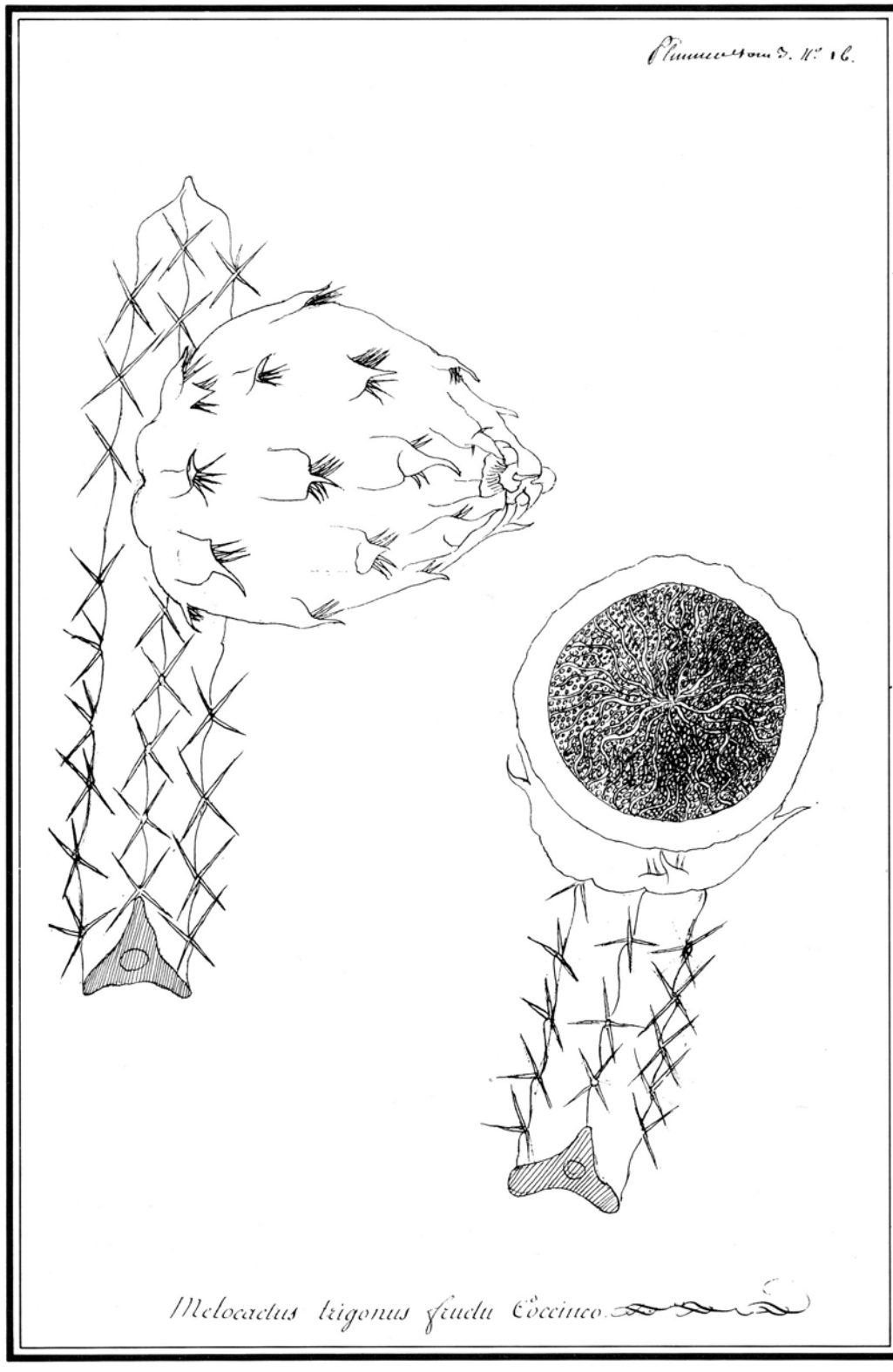
8. Melocactus repens pentagonus flore albo fructu rubro Plumier 3:12



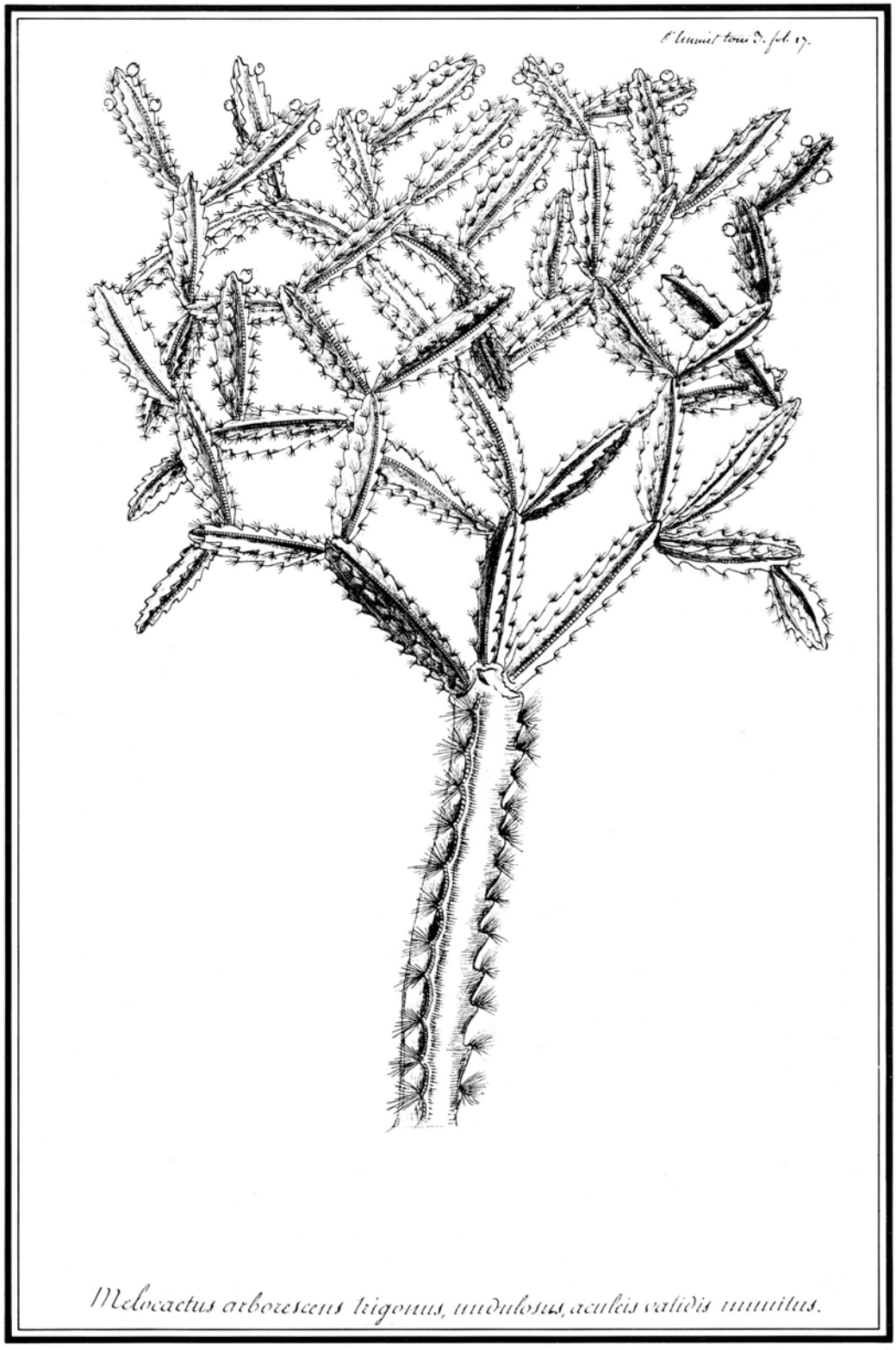
9. Melocactus tetragonus repens fructu [rubro] coccineo Plumier 3:13



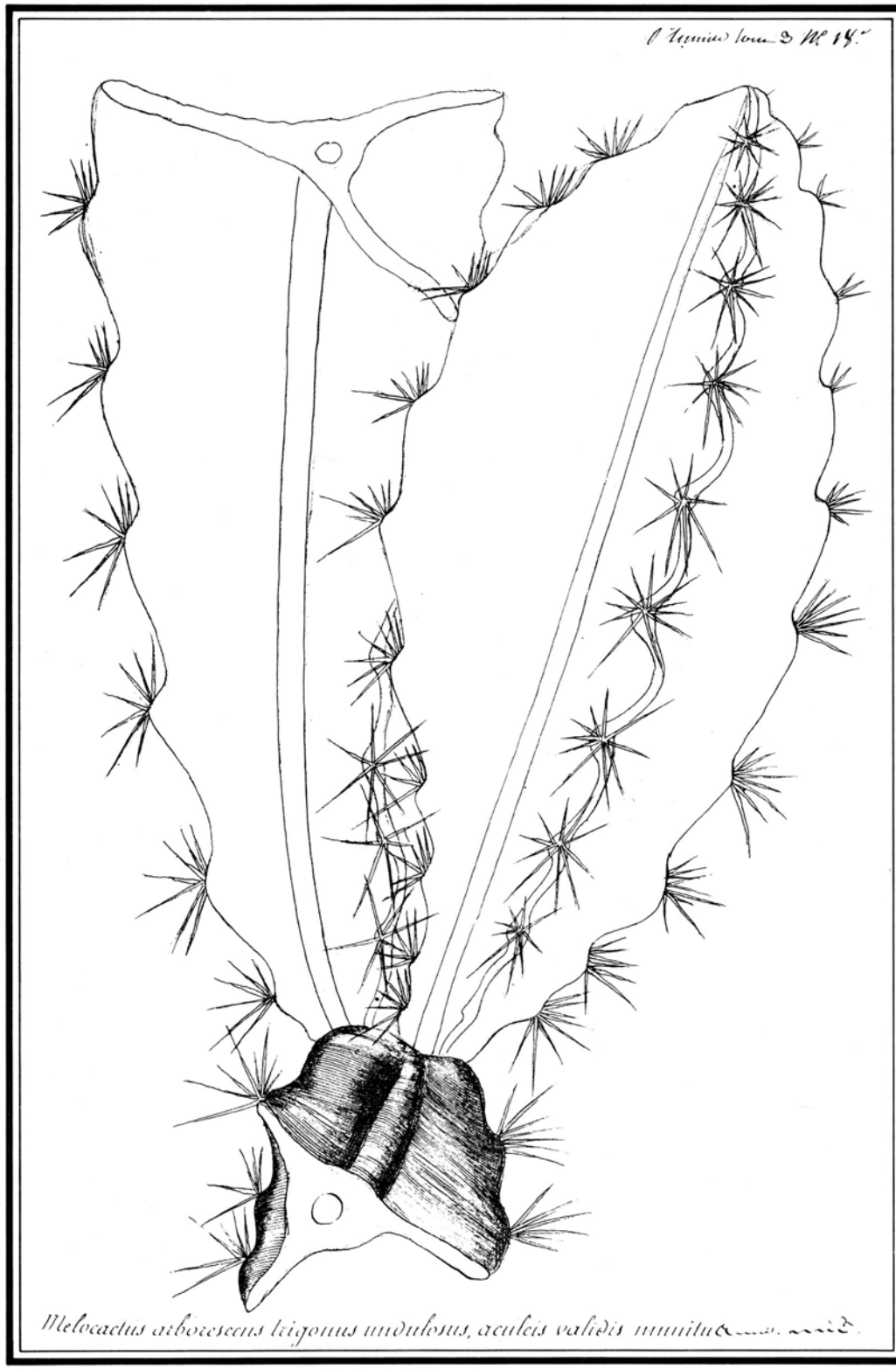
10. Melocactus repens trigonus flore albo fructu coccineo Plumier 3:14



12. Melocactus [alius] trigonus [repens] fructu [e violaceo] coccineo Plumier 3:16



13. Melocactus arborescens trigonus undulosus aculeis validis munitus Plumier 3:17



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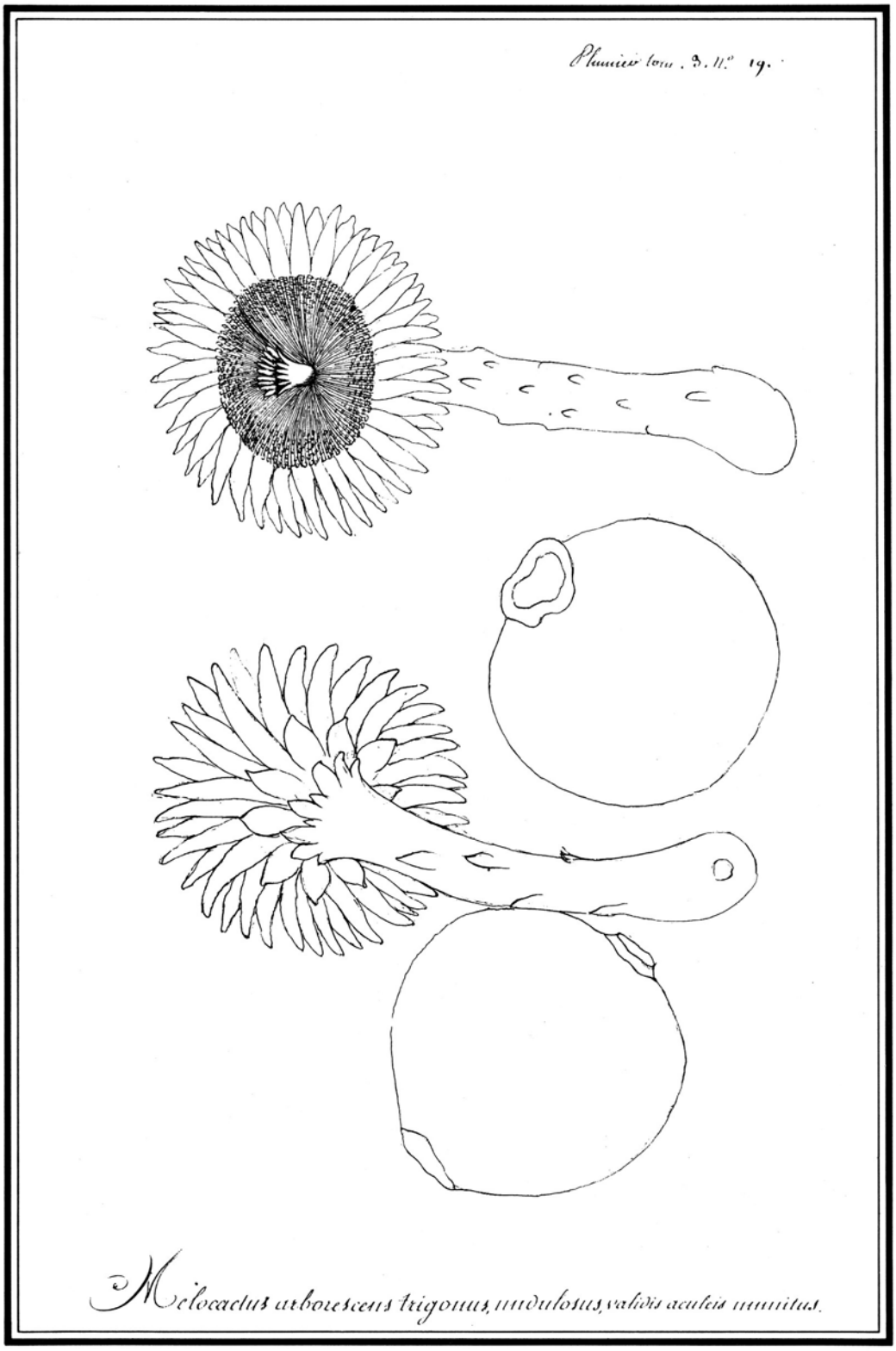
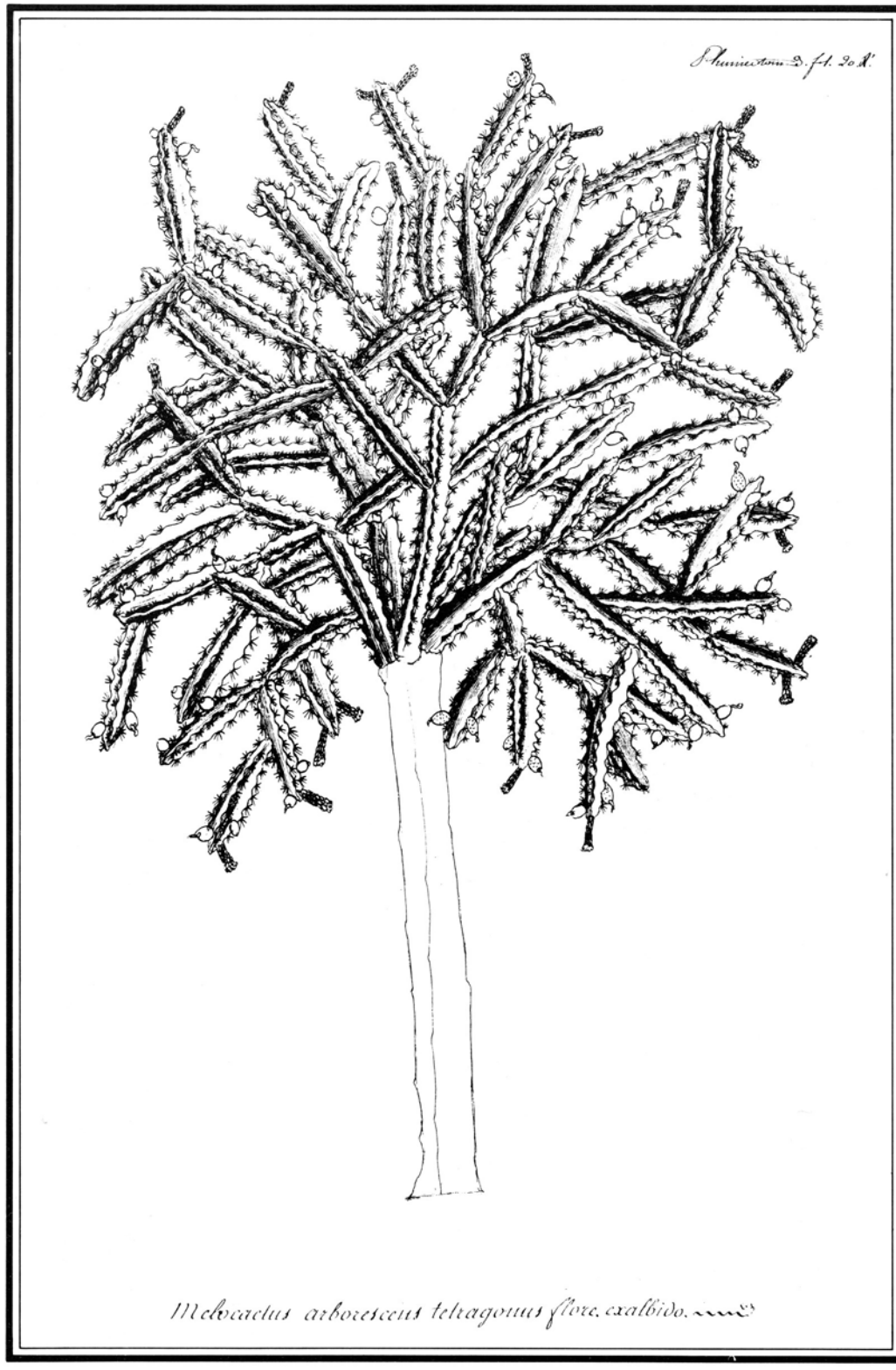
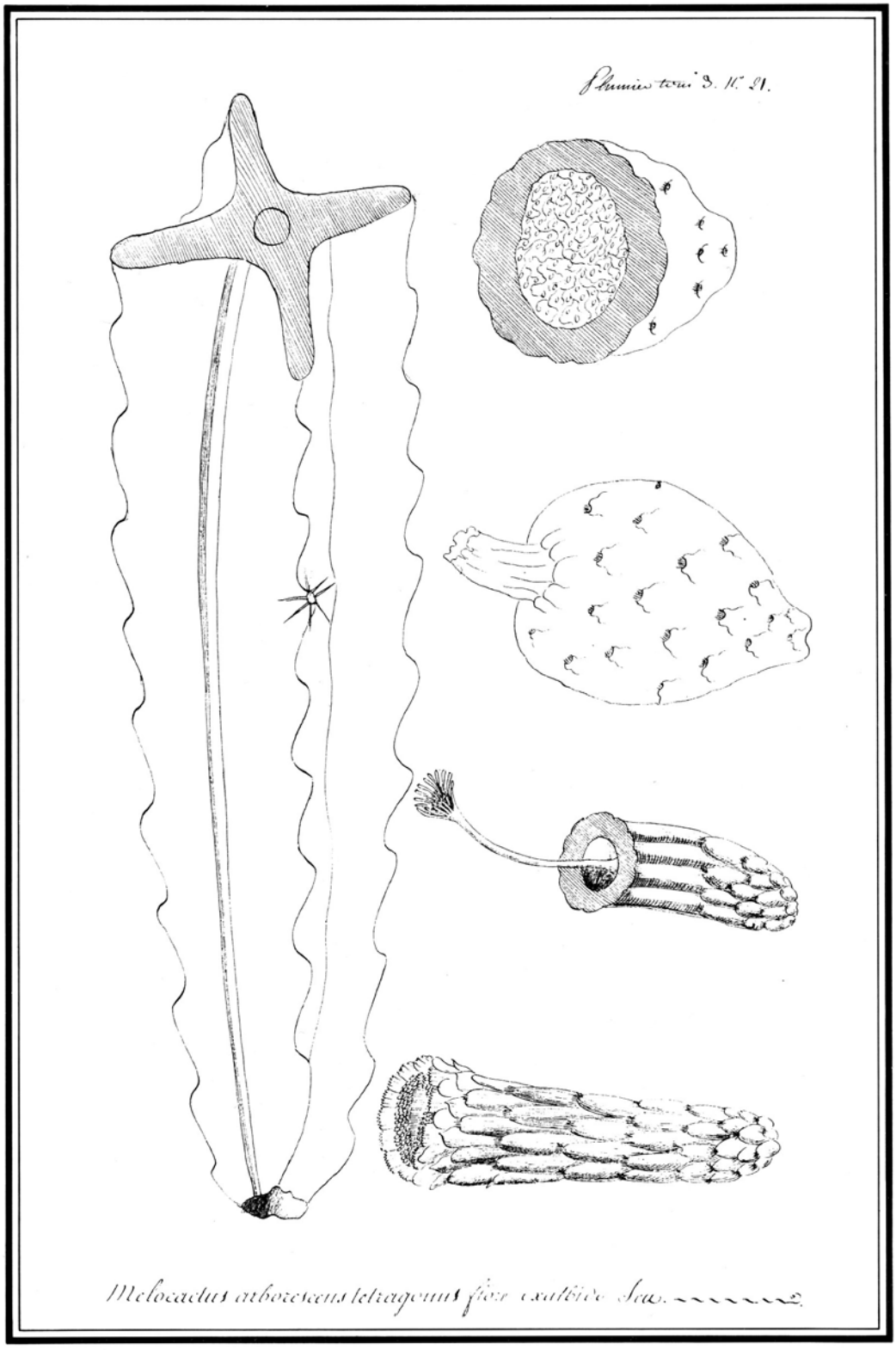


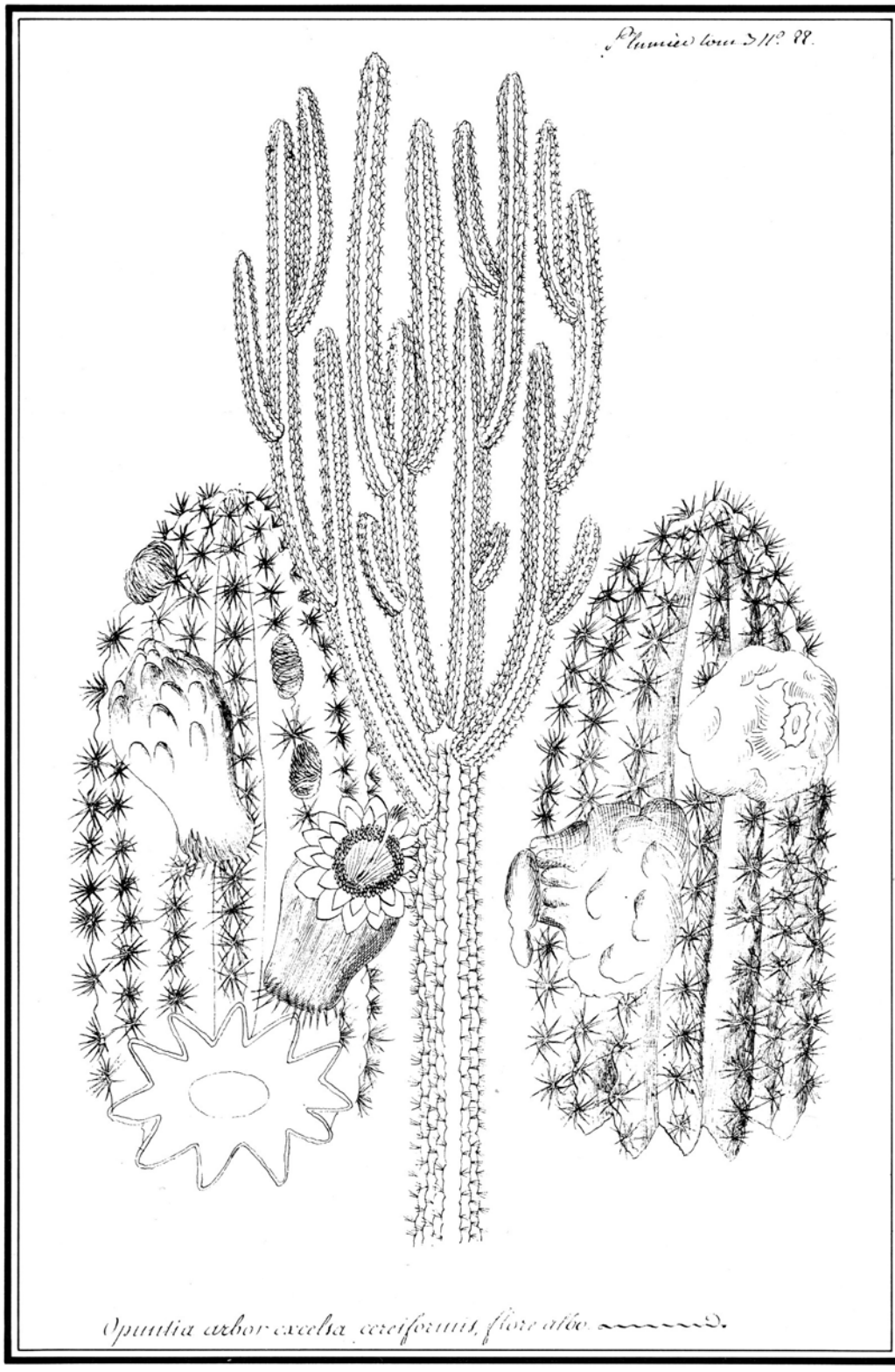
13. Melocactus arborescens trigonus undulosus aculeis validis munitus Plumier 3:19



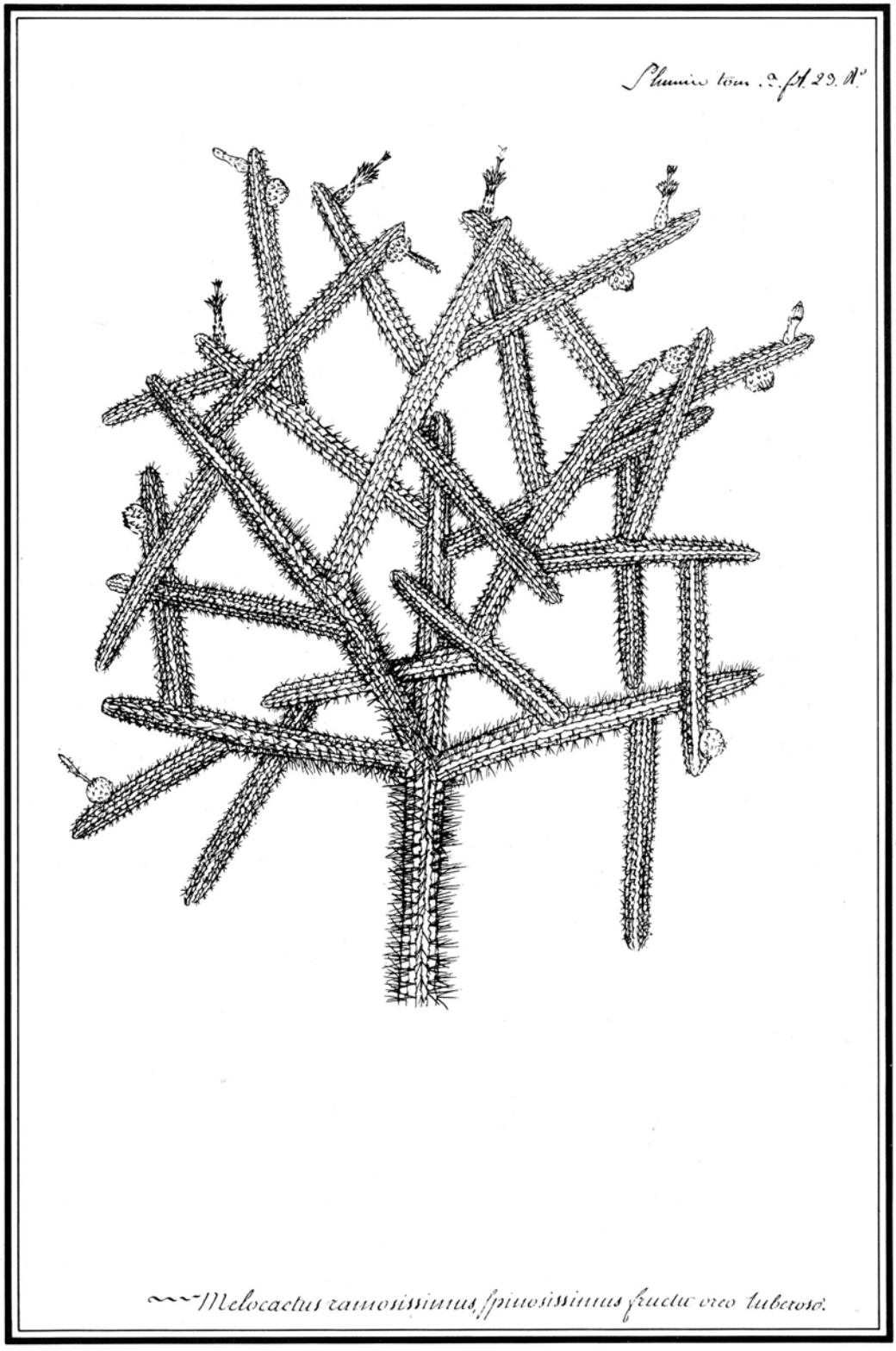
14. Melocactus [seu Opuntia] arborescens tetragonus flore exalbido Plumier 3:20



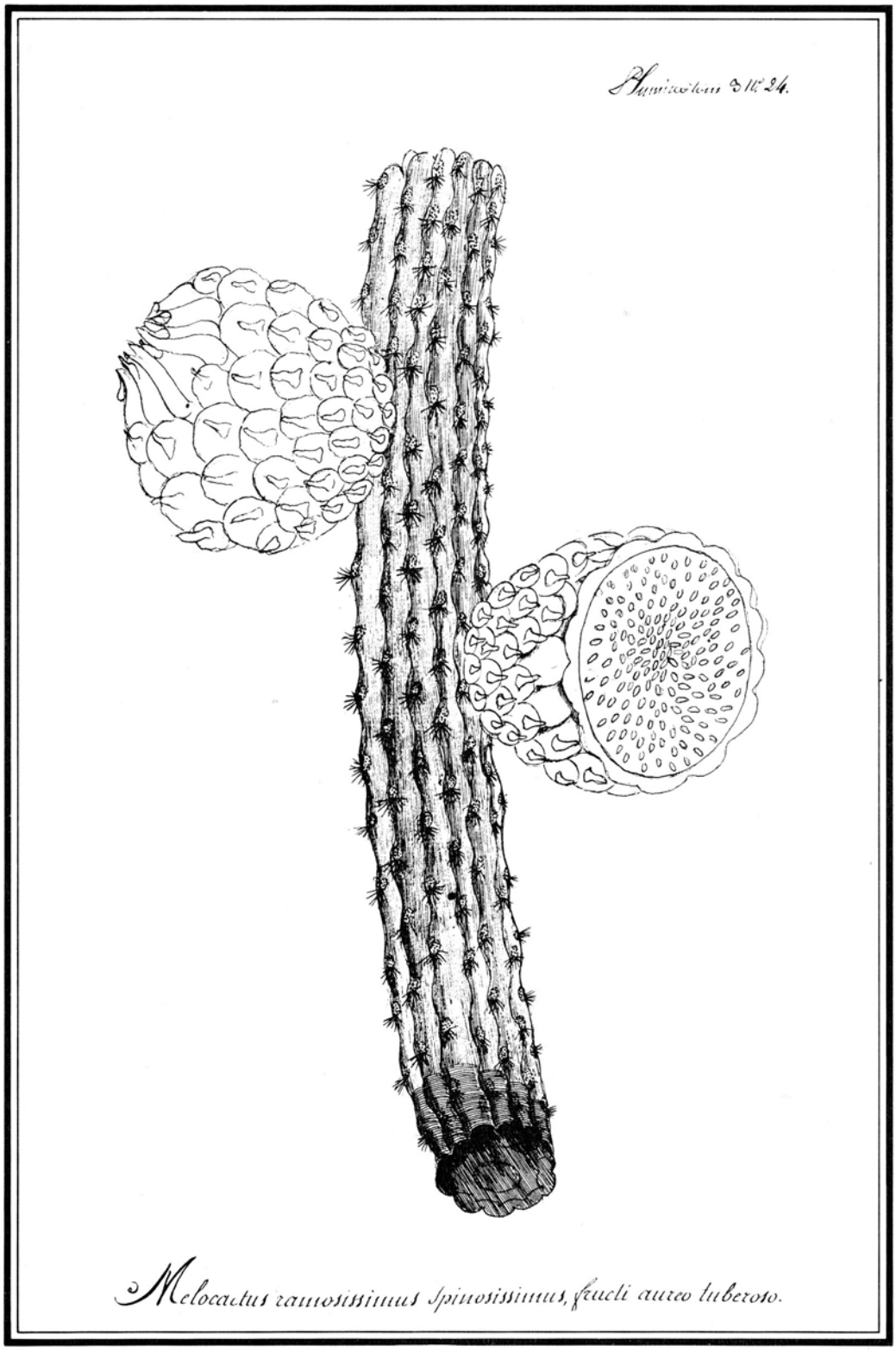
14. Melocactus [seu Opuntia] arborescens tetragonus flore exalbido Plumier 3:21



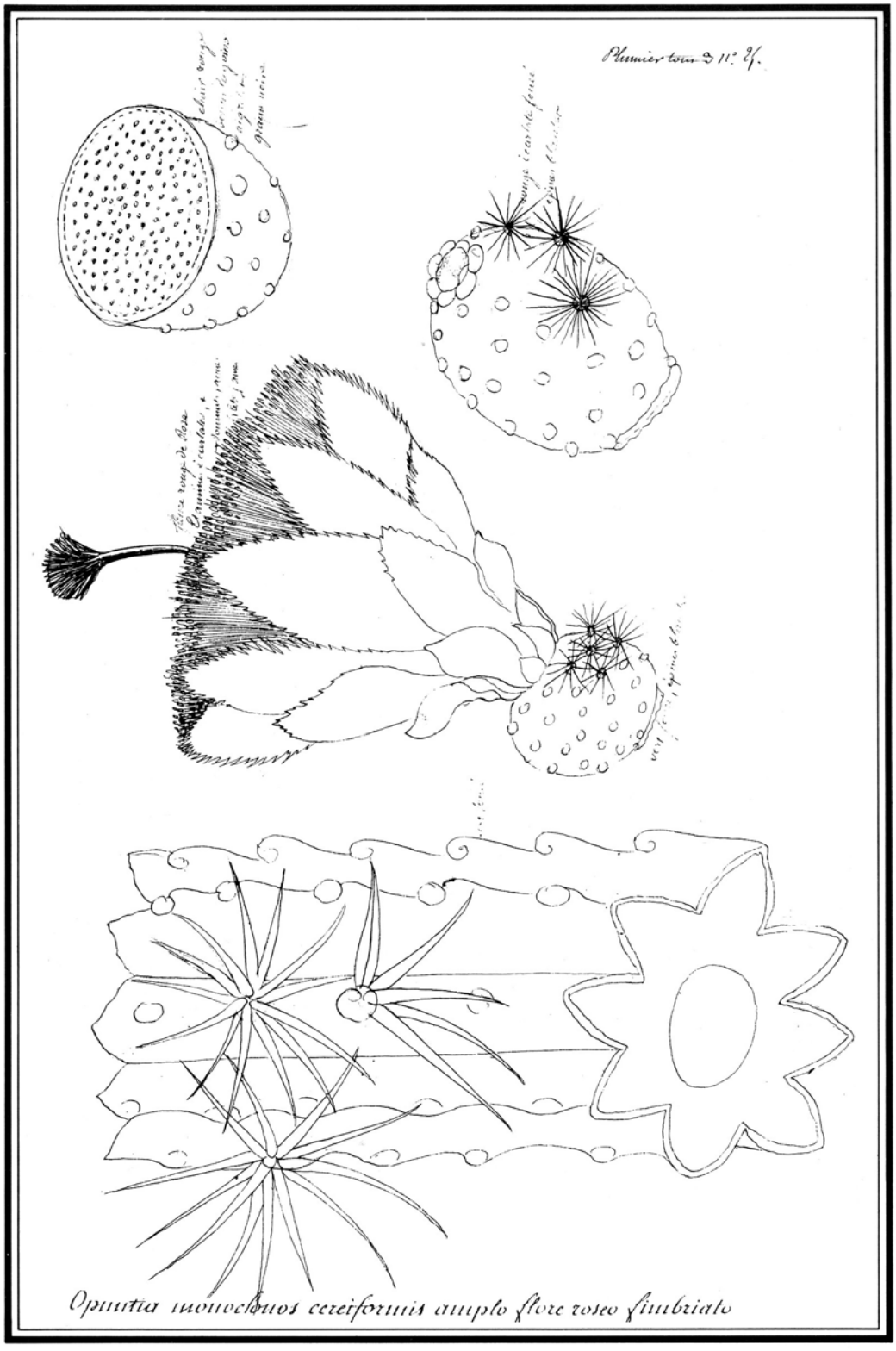
15. Opuntia arbor excelsa, cereiformis, flore albo Plumier 3:88



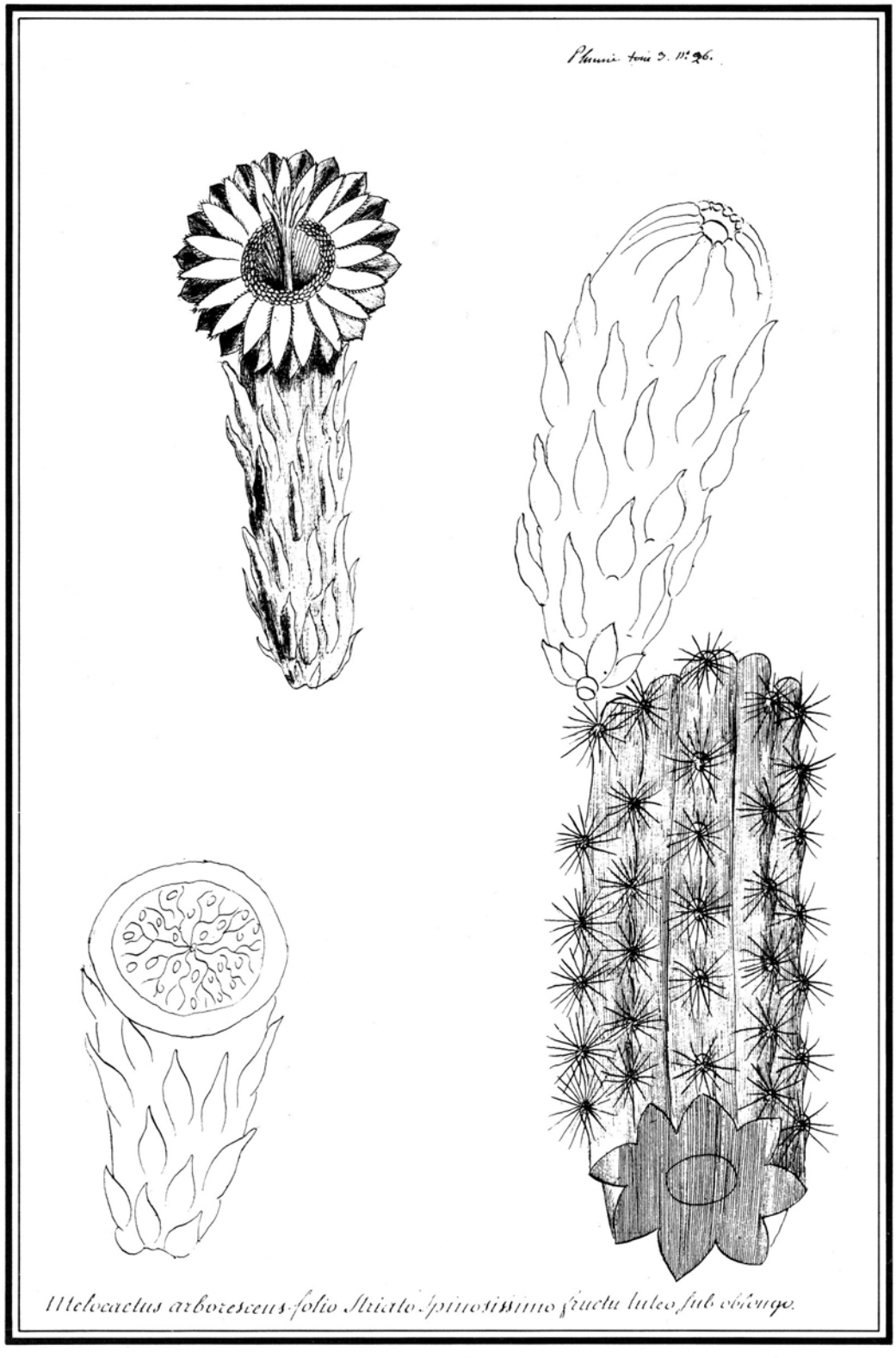
16. Melocactus [cereiformis] ramosissimus spinosissimus fructu aureo tuberoso Plumier 3:23



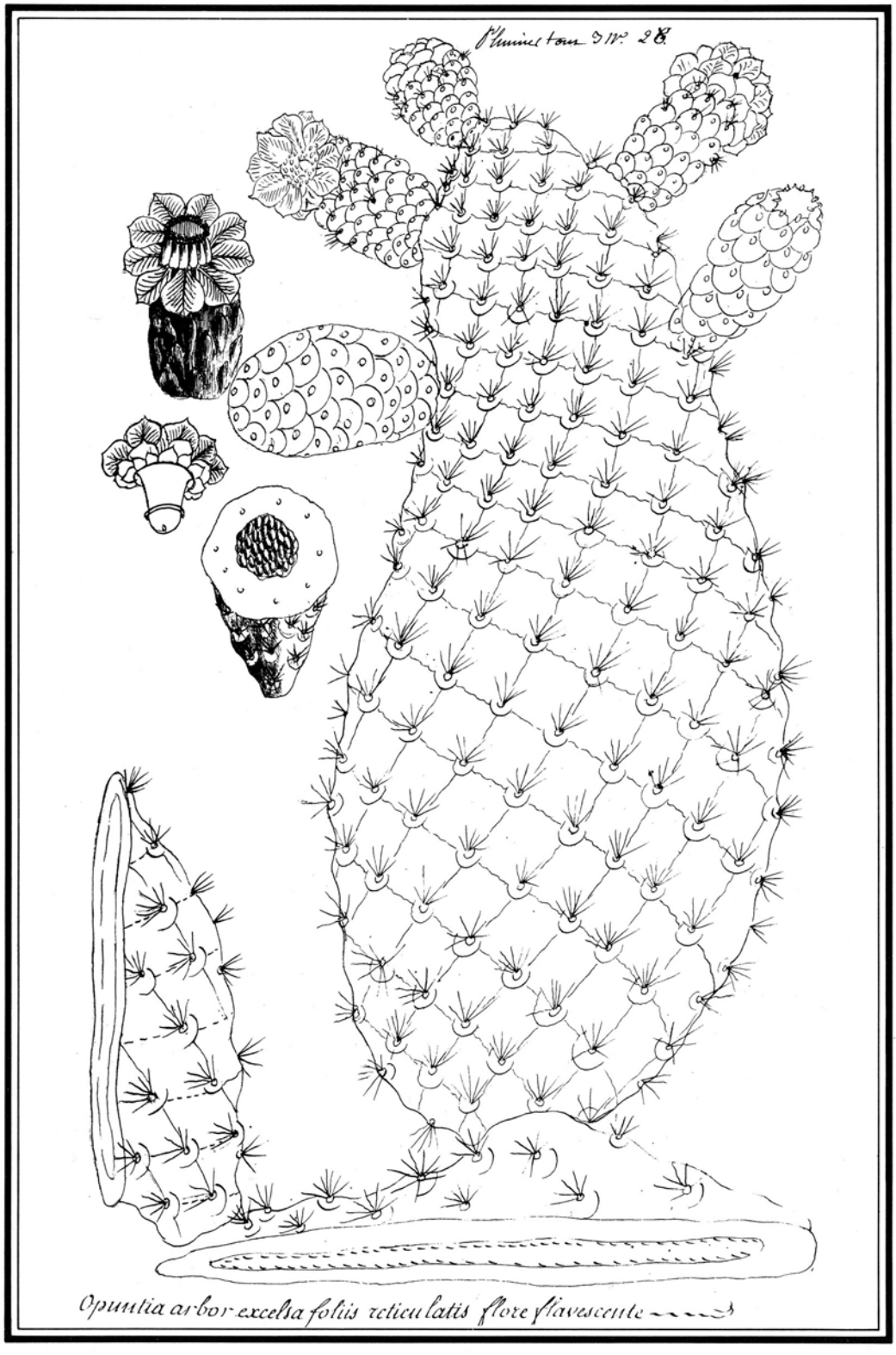
16. Melocactus [cereiformis] ramosissimus spinosissimus fructu aureo tuberoso Plumier 3:24



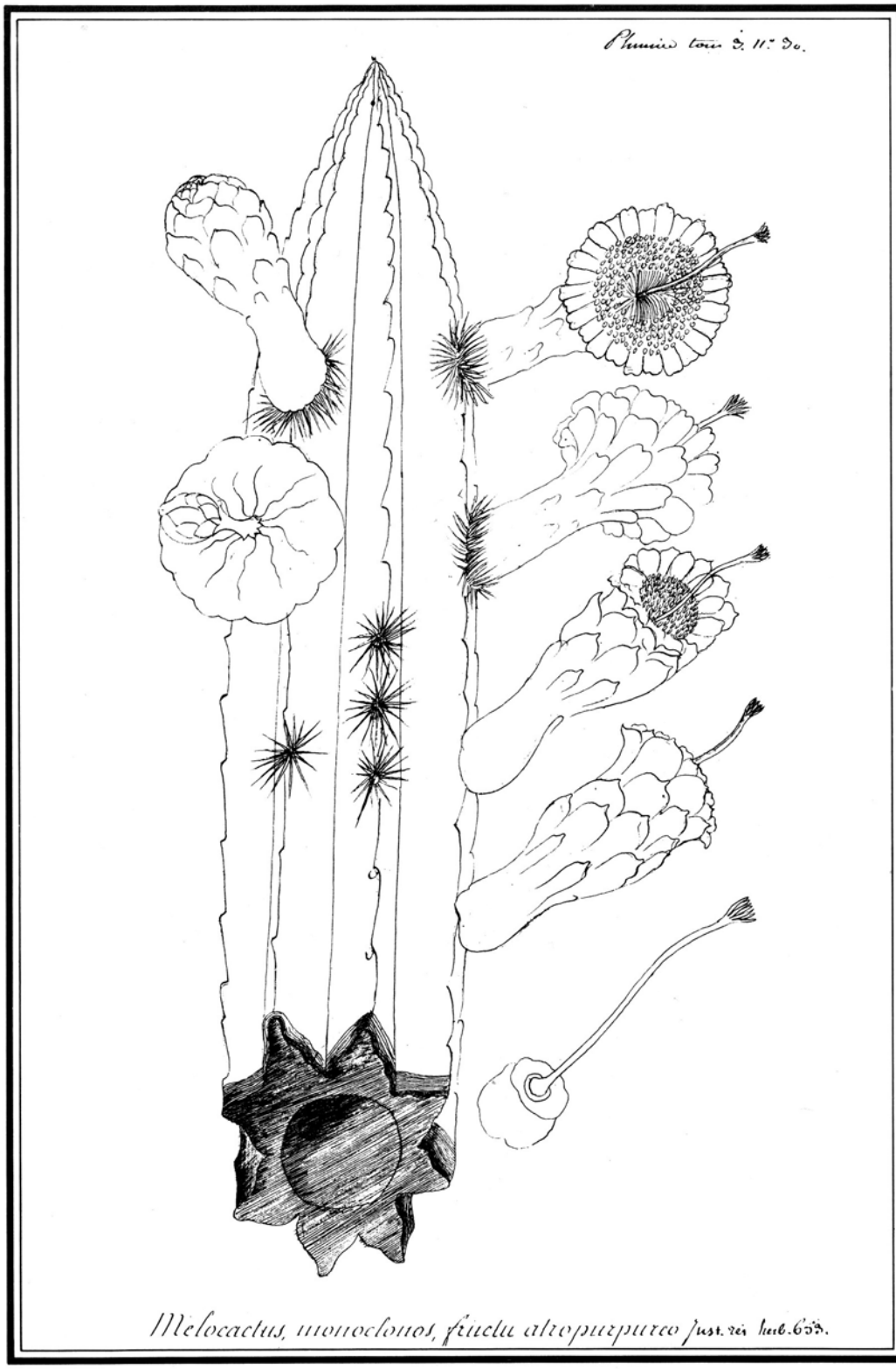
17. Opuntia monoclonos cereiformis amplo flore roseo fimbriato Plumier 3:25



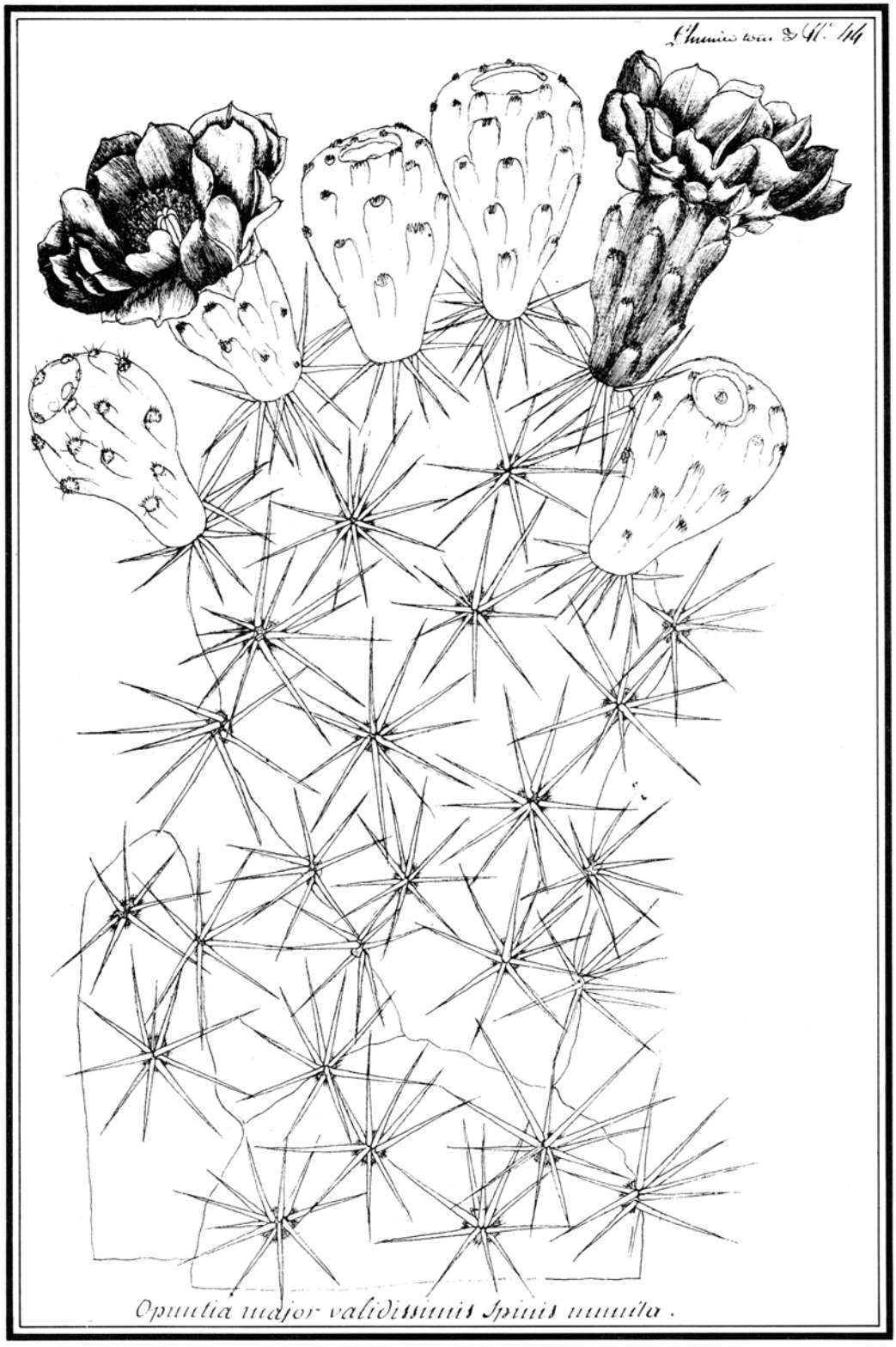
18. Melocactus arborescens folio striato spinosissimo fructu luteo suboblongo Plumier 3:26



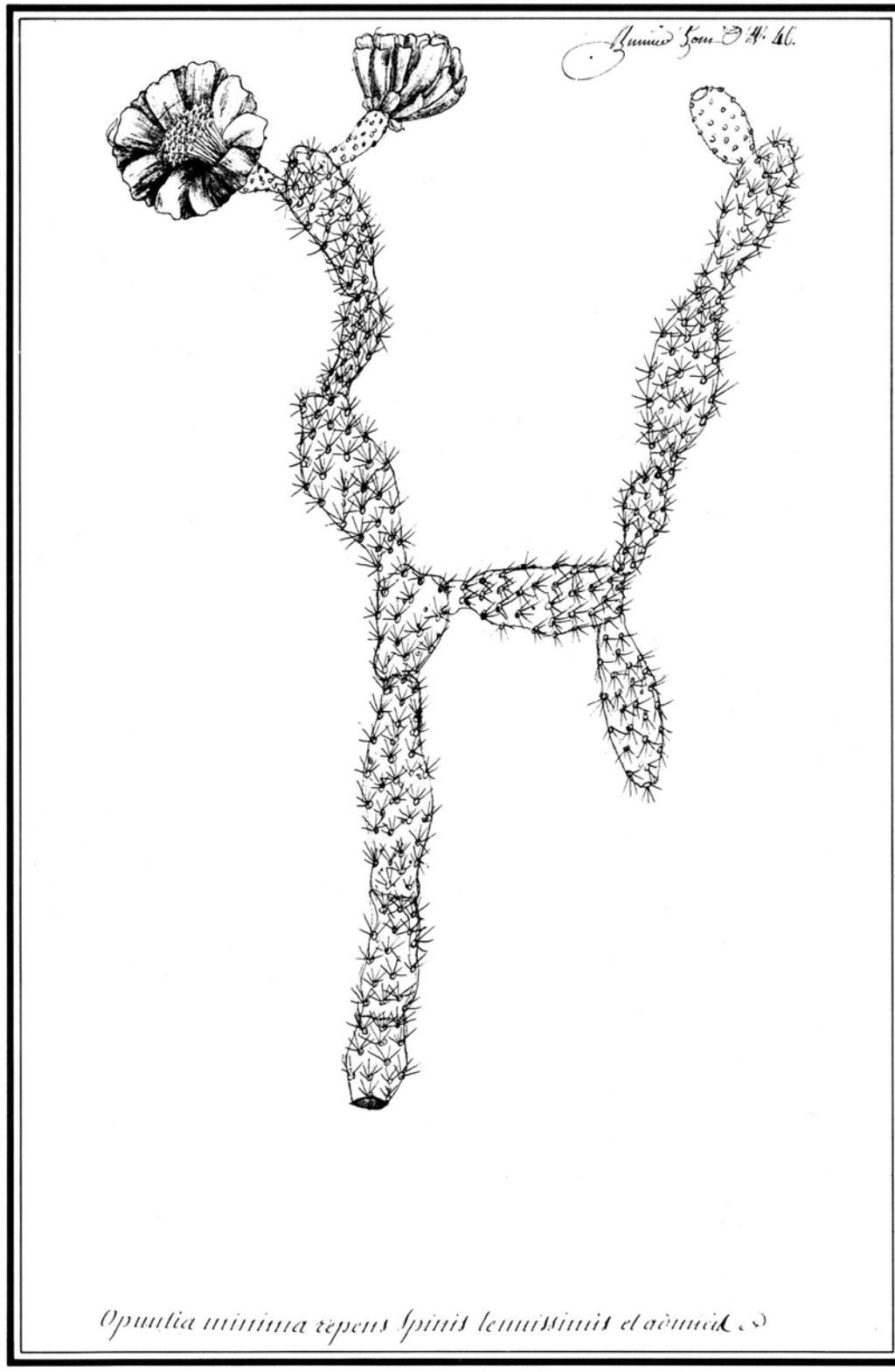
19. Opuntia arbor excelsa foliis reticulatis, flore flavescente Plumier 3:28



21. Melocactus monoclonos, fructu atropurpureo, [cereiformis] Plumier 3:30



22. Opuntia major, validissimis spinis munita Plumier 3:44



23. Opuntia minima repens spinis tenuissimis et aduncis Plumier 3:46

Bradleya 2/1984
pages 65-96

A new review of Mammillaria names D-K

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Summary. This is the second instalment of an annotated index of *Mammillaria* names, continued from Bradleya 1: 105-128 (1983). The series-name *Macrothelae* is replaced by *Mammillaria* in accordance with Art. 22.1 of the 1983 (Sydney) edition of the International Code of Botanical Nomenclature. The species *M. heidiae* is transferred to subg. *Mammillaria* ser. *Ancistracanthae.*

M. dactylithele Lab. *(Coryphantha macromeris:* Craig 347)

M. daedalea Scheidw. *(M. geminispina:* Craig 80)

M. daimonoceras Lem. *(Coryphantha radians:* Craig 347)

M. dasyacantha Engelm. (basionym for *Escobaria dasyacantha)*

M. dawsonii (Houghton) Craig, Mamm. Handb., 67, fig. 48 (1945); *Neom. dawsonii* Houghton in CSJA 7: 88 (1935), with drawing. Source: Mexico, Baja California, ocean front SW of Punta Prieta, 28° 40′N, 114° 12′W, elev. 10 ft, June 1933, *Dawson* s.n. (UC 540368, type!).

Series MAMMILLARIA*. A redescription of *M. glareosa*, q.v.

M. dealbata A. Dietr. in Allg. Gartenz. 14: 309 (1846). Source: Mexico, without locality data, *Ehrenberg.*

Though claimed by its author to be a member of series Leucocephalae and similar to *M. parkinsonii* and *M. leucocentra*, this species was speculatively identified by Britton & Rose with a plant originating from the lava flow (pedregal) near Mexico City, known in collections, they said, as *M. peacockii.* Craig (p. 119) listed *M. dealbata* as a synonym of *M. parkinsonii* but treated *Neomammillaria dealbata* B. & R. as a synonym of *M. elegans* var. *dealbata* K. Schum. The pedregal plant, now extremely rare, has been renamed *M. san-angelensis* Sanchez-Mejorada in Cact. Suc. Mex. 26: 8 (1981), with fig. 6, but no characters have been suggested by which it can be distinguished from *M. haageana* Pfeiff. *(M. elegans* hort.).

M. decholora Schlumberger in Rev. Hort., ser. 4, 5: 404 (1856) *(as decholara;* but this spelling 'corrected' to *decholora* on p. 480 of the same volume). Unidentifiable, as it was merely described as 'fleurs rouge, très-vif, très-petites'.

M. decipiens Scheidw. in Bull. Acad. Sci. Brux. 5: 496 (1838). Source: None given, but almost certainly collected by Galeotti in San Luis Potosi; type not known to have been preserved.

Series DECIPIENTES. Clustering, the individual stems [globose or] clavate, to 10 × 4-7 cm; tub. terete, obtuse, 10-22 × 5-7 mm at base; ax. with sparse wool and a few bristles. Cent. sp. 1-2, rarely lacking, up to 18-27 mm, slender acicular, straight, brown; rad. sp. 7 [5-11], c. 7-15 mm, slender acicular, yellowish or white, the uppermost sometimes tipped brown. Fl. 15-18 mm, delicately scented. Fr. cylindric [to slender-clavate, 20 × 4 mm, green with reddish tint, withered perianth persistent (Craig); seeds curved pyriform, 1.1 mm, light brown, pitted and with cross-striate testa cell-walls (MS 528)].

Reported by Britton & Rose, The Cact. 4: 131 (1923), from San Luis Potosi, without further locality, growing in the top of a *Calibanus* plant, coll. 1905, *Palmer;* also by Glass & Foster in CSJA 43: 4, fig. 79 (1971) E of the city of San Luis Potosi, by highway Mex. 86, in forests of *Myrtillocactus* and arborescent opuntias, 15 Nov. 1968. *G. & F.* s.n..; and from the valley of Lourdes, a form without central spines (l.c., fig. 80), 6 Nov 1968, *G. & F.* 960; and near Tierranueva, 24 Feb 1972, *Glass* 3877. The species also grows near highway Mex. 57, 122 km N of Querétaro, alt 2000 m, in crevices around rock outcrops, where I photographed it on 25 Aug 1971 (H. 8059p). Reppenhagen has collected a form intermediate with *M. albescens* at Villa Victoria, near San Luis de la Paz, Querétaro (Repp. 349).

Vicariants: *M. albescens* Tiegel, *M. camptotricha* Dams. Hybrids: *M.* × *beaujardii* Bertrand *(M. camptotricha* × *M. decipiens);* *M.* × *kuentzii* (auct.?), mentioned in JMS 7: 13, a putative hybrid between *M. decipiens* and *M. elongata. (M.* × *kuentzii* should not be confused with *M. kuentziana* Fearn, a synonym of *M. vetula.)*

M. declivis A. Dietr. *(M. applanata:* Craig 97)

M. decora Foerst. *(Coryphantha?:* Craig 347)

M. dedicata Hort. (Backeb. 3494)

M. deficiens, M. deficum Hort. *(M. decipiens:* Craig 229)

M. deflexispina Lem. *(M. magnimamma:* Craig 33)

M. deg(r)andi(i) Rebut Cat.; Walton Cat. (Craig 344)

M. deherdtiana Farwig in CSJA 41: 28, figs. 1-3 (1969). Source: Mexico, Oaxaca, between Nejapa, Juquila Mixes and Lachiguiri, barren rocky soil along both sides of the road Oaxaca—Tehuantepec, originally collected in 1959 by Schwarz. Holotype at POM.

Series LONGIFLORAE. Solitary, depressed globose, 2.5 × 4.5 cm, roots thickened fibrous; tub. conical, up to 10 mm; ax. slightly woolly or naked. Cent. sp. 0-6, 3-7 mm long, more or less stout, nearly porrect, pale to dark reddish brown or rarely yellow; rad. sp. (25-) 33-36, 3-6 mm, fine acicular, somewhat curved, at first yellow, soon glistening white, occasionally slightly reddish brown tipped. Fl. up to 5 cm diam. with a distinct tube 2 cm long; inner per. segs. bright rose-violet, anthers egg-yolk yellow, stigmas white. Fr. globose, 3-4 mm diam., remaining half-embedded in the stem, pale green in exposed portion, withered perianth persistent; seeds 2 mm long, dark brown-black, with a prominent ridge around the

*Formerly called MACROTHELAE. The change is required by Art. 22.1 of the latest (Sydney) edition of ICBN.

hilum and with ridges running lengthwise through the testa.

The type locality given covers such a large area as to be almost meaningless. On my map Juquila Mixes is about 50 km N of Nejapa, and there are two villages called Lachiquiri, one about 60 km S of Nejapa, the other 60 km E of Nejapa. Glass & Foster (in CSJA 44: 96.1972) claimed that the species was discovered by C. Mieg in the mountains near Mitla, which is 60 km NW of Nejapa and close to localities for *M. dodsonii*. Later (in CSJA 51: 125.1979) they reduced the latter species to varietal status after studying collections of both taxa and Tom MacDougall's field observations.

M. delaetiana Quehl *(Coryphantha salm-dyckiana:* Craig 347)

M. deleulii Rebut Cat. (Craig 295, 344)

M. delieui Rebut Cat. *(M. droegeana?:* cf. MfK 9: 159. 1899)

M. deliusiana Shurly in CSJGB 10: 92, with fig. (1948). Source: Mexico, Guerrero, Iguala mountains, in shade of trees between rocks, in leaf-mould, *Schwarz* s.n. (K, holotype!).

Series POLYACANTHAE. Described in ignorance of *M. bella* Backeb., and later acknowledged by Shurly to be synonymous with it.

M. densa Link & Otto *(M. echinaria:* Craig 253)

M. densispina (Coulter) Orcutt, Cactography, 7 (1926); *Cactus densispinus* Coulter in Contr. U.S. Nat. Herb. 3: 96 (1894); Vaupel in MfK 30: 55 (1920). Source: Mexico, San Luis Potosi, 1891, *Eschanzier* s.n. (F, holotype).

Series LEPTOCLADODAE. Typically solitary, globose [to slender columnar, 12 × 6 cm]; ax. woolly at first. Cent. sp. 6, 10-12 [-15] mm long, straight, more rigid and darker than the rad., black-tipped; rad. sp. about 25, unequal, 8-10 mm, erect-spreading, slender but rigid, yellow. [Fl. pale yellow, outer segs. with reddish midstripe.] Fr. described as red, but in fact greenish pink. Seeds reddish brown.

A distinctive species which has been collected or reported on numerous occasions by leading cactus-fieldsmen in the states of Guanajuato and Zacatecas, and I saw it myself in the mountains 25 km W of Dolores Hidalgo, Gto., 2400 m, on outcrops of igneous rock in steep oak-*Arbutus* woods, 25 Aug 1971, *H.*8064. Reports of its occurrence in Jalisco and Nayarit *(Lau* 1050, 1051) need verification, whilst a purely yellow-spined form from Querétaro, reported and illustrated by Craig (Mamm. Handb. 288-9, fig. 259) and sold by Schmoll as '*M. esaussieri* Fric' appears to be intermediate with *M. mieheana* Tiegel. The latter, also from Querétaro, is in turn a link with the *M. microhelia* complex (Sierra Zamorano, Que.) and *M. elongata* (Que. and Hidalgo).

The variously spelt *M. esaussieri* seems, incidentally, to have been a misreading and a misapplication of *M. eschauzieri* (Coulter) Craig, the brothers Eschauzier have collected the types of both *M. eschauzieri* and *M. densispina.*

M. densispina Hort. *(Coryphantha densispina:* Craig 347)

M. denudata (Engelm.) A. Berger, Kakteen, 288 (1929); *M. lasiacantha* var. *denudata* Engelm., Cact. Mex. Bound., 5, t.4 (1859). Source: U.S.A., Texas, 'about Leon spring and Camanche spring, west of the Pecos, on low limestone hills, among herbage, 1852, *C. Wright* (MO, holo.; POM 317820, iso.).

Series LASIACANTHAE. The common form of *M. lasiacantha, q.v.*

M. depressa [attrib. to DC. by] Pfeiffer, as synonym (error for *Cactus depressus; M. discolor;* Craig 261)

M. depressa Scheidw. *(M. uncinata:* Craig 42)

M. deserti Engelm. (basionym for *Escobaria vivipara* var. *deserti)*

M. desertorum Walton Cat. *(M. magnimamma:* Schelle; cf. Craig 344)

M. desnoyersii Brongn. *(Brachyphyllum desnoyersii* Saporta, a fossil conifer; cf. MfK 16: 177. 1906)

M. destorum Hildm. Cat. (error for *desertorum?; M. magnimamma:* K. Schum.; cf. Craig 363)

M. detampico Hort. *(M. magnimamma:* K. Schum.; cf. Craig 363)

M. diacantha Haage *(M. haageana:* Craig 247)

M. diacantha Lem. *(M. sempervivi:* Craig 58)

M. diacentra Jacobi in Allg. Gartenz. 24: 91 (1856). Source: A plant of unrecorded origin in the 'Wegnerschen Sammlung'.

Perhaps Series MAMMILLARIA. Unidentifiable, but listed by Craig (74) after *M. zuccariniana.* The spurious *M. diacentra* listed by Uhlig, no. 934 in his 1976 catalogue, was a plant allied to *M. rhodantha,* according to Mottram, Mamm. Index, 23 (1980).

M. diadema Muehlenpf. *(M. magnimamma:* Craig 33)

M. diaphanacantha Lem. *(Neolloydia conoidea:* Craig 347)

M. dichotoma Forbes, J. Hort. Tour, 149 (1837) (perhaps a yellow-spined form of *M. rhodantha)*

M. dietrich(i)ae Tiegel in Moeller's Deutsch. Gart. Zeit. 48: 413, with fig. (1933). Source: Mexico, Querétaro, sent by F. Schmoll.

Series LEUCOCEPHALAE. Treated as synonymous with *M. parkinsonii,* of which it was a long-spined form.

M. differentes Boarder in Mamm. Soc. J. 6: 41 (1966), name only

M. difficilis (Quehl) *(Coryphantha poselgeriana:* Craig 347)

M. digitalis Ehrenb. *(M. haynii:* Craig 332)

M. diguetii (Weber) D. R. Hunt in JMS 11: 59 (1971); *M. senilis* var. *diguetii* Weber in Bull. Mus. Nat. Hist. Paris 10: 383 (1904). Source data: Mexico, Jalisco, in the mountains, alt. 2500 m., March 1900, *L. Diguet* (P, not examined).

Subg. MAMILLOPSIS. Closely allied to *M. senilis* but with more rigid, dark straw-coloured spines and smaller flowers, 3 cm long and deep red.

Further collections: Sinaloa, Sierra de Chabarra, Concordia, 1921, *J. G. Ortega,* (cf. Britton & Rose, The Cact. 4: 20. 1923); Sierra Madre Occidental, *Kimnach & Sanchez-Mejorada (?).*

The status of this elusive plant is still in doubt, but it is probably no more than a phase of *M. senilis.* Specimens collected by Kimnach & Sanchez-Mejorada in 1974 had the requisite stiff, yellowish spines but died without flowering (Sanchez-Mejorada, pers. comm.).

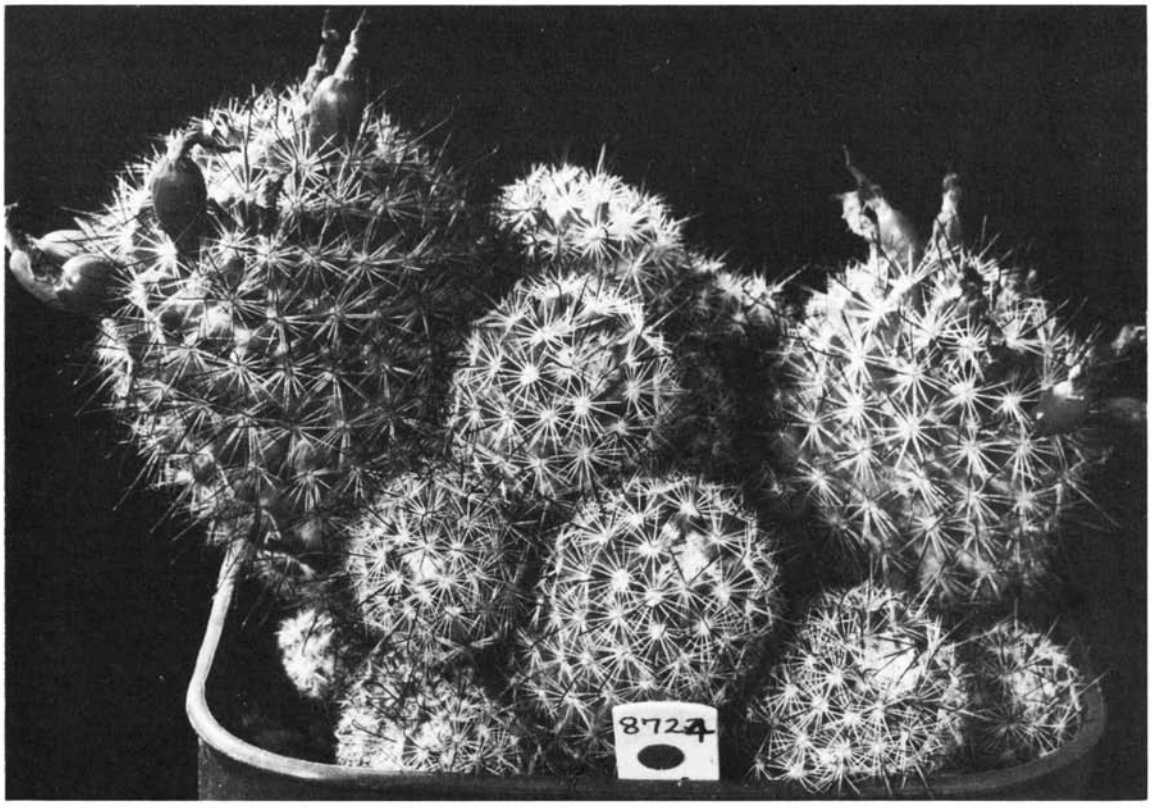
M. dioica K. Brandegee in Erythea 5: 115 (1897). Source data: U.S.A., California, near the coast a short distance north of San Diego southwards; Mexico, Baja California and adjacent islands.

Series ANCISTRACANTHAE. Simple, caespitose or occasionally branching; ax. with 4-15 bristles, as long as the tubercles. Cent. sp. 1-4, the upper ascending with the radials, the lowest longer, stouter, porrect and hooked, 8-15 mm long; rad. sp. 11-22, usually white. Fl. 10-22 mm long, incompletely dioecious (see notes), yellowish white, sometimes reddish; per. segs. longer and more spreading in the male [perfect]fl. Fr. clavate or ovoid, 10-25 mm long, scarlet.

The Californian habitat is described by Munz (A Californian Flora, 319. 1959) as 'sandy places, below 500 ft.; Chaparral, Coastal Sage Scrub.'

A form from the western edge of the Colorado Desert and Santa Rosa Mts. was described as *M. incerta* Parish and treated by Munz (l.c.) as a variety of *M. dioica.*

During a trip down Baja California with Dr Reid Moran, Gordon Rowley and David Minnion in September 1974, I was struck by the variability of this species, and collected seeds or small plants from several populations. The differences have been maintained in cultivation, the northern forms *H.* 8702 (Arroyo Seco, lat. 31° 05′N), *H.* 8713 (Arroyo Socorro, lat. 30° 15′N), *H.* 8719 *(Idria* zone, lat. 30° 10′N) and *H.* 8724 (Boca de Marron, lat. 28° 40′), being more globose and sometimes freely clustering, those from further south, i.e. *H.* 8732 (N of Insurgentes, lat. 25° 30′) and *H.* 8739-8741 (80 km W of La Paz, lat. 24° 15′N), being more narrowly cylindric and remaining solitary. In the extreme southern part of Baja California, *M. dioica* seems to be replaced by *M. phitauiana* (inland) and *M. armillata* (coast). *M. angelensis, M. estebanensis* and *M. neopalmeri* all invite interpretation as insular vicariants of *M. dioica,* whilst *M. cerralboa* may be referable to *M. armillata. M. neopalmeri* was in fact treated as *M. dioica* var. *insularis* by K.



M. dioica H. 8724 *(photo: Harwood)*

Brandegee, l.c., and this would be its correct name at varietal rank.

Cytological observations on *M. dioica* (Johnson in CSJGB 42: 43-47. 1980) showed *H.* 8724 and *H.* 8740 to be tetraploid (2n = 44) along with *M. blossfeldiana*, and *H.* 8702 to be hexaploid (2n = 66). Other species of ser. Ancistracanthae from Baja were diploids (2n = 22). The survey will be continued with material collected by N. P. Taylor in 1983.

Some plants from my 1974 trip bear perfect (hermaphrodite) flowers, whilst others are functionally female, lacking fertile stamens. This is in accord with the observations of Ganders & Kennedy (in Madrono 25: 234. 1978), who found the same 'gynodioecism' in populations from the Anza Borrego Desert State Park in SE San Diego Co., California. The truth of Mrs Brandegee's original statement that many plants were either male or female and others hermaphroditic or 'imperfectly dioecious in all degrees' thus needs corroboration.

Also needing more study is the occurrence of *M. dioica* in mixed populations with various forms of *M. hutchisoniana* or *M. blossfeldiana*. It is unusual for more than one member of a 'series' to occur in a single locality, since the differences between members of one series are usually relatively small, and one expects them to be inter-fertile and liable to merge when growing together. Possibly there is some hybridization between *M. dioica* and species growing with it, but there is little evidence for it and differences of pollen and stigma microstructure revealed by the SEM (Owens, unpubl. data) imply physical, if no other, barriers to inter-breeding between *M. dioica* and *M. blossfeldiana*. Such differences further imply that the general habit of the Ancistracanthae could conceal two or more convergent evolutionary lines, analogous perhaps to the series Supertextae and Leucocephalae, but in this case sympatric.

M. disciformis DC. *(Strombocactus disciformis)*

M. discocactus [attrib. to Haage by] Shurly (cf. Backeb. 3910)

M. discolor Haworth, Syn. Pl. Succ., 177 (1812) and in Phil. Mag. n.s. 7: 113 (1830). Source: A plant 'in Mr Vere's collection', origin unknown.

The type of Series HETEROCHLORAE. Such a mass of doubts attaches to this early-described species, however, that a strong case could be made to get rid of the name and start again, as with *M. elegans*. Haworth's original description '*M.* (Discolour'd) *simplex discolor subrotunda: tecta tuberculis ovatis apice spiniferis, spinis radiantibus discoloribus*' was hardly adequate to distinguish whatever it was he had from *M. mammillaris*, the only other species known to him apart from *M. prolifera*. And in his 1830 paper, he admitted that the type plant had died before 1812, the year his description appeared. Meanwhile, as early as 1813, De Candolle had described a plant in the Montpellier botanic garden rather more fully as *Cactus depressus*, later identified by De Candolle himself with *M. discolor* and illustrated as such in his Révue de la famille des Cactées (1828), t.2. It does not take an impossibly large stretch of the imagination to make De Candolle's plant fit one of the pale-flowered forms we call *M. discolor* today, but it could equally well be some other species, and, anyway, Haworth (1830) was adamant that it was not what *he* had called *M. discolor*.

Haworth (1830) also mentioned that before Mr Vere got the plant, it had been at Messrs Loddiges, and thus the discovery that Messrs Loddiges figured *M. discolor* in their 'Botanical Cabinet', vol. 17: t. 1671 (1830) looks a promising clue. But, alas, the plant figured was received from Mr Deppe in 1829, sent from Xalapa, and there is no suggestion that it was authenticated by Haworth, or any recollection of an earlier

plant under the same name. Moreover, the Deppe plant is shown globose with glaucous tubercles, at least), curving spines, and carmine flowers!

In my earlier notes on *M. discolor* (JMS 8: 93. 1968) I said that the epithet 'discolor' refers to the differences in colour between the central and radial spines. There is certainly such a difference in the spines of typical plants of *M. discolor* as grown today, and it is a feature noted in De Candolle's description of *C. depressus*, but, again, Haworth's 1830 paper casts doubt on the relevance of the feature, describing the spines as '*uno colore toto apicem versus, altero inferiore*', implying that the spines were simply darker-tipped.

Perhaps someone will someday discover who it was that supplied the original plant to Loddiges and where they had travelled, but until then we are faced with the choice of abandoning the epithet *discolor* or attaching it to one particular form of what is called *M. discolor* today, which can serve as a neotype. For the latter alternative, the best choice might be the form from above Pachuca, Hidalgo, which remains solitary and has pale, pink-tinged flowers, and is in a part of the country readily accessible by the beginning of the nineteenth century. It is the form identified by Britton & Rose and others as *M. amoena* (q.v.), but this is certainly incorrect. I do not have plants of this provenance in cultivation but took detailed notes and photographs when in the locality in 1973 (*H.* 8548p, *H.* 8550p). One of the collections cited as *M. discolor* by Scheinvar in her thesis 'La Familia de las Cactáceas en el Valle de México' (UNAM, Mexico, 1982, unpubl.), namely *Scheinvar* 1371, is probably this form. My description, with Scheinvar's of the fruit, is as follows:

Series HETEROCHLORAE. Simple, depressed, only 3-4.5 cm showing above ground, 6-11 cm diam., with watery sap; tub. cylindric-terete, 10-15 × 8-9 mm, green or slightly glaucous; ax. with scant wool or naked. Cent. sp. 4-6, lowest longest, to 22 mm, dark brown at first, paler in lower half, later greyish brown throughout; rad. sp. 23-28, to 8-9 mm, acicular, glassy white or with slight yellowish tinge. Fls. 20-27 mm, not opening widely, outer segments pinkish brown with white margins, inner with broad pink mid-stripe and white margins, filaments and style white, anthers yellow, stigmas slender, 5, 2.5 mm, pale greenish yellow. Fr. clavate, 2-3 cm, greenish white, pink below.

MEXICO. Hidalgo, Sierra de Pachuca, 2700 m, in shade of junipers etc., 6 Nov 1973, *Hunt* 8548p; the same, 1 km towards El Chico from junction with road to Mineral del Monte, 2750 m, *Hunt* 8550p. Mpio. Mineral de la Reforma, Rancho Rufina, 2900 m, 20 Mar 1974, *Scheinvar & Velasco* 1371 (MEXU, ENCB).

This form, which characteristically grows deep-seated in the relatively deep soil of grassy slopes, sometimes accompanied by *M. magnimamma*, is illustrated by Glass & Foster (in CSJA 43: 75, fig. 107. 1971), along with a plant that has produced offsets (fig. 106, *G. & F.* 1232), both as *M. amoena*. Other illustrations on the same page show other putative species of the *M. discolor* complex, none of which, they assert (and I agree) deserve specific rank, and all of which should be 'synonymized' with *M. discolor*. The taxa concerned are *M. esperanzaensis* Boed., from Puebla; *M. pachyrhiza* Backeb., from the borders of Puebla and Veracruz; *M. ochoterenae* (Bravo) Werdermann and *M. schmollii* (Bravo) Werdermann, both from Oaxaca. All of these, as originally described, are pale-flowered, whitish with pink mid-stripes or pale yellow. Other plants of the affinity of *M. discolor* can have quite deep pink flowers, such as that which goes under the nursery name of '*M. ginsaumae*'.

Glass & Foster also report collecting '*M. amoena*' in the mountains south of Mexico City. Mexican friends have told me that *M. discolor* used to be fairly common in the hills to the west of the city too, though it is now very scarce due to urban spread. Dr Jorge Meyran showed me one of its habitats in August 1976, just outside the Distrito Federal, in the state of Mexico, about 6 km W of Naucalpan. The one small plant I collected (*H.* 9547), from a population growing on a rock outcrop, now seems to correspond with the cultivated form which is illustrated by Pilbeam (Mammillaria, A Collector's Guide, p. 54).

M. dispina Walton Cat. (Craig 344)

M. divaricata Forbes (Craig 328)

M. divaricata A. Dietrich (Craig 328)

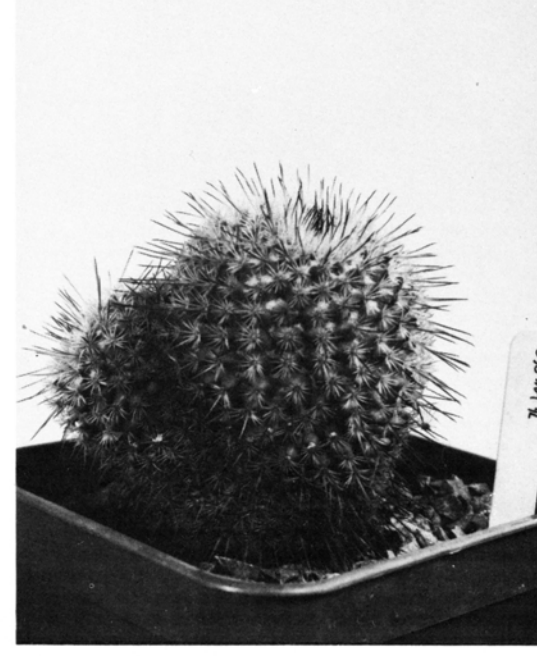
M. divergens DC. *(M. magnimamma:* Craig 33)

M. divica Hort. A plant I saw with this name was the form of *M. decipiens* with no central spine.

M. dixanthocentron Backeb., Descr. Cact. Nov. 3: 8 (1963). Source: Mexico, between Tehuacan and Oaxaca, *Buchenau* 4 in 'coll. Backeberg'. Since Backeberg did not preserve specimens, the name may have to be regarded as technically invalid until Mottram (Mamm. Index, 24. 1980) designated Backeberg's illustration (Das Kakteenlexikon, 606, fig. 212. 1966) as type ('lectotype').

Series SUPERTEXTAE. Solitary, to 20 × 7-8 cm; tub. 13: 21, c. 6 mm; ax. with grey [or white] wool; ar. sparsely woolly at first. Cent. sp. 2, c. 5 mm, divaricate, at first clear yellow, later horn-coloured or whitish; rad. sp. c. 19-20, 2-4 mm, white. Fl. light red. Fr. 2 cm, slender, yellowish below, orange above; seed not described (brown, 0.75-1.1 × 0.6-0.75 mm: MS 712).

Backeberg (1966) modified the description of the central spines to 'upper erect, c. 5 mm, lower porrect or directed downwards, to 15 mm', which fits his illustration and the usual form cultivated. Whether or not the original version was simply wrong, or based on a different plant, is unclear. Felipe Otero took me to what he claimed was Buchenau's 'type locality', south of Teotitlan del Camino, Oax., in September 1974, and the plants there certainly have the long, lower central (*H.* 8840). Other forms from the same general area are discussed by Lau in CSJGB 41: 64-65 (1979), including *Lau* 062, 063, 063A and 1087. Of these, *Lau* 1087 seems to me to correspond closely with the plant Britton & Rose identified as *M. celsiana*, both collections being from Cuicatlan, but the correctness of Britton & Rose's interpretation is extremely doubtful, as Lemaire's description of *M. celsiana* calls for 6-7 centrals and 24-26 radials, and it is unlikely that he would have had material from Cuicatlan at that time. (Karwinsky had sent material from the Tomellin valley to Martius, but not, apparently, anything corresponding to *M. dixanthocentron*.)



M. dixanthocentron Lau 063 *(photo: Harwood)*

M. dodsonii near Cuajimoloyas, Oax. *(photo: Greenwood)*

M. docensis Soulaire (Backeb. 3158: error for *bocensis*)

M. dodsonii Bravo in Cact. Suc. Mex. 15: 3-5, figs. 2, 3 (1970). Source: Mexico, Oaxaca, Cerro de San Felipe del Agua, north of Oaxaca City, in rock crevices amongst mosses and ferns, 6 Feb. 1969, *J. W. Dodson* 401 in MEXU 118775 (type), 118857, 118858! (All labelled '*M. greenwoodii* Bravo, sp. nov.').

Series LONGIFLORAE. Stem solitary or clustering, depressed-globose, up to 3 cm tall, 4 cm diam, roots fibrous; tub. 5: 8, conical, 5 mm long, 4 mm diam. at base; ax. naked. Cent. sp. 3-5, 1-2 cm long, reddish brown, stronger than the radials, straight or slightly curved; rad. sp. 20-21, the lowest longest, up to 18 mm long, acicular, vitreous white. Fl. large, 4 cm long, purple; filaments cream, anthers intense yellow, style and stigmas purple. Fr. not described, enclosed in the stem at the base of the tubercles; seeds 1.5 mm long, black.

Differs from *M. deherdtiana* in the spiral count (significant?), the fewer and longer radial spines, the longer and more regularly produced centrals, and details of the areoles and flowers. The type locality is some 80 km from that of *M. deherdtiana* and I would venture to prophesy that linking forms will be discovered when the area is explored more fully. Glass & Foster (in CSJA 51: 125. 1979) now treat *M. dodsonii* as a variety of *M. deherdtiana* and this seems appropriate.

Additional collections: Oaxaca, near Benito Juarez (Ixtlan de Juarez?) Jan. 1965, *T. MacDougall;* municipio de Tlacolula, Carrizal, *Anita Jones* (both reported by Bravo, l.c.); also reported from the Sierra Juarez, 3100 m., and near Cuajimoloyas, 3080 m., *Greenwood.*

M. dolichacantha C. F. Foerster, pro syn. *(M. dolichocentra:* Craig 228)

M. dolichocentra Lem., Cact. Nov. Hort. Monv., 3 (1838).

Series HETEROCHLORAE. Regarded as synonymous with *M. obconella* Scheidw., itself a form of *M. polythele* Mart.

M. donatii Berge ex K. Schum., Gesamt. Kakt. Nachtr., 135 (1903). Source: Based on a cultivated plant of unknown origin, obtained from Berge (Leipzig).

Series SUPERTEXTAE. Reported by Craig (251) from near Esperanza, Puebla, and thought by him to be perhaps synonymous with *M. collina*, not described till 1912. Britton & Rose's illustration (The Cact. 4: 111, fig. 114, 1923) of a plant they had received from Haage & Schmidt in 1920 shows *four* centrals at some areoles and large tubercles and may have been, coincidentally, another species from Esperanza, namely *M. esperanzaensis.* In view of the unsatisfactory typification of the original *M. donatii,* the name is best discarded.

M. donkele(a)ari Hildm. ex Haage, name only (Craig 344)

M. droegeana Hildmann Cat. (cf. Quehl, MfK 25: 48. 1915); *M. rhodantha* var. *droegeana* K. Schum., Gesamt. Kakt., 550 (1898); *M. droegeana* (K. Schum.) Borg, Cacti, 393 (1937).

The identity of the original *M. droegeana* is obscure. It seems to have been a Hildmann nursery plant, though attributed to Rebut's 1896 Catalogue (along with '*M. deleulii*') by Craig (295). A Mr Fröhlich is said to have equated *M. droegeana* Hildm, and the equally foggy *M. delieui* Rebut at a meeting of the German Cactus Society on 25 Sept 1899 (MfK 9: 159. 1899). Schumann thought it a variety of *M. rhodantha* 'with lighter or darker brown centrals and yellowish radials', and Quehl (l.c. above) a seedling form of *M. discolor.* Borg says it came from Puebla, and Craig (fig. 266) illustrates a Schmoll introduction from the Sierra de San Moran (Sierra Zamorano, Querétaro) referable to *M. microhelia* Werdermann (1930). This relatively inaccessible mountain range is not known to have been visited by collectors before about 1925, but if Schumann or Quehl *had* received *M. microhelia* it is unlikely they would both have failed to recognise it as distinct. For these reasons, I dismiss the modern *M. droegeana* as an impostor. It could perhaps be re-named as a cultivated form of *M. microhelia.*

M. dubia Rebut Cat. (Craig 344)

M. dumetorum J. A. Purpus in MfK 22: 149 (1912); ibid., 23: 89, with fig. (1913). Source: Mexico, San Luis Potosi, near Minas de San Rafael, winter of 1910/11, *C.A. Purpus*, growing on limestone barrancas with *M. pilispina* J. A. Purpus.

Series LASIACANTHAE. Forming few-headed clusters, individual stems depressed-globose, eventually cylindric-globose; tub. 10 × 5 mm, conic, dark green; ax. with a few fine curly hairs. Cent. sp. 0; rad. sp. numerous, 4-6 mm, the inner described as finely bristly and somewhat longer, the outer as thicker, subulate, all rigid, white or yellowish. Fls. 18 × 18 mm, greenish white, Fr. red; seeds black.

There are several places called Minas de San Rafael in the state of San Luis Potosi, but the one at which C. A. Purpus collected is between the cities of San Luis Potosi and Valles (Sousa Sanchez, in Univ. Calif. Publ. Bot. 51: 23. 1969). *M. dumetorum* has been re-collected hereabouts by Glass & Foster on several occasions, and by Lau. It is usually regarded as a close ally of *M. schiedeana*, which was described from Hidalgo, though I have yet to see a field-collected plant. *M. dumetorum* has more rigid spines, graded from very finely to more coarsely bristly, and is sometimes confused on this account with *M. viereckii*, which occurs further north.

The graded spines of *M. dumetorum* certainly suggest kinship with series Proliferae, in which I place *M. viereckii* and also *M. pilispina*. The latter was originally collected with *M. dumetorum* and has also been re-collected by Glass & Foster (unpubl. data), who consider it the same as *M. sanluisensis* Shurly, but (by implication) not the same thing as *M. dumetorum*. Question-marks hang, nevertheless over these and other similar plants, and the two series to which I have assigned them.

M. duncanii (Hester) Weniger, invalid *(Escobaria dasyacantha* var. *duncanii)*

M. duoformis Craig & Dawson in Allan Hancock Foundation Occ. Papers 1-2: 59, t. 19 (1948). Source: Mexico, Puebla, Puebla—Oaxaca highway, near Tehuitzingo, on dry exposed lava hill slope of southern exposure, 30 Jan. 1947, *E. Y. Dawson* 4555 in Allan Hancock Herb. 10860 (type of var. *duoformis*), 10861 (type of var. *rectiformis*).

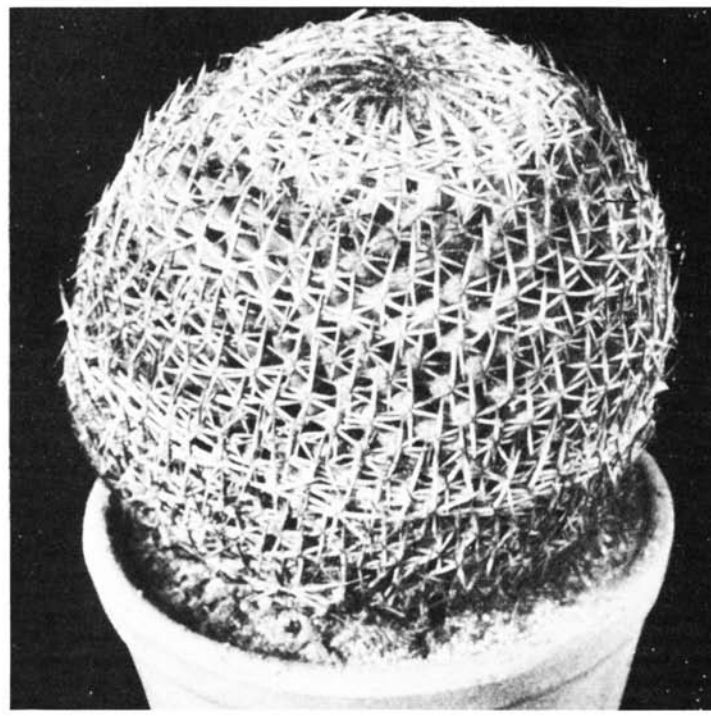
Series POLYACANTHAE. Stem simple or branching from the base, cylindric, to 9 × 3.5 cm; sap watery in tub., or semi-milky in stem; ax. with bristles. Cent. sp. 4, 10-12 mm long, upper three straight, lowermost longest, stout acicular, hooked (var. *duoformis*) or straight (var. *rectiformis* Craig & Dawson, l.c. 60), all pinkish tan below, blackish above; rad. sp. 18-20, 5-7 mm long, slender acicular, straight, orange-tan at very base, chalky white to pale yellow above. Fl. 15 mm long, 12 mm in diam., crimson. Fr. brownish pink, 18 mm long, 4 mm diam., perianth persisting; seeds brown, pitted.

Craig & Dawson's original epithet for the typical variety (var. *typica*) must be replaced under current ICBN rules by *duoformis*. In any case, the hooked/straight spine phases hardly merit varietal rank.

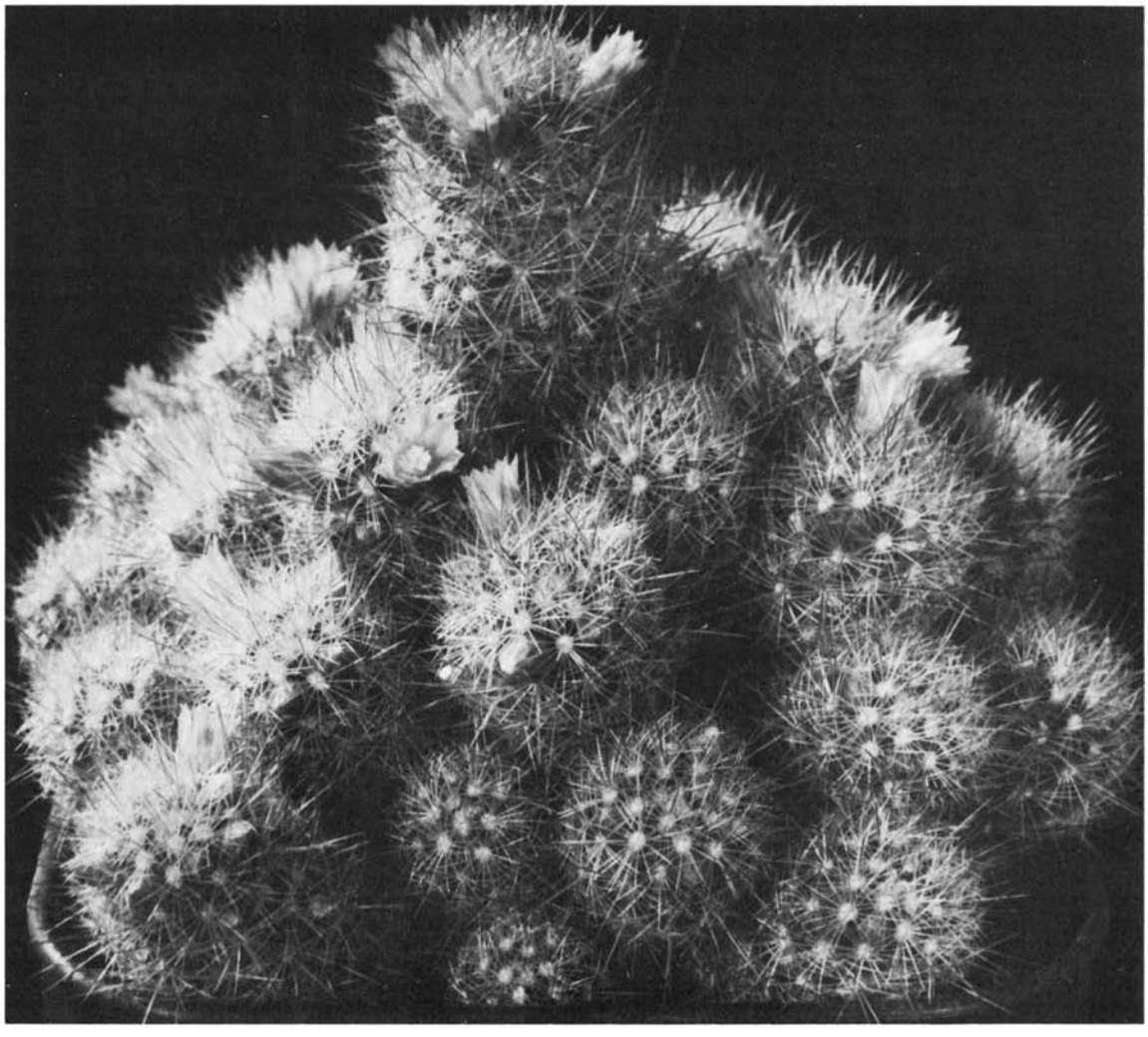
A third specimen cited by Craig & Dawson, from Guerrero, Acapulco—Mexico highway just west of Tierra Colorada, 1 Feb. 1947, *Dawson* 4562 (living material only?) was probably a different species, perhaps the more recently described *M. xaltianguensis* Sanchez-Mejorada, whose type locality is not far distant.

An interesting, but rather inconclusive, article on various members of the *M. nunezii* group, including *M. duoformis*, published by R. Pillar in Mtbl. AfM 1982(3): 82-100 attests to the difficulty of making any sense of the names and suggests a grouping based on whether the plants are solitary or clustering, globose or cylindric and the tubercles 8:13 or 13:21. *M. duoformis* may be the best name for the more slender forms with axillary bristles.

M. durangensis Runge ex K. Schum. *(Coryphantha durangensis)*



M. durispina: reproduction of Boedeker's original illustration (1928).



M. echinaria H. 8636 *(photo: Harwood)*

M. durispina Boed. in ZfS 3: 342, with fig. (1928). Source: Introduced by Graessner, presumably from central Mexico.

Series HETEROCHLORAE. Stem simple, subglobose or shortly columnar; ax. woolly at first, later naked. Spines 6-8 mm, radiating horizontally, the lower and lateral about 7 mm long, the upper up to 15 mm long, straight, subulate, greyish white, dark reddish brown or black. Fl. 15 mm long, carmine. Fr. up to 2 cm long, clavate; seeds described as opaque, yellowish, [light brown, irregularly] pitted.

Reported by Boedeker (Mamm. Vergl. Schluss., 38. 1933) from Guanajuato and by Craig (138) from Querétaro ('San Moran'). As someone (Father Fittkau, I think) has pointed out, there is no Saint Moran (a certain well-known Californian botanist having yet to be canonized), and Craig's report, based on information from Schmoll (whence, no doubt, the cultivated stock derives), refers to the Sierra Zamorano in western Querétaro. The species has been collected in this area (west of Bernal) by Reppenhagen (*R.* 478), but can only be regarded as an extreme form of *M. kewensis*, itself only a vicariant of *M. polythele*. The distinctive adpressed spines make it, nevertheless, one of the most worthwhile of the group horticulturally.

M. dyckiana Zucc., Pl. Nov. Monac., 705 (1837).

Traditionally regarded as a synonym of *'M. elegans'*, i.e. *M. haageana* sensu lato.

M. dyckii attrib. by Craig (344) to MfK 3: 78 & 6: 58, but both refs. are wrong; *?dyckiana:* Backeb. 3494.

M. ebenacantha Schmoll ex Backeb., Die Cact. 5: 3469, fig. 3538 (1962).

A catalogue name of Schmoll's for a form of *M. karwinskiana* or one of its allies, for which a German description was provided by Backeberg, but not the Latin and type-designation needed for validation.

M. eborina Ehrenb. (Craig 328)

M. eburnea Miquel *(M. geminispina:* Craig 80)

M. echinaria DC. in Mém. Mus. Nat. Hist. Paris 17: 110 (1828). Source: Mexico, *T. Coulter* 35. Without locality, but almost certainly collected in Hidalgo. No material appears to have been preserved.

Series LEPTOCLADODAE. Originally distinguished from *M. elongata* by having two darker central spines (none in *M. elongata*) and the radials 'spreading recurved', although

Coulter himself (quoted by De Candolle) did not regard it as distinct. As now understood, *M. echinaria* is generally a somewhat thicker-stemmed plant than *M. elongata*, like *H.* 8636, a seed-collection I made in Querétaro, 6 km along the San Joaquin road from its junction with the highway Mex 85, 1950 m, edge of *P. cembroides* woodland. The parent plant had stems 3-3.5 cm diam. and 2-3 rusty brown centrals to 14 mm.

Although *M. echinaria* is conspecific with *M. elongata* and widespread in the same general area of Mexico, my limited field experience suggests that they do not grow together (as, however, do the various forms of *M. elongata* in the narrow sense), but inhabit different terrain, *M. echinaria* being more characteristic of relatively open ground and rocky slopes, *M. elongata* inhabiting the steepest cliffs and ravines.

M. echinata DC. (1834) *(M. echinaria:* Craig 253)

M. echinocactoides Pfeiffer *(Neolloydia conoidea:* Craig 347)

M. echinoidea Quehl *(Coryphantha echinoidea:* Craig 347)

M. echinops Scheidw. in Hort. Belg. 5: 95, t. 5 (1838). Source: Mexico, 'dans une terre blanche calcaire', *Galeotti.* No material extant.

Series POLYEDRAE. Stem simple, depressed-globose, 4 × 8 cm; tub. obscurely 4-sided, with milky sap; ax. with wool and bristles. Cent. sp. 4, 8 mm; rad. sp. 12-13, 8 mm, the uppermost three much shorter, all spines straight, white at first, tipped pinkish brown, later grey. Fl. unknown. Fr. clavate, 8 mm, red.

Galeotti probably collected this in Veracruz or Oaxaca, and it could have been a form of *M. sartorii* J. A. Purpus, of which the spination is very variable. This is only surmise, however, and in the absence of definite locality and flower data there would be no merit in resurrecting the name.

M. echinus Engelm. *(Coryphantha echinus:* Craig 347)

M. eckman(n)ii Backeb. (errors for *ekmanii*)

M. edmundtsiana Lawrence (error for *emundtsiana:* Craig 329)

M. egregia Backeb., Die Cact. 5: 3261, t. 237, fig. 3025 (1961), not validly published. Source: Mexico, without locality, type not designated. Originally offered in Schwarz's catalogue as *'M. agregia'*.

Series LASIACANTHAE. Simple, to 5 × 5 cm. Cent. sp. 0; rad. sp. c. 50 or more, in several series, white, tipped somewhat rose at first. Fl. 11 × 8-9 cm, outer segs. white, striped rose, inner muddy olive greenish white, darker striped. Fr. and seed not described.

A close ally of *M. magallanii.* In 1976, W. Reppenhagen showed me a plant he had collected at Cuencamé, Durango, (*Repp.* 315) as this species, but it seemed to me inseparable from *M. magallanii.* A plant in W. F. Maddams' collection, noted in 1972, measured 14.5 × 6 cm. Seeds of *M. egregia* in the collection bequeathed to the Mammillaria Society by E. Shurly, of unrecorded origin but perhaps from Schwarz or Backeberg, are black, pitted, as are those distributed by the Mamm. Soc. in 1965.

M. ehrenbergii Pfeiffer *(M. magnimamma:* Craig 33)

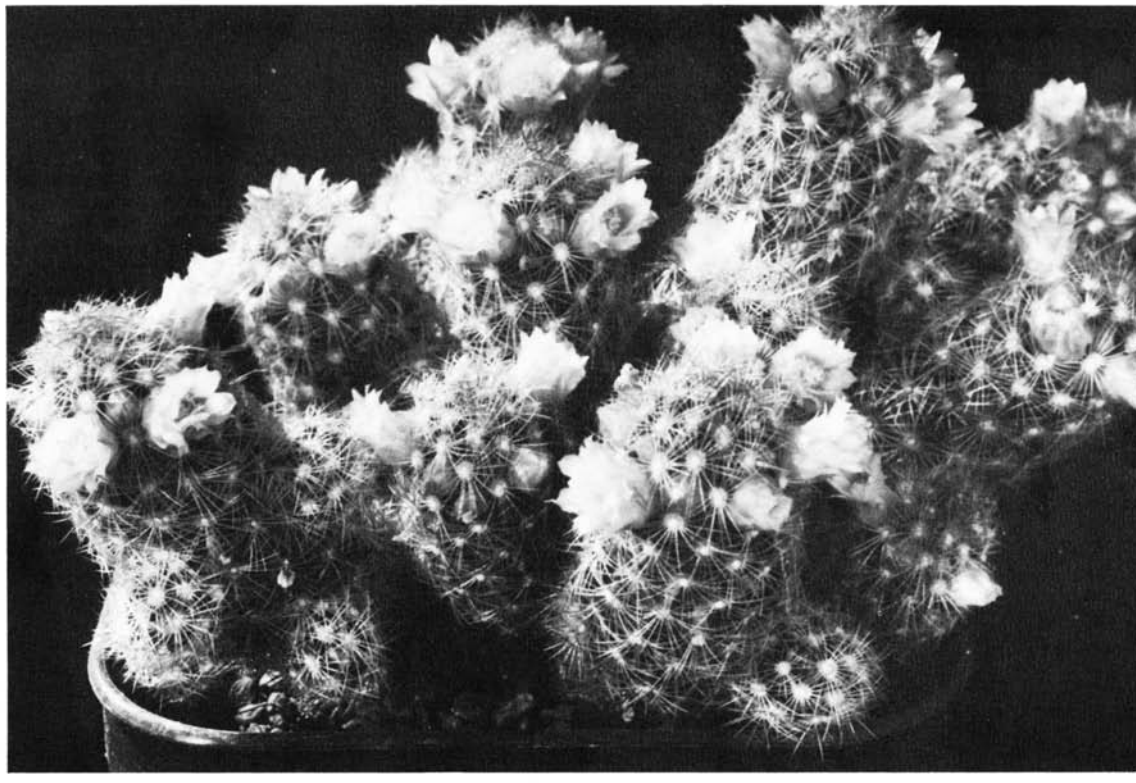
M. ehreteana Shields in CSJA 30: 53, fig. 31 (1958), fig. only *(M. magnimamma)*

M. eichlamii Quehl in MfK 18: 65 (1908). Source: Honduras, near Sabaneta (formerly in Guatemala), not uncommon in infertile sandy and stony soils. Type not designated.

Series POLYEDRAE. Clustering, stems cylindric to subclavate; ax. with white bristles 1 cm and yellowish wool at first. Cent. sp. 1, 1 cm, yellow at base, brownish red in upper half; rad. sp. 6, 5-7 mm, the upper three shorter and weaker, all acicular, straight, yellowish with darker tip. Fl. 2 cm, yellow, outer segs. with brownish midstripe.

The most southerly of several vicariants of *M. voburnensis*, q.v.

M. ekmanii Werderm. in Feddes Repert. 29: 242 (1931). Source: Hispaniola, Haiti, Ile de la Navasse, east of the lighthouse



M. elongata H. 8626 *(photo: Harwood)*

(according to the description; the label on the herbarium specimen at Kew says 'quaternary limestone, edge of the tableland), extremely arid place, sterile, rare, 21 October 1928, *E. L. Ekman* 10836 (S, holotype, K, isotype!).

Series MACROTHELAE. Simple, globose or short cylindric; ax. with white wool but no bristles. Cent. sp. 2-4, 9-15 mm, dull yellow, tipped darker; rad. sp. 15-17, 4-10 mm, slender acicular, white. Fl., fr. and seed undescribed.

Treated by Craig (106) as synonymous with *M. mammillaris*, but differing in spination and far removed from other known sites of that species. Until recollected, it will remain of uncertain status. See also Hunt in JMS 3: 51-2 (1963).

M. elegans DC., Rev. Fam. Cact., in Mém. Mus. Hist. Nat. Paris 17: 111 (1828).

This, the type of the old series *Elegantes*, has long been identified with a species widespread in Puebla and adjacent Veracruz for which the name *M. haageana* Pfeiff. (q.v.) is to be preferred. The type of the name *M. elegans* was collected by Thomas Coulter (no. 48), probably in Hidalgo, and had more numerous spines. It may have been a form of *M. geminispina*. As long ago as 1838, serious doubts attached to the identity of *M. elegans* and unfortunately the name must at last be discarded. See Hunt in CSJGB 39: 97-8 (1977).

M. elegantissima Bulthuis Cat. 1971/2 (fide Mottram, 27)

M. elephantidens Lem. *(Coryphantha elephantidens:* Craig 347)

M. elongata DC., Rev. Fam. Cact., in Mém. Mus. Hist. Nat. Paris 17: 109 (1828). Source: Based on living plants collected by T. Coulter (no. 33), not known to have been preserved.

Series LEPTOCLADODAE. Stems clustering, elongate, cylindric; ax. naked. Cent. sp. typically absent, sometimes 1 (-3), up to 10-15 mm, pale yellow to rusty brown or dark-tipped; rad. sp. typically 16-18, but varying from 14-25, 4-9 mm, whitish to golden yellow, slender acicular. Fls. pale yellow, sometimes pinkish. Fr. reddish; seeds brown.

One of the most familiar and variable of *Mammillaria* species. Many of the variants have been treated as species or varieties, but once one has assembled a reasonably comprehensive collection of these plants, the difficulty of applying the various names and of reconciling them satisfactorily with published descriptions becomes very apparent. Backeberg's account and key (Die Cact. 5: 3247. 1961) cannot be relied on, and a brief description ('spines uniformly yellow, 0-1 centrals'), or reference to a field number, is a more unambiguous way of referring to a particular plant of this group than a botanical epithet, however dignified.

M. elongata Hemsley *(Ariocarpus retusus:* Craig 347)

M. elyii Texas Cactus Co. Cat. ('Possibly *Neobesseya* or *Coryphantha*': Craig 344)

M. emskoetteriana Quehl (basionym for *Escobaria emskoetteriana)*

M. emundtsiana C. F. Foerster (Craig 329)

M. engelmannii Cory *(Coryphantha scheeri:* Benson, Fl. Texas 2: 303. 1969)

M. engelmannii Lem., name only *(Coryphantha sp.)*

M. enneacantha Otto ex C. F. Foerster, name only (Craig 344)

M. eppeliana Hort. A photograph attributed to Eppele & Cowper and captioned with this name ('not yet described') appeared in CSJGB 24: 16 (1962). The plant appears to have been one of the *M. heyderi* group.

M. erecta Lem. (basionym for *Coryphantha erecta)*

M. erectacantha C. F. Foerster in Allg. Gartenz. 15: 50 (1847). Source: Raised in Europe from seeds of unlocalized origin. No material extant.

Series HETEROCHLORAE. Roots thick, fleshy; stem simple, depressed-globose, with milky sap in growing season; tub. conical, keeled below, 4-10 × 4-6 mm, dark grey-green; ax. nearly naked; young areoles with white wool. Cent. sp. 1-2, 6-10 mm, the upper erect, brownish with dark tip; rad. sp. 9-15, c. 2-6 mm, white with brown tip, the laterals somewhat longer than the upper and lower, or the lower longest. Fl. 15 mm, red, pleasantly scented; stigmas 0.5 mm, violet-red. Fr. 1.5 cm, clavate, dark red.

The original description of *M. erectacantha* was incomplete but mentions a solitary erect central spine and 10-11 radials, a relatively unusual complement matched by plants which occur in the Sierra de Guadalupe just north of Mexico City. These have been collected by Fittkau (Cact. Suc. Mex. 13: 20, fig. 1. 1968) and Otero (in JMS 8: 83. 1968), who have completed the description on the assumption that their identification is correct.

Whether or not Fittkau's identification *is* correct, the plant is rather problematical, being intermediate between *M. rhodantha* and *M. discolor*, both of which occur in the Mexico City area. It has the red flowers and short stigmas of *M. rhodantha* but the depressed-globose habit and pasture habitat typical of *M. discolor*. Another such intermediate is *M. wiesingeri* Boed., q.v.

M. erectohamata Boed. in MDKG 2: 189, with fig. (1930). Source: Imported by R. Graessner from the southern part of the state of San Luis Potosi, where it was found growing in ravines. Type not known to have been preserved.

Series STYLOTHELAE. Caespitose, globose or subglobose; ax. with a few fine bristles. Cent. sp. typically 2, rarely 3, the lower thicker, longer, to 17 mm, hooked, reddish brown or blackish, later becoming yellowish; rad. sp. about 25, about 7 mm long, setaceous, straight, white. Fl. up to 18 mm diam., white. Fr. clavate, red; seeds blackish brown.

The original introduction does not survive, so far as known, and cannot be reliably repeated in the absence of a precise type locality. Modern impostors resemble *M. aurihamata*, which theoretically has a few less radial spines.

M. eriacantha Link & Otto ex Pfeiffer, Enum. Cact., 32 (1837), and in Beschr. u. Synon., 30 (1837); Zuccarini, Pl. Nov. Monac., 704 (1837). Source: Mexico, without further details, but reported by Ehrenberg (in Linnaea 19: 346. 1847) from the state of Veracruz, near Jalapa, Malpais de Naulingo (specimens 60 cm tall).

Series POLYACANTHAE. Simple, cylindric; ax. woolly. Cent. sp. 2, 8-10 mm, straight, rigid, ascending and descending, golden yellow, pubescent; rad. sp. 20-24, 6 mm, setaceous, pubescent, yellowish at first, fading to whitish. Fl. 12-14 mm diam., yellowish. Fr. clavate, orange.

A very distinct species, now known from several sites between Jalapa and the town of Veracruz. I photographed plants and collected seeds near the Jalapa-Veracruz highway, a few km above Cerro Gordo, 900 m, on 11 Nov 1973 (*H.* 8570). The vegetation was a rich saxicole flora on volcanic rock with small trees, orchids, peperomias, *Tillandsia ionantha*, *Agave spp.*, etc. Professor Arturo Gomez-Pompa told me that many species are found in this area which also occur much further west in Guerrero but not in between (for lack of suitable habitats). This is an interesting observation in view of the disjunction of *M. eriacantha* from the rest of the Polyacanthae and its affinities with species such as *M. guerreronis* and *M. xaltianguensis*. I made the following description of *M. eriacantha* in the field:

Simple or branching at or above the base, to 30-48 × 5 cm; sap watery; tub. conic, somewhat laterally compressed and angled above and below and rather pointed, c. 7 × 6 mm, mid-green; ax. naked or sparsely woolly in non-flowering zone, densely white-woolly in flowering zone. Cent. sp. constantly 2, even in small seedlings, c. 8-10 mm, more or less equal, golden yellow, minutely scabrid-puberulent (hairs visible to the naked eye); rad. sp. 20-21, 4-5 mm long, setaceous or very fine-acicular, pale golden yellow, minutely scabrid-puberulent like the centrals. Fl. not seen. Fr. purplish, dried perianth persistent.

M. eriantha Hort. *(M. eriacantha:* Pfeiffer, Enum. Cact. 32. 1837)

M. erinacea Wendland ex Steudel *(M. rhodantha:* cf. Craig 237)

M. erinacea Poselger *(M. melanocentra:* Craig 64)

M. ernestii Fittkau in Cact. Suc. Mex. 16: 36, fig. 23 (1971). Source: Mexico, state of Mexico, La Puerta, 1800-1900 m, on steep cliffs of volcanic rock. Type: MEXU 141523.

M. eriacantha H. 8570. *(photo: Harwood)*

Series POLYACANTHAE. Usually simple, to 45 × 6 cm; tub. conic, 9-11 × 6-9 mm; ax. with scant wool, naked after flowering. Cent. sp. 1, 8-12 mm, ascending; rad. sp. 5-11, 4-10 mm, upper shorter, all spines yellowish with brown tips or entirely brown with darker tip, later grey. Fl. 22 × 24 mm, purplish red. Fr. 13-25 × 5-6 mm, olive-green above, salmon-pink below; seeds light brown.

Not adequately distinguished from *M. backebergiana* to merit separate status, except perhaps at the level of *forma.*

M. erythrocalix F. G. Buchenau in Cact. Suc. Mex. 11: 17-21, 27, with figs. 1 (front cover) and 11; 42 (Latin descr.) (1966). Source: Mexico, Puebla. south of Chiautla, 4250 ft (1300 m), on rock, under trees and bushes in black soil, pH 6. Type: MEXU 118615!

Series POLYACANTHAE. Clustering, stems cylindric 7-10 × 2.5 cm, with milky sap; tub. conic, 5-6 × 5 mm, with watery sap; ax. with 1-5 bristles, 5-6 mm. Cent. sp. 4-6, rarely 7, 5-8 mm, the lowest hooked, strongly acicular, reddish tipped, paler below, becoming greyish; rad. sp. 16-20, 3-6 mm, finely acicular, greyish. Fl. 18-20 × 12-13 mm, outer segs. brownish purple, ciliate, inner longer, blood red. Fr. elongate, clavate, 18 × 3-4 mm seeds brown.

Buchenau was at pains to distinguish this plant from what he understood as *M. duoformis* (q.v.) by its more slender stem, more milky sap, fewer axillary bristles and spines, slightly larger flowers with different internal dimensions, and fractionally larger seeds, but the scale of the differences is no more than might be expected from one population, or even one individual, to the next. Moreover, what Buchenau described as *M. duoformis* fits the original description of that species rather less well than does his *M. erythrocalix!*

M. erythrocarpa Hort. Mentioned in CSJA 11: 86 (1939)

M. erythrosperma Boed. in MfK 28: 101, with fig. (1918). Source: Imported from Mexico by De Laet, without details. Later reported by Boedeker from San Luis Potosi, and by Craig from Alvarez in that state.

Series STYLOTHELAE. Freely clustering, individual stems to 5 × 4 cm; ax. with hair-like white bristles. Cent. sp. 1-3, rarely 4, up to 10 mm, the lowest hooked, yellowish in the lower half, dark reddish brown at the tip; rad. sp. 15-20, 8-10 mm, very thin white. Fl. 15 × 15 mm, carmine red, including the stigmas. Fr. clavate, 2 cm, carmine; seeds dark red to blackish.

A further collection at Alvarez, the type locality of *M. multiformis* (B. & R.) Boed., was made some years ago by Reppenhagen (*Repp.* 916), and seems to confirm my earlier suggestion that *M. erythrosperma* and *M. multiformis* are synonymous. The variability of *M. multiformis* was well-displayed in Britton & Rose's original illustration and in Mr Reppenhagen's collection, and in the circumstances it seems likely that the plant Boedeker studied was simply a sparsely spined specimen, whilst that which he called var. *similis* (attributing the name to De Laet) exemplified the kind of variation of which the species is capable, being smaller, with yellow centrals and paler flowers with yellow stigmas.

M. esaussieri Schmoll Cat. *(M. densispina,* q.v.)

M. escobaria Cory in Rhodora 38: 405 (1936) *(Escobaria runyonii)*

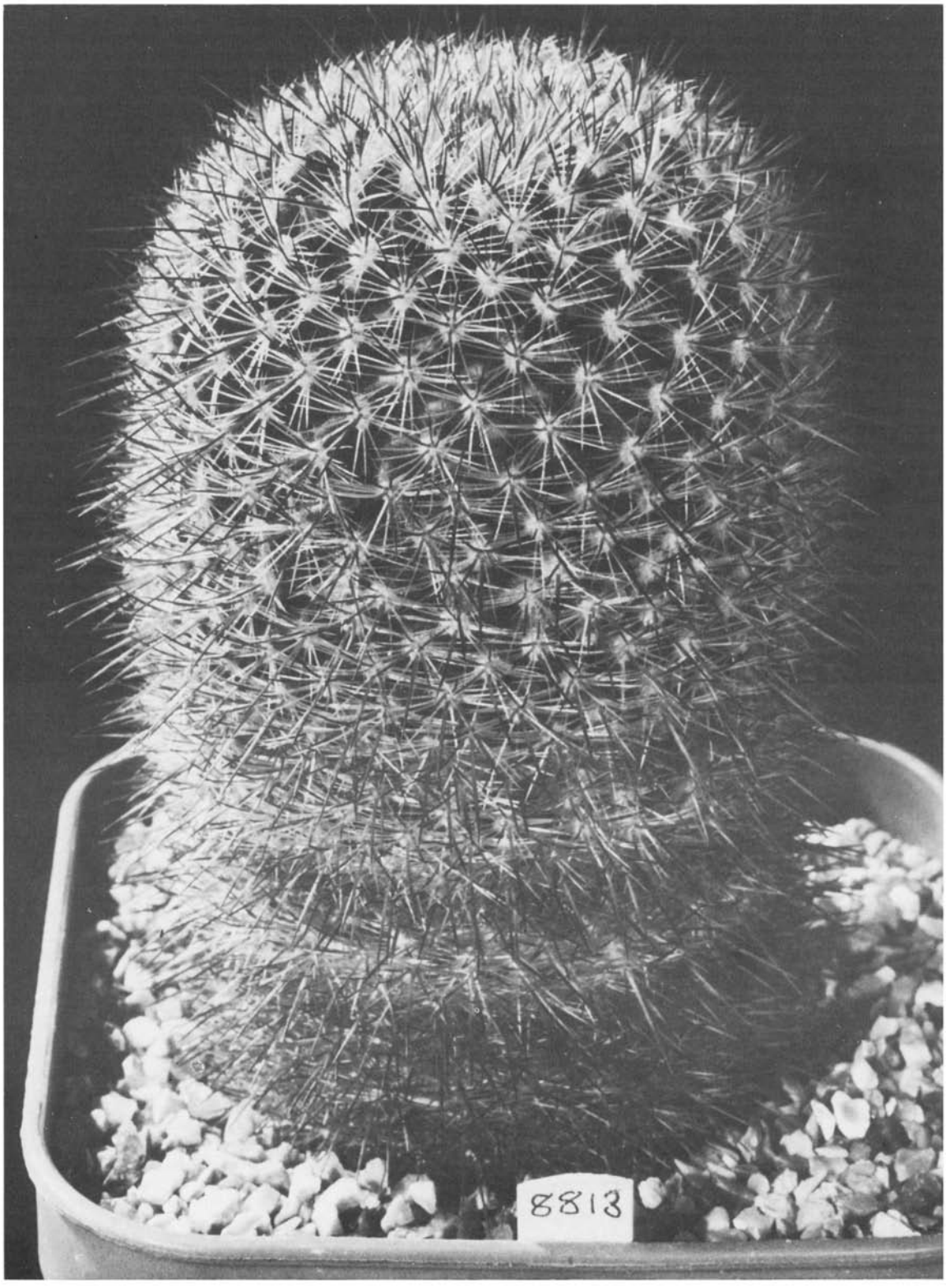
M. eschauzieri (Coulter) Craig, Mamm. Handb. 329 (1945) (as *'eschanzieri'); Cactus eschanzieri* Coulter in Contr. U.S. Nat. Herb. 3: 104 (1894); *Neomamillaria eschausieri* (Coulter) Britton & Rose ex Standley in Contr. U.S. Nat. Herb. 23: 1678 (1926). Source: Mexico, San Luis Potosi, 1891, *F. & L. Eschauzier,* 'in herb. Coulter' (not found by Britton & Rose at US, cf. The Cact. 4: 156. 1923, but later the type stated to be from Zapatillo, cf. l.c., 1926). Also collected by Orcutt, no. 22 (US?), though not until 1925.

Series STYLOTHELAE. The original description, verbatim, runs: 'Depressed-globose, 3 cm in diameter, simple; tubercles broader at base, 6-8 mm long, with naked axils; spines all pubescent; radials 15-20, with dusky tips, the lateral 10-12 mm long, the lower weaker, shorter and curved, the upper shorter; solitary central spine reddish, slender, somewhat twisted, usually hooked upwards, 15-25 mm long; flowers red (?); fruit reddish (?), ovate, about 10 mm long; seeds reddish oblique obovate, 1.2 mm long, pitted with subventral hilum'.

A problematical species, placed by Craig in the synonymy of no less than five other species and also treated by him as a dubious species, which must be a record for bet-hedging! *M. eschauzieri* has also been a favourite with the typographical gremlins. Besides the three variations offered in the heading to these notes, at least four others have appeared in print: *esaussieri, eshaussieri, essaussieri* and *esshausieri.* According to Barnhart (Biographical Notes upon Botanists 1: 515. 1965), the poor brothers who unwittingly started all the trouble were Francis and Louis (or Luis) ESCHAUZIER, and so I think we might at least try to spell their name correctly.

As to the identity of the plant, Pohanka (in Friciana 2, no. 20: 3-6. 1963; see Newton in JMS 4: 40. 1964) has suggested that it must have been *M. monancistracantha* Backeb. *(M. nana* Backeb.), on the basis that a plant collected by A. V. Fric in 1923 60 km from San Luis Potosi which survived in cultivation in 1963 in Brno as *M. eshaussieri* nom. nud. was this species. Unfortunately, we are not told whether Fric's locality was the elusive Zapatillo, one of those beckoning places that are not marked on normal maps, but which (allowing for a few minor adjustments to the spelling, such as befell Messrs Eschauzier) turn up by the half-dozen in the excellent Gazetteer of the Chihuahuan Desert Region (Henrickson & Straw, 1976). Here, sprinkled over the relevant state, are to be found La Zapatilla, Arroyo La Zapatilla, Arroyo La Zapolera, Tanque Zapolillo, Cerre Zapolillo, Arroyo Zapotillo and so forth, BUT NO *Zapatillo!*

Pohanka's argument is also to be regarded as unproven in face of the discrepancies in radial spine count and the tubercular axils between *M. eschauzieri* and *M. nana.* The mystery will not be solved until someone rediscovers the



M. esperanzaensis H. 8813 *(photo: Harwood)*

original locality and the plant that grew there in 1891.

M. esperanzaensis Boed. in Mamm. Vergl. Schlussel, 40 (1933). Source: None given, but the alternative name *M. fuscata-esperanza* given by Boedeker and attributed by him to 'Hort. I.A. Purp. 1914' suggests that the original introduction may have been made by one of the Purpus brothers, probably C.A., presumably from Esperanza, Puebla.

Series HETEROCHLORAE. (Simple,) globose or ovoid, to 8 cm diam.; tub. cylindric-conic; ax. naked. Cent. sp. 4-7, thickened at base, the lower longest and down-curved, amber-brown; rad. sp. up to 20, thin, prickly, pale yellow, all spines hard, with metallic sheen. Fl. 2.5 cm diam., white with red mid-stripes; filaments white; style yellowish white, stigmas 5, pale yellow.

Not distinguishable as a species from *M. discolor.* Often recollected at Esperanza, where it grows on low hills close to the town, at 2400 m, becoming somewhat larger than described. After 10 years, a seedling I collected there with Felipe Otero on 30 Sept 1974 is cylindric, 14 × 8.5 cm (*H.* 8813).

M. esseriana Boed. in ZfS 3: 289 (1928), with fig. Described from an old plant at Cologne Botanic garden, 'from southern Mexico to Central America judging from the characters of the plant'.

Series POLYEDRAE? Simple, clavate, later dividing apically, sap milky; tub. 8 × 8 mm, rhomboid at base, many-faceted towards apex, leek-green; ax. with white wool and bristles, the latter up to 16, and up to 15 mm long. Cent. sp. regularly 6, up to 7 mm, lower to 15 mm, straight, acicular to subulate, transparent amber-yellow, tipped reddish brown; rad. sp. up to 10, directed laterally and ventrally only, varying in size from the laterals 3 mm to the lowermost 8 mm, pure white. Fl. c. 12 mm diam., carmine red, stigmas 5-6 whitish to pale pink. Fr. and seed unknown.

Since this plant is unknown in the wild, any authentic specimens still in cultivation must derive from the Cologne original. There are plants in Germany and Switzerland which might qualify, matching the description and illustration very closely. The squat tubercles and red flowers recall *M. compressa* as much as any of the species with axillary bristles from further south, but there are too many spines for pure *M. compressa.*

M. estanzuelensis Moeller ex A. Berger, Kakteen, 287 (1929). Illustration only in Moeller's Deutsche Gartenzeitung 51: 218 (1926).

A synonym of *M. candida,* judging from the description and very clear illustration cited above. A plant collected by Reppenhagen at Rayones, Nuevo Leon, as *M. estanzuelensis,* which he showed me in 1976, was without doubt *M. candida* also.

M. estebanensis Lindsay in CSJA 39: 31 (1967), with figs. Source: Mexico, Baja California, Isla San Esteban, in a broad arroyo on the south-east side, near 28° 41'N, 112° 32'W, 13 Jan 1961, *Lindsay* 3002 (TRA, holotype, MEXU, CAS, UC, US, isotypes).

Series ANCISTRACANTHAE. Usually clustering, sometimes with 50 branches to 50 cm tall, but stems usually less than 30 × 6-10 cm; tub. obtuse pyramidal, c. 5 × 5 mm; ax. with white wool and 5-8 bristles to 8 mm. Cent. sp. 1, 4-15 mm, straight or hooked, chestnut with chocolate tip; rad. sp. 15-22, to 10 mm, chestnut or gold fading to white. Fl. usually 20 × 25 mm, white; stigmas light green, not spreading. Fr. clavate 15-20 × 4-7 mm, red; seeds c. 1.2 × 1 mm, black.

One of the insular races of *M. dioica.* According to Lindsay it was first collected by I. M. Johnston in 1921 (San Esteban, *Johnston* 3198, and South San Lorenzo, *Johnston* 3543), and recollected by Lindsay himself on several occasions between 1947 and 1966. According to Lindsay it is a more robust and caespitose plant than *M. dioica* or *M. angelensis,* has a different number of tubercle spirals (13/21 rather than 8/13), only one central spine which is usually straight: 'Some specimens have no hooked spines, but most, including the holotype, have bands of hooked central spines alternating with areas which have only straight spines'. On San Lorenzo it grows in association with *M. dioica.*

Lau 017, from San Lorenzo, is in cultivation, and appears to be Lindsay's species.

M. euacantha Backeb., name only *(M. neocoronaria:* Backeb. 3302)

M. euchlora Ehrenb. (Craig 329)

M. eugenia Lem. *(M. rutila:* Craig 255)

M. euthele Backeb., name only. Backeberg (Die Cact. 5: 3167. 1961) states that was a provisional name he gave to Schwarz for forms of *M. melanocentra* with conspicuous tubercles and longer, paler spines, the apex more brownish than black. His fig. 2946 apparently illustrates the plant in question.

M. evanescens C. F. Foerster *(Coryphantha erecta?:* Craig 347)

M. evermanniana (Britton & Rose) Orcutt, Cactography, 7 (1926). *Neomammillaria evermanniana* B. & R., The Cact. 4: 97, fig. 95 (1923). Source: Mexico, Baja California, Cerralbo Island, growing wedged in narrow dirt-filled cracks on the canyon side of the island, 1921, *I. M. Johnston* 4058 (US, holotype).

Series MAMMILLARIA. Usually simple, globose to elongate turbinate, 5-7 cm diam.; tub. terete; ax. at first very woolly and setose. Cent. sp. 3, erect or nearly so; white, tipped brown; rad. sp. 12-15, white, tipped brown. (Fl. 25 mm, yellowish cream with greenish cast and pinkish brown midstripe.) Fr. c. 1 cm, red; seeds brown.

Britton & Rose also mention a plant from San Pedro Nolasco Island (*Johnston* 3121). This was shown by Glass & Foster (in CSJA 47: 173-176. 1975) to be an altogether different species which they described as *M. tayloriorum.* They also provided floral data for *M. evermanniana,* which Britton & Rose had not, from a plant collected on Cerralbo Is. (l.c. fig. 3, miscaptioned *M. tayloriorum;* see correction, l.c. 194). Whereas *M. tayloriorum,* with pink flowers, is allied to *M. standleyi, M. evermanniana* can be interpreted as an insular form related to the *M. baxteriana* group in mainland Baja California.

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

M. exsudans Zucc. *(Coryphantha exsudans:* Craig 347)

M. falcata Hort. ex Ruempler *(M. magnimamma:* Craig 34)

M. falsicrucigera Backeb., Die Cact. 6: 3895 (1962), provisional name, later replaced by *M. buchenaui,* q.v.

M. farinosa Fennel, name only *(M. livida:* cf. Craig 334)

M. fasciculata Engelmann in Emory, Notes Military Reconn., 156, fig. 2 (1848), provisional name. Based on a drawing by Stanly, the artist to Emory's party, on 26 Oct 1846, when they were at Camp 83 on the Gila River, Arizona, at about 3000 ft elevation. No specimen preserved.

It is hard to escape the view that *M. fasciculata* must be rejected as a provisional name, as I suggested in my earlier notes (JMS 9: 38. 1969). Mottram (Mamm. Index, 30. 1980) would like to give it the benefit of the doubt, but, if we do we are faced with Benson's neotypification of it by an *Echinocereus* and the combination *E. fasciculatus* (Engelm.) L. Benson, which threatens to displace the well-known name *E. fendleri.*

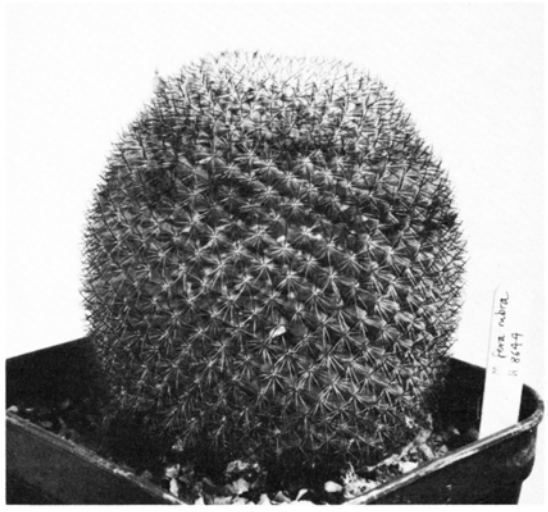
Engelmann himself was uncertain whether the plant Stanly drew was a *Mammillaria* or an *Echinocereus* and never validated the name or referred to it again. In this century, until Benson pointed out that the only *Mammillaria* native in the area of Camp 83 is *M. grahamii, M. fasciculata* has become associated with the species from around Tucson which Orcutt described as *M. thornberi.* Orcutt himself, at one time, and Britton & Rose, were inclined to equate *M. fasciculata* and *M. thornberi* (cf. Britton & Rose, The Cact. 4: 162. 1923), but Benson's opinion is hard to override.

M. felipensis Reppenhagen, ined.; Piltz Seedlist, 1982/3, no. 865 (R. Zahra, in litt., 29 Oct 1983). A name for *Repp.* 636, which Mr Reppenhagen tells me (in litt., 29 Jan 1984), is 'aus dem *bocasana*-Kreis'.

M. fellneri Ehrenb. (Craig 330)

M. fennelii Hopffer *(M. zephyranthoides:* Craig 178)

M. fera-rubra Schmoll ex Craig, Mamm. Handb., 309, fig. 281



M. fera-rubra H. 8644. *(photo: Harwood)*

(1945). Source: Mexico: Querétaro, San Lazara, *Schmoll.* No material recorded as preserved.

Series HETEROCHLORAE. Simple, globular to short cylindric, 10 × 9 cm; tub. 9 × 7 mm; ax. with short wool. Cent. sp. 6, occasionally 7, the seventh porrect, 12 mm, orange brown, paler at base; rad. sp. 15-18, 3-7 mm, upper shorter, Fl. unknown. Fr. 20 × 6 mm, scarlet; seeds brown, 1.2 × 0.7 mm.

This is clearly a very close ally of *M. rhodantha*, and I have argued (in Cact. Suc. Mex. 21: 36. 1976) that it represents a westerly form of the species with fewer radial spines and smaller flowers.

M. fertilis Hildmann ex K. Schum., Gesamt. Kakt. 530 (1898). Described from cultivated material of unrecorded origin, the identity of this name has remained obscure. For a time it was used for what is now called *M. backebergiana.* Material claimed to be authentic, obtained from Haage, was given to me by F. Kraehenbuehl in 1976, but died before becoming sufficiently mature for me to identify it satisfactorily.

M. filipendula K. Brandegee in Bailey, name only (Craig 344)

M. fischeri Pfeiffer in Allg. Gartenz. 4: 257 (1836). *(M. karwinskiana:* Craig 26)

M. fissurata Engelm. *(Ariocarpus fissuratus:* Craig 347)

M. fittkaui Glass & Foster in CSJA 43: 116, figs. 1-5 (1971). Source: Mexico, Jalisco, on rocks near north shore of Lake Chapala, *Fittkau* in Abbey Garden 69-1169 (POM, holotype).

Series STYLOTHELAE. Clustering, individual stems cylindric, to 10 × 4-5 cm; tub. terete, to 10 × 7 mm; ax. naked. Cent. sp. 4, 3 like the upper radials, 1 porrect, 8-10 mm, strongly hooked, dark brown; rad. sp. 7-9, 5.5-7 mm, fine-acicular, white, occasionally tipped dark brown, smooth. Fl. 15 mm, segs. whitish with pale pink cast and slightly darker midline, filaments darker lavender pink, style and stigmas white. Fr. small, 7 × 5 mm, pale tan, pinkish in lower half; seeds few, 1.5 mm, very dark brown to blackish, constricted above hilum.

This distinctive taxon, which links series Stylothelae and Ancistracanthae, has also been collected in the Barranca of Guadalajara by Kimnach.

M. flava Ehrenb. in Allg. Gartenz. 17: 261 (1849). Source: None given.

Along with *M. tomentosa* Ehrenb. (l.c. 262), this appears to have been one of the plethora of forms of *M. spinosissima* described by Ehrenberg. A plant labelled *M. flava* in the collection of W. F. Maddams, noted in 1969, was certainly referable to *M. spinosissima.*

M. flavescens Haw., Suppl. Pl. Succ., 71 (1819). Based on a plant grown in the Chelsea Physic Garden before 1811; ?*Cactus flavescens* DC., Cat. Hort. Monsp., 83 (1813).

Haworth's description runs 'M. (Yellow-spined) simplex tuberculis subconicis, spinis validis, saturatissime stramineis sive flavis', and he was able to provide no information on the source or flowers. Although it has generally been assumed that he made a new combination based on *Cactus flavescens* DC. there is no evidence that he did. In any event, De Candolle's name, based on a plant in the Montpellier Botanic Garden, was scarcely better described, and the pre-Linnean elements included in his synonymy are a mixture of *M. mammillaris* and *M. prolifera* and some that are not positively indentifiable.

It is quite possible that *M. flavescens* Haw. was the West Indian species otherwise known as *M. nivosa* Link ex Pfeiffer, not described until 1837. To adopt *M. flavescens* as the correct name for this species, as Backeberg did, in preference to the better-described *M. nivosa* (type locality, Tortola Is.), does not seem justified, however, on such tenuous evidence.

M. flavescens Hitchen, name only (Backeberg 3494)

M. flavescens [attrib. to Zucc. by] Ruempler *(M. karwinskiana:* Ruempler in Foerster, Cacteen, ed. 2, 348. 1885)

M. flavicentra Backeberg in Descr. Cact. Nov. 3: 8 (1963). Source: Mexico, Oaxaca, between Tehuacan and Oaxaca, *Buchenau,* 3 in 'coll. Backeberg'. Since Backeberg did not preserve specimens, the name may have to be regarded as technically invalid until Mottram (Mamm. Index, 31. 1980) designated Backeberg's illustration (Das Kakteenlexikon, 606, fig. 212. 1966) as type ('lectotype').

Series SUPERTEXTAE. Simple, becoming clavate to cylindric-columnar, to c. 18 × 9-10 cm; tub. pyramidal, c. 7 × 6 mm; ax. woolly. Cent. sp. 4-6, c. 5-6 mm, yellowish; rad. sp. c. 22-24, c. 2-4 mm, hyaline. Fl. very small, 3-4 mm diam., red. Fr. clavate, c. 1.5 cm, whitish green at base, pink above; seeds brown.

One of the numerous Supertextae of the 'Tomellin Canyon' area, very close to *M. dixanthocentron* Backeb. *(Neomammillaria celsiana* B. & R.).

The type locality was narrowed by Backeberg (Kakteenlexikon, 238. 1966) to 'higher western slopes above the locality of *M. buchenaui*'.

M. flaviceps C. F. Foerster, name only

M. flaviceps Scheidw. ex Lab. (cf. Index Kewensis)

M. flavicoma Ruempler (attrib. to Foerster by Craig: 330)

M. flavihamata Backeb., Die Cact. 6: 3895, fig. 3542 (1962). Source: Mexico, Aguascalientes, *Zehnder* 2. No material recorded as preserved, and the name probably invalid.

Series STYLOTHELAE. Simple, more or less hemispherical, 4.5 cm diam.; tub. conic; ax. naked. Cent. sp. c. 6-7, up to 9 mm, yellow, one hooked, rad. sp. to 35, to 5 mm, thin, yellow, becoming white. Fl. 1.5 × 1.1 cm, white. Fr. and seed unknown.

Probably conspecific with *M. gilensis* Boed. and other members of this group of Stylothelae in the same general area.

M. flavispina Walton Cat. (Craig 344)

M. flavispina Neale, Cacti and other Succulents, 87 (1935). Briefly described in catalogue/price list. (Not *M. vaupelii* var. *flavispina*)

M. flavovirens Salm-Dyck, Cact. Hort. Dyck. 1849, 117 (1850). Source: A sterile cultivated plant of unknown origin.

Series MAMMILLARIA. Identified by Craig, Mamm. Handb. 55, fig. 37 (1945), with plants sent by Schmoll from the state of Guanajuato, Mexico, which are, to my mind, *M. gigantea* (see JMS 18: 61. 1978). Guesswork is no substitute for clear typification, and Salm-Dyck's species-name should be discarded.

M. floccigera Salm-Dyck, name only (Craig 237)

M. floresii Backeb., Blätter f. Sukk. 1: 5 (1949); and in Cactus (Paris) no. 33: 13-14 (1952) (descr. of flower). Source: Mexico, Sonora, foothills of Sierra Canelo.

Series MAMMILLARIA. Offsetting, individual stems to 16 ×

12 cm; tub. thick-conic, rather short; ax. very woolly, without bristles. Cent. sp. 4, lowest longest, to 2 cm, somewhat downcurved, dark brown at first; rad. sp. 11-12, upper shortest, thin, brown. Fl. 15 × 20 mm, pale carmine. Fr. and seeds undescribed.

One ot the *M. standleyi* group, probably indistinguishable from *M. canelensis.*

M. floribunda Hooker in Curtis's Bot. Mag. 65: t. 3647 (1838) *(Neoporteria subgibbosa:* see note on *M. atrata)*

M. fobeana Boed. *(M. yucatanensis:* Craig 285)

M. fobei Hort. *(Escobaria fobei/Fobea viridiflora* Fric: Craig 347)

M. foersteri Muehlenpf. *(M. magnimamma:* Craig 33)

M. fordii Orcutt *(M. dioica:* Craig 161)

M. formosa Galeotti ex Scheidw. in Bull. Acad. Sci. Brux. 5: 497 (1838). Source: Mexico, San Luis Potosi, near San Felipe, c. Dec. 1837, *Galeotti.* Living material sent to Galeotti's sponsor, Vandermalen, was seen by Scheidweiler, but none was preserved.

Series LEUCOCEPHALAE. (Usually) simple, subclavate with umbilicate apex (becoming depressed-globose, 10 cm or more diam.); tub. crowded, obscurely 4-angled, light green, glabrous, white-dotted when viewed under the lens; ax. floccose-woolly; ar. naked. Cent. sp. 6, stellate, (to 8 mm), acicular, thickened at base, at first flesh-coloured with black tip and base, later black and then grey; rad. sp. 20-22, (3-6 mm), radiating, thin acicular, white. (Fl. 10-15 × 10-15 mm, pale pink. Fr. red; seeds brown).

This is a characteristic species of the matorral vegetation on calcareous soils in NE San Luis Potosi, and has been collected at numerous sites between San Luis Potosi itself and Matehuala. References to the type locality being in the state of Guanajuato are erroneous. Galeotti's itinerary is summarized by McVaugh in Contr. Mich. Univ. Herb. 11(5): 293-297 (1978).

To the north, *M. formosa* grades into the *M. chionocephala* complex, and to the south, *M. sempervivi,* via the form described by Craig as *M. pseudocrucigera.*

The 'true', white-flowered, *M. microthele* of cultivation, appears to be a form of *M. formosa.* A plant of *M. formosa* I collected east of Huizache in 1973 (*H.* 8575), certainly leans towards *M. microthele,* though is has remained solitary.

M. fortispina W. M. Pierce ex Shurly, not valid (cf. *M. hamiltonhoytea:* Shurly in CSJGB 4: 11. 1935)

M. foveolata Muehlenpf. *(M. seitziana:* Craig 20)

M. fragilis Salm-Dyck ex K. Brandegee *(M. gracilis:* cf. JMS 5: 45-48. 1965)

M. fragrans (Hester) Weniger, invalid *(Coryphantha fragrans)*

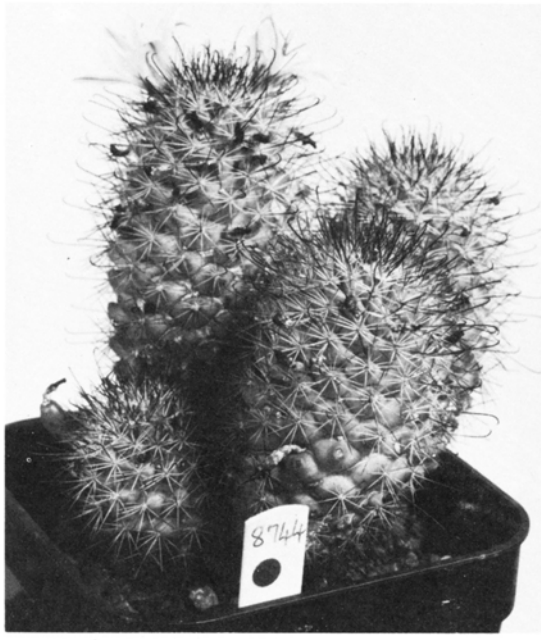
M. fraileana (Britton & Rose) Boed., Mamm. Vergl. Schlussel, 30 (1933); *Neomammillaria fraileana* B. & R., The Cact. 4: 157 (1923). Source: Mexico, Baja California, Pichilingue Island, 27 Mar 1911, *Rose* 16508 (US 638557, type!); Cerralbo Is., 19 Apr 1911, *Rose* 16895 (US); Catalina Is., 16 Apr 1911, *Rose* 16831 (US).

Series ANCISTRACANTHAE. Stems elongate, cylindric, 10-15 cm; ax. naked or with at most a single bristle. Cent. sp. dark brown, one of them strongly hooked. Fl. rather large pinkish, inner segs. acuminate, 2-2.5 cm, often lacerate towards the tip, filaments and style pinkish, the latter paler and much longer than the stamens, stigmas lobes 6, long and slender, rose-coloured.

Although Britton & Rose's description was rather incomplete, the floral data and type locality leave no doubt as to the application of the name *M. fraileana.* The species also occurs on the mainland coast of southern Baja California. Data for two collections of mine are as follows: S of Todos Santos, San Pedrito, cliffs near sea, 22 Sept 1974, *H.* 8744; La Paz bay, hills opposite Pichilingue Island, 23 Sept 1974, *H.* 8752.

The unusually long, bright purplish pink stigmas point to a group-affinity with *M. mainiae, M. thornberi* and *M. yaquensis* on the mainland of Mexico.

M. formosa in habitat NE of the city of San Luis Potosi. *(photo: Hunt)*



M. fraileana H. 8744 *(photo: Harwood)*

M. franckii Hort. *(Coryphantha ottonis?:* Backeb. 3055, 3494)

M. fuauxiana Backeb. in Fuaux Herb. Bull. 1: 53 (1950) and in Cactus (Paris) no. 33: 86 (1952) (descr. of fl.); illustration in CSJGB 23: 65 (1961). Source: Mexico, Guerrero, near Puente Mescala. The illustration, fig. 3168 (Backeb., Die Cact. 5: 3430. 1961) of a plant labelled '*M. fuauxiana* Bbg. Guerrero. *Schwarz* 1', is designated 'lectotype' by Mottram, Mamm. Index, 32 (1980).

Series SUPERTEXTAE. Simple, cylindric to 30 × 8 cm; tub. very small; ax. with short greyish felt, more densely white-woolly in the flowering zone. Cent. sp. 2, pointing up and down, 5 mm, white, tipped red-brown; rad. sp. 20-22, 2.5 mm, very thin, white. Fl. c. 7 × 7 mm, dark wine-red, anthers cream, style white. Fr. short-clavate, orange-red; seeds ovoid, 0.8 mm, pale brown.

In its typical form, this is a more narrowly cylindric and stronger spined plant than its presumed close-ally *M. albilanata*. It grows very close to *M. guerreronis* and there is just a suspicion of some *M. guerreronis* genes in its makeup. A small plant I collected in Guerrero, Canon del Zopilote, km 74½, 900 m, 10 Oct 1974, *H.* 8853, is now 10 × 6 cm.

M. fuliginosa Salm-Dyck, Cact. Hort. Dyck. 1849, 93 (1850). Source: A plant sent to Salm-Dyck by Scheer, of uncertain origin. No material extant.

The Index Kewensis suggests Venezuela as the origin of the plant, with no apparent justification, unless from information derived from Scheer, who lived at Kew and had much to do with the cactus collection at the Royal Gardens, or else quoting Labouret, Monogr. Cact., 39 (1853). Craig (Mamm. Handb., 257, fig. 233) accepted as authentic a plant then (1945) in the trade which I identify as *M. polythele* (JMS 18: 61. 1978). Salm-Dyck's description certainly sounds like a member of the Heterochlorae, of which none are known from Venezuela, but there can be no certainty of its identity and the name should be discarded.

M. fulvescens Salm-Dyck, name only (Craig 344)

M. fulvispina Haworth *(M. rhodantha:* Craig 235)

M. fulvolanata Haage, name only *(M. malletiana:* cf. Craig 344)

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

M. furfuracea S. Watson *(Ariocarpus retusus:* Craig 347)

M. fuscata Link & Otto ex Pfeiffer, Enum. Cact., 28 (1837). Source: None given, but reported by Ehrenberg from Mesa de Magdalena.

This name was resurrected by Craig, Mamm. Handb., 279 (1945) for a plant from the Valley of Mexico and central plateau which, he said, is very close to and intergrades with the variations of *M. rhodantha*, but differs chiefly in the greater number of radial spines (25-28, compared with the 16-20 given by him for *M. rhodantha*). He was unable to provide or cite an illustration. Recent surveys of the *M. rhodantha* group in the Valley of Mexico have failed to reveal anything with more than 25 radials, except possibly the form known as *M. aureiceps*. Since Craig rejected Britton & Rose's interpretation of *aureiceps*, it is possible that this was what he had in mind, although he does not say as much. *M. fuscata* is actually an older name than *M. aureiceps* (1838), but its application is far too nebulous for there to be any case made in its favour unless Ehrenberg's report can be substantiated.

M. fuscata-esperanza Boed., Mamm. Vergl. Schlussel, 40 (1933). An alternative name supplied by Boedeker for *M. esperanzaensis*, the latter being generally preferred.

M. fuscohamata Backeb., Die Cact. 6: 3897, fig. 3544 (1962), not valid. Source: Mexico, Jalisco, without locality, *Zehnder* 3. No material preserved.

Series STYLOTHELAE. Perhaps referable to *M. jaliscana*.

M. gabbii (Coulter) K. Brandegee in Erythea 5: 116 (1897). *Cactus gabbii* Coulter in Contr. U.S. Nat. Herb. 3: 109 (1894) *(M. gabbii* Engelm., ms.). Source: Mexico, Baja California, from San Ignacio to Mision San Fernando, among rocks, 1867, *W. M. Gabb* 19 (MO, holotype).

Series MAMMILLARIA. Simple, globose, 5-10 cm diameter; tub. slender cylindric 12-14 mm; ax. woolly. Cent. sp. 1, shorter than the rad., straight, robust; rad. sp. c. 13, 5-8 mm, lower longer. Fl. yellowish.

A northern form of *M. brandegei*, not distinguishable as a species.

M. galeottii Scheidw. in Hort. Belge. 4: t. 6 (1837). Source: Mexico, Veracruz, 'des environs de Jalapa', *Galeotti*. No material extant.

Scheldweiler (l.c., 93) described this as a variety of *M. obconella*, but the name *M. galeottii* captioned the illustration. The source locality, even if reliable, is too vague to be useful. Both *M. galeottii* and *M. obconella* are referable to *M. polythele* Mart.

M. garessii Cowper in CSJA 42: 14, with fig. (1970). Source: Mexico, Chihuahua, on a bushy, rocky hill about 5-6 miles SW of Matachic. Originally collected by Elmer Garess and John Green in 1962 and subsequently by Denis Cowper in 1965. Type: *Cowper* 571 (UNM). One of several introductions described by Cowper which are referable to *M. barbata*.

Series ANCISTRACANTHAE. Differs from *M. barbata* (see Bradleya 1: 112, 1983) in having fewer spines: Centrals 1, rarely 2; radials 16-22.

M. gasseriana Boed. in ZfS 3: 75, with fig. (1927). Source: Mexico, Coahuila, near Torreon, San Pedro, collected by A. F. Möller. No specimen was cited, but there is a specimen at Zürich (ZSS, Diverse no. 71) which Krainz regarded as the type; cf. Die Kakteen Lfg. 17 (15 June 1961). This specimen was given to Krainz by G. Ross and does not appear to have been seen by Boedeker, although it was from the original batch of plants shipped by Möller. Hence it should not be regarded as the 'holotype'.

Series STYLOTHELAE. Identified with *M. stella-de-tacubaya* Heese. See Hunt in JMS 10: 17-18 (1970).

M. gasterantha Reppenhagen in KuaS 31: 138, with figs. (1980). Source: Mexico, Guerrero, W of Iguala, 1600 m, 11 Feb 1975, *Reppenhagen* 934 (ZSS, holotype).

Series POLYACANTHAE. Caespitose, stems cylindric, to 14 × 4-5.5 cm; tub. acute-conic, 8-10 × c. 4 mm, with milky sap; ax. naked. Cent. sp. 2-4, usually 2, 5-10 mm, straight, the upper very short, the lower sometimes hooked, brown, paler at base; rad.

sp. 13-16, 2-6 mm, white. Fl. 14-18 × 7-10 mm, deep red. Fr. maturing 3 months after anthesis, elongate-pear shaped, 12-18 × 4-5 mm, red-brown; seeds 1 × 0.75 mm.

A poorly differentiated element in the *M. spinosissima* complex, not clearly distinct from *M. virginis*. Plants from the type collection are in cultivation.

M. gatesii M. E. Jones in CSJA 8: 99, with fig. (1937). Source: Mexico, Baja California, steep coastal hillside midway between Cabo San Lucas and San Jose del Cabo, 22° 58′N, 109° 50′W, 15 Mar 1933, *Gates* 128 (DS).

Series MAMMILLARIA. Clustering, stems globular to subcylindric, to 20 × 10-15 cm; tub. to 15 × 15 mm, blue-green; ax. with white wool. Cent. sp. 1, to 3 cm, stout acicular, dark purple shading to yellow brown at base; rad. sp. 8 (6-9), 10 (8-13) mm, upper shorter, lower longer, acicular, yellow with dark tips, becoming white. Fl. 16 × 20 mm, perianth segs. golden to greenish yellow, outer with purplish midstripe, stigmas light green. Fr. 15 mm, red.

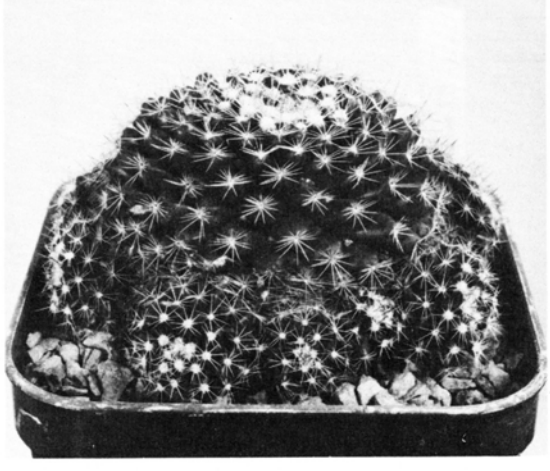
One of the *M. petrophila* group characterized by the long central spine and largish tubercles but otherwise dubiously separable from *M. baxteriana* etc. Jones's description of the seed as 'punctate' is discounted. Recent attempts to recollect the plant have failed (N. P. Taylor, pers. comm.).

M. gaumeri (B. & R.) Orcutt, Cactography, 7 (1926). *Neomammillaria gaumeri* B. & R., The Cact. 4: 72, with t. 8 (fig. 1) & t. 13 (fig. 2) (1923). Source: Mexico, Yucatan, Progreso, rocky scrublands and open places, Apr 1916, *Gaumer* 23349 (US 842324, holotype!; GH, isotype!).

Series MAMMILLARIA. Clustering, stems globose to short-cylindric, to 15 cm; tub. nearly terete, obtuse, 5-7 mm; ax. naked. Cent. sp. 1, porrect, usually brown; rad. sp. 10-20, acicular, white with brown tips or the lower darker. Fl. 10-14 mm, creamy white. Fr. clavate, 18-20 mm, crimson.

The holotype bears the note 'On the sand dunes of Progreso it blooms in May and June; it ripens its crimson berries one by one at long intervals'. According to Britton & Rose, the Gaumers (father and sons) recollected the plant again in 1918 and 1921. There are several further collections from near Progreso in the University of Mexico Hebarium: *Lundell* 8136 (MEXU 69826!); *Bravo* s.n. (MEXU 118239!; rad. sp. 18-20); '*J.E.B.*' s.n. (MEXU 105677!). More recently, live material has been obtained by Lau (*Lau* 1034) and by B. R. Adams.

M. gaumeri is one of the *M. heyderi* group, and the link, perhaps, between that group and other species of the Caribbean coastline, including *M. mammillaris*. The sand-dune habitat is very unusual, but the plant seems amenable to cultivation in ordinary composts.



M. gaumeri: specimen collected by B. Adams near Progreso, Yuc. in 1979. *(photo: Harwood)*

M. gebweileriana Haage ex Ruempler, name only *(M. magnimamma:* Ruempler)

M. geminata Scheidw. in Allg. Gartenz. 9: 42 (1841). Source: Mexico, Oaxaca, 5000 ft., *Galeotti*. No material extant.

Series POLYEDRAE. The description, based on a live plant in the Van der Maelen collection, is almost certainly of *M. karwinskiana*.

M. geminiflora Haage, name only (Craig 344)

M. geminispina DC. in Mem. Mus. Nat. Hist. Paris 17: 30 (1828). Based on the Mocino & Sesse plate and description of a plant identifiable as *M. haageana* Pfeiffer *(M. elegans* auctt. non DC.). Not *M. geminispina* Haw.

M. geminispina Haw. in Phil. Mag. 63: 42 (1824). Based on one of a collection of plants 'recently brought from Mexico by Mr Bullock of the Egyptian Hall, Piccadilly; and now preserved with many other very rare plants in the nursery of Mr. Tate in Sloane Street'. (From the heading to Haworth's article, l.c., 40). No material extant.

Series LEUCOCEPHALAE. The original description is brief and incomplete and can be summarized as follows: Columnar, usually simple, exceeding 15 cm, terete, slightly thicker above; tub. very numerous, slender, pale green. Cent. sp. 2, stronger and much longer than the radials, tipped black; rad. sp. small, hair-like, radiating-recurved, interlacing, white.

Apart from believing the plants to be usually simple (having only seen, perhaps, individual stems removed from a cluster), Haworth could have been describing what we know as *M. geminispina*. Other species decribed in the same article were *Cactus* (i.e. *Cephalocereus*) *senilis, Cactus* (i.e. *Ferocactus*) *latispinus, M. magnimamma* and *M. lanifera* (regarded by Coulter as an earlier name for *M. rhodantha*), indicating that Bullock visited the area where *M. geminispina* grows and providing circumstantial support for the traditional application of the name.

Since penning my earlier notes (JMS 10: 20. 1970), I have been able to rectify my deplorable ignorance of the industrious Mr. Bullock, thanks to hearing a mention of him in a broadcast review of the book 'The Shows of London' by Richard D. Altick (Harvard Univ. Press, 1978), which has a whole chapter on 'William Bullock and the Egyptian Hall'. A remarkable showman and entrepreneur, Bullock visited Mexico in 1823 and returned with all kinds of souvenirs, enabling him to mount an impressive exhibition of 'Ancient and Modern Mexico' at his Egyptian Hall, the ancient carvings he had collected later forming the nucleus of the British Museum's pre-Columbian collection.

For a modern description of *M. geminispina*, one may turn to Craig, Mamm. Handb., 80 (1945). In the classic site for the species, the Barranca of Metztitlan, Hidalgo, there is marked variation in the shape size and spination of individual plants and stems. The species is common in the lower part of the ravine (usually below 1800 m), growing on limestone rocks (calcareous conglomerates and lutites) (Sanchez-Mejorada, Manual de Campo de las Cactaceas y Suculentas de la Barranca de Metztitlan, 1978). Near the town of Metztitlan itself, there is a particularly attractive long-spined form which I photographed in 1969. It might be the plant called *M. geminispina* var. *nobilis* by Backeberg, Die Cact. 5: 3185, fig. 2958 (1961), but can hardly be Pfeiffer's *M. nobilis*, since the description of the latter plant calls for central spines only 8-10 mm long.

M. general cepeda Hort. Heinr. *(M. chionocephala:* Backeb. 3211)

M. georgii [attrib. to Boed. by] Craig in error *(Coryphantha georgii)*

M. gibbosa Salm-Dyck *(Neoporteria subgibbosa:* Backeb. 3499)

M. gielsdorfiana Hort. (Hybrid of *M. parkinsonii:* Backeb. 3218)

M. gielsdorfiana [attrib. to Werdermann by] Craig, in error *(Echinocactus gielsdorfianus)*

M. giesekei Piltz Seedlist, 1982/3, no. 916 (R. Zahra, in litt., 29 Oct 1983).

M. gigantea Hildm. ex K. Schum., Gesamt. Kakt., 578 (Oct 1898, formal description); MfK 8: 126 (Aug 1898, note on flower colour, systematic position only). Source: Mexico, Guanajuato, *MacDowell.* First mentioned in Hildmann's Catalogue, 4 (1888); *M. macdowellii* Heese Cat.; *M. guanajuatensis* Runge Cat. No material preserved.

Series MAMMILLARIA. Simple, depressed-globose, 9-10 × 15-17 cm; tub. pyramidal to 10 mm or more, blue green; ax. woolly. Cent. sp. 4-6, robust, lowest longest, to 20 mm, dark yellowish, later horn-coloured; rad. sp. up to 12, very small, to 3 mm, subulate, white. Fl. yellow green.

M. gigantea is closely allied to *M. petterssonii* Hildm., also from Guanajuato and without a precise type locality, and to *M. hamiltonhoytea* ('Queretaro'), *M. ocotillensis* (Ocotillo, Queretaro), *M. pilensis* (La Pila, SLP) and other later-described, large-growing, simple-stemmed forms from this part of central Mexico. *M. gigantea*, as now understood, can be seen near the main highway from Queretaro to San Luis Potosi (Mex 57) in lat. 21°, in the matorral zone (e.g., growing on rocky hillsides associated with *Hechtia sp.* and *Myrtillocactus geometrizans*, 4 May 1965, *Bravo* 10 in MEXU 75041!), whereas *M. petterssonnii*, as now understood, occurs further west, in somewhat higher, moister conditions (e.g. on rocks on steep wooded hillsides between Dolores Hidalgo and Guanajuato (*Glass & Foster* 1457; *Hunt* 8063p).

M. gigantothele C. F. Foerster *(M. longimamma?:* Craig 347)

M. gilensis Boed. in Jahrb. DKG 1: 60, with fig. (1936); name mentioned in Backeb & F. M. Knuth, Kaktus ABC, 385 (1935). Source: Mexico, Aguascalientes, near San Gil. Described from plants sent to Boedeker by Georgi in 1934. No material extant.

Series STYLOTHELAE. Simple, globose or shortly cylindric, 4 cm diam; tub. cylindric, 8-9 × 3-4 mm; ax. with fine white bristles. Cent. sp. 3, rarely 4, upper to 7 mm, straight, lowermost to 10 mm, hooked, brownish yellow, smooth; rad. sp. 20-25/30, 5-6 mm, hairlike, whitish or yellowish. Fl. 12-15 mm diam, creamy with rosy midstripe to perianth segs. Fr. small, clavate (colour?); seed 'dark brownish grey'.

One sometimes sees plants speculatively labelled '*M. gilensis*' in collections, but I have yet to meet one that resembled the original illustration. A reproduction of this picture appears in CSJGB 39: 72 (1977), where (p. 71) I have suggested that *M. gilensis, M. posseltiana* and *M. rettigiana* may all be conspecific.

M. ginsaumae Hort. Plants referred to me from Uebelmann's nursery are pink-flowered *M. discolor.*

M. giseliana Schmoll Cat.; *M. hahniana* var. *giselana* Neale, Cacti and other Succulents, 88 (as *Neomamm.),* 183 (photo.) (1935); Craig, Mamm. Handb., 111, fig. 92 (1945). Form of *M. hahniana* with fewer, shorter axillary hairs 'showing the green tubercles' (Neale) but with more numerous (c. 40) rad. sp. (Craig). Name not validated.

M. glabrata Salm-Dyck ex Meinsh. in Allg. Gartenz. 16: 20 (15 Jan 1848). Briefly distinguished from *M. heyderi* by having two central spines and only 12 radials. Possibly the oldest name at specific rank for *M. gummifera*, but too uncertain, even with Salm-Dyck's amplified description (Cact. Hort. Dyck. 1849, 109. 1850) to be a serious contender.

M. glabrescens Walton Cat. (Craig 344)

M. gladiata Mart. *(M. magnimamma:* Craig 33)

M. gladiispina Boed. (basionym for *Coryphantha gladiispina)*

M. glandulifera Orcutt (error for *glanduligera:* Backeb. 3057)

M. glanduligera Otto & Dietrich *(Coryphantha exsudans:* Craig 347)

M. glareosa Boed., Mamm. Vergl. Schlussel, 59 (1933). Source: Mexico, Baja California, W coast, lat. 28½°, (collector?). No material extant.

Series MAMMILLARIA. Usually simple, base tuberous, deep-seated, visible part only 1.5-2 × 3-5 cm; tub. 4-angled, c. 6 × 4 mm; ax. slightly woolly. Cent. sp. 1, to 6 mm, brown. rad. sp. up to 9-10, to 6 mm, uppers shorter, whitish, others longer, brown. Fl. 12-20 mm, pale greenish yellow, outer segs. with reddish brown midstripe; stigmas greenish yellow. Fr. clavate, 15 × 5 mm, very light pink above, whitish below.

I regard this as an extreme form of *M. brandegei.* It was redescribed by Houghton as *Neom. dawsonii* (for type data, see under *M. dawsonii*) and recollected on several occasions from the type locality or nearby (e.g. *E. & B. Gay* 2616, *Lau* 028). It grows with *M. blossfeldiana* and other species (see Bradleya 1: 116. 1983). A plant I collected in September 1974 survived several years in cultivation, producing flowers and fruits indistinguishable from those of *M. brandegei,* and finally succumbed, as my plants of *M. brandegei* have also done, to rot from the base of the fruits (*H.* 8726, K).

M. glassii R. A. Foster in CSJA 40: 132, with figs. (1968). Source: Mexico, Nuevo Leon, near Dieciocho de Marzo, growing near the rim of a deep canyon in full shade with good drainage, 27 Feb 1968, *Glass & Foster* 631 (POM, holotype; MEXU, US, isotypes).

Series STYLOTHELAE. Clustering, stems globose to 3 × 3 cm, eventually cylindric, to 10 cm; tub. terete, 7 × 2-3 mm; ax. with 20-30 bristly hairs to 25 mm, white. Cent. sp. 1, 4-5 mm, porrect, hooked (or straight), golden amber, 6-8 subcentral, to 3 mm, pale amber, difficult to distinguish from radials; rad. sp. 50-60, 10-15 mm, hair-like, white, interlacing, Fl. to 14 × 3-5 mm, opening completely only in bright sunlight, inner per. segs. light pink. Fr. to 20 × 3-4 mm, green, becoming pinkish before withering; seed 1.5 × 1 mm, black.

In cultivation, the main central spine is often straight. The fruit is commonly purplish. The relationship of this curious small-flowered plant with *M. ascensionis* Reppenhagen (which Glass & Foster regard as a variety of *M. glassii),* and the still larger-flowered plants collected at Cerro Viejo and Dulces Nombres by Lau (*Lau* 1186 and 1186A, respectively), and *M. schwarzii* Shurly, demands critical study. The group as a whole appears to connect Series Stylothelae and Proliferae.

M. glauca A. Dietr. *(M. magnimamma:* Craig 34)

M. globosa Link *(M. longimamma:* Craig 347)

M. glochidiata Mart., Beschr. Neuen Nopaleen, in Nov. Act. Nat. Cur. 16: 337, t. 23 (1832). Source: Mexico, *Karwinski.* No locality given; no material extant.

Series STYLOTHELAE. Densely clustering, to 15 cm; tub. cylindric, obtuse, 8-16 × 4-6 mm; ax. (?). Cent. sp. 3-4, not much larger than the radials, dark coloured, one porrect, hooked, the others spreading, minutely pubescent; rad. sp. 12-15, c. 12 mm, bristly, spreading, white, minutely pubescent. Fl. c. 16 mm, outer segs. greenish-reddish or yellowish, inner white. Fr. cuneate, deep red; seeds black.

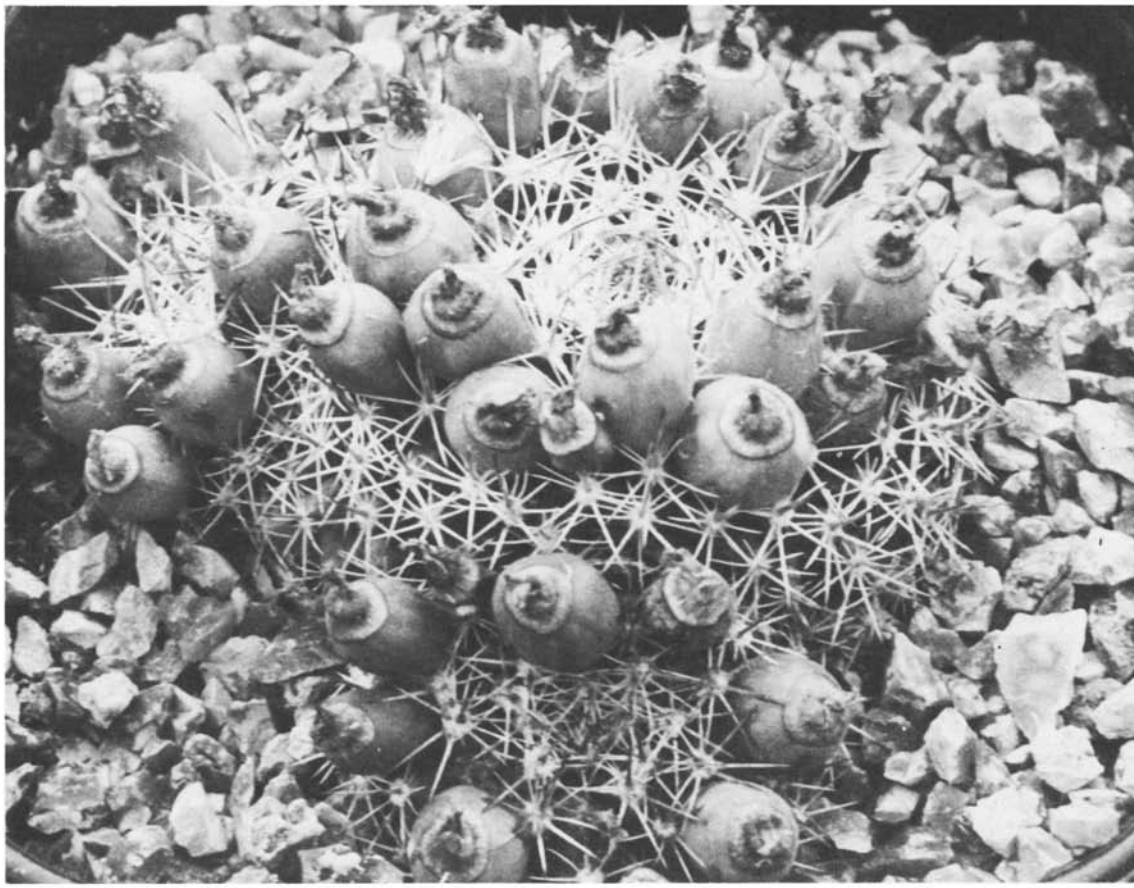
An original coloured drawing exists in the Munich herbarium which is clearer than the published plate and might be positively identifiable. The modern, pink-flowered substitute which is commonly grown as *M. glochidiata* does not tally, however, and has yet to be matched with anything occurring in the wild, though it could be a form of *M. wildii.*

M. glomerata (Lam.) DC., Prodr. 3: 459 (1828); *Cactus glomeratus* Lam., Encycl. Meth. 1: 537 (1783). Source: Hispaniola, Santo Domingo, 'vers l'étang Saumatre, quartier du Cul-de-Sac', *Plumier.*

Plumier's '*Melocactus minimus, lanuginosus et tuberosus*', described and figured by him in his manuscript 'Botanicum Americanum', and the basis of a description and plate in Burman's 'Plantarum americanarum fasciculus', as well as the name given by Lamarck, has never been positively identified by recollection in the type locality. The plant could have been *M. prolifera,* as commonly supposed, though the described flower colour (red) is wrong, or perhaps something akin to *M. ekmanii* or *M. nivosa,* with the same difficulty. See Hunt in JMS 4: 53 (1964).

M. goeringii Haage *(Coryphantha sulcata:* Craig 347)

M. goldii Glass & Foster in CSJA 40: 151, with figs (1968); *M. saboae* var. *goldii* (G. & F.) Glass & Foster in CSJA 51: 124 (1979). Source: Mexico, Sonora, a few miles N of Nacozari on road to Agua Prieta, alt. c. 3500 ft, growing in greyish white volcanic tuff and exposed to full sun but nearly covered with



M. glareosa H. 8726 *(photo: Weightman)*

pebbles, 27 Mar 1968, *Glass & Gold* 1027/1 (POM, holotype; MEXU, US, isotypes).

Series LONGIFLORAE. Simple or sparingly caespitose, individual stems small, subglobose, to 25 mm; tub. terete, 5-7 mm; ax. naked. Cent. sp. 0; rad. sp. 35-45, 2-3 mm, thin, subpectinate, interlacing, glassy white. Fl. funnel-shaped c. 3.5 × 3.5 cm, the tube c. 18 × 2.5 mm, inner segs. dark lavender pink, anthers orange yellow. Seed 1.5 × 1.1 mm.

The most northerly of the forms of *M. saboae*, and differing from the others in being less inclined to cluster, the higher tubercular spiral count (8:13), more numerous spines, seed size, and other details.

M. golziana Haage *(Coryphantha ottonis:* Craig 347)

M. goodridgii Scheer ex Salm-Dyck, Cact. Hort. Dyck 1849, 91 (1850) (as *'goodrichii'*); Scheer in Seeman, Bot. Voy. Herald, 286 (1856). Source: Mexico: Baja California, Isla Cedros (or Cerros). Based on a living specimen collected by J. Goodridge in Oct 1846, not known to have been preserved.

Series ANCISTRACANTHAE. Stem erect, cylindric, branching from the base, to 10 × 4 cm; ax. naked. Cent. sp. 4, whitish below, brown above, upper 3 straight, lowermost hooked; rad. sp. 12, sub-bifarious, interlacing.

The 'type' of *M. goodridgii* died without having flowered, and, as related by Lindsay & Dawson (in CSJA 24: 79. 1952), various other Baja Californian plants have subsequently been confused with it. Lindsay & Dawson, who used the spelling *'goodridgei'*, did little better themselves, as it seems clear that the var. *rectispina* they described belongs to a different group of species. Whether or not their *M. goodridgei* var. *goodridgei* was what Goodridge originally collected, I am uncertain, but if it was, then from the floral description they provide, and the naked axils as called for by Salm-Dyck, the plant must have been a form of *M. hutchisoniana*, for which, of course, it would be an earlier name. The Lindsay & Dawson floral description (l.c. 78) is as follows: flowers cream-colored, funnelform, 15 × 15 mm; outer perianth segments 6-8, acute, cream-colored with a broad maroon midstripe; inner perianth segments 7-8, 3 mm broad, obtuse, cream-colored with a very pale pink blush from the ventral maroon midstripe; anthers yellow; filaments pink; style yellow to pink; stigma lobes 6, to 3.5 mm, olive green; fruit clavate, red, to 2.5 cm long, with persistent perianth; seeds smooth, black with small round hilum.

Under modern rules of nomenclature, it is permitted to correct the original spelling *'goodrichii'*, but we should adopt Scheer's earlier and more classical *'goodridgii'* in preference to the *'goodridgei'* favoured by Britton & Rose and others. Also, Lindsay & Dawson's description of Scheer as a 'German botanist', though not actually untrue, is misleading, since Scheer was professionally a city merchant who resided by Kew Green for much of his life!

M. goodridgii var. *rectispina* Dawson ex Lindsay & Dawson in CSJA 24: 80, fig. 46 (1952). Source: Isla Cedros, ridges and steep hillslopes, 600-800 ft, immediately overlooking the Punta Norte lighthouse, 21 Apr 1951, *Dawson* 10631 (AHFH). Differing from var. *goodridgii* (sensu Lindsay & Dawson) in the straight cent. sp., sometimes slightly curved at tip, the 14-18 rad. sp., the deep red stigma lobes and the 'lightly pitted' (as opposed to 'smooth') seeds. 'The habitat is well separated from

that of the hook-spined type variety which in the Punta Norte area grows only on stony flats near the shore'.

No *Mammillaria* of the group with *red* stigmas (*M. fraileana* etc.) is known from this far north on the west side of Baja, and I am uncertain to which species this plant can be referred. *Lau* 033, a straight-spined plant from Punta Norte, 300 m, is claimed by its collector to be a form of *M. dioica*. I have not been able to check whether it has naked or bristly axils, or studied the flowers.

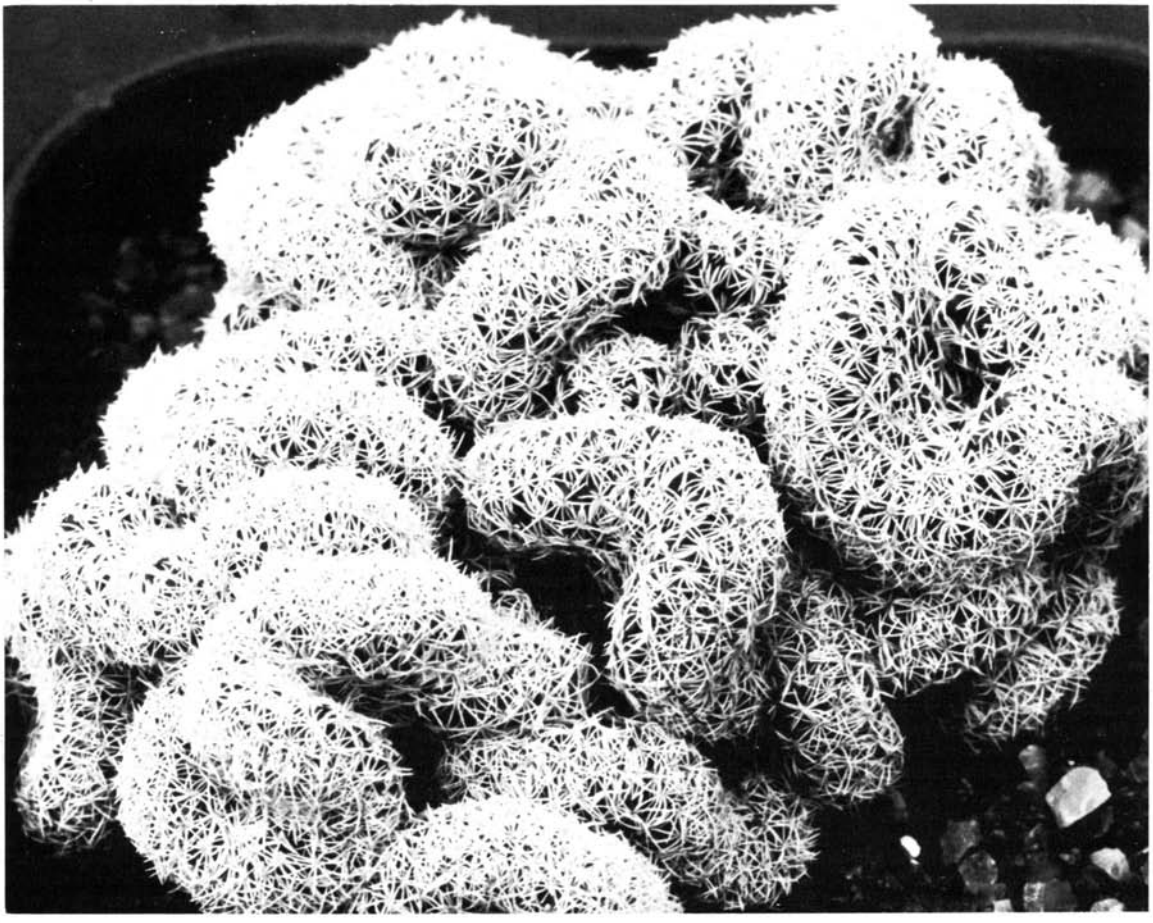
M. gracilis Pfeiffer in Allg. Gartenz. 6: 275 (1838); Ehrenberg in Linnaea 19: 351 (1846); Hunt in JMS 5: 45-48 (1965) & 6: 31-34 (1966). Source: In a consignment received in early 1838 from Ehrenberg, who was based at Mineral del Monte, Hidalgo, Mexico. Ehrenberg (l.c.) subsequently reported that he had collected it at Puente de Dios, Hidalgo, under shrubs in leaf mould on limestone rocks, 5310 ft (1600 m): 'Sometimes it occurs with stronger spines and centrals, and inhabits all the barrancas around Metztitlan and Zimapan at a height of 4-5000 ft. It did not grow at Mineral del Monte. In 1840, near San Onofre, I found a very slender variety only 4 mm thick with brown, firmly adpressed spines; in cultivation it lost its peculiarities'.

Series PROLIFERAE (?). Proliferous, the offsets very easily detached; stems slender, cylindric, to 13 × 1-3 cm; tub. short, obtusely conic, 6 × 6 m; naked. Cent. sp. 0-2(-5), up to 10-12 mm, stiffer than the radials, white or dark brown; rad. sp. 11-16, 3-8 mm, bristly, chalky white. Fl. small, c. 12 mm, segments pale yellow with pinkish or brownish mid-line. Fr. small, clavate, to 12 mm, red, the dried perianth not persistent; seeds black, with lateral hilum.

I dealt with the nomenclature of the cultivated forms of *M. gracilis* in my two articles cited above. It seems possible that until relatively recently the species was perpetuated in cultivation in two or three clones only, thanks to its remarkably proliferous habit and rare fruiting. The two commonest forms correspond with Pfeiffer's original, a relatively robust form with central spines developed on mature growth (var. *gracilis*) and the var. *pulchella* Salm-Dyck, Cact. Hort. Dyck. 1849, 103 (1850), a smaller form, stems usually less than 5 × 2 cm; cent. sp. 0; rad. sp. c. 3 mm, white but not chalky, the uppermost 2-3 dark-coloured. This form has been reported from San Joaquin, Querétaro, by Dr. J. Meyran (pers. comm.), but the cultivated clone should be regarded as a cultivar (i.e. as *M. gracilis* 'Pulchella').

In November 1973, Dr Meyran showed me the wild form of var. *gracilis* growing above Tolantongo Canyon, Hidalgo (*H.* 8624), and I also found it beside the road to San Joaquin, growing at 1950 m with *M. echinaria* and one of the *M. parkinsonii-M. perbella* complex (*H.* 8635). Felipe Otero has found var. *gracilis* with up to 5 centrals at Ixmiquilpan, and a form with brown upper radials, but also 1 central on old plants, near Metztitlan. A small form with dark reddish brown spines is also in cultivation. I received this from Mr. R. Hösslinger of Nürnberg.

M. gracilis is closely allied to *M. vetula* Mart. (incl. *M. magneticola* Meyran), which occurs at higher elevations in Hidalgo. Beyond this, the affinities of the species are obscure.



M. gracilis 'Bunty' *(photo: Weightman)*

The basic resemblances to the *M. prolifera* group are probably only superficial, and the real allies of *M. gracilis* and *M. vetula* may lie elsewhere.

Pilbeam (Mammillaria, 65. 1981) describes the fruit as 'whitish, showing the black seeds through the almost transparent walls of the berries'. My plants have occasionally produced small red fruits with only one or two seeds. Further observations are needed.

Some years ago I was given a fast-growing (but rot-prone!) cristate form, which I take to be of *M. gracilis*. This had been purchased in a shop in Cornwall by Mrs Bunty Kitson, and I have distributed numerous cuttings as *M. gracilis* 'Bunty'.

M. graessneriana Boed. in MfK 30: 84, with fig. (1920). Source: a cultivated specimen of unknown Mexican origin received from Grässner. No material extant.

Series SUPERTEXTAE. This name is worthless in face of the lack of information concerning its origin. The original plant was evidently allied to *M. columbiana*, but the authenticity of others still being grown as *M. graessneriana* is doubtful. One in the possession of Dr. W. F. Maddams, for instance, has 6 central spines, rather than the 2 or sometimes 4 prescribed by Boedeker.

After the *volte face* in the latest edition of the International Code of Botanical Nomenclature (1983), the correct termination of epithets formed from names ending in 'er' is again '-iana', not '-ana'.

M. grahamii Engelm. in Proc. Amer. Acad. 3: 262 (1856); Cact. Bound., 7, t. 6 (1859). Benson, Cacti Ariz., ed. 3, 159, Fig. 4.12, upper (1969), Fl. Texas 2(2): 279 (1969) & Cacti U.S. & Canada, 896, figs. 933-938 (1982). Lectotype: U.S.A., Texas, El Paso Co., Franklin Mts., E. Side, 1852, *Wright* (MO). The following description of var. *grahamii* is taken from Engelmann (1859) and Benson (1969).

Series ANCISTRACANTHAE. Simple or branched at base, globose to ovoid, 7.5-10 × 7.5-11 cm, from thickened roots; tub. ovoid-cylindric, 6-12 × 4.5 mm in 13: 21 spirals; ax. naked. Cent. sp. 1-3, longest hooked, to 18(-25) mm, dark brown, width of hook 1.5 mm (compared with 3 mm in *M. microcarpa*), others where present straight, shorter, paler; rad. sp. 20-30(-35), lateral longest, 6-6(-12) mm, fine acicular, white. Fl. 2-3.5 (-4.4) cm diam., outer segs. ciliolate, inner oblong, pink; stigmas green or creamy green, to 8 mm. Fr. subglobose or barrel-shaped, 12-25 × 6 mm, red; seeds obliquely obovate, 0.8-1.0 mm, black.

U.S.A.: Arizona, New Mexico and E. Texas. Documented distribution records are given by Benson.

Merged with *M. microcarpa* by Britton & Rose, and unrecognized by Craig, *M. grahamii* was re-distinguished by Benson on the basis of habit, spine, flower, fruit and seed characters, and has more south-easterly range, at higher elevations. Nevertheless, Benson says, the two intergrade where their ranges overlap in S. Arizona.

According to Benson, *M. oliviae* Orcutt is a form of *M. grahamii* with straight central spines *(M. grahamii* var. *oliviae* (Orcutt) Benson, Cacti Ariz., ed. 3, 22, 161, 1969; *M. oliviae* Orcutt in West Amer. Sci. 12: 163. 1902).

M. grandicornis Hort. *(M. magnimamma:* Backeb. 3135)

M. grandicornis Muehlenpf. *(Coryphantha sp.*?: Backeb. 3499)

M. grandidens Hort. *(M. magnimamma:* Craig 363)

M. grandiflora Otto ex Pfeiffer (basionym of *Neolloydia grandiflora)*

M. grandis Hitchen ex Forbes, name only (Craig 344)

M. granulata Meinsh. in Wochenschr. 1: 264 (1858). Source: Mexico, Nuevo Leon, Escondida? ('La Escondida'), c. 1842, *Karwinsky*. No material extant.

Series PROLIFERAE. Clustering, stems 5-6.5 × 4-5 cm; tub. oblong, 8-12 × 4-6 mm; ax. with wool and 8-15 very thin bristles. Cent. sp. 6, 12-14 mm, straight, yellow with purplish tip; rad. sp. 18-20, 12-14 mm, flexuous, white. Fl. & fr. not described.

Meinshausen himself claimed the plant, which had been collected by Karwinsky on his second journey to Mexico, resembled *M. pusilla*, i.e. *M. prolifera*, and there are certainly species of the *M. prolifera* group, including *M. prolifera* var. *texana*, on the eastern flank of the Sierra Madre Oriental, which Karwinsky visited on his second Mexican trip. 'La Escondida', where he is said to have collected the plant, is presumably the Escondida between Ascension and Doctor Arroyo.

Craig (Mamm. Handb., 331. 1945) was under several misapprehensions concerning the description of this plant (that the *habitat*, not the habit was similar to *M. pusilla;* that Meinshausen compared it with *M. glochidiata*, which he didn't—his remarks on *M. glochidiata* were separate; and that the type locality 'is rather indefinite'), and the confusion he referred to seems largely of his own making! If Karwinsky *did* collect something other than *M. prolifera*, some later name could be in jeopardy.

M. greenwoodii Bravo, ms. See *M. dodsonii.*

M. greggii (Engelm.) Safford *(Epithelantha micromeris* var. *greggii)*

M. grisea Salm-Dyck (Craig 331)

M. groeschneriana Schwarz Cat., 1955 (Backeb. 3494)

M. grusonii Runge in Gartenflora 38: 105, fig. 20 (1889); Maddams & Sharp in JMS 4: 37-38 (1964). Source: Mexico, Coahuila, Sierra Bola, *Runge*. No material extant.

Series MAMMILLARIA. Mostly simple, globose and later cylindric, to 25 cm diam.; tub. four-angled, 6-8 mm; ax. naked. Cent. sp. 2(-3), 4-6 mm, stronger than the radials, straight, reddish at first, later snow white, one ascending, one descending; rad. sp. (12-) 14, 6-8 mm, the upper shorter. Fl. yellow, 2.5 × 2.5 cm. Fr. scarlet.

This rather well-characterized species seems to me the same as Craig's incompletely described *M. mexicensis* (a name only slightly less informative than Craig's description) and Backeberg's *M. pachycylindrica*, also from a 'Standort nicht bekannt', despite differences in spine count and (in the case of *M. pachycylindrica*) flower colour. Craig listed it amongst the 'Little Known' species, but its reintroduction was reported by Maddams & Sharp in 1964. It has subsequently been collected on several occasions by Glass & Foster and by Reppenhagen.

M. guanajuatensis Runge *(M. gigantea:* Schumann, Gesamt. Kakt., 578)

M. guaymensis Schwarz Cat. *(M. johnstonii* var. *guaymensis:* Backeb. 3200)

M. guebwilleriana Haage, name only (Craig 344)

M. gueldemanniana Backeb., Beitr. Sukk. -u. pflege 1941: 57 (1941). Source: Mexico, Sonora, Rancho Guirocoba near Alamos. Based on a living plant sent to Backeberg by Lindsay in 1939; *M. guirocobensis* Craig, Mamm. Handb., 220, fig. 201 (1945). Source: numerous collections from Rancho Guirocoba and elsewhere, including the Lindsay & Craig material, of which part was sent to Backeberg. The type was note explicitly designated, but stated to have been deposited in the Dudley Herbarium (DS).

Series ANCISTRACANTHAE. Clustering from the base and above, stems to 11 × 5 cm; tub. conic-cylindric, 7 × 5-7 mm; ax. naked, rarely an occasional bristle. Cent. sp. 1-3 straight, one porrect, very short (2-3 mm), the others in plane of radials, 6 mm, or the porrect spine hooked, 8-10 mm, all reddish brown, brown at tip; rad. sp. 18-21, 5-8 mm, thin, yellowish tan to chalky grey. Fl. 17-20 × 10-20 mm, whitish, inner segs. with reddish brown midline; stigmas 2-4 mm, olive-green to yellow. Fr. clavate, 12 × 6 mm, scarlet; seed 1 × 0.7 mm.

The above is a confection of essential points from the Backeberg and Craig descriptions. The plants are referable to the Sonoran group which also includes *M. sheldonii, M. swinglei, M. inaiae* and *M. multidigitata.* Variation in this complex is discussed in general terms by Maddams in JMS 10: 34-37 (1970).

M. guelzowiana Werdermann in ZfS 3: 356, with fig. (1928); Craig, Mamm. Handb., 217 (descr. of fruit), fig. 198 (1945). Source: Mexico, Durango. Imported to Europe by Herrn Gülzow. Type not known to have been preserved.

Series ANCISTRACANTHAE. Simple or clustering, stems

M. guelzowiana *(photo: Weightman)*

globose, often 4-6 × 7 cm; tub. conic-cylindric, c. 12-13 × 4-5 mm, flabby; ax. naked. Cent. sp. 1(-2), 8-10 mm, slender acicular, hooked, glabrous, reddish or rarely yellowish; rad. sp. c. 60-80, up to 15-20 mm, hair-like, tortuous, pure white. Fl. large, campanulate-funnel shaped, c. 5 × 6 cm, intense purplish red, stigmas greenish. Fr. almost globose, 8 × 7 mm, yellowish; seed oblong-dome shaped with very broad hilum, 1.0 × 1.25 mm excluding the conspicuous strophiole, black.

This, probably the showiest-flowered *Mammillaria,* was recollected in Durango, 15 miles NW of highway Mex 45, grassy slopes of the mountains N of the Rio Nazas, 30 Oct 1968, by Glass & Foster *(G. &. F.* 807); see CSJA 42: 76, 107, 109, figs 15, 16 (1970); also near S. Francisco Asis, *Lau* 640. The form with yellow central spines was called var. *splendens* by Neale, Cacti and other Succulents, 88 (1935).

M. guerkeana Boed. (basionym of *Coryphantha guerkeana)*

M. guerreronis (Bravo) [attrib. to Boed. by] Backeb. & F. M. Knuth, Kaktus ABC, 391 (1935); *Neom. guerreronis* Bravo in An. Inst. Biol. Mex. 3: 395, figs. 23, 24 (1932). Source: Mexico, Guerrero, Canon del Zopilote. Type not designated. *M. zapilotensis* Craig, Mamm. Handb., 132, fig. 114 (1945), and varieties of *M. guerreronis,* l.c. 130. Source: as for *M. guerreronis;* types not designated.

Series POLYACANTHAE. Clustering, individual stems cylindric, to 60 × 6 cm; tub. cylindric, 8-10 × 4-5 mm; ax. with short wool and 15-20 white bristles. Cent. sp. usually 4 (2-5), upper straight, to 15 mm, lowermost straight or commonly hooked, to 25 mm, light (to dark) brown at first, later becoming whitish; rad. sp. 20-30, 5-10 mm, bristly, white. Fl. small, red. Fr. cylindric-clavate, to 25 mm, greenish white, eventually tinged pink or purplish, with dried perianth persistent; seeds 1.5 × 0.8-1.0 mm, brown.

Abundant in the Canon del Zopilote at elevations of 650-900 m, growing with *Neobuxbaumia mescalaensis* etc. A stem I collected in Oct 1974 (*H.* 8851) thrust out numerous fruits the following year, evidence of prolific flowering in its tropical habitat, but I failed to germinate the seeds, and the stem later rotted. Other smaller cuttings have hung on, growing very slowly, but clearly miss their warm, dry, Mexican home. John Pilbeam has had more success; cf. CSJA 55: 52, fig. 2 (1983).

In Mexico, plants with straight and hooked central spines grow intermingled, and there can be no justifying the various taxa proposed by Craig. Also, some of the most vigorous plants I saw were dark-brown spined near the apex, a point not hitherto reported, so far as I know.

M. guiengolensis [attrib. to Bravo & MacDougall by] Bravo in An. Inst. Biol. Mex. 32: 187, with figs. (1962). T. MacDougall in CSJA 38: 24-25, with figs. (1966). Source: Mexico, Oaxaca, NE of Tehuantepec, Cerro de Guiengola, May 1961, *MacDougall* s.n. in MEXU 61077! (type?). Also collected in the same locality, 6 Feb 1969, *Dodson* in MEXU 118778!

Subg. OEHMEA. Not distinguishable from *M. beneckei* Ehrenb. The flower was described by Bravo from some other species (purple). MacDougall, who did not write the original article (as is clear from the text) later described the flower as orange-yellow, as in *M. beneckei.*

M. guillauminiana Backeb. in Cactus (Paris) no. 33, suppl. 2: 81 (1952); Die Cact. 5: 3450, fig. 3190 (1961). Source: Mexico, Durango, 60 km E (W?) of the city, on humus between rocks, in shade. Apparently discovered by Schwarz near El Salto (Schwarz Cat., 1955), according to Backeberg (1961), but El Salto is WEST of Durango. Type not preserved.

Series STYLOTHELAE. Simple, c. 5.5 × 5.5 cm above napiform base; tub. pale green, sometimes reddish tinged; ax.

M. gummifera in habitat W of the city of Durango. *(photo: Hunt)*

naked. Cent. sp. 4-5, to 6 mm, the upper 3-4 straight, the lowermost hooked, brown-tipped, paler below; rad. sp. c. 30-32, 6-7 mm. white, bristly. Fl. 10 × 8-10 mm, inner segs. white with pink midstripe, stigmas white. Fr. not described.

In view of the doubt about the type locality of this plant, it is difficult to be certain of its identity, and anyone who still has one of Schwarz's plants should bring it forward for specialist examination. On the assumption that Backeberg's 'östlich' was a slip for 'westlich' I have tentatively attached the name *M. guillauminiana* to plants I collected near El Salto in 1974, as illustrated in CSJGB 42: 52 (1980) and in Pilbeam, Mammillaria, 68 and col. plate (1981). These have produced white fruits, and seem to me to be allied to *M. zeilmanniana.*

M. guilleminiana Lem. *(M. decipiens:* Craig 229)

M. guirocobensis Craig *(M. gueldemanniana:* see above)

M. gummifera Engelm. in Wislizenus, Mem. Tour N. Mexico, 105 (about 2 Apr 1848); and in Boston J. Nat. Hist. 6: 199 (1850) (descr. of flower). Source: Mexico, Chihuahua, Cosihuiriachi, 6275 ft, Oct 1846, *Wislizenus* (MO, holotype; POM 317822, isotype); a 'topotype' is *Rose* 11667 (US).

Series MAMMILLARIA. Simple, hemispheric, 7-10 × 7.5-12.5 cm; tub. quadrangular-pyramidal, 12-14 × 10-12 mm; young ax. woolly. Cent. sp. 1-2, 4 mm, dark; rad. sp.10-12, upper 4-6 mm, bristly, whitish, lower 12-14 mm, stronger, dark. Fl. 3 × 1.2-2.4 cm, petals reddish white with dark red in the middle.

Closely allied to *M. heyderi* Muehlenpf., but distinctive in appearance and spination, and more south-westerly in distribution.

In my earlier notes on this group (JMS 11: 8, 36. 1971), I raised doubts about the publication date of the 'Wislizenus Report', assumed by Professor Benson to have been 13 Jan 1848, and prompted him to make enquiries via the U.S. Library of Congress. The results of the ensuing detective work are recorded by Benson in his monograph, The Cacti of the United States and Canada, page 936 (1982), where he concludes that the actual date of publication was 'most likely about April 2'. This gives clear priority of publication to *M. heyderi,* if *M. gummifera* is treated as conspecific. Benson, incidentally, did not study *M. gummifera,* because it is Mexican, and the particulars he gives on pp. 872 and 966 contain a number of errors, notably in the statement that the *upper* radial spines are longer, making a false contrast with *M. heyderi* var. *macdougalii.* The altitude at which it occurs is not 'unknown', Wislizenus himself having given the elevation of Cosihuiriachi as 6275 ft (1900 m), and I believe Craig was correct in reporting the fruit as scarlet. Wislizenus collected the type in 1846, not 1848, and the original description appears on page 105, not 106, of the Memoir.

Regrettably, however, it is true that (as is the case with most other Mexican Mammillarias) there is little specific ecological information available. *M. gummifera* apparently replaces *M. heyderi* sensu stricto in the south-western sector of the Chihuahuan Desert Region, and has been reported from various sites in Chihuahua, Durango and N. Zacatecas as far south as lat. 24°N. Further south, it may be replaced by the *M. petterssonii* complex via the nebulous *M. wagneriana,* but the whole group demands careful field study. I myself have observed *M. gummifera* on rocky hill slopes west of the city of Durango in a matorral-pastizal vegetation type, i.e. a desert grassland with frequent thickets of *Opuntia spp., Yucca sp.* and other shrubs, alt. 1900 m, 29 Sept 1974, *H.* 8798p. The largest plants were 25 × 15 cm with 1 central spine to 10 mm. Most plants were single-stemmed, but I noted a very few dichotomizing, with up to 10 heads. A pectinate *Echinocereus* also grew in the locality. The substrate was the characteristic reddish volcanic rock thereabouts.

To round off these notes on *M. gummifera,* I will leave you a

thought from Wislizenus (l.c., 51): 'Gentle reader, whenever in the course of your life you should feel tempted to pronounce a foreign, jaw-breaking word, or to visit a strange looking, incomprehensible, awful place, I would recommend your kind attention to Cosihuiriachi . . .'

M. haageana Pfeiffer in Allg. Gartenz. 4: 257 (1836). Source: Mexico, Veracruz, Perote (?). Based on a living plant received by Pfeiffer from the nursery of F. A. Haage. Erfurt, as *M.* 'Perote'. No material extant.

Series SUPERTEXTAE. Subglobose, glaucous green, to 4 cm diam.; tub. crowded, very small, tetragonal at base; ax. slightly woolly. Cent. sp. 2, upper 6 mm, lower 8 mm, slender, black; rad. sp. 20, 3 mm, bristly, white, radiating.

The rejection of the name *M. elegans,* which is inapplicable to the well-known white-spined Mammillarias of Puebla and adjacent Veracruz, leaves *M. haageana* as the next contender. It is a little unfortunate that the name is better known in a more restricted sense, i.e. for a form of *'M. elegans'* with longish, dark spines, but it is apparent that many other named forms in this complex cannot be regarded as separate species, including *M. collina* and *M. conspicua.*

M. haehneliana Boed. in Kakteenkunde, 27, with fig. (1934). Source: Mexico, San Luis Potosi, c. 15-20 km S of the city, in ravines, 2000 m. Collected in 1930 by E. Georgi and named after Prof. Curt Haehnel of Guadalajara, an enthusiastic collector and member of the German Cactus Society. No material extant.

Series STYLOTHELAE. Indistinguishable from *M. knebeliana,* q.v.

M. haasii Uhlig Cat., 1979 (U2941). An undescribed variant of *M. virginis.*

M. haematactina Ehrenb. (Craig 331)

M. hahniana Werd. in MDKG 1: 77, with fig. (1929); Blühende Kakt., 2 (1930). Transl. by F. Weinberg in CSJA 1: 127 (1930). Source: Mexico, Querétaro, Sierra de Jalapa, 2000 m. A specimen in the Berlin Herbarium *(Schmoll,* s.n.) may be the holotype (cf. Leuenberger in CSJGB 40: 104. 1978). Named for Herr Hahn of Lichterfelde.

Series LEUCOCEPHALAE. Clustering, rarely simple, stems globose, to 9 × 10 cm; tub. very numerous, triangular-conic, small, c. 5 × 2-3 mm; ax. with 20 or more long white bristles to 35-40 mm. Cent. sp. 1, rarely 2-4, at most 4 mm, whitish with reddish brown tip; rad. sp. 20-30, 5-15 mm, hair-like, white. Fl. 12-15 mm diam., purplish red. Fr. small, clavate, 5-7 mm, red.

The original illustration depicts a remarkably well-combed (and shampooed?) specimen. In fact, its *coiffure* is so touched-up as to be almost unbelievable, and I have yet to see anything to match it. It represents the most extreme form of a series which can be taken to include not only the vars. *giseliana* Neale and *werdermanniana* Schmoll, but *M. mendeliana* (Bravo) Werdermann, *M. bravoae* Craig and *M. woodsii* Craig, which merely differ in the actual and relative lengths of the axillary bristle-hairs and radial spines. 'This', as a perplexed and equivocating Dr. Craig put it, 'is a typical illustration of the fact that this genus contains many species that do not have definite dividing lines but they merge from one into another' (Craig, Mamm. Handb., 114, 1945).

M. halbingeri Boed. in Kakteenkunde 1933: 9, with fig. (1933). Source: Mexico, SW Oaxaca, *Conzatti;* sent to Boedeker in Spring 1931 by Chr. Halbinger of Mexico, D.F. No material extant.

Series SUPERTEXTAE. Simple, globose, to 15 cm diam.; tub. conic or subovoid, c. 4-5 × 3 mm; ax. with woolly hairs. Cent. sp. 2, 5-6 mm, yellowish white, tipped brown; rad. sp. c. 25, 5-7 mm, white. Fl. 12 mm diam., clear sulphur yellow with pale pink edges. Fr. (ripe?) described as small, clavate, white.

Never positively re-collected, though Buchenau and others have collected Supertextae with clear pale yellow, pink-tinged, flowers. The present claimant to the name is *Lau* 1108, from Ocotepec, Oax. Is this the Ocotepec near Tlaxiaco, or the one near Juquila Mixes? It hardly matters, as *Lau* 1108 has only 14-19 radial spines and dark pink/magenta flowers, which put it out of contention (Hunt in JMS 24: 49. 1984).

M. hahniana: reproduction of Werdermann's original illustration (1929).

M. halei T. S. Brandegee in Proc. Calif. Acad. 2: 161 (1889). Source: Mexico, Baja California, Magdalena and Santa Margarita islands, abundant, Jan 1889, *T. S. Brandegee* in UC 108174 (holotype!). Recollected by Rose in 1911.

Subg. COCHEMIEA. Clustering, stems 30-50 × 5-7.5 cm; tub. short, rounded; ax. woolly. Cent. sp. 3-4, 25 mm, straight; rad. sp. 10-21, 12 mm. Fl. vertical, from ax. of young tub., 2.5-5 cm, scarlet. Fr. clavate, 12 mm, red.

The type of subgenus *Cochemiea* K. Brandegee, and the only member of the group without hooked central spines. Named after J. P. Hale, a landowner in Baja California who assisted Brandegee. Some details in the above description are from Britton & Rose, The Cact. 4: 22 (1923).

In cultivation from *Lau* 040 (Isla Magdalena). A form from the peninsula mainland is also known and is now in cultivation from *N. P. Taylor* 65 (between Cd. Constitucion and San Carlos, among bushes in sand; seeds collected April 1983). Seedlings from this source have some central spines weakly hooked at one year old. Unfortunately, on the mainland, it is endangered through agricultural development (N.P.T., pers. comm.).

M. hamata Lehmann ex Pfeiffer, Enum. Cact., 34 (1837); Del. Sem. Hamb. 1832. Source: Mexico, without locality; collector not recorded.

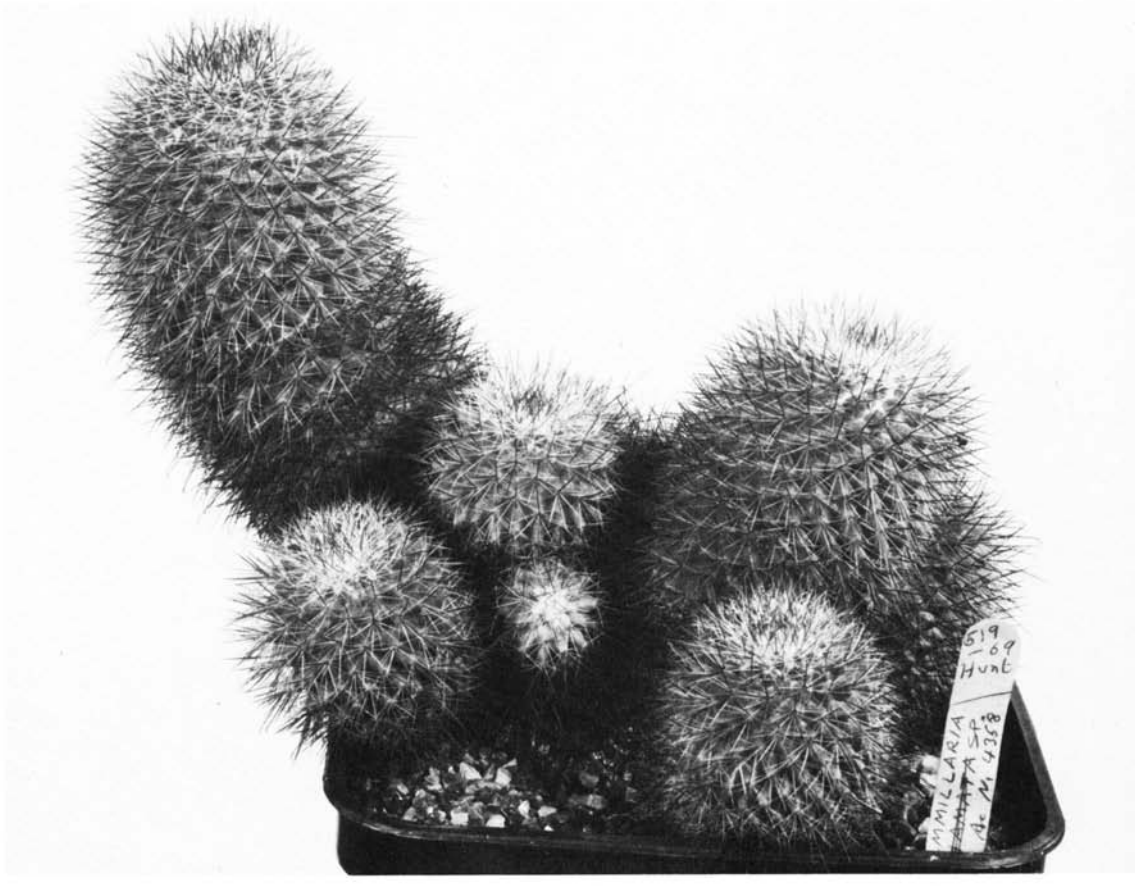
Series POLYACANTHAE(?). Simple, ovate-oblong; tub. pyramidal-conic; ar. woolly, ax. nearly naked. Cent. sp.3-4, erect, dark, the terminal elongate, hooked; rad. sp. 12-16, white.

Said by Pfeiffer to resemble *M. coronaria* Haw., this very uncertain species has also been equated with *Cactus cylindricus* Ortega, the earliest Mexican Mammillaria to be figured. The original plant of *M. hamata* died before 1837 and no material was preserved, so the name might better have been forgotten. The late F. G. Buchenau, however, followed by Father Fittkau, Mr. Reppenhagen and others, attached it to a relatively stout ally of *M. duoformis* from NW Puebla, and there are now many seed-grown plants of this type in collections (see CSJGB 38: 38. 1976).

The Hamburg seedlist for 1832, in which the name *M. hamata* first appeared, is not in the set at Kew, and I have yet to ascertain whether or not Lehmann provided a validating description there.

M. hamauligera Craig, 172, error for *hamuligera*

M. hamiltonhoytae Craig, 72, error for *hamiltonhoytea*



M. hamata: a plant collected by Buchenau in Puebla in the 1960s. The same specimen was figured in CSJGB 38: 38 (1976). *(photo: Harwood)*

M. hamiltonhoytea (Bravo) Werdermann in Backeb., Neue Kakt., 99 (1931); *Neom. hamiltonhoytea* Bravo in An. Inst. Biol. Mex. 2: 130, with figs. (1931). Source: Mexico, Querétaro, *Schmoll.* Type not stated to have been preserved.

Series MAMMILLARIA. Usually simple, depressed, to 18 cm diam.; tub. somewhat 4-angled, 10-14 × 9-10 mm; ax. naked. Cent. sp. 2-3, much thicker than the radials, the upper 1-2 cm, the lowermost exceeding 3 cm, curved downwards, reddish at first, later ashy grey, blackish tipped; rad. sp. usually 5, to 8 mm, white with dark tip. Fl. 2 cm, purple. Fr. clavate, 20 mm, purple, 'perianth not persisting' (Craig).

This I interpret as a purple-flowered variant in the *M. petterssonii—M. gigantea* group. A variety with smaller, yellowish-brown flowers (var. *fulvaflora*) was described by Craig with some pseudo-Latin and said to have the same distribution as the type, which he reported from 'San Moran'.

M. hamuligera Haage & Schmidt Cat. (Backeb. 3293)

M. handsworthii Walton Cat. (Craig 344)

M. haseloffii Ehrenb. *(M. spinosissima:* Craig 268; *M. senilis:* Craig 347)

M. haseltonii Schmoll Cat. *(M. hahniana* var.: Mottram 38)

M. hastifera Krainz & Keller in Schweiz. Gart. 1946: 11, with fig. (1946). (Krainz's paper, 'Neue und seltene Sukkulenten', was also issued as a separate publication with new pagination; in this *M. hastifera* is on p.3.). Source: Mexico. No further data. Described from an imported example which Dr. A. Keller of Cademario obtained in 1938.

Series MAMMILLARIA. Evidently a variant of *M. gigantea*, the perianth segments cream with brown midstripe, but hardly meriting discussion in view of the absence of source data.

M. haudeana Lau & Wagner in KuaS 29: 253, with figs. (1978). Source: Mexico, Sonora, Yecora, *Lau* 777 (in HEID 46636).

Series LONGIFLORAE. A variant of *M. saboae,* q.v.

M. haynii Ehrenb. (Craig 332)

M. heeriana Backeb., name only (Backeb. 3424, 3474, fig. 3205)

M. heeseana MacDowell *(M. petterssonii:* Craig 108)

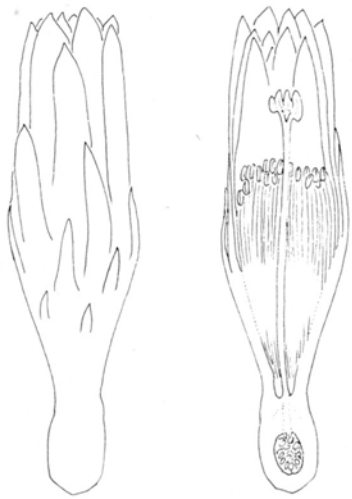
M. hegriana Hort. *(M. spinosissima* complex: Mottram 39)

M. heidiae Krainz in KuaS 26: 217, with fig. (1975). Source: Mexico, Puebla, N of Acatlan, near El Papayo, 1600 m, Jan 1974/Mar 1975, *H. & F. Kraehenbuehl* s.n. (ZSS).

Series ANCISTRACANTHAE. Simple or clustering, roots fibrous, stem c. 3 × 5.5 cm; tub. cylindric, 8-11 × 6 mm; ax. with 1-5 fine bristles to 10 mm. Cent. sp. 0-2, c. 12 mm, hooked, reddish brown, yellowish below, or only 1-2 mm, straight; rad. sp. 16-24, to 11 mm, bristly, glassy white. Fl. near apex, funnel shaped, to 3 × 2.5 cm, yellowish green, stigmas 6, emerald green. Fr. appearing 9 months after anthesis, globose to broadly ovoid, 7-8 mm diam., green becoming brownish; seeds 1.25-1.4 mm, black with a hint of brown.

Hitherto I have classified this interesting species in subgenus *Dolichothele,* largely because of its yellow flower and green to brownish red fruit. By the courtesy of the collector, Mr. Felix Kraehenbuehl, I have now had the opportunity to

examine and section a flower in order to determine whether it has the 'solid tube' which is a diagnostic feature of the subgenus. From the plant Mr. Kraehenbuehl gave me, I removed a flower as it began to open (see drawing). The tube in this flower was solid in the basal 2 mm only, whereas in a flower of *M. longimamma* (*H.* 8546) cut at the same time the solid portion was 8 mm long. No measurement for *M. zephyranthoides* seems to have been published, but the shape of the flower appears to preclude the solid portion from being more than about 2 mm. I now accept Krainz's original suggestion that *M. heidiae* and *M. zephyranthoides* are allied, mainly in view of the flower-structure, but also taking into account the coincidences in stigma colour, general facies and geographical distribution. I must therefore 'move' *M. heidiae* in my classification to the *M. zephyranthoides* group (series Ancistracanthae) and, in effect, restrict subg. *Dolichothele* to the *M. longimamma* group.



Drawings by the author of an opening flower-bud of *M. heidiae* from the outside and cut in half. Note the very short solid tube above the ovary. Magnification × 2.

M. heinii Ehrenb. (orig. spelling, later corrected to *haynii)*

M. heldii Walton Cat. (Craig 344)

M. helicteres DC. in Mém. Mus. Hist. Nat. 17: 111 (1828) & Prodr. 3: 460 (1828). Based on the Mocino & Sesse drawing of *Cactus helicteres.* Not positively identifiable.

M. hemisphaerica Engelm. in Boston J. Nat, Hist. 6: 198 (1850). Source: U.S.A., Texas, 'Below Matamoras [sic], on the Rio Grande; brought home by the St. Louis Volunteers, in 1846: flowers (in St. Louis) in May'. Lectotype at MO (Benson in CSJA 41: 128. 1969).

Series MAMMILLARIA. Simple, hemispheric, 5-7.5 × 7.5-11.5 cm; tub. elongate-pyramidate, subquadrangular; ax. naked. Cent. sp. 1, 4-6 mm; rad. sp. 9-10, unequal, 4-8 mm. Fl. 2-3 × 2-3 cm, dirty white or reddish. Fr. elongate-clavate, scarlet.

This is regarded by Benson as a lowland element in the *M. heyderi* complex, occurring in grasslands and thickets near sea level on the Rio Grande plain, and extending into the adjacent Mexican states of Tamaulipas and Nuevo Leon (Benson, Cact. U.S. & Canada, 871. 1982).

M. hennisii Boed. in MDKG 4: 7, with fig. (1932). Source: Venezuela, NW part, at 500 m, on limestone, *Hennis fil.;* type presumably not preserved.

Series SUPERTEXTAE. Probably not distinguishable from *M. columbiana,* q.v. The description was from a small plant without flowers or fruit.

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

M. hermantiana Hort. ex Lab., name only *(M. mystax:* Craig 55)

M. hermantii Rebut (variant spelling of *hermantiana:* Craig 55)

M. hernandezii Glass & Foster in CSJA 55: 22, with fig. (1983). Source: Mexico, Oaxaca, low hills near Telixtlahuaca, in black soil with grass cover (pH7.5), 16 Sept 1978, *Otero & Hernandez* FO-023 (POM, holotype).

Series LONGIFLORAE. Simple, depressed-globose, c. 25-45 mm diam., tub. terete, c. 5.5 mm, eventually pyramidal and 10 mm broad at base; ax. with short wool, esp. in fl. zone. Cent. sp. 0; rad. sp. (17-)25, 1.2-2.2 mm, not interlacing, white. Fl. 20 × 20 mm, medium cerise to pale magenta, ovary embedded in stem. Fr. and seed unknown.

The authors offer no cogent means of distinguishing this novelty, interesting as it is, from *M. napina,* of which it seems to be perhaps a dwarf or neotenous form. It is known from one locality only.

M. herrerae Werdermann in Notizbl. Bot. Gart. Mus. Berlin 11: 276 (1931) and in MDKG 3: 247, with fig. (1931); Fric in Cesk. Zahr. Listu, 140 (1924), name only, fide Gray Herb. Card Cat. Source: Mexico, Querétaro, near Cadereyta. Described from plants sent to Europe by Schmoll. A specimen in the Berlin Herbarium is apparently the holotype (Leuenberger in CSJGB 40: 104. 1978).

Series LASIACANTHAE. Simple or clustering from the base, globose, to 3.5 cm diam.; tub. numerous, small 5-6 × 2 mm; ax. naked. Cent. sp. 0; rad. sp. c. 100 or more, unequal, c. 1-5 mm, bristly, whitish or greyish. Fl. 2-2.5 cm, typically pink, with green stigmas. Fr. small subglobose, c. 6 mm diam., whitish.

Werdermann also described a white-flowered variety (var. *albiflora* Werd., l.c., 277) with fewer spines (60-80) and larger flowers (3.5 cm long), subsequently treated as a separate species by Backeberg *(M. albiflora).*

The pink-flowered form has been reintroduced by Lau and is illustrated in KuaS 29: 32 (1978), the source given as Querétaro, Vista Hermosa, *Lau* 711. The white-flowered form, apparently more slender and cylindric in habit, is illustrated by Pilbeam, Mammillaria (1981), col. plate.

The classification of *M. herrerae* in series Lasiacanthae is open to question, but I leave it there pending fuller knowledge and comparison of all the species currently grouped with it.

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

M. hertrichiana Craig, Mamm. Handb., 92, figs. 74, 75 (1945). Source: Mexico, Sonora, E of Tesopaco, Rancho El Agriminsor. Described from living plants collected by H. S. Gentry in 1937. Type not designated.

Series MAMMILLARIA. Clustering to form clumps nearly 1 m wide, individual heads flattened globular (to c. 7 cm diam.); tub. 8-10 × 8 mm, irregularly angled to tip; ax. with dense wool in flowering area and only an occasional bristle. Cent. sp. 4-5, uppers 5-10 cm, lower to 25 mm and heavier, chestnut brown; rad. sp. 12-15, 3-10 mm, upper shorter, white to pale tan with brown tip. Fl. 10 × 18 mm, inner per. segs. very deep pink to purplish pink. Fr. clavate, 30 × 8 mm, scarlet.

Probably conspecific with *M. standleyi,* but given the benefit of the doubt in view of the non-bristly axils. *Lau* 086, from the borders of Sonora and Chihuahua (Sierra Oscura) has been distributed as *M. hertrichiana,* but does not appear to resemble the original plants particularly closely.

M. hesteri (Y. Wright) Weniger, not valid *(Escobaria hesteri)*

M. heteracantha Mart., name only *(M. loricata:* Craig 334). A drawing labelled *M. heteractis sub loricata* exists in the Munich herbarium. It appears to be of a *Coryphantha sp.*

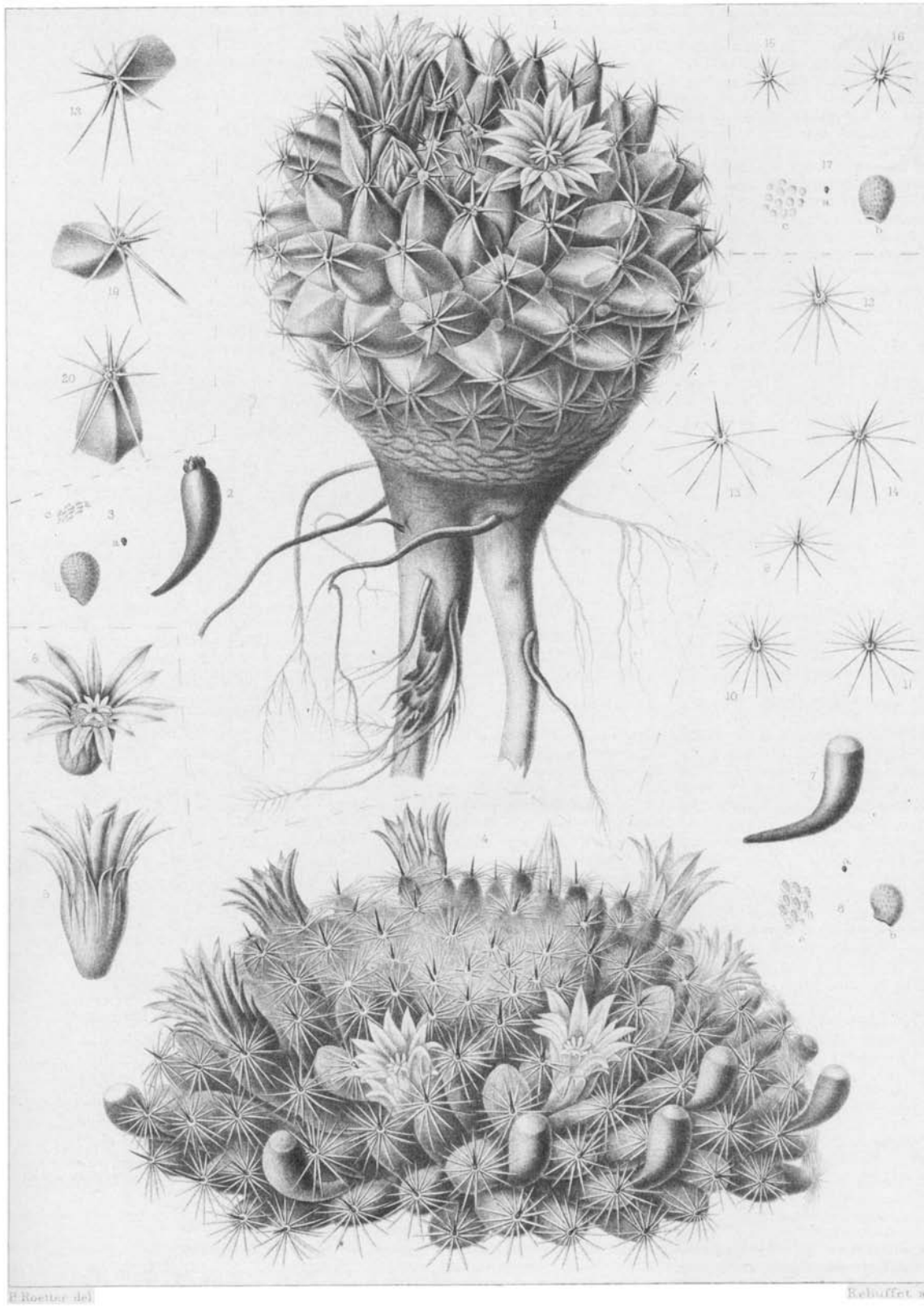
M. heteracentra attrib. to Otto by C. F. Foerster (Craig 344)

M. heteromorpha Scheer ex Salm-Dyck *(Coryphantha macromeris:* Craig 347)

M. hevernickii Rebut Cat. (Craig 344)

M. hexacantha Salm-Dyck (Craig 332)

M. hexacantha attrib. to Otto by C. F. Foerster *(M. longimamma:* Craig 347)



M. heyderi Muehlenpfordt in Allg. Gartenz. 16: 20 (15 Jan 1848). Source: U.S.A, N. Texas. Described from plants collected by Dr. Roemer of Hildesheim. Benson (Cacti U.S. & Canada, 966. 1982) indicates that the locality would now be in central Texas, and that Roemer reported it as 'Am Llanoflusse'. No material extant.

Series MAMMILLARIA. Globose, green, apex depressed; tub. conic, elongate, 12 × 6 mm; ar. and ax. woolly at first. Cent. sp. 1, 5-6 mm, erect, horny, dark at base and apex; rad. sp. 20-22, bristly, white, the upper 6 mm, the lower 7-8 mm.

As noted under *M. hemisphaerica*, the name *M. heyderi* has clear priority of publication over Engelmann's names for members of this complex, which is unfortunate as Engelmann's are better typified. Benson (l.c.) equates *M. heyderi* with Engelmann's *M. applanata* (q.v.) and regards them as exemplifying a form characteristic of gravelly limestone soils in deserts and grasslands from near sea level to about 1350 m in SE Arizona, S New Mexico, S Texas and undetermined areas of Mexico (Benson, l.c., 869).

M. hidalgensis J. A. Purpus in MfK 17: 118, with fig. (1907). Source: Mexico, Hidalgo, in the mountains near Ixmiquilpan, 1905, *C. A. Purpus.* Type probably not preserved.

Series HETEROCHLORAE. A redescription of *M. polythele.*

M. hild(e)manniana Hort. (Craig 344). Plants in collections so named are usually *M. polythele.*

M. hildemannii Uhlig Cat., 1979 (U2821) (Mottram 41)

M. hirschtiana Haage *(Escobaria vivipara:* Craig 347)

M. hirsuta Boed. in MfK 29: 130, with fig. (1919). Source: Mexico, without further data. No material extant.

Series STYLOTHELAE. The precise application of this name is impossible to determine and the name should be discarded. Bravo's reporting it from Guerrero (Canon del Zopilote), where nothing like the original has been found, and Craig's fig. 179 'from a plant obtained in Mexico' throw no light on the subject whatever. Plants in collections as '*M. hirsuta*' are usually *M. bocasana* or *M. longicoma.*

M. hochderf(f)eri C. A. Purpus, name only (Craig 344)

M. hoffmanniana (Tiegel) Bravo, Las Cact. Mex., 687 (1937); *Neom. hoffmanniana* Tiegel in An. Inst. Biol. Mex. 5: 269 (1934). Source: Mexico, Querétaro, *Schmoll.* Type presumably not preserved.

Series HETEROCHLORAE. A long-spined variant of *M. polythele* with 6 (rarely 4 or 7) central spines and rudimentary, 'often deciduous', radials. Craig's illustration (fig. 232) is presumably authentic.

M. hoffmannseggii Salm-Dyck *(Neoporteria subgibbosa:* Craig 347)

M. hookeri Hort. *(Coryphantha sp.?:* Backeb. 3500)

M. hopf(f)eriana Linke (not 'Link') *(M. magnimamma:* Craig 34)

M. horripila Lem. (basionym for *Neolloydia horripila)*

M. huajuapensis Bravo in An. Inst. Biol. Mex. 25: 535, 536, fig. 29 (1954). Source: Mexico, Oaxaca, cerros W of Huajuapan de Leon. Type deposited at MEXU.

Series POLYEDRAE. Simple, globose, 10-12 cm diam., apex depressed, woolly; tub. crowded, more or less angled, 8 × 8 mm; ax. with numerous white bristles longer than the tub. and white wool at first in fl. zone. Cent. sp. 2(-3), 3-5 mm, subulate, reddish brown, tipped black; rad. sp. 6-8, 3-8 mm, white with red tip. Fl. purple. Fr. 2 cm. purple.

A local form of *M. mystax.*

M. hubertmulleri Reppenhagen in KuaS 35(8): 182-184 (1984) with figs. Source: Mexico, Morelos, wooded gorge near Chinameca, El Cajon, *Reppenhagen* 1460 (holotype, K), *Reppenhagen* 1666; discovered near Zacapalco, 4 Jan 1979 by Hubert Muller.

Series POLYACANTHAE. Very close to *M. nunezii* var. *solisii* but said to differ in the solitary habit, darker spination, fewer (14-22) radial spines, later flowering, earlier fruiting, details of flower and fruit shape, and self-sterility.

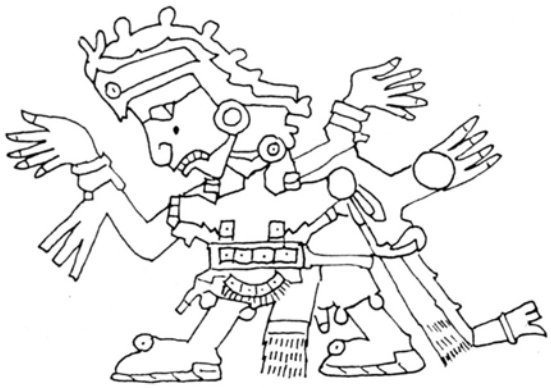
M. hubertmulleri: the holotype prior to preservation. *(photo: Harwood)*

Opposite page: A reproduction of pl. 9 from Engelmann's 'Cactaceae of the Boundary', showing *M. meiacantha* (top) and *M. heyderi* var. *applanata* (bottom) and various details.

M. huitzilopochtli D. R. Hunt in CSJGB 41: 106, with figs. (1979). Source: Mexico, Oaxaca, Tomellin valley, gorge near confluence of Rio Salado and Rio Quiotepec, on red conglomerate rocks, *Lau* 066 (K).

Series SUPERTEXTAE. Simple at first, eventually branching apically, globose, later clavate-cylindric, to 13 × 8-9 cm; tub. obtusely terete-conic, compressed laterally, 6 × 5 mm, dark green; fl. ax. with dense whitish wool. Cent. sp. 0-1, rarely 2, in juvenile plants, erect, 4 mm, fine acicular, very dark brown at first, in mature specimens an additional, porrect, subulate, dark brown to black central 1.5-2 cm also often developed (to 5 cm, *fide* Lau); rad. sp. c. 15-30, 2.5-3.5 cm, glassy white. Fl. 12-15 × 7 mm (not expanding widely), carmine. Fr. clavate-cylindric, c. 15 mm, red; seeds 1.4 × 0.75 mm.

One of the more remarkable of the numerous Supertextae from the famous, deep-sided valley south of Tehuacan.



Huitzilopochtli, supreme deity of the Aztecs, whose name is linked with some of the cruellest human sacrifices of all time (Codex Borgia).

M. humboldtii Ehrenb. in Linnaea 14: 378 (1840). Source: Mexico, Hidalgo, limestone hills between Ixmiquilpan and Metztitlan, Jan 1840, *Ehrenberg*. Type not stated to have been preserved.

Series LASIACANTHAE. Simple or several-headed, individual stems depressed globose or globose, to c. 7 cm diam.; tub. cylindric, 4-13 × 2-3 mm; ax. with wool and white bristles shorter or longer than the tub. Cent. sp. 0; rad. sp. 80 or more, 4-6 mm, unequal, snow-white. Fl. 2.5 × 1.5 cm, bright purplish pink with green stigmas. Fr. (*fide* Craig) clavate, reddish, dried perianth not persisting; seeds black.

This choice species has no obvious close relatives, and the resemblance to *M. candida* is certainly only superficial. According to Craig (Mamm. Handb., 143. 1945) it grows with *M. schiedeana* and hybrids occur, but none have been studied. It would be interesting to ascertain whether the two species are, in fact, found on the same substrate. Further north, another comparable pair of species, *M. carmenae* and *M. laui*, are found in the same area, according to Lau, but grow on different rock-types.

A flowering specimen I examined in the collection of Prof. Dr. Schreier in 1976 had tubercles 13 × 3 mm and flowers 25 mm long.

M. humilior [attrib. to Foerster by] K. Schum., Gesamt. Kakt., 824 (1898) (indexing error for *M. raphidacantha* var. *humilior* C. F. Foerster, Handb. Cact., 244. 1845).

M. humilis [attrib. to Donn by] Craig (344) *(Cactus humilis)*

M. humilis [attrib. to Meinsh. by] Quehl in MfK 14: 75 (1904) *(M. prolifera:* Quehl, l.c.)

M. hutchisoniana (Gates) Boed. ex Backeb. & F. M. Knuth, Kaktus ABC, 387 (1935); *Neom. hutchisoniana* Gates in CSJA 6: 4, with fig. (1934). Source: Mexico, Baja California, 8 miles W of Calmalli, 28° 15′N, 113° 40′W, silty bottom land, 22 July 1932, *Gates* 121 (DS, holotype).

Series ANCISTRACANTHAE. Simple to caespitose, stems cylindric, to 15 × 4-6 cm; roots fibrous; tub. short, conic, olive green; ax. naked or very slightly woolly. Cent. sp. 4, 7-10 mm, light tan with purple tip, at least the lowermost hooked; rad. sp. 10-20, purple-tipped. Fl. 2.5-3 cm diam., inner per segs. 20 × 7 mm, cream, outer with maroon midstripe; stigmas 7, 5 mm, green. Fr. clavate, 2 × 1 cm, scarlet.

Lindsay & Dawson (in CSJA 24: 80-81. 1952) noted discrepancies between the spination detailed in Gates's original description ('central spines usually 3'; 'radial spines 25-35') and his designated type, which has 4 centrals and 15-20 radials. They modified the description in the light of these facts and further study of the species, which has a rather wide distribution in Baja California, especially when it is taken to include the coastal *M. louisiae*, from near Socorro (lat. 30° 18′N), and *M. bullardiana*, from La Paz (lat. 24°N).

Throughout this range, *M. hutchisoniana* often grows with forms of *M. dioica*, and the nature of their relationship merits detailed enquiry.

M. hutchisoniana is probably also conspecific with *M. goodridgii*, at least as the latter is interpreted by Lindsay & Dawson (var. *goodridgii* only), but the confused history of *M. goodridgii* argues against using that name for the mainland forms.

A collection of *M. hutchisoniana* I made in 1974 (Llano Madgalena, sandy plains N of Villa Insurgentes (25° 13′N), with *Pachycereus pringlei, Stenocereus thurberi, S. eruca* and *M. dioica*, 22 Sept 1974, *H.* 8735), is cytologically diploid (2n=22; Johnson in CSJGB 42: 44. 1980).

Variability in *M. hutchisoniana* was noted by Voss (in JMS 8: 56. 1968) in a population near Camalu (30° 50′N, 116° W, approx.?).

M. hybrida Hort. Berol., name only *(M. rhodantha:* Craig 237)

M. hystricina Loudon, name only (Craig 344)

M. hystrix Mart., name only *(M. magnimamma:* Pfeiffer, Enum. Cact., 21. 1837). An unpublished drawing labelled *M. hystrix* exists in the Munich herbarium.

M. icamolensis Boed. in Kakteenkunde 1933: 168, with fig. (1933). Source: Mexico, Nuevo Leon, near Monterrey and Icamole; described from a plant received by Boedeker in 1931 from Halbinger. No authentic material extant.

Series STYLOTHELAE. Simple or rarely sprouting from base, elongate-globose or short-cylindric; tub. ax. with a few short white bristles. Cent. sp. 4, lowermost hooked, 7 mm, red brown; rad. sp. 16-20, 5-7 mm, bristly, white. Fl. c. 12 mm diam, pale pinkish white. Fr. small, red; seeds 'olive gray'.

Nothing to correspond with Boedeker's plant is known from the area cited and a mix-up must be suspected, possibly with a reintroduction of *M. carretii* which is reported from Icamole. The name should be discarded. (See JMS 23: 27. 1983).

M. ignota Loudon, name only (Craig 344)

M. imbricata Wegener (*M. rhodantha:* Craig 344)

M. impexicoma Lem. (*Coryphantha radians:* Craig 347)

M. inaiae Craig in CSJA 10: 111 with fig. (p.105) (1939); Mamm. Handb. 239, fig. 216 (1945). Source: Mexico, Sonora, inlet W of San Carlos Bay near Guaymas, near water's edge, March 1936, *Craig* 289; the same, Nov 1937, *Craig* 844; type: US 1730815!

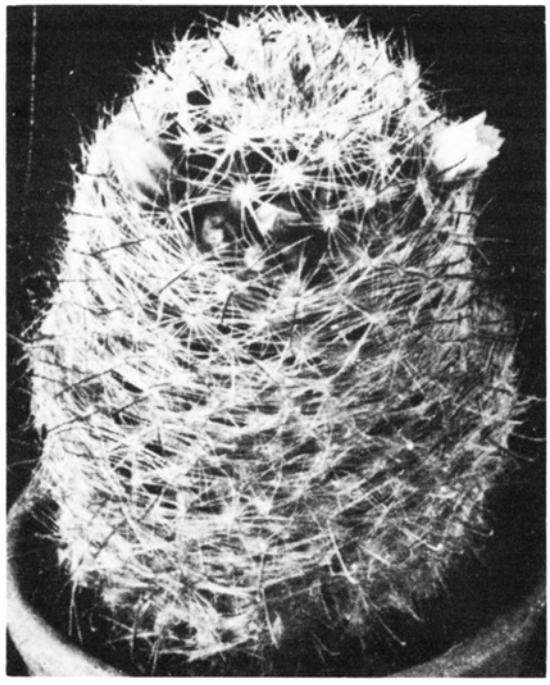
Series ANCISTRACANTHAE. Simple, occasionally branching from base, to 20 × 6 cm, roots fibrous; tub. rounded pyramidal, 8 × 5 mm, light green; ax. with occ. bristle. Cent. sp. 2-3, 9 mm, 1 porrect, 1-2 ascending, reddish tan, purplish to nearly black, tip darker; rad. sp. 17-24, 4-6 mm, white. Fl. July, 18 × 20 mm, creamy white, pinkish brown midstripes; stigmas 3 mm, light green. Fr. ovoid, 11 × 5 mm, scarlet; seeds black, 0.8 × 0.5 mm.

Regarded as a straight-spined phase of *M. swinglei*. See Foster in JMS 7: 3 (1967).

M. incerta Parish (*M. dioica:* Craig 161; Mottram, Mamm. Index, 42. 1980)

M. inclinis Lem. (*M. praelii:* Craig 29)

M. inconspicua Scheidw. (*Neolloydia conoidea:* Craig 347)



M. icamolensis: reproduction of Boedeker's original illustration (1933).

M. incurva Scheidw. (*Coryphantha pallida?:* Craig 347)

M. inermis Hort.; cf. CSJA 9: 177 (1938); Holt in JMS 12: 70 (1972); Huijssoon in JMS 15: 28 (1975).

Apparently the same as *M. bocasana* var. *inermis,* mentioned by Hummel in CSJA 8: 102, with fig. (1937), and presumably the variant of *M. bocasana* also known as 'Ed. Hummel'.

M. infernillensis Craig, Mamm. Handb. 123, fig. 104 (1945). Source: Mexico, Querétaro, Infernillo, *Schmoll.* Type not stated to have been preserved.

Series LEUCOCEPHALAE. Simple, flattened-globose, 9 cm diam.; tub. 4-sided but not sharply angled, 6-8 × 5-7 mm, grayish green, white-spotted; ax. woolly but without bristles. Cent. sp. 1-2, rarely 4, 4-10 mm, chalky white to chalky lavender with dark brown to black tip; rad. sp. 25-30, 2-10 mm, bristly to slender acicular, white. Fl. size not stated, deep purplish pink. Fr. clavate, 12 × 4 mm, light pink; seeds 1.1 × 0.7 mm, light brown.

One of the numerous variants of the *M. parkinsonii-M. perbella-M. geminispina* complex characteristic of E. Querétaro and W. Hidalgo. Craig also mentions Guanajuato in the distribution of *M. infernillensis,* but on what basis he does not say.

M. ingens Backeb. in Feddes Repert. 51: 63 (1942), and in Stachlige Wildnis, 347 (1942). Source: Mexico, Hidalgo, upper part of Barranca Grande, on the way from Atotonilco; type not preserved.

Series HETEROCHLORAE. Simple, to 40 × 15 cm, leaf-green or paler; tub. 12 × 8 mm; ax. with sparse wool. Sp. 2, rarely 3, to c. 2 cm, pointing up and down and recurved, yellowish below, coffee-brown above. Fl. c. 10 mm, pale clear red, without purplish tint. Fr. red.

A localized form of *M. polythele* with distinctive coloration (lacking the usual purplish ingredient in the tubercle, spine and flower colour) and strongly divergent spines.

M. insularis Gates in CSJA 10: 25, with fig. (1938). Source: Mexico, Baja California, along mica-schist ledges on outer islet of Smith Island group, Los Angeles Bay, 29° 05′N, 113° 30′W, May 1935, *Gates* 523 (DS).

Series ANCISTRACANTHAE. Clustering from fleshy roots (or often remaining simple), individual stems flattened-globular, to 6 × 5 cm; tub. conic, 7 × 7 mm, blue-green; ax. naked or slightly woolly. Cent. sp. 1, 1 cm, hooked, black-tipped; rad. sp. 20-30, 5 mm, acicular, white. Fl. 15-25 mm, funnel shaped, outer segs. light green, inner light pink with white mid-stripe. Fr. clavate, 1 cm, orange red, tending to be hollow; seeds dull black, pitted.

An interesting and equivocal member of the *M. microcarpa* group, often considered closely allied to *M. boolii* (q.v.), but with leanings towards several Baja Californian members of the group also, including *M. hutchisoniana, M. blossfeldiana* and *M. schumannii.* The dwarfish habit, thick roots and black-tipped central spine are all distinctive.

M. intermedia Backeb., 3990 (error for *Escobaria (Mammillaria) intermedia;* see Backeb., 2972).

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

M. intricata Otto ex C. F. Foerster, name only

M. inuncinata Lemaire, name only (*M. anancistria:* Craig 344).

M. inuncta Hoffmannsegg (*M. rhodantha:* Craig 268)

M. irregularis DC.

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

M. iwerseniana Schmoll Cat. (Backeb. 3492)

M. jalap(p)ensis Pfeiffer, name only (*M. subpolyedra:* Craig 23)

M. jaliscana (Britton & Rose) Boedeker, Mamm. Vergl. Schlüssel, 35 (1933); *Neom. jaliscana* B. & R., The Cact. 4: 160 (1923). Source: Mexico, Jalisco, Rio Blanco, near Guadalajara, Sept. 1903, *Rose & Painter* 858 in US 399574, holotype!; also collected by Orcutt and Reko.

Series STYLOTHELAE. Clustering, stems globose, 5 cm diam.; tub. 4-5 mm; ax. naked. Cent. sp. 4-6, one hooked, reddish brown, darker towards tips; rad. sp. 30 or more, (finely acicular in the type). Fl. 1 cm diam., pinkish to purplish, delicately fragrant, stigmas white. Fr. 8 mm, white; seeds black.

One of a group of forms characteristic of the eastern flank of the Sierra Madre Occidental, others being *M. zacatecasensis* and *M. mercadensis.* Several localities for *M. jaliscana* have been noted by Reppenhagen, including one near Leon, state of Guanajuato, near its border with Jalisco.

M. jalpanensis Schmoll Cat. (Backeb. 3492)

M. jaumavensis Haage (*Coryphantha sp.:* Backeb. 3039)

M. jaumavei [attrib. to Fric by] Stoyes (postcard no. 185) (*Coryphantha sp.:* Backeb. 3039); Schwarz Cat., fide Mottram, 43.

M. johnstonii (B. & R.) Orcutt, Cactography, 7 (1926); *Neom. johnstonii* B. & R., The Cact. 4: 80, fig. 72b (1923). Source: Mexico, Sonora, San Carlos Bay, common on tufa ledges about bay, 8 July 1921, *I.M. Johnston* 4373 (US 1821108, holotype!; CAS 81376, type collection). The US sheet consists of fragments and a photograph of a living plant. It does not appear to have been annotated by Britton & Rose, but bears a note pinned to the sheet which reads as follows: 'Mr Ivan M. Johnston under date of July 30, 1922 writes of this plant as follows: "The plant was very common on the tufa slopes which rise abruptly from the water's edge and form the SE shore of San Carlos Bay. A few plants were found on a tufa ledge in a canyon near the head of San Pedro Bay, a deep bight which lies a few miles to the north of San Carlos Bay. The plant is very milky. The plant probably ranges through the volcanic hills which parallel the coast north of Guaymas" '. The label on the specimen states the locality of collection as 'Lower California, San Lorenzo Island', but this is clearly in error.

Series MAMMILLARIA. (Simple or occasionally clustering), globular to short oblong, reaching 15-20 cm; tub. 4-angled, 10-15 mm, somewhat bluish; ax. naked. Cent. sp. 2 (4-6 in var. *guaymensis* Craig), much longer and stouter than the radials (10-25 mm, fide Craig), slightly diverging, bluish brown; rad. sp. 10-14 (-18 in varieties), (6-9 mm), stiff acicular, white but with brown tips. Fl. 2 cm, outer segs. greenish white with reddish

brown midrib, inner white, stigmas green (or olive-green, fide Craig). (Fr. globular to clavate, scarlet; seeds brown).

Craig (Mamm. Handb., 99, figs. 80, 81, 1945) described two variants: var. *sancarlensis* with 2 tortuous centrals and 15-18 radials, and var. *guaymensis* with 4-6 straight centrals and 18 radials. He added that such variations 'are all found intermixed in a very limited area' and that the species is often found so close to the sea as to be sprayed with sea-water. Foster (JMS 7: 3. 1967) also described the variability of the species in the field, and could see 'no taxonomic reason for upholding the varieties as they stand', since to do justice to the actual state of affairs at least six more would need to be described. As Foster argued, the species is more easily understood by merely expanding the original description to cover the extreme variation that is found when more than a few specimens are examined.

M. johnstonii, despite its variability, it is distinctive species with no obvious close allies. Superficially, it seems to me to have more in common with the *M. petrophila* group in Baja California than the other Sonoran representatives of the series, but this classification requires verification.

M. joossensiana Quehl in MfK 18: 95 (1908). Source: Mexico, without locality; obtained by De Laet from Purpus. No material extant.

Series STYLOTHELAE? Simple, becoming cylindric, 5 × 4 cm; tub. 1 cm; ax. naked. Cent. sp. 4, to 15 mm, one hooked, white; rad. sp. more than 20, to 1 cm, bristly, white. Fl. reported by De Laet as small, yellowish-striped.

Not positively identifiable, even from Backeberg's illustration (Die Cact. 5: 3477, fig. 3207), whose authenticity I have not checked. Borg (Cacti; ed. 2, 393. 1951) misspells the name '*jossensiana*' and reports the flower colour as pale *red*.

M. jorderi Hort. (listed by K. Schumann, Gesamt. Kakt. 582. 1898, as referable to *M. magnimamma;* cf. Craig 363).

M. jucunda Ehrenb. (Craig 333)

M. karstenii Poselger (*M. mammillaris:* Craig 106)

M. karwinskiana Martius in Nov. Act. Nat. Cur. 16(1): 335, t.22 (1832). Source: Mexico, *Karwinski.* In the absence of preserved material, Martius's admirable plate and description may serve as type.

Series POLYEDRAE. Stem simple, obovate-cylindric, the plants described by Martius 7.5-10 × 7.5-10 cm (sometimes branching dichotomously or by offsets); tub. obscurely angled; ax. bristly. Spines (4-)6(-7), all subulate, the upper and lower 10-12 mm, the lateral shorter, occasionally an additional porrect central to 25 mm also present, all brownish red at first, later all except the uppermost fading to white in the lower half. Fl. (20-)25 mm, per. segs. with whitish margins and purplish midstripe.

Readily identified from the plate and description with the common member of the group around the city of Oaxaca, whence Karwinski despatched much of his material to Europe.

It is not necessary to repeat here the discussion given in JMS 11: 34-36 (1971), except to note that *M. knippeliana* (q.v.) has since been rediscovered, and that I nowadays treat *M. carnea*, but not *M. compressa*, as a member of the series.

M. karwinskii Lawrence in Loudon, Gard. Mag. 22: 315 (1841). Briefly described under 'subsect. 3. Polyedreae' and evidently a variant spelling of *M. karwinskiana.*

M. kelleriana Schmoll ex Craig, Mamm. Handb. 231, fig. 210 (1945). Source: Mexico, Querétaro, 'La Sierra San Moran' (Sierra Zamorano). 'Fig. 210 is from a photograph of a plant sent to us by Sr F. Schmoll'. No material stated to be preserved.

Series HETEROCHLORAE. A form of *M. polythele* linking *M. kewensis* and *M. durispina*, the last-named also reported from Sierra Zamorano.

M. karwinskiana in habitat beside the road to Monte Alban, Oax. *(photo: Hunt)*

M. kewensis Salm-Dyck, Cact. Hort. Dyck. 1849, 112 (1850). Source: a plant sent to Salm-Dyck from the Royal Botanic Gardens, Kew, of unknown origin, and not known to have been preserved.

Series HETEROCHLORAE. Stem tall, cylindric; tub. conic, deep green; ax. woolly at first. Spines 4-6, radiating, somewhat recurved, the lateral 6 mm, the upper and lower 10 mm, rigid, purplish brown. Fl. dark rose pink, stigmas pale pink.

Allied by Salm-Dyck to *M. affinis* (=*M. polythele*), this plant has usually been identified as the typically 6-spined variant of *M. polythele* native near Ixmiquilpan, Hidalgo (see, for instance, Craig's fig. 117). Unfortunately, the 'Kew Mammillaria' can hardly be regarded as a distinct species, and even if it were, *M. kewensis* would probably not be the oldest name for it!

M. kieferiana Hort. ex Boed. (*Coryphantha kieferiana:* Backeb. 3050)

M. kladiwae Hort. (cf. *M. nunezii:* Pilbeam 78)

M. kleinii Regel (Craig 333)

M. kleinschmidtiana Zeissold (*M. compressa:* Craig 19)

M. klenneirii Schlumberger, name only (Craig 344)

M. klissingiana Boed. in ZfS 3: 123, with fig. (1927). Source: Mexico, Tamaulipas, near Calebassas (Calabazas, c. 15 km N of Jaumave), collected by P. Montemayor and Baum growing along the top edge of vertical limestone cliffs in indirect sun, also sometimes amongst rocks in thin undergrowth. Type not known to have been preserved.

Series LEUCOCEPHALAE. Stem simple at first, eventually clumping by offsets, individual stems globose to clavate, 16 × 9 cm; tub. 5 × 2 mm; ax. with numerous white bristles to 10 mm. Cent. sp. 2-4, 2 mm, subulate, whitish, darker towards tip; rad. sp. 30-35, to 5 mm, spreading, more or less straight, whitish. Fl. rose pink, c. 10 × 8 mm, stigmas yellow. Fr. small, 5-6 mm, clavate.

A distinctive member of the series, recollected or reported from the Jaumave Valley on several occasions. The authenticity of some cultivated specimens which branch dichotomously needs investigation. See notes in this Review on *M. brauneana* (Bradleya 1: 119. 1983).

M. klugii Ehrenb. (*M. haageana* vel aff.)

M. knebeliana Boed. in MDKG 4: 52, with fig. (1932). Source: Mexico, Sierra de San Luis Potosi, collected by E. Georgi. Type not known to have been preserved.

Series STYLOTHELAE. Stem, simple or branching from the base, shortly cylindric, to 6 × 4.5 cm; tub. cylindric, 6-7 × 3-4 mm; ax. with 5-8 hairlike white bristles. Cent. sp. at first 4, later 5-7, acicular, reddish brown, the lowermost porrect, to 15 mm, hooked; rad. sp. 20-25, very fine, white, glabrous. Fl. c. 15 mm diam., yellow, outer segs. with pale reddish brown midstripes. Fr. clavate, red; seed reddish brown with lateral hilum.

Intermediate in various respects between *M. bocasana* and *M. leucantha* and closest in appearance, perhaps, to the typically black-seeded *M. longicoma.* Some plants grown as *M. knebeliana* are, however, *M. pygmaea,* and the picture is generally so confused that the name is best avoided.

M. knippeliana Quehl in MfK 17: 59 (1907) & MfK 20: 140 (1910) (flower descr.). Source: received without data from Carl Knippel of Klein-Quenstedt.

Series POLYEDRAE. Stem simple and later offsetting or dichotomous,7-8 × 6 cm, fresh leaf-green; tub. 13:21, pyramidal and 4-sided, 8 × 5 mm, blunt; ax. with white bristles. Spines at first 6, the lowest or also the uppermost longest, to 3 cm, all spines spreading, acicular, white with blood-red or brown tip; later up to 6 weaker spines of the same colour developing. Fl. 15 × 10 mm, outer segs. red with yellow margins, inner straw yellow with red midstripe, innermost straw yellow with red tip, stigmas pale green.

This inadequately typified name probably owes its persistence to being taken up by Schmoll for a plant from near Cuernavaca, Morelos, and figured by Craig, Mamm. Handb. 28, fig. 12 (1945). One of Schmoll's plants survives at the Städtische Sukkulentensammlung, Zürich. In recent years, various collectors have found the same plant near Cuernavaca and it is becoming well-known in collections. Acquaintance with the modern *M. knippeliana,* or even a glance at Craig's illustration, cannot be said to give one much confidence that Schmoll's conjectural identification is correct (where are the 3 cm spines, or the subsidiary spines, the tubercles in 13:21 spirals or the red-striped perianth segments?), but in the absence of any other claimant to the name *M. knippeliana* it is best, perhaps, to let sleeping dogs lie. The Cuernavaca plant seems to me one of the more distinctive of the *M. karwinskiana* group and apart from *M. beiselii* its most northerly representative.

M. knippeliana, plant raised from seed collected at San Rafael, Mor., by Reppenhagen. *(photo: Harwood)*

M. knuthii Hort. (Mottram 45)

M. knuthiana Boed. (basionym for *Neolloydia knuthiana* etc.)

M. kotsch(o)ubeyoides Hort. (*Ariocarpus: Craig 347)*

M. kraehenbuehlii (Krainz) Krainz in Die Kakteen Lfg. 46-47, sine pag. (1 June 1971); KuaS 22: 93 (1971), without basionym citation; D.R. Hunt in JMS 11: 61 (Oct. 1971). *Pseudomammillaria kraehenbuehlii* Krainz in KuaS 22(1): Gesellschaftsnachtrichten, sine pag. (1971). Source: Mexico, Oaxaca, near Tamazulapan, on stony hillsides mostly amongst grass or in the shade of low shrubs, often also on top of rocks in indirect sun, 15 Mar 1968, *Kraehenbuehl* FK 153.68 (ZSS, holotype).

Series SPHACELATAE. Old plants densely caespitose, individual stems cylindric, 3-12 × 3.5 cm, softly fleshy; tub. attenuate to conic, 5-10 × c. 5-6 mm; ax. naked. Cent. sp. 0-1, thicker and longer than the rad., brownish tipped; rad. sp. 18-24, c. 3-8 mm, very thin, mostly curving and interlacing, chalky white, brownish tipped. Fl. c. 18 mm, lilac-carmine, stamens and style white, stigmas 1.5 mm, yellowish white, Fr. clavate, c. 20 × 5 mm, dark carmine; seeds ovoid, 1.4-1.6 mm.

After a few hiccups in its naming (it was first distributed as '*M. alpina*', then initially published as a *Pseudomammillaria,* then transferred to *Mammillaria* without the proper procedure), this very distinct species, one of the few from 'south of the belt' with watery sap, has become widely known, though not one of the easiest to grow.

M. krameri Muehlenpf. (*M. magnimamma:* Craig 33)

M. krauseana Gruson Cat. (*M. mutabilis:* Schumann 595; cf. Craig 55).

M. krausei Rebut Cat. (*M. magnimamma:* Craig 34)

M. kuentziana P. & B. Fearn in NCSJ 18: 33 (1963), not valid (no type designated). Source: 'Described from plants obtained from Mexico from Sr Schmoll of Cadereyta, Qro.'

Series PROLIFERAE. Referable to *M. vetula*. A glaring example of how *not* to describe a 'new species'; for my strictures on the subject, see JMS 11: 38 (1971).

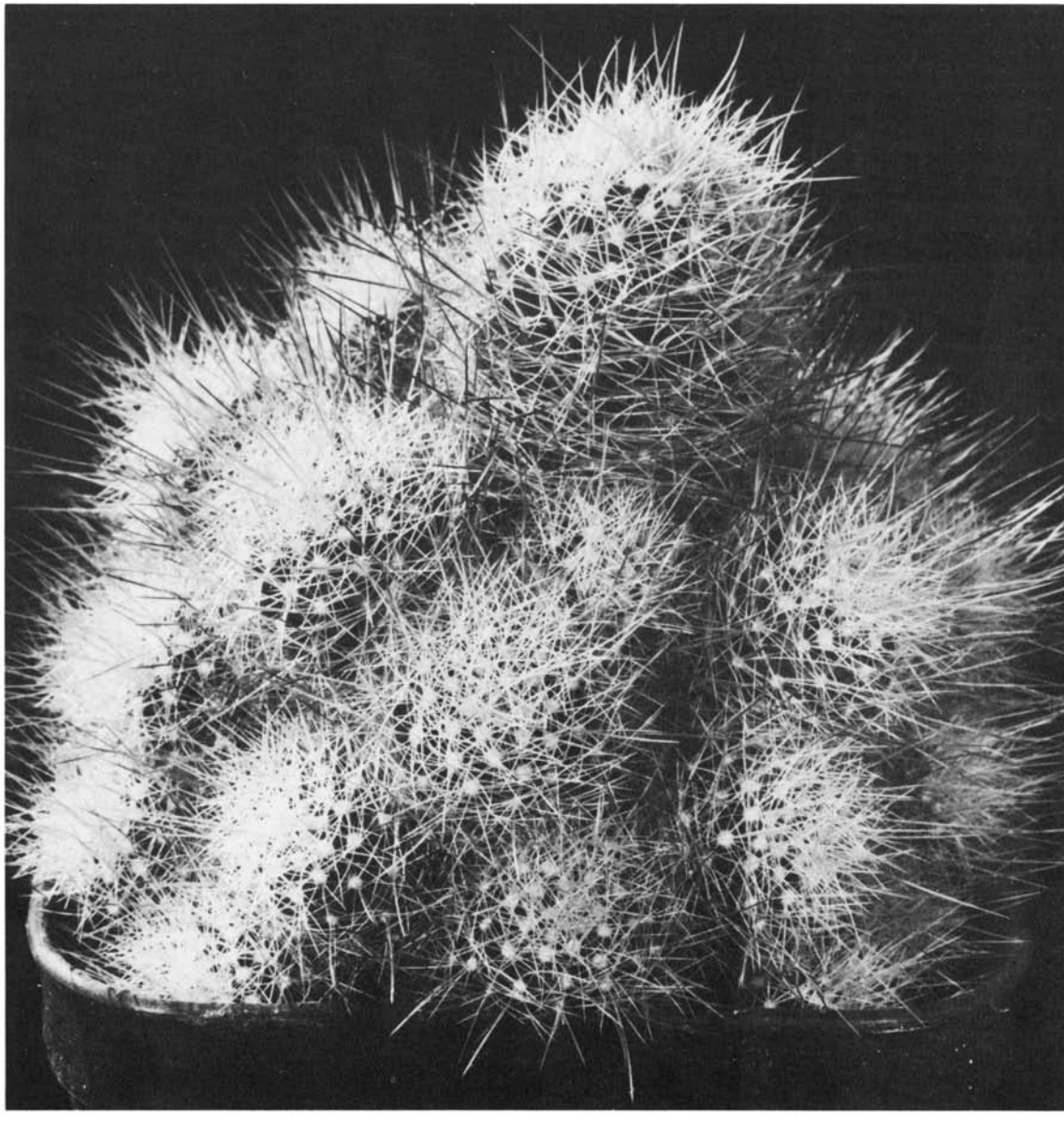
M. × *kuentzii* Hort. An invalidly published name for hybrids between *M. decipiens* and *M. elongata*. See JMS 7: 13 (1967).

M. kunthii Ehrenb. (*M. haageana* vel aff.)

M. kunzeana Boed. & Quehl in MfK 22: 177, with fig. (1912). Source: Mexico. Described from plants sent to the authors by Dr. R. E. Kunze of Phoenix, Arizona, without details. Type not stated to have been preserved, but there is a specimen at the Smithsonian Institution (US 1821100), from cultivation in Germany, 1912, consisting of spines, part of a plant and photographs. which seems likely to be authentic.

Series STYLOTHELAE. Clustering, individual stems to 7 × 4-5 cm; tub. cylindric, c. 15 × 8 mm; with hairlike bristles. Cent. sp. 3-4. variable in colour, white or yellow at base and brown, purplish or blackish towards tip, the upper 15mm, the lowermost hooked, 20 mm; rad. sp. c. 25, to 13 mm bristly, white. Fl. 2 × 1.5 cm, white or whitish yellow. Fr. red; seeds eggshaped, scarcely 1 mm, brown.

In a group so taxonomically difficult as the Stylothelae, names based on material of unlocalized origin are inevitably a source of confusion and must be passed over in favour of others which are better typified. The plants often seen in present-day collections as '*M. kunzeana*' can usually be referred to the *M. bocasana-M. longicoma* complex, but less readily reconciled with the original description and illustration. Like the equally nebulous *M. seideliana*, *M. kunzeana* may have been obtained by Kunze in Zacatecas (though, contrary to my 'hunch' expressed in JMS 14: 23. 1974, it looks to have been a different species), but speculation is no substitute for information.



The putative hybrid '*M.*×*kuentzii*' (*M. decipiens*×*M. elongata*), a plant given to the author by Prof. Dr. K. Schreier. *(photo: Harwood)*

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