

PRELIMINARY REVISION OF THE NORTH AMERICAN SPECIES OF CACTUS, ANHALONIUM, AND LOPHOPHORA.

PREFATORY NOTE.

In the fall of 1890 Dr. George Vasey, then Botanist of the Department of Agriculture, arranged with me to prepare a revision of North American *Cactaceæ*. Owing to the peculiar difficulty of preserving material the family was poorly represented, even in our leading herbaria. To secure a large amount of additional material in the way of specimens and field notes the Department authorized me to visit the region of the Mexican boundary during the summer of 1891. Preliminary to this exploration it was necessary to examine the Engelmann collection of *Cactaceæ*, in the possession of the Missouri Botanical Garden. This collection, supplemented by the continual additions made at the garden, is by far the largest collection of skeletons and living specimens in this country, and also contains the large majority of our types.

In March, 1891, I visited this collection and made such notes as seemed necessary for use in the field, and in June, accompanied by Mr. W. H. Evans and Mr. G. C. Nealley, I began field work in the neighborhood of El Paso, Tex. After ten days of exploration it was necessary for me to leave the field work in charge of Mr. Evans, who, with Mr. Nealley, continued work westward, during July and a part of August, to southern California, along the Southern Pacific Railway. As a result a large number of complete plant bodies was secured, but very few of them were in flower and the field notes indicated little besides collecting stations. During the following fall and winter preliminary determinations of this material were made by Mr. Evans.

In the fall of 1892 critical study of this and other collections was begun in connection with my assistants, Dr. Elmon M. Fisher and Mr. Edwin B. Uline, who have ever since rendered constant and most important assistance in the examination of material and bibliography, which alone has made the work possible in the midst of other pressing duties.

In the spring of 1893 these two gentlemen spent several weeks at the Missouri Botanical Garden in the critical study of its rich material, and during the latter part of their stay I assisted in the work. Dr. William Trelease, the director of the garden, had hastened the arrangement of the Engelmann material, and had mounted in convenient form the large mass of notes left by Dr. Engelmann. These notes contained

not only critical remarks upon known species, but also the diagnoses of many unpublished species which had come into his hands, notably those collected by Mr. William Gabb in 1867 in Lower California. The collections that have thus far been studied are:

(1) Those of the Missouri Botanical Garden; and thanks are especially due to Dr. Trelease for his generous cooperation in the use of this material, without which the work would have been impossible.

(2) Those of the Department of Agriculture, including the results of several recent explorations, for the use of which I am indebted to Mr. Frederick V. Coville.

(3) Those of the Gray Herbarium at Harvard University, which Dr. B. L. Robinson kindly placed at my disposal.

(4) Those of the California Academy of Sciences, notably rich in forms from Lower California and the adjacent islands, kindly loaned by Mr. T. S. Brandegee.

(5) Those of Dr. Louis Eschancier, of San Luis Potosi, Mexico, who sent a large series of Mexican forms collected in 1891.

(6) Numerous small sets from different correspondents, who have given both time and material in aiding the work.

It is needless to say that Dr. George Engelmann, the great pioneer student of this difficult family, has opened the paths in which we must follow, and it was exceedingly unfortunate that he was not able to complete the final revision that he had in mind.

The difficulties which beset the critical study of this group can not easily be exaggerated. Such scanty material as has been collected has been for the most part very incomplete, consisting of plant bodies without flower or fruit, flower or fruit without plant bodies, and bunches of spines without either. The species are displayed also in the most inaccessible regions, and their culmination is found in the still poorly known regions of Mexico.

On account of their singular forms and often brilliant flowers they have long been extensively cultivated, especially in Europe. These cultivated forms have formed the basis of original descriptions in almost all of the European publications, and in very rare cases have any types been preserved. As a result, the bibliography of *Cactaceæ* is appalling, and it is questionable whether satisfactory conclusions can be reached in the case of hundreds of published names. The earlier descriptions were not only meager, but were based upon what are now regarded very insufficient characters, and in the absence of types it is not only unsafe, but impossible to venture an opinion concerning their identity. In view of these facts, I have thought it advisable to present a preliminary revision of the order, which shall contain the results of the study of material confessedly insufficient. With such knowledge as we possess brought together, it is hoped that the study of this very interesting and much neglected group will be stimulated, and that more critical exploration of our southwestern territory and adjacent Mexico will

make a more satisfactory presentation possible. It would be useless to notice the vast number of reputed species that are not represented by actual specimens in our possession.

In the proposed preliminary account of the family, of which the present paper is the first part, only those genera are considered which form a part of the flora of the United States, and those species which I have been able to examine and to identify with reasonable certainty. All forms credited to the United States have been studied, and the account of these species may be considered fairly complete, but the far more numerous Mexican species are but scantily represented. The Mexican boundary is so unnatural a dividing line in the distribution of Cactaceæ that it has been disregarded, and all the species studied have been arranged in a lineal series of uniform prominence. So far as known the subject of geographical distribution is considered, but it will be seen how meager is our knowledge of this subject. It is to be hoped that this preliminary presentation will provoke exploration and study, and that species will not only be collected, but all the facts of their distribution noted. It is more than probable that our present notion of species in this group must be much modified, and doubtless many forms are at present kept specifically distinct which will prove to be but different phases of a single species.

In the matter of generic delimitation we are in still greater uncertainty, and several generic lines at present recognized must be regarded as purely arbitrary, a fact which must become still more evident with additional material. The whole group is to be regarded as made up of poorly differentiated forms and only long observation under cultivation can determine the possibilities of specific variation under the influence of environment, of age, of inherent tendencies. For instance, that these plants change in form and in spine characters with increasing age and after they have begun to flower can not be doubted, but what described forms have thus been separated in descriptions can only be guessed at.

JOHN M. COULTER.

LAKE FOREST UNIVERSITY,

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CACTUS, ANHALONIUM, AND LOPHOPHORA.

1. CACTUS Linn. Sp. Pl. 466 (1753), restricted.

MAMILLARIA Haw. Synop. 177 (1812), not Stackh. (1809).

Usually globose to oblong plants (simple, branching or cespitose), but sometimes slender-cylindrical, covered with spine-bearing tubercles: flower-bearing areola axillary (with reference to tubercles), entirely separate from the terminal spine-bearing areola, although sometimes (CORYPHEANTHA) connected with it by a woolly groove along the upper face of the tubercle: ovary naked: seeds smooth or pitted: embryo usually straight, with short cotyledons.—Originally defined by Linnaeus in his *Systema*, ed. 1 (1735).

The Linnaean genus *Cactus* of 1753 included 22 species and was coextensive with the present order. In 1812 the species were separated by Haworth into five genera, the original generic name *Cactus* being discarded. Among these species *C. mamillaris* seems to have stood as the type, not only of the Linnaean genus *Cactus*, but also of Haworth's *Mamillaria*, and as such should retain the original generic name. Besides, *Mamillaria* was used as the generic name of an alga in 1809. *Cactus mamillaris* L. is the West Indian *Mamillaria simplex* Haw.

From one point of view the two sections of the genus (EUMAMILLARIA and CORYPHEANTHA) deserve generic separation, for the character of grooveless and grooved tubercles seems to hold without exception, and the sections are separated with more certainty than are certain species of *Coryphantha* and *Echinocactus*. If genera are simply groups of convenience the separation should be made.

I. EUMAMILLARIA. *Flowers from the axils of the older or full-grown tubercles (hence usually appearing lateral), mostly small, and generally from whitish to pink or red: tubercles never grooved: fruit almost always clavate and scarlet.*

A. Tubercles more or less quadrangular.

* Central spines not hooked.

+ More than one central spine.

1. *Cactus alternatus*, sp. nov.

Subglobose, 10 cm. in diameter, simple: tubercles long (15 to 20 mm.) and spreading, with woolly axils: radial spines 3, rigid and recurved, 5 mm. long; central spines 3, very stout and much recurved, 20 to 30 mm. long, alternating with the radials; all ashy colored and often twisted: flower and fruit unknown.—Type in Herb. Coulter.

San Luis Potosi.

Specimens examined: SAN LUIS POTOSI (*Eschanzier* of 1891).

The few spines, with the very short radials alternating with the very long and stout centrals, furnish a striking character. Occasionally one of the centrals is wanting.

2. *Cactus acanthophlegmus* (Lehm.) Kuntze, Rev. Gen. Pl. 260 (1891).

Mamillaria acanthophlegma Lehm. Delect. Sem. Hamb. (1833).

Subglobose with a deeply depressed vertex, or becoming cylindrical, 3 to 8.5 cm. in diameter: tubercles sharply quadrangular-conical, with densely woolly axils: radial spines 15 to 30, white, very slender (bristly) and radiant, sometimes coarse capillary, 4 to 7 mm. long, interwoven with those of neighboring tubercles and so covering the whole plant; central spines 2 to 4, robust and straight, erect or divergent, whitish or reddish, black-tipped, 5 to 6.5 mm. long: flowers reddish, 1 to 2 cm. broad: fruit unknown.—Type unknown.

From Coahuila and San Luis Potosi to Oaxaca. Fl. May.

Specimens examined: COAHUILA (*Poselger* of 1856; *Pringle* 3116 of 1890): SAN LUIS POTOSI (*Eschanzier* of 1891).

The central spines are quite variable in number and arrangement. In case there are two they are vertically placed and are either erect and parallel or widely divergent. Even three centrals may occur in the same vertical plane; but more usually the three or four centrals are arranged about a center and are widely divergent. The tubercles are apt to persist and to become naked and corky with age. The axillary wool and the capillary radials are also apt to be more or less persistent, thus giving the whole plant a woolly appearance.

3. *Cactus brandegei*, sp. nov.

Cylindrical: tubercles sharply quadrangular-conical, 6 to 8 mm. long, with densely woolly axils: radial spines about 10, slender and rigid, whitish with dusky tips, spreading but not radiant, 7 to 10 mm. long; central spines 3 or 4, stouter and slightly longer, erect-spreading (sometimes slightly curved), reddish-brown below, becoming blackish above: flowers small (scarcely longer than the tubercle?): fruit unknown.—Type in Herb. Calif. Acad.

San Jorge, Lower California. Fl. April.

Specimens examined: LOWER CALIFORNIA (*Brandegge* of 1889, at San Jorge).

The species has somewhat the spine characters of *C. palmeri*, but the sharply quadrangular and longer tubercles with axillary wool free from bristles suggest a very different affinity.

4. *Cactus densispinus*, sp. nov.

Globose, 7.5 cm. in diameter, simple: tubercles short, with woolly axils: radial spines about 25, erect-spreading, slender but rigid, yellow (brownish to black with age), unequal, 8 to 10 mm. long; central spines 6, a little longer (10 to 12 mm.) and straight, more rigid and darker, black-tipped: seeds obovate, reddish-brown, 1 mm. long.—Type in Herb. Coulter.

San Luis Potosi.

Specimens examined: **SAN LUIS POTOSI** (*Eschanzier* of 1891).

Very easily distinguished by its dense, erect spines, which so completely cover the plant as to give it the appearance of a large chestnut bur. Another much smaller form, which seems to be a variety, has stouter and longer ashy-white spines, the centrals darker-tipped, and the lower centrals slightly curved.

+ + One short central spine (rarely two or none): ovaries immersed: seeds small, yellow and rugulose: juice milky: simple.

5. Cactus heyderi (Muhlenpf.) Kuntze, Rev. Gen. Pl. 260 (1891).

Mamillaria heyderi Muhlenpf. Allg. Gart. Zeit. xvi. 20 (1848).

Mamillaria declivis Dietr. Allg. Gart. Zeit. xviii. 235 (1850).

Mamillaria applanata Engelm. Pl. Lindh. 198 (1850).

Mamillaria texensis Labourot, Monogr. Cact. 89 (1858).

Depressed-globose, usually with depressed vertex, 8 to 12 cm. broad, 2.5 to 5 cm. high: tubercles elongated: radial spines 10 to 22, whitish, 5 to 12 mm. long, the lower usually the longer, stouter, and often darker; central spine 4 to 8 mm. long, light yellowish-brown, stout, straight, and porrect: flowers 2 to 2.5 cm. long, reddish-white: fruit incurved, 1.5 to 3 cm. long. (*Ill. Cact. Mex. Bound. t. 9. figs. 4-14*)—Type unknown.

From the Guadalupe River, Texas, to the mouth of the Rio Grande, and westward to Arizona and Sonora. Fl. April, May.

Specimens examined: TEXAS (*Lindheimer* of 1845, 1847, 1853; *Wright* 226, also collections of 1849, 1852, 1853, 1855, 1856; *Bigelow* of 1853; *Trelease* of 1892; *Nealley* of 1892): NEW MEXICO (*Wright* 311; *Bigelow* of 1853; *Evans* of 1891): ARIZONA (*Pringle* of 1881): also growing in Mo. Bot. Gard. 1893; and in the World's Fair collection of *Mrs. Nickels*.

The radial spines are somewhat variable in relative length, often becoming almost equal, while sometimes the upper radials are very much reduced. The figure referred to in *Cact. Mex. Bound.* is not satisfactory as to the general habit of the plant, which is flat-topped rather than hemispherical.

6. Cactus heyderi hemisphaericus (Engelm.).

Mamillaria hemisphaerica Engelm. Pl. Lindh. 198 (1850).

Differs in being hemispherical instead of flat-topped, in its fewer (9 to 12) and shorter (4 to 8 mm.) radial spines, and much smaller less rough and lighter-colored seeds. (*Ill. Cact. Mex. Bound. t. 9. figs. 15-17*)—Type, the "Goebel's Garden" plants in Herb. Mo. Bot. Gard.

Throughout southern Texas and southern New Mexico, and southward; not extending so far north or west as the species, and apparently not so abundant within the United States. Fl. May.

Specimens examined: TEXAS (*Schott* 322, 614): NEW MEXICO (*Evans* of 1891): also specimens cultivated in the Goebel Garden, St. Louis, in 1847, brought from "below Matamoros on the Rio Grande" by the St. Louis Volunteers, in 1846.

On account of its convex top the variety becomes somewhat higher than the species (5 to 7.5 cm.), and the flowers are sometimes slightly longer (2 to 3 cm.).

7. *Cactus meiacanthus* (Engelm.) Kuntze, Rev. Gen. Pl. 260 (1891).

Mamillaria meiacantha Engelm. Syn. Cact. 263 (1856).

Hemispherical or with depressed vertex, 7.5 to 12.5 cm. in diameter, with a broad top-shaped base: tubercles compressed, 14 to 18 mm. long: radial spines 5 to 9 (usually about 6), stout and strongly subulate, 6 to 10 mm. long, straight or somewhat curved, whitish or yellowish, the lower mostly a little longer, the upper one sometimes wanting; central spine shorter and stout, darker, straight, and porrect, turned upwards among the radials, or rarely wanting: flowers 2.5 to 3 cm. long, reddish-white: fruit incurved, 2 to 3 cm. long. (*Ill. Cact. Mex. Bound. t. 9, figs. 1-3*)—Type specimens are those of the collections of 1847, 1851, 1852, and 1853, from which the original description was drawn and all of which are in Herb. Mo. Bot. Gard.

From the Guadalupe River, Texas, to the "Great Bend" of the Rio Grande, westward through western Texas and New Mexico; also northern Mexico (Hemsley). Fl. May, June.

Specimens examined: TEXAS (*Wright* of 1851, 1852; *Bigelow* of 1853); NEW MEXICO ("Missouri Volunteers" of 1847; unknown collector in 1880); also specimens cultivated in St. Louis in 1853, and others growing in Mo. Bot. Gard. 1893.

Dr. Englemann regarded this species as possibly only a variety of *C. heyderi*, to which it is certainly very closely allied through var. *hemisphaerica*, but the different tubercles and fewer stouter spines serve so well to distinguish it that it seems best to retain its specific rank.

In reference to the citation of the original description an explanation seems necessary, which will apply to numerous similar cases. The *Pacif. R. Rep. iv. 27* (1856), *Syn. Cact. 263* (1858), and *Cact. Mex. Bound. 9* (1859), have each been cited as the original publication. The confusion has arisen from the fact that in both the publications of 1856 the description in the *Rep. Mex. Bound.* is referred to, and in that report the plant is fully described as "sp. nov." However, the publication of the Boundary Report was long delayed on account of the preparation of the plates, and in the meantime both the publications of 1856 had appeared, in each one of which the species is distinctly characterized and reference made to the description in the forthcoming Boundary Report. As between the two publications of 1856 the *Syn. Cact.* (*Proc. Amer. Acad. iii. 259*) was evidently distributed first.

8. *Cactus gummiferus* (Engelm.) Kuntze, Rev. Gen. Pl. 260 (1891).

Mamillaria gummifera Engelm. Wislitz. Rep. 21 (1848).

Hemispherical, 7.5 to 12.5 cm. broad and 6 to 10 cm. high: tubercles 12 to 15 mm. long: radial spines 10 to 12, the lower stout, with dusky apex, 12 to 15 mm. long, twice or thrice as long as the whitish setaceous upper ones; central spine (sometimes two) shorter (about 4 mm.), stout, dusky and porrect: flowers 3 cm. long, reddish-white, brownish-red outside: fruit unknown. (*Ill. Cact. Mex. Bound. t. 9, figs. 18-20*)—Type probably lost, as no specimens could be found in the Englemann Herbarium.

Chihuahua, near Cosihuiriachi.

So far as can be discovered, this species has not been collected since the original Wislizenus collection of 1846-47. The plants were cultivated by Dr. Englemann

and made to bloom, showing the flowers to be larger and darker colored than in the rest of the group, from which the species also differs in its more robust habit, its very unequal radial spines, and the occasional occurrence of two centrals.

** *Central spine hooked.*

9. **Cactus uncinatus** (Zucc) Kuntze, Rev. Gen. Pl. 261 (1891).

Mamillaria uncinata Zucc. in Pfeiff. Enum. 31 (1837).

Mamillaria bihamata Pfeiff. in Otto and Deitr. Gart. vi. 274 (1840).

Mamillaria adunca Scheidw. (1845-1849?).

Mamillaria depressa Scheidw. (1845-1849?).

Usually globose (occasionally depressed or even subcolumnar), 5 to 6 cm. in diameter (doubtless becoming larger): tubercles 8 to 10 mm. long, woolly in the upper axils: radial spines 4 to 6, rigid, 4 to 6 mm. long, the upper one stouter than the rest and sometimes shorter, reddish-brown and horny, straight or slightly curved, the remainder straight and white with dusky tips; central spine stout and horny, reddish-brown, 7 to 10 mm. long: flowers greenish-white or tinged with red: fruit unknown—Type unknown.

Entirely Mexican, reported from Chihuahua to San Luis Potosi.

Specimens examined: SAN LUIS POTOSI (*Gregg* of 1848; *Parry* 268; *Eschanzier* of 1891): CHIHUAHUA (*Wislizenus* of 1846-47; also Chihuahua specimens cultivated in the Jacoby Garden in 1856 and 1857).

The variations observed in this species do not seem sufficient for the establishment of varieties. The type form seems to have been globose, with 4 radial spines and a stout central one. The depressed forms with 6 radials and a more slender central represent var. *spinosior* Lem. (*M. depressa* Scheidw.); and the subcolumnar forms with 6 radials (the upper one of which is somewhat curved) and a stout strongly hooked central represent var. *biuncinata* Lem. (*M. bihamata* Pfeiff.). Such combinations of characters, however, do not hold, as any one of the plant body forms may display any one of the spine characters referred to.

B. Tubercles terete.

* *Central spines none: mostly simple globose plants, with very numerous straight whitish setaceous radials.*

10. **Cactus lasiacanthus** (Engelm.) Kuntze, Rev. Gen. Pl. 259 (1891).

Mamillaria lasiacantha Engelm. Syn. Cact. 261 (1856).

Globose or ovate globose, 2 to 2.5 cm. high and 1 to 2 cm. broad: tubercles 4 mm. long, about 2 mm. in diameter, with naked axils: spines 40 to 60, in many series, very unequal, 2 to 4 mm. long, white and pilose, the upper exterior usually longer than the rest, the innermost usually much shorter: flowers 12 mm. long, whitish or pinkish (petals with red median band): fruit 1 to 2 cm. long: seeds about 1 mm. long, blackish and conspicuously pitted. (*Ill. Cact. Mex. Bound. t. 3*)—Type, the specimens of Wright in Herb. Mo. Bot. Gard.

From western Texas ("west of the Pecos, on low limestone hills, among herbage") to Arizona and Chihuahua. Fl. April, May.

Specimens examined: TEXAS (*Wright* 121, also of 1852; *Parry* of 1852): ARIZONA (*Miller* of 1881): CHIHUAHUA (*Pringle* 213, 250, 258): also specimens cultivated in St. Louis in 1852 and 1855.

11. *Cactus lasiacanthus denudatus* (Engelm.).

Mamillaria lasiacantha denudata Engelm. *Caet. Mex. Bound.* 5 (1859).

Larger, 2.5 to 3.5 cm. in diameter, with longer tubercles (5 to 6 mm.), and more numerous (50 to 80) longer (3 to 5 mm.) spines which are naked or nearly so. (*Ill. Caet. Mex. Bound.* t. 4)—Type, *Wright* specimen in Herb. Mo. Bot. Gard.

From western Texas (with the species) to Coahuila.

Specimens examined: TEXAS (*Wright* of 1852): COAHUILA (*Palmer* of 1880).

In the *Syn. Caet.* Dr. Engelmann merges this variety with the species, and has been followed in this by subsequent writers, but the characters seem so distinctive that its varietal rank has been restored.

12. *Cactus micromeris* (Engelm.) Kuntze, *Rev. Gen. Pl.* 260 (1891).

Mamillaria micromeris Engelm. *Syn. Caet.* 260 (1856).

With depressed top and very rarely branching, 1 to 3.5 cm. in diameter: tubercles very small (about 1 mm. long) and wart-like, crowded, shedding the spines with age and giving the base of the plant a tuberculated appearance: spines from white to ashy-gray, 1 to 3 mm. long; in young plants and on lower tubercles of adult plants about 20, equal and radiant; on flower-bearing tubercles 30 to 40, stellate-porrect in every direction, the 6 to 8 upper ones two to four times longer than the rest (4 to 8 mm.), clavate toward the apex and acute (the clavate top at length deciduous), intermixed with loose wool of about the same length and forming a small tuft on the top of the plant which includes and partly hides flowers and fruit: flowers whitish to light pink, almost central, very small (6 mm. in diameter), much reduced (3 to 5 sepals, 5 petals, 10 to 15 stamens, 3 stigmas): fruit 8 to 12 mm long: seeds 1.5 mm. long, black and shining. (*Ill. Caet. Mex. Bound.* t. 1 and 2, figs. 1-4)—Type, the specimens of *Wright* in Herb. Mo. Bot. Gard.

On naked mountain tops and sides, extreme southwestern Texas (Val Verde County to El Paso) and southward into Coahuila and Chihuahua.

Specimens examined: TEXAS (*Wright* 227 of 1849, also of 1852; *Nealley* of 1892): COAHUILA (*Bigelow* of 1853): CHIHUAHUA (*Pringle* 212): also growing in Mo. Bot. Gard. 1893.

The plants densely covered above with delicate ashy-gray spines and with naked tuberculate base are readily recognized. It still remains an open question whether the flowers are developed from the axils of tubercles of the same season or the last ones of the preceding season. Dr. Englemann inclined to the latter view, as all the other characters of the plant associate it with the "lateral-flowered" species; and in the absence of definite observation we have retained it there. If the nearly central flowers indicate that they are produced from growth of the same season the species would seem to be allied to *CORYPHANTHA*, in which group its small flowers and small tubercles would be anomalous.

13. Cactus micromeris greggii (Engelm.).*Mamillaria micromeris greggii* Engelm. Syn. Cact. 261 (1856).

Larger (2.5 to 5 cm. in diameter) and becoming oblong, with larger globose-ovate tubercles (2 to 2.5 mm. long), fewer rigid spines all radiant (interior 5 to 7 shorter and stouter, 1 to 2 mm. long; the outer 15 to 18, 3 to 4 mm. long), and fruit 1.5 to 2 mm. long. (*Ill. Cact. Mex. Bound.* t. 2. figs. 5-8)—Type, Gregg 508 in Herb. Mo. Bot. Gard.

Mountain ridges near Saltillo, Coahuila. Said by Budd to occur within the southern borders of Pecos County, Tex.

Specimens examined: COAHUILA (*Gregg 508; Palmer of 1880*).

It is a question whether this variety does not merely represent an older and better developed plant than those upon which the species is based. Mr. Harry I. Budd, who has made extensive collections of Texan and Mexican Cacti for the market, reports that it is impossible to separate sharply the variety from the species in the field, and regards the difference merely as one of age. Unfortunately, only living material of the species could be examined, but its characters seem well sustained even in the most vigorous plants, some of which reach the size of the variety. Through this variety the species is brought very near the following:

14. Cactus bispinus.*Mamillaria microthele* Muhlenpf. Allg. Gart. Zeit. p. 11 (1848), not Lem. (1838).

Differs from the last form (var. *greggii*) chiefly in its cespitose habit, much larger tubercles, and two unusually stout and short central spines (*vide* Engelmann, who examined specimens in Coll. Salm-Dyck).

Credited to Mexico in general, but said by Budd to occur within the southern border of Pecos County, Tex.

* * Central spines present and one or more hooked.

+ Mostly globose and simple plants (occasionally somewhat cylindrical).

15. Cactus wrightii (Engelm.) Kuntze, Rev. Gen. Pl. 261 (1891).*Mamillaria wrightii* Engelm. Syn. Cact. 262 (1856).

Globose or depressed globose (top-shaped below), 3 to 7.5 cm. in diameter, simple: tubercles 10 to 12 mm. long, with naked axils: radial spines 8 to 12, white (the upper dusky-tipped), pubescent, 8 to 12 mm. long; central spines mostly 2 (usually side by side and divergent), rarely 1 or 3, scarcely longer, hooked and reddish-black: flowers 2.5 cm. long, bright purple: fruit about 2.5 cm. long, somewhat subglobose, purple: seeds 1.4 mm long, black and pitted. (*Ill. Cact. Mex. Bound.* t. 8. figs. 1-8)—Type, Wright of 1851 in Herb. Mo. Bot. Gard.

High plains and rocky places, from the Upper Pecos, east of Santa Fé, N. Mex., southward through extreme southwestern Texas (between the Pecos and El Paso), and into Chihuahua (near Lake Santa Maria).

Specimens examined: NEW MEXICO (*Wright of 1851; Rusby of 1880*): also growing in Mo. Bot. Gard. 1893.

Dr. Engelmann calls attention to the fact that this species is closely allied to the Mexican *C. zephyranthoides* (Schiedw.), but in the absence of material representing the latter species no comparison can be made. In descriptions of the Mexican species the differently colored flowers and the much longer spines suggest differences that an examination of fruit and seed characters may still further emphasize.

16. *Cactus goodrichii* (Scheer) Kuntze, Rev. Gen. Pl. 260 (1891).

Mamillaria goodrichii Scheer in Salm Cact. Hort. Dyck. 91 (1850).

Globose or ovate, 5 to 7.5 cm. high, subsimple: tubercles ovate, short (3 to 5 mm.), somewhat corky and persistent, with dense wool in the young axils containing 5 to 8 stiff bristles: radial spines 11 to 15 (the uppermost one sometimes wanting), white and rigid, 5 to 7 mm. long, entangled with adjoining clusters; central spines 3 or 4 (often solitary in young plants), brownish-black, the upper ones divergent and straight (rarely showing a tendency to hook), the lower longer (9 to 10 mm.), stouter and hooked (usually upwards): flowers 12 to 18 mm. long, the petals yellowish-white with red midribs: fruit clavate and scarlet. (*Ill. Cact. Mex. Bound. t. 8. figs. 9-14*)—Type: Scheer says that the plant was brought from the Island of "Corros" (Cedros?) by Dr. Goodrich, and "unfortunately perished in the gardens," which generally means that there is not a fragment of the type in existence.

In dry ravines, from San Diego County, California, southward throughout Lower California and the neighboring islands (including Guadalupe Island). "Llavina."

Specimens examined: CALIFORNIA (*Parry* of 1850, 1875; *Agassiz* of 1872; *Parish* 450 of 1882 at Vallecito): LOWER CALIFORNIA (*Gabb* 18 of 1867; *Brandege* of 1889 on Magdalena Island, and 240 of 1890 from San Jose del Cabo): also specimens cultivated in Gard. Salm-Dyck.

By a misprint in *Cact. Mex. Bound.* the specific name appeared as "Goodridgii," and this error appears in almost every subsequent mention of the species, even in *Watson's Bibliographical Index*, although in *Syn. Cact.* and other references by Dr. Engelman the correct form appears.

17. *Cactus pondii* (Greene).

Mamillaria pondii Greene, *Pittonia*, i, 268 (1889).

Oval or cylindrical, from low to 30 cm. high, simple or sparingly branched: radial spines 20 to 30, white and slender; centrals 4 or 5, the longest over 25 mm. long, rigid and strongly hooked, dark brown above the middle: flowers nearly 5 cm. long, bright scarlet: fruit unknown.—Type, Pond specimens in Herb. Greene.

Cedros Island, off the west coast of Lower California. Fl. February.

Unfortunately, the type specimen has been mislaid, so that no examination of it could be made. Evidently related to *C. goodrichii*, but differing in its much more robust habit, more numerous radials, much longer spines, and larger scarlet flowers.

18. *Cactus barbatus* (Engelm.) Kuntze, Rev. Gen. Pl. 261 (1891).

Mamillaria barbata Engelm. *Wisliz. Rep.* 22 (1848).

Depressed-globose, about 4 cm. in diameter, simple: tubercles 8 mm. long, with naked axils: radial spines very numerous (50 to 60), in two series, 6 to 8 mm. long, the outer (about 40) slender but rigid and white, the inner (10 to 15) a little stouter and yellow; usually one central spine, stout and erect, hooked downwards, brownish: flowers 18 to 20 mm. long, rose-red: fruit oblong, 10 to 12 mm. long, green (when mature?)

seeds minute, dark brown and lightly pitted. (*Ill. Cact. Mex. Bound. t. 6. figs. 9-12*)—Type, Wislizenus of 1846 in Herb. Mo. Bot. Gard.

Central Chihuahua. Fl. May, in cultivation.

Specimens examined: CHIHUAHUA (*Wislizenus* of 1846, 1850): also specimens cultivated in Baumann's Garden in 1857, 1858; also growing in Mo. Bot. Gard. 1893.

Dr. Engelmann observed a curious intermediate character in the origin of the flowers of this species, the first ones of the season appearing in the axils of the last tubercles of the preceding year, while the later ones develop from the axils of the first tubercles of the same season. The specimen growing in Mo. Bot. Gard. in 1893 had 3 central spines, one or two being hooked.

19. *Cactus grahami* (Engelm.) Kuntze, *Rev. Gen. Pl.* 260 (1891).

Mamillaria grahami Engelm. *Syn. Cact.* 262 (1856).

Globose or at length ovate, 2.5 to 7.5 cm. high, simple or branched from the base and even cespitose: tubercles ovate, 6 mm. long, dilated at base (corky and persistent when old), with naked axils: radial spines 15 to 30 in a single series, white, often dusky-tipped, slender but rigid, naked or puberulent, 6 to 12 mm. long, the shorter ones uppermost, the longer ones lateral; central spines 1 to 3, blackish from a paler base, the lower (often the only) one stouter and longer (6 to 18 mm.), hooked upward, the one or two upper ones (when present) shorter and slenderer, divergent: flowers 2 to 2.5 cm. long, rose-colored: fruit 2 to 2.5 cm. long: seeds 0.8 to 1 mm. long, black and pitted. (*Ill. Cact. Mex. Bound. t. 6. figs. 1-8*)—Type, Wright of 1852 and Bigelow of 1852 in Herb. Mo. Bot. Gard.

In rocky places, from the mountains of extreme southwestern Texas (west of the Pecos) to southern Utah, southern California (common along the Colorado), and Sonora. Fl. June–August.

Specimens examined: TEXAS (*Wright* of 1852; *Newberry* of 1858; *G. R. Vasey* of 1881; *Miller* of 1881; *Briggs* of 1892): NEW MEXICO (*Evans* of 1891): ARIZONA (*Bigelow* of 1852; *Schott* of 1858; *Cous* of 1865; *Palmer* of 1869, 1870; *Engelmann* of 1880; *Pringle* of 1884): UTAH (*Parry* of 1874): SONORA (*Schott* of 1853): also specimens cultivated in the Mo. Bot. Gard. in 1881.

In all references to the fruit of this species it is described as "oval and green," except in Ives Report, where Dr. Engelmann describes its real character as the ordinary fruit of *EUMAMILLARIA*. The immature fruit is "oval and green," but with maturity it becomes clavate and scarlet. The Utah specimens of Parry show an exceptional character in their 30 to 33 scabrous radial spines, but otherwise they are quite normal. *M. microcarpa* Engelm., *Emory's Rep.* 156. f. 3, should be dropped as a synonym of this species, at least as to figure and description. In all probability *C. grahami* is one of the forms of the Mexican *C. schelhasii* (Pfeiff.). Except that in *C. grahami* the radial spines are apt to be more numerous and longer, and the centrals much darker; and in *C. schelhasii* the 3 centrals seem to be always present and sometimes all hooked, the descriptions suggest no difference. In the absence of authentic specimens of the latter species, however, and with its fruit and seed entirely unknown, such a reference of *C. grahami* must be deferred.

20. Cactus bocasanus (Poselger).

Mamillaria bocasana Poselger, Gart. Zeit. 94 (1853).

Depressed-globose, 2 to 3 cm. high: tubercles 8 mm. long, with long axillary wool: radial spines 25 to 30, white and capillary, 10 to 25 mm. long; central spines 2 to 4, slender and naked (or slightly puberulent), the most central one hooked (usually upwards), 15 to 25 mm. long, the upper 1 to 3 shorter and straight, all yellow with red tips, the hooked one often brownish-red nearly to the base: flowers unknown: fruit green, about 4 mm. long: seeds cinnamon-brown, oblique, broadly obovate, with narrowly ovate basal hilum.—Type unknown.

San Luis Potosi, so far as known. Poselger says, "Texas, auf der Seira de Bocas, among rocks," which station we have been unable to locate.

Specimens examined: SAN LUIS POTOSI (*Eschanzier* of 1891): also specimens cultivated in Hort. Pfersdorff in 1869; in Mo. Bot. Gard. in 1891; also growing in Mo. Bot. Gard. 1893.

The capillary radials give the plant a white-woolly appearance. The younger spines at the vertex are erect and tufted. It resembles *C. grahami*, but the tubercles are much more slender and not thickened at base, all the spines are more slender, the central hooked one is more reddish, and the fruit is much shorter.

21. Cactus eschanzieri, sp. nov.

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

San Luis Potosi.

Specimens examined: SAN LUIS POTOSI (*Eschanzier* of 1891).

Resembles *C. grahami*, but with fewer and more slender pubescent spines, longer and less rigid central, more exserted fruit, and much larger reddish and strongly pitted seeds with subventral hilum.

22. Cactus tetrancistrus (Engelm.).

Mamillaria tetrancistra Engelm. Am. Jour. Sci. II. xiv. 337 (1852), in part.

Mamillaria phellosperma Engelm. Syn. Cact. 262 (1856).

Cactus phellospermus Kuntze, Rev. Gen. Pl. 261 (1891).

Ovate or ovate-cylindrical, 5 to 25 cm. high, 3.5 to 7.5 cm. in diameter, simple or rarely branching at base: tubercles ovate-cylindrical, 8 to 14 mm. long, with axillary bristle-bearing wool, at length naked: radial spines 30 to 60, in two series, the exterior bristle-like, shorter and white, the interior stouter, longer and dusky-tipped or purplish; central spines 3 or 4, stouter, longer, brown or blackish from a paler base, the upper 2 or 3 (10 to 14 mm. long) straight, or one or two or even all hooked, the lower stouter and longer (12 to 18 mm.), hooked

upwards: flowers about 2.5 cm. long: fruit 1 to 2.5 cm. long: seeds large (1.2 to 1.5 mm. in diameter), globose and wrinkled, partly immersed in a brown spongy or corky cup-shaped 3-lobed appendage. (*Ill. Cact. Mex. Bound. t. 7*)—Type, Parry of 1850, but modified by Le Conte 14 and Bigelow of 1854, all in Herb. Mo. Bot. Gard.

Gravelly soil and sandy stream-banks, from the eastern slopes of the mountains of southern California, throughout western Arizona and southern Nevada to southern Utah; referred also to "N. W. Mexico" by Hemsley (*Biol. Centr.-Amer.*).

Specimens examined: CALIFORNIA (*Parry* of 1850; *Newberry* of 1858; *Parish* of 1882): ARIZONA (*Le Conte* 14; *Bigelow* of 1854; *Dr. Loew* of 1875): also *Palmer* of 1870, but with no locality.

In the original description this species was confounded with *C. grahami*, with which it grows and which it much resembles; and this, together with the fact that 4 central hooked spines are seldom found, induced Dr. Engelmann (*Syn. Cact.* 262) to propose the more appropriate but untenable name *M. phellosperma*. The resemblance to *C. grahami* is not so close as general appearance would indicate, as the more oblong or cylindrical form, longer and less crowded tubercles, more numerous spines, often more than one hooked central, large seeds, and remarkable seed-appendages serve well to distinguish it.

+ + *Plants with fasciculate slender cylindrical stems (30 to 45 cm. high, and 2.5 to 6 cm. in diameter): Lower Californian.*

23. *Cactus roseanus* (Brandege).

Mamillaria longihamata Engelm. Mss.

Mamillaria roseana Brandege, *Zoe*, ii. 19 (1891).

Fasciculately branched at base, the stems 30 to 45 cm. long (sometimes pendent from rocks and as much as 200 cm. long) and 2.5 to 5 cm. in diameter, the whole plant glaucous: tubercles elongated-conical, ascending, 10 to 12 mm. long, with woolly axils: radial spines 7 to 10, straight, rigid and sharp, 9 to 15 mm. long, dark reddish when young, becoming ashy, the upper ones the longer; the solitary central much longer (20 to 30 mm.), almost black below and with reddish tip, becoming ashy with age, usually hooked downwards: flowers numerous, 2.5 to 3.5 cm. long, bright scarlet: fruit obovate to globose, scarlet, 6 to 9 mm. in diameter, fleshy: seeds black and pitted.—Type in Herb. Calif. Acad.

Apparently common at low elevations throughout southern Lower California, especially the eastern side.

Specimens examined: LOWER CALIFORNIA (*W. M. Gabb* 17 of 1867, near Loreto; *Brandege* of 1889, at San Gregorio; *Palmer* 139 of 1890, near La Paz; *Palmer* 880 of 1890, on Carmen Island; *Brandege* 241 of 1890, at Rancho Colorado).

One of the most showy species of Lower California. The plant has the appearance of a *Coryphanth*, and is remarkable for its tall and slender habit, its large central hooks, and its globose fruit. Since 1867 this species has been in Herb. Engelmann, fully characterized as above under the very appropriate specific name *longihamatus*.

24. *Cactus setispinus*, sp. nov.*Mamillaria setispina* Engelm. Mss.

Fasciculate and ascending, simple or branched at base, the stems about 30 cm. high and 3 to 6 cm. in diameter, densely covered with remarkably long stout spines: tubercles short and broadly conical, with axillary wool: spines white, with black tips; radials 10 to 12, widely spreading, very unequal, 10 to 34 mm. long, slender and flexuous; central spines 1 to 4, more rigid and much longer (20 to 50 mm.), the upper ones straight, the lowest one longest and hooked (usually upwards) and often variously curved and twisted: fruit obovate and scarlet, 30 mm. long: seeds, black and pitted.—Type, Gabb 15 in Herb. Mo. Bot. Gard.

Rocky or gravelly soil, San Julio Canyon, and in the vicinity of San Borgia, Lower California.

Specimens examined: LOWER CALIFORNIA (*W. M. Gabb* 15 of 1867, at San Borgia; *Brandegee* of 1889, from San Borgia and San Julio Canyon).

In his notes Mr. Gabb describes the flower as "large, 3 to 3½ inches long, bell-shaped, of a beautiful purplish red color," concerning which Dr. Engelmann remarks "this would indicate a *Coryphanth*, but the tubercles show no trace of a groove, and, moreover, a withered remnant of a flower laterally attached (say 18 to 20 mm. long), so that I have no doubt that Mr. Gabb's statement is founded on some error." It is very probable that the flowers are scarlet and larger than Dr. Engelmann suggests. The species is closely allied to *C. roseanus*, but differs in its shorter tubercles and much longer spines. About a dozen stems rise in a clump, about a foot high, covering an area of 2 or 3 feet. These two species represent a very distinct Lower Californian group of cylindrical and hooked *Eumamillarias*. Both probably have showy scarlet flowers and may attain considerable length when growing upon rock ledges so as to become pendent. The specimens of *C. setispinus* from San Julio Canyon are from younger parts and show but a single long and hooked central. The San Borgia specimens show mostly 3 or 4 centrals, the lowest one hooked and becoming remarkably long and often variously twisted and curved. However, I can discover no difference except such as may be due to age.

* * * *Central spines present and not hooked.*

+ *Central spines more than one, longer than the radials, which are numerous, white and slender (capillary or bristle-like) (rigid in C. Halei).*

25. *Cactus halei* (Brandegee).*Mamillaria halei* Brandegee, Proc. Calif. Acad. Sci. Ser. 2. ii. 161 (1889).

Stems cylindrical, 8 to 10 in a clump, about 30 cm. high and 5 to 7.5 cm. in diameter: tubercles short, with axillary wool: radial spines 10 to 22, rigid and erect-spreading, unequal, 6 to 15 mm. long; central spines numerous and erect-spreading, 1 to 3 of them very stout and prominent (25 to 35 mm. long); all the spines straight, at first reddish brown, becoming yellowish and ashy, more or less dark-tipped: flowers 2.5 cm. long, bright scarlet (almost throughout): fruit 12 mm. long, clavate and red: seeds black and pitted. (*Ill. l. c. t. 6*)—Type in Herb. Calif. Acad.

Abundant on Magdalena and Santa Margarita Islands, western coast of Lower California. Fl. January.

Specimens examined: LOWER CALIFORNIA (*Brandege* of 1889, on Magdalena Island).

The tubercles are so close together that the plant appears thickly covered with the unusually stout and erect-spreading straight spines, a few of the centrals being specially prominent. The plant is more slender than the ordinary "cylindrical" members of the genus, but stouter than the slender hooked forms of the preceding section.

26. *Cactus rhodanthus* (Link & Otto) Kuntze, Rev. Gen. Pl. 261 (1891).

Mamillaria rhodantha Link & Otto, Icon. t. 26 (1828-31).

Mamillaria lanifera Haw. Phil. Mag. lxiii., 41 (), not Salm-Dyck (1850).

Oblong or subcylindric, 30 cm. or more high, 7.5 to 10 cm. in diameter, often forking from the middle: tubercles conical, 12 mm. long, 8 mm. in diameter, with woolly axils: radial spines 16 to 20, bristle-like, white, the lower longer (8 to 10 mm.); central spines 6 or 7, rigid, whitish with black tip, 12 mm. long: flowers rose color, 12 mm. in diameter: fruit 2.5 cm. long, cylindrical. (*Ill. l. c.*)—Type unknown.

Referred to Mexico in general, but reported as yet from San Luis Potosi to southern Mexico. Fl. profusely all summer.

Specimens examined: SAN LUIS POTOSI (*Bourgeau* 47; *Pringle* 3679; *Eschanzier* of 1891): also growing in Mo. Bot. Gard. 1893.

The specimens of Bourgeau and Pringle have somewhat larger spines than the type, as indicated by the description.

27. *Cactus rhodanthus sulphureospinus*.

Mamillaria sulphurea Forst. Handb. Cact. (1846), not *Cactus sulphureus* Gill. (1830).

Mamillaria rhodantha sulphurea Salm, Hort. Cact. Dyck. 11 (1850).

Central spines sulphur-yellow; otherwise like the species.—Type unknown.

San Luis Potosi.

Specimens examined: SAN LUIS POTOSI (*Pfeiffer*, with no number or date; *Eschanzier* of 1891).

The varietal distinction maintained seems a small one, but it is constant and striking, so far as can be discovered.

28. *Cactus capillaris*.

Mamillaria lanifera Salm, Cact. Hort. Dyck. 98 (1850), not Haw.

Cactus laniferus Kuntze, Rev. Gen. Pl. 250 (1891).

Cylindrical and erect: tubercles crowded, conical, glaucous, with axillary bristles: radial spines capillary and very numerous, white and crisped, entirely covering the plant; central spines 4 to 6, rigid, straight and spreading, straw-colored, 8 to 12 mm. long: flowers equaling the tubercles, the yellow petals striped with red: fruit unknown.—Type unknown.

Referred to Mexico in general, but definitely known only from Coahuila.

Specimens examined: COAHUILA (*Palmer* of 1880).

There is a confusion of synonymy between this species and *C. rhodanthus*, both having been named *Mamillaria lanifera*. The earlier *M. lanifera* of Haworth, how-

ever, is clearly *M. rhodantha* of Link & Otto; and although Prince Salm-Dyck revived the name for the present species, the law of homonyms will not permit it to stand. The name proposed refers to the abundant display of capillary radial spines, which is probably the most notable feature.

29. *Cactus palmeri*, sp. nov.

Cylindrical: tubercles crowded, glaucous, cylindrical (somewhat broadest above), about 4 mm. long, with dense axillary wool containing bristles: radial spines 25 to 30, very slender and white but rigid, about 5 mm. long, spreading or somewhat radiant, entangled with those of neighboring tubercles, and so covering the whole plant; central spines 3 to 5 (usually 4), more robust, erect or slightly divergent, brownish with darker tip, 7 to 8 mm. long: flowers small: fruit clavate and scarlet: seeds black and strongly pitted, 0.5 to 0.8 mm. in diameter.—Type, Palmer 921 in U. S. Nat. Herb.

San Benito Island, off the west coast of Lower California.

Specimens examined: LOWER CALIFORNIA, San Benito Island (*Palmer* 921 of 1889, reported as *Mamillaria Goodrichii*).

Very closely allied to *C. capillaris* of eastern Mexico.

30. *Cactus stellatus* Willd. Enum. Suppl. 30 (1813).

Cactus pusillus DC. Cat. Hort. Monsp. 181 (1813), not Haw. (1803).

Mamillaria pusilla DC. Prod. iii. 459 (1828).

A very common West Indian species, apparently differing from the variety only in the very much fewer (12 to 20) radial spines, although numerous specimens, both dried and living, were examined for additional characters. This difference, however, is so constant and striking that, taken together with the wide geographical separation, it should stand as varietal.

31. *Cactus stellatus texanus* (Engelm.).

Mamillaria pusilla texana Engelm. Syn. Cact. 216 (1856).

Mamillaria texana Young, Fl. Texas, 279 (1873).

Ovate-globose, 2.5 to 3 cm. in diameter, 2.5 to 6 cm. high, proliferous and at length cespitose: tubercles 7 to 9 mm. long, the long axillary wool intermixed with several coarse twisted bristles: radial spines very numerous, in many series, the outer ones (30 to 50) capillary, white, elongated and flexuous or crisped (12 to 16 mm. long when straightened), the inner ones (10 to 12) more rigid, shorter (6 to 8 mm.), puberulent, whitish or yellowish, usually dark-tipped; central spines 5 to 8, rigid, straight, pubescent, unequal, white below and reddish or dark above: flowers 1.5 to 2 cm. long, the yellowish-white petals with reddish median band: fruit 1.5 to 2 cm. long: seeds black and shining, conspicuously pitted, 1.2 mm. long. (*Ill. Cact. Mex. Bound. t. 5.*)—Type, Bigelow specimens in Herb. Mo. Bot. Gard.

From the mouth of the Rio Grande to El Paso, Tex., and southward into Coahuila and Chihuahua. Fl. March—May.

Specimens examined: TEXAS (*Bigelow* of 1853; *Neally* of 1892): COAHUILA (*Bigelow* of 1853): also growing in Mo. Bot. Gard. 1892 and 1893.

The exterior capillary spines cover the whole plant as with a coarse wool.

32. *Cactus pringlei*, sp. nov.

Globose (?), 5 cm. in diameter: tubercles short-conical, about 6 mm. long, with very woolly axils: radial spines 18 to 20, setaceous-bristly and radiant, 5 to 8 mm. long; central spines 5 to 7 (usually 6), stout and horny, more or less recurved, spreading, 20 to 25 mm. long; all straw-colored, but the centrals darker: flowers deep red (darker, even brownish, outside), 8 to 10 mm. long: fruit unknown.—Type, Pringle of 1891 in Herb. Gray.

San Luis Potosi.

Specimens examined: SAN LUIS POTOSI (*Pringle* of 1891).

Evidently a member of the *Chrysacantha* group and near *C. rhodanthus sulphureospinus*, but differs in the much shorter tubercles, straw-colored spines, shorter radials, much longer centrals, and smaller darker flowers.

33. *Cactus sphærotrichus* (Lem.) Kuntze, Rev. Gen. Pl. 261 (1891).

Mamillaria sphærotricha Lem. Caet. 33 (1839).

Depressed-globose: tubercles cylindrical, obtuse, with some axillary bristles: radial spines very much crowded, exceedingly numerous, radiant, very slender and bristle-like, white; central spines 6 to 10 and even more, erect and more rigid: flowers pale reddish: fruit unknown.—Type unknown.

Referred to Mexico in general, but reported only from San Luis Potosi.

Specimens examined: Mexican specimens from Hort. Dyck in 1857; from Hort. Pfersdorf in 1869; and growing in Mo. Bot. Gard. 1893 (from material sent by Pringle from San Luis Potosi).

— — *The single central spine shorter than the radials (in C. longimamma centrals often more than one and somewhat longer).*

34. *Cactus gabbii*, sp. nov.

Mamillaria gabbii Engelm MSS.

Globose, 5 to 10 cm. in diameter, simple: tubercles cylindrical, slender, 12 to 14 mm. long, with woolly axils: radial spines about 13, 5 to 8 mm. long, lower ones longer and stouter, especially the lateral ones pectinate; the central shorter, straight, and robust: flowers small, yellowish-red: fruit unknown.—Type in Herb. Mo. Bot. Gard.

Among rocks, from San Ignacio to Mission San Fernando, Lower California, and "perhaps farther north in the interior."

Specimens examined: LOWER CALIFORNIA (*W. M. Gabb* 19 of 1867).

35. *Cactus sphæricus* (Dietr.) Kuntze, Rev. Gen. Pl. 261 (1891).

Mamillaria sphærica Dietr. Allg. Gart. Zeit. xxi. 94 (1853).

Obovate or clavate, 5 cm. or more high, proliferous and at length densely cespitose: tubercles elongated-ovate, acutish, 12 to 16 mm.

long, with axillary wool: radial spines 12 to 14, setaceous, 7 to 9 mm. long, bulbous at base, straight or curved, white; central spine straight, subulate, somewhat shorter, but scarcely stouter: flowers yellow, 3.5 to 5 cm. long: fruit unknown.—Type unknown.

Sandy ridges in the valley of the Rio Grande (both sides of the river), from the mouth to Eagle Pass. Fl. from March throughout the season.

Specimens examined: TEXAS (*Schott* of 1852): also specimens cultivated in St. Louis in 1845 and 1861.

Dietrich's description was taken from plants collected by Poselger at Corpus Christi. The *Schott* specimens are from Eagle Pass. Dr. Engelmann calls attention to the fact that this species approaches *CORYPHANTHA* in its exserted ovary and large flower, but the flowers are clearly from the growth of the preceding season. The species is said to be too near the Mexican *C. longimamma* of central and southern Mexico, but in the absence of type specimens of either the question can not be settled. The usual characterization of *C. longimamma* is as follows, which seems to make it distinct enough:

36. *Cactus longimamma* (DC.) Kuntze, Rev. Gen. Pl. 260 (1891).

Mamillaria longimamma DC. Rev. Cact. 113 (1829).

Ovate or at length cylindrical, simple or cespitose: tubercles oblong-ovate, large at base, 4 to 5 cm. long: radial spines 7 or 8, radiant and equal, 8 to 10 mm. long or more, more or less pubescent; central spines 1 to 3, somewhat longer and spreading: flower 4 cm. long, becoming 6 cm. broad when fully expanded, yellow. (*Ill.* DC. Mem. Cact. t. 5.)

II. *CORYPHANTHA*. *Flowers from the base of a groove on young or nascent tubercles (hence appearing terminal), mostly large: spines never hooked (except in the doubtful C. brunneus).*

* *Flowers yellow.*

† *The originally central flowers pushed aside by the continuous development of new tubercles: usually a single prominent central spine.*

37. *Cactus missouriensis* (Sweet) Kuntze, Rev. Gen. Pl. 259 (1891).

Cactus mamillaris Nutt. Gen. i. 295 (1818), not Linn. (1753).

Mamillaria missouriensis Sweet, Hort. Brit. 171 (1827).

Mamillaria simplex Torr. & Gray, Fl. N. Am. i. 553 (1840).

Mamillaria nuttallii Engelm. Pl. Fendl. 49 (1849).

Mamillaria notesteinii Britton, Bull. Torr. Bot. Club, xviii, 367 (1891).

Globose, 3.5 cm. in diameter, simple or nearly so: tubercles ovate-cylindrical, 12 to 14 mm. long, slightly grooved: radial spines 13 to 17, straight, whitish, setaceous, somewhat unequal, 8 to 10 mm. long; central spine more robust, straight and porrect, puberulent, 10 to 12 mm. long, often wanting: flowers about 2.5 cm. long, yellow or reddish: stigmas 2 to 5: fruit globose, scarlet, 6 to 8 mm. in diameter: seeds globose, black and pitted, 0.8 to 1.1 mm. in diameter. (*Ill.* Cact. Mex. Bound. t. 74., f. 6, seeds.)—Type unknown.

High prairies of the Upper Missouri, from Montana to South Dakota and southward through western Nebraska to western Kansas and the eastern slopes of the mountains of Colorado. Fl. May.

Specimens examined: MONTANA (*Notestein* of 1893): NATIONAL PARK (*Tweedy* 423): SOUTH DAKOTA, (collectorun known, in 1847, 1848, 1853): NEBRASKA (*Hayden* of 1855).

38. *Cactus missouriensis similis* (Engelm.).

Mamillaria similis Engelm. Pl. Lindh. 246 (1845).

Mamillaria nuttallii caespitosa Engelm. Syn. Cact. 265 (1856).

Mamillaria missouriensis caespitosa Watson, Bibl. Index, 403 (1878).

Cespitose, with 12 to 15 puberulent radial spines, the central very often wanting, larger flowers (2.5 to 5 cm. long), fruit and seeds (1.6 to 2.2 mm. in diameter), and 5 stigmas. (*Ill. Cact. Mex. Bound. t. 74. f. 7, seeds*)—Type, Lindheimer, of 1845 (?) in Herb. Mo. Bot. Gard.

From the Kansas River, Kansas, and eastern Colorado, southward through Oklahoma to the San Antonio River, Texas.

Specimens examined: COLORADO (*Greene* of 1870): KANSAS (*Carleton* 551 of 1891, from Kingman County, distributed as *Mamillaria dasyacantha*): OKLAHOMA (*Carleton* 120 of 1891): TEXAS (*Lindheimer* of 1845, 1850; *Wright* of 1850; *Reverchon* 725): also specimens cultivated in Goebel's Garden in 1846; and in St. Louis in 1846, 1847, 1851.

The caespitose masses are often a foot broad.

39. *Cactus missouriensis robustior* (Engelm.).

Mamillaria similis robustior Engelm. Pl. Lindh. 200 (1850).

Mamillaria nuttallii robustior Engelm. and Bigel. Pacif. R. Rep. iv. 28 (1856).

Mamillaria missouriensis robustior Watson, Bibl. Index, 410 (1878).

Almost simple, with longer and looser tubercles, 10 to 12 stouter radial spines (6 to 16 mm. long), a single stout central, larger flowers, and 7 or 8 stigmas—Type, Lindheimer of 1845 in Herb. Mo. Bot. Gard.

From southeastern Colorado and the Canadian River (Oklahoma and Indian Territory), to the Colorado River of Texas.

Specimens examined: TEXAS (*Lindheimer* of 1845, 1846; *Bigelow* of 1853): also specimens cultivated in St. Louis in 1847.

In Bigelow's specimens the central spine is mostly lacking.

40. *Cactus scheerii* (Muhlenpf.) Kuntze, Rev. Gen. Pl. 261 (1891).

Mamillaria scheerii Muhlenpf. Allg. Gart. Zeit. xv. 97 (1847).

Mamillaria scheerii valida Engelm. Syn. Cact. 265 (1856).

Ovate-globose, 7.5 to 17.5 cm. high, 7.5 to 12.5 cm. in diameter, simple or sparingly proliferous at base: tubercles large (2.5 to 3.5 cm. long), from a broad base and suddenly contracted and almost cylindrical (10 to 14 mm. in diameter), deeply grooved (1 to 5 orbicular glands in the groove), distant, spreading and ascending, the lower ones shorter, more conical and somewhat imbricated, with broad axils and the younger densely woolly: radial spines 6 to 16, straight or slightly curved, stout, rigid, bulbous at base, whitish or yellowish (sometimes reddish) with dark tip, the 2 to 5 lower and lateral ones stouter and compressed (18 to 30 mm. long), the 4 to 11 upper ones weaker and terete (10 to 20 mm. long); central spines 1 to 5, stout and angled, 20 to 36 mm. long,

mostly yellow (sometimes reddish), a single one very stout and porrect: flowers 5 cm. long, yellow (sometimes reddish tinged): fruit ovate or subglobose, green: seeds large (3 mm. long), flat and obovate, red.—Type unknown; that of the old var. *valida* is the Wright material in Herb. Mo. Bot. Gard.

Sandy ridges, southwestern Texas, from Eagle Pass and head of the Limpia to El Paso, and southward into Chihuahua, Coahuila, and San Luis Potosi; also southern Mexico (*vide* Hemsley). Fl. July.

Specimens examined: TEXAS (*Wright* 416, 478, of 1851, 1852; *Evans* of 1891): SAN LUIS POTOSI (*Eschanzier* of 1891).

The var. *valida* was described by Dr. Engelmann without having seen *C. scheerii*, the only knowledge of that species being obtained from the description of Prince Salm-Dyck in *Cact. Hort. Dyck.*, which seemed to indicate a smaller form, with fewer spines than the Texan form. However, when visiting the collections of Prince Salm-Dyck, Dr. Engelmann found original specimens of *C. scheerii* which were exactly his var. *valida*. So far as collections show the Texan form seems to be more robust than the Mexican, but the material is too scanty to justify such a generalization. Dr. Engelmann speaks of this species as "a stately plant, by far the largest of the northern *Mamillariae*." Its tubercles are bright green and in beautiful contrast with the showy yellow spines.

41. *Cactus robustispinus* (Schott) Kuntze, *Rev. Gen. Pl.* 261 (1891).

Mamillaria robustispina Schott in *Engelm. Syn. Cact.* 265 (1856).

A large stout plant, simple or cespitose: tubercles large, subterete, nearly 2.5 cm. long (and about the same distance from each other): radial spines 12 to 15, stout and rigid, 18 to 30 mm. long, the lower ones the stouter, more dusky, straight or often curved downwards, the upper straight and fascicled; the solitary central spine stout, compressed, curved downwards (occasionally an additional straighter upper one), not much longer than the radials, the base nearly 2 mm. wide; all the spines horny and black-tipped: flowers 3.5 to 5 cm. long, with very slender and constricted tube, saffron-yellow: fruit green: seeds large (3 to 3.2 mm. long and 2 mm. in diameter), obliquely obovate and curved, smooth and brownish. (*Ill. Cact. Mex. Bound.* t. 74, fig. 8, seeds)—Type, Schott specimens in Herb. Mo. Bot. Gard.

"On grassy prairies on the south side of the Babuquibari Mountains," Sonora. Fl. July.

Specimens examined: SONORA (*Schott* of 1853-4).

Dr. Engelmann remarks that the seeds of this species are larger than those of any other *Mamillaria* known to him.

42. *Cactus recurvatus* (Engelm.) Kuntze, *Rev. Gen. Pl.* 259 (1891).

Mamillaria recurvispina Engelm. *Syn. Cact.* 265 (1856), not Vries.

Mamillaria recurvata Engelm. *Trans. St. Louis Acad.* ii. 202 (1863).

Globose or depressed-globose, 7.5 to 20 cm. in diameter, simple: tubercles ovate, deeply grooved, crowded, somewhat imbricate, 10 to 12 mm. long: radial spines 12 to 20, bulbous at base, compressed, rigid, recurved or flexuous, 8 to 18 mm. long, whitish or horny, interwoven with adjacent clusters; central spine solitary (sometimes an additional

upper one), stouter and longer (12 to 20 mm.), dark, mostly strongly recurved and appressed (rarely straightish): flowers about 3.5 cm. long, yellow (brownish-tinged outside): fruit unknown.—Type, Schott specimens in Herb. Mo. Bot. Gard.

From Sonora to southern Mexico. Fl. June–August.

Specimens examined: SONORA (*Schott* of 1855).

43. *Cactus salm-dyckianus* (Scheer) Kuntze, Rev. Gen. Pl. 261 (1891).

Mamillaria salm-dyckiana Scheer in Salm, Cact. Hort. Dyck. 134 (1850).

Subglobose: tubercles very broad and retuse, almost 2-parted by the tomentose groove, with axillary floccose wool: radial spines 7 or 8, very rigid, widely radiant, somewhat curved, 3 to 3.5 cm. long, in older tubercles 3 to 6 additional slender and straight or twisted spines; the solitary central spine very stout, erect, almost 5 cm. long: flowers and fruit unknown.—Type: Scheer says that this plant, brought from Chihuahua by Potts, “unfortunately perished,” and the description was drawn from fragments, which in those days were not apt to be preserved.

Chihuahua.

Specimens examined: CHIHUAHUA (“Salm of 1857”).

The specimen referred to is in Herb. Mo. Bot. Gard., and reveals no additional characters; nor can the label be interpreted, except that it indicates that the specimen is from plants cultivated successfully in the gardens of Prince Salm-Dyck.

+ + *Flower and fruit remaining central in the very woolly vertex of the plant.*

↔ *Central spine solitary or wanting.*

44. *Cactus compactus* (Engelm.) Kuntze, Rev. Gen. Pl. 260 (1891).

Mamillaria compacta Engelm. Wislitz. Rep. 21 (1848).

Depressed-globose, 5 to 10 cm. in diameter, simple: tubercles short-conical, crowded, 8 mm. long: radial spines 13 to 16, rigid, recurved and appressed, interwoven with adjacent clusters, whitish or horny, 10 to 20 mm. long; the erect central spine often wanting: flowers 3 to 3.5 cm. long and broad, yellow (brownish without): fruit oval, green: seeds 1.4 mm. long, smooth and yellow. (*Ill. Cact. Mex. Bound. t. 74. fig. 2, seeds*)—Type, Wislizenus of 1846 in Herb. Mo. Bot. Gard.

Mountains of Chihuahua. Fl. June–July.

Specimens examined: CHIHUAHUA (*Wislizenus* of 1846): also specimens cultivated in St. Louis in 1848, 1850, 1854.

45. *Cactus radians* (DC.) Kuntze, Rev. Gen. Pl. 261 (1891).

Mamillaria radians DC. Rev. Cact. 111 (1829).

Mamillaria pectinata Engelm. Syn. Cact. 266 (1856).

Globose, 3.5 to 7.5 cm. in diameter, simple: tubercles conical, from a 4-angled base, lower ones short (4 to 6 mm.), upper flower-bearing ones longer (10 to 12 mm.), terete and grooved: radial spines 16 to 24, somewhat recurved from a bulbous compressed base, stiff and pectinate, horny or whitish (at length ashy), interwoven with adjacent clusters, those on lower tubercles about equal (6 to 10 mm.), on flower-bearing

tubercles elongated, mixed with a few stouter ones and fasciculated (lower ones 10 to 12 mm. long, upper ones 12 to 18 mm. long and forming an apical tuft); centrals none: flowers over 5 cm. long and about 6 to 7.5 cm. in diameter when expanded, bright sulphur-yellow: fruit ovate and green, about 12 mm. long: seeds compressed, brownish, smooth and shining, 1.8 mm. long. (*Ill. Cact. Mex. Bound. t. 11*)—Type unknown; that of *M. pectinata* Engelm. is the Wright material in Herb. Mo. Bot. Gard.

Extending from the hills along the Lower Pecos to El Paso, southwestern Texas, southward through Coahuila and San Luis Potosi to southern Mexico.

Specimens examined: TEXAS (*Wright* 226 of 1849, also of 1852; *Evans* of 1891): COAHUILA (*Palmer* of 1880; *Mrs. Nickels*): SAN LUIS POTOSI (*Parry & Palmer* 265; *Eschanzier* of 1891): also specimens cultivated in St. Louis in 1853; in Mo. Bot. Gard. in 1892; and in Harv. Bot. Gard.

Even in the absence of the type I have ventured to refer *Mamillaria pectinata* Engelm. to this species. Dr. Engelmann had concluded that the two were "not sufficiently distinct," and the examination of Mexican forms which pass as *C. radians* abundantly confirms this conclusion. Besides, every character in the original description of *C. radians* applies exactly to these Mexican plants and to our Texan specimens as well. Aside from the fact that the Mexican specimens are apt to be more robust, I can discover no difference whatever. For discussion of relationships see under *C. scolymoides*.

46. *Cactus radians pectenoides*, var. nov.

Differs in its cespitose habit, fewer (16 or 17) and stouter spines (8 to 9 mm. long), and its larger and longer (10 mm.) less deeply grooved tubercles.—Type in Herb. Coulter.

San Luis Potosi.

Specimens examined: SAN LUIS POTOSI (*Eschanzier* of 1891).

47. *Cactus corniferus* (DC.) Kuntze, Rev. Gen. Pl. 260 (1891).

Mamillaria cornifera DC. Rev. Cact. 111 (1829).

Mamillaria impericomma Lem. Hort. Monov. Cult. 5 (1839).

Mamillaria cornifera impericomma Salm. Cact. Hort. Dyck. 20 (1850).

Globose, 7.5 cm. in diameter, simple: tubercles oblong-ovate, 2 cm. long, crowded, the younger axils woolly: radial spines 15 to 26, rigid and horny, curved or sometimes straight, reflexed, bulbous at base, yellowish (whiter with age) and with dark tips, very sharp, 10 to 12 mm. long; the central one much stouter, darker, slightly deflexed, 12 to 16 mm. long, sometimes wanting: flower unknown: fruit obovate, red, 2 cm. long: seeds reddish, angular, smooth, 2 mm. long.—Type unknown.

From San Luis Potosi to southern Mexico.

Specimens examined: SAN LUIS POTOSI (*Parry* of 1879; *Eschanzier* of 1891): also specimens cultivated in Mo. Bot. Gard. in 1892; growing in same garden in 1893.

Mamillaria impericomma Lem., afterwards reduced to a variety, was based upon fewer radial spines and no central. As the central is occasionally wanting in connection

with the most numerous radials, and present with the fewest, such a form would have to be separated solely on the absence of the central spine, and even in the original description of *impericoma* the central spine is only said to be "sometimes wanting." It has been impossible for me to separate the forms. It should be said that the fruit and seed characters given above were taken from a specimen whose few radials and no centrals would undoubtedly refer it to *impericoma*. As yet we are ignorant of the flower of *C. corniferus*. For discussion of relationships see under *C. scolymoides*.

++ ++ Central spines 1 to 4.

48. *Cactus scolymoides* (Scheidw.) Kuntze, Rev. Gen. Pl. 261 (1891).

Mamillaria scolymoides Scheidw. Allg. Gart. Zeit. ix. 44 (1841).

Globose or ovate, 5 to 7.5 cm. high, subsimple: tubercles conical, 10 to 16 mm. long, the upper elongated, incurved and imbricate: radial spines 14 to 20, straight or often recurved, white or horny, 10 to 20 mm. long (the upper the longer); central spines 1 to 4, longer (18 to 32 mm.), more dusky, curved, the upper ones turned upwards and intermixed with the radials, the lower one stouter, longer, and curved downwards: flowers 5 cm. long: fruit unknown.—Type unknown.

From the Pecos River, western Texas, westward into southern New Mexico, and southward into Chihuahua and San Luis Potosi.

Specimens examined: TEXAS (*Hays* of 1858): NEW MEXICO (*Bigelow* of 1853): CHIHUAHUA (*Wislizenus* of 1846): also specimens cultivated in St. Louis in 1858.

Specimens collected by Mrs. Anna B. Nickels across the Rio Grande from Laredo, Texas, and showing neither flower nor fruit, seem to intergrade between *C. scolymoides* and *C. scolymoides sulcatus*. The habit is that of the former, the tubercles are those of the latter, while the spines are somewhat different from either. The number of central spines in these specimens is very hard to determine, as on the adult tubercle they all assume a radial position. The usual adult arrangement is an apparent absence of central spines; 10 to 12 rigid, spreading and more or less recurved radials (increasing in length from the lowest), which are mostly white or the upper more or less dusky; and above, just behind the radial row, 2 or 3 stout recurved-ascending spines, which are white with tips more or less reddish-black, one of the spines usually much stouter and longer than the others. This form may represent a distinct species, but it seems very unsafe to add species to the *C. scolymoides* group without the fullest information.

Prince Salm-Dyck refers *C. scolymoides* to "*M. daimonoceras* Lem. Cact. gen. nov., p. 5," but no mention of such a name can be found in the work referred to. Labouret refers *C. corniferus* to the same name and reference. If "*M. daimonoceras*" was anything more than a garden or herbarium name used by Lemaire I have been unable to find it, and Dr. Engelmann's notes indicate that his search met with the same result. It is possible that the name was applied loosely to this assemblage of closely related forms that seem to cluster about *C. corniferus*.

A most perplexing question of relationship is presented by the forms that have been called *pectinatus*, *scolymoides*, *sulcatus* (*calcaratus*), *Echinus*, and the Mexican forms *radians*, *impericomus*, and *corniferus*. It may be that they are all merely varieties of one strong polymorphic type, but our knowledge of *corniferus* is so incomplete, and material of other forms is so scanty, that I can not venture to make such an assertion. However, it seems probable that *radians*, *pectinatus*, *scolymoides*, *sulcatus*, and *Echinus* all have green fruit, while in *impericomus* and *corniferus* it is red. It has also seemed proper to merge *radians* and *pectinatus*, also *impericomus* and *corniferus*, and to refer *sulcatus* to *scolymoides* as a variety. These seven forms are thus reduced at least to four species.

49. *Cactus scolymoides sulcatus* (Engelm.).

Mamillaria sulcata Engelm. Pl. Lindh. 246 (1845), not Pfeiff. (1848).

Mamillaria strobiliformis Muhlenpf. Allg. Gart. Zeit. xvi. 19 (1848), not Scheer (1850).

Mamillaria calcarata Engelm. Pl. Lindh. 195 (1850).

Cactus calcaratus Kuntze, Rev. Gen. Pl. 259 (1891).

Differs in its smaller size, proliferous and much more cespitose habit, the dilated base of the more spreading tubercles, fewer (8 to 12) radial spines, usually a single central spine (wanting in young plants) and somewhat larger flowers. (*Ill. Cact. Mex. Bound. t. 74. fig. 1, seeds*) Type, Lindheimer of 1844 in Herb. Mo. Bot. Gard.

Texas, from the Brazos to the Nueces.

Specimens examined: TEXAS (*Lindheimer* of 1844; *Fendler* 34; *Wright* of 1850, 1854, 1857): also specimens cultivated in St. Louis in 1845, 1848, 1853, 1859.

This seems to represent the northeastern extension of the species, and doubtless it will be found merging into it south and west of the Nueces. Curiously enough, one of the prominent distinctions originally given was the single central spine, while in the type specimen there occur tubercles with more than one central.

50. *Cactus echinus* (Engelm.) Kuntze, Rev. Gen. Pl. 260 (1891).

Mamillaria echinus Engelm. Syn. Cact. 267 (1856).

Globose or subconical, 3.5 to 6.5 cm. in diameter, simple: tubercles terete, conical, grooved above, 10 to 12 mm. long: radial spines 16 to 30, pectinate, straight or little curved, rigid and appressed (interwoven with neighboring clusters), ashy-white (often dusky at apex), 8 to 12 mm. long, the uppermost longer (12 to 20 mm.); central spines 3 or 4, the upper ones turned upward and intermixed with the radials, the lower one very stout, 15 mm. long, subulate from a very thick bulbous base, straight (rarely slightly curved) and porrect (deciduous in old specimens): flowers 3 to 5 cm. long: fruit oval, elongated, about 2 cm. long, green: seeds elongated-obovate, brown and smooth, about 1.8 mm. long. (*Ill. Cact. Mex. Bound. t. 10*)—Type, the Wright and Bigelow specimens in Herb. Mo. Bot. Gard.

On limestone hills, from the Pecos River, southwestern Texas, and southern New Mexico, westward to the Rio Grande (from Presidio del Norte northward). Fl. June.

Specimens examined: TEXAS (*Wright* of 1849, 1851, 1852; *Bigelow* of 1852; *Engelmann*, with no number or date; *Evans* of 1891).

The characteristic appearance of the plant is given by the very stout and straight central spine standing in each cluster perpendicular to the plant body. The range of this species, between the Pecos and the upper Rio Grande, suggests another separated group, such as is presented by *C. scolymoides sulcatus* to the east, between the Brazos and Nueces. Very frequently specimens of *C. echinus* occur in which some of the tubercles do not develop central spines, and then the spine characters resemble those of *C. radians*. In *C. radians*, also, an occasional porrect central spine is found. These intergrading forms I have only seen in Mexican material. For discussion of relationships see under *C. scolymoides*.

* * *Flowers red.*— *Central spine solitary or sometimes wanting.***51. *Cactus dasyacanthus* (Engelm.) Kuntze, Rev. Gen. Pl. 259 (1891).***Mamillaria dasyacantha* Engelm. Syn. Cact. 268 (1856).

Subglobose, 3.5 to 6.5 cm. high, simple: tubercles slender and terete, spreading, lightly grooved even to the base, 8 to 10 mm. long: radial spines 30 to 50, mostly in two series, straight and loosely spreading, the exterior ones (25 to 35) capillary and white, 6 to 18 mm. long, the interior ones (7 to 13) stiffer (setaceous), longer and darker and black-tipped; the central spine straight and porrect, 12 to 20 mm. long, often wanting: flowers small, red: fruit ovate, small (8 to 10 mm. long?): seeds globose-angled, almost black, pitted, 0.8 to 1.2 mm. long (*Ill. Cact. Mex. Bound. t. 12. figs. 17-22*)—Type, Wright 110 in Herb. Mo. Bot. Gard.

From Eagle Pass, Texas, westward to El Paso and southern New Mexico, and southward into Chihuahua.

Specimens examined: TEXAS (*Wright 110 of 1852*): NEW MEXICO (*Vasey of 1881; Mearns of 1892, in Big Hatchet Mountains*): CHIHUAHUA (*Pringle 251 of 1885, in part*).

Pringle 251 as distributed to Nat. Herb. is *C. tuberosus*.

52. *Cactus maculatus*, sp. nov.

Obovate-cylindrical, 6 by 8 cm., somewhat cespitose: tubercles ovate, terete, 10 mm. long, grooved to the base, with naked axils: radial spines 10 or 11, straight and spreading, rigid, blackish (becoming ashy with age), black-tipped, 12 mm. long; central spine large, more or less spotted, erect, 25 to 35 mm. long: flower 13 mm. long, pinkish: fruit unknown.—Type in Herb. Coulter.

San Luis Potosi.

Specimens examined: SAN LUIS POTOSI (*Eschancier of 1891*).

Somewhat resembles *C. tuberosus* in general appearance, but very different in spine characters.

53. *Cactus brunneus*, sp. nov.

Obovate-cylindrical, 3 by 6 cm., simple: tubercles ovate, grooved to the base, 5 to 6 mm. long, with woolly axils: radial spines 11 to 15, spreading, rather rigid and brownish (lighter with age), 8 to 10 mm. long; central spine much larger, 20 mm. long, hooked: flower and fruit unknown.—Type in Herb. Coulter.

San Luis Potosi.

Specimens examined: SAN LUIS POTOSI (*Eschancier of 1891*).

+ + *Central spines 3 to 12.***54. *Cactus conoideus* (DC.) Kuntze, Rev. Gen. Pl. 260 (1891).***Mamillaria conoidea* DC. Rev. Cact. 112 (1829).*Mamillaria strobiliformis* Engelm. Wislitz. Rep. 113 (1848), not Scheer (1850).

Ovate-conical, 3.5 to 10 cm. high, 4 to 7 cm. in diameter below, with densely woolly vertex, simple: tubercles conical, about 12 mm. long,

closely appressed-imbricate ("giving the plant the appearance of a pineapple or cone"): radial spines 10 to 16, ashy to white, straight and stout, 6 to 10 mm. long, the upper longer (10 to 15 mm.); central spines 3 to 5, stouter, brownish-black, 10 to 16 mm. long, the two or three smaller ones erect-spreading, the single lower one more rigid, porrect or deflexed, 15 to 20 mm. long: flowers 2 to 3 cm. long and wide, deep purple: fruit unknown. (*Ill. DC. Mem. Cact. t. 2*)—Type unknown.

On rocks, Coahuila and Nuevo Leon to San Luis Potosi and southern Mexico.

Specimens examined: COAHUILA (*Palmer 378* of 1882; *Pringle 3117* of 1890): NUEVO LEON (*Wislizenus* of 1847): SAN LUIS POTOSI (*Poselger* of 1851; *Eschanzier* of 1891).

55. *Cactus potsii* (Scheer) Kuntze, *Rev. Gen. Pl.* 261 (1891).

Mamillaria potsii Scheer in *Salm Cact. Hort. Dyck.* 104 (1850).

Cylindrical, 30 to 35 cm. high, 2.5 to 3 cm. in diameter, somewhat branching: tubercles ovate, obtuse, very lightly sulcate, with somewhat woolly axils: radial spines very numerous (entirely covering the whole plant), slender and white; central spines 6 to 12, stouter from a broad base: flowers large, green, or reddish: fruit red—Type unknown.

From the Rio Grande region, near Laredo, Texas, to Chihuahua.

Specimens examined: TEXAS (*Poselger* of 1851): CHIHUAHUA (specimens from Coll. Salm-Dyck.).

56. *Cactus tuberculatus* (Engelm.) Kuntze, *Rev. Gen. Pl.* 261 (1891).

Mamillaria strobiliformis Scheer in *Salm Cact. Hort. Dyck.* 104 (1850), not Muhlenpf. (1848), nor Engelm. (1848).

Mamillaria tuberculosa Engelm. *Syn. Cact.* 268 (1856).

Ovate to cylindrical, 5 to 15 cm. high, 2.5 to 5 cm. in diameter, simple or branching at base: tubercles short-ovate from a broad base, 5 to 6 mm. long, deeply grooved, crowded and imbricate, at length covering the older parts as naked and gray corky protuberances: radial spines 20 to 30, slender but stiff, white, radiant and interwoven with adjacent clusters, 4 to 8 mm. long (uppermost rarely 10 to 12 mm.); central spines 5 to 9, stouter, purplish above, the upper ones longer, erect, 10 to 14 mm. long (sometimes even 16 to 18 mm.), the lower one shorter (6 to 8 mm.), stout, porrect or deflexed: flowers about 2.5 cm. in diameter, pale purple: fruit oval, elongated (sometimes almost cylindrical), red, about 18 mm. long: seeds subglobose, brown and pitted, very small (0.8 to 1.2 mm. long). (*Ill. Cact. Mex. Bound. t. 12. figs. 1-16*)—Type of Scheer's *strobiliformis* is unknown; but the specimens of Prince Salm-Dyck in *Herb. Mo. Bot. Gard.* are marked "authentic" by Dr. Engelmann. The Wright specimens in the same *Herb.* represent the type of *M. tuberculosa* Engelm.

From the mountains of extreme southwestern Texas (common west of Devil's River), southward into Chihuahua and Coahuila. Fl. May-June.

Specimens examined: TEXAS (*Wright* 18, 19, 20, 23, 24, 29, 30, 31, 32, 535, of 1849 and 1852; *Bigelow* of 1852; *Engelmann*, with no number or date; *Evans* of 1891): CHIHUAHUA (*Pringle* 250, 251 in part, and 258 of 1885): COAHUILA (*Palmer* of 1880): also specimens from Coll. Salm-Dyck in 1857; also growing in Mo. Bot. Gard. 1893 (specimens sent by *G. G. Briggs* in 1892 from El Paso, Texas).

The identification of Engelmann's *tuberculosa* with Scheer's *strobiliformis* was made by Dr. Engelmann himself upon an examination of Scheer's type. The use of the specific name *tuberculosa* is necessitated by the law of homonyms, as *strobiliformis* had been used twice already before it was taken up by Scheer. *M. strobiliformis* Muhlenpf. is *C. scolymoides sulcatus*; and *M. strobiliformis* Englem. is *C. conoides*.

57. *Cactus viviparus* Nutt. in Fraser's Cat. (1813).

Mamillaria vivipara Haw. Syn. Succ. Suppl. 72 (1819).

Low and depressed-globose, usually proliferous and cespitose (forming large masses), but sometimes simple: tubercles terete and loose, lightly grooved: radial spines 12 to 20, stiff and white, often dark-tipped, 6 to 8 mm. long; central spines usually 4 (sometimes less, often more, even as many as 8), brownish, 8 to 12 mm. long, 3 spreading upwards, the lowest stouter and shorter and deflexed: flowers about 3.5 cm. long (large for the size of the plant) and even broader when expanded, bright purple: stigmas pointed with a short mucro: fruit oval, pale green, juicy, 12 to 18 mm. long: seeds yellowish-brown, obliquely obovate and curved about the small hilum, 1.4 to 1.6 mm. long). (*Ill. Cact. Mex. Bound. t. 74. fig. 3, seeds*)—Type unknown.

On the northwestern plains, from the boundary provinces of British America (western Manitoba, Assiniboia and Alberta), and throughout the Upper Missouri region, southward through western Nebraska to western Kansas and to the eastern foothills of central Colorado. It is also mentioned by Howell (Cat. of Oregon, Washington and Idaho plants), as occurring beyond the Rocky Mountain divide in Idaho and Washington, which is probable, but no specimens have been seen.

Specimens examined: MONTANA (*Hayden*, nos. 1854, 1855; *Vernon Bailey* of 1890, near Bridger): COLORADO (*Hayden* of 1869): NEBRASKA (*Rydberg* 1379 of 1893, Thomas Co.): also specimens cultivated in St. Louis in 1869; also growing in Mo. Bot. Gard. 1893.

It seems best to keep this northwestern form specifically separate from that large assemblage of southern forms that have been commonly referred to it. The forms referred to this species from western Kansas (Smyth's check list) have not been examined, and they may represent intermediate forms, inclining to simple habit and ovate form, as in the Colorado forms. The southern type (*C. radiosus*) is distinguished from *C. viviparus* not only by its very different range, but also by its ovate to cylindrical form, simple habit, more numerous (12 to 40) and longer (6 to 22 mm.) radial spines, usually more numerous (3 to 14) central spines in which the upper are more robust than the lower, porrect lower central, obtuse stigmas, and brown obovate straight seeds.

58. Cactus radiosus (Engelm.).*Mamillaria vivipara* Engelm. Pl. Fendl. 49 (1849), not Haw. : 1819).*Mamillaria radiosa* Engelm. Pl. Lindh. 196 (1850).*Mamillaria vivipara radiosa texana* Engelm. Syn. Cact. 269 (1856).

Ovate or cylindrical, 5 to 12.5 cm. high and about 5 cm. in diameter, simple or sparingly proliferous: tubercles terete, more or less grooved above, 8 to 12 mm. long: radial spines 20 to 30, straight, slender, white with dusky apex, very unequal, 6 to 8 mm. long; central spines 4 or 5, stouter, yellowish or tawny, 8 to 12 mm. long, the upper ones the longer and more robust, the lowest one shorter and porrect: flowers 3.5 to 5.5 cm. long, about the same diameter when fully open, violet to dark purple: stigmas 7 to 9, obtuse: fruit oval and green: seeds yellowish or brown, obovate, pitted, fully 2 mm. long. (*Ill. Cact. Mex. Bound. t. 74. fig. 5, seeds*)—Type, Lindheimer of 1846 in Herb. Mo. Bot. Gard.

Extending across southern Texas, from the Guadalupe to El Paso, thence into contiguous New Mexico and across the Rio Grande near Juarez (northern Chihuahua). Fl. May–June.

Specimens examined: TEXAS (*Lindheimer* of 1846): NEW MEXICO (*Bigelow* of 1855): CHIHUAHUA, near Juarez (*Evans* of 1891): also specimens cultivated from the type in St. Louis in 1846.

Attention has been called under *C. viviparus* to the characters that distinguish it from *C. radiosus*. The characters there given for the latter species apply to the whole group of included forms. The type of the species is the var. *Texana* of Engelmann's Syn. Cact. and Mex. Bound., which is characterized in the above description.

59. Cactus radiosus neo-mexicanus (Engelm.).*Mamillaria vivipara radiosa neo-mexicana* Engelm. Syn. Cact. 269 (1856).

Generally lower (3.5 to 10 cm.) and subglobose to ovate or even sub-cylindrical, branching at base or simple, with more numerous (12 to 40) radial spines, more numerous (3 to 12) and purplish centrals, and smaller seeds. (*Ill. Cact. Mex. Bound. t. 74. fig. 4, seeds*)—Type, presumably the Wright, Bigelow, and Schott specimens from western Texas, New Mexico, and Sonora, all in Herb. Mo. Bot. Gard.

From southern Utah, central Colorado, and western Kansas, southward through western Texas, New Mexico and Arizona into Chihuahua and Sonora.

Specimens examined: KANSAS (*Carleton* 530 of 1891, in Meade County): OKLAHOMA (*Carleton* 233 of 1891): COLORADO (*Hall and Harbour* of 1862; *Brandege* 645 of 1873; *Hicks* of 1890): UTAH (*Siler* of 1870): NEW MEXICO (*Wislizenus* of 1846; *Fendler* 244, 271, of 1847; *Wright* 298; *Bigelow* of 1853; *G. R. Vasey* of 1881): TEXAS (*Wright* of 1849, 1851, 1852; *Bigelow* of 1853): ARIZONA (*Rothrock*, with no number or date): SONORA (*Schott* of 1855): CHIHUAHUA (*Evans* of 1891, near Juarez).

It is through this variety that *C. radiosus* approaches most nearly to *C. viviparus*, in the forms with few radials and centrals, but the specific characters seem to hold. This is the *Mamillaria vivipara* of the Syn. Fl. Colorado (Porter and Coulter).

60. *Cactus radiosus arizonicus* (Engelm.).*Mamillaria arizonica* Engelm. Bot. Calif. i. 244 (1876).

A robust globose or ovate simple form (7.5 to 10 cm. in diameter), with long (12 to 25 mm.) deeply-grooved tubercles, 15 to 20 long (10 to 30 mm.) rigid whitish radial spines, and 3 to 6 centrals deep brown above.—Type, the specimens of Cous, Palmer, Bischoff, and Johnson, all in Herb. Mo. Bot. Gard.

Sandy and rocky soil from southern Utah through northern and western Arizona to southern California.

Specimens examined: ARIZONA (*Cous* of 1865; *Cous & Palmer* of 1865 and 1872; *Palmer* of 1869; *Bischoff* of 1871; *Miller* of 1881; *Rushby* 617 of 1883; *Pringle* of 1884): UTAH (*Johnson* of 1871, 1872, 1874; *Parry* of 1875, 1877): CALIFORNIA (*Parish* of 1880): also specimens cultivated in Mo. Bot. Gard. in 1881; and in Meehan's Gard. in 1882.

61. *Cactus radiosus deserti* (Engelm.).*Mamillaria deserti* Engelm. Bot. Calif. ii. 449 (1880).

Subglobose or oval (5 to 10 cm. high) and simple, with deeply grooved tubercles (slender and about 12 mm. long), 25 to 30 rather long (10 to 16 mm.) grayish white radial spines (the larger with reddish tips), 3 or 4 shorter and stouter centrals with 5 or 6 intermediate ones above, small (2.5 cm. long) straw-colored flowers (becoming purplish-tipped), 5 or 6 stigmas, and obliquely obovate curved seeds.—Type, *Parish* 453 in Herb. Mo. Bot. Gard.

In the mountains bordering the deserts of southeastern California (San Bernardino County) and extending to central Nevada (Reese River Valley).

Specimens examined: CALIFORNIA (*Parish* 453 of 1880, also of 1882; *Bailey* of 1890): NEVADA, Lincoln County (*Coville & Funston* of 1891, Death Valley Expedition): also specimens cultivated in Meehan's Gard. in 1882.

The smaller straw-colored flowers alone suggest the propriety of keeping this form specifically distinct, but even in size and color there is an occasional tendency toward the specific character. The obliquely obovate curved seeds resemble those of *C. viviparus*. The plant densely covered with stout ashy-gray interlocking spines is easily recognized.

62. *Cactus radiosus chloranthus* (Engelm.).*Mamillaria chlorantha* Engelm. Wheeler's Rep. 127 (1878).

Oval to cylindrical (7.5 cm. in diameter, sometimes 20 to 22.5 cm. high), with 20 to 25 gray radial spines almost in two series, 6 to 9 stouter reddish or brownish-tipped centrals (12 to 25 mm. long), and yellowish or greenish-yellow flowers 3.5 cm. long and wide.—Type: Southern Utah specimens of both *Parry* and *Johnson* occur in Herb. Mo. Bot. Gard., but they are all referred to *C. radiosus arizonicus*, and I can find no trace of any specimens of *C. radiosus chloranthus* in the Engelmann collection.

Southern Utah, east of St. George (*Parry; Johnson*).

The plant is evidently near *C. radiosus deserti*, of which variety it seems to be the Utah representative, but in the absence not only of the type, but even of authentic specimens, the two are kept separate, a thing fully justified by the description.

63. *Cactus radiosus alversoni*, var. nov.

Differs from var. *deserti* in its more robust and branching habit (becoming 12.5 cm. tall and 10 cm. in diameter), shorter and thicker tubercles, more numerous (12 to 14 centrals) stouter and longer (12 to 22 mm.) spines, all of which are black-tipped (the centrals black half way down, shading into red), and pink flowers.—Type, Alverson's specimens in Herb. Mo. Bot. Gard. and in Herb. Coulter.

In the desert region of extreme southeastern California.

Specimens examined: SOUTHERN CALIFORNIA (*A. H. Alverson* of 1892): also growing in Mo. Bot. Gard. 1893.

The covering of stout bushy interlocking spines is like that of var. *deserti*, but the black and reddish coloration gives a decidedly different appearance. On account of this appearance of a reddish-black brush the plant has been popularly called "fox-tail cactus." The decidedly pink flowers were sent by Mr. S. B. Parish from specimens growing in cultivation in San Diego, and are not from the original collection of Mr. Alverson.

64. *Cactus macromeris* (Engelm.) Kuntze, Rev. Gen. Pl. 260 (1891).

Mamillaria macromeris Engelm. Wisliz. Rep. 13 (1848).

Mamillaria heteromorpha Scheer in Salm. Cact. Hort. Dyck. 128 (1850).

Mamillaria dactylithele Labouret, Monogr. Cact. 146 (1858).

Ovate or cylindrical, 5 to 10 cm. high, simple or branching from the base and at length cespitose: tubercles large, loose and spreading, from a dilated base, more or less elongated (12 to 30 mm.) and teretish (often incurved), the groove absent in young plants and never reaching the axil: radial spines 10 to 17, slender and terete, or stouter and often angled, spreading, 12 to 40 mm. long, whitish (or more or less rose-colored when young), straight or a little curved; central spines 4 (or fewer in young plants or even wanting), spreading, 25 to 55 mm. long, stouter, bulbous at base, mostly black (the lowest the longest and stoutest), straight or sometimes curved or twisted: flowers 6 to 7.5 cm. long and of same diameter, deep red to purple: fruit ovate-subglobose, green, 15 to 25 mm. long: seeds globose-obovate, yellow, and smooth, 1.2 to 1.6 mm. long. (*Ill. Cact. Mex. Bound. t. 14 and 15*)—Type, Wislizenus of 1846 in Herb. Mo. Bot. Gard.

Mostly in loose sand, in the valley of the Rio Grande (on both sides of the river), from southern New Mexico to Eagle Pass, Texas, and doubtless further down.

Specimens examined: NEW MEXICO (*Wislizenus* of 1846; *Wright* 384, 531, of 1852; *G. R. Vasey* of 1881): TEXAS (*Wright* of 1850, 1851, 1852; *Bigelow* of 1852): CHIHUAHUA (*Evans* of 1891; *Budd* of 1891): also growing in Mo. Bot. Gard. 1893.

This species shows an interesting transition from CORYPHANTHA to *Echinocactus*. The woolly groove of the Coryphanths extends from the spine-bearing areola to the axil of the tubercle, where it expands into the flower-bearing areola. In *C. macro-*

meris the groove extends only about half way down the tubercle and gives origin to the flower-bearing areola on the side of the tubercle; while in *Echinocactus* the flower-bearing areola becomes adjacent to the spine-bearing areola and the flower appears at the summit of the tubercle.

ARTIFICIAL KEY TO THE SPECIES.

It seems impossible to make a simple artificial key that will serve as a useful guide to each individual species and variety. Our knowledge of so many of the species is imperfect, that no set of characters can be applied throughout. However, as no plants are collected in such fragmentary condition, it will be useful to construct a key based upon such characters as are always likely to be present, even if specific distinctions are not always reached. In many cases, species are so closely and differently related to each other that the complete descriptions will have to be consulted to determine the differences, and in such cases the artificial key can only indicate the group. Even the full descriptions are very compact, all characters not necessary for discrimination having been eliminated. No attempt need be made to determine any species by means of the flowers alone. In most cases more or less of the plant body will be available, presenting spine and tubercle characters, and these are used in the following key. The distinction between *Eumamillaria* and *Coryphantha*, on the basis of grooveless and grooved tubercles should always be made out easily. It may be useful to suggest as a caution, however, that often tubercles in drying develop folds which simulate grooves, and especially is this true in quadrangular tubercles. In such cases it is necessary to restore the original plumpness of the tubercle by boiling, before the presence or absence of the groove can be definitely determined. The species and varieties are indicated only by their specific or varietal names in the following key, and the numbers refer to the serial numbers of the synoptical presentation. Forms occurring within the United States are italicized:

1. *Tubercles never grooved.*

**Central spines none.*

Radials 5 to 9, stout.

meiacanthus (7).

Radials 20 to 40.

micromeris (12), *greggii* (13).

Radials 40 to 80.

lasiacanthus (10), *denudatus* (11).

***Central spine solitary and not hooked.*

← *Central spine longer than the radials*

Radials 7 or 8: tubercles very long (40 to 50 mm.).

longimamma (36).

Radials 15 to 20: tubercles 6 to 8 mm. long.

eschanzieri (21).

← ← *Central spine shorter than the radials.*

Radials 5 to 9, stout.

meiacanthus (7).

Radials 9 to 22.

heyderi (5), *hemisphaericus* (6), *gummiferus* (8), *gabbii* (34), *sphaericus* (35).

*** *Central spine solitary and hooked.*

← *Stems slender cylindrical: Lower Californian.*

Centrals 1, 20 to 30 mm. long.

roseanus (23).

Centrals 1 to 4, 20 to 50 mm. long.

setispinus (24).

← ← *Stems depressed-globose to ovate.*

Radials 4 to 6, rigid.

uncinatus (9).

Radials 8 to 12.

wrightii (15).

Radials 15 to 30.

grahami (19), *eschanzieri* (21).

Radials 50 to 60.

barbatus (18).

* * * * *Central spines more than one, and none of them hooked.*

← *Slender or sometimes stout cylindrical plants, branching at base: Lower Californian.*

brandegei (3), *setispinus* (24), *halei* (25).

← ← *Depressed-globose to ovate and stout cylindrical.*

← ← *Radials few (3 to 12) and rigid: Mexican.*

Radials 3: centrals 3.

alternatus (1).

Radials 7 or 8: tubercles 40 to 50 mm. long.

longimamma (36).

Radials 10 to 12: tubercles 12 to 15 mm. long.

gummiferus (8).

← ← ← *Radials numerous (16 to 60), capillary or bristle-like.*

Radials 15 to 30, slender but rigid (bristly).

acanthophlegmus (2), *densispinus* (4), *bispinus* (14), *rhodanthus* (26), *sulphureospinus* (27), *palmeri* (29), *pringlei* (32).

Radials 30 to 60 or more, mostly capillary.

tetrancistrus (22), *capillaris* (28), *texanus* (31), *sphaerotrichus* (33).

* * * * * *Central spines more than one and but one of them hooked.*

Radials 10 to 15.

goodrichii (16), *setispinus* (24).

Radials 15 to 30.

pondii (17), *grahami* (19), *bocasanus* (20).

Radials 30 to 60.

tetrancistrus (22).

* * * * * *Central spines more than one, and more than one of them hooked.*

Radials 8 to 12.

wrightii (15).

Radials 30 to 60.

tetrancistrus (22).

II. *Tubercles with a more or less prominent groove.*

* *Central spines none.*

← *Radials whitish and rigid, appressed (pectinate) and interwoven with adjacent clusters.*

Depressed-globose and simple.

compactus (44).

Globose and simple.

radians (45), *corniferus* (47).

Cespitose.

pectenoides (46), *sulcatus* (49).

← ← *Radials more slender and spreading.*

Radials 10 to 17.

missouriensis (37), *similis* (38), *macromeris* (64).

Radials 30 to 50, capillary.

dasyacanthus (51).

** *Central spine solitary, not hooked.*

← *Central spine porrect.*

Radials 6 to 17.

missouriensis (37), *robustior* (39), *schecit* (40).

Radials 30 to 50, white and capillary.

dasyacanthus (51).

← ← *Central spine curved downwards.*

Radials 8 to 12.

sulcatus (49).

Radials 12 to 26.

robustispinus (41), *recurvatus* (42), *corniferus* (47), *scolymoides* (48).

← ← ← *Central spine erect: Mexican.*

Radials 7 or 8: central 50 mm. long.

salm-dyckianus (43).

Radials 10 or 11: central 25 to 35 mm. long.

maculatus (52).

Radials 13 to 16.

compactus (44).

*** *Central spine solitary and hooked.*

brunneus (53).

* * * * Central spines more than one and none of them hooked.

Centrals 2: radials 6 to 20.

scheerii (40), *robustispinus* (41), *recurvatus* (42), *scolymoides* (48).

Centrals 3: radials 6 to 40.

scheerii (40), *scolymoides* (48), *echinus* (50), *conoidens* (54), *neo-mexicanus* (59), *arizonicus* (60).

Centrals 4 or 5: radials 6 to 40.

scheerii (40), *scolymoides* (48), *echinus* (50), *conoidens* (54), *tuberculosis* (56), *viviparus* (57), *radiosus* (58), *neo-mexicanus* (59), *arizonicus* (60), *macromeris* (64).

Centrals 6 or 7: radials 12 to 40.

potsii (55), *tuberculosis* (56), *viviparus* (57), *neo-mexicanus* (59), *arizonicus* (60), *chloranthus* (62).

Centrals 8 to 14: radials 12 to 40 or more.

potsii (55), *tuberculosis* (56), *viviparus* (57), *neo-mexicanus* (59), *deserti* (61), *chloranthus* (62), *alversoni* (63).

GEOGRAPHICAL DISTRIBUTION.

It is only possible to deal with the forms that occur within the borders of the United States, as even individual stations of common Mexican forms are little if at all known. These United States forms represent a northern extension of an abundant Mexican display. The group EUMAMILLARIA, containing twelve of the thirty-one forms defined as occurring north of the Rio Grande, makes the feeblest extension northward, at no place being found far from the boundary, and all the twelve are Mexican forms which extend but slightly into the United States. Only five of the forms are found east of the Pecos: *heyderi*, the most widely distributed EUMAMILLARIA, extending from the southeastern border of Texas westward along the whole Mexican boundary except in California; *hemisphaericus*, extending through southern Texas and southern New Mexico; *meiacanthus*, also along the Mexican border of Texas and New Mexico; *texanus*, a low ground form of the Rio Grande Valley, extending from the mouth of the river to El Paso, and suggesting a connection with the West Indian *stellatus*; and *sphaericus*, another low ground valley form of similar range, but apparently only extending up the Rio Grande to the region of Eagle Pass.

The Pecos forms the eastern boundary of five other EUMAMILLARIA forms: *micromeris*, extending northward from Coahuila and Chihuahua, apparently only in the mountains between the Pecos and El Paso; *wrightii*, of similar narrow northward extension, but ranging further northward on the high plains of the Upper Pecos in New Mexico; *denudatus*, also with a narrow northward extension west of the Pecos; *lasiacanthus*, extending from Chihuahua with a northern limit between the Pecos and Arizona; and *grahami*, a Sonoran type which has spread between the Pecos and southeastern California.

The ten preceding forms have evidently entered our borders from the highlands of Sonora and Chihuahua, with the exception of the Rio Grande Valley forms, *texanus* and *sphaericus*. Another species, *tetrancistrus*, is also a Sonoran type which has reached the eastern slopes of

the mountains of southeastern California, and extended through western Arizona to southern Nevada and southern Utah, the most extended northern range of any EUMAMILLARIA. The twelfth form, *goodrichii*, is Lower Californian, and extends into California only in San Diego County. A summarized statement of the distribution of our twelve EUMAMILLARIÆ would be that two of them have extended from the low grounds of Coahuila and Chihuahua and spread along the valley of the Rio Grande; nine have come from the high grounds of Chihuahua and Sonora, four of which have extended eastward to the low levels of southeastern Texas; four have kept to the highlands west of the Pecos, and one has kept to the Colorado Valley and its tributaries, while one has a short northern extension from Lower California.

The nineteen forms of CORYPHANTHA are decidedly more northern in their distribution, and are our characteristic representatives of the genus *Cactus*. Ten of these, however, are but northern extensions of Mexican forms, and six of the ten have simply that tongue-like northern extension in the mountains between the Pecos and the Upper Rio Grande (above El Paso), viz.: *dasyacanthus*, *tuberculosis*, *scheerii* (which has also spread somewhat east of the Pecos), and the three pectinate and closely related forms *radians*, *echinus*, and *scolymoides*. Of the four remaining Mexican forms, *macromeris* is a low ground Rio Grande Valley form, extending from above El Paso well towards the Lower Rio Grande; *potsii* just crosses the border in the neighborhood of Laredo; and *radiosus* and *neo-mexicanus* have by far the greatest northern extension, stretching from Sonora and Chihuahua to southern Utah and central Colorado, and eastward to the Guadalupe River of Texas.

The nine remaining coryphanths are distinctly forms of the United States, occupying two well-marked regions, viz.: the northern plains, and the desert region of western Arizona and adjacent California, Nevada, and Utah. In the former region is found the widespread *viviparus*, which extends from the southern borders of British America to the plains of eastern Colorado and western Kansas; and even crosses the Rocky Mountain divide into northern Idaho and northeastern Washington; and *missouriensis*, which also ranges from the high prairies of the Upper Missouri to the same southern limit, and is continued southward into Texas in its varieties *similis* and *robustior*.

In the Arizona desert region, four distinct but closely allied forms have become differentiated from the strong *radiosus* stock, viz.: *arizonicus*, *deserti*, *alversoni*, and *chloranthus*, all of which might be regarded as distinct species. In southeastern Texas is found an isolated form, *sulcatus*, occurring between the Brazos and Nueces rivers. That *viviparus* must be regarded as a strong northern extension of the *radiosus* stock can not be doubted, as the low depressed cespitose northern form seems to merge southward so gradually into the simple more robust ovate to cylindrical forms of *radiosus* as to suggest the propriety of regarding them all as specifically identical.

The result of a closer inspection of the distribution of these nearly related forms is worthy of note. *C. viviparus* extends from British America and the Upper Missouri to eastern Colorado and western Kansas; *neo-mexicanus* (the form most nearly related to *viviparus*) extends from central Colorado and southern Utah into Mexico; at the southeastern edge of this range begins *radiosus* and extends eastward through southern Texas; from the western edge of *neo-mexicanus* the form *arizonicus* extends westward into southern California, touching *chloranthus* at its Utah limit, and at its California extension reaching *alversoni* and *deserti*, the latter of which extends northward into the desert region of southeastern California and adjacent Nevada. Taking this type as of Mexican origin, it seems to have entered the United States from Sonora and Chihuahua, and to have spread in three directions, viz.: eastward through southern Texas; westward and northward into southern California and southern Utah; and northward to the head waters of the Missouri and British America, though we would limit the northern extension of the present specific type to central Colorado, and would regard the still more northern forms as of the same origin but entitled to specific rank.

2. ANHALONIUM Lem. Cact. Gen. Nov. (1839).

Depressed or flattened, simple, unarmed plants, covered with peculiar imbricated tubercles above and their scale-like remains below: tubercle with lower and upper parts very different; lower part comparatively thin and flat; upper exposed part triangular in outline and divergent, very thick and hard, the lower surface smooth and keeled, the upper surface plane or convex, smooth or tuberculate or variously fissured, with a broad wool-bearing groove or simply a more or less evident tomentulose apical areola: spine-bearing areolæ obsolete: flower-bearing areola at the summit of the lower peduncle-like portion of the very young tubercle (thus appearing axillary with reference to the exposed part of the tubercle) and bearing a dense penicellate tuft of long soft hairs which conceals the lower part of the flower and the entire fruit and persists about the apical region of the plant as matted and apparently axillary wool: ovary naked: seeds large, black, and tuberculate: embryo obovate, straight.

According to the present views concerning generic limitations in *Cactaceæ*, *Anhalonium* must certainly be kept distinct from *Mamillaria*, and to such a view Dr. Engelmann had finally come. The generic distinction is based upon such characters as (1) the complete suppression of the spine-bearing areolæ; (2) the strong differentiation of the tubercles into two very distinct regions; (3) the production of the flower at the apex of the basal or peduncle-like portion (which becomes flattened and expanded at maturity) of a very young tubercle; and (4) the large tuberculate seeds.

In the case of *engelmanni* the broad woolly groove of the upper portion of the tubercle expands below into the flower-bearing areola, but terminates blindly above just behind the sharp apex. In *prismaticum* and *furfuraceum* the groove is obliterated, but there usually remains a small (more or less tufted) areola and depression

just behind the apex to mark its upper extremity. This apical areola, therefore, does not represent a spine-bearing areola, but the closed upper extremity of a tubercle groove.

It seems evident that *Anhalonium* is a much modified *Cactus*, and that its affinity is with the coryphanths, through such a species as *C. macromeris*, in which the flower becomes extra-axillary. If in *macromeris*, with the flower standing well up on the tubercle, the portions of the tubercle above and below the flower should become very different from each other, the upper portion being so much modified as to cause the spine-bearing areola to be obliterated, the condition of things in *Anhalonium* would be obtained.

* Upper surface of tubercle with a broad and deep wool-bearing longitudinal groove which widens below.

1. *Anhalonium engelmanni* Lem. Cact. 42 (1839).

Mamillaria fissurata Engelm. Syn. Cact. 270 (1856).

Anhalonium fissuratum Engelm. Bot. Mex. Bound. 75 (1859).

Depressed-globose or flat, top-shaped below and tapering into a thick root, 5 to 12 cm. in diameter: tubercles (upper portion) appressed-imbricate, 12 to 18 mm. long and about as wide at base, the upper surface convex and variously fissured (presenting an irregular warty appearance) even to the edges: flowers apparently central, about 2.5 cm. long and broad, shading from whitish to rose: fruit oval, pale green, about 10 mm. long: seeds 1.6 mm. long. (*Ill. Bot. Mex. Bound. t. 16*)—Type unknown; but specimens of Wright, Bigelow, and Parry in Herb. Mo. Bot. Gard. are the basis of Engelmann's *Mamillaria fissurata*.

On limestone hills, in the "Great Bend" region of the Rio Grande in Texas, and southward into Coahuila. Fl. September–October.

Specimens examined: TEXAS (*Wright* of 1850; *Bigelow* of 1852; *Parry*, with no number or date; *Lloyd* of 1890; *Evans* of 1891; *Briggs* of 1892): also growing in Mo. Bot. Gard. 1893.

This species is very closely related to the Mexican *A. kotchubeyi* Lem. (*A. sulcatum* Salm-Dyck), but unfortunately no type of that species seems to be in existence, and Dr. Engelmann notes (Mex. Bound. Rep. 75) that "it seems no living or dead specimen is at present extant in Europe." Judging from the description, the upper surface of the tubercles in *A. kotchubeyi*, aside from the central furrow, is smooth; at least the margin is "very entire."

* * Upper surface of tubercle not grooved, but usually with a tomentose pulvillus at the tip.

2. *Anhalonium prismaticum* Lem. Cact. 1 (1839).

Mamillaria prismatica Lem. Hort. Univ. i. 231 (1839).

Cactus prismaticus Kuntze, Rev. Gen. Pl. 261 (1891).

Flat above, top-shaped below, 7.5 to 12.5 cm. in diameter: tubercles (upper portion) closely imbricate but squarrose-spreading, sharply triangular-pyramidal and very acute (with a sharp cartilaginous tip, which usually disappears with age and leaves the older tubercles blunt or retuse), 18 to 25 mm. long and about as wide at base, the upper surface almost plane and smooth, except that it is more or less

pulverulent and usually bears a small tomentose pulvillus (often evanescent later) just behind the claw-like tip: flowers rose-color: fruit elongated-oval and reddish. (*Ill. Lem. Cact. t. 1.*)—Type unknown.

Referred to Mexico in general, but reported definitely only from San Luis Potosi. Undoubtedly found in Coahuila, and possibly crosses the Rio Grande in the region of the "Great Bend."

Specimens examined: SAN LUIS POTOSI (*Eschanzier* of 1891): MEXICO in general (specimens from Coll. Salm-Dyck in 1858; *Schott* of 1858): also specimens cultivated in Mo. Bot. Gard. in 1881; also growing in same garden in 1893.

3. *Anhalonium furfuraceum* (Watson).

Mamillaria furfuracea Watson, Proc. Amer. Acad. xxv. 150 (1890).

Very closely related to *prismaticum*; but triangular portion of tubercle acuminate and shorter, having an irregularly mamillate upper surface, and the acumination ending abruptly in a cartilaginous depression containing a tomentose pulvillus: flowers 2.5 to 3 cm. long, white or pinkish, the sepals brownish.—Type, Pringle 2580 in Gray Herb.

At Carneros Pass, Coahuila.

Specimens examined: COAHUILA (*Pringle* 2580 of 1889).

The type of this species was not among the collections received from Cambridge, but a specimen of the same distribution from the National Herbarium shows tubercle dimensions different from those recorded in Dr. Watson's description. In that description the triangular terminal surface is said to be "about an inch broad by one-half inch," which is decidedly different from the equilateral surface of the tubercle of *prismaticum*. In the National Herbarium specimen of *furfuraceum*, however, of the same distribution, the surface is almost equilateral, measuring 15 mm. long by 18 mm. wide at base. Without the acuminate upper portion the breadth of the triangular portion would be about double its length. The lower rim of the cup-like depression which terminates the tubercle and contains the pulvillus is sometimes slightly prolonged into a tooth, which in *prismaticum* becomes the sharp tip of the tubercle. The "minutely furfuraceous-punctulate" character of the tubercle is common to all the species of *Anhalonium* I have seen, and simply represents the external openings of the remarkably long cuticular passageways to the stomata.

4. *Anhalonium pulvilligerum* Lem. Cact. (1839).

Anhalonium elongatum Salm-Dyck (1850).

This seems to be a third grooveless Mexican species. I have seen no specimens, but judge from the description that it differs from the two preceding species chiefly in its less crowded and more elongated tubercles (triangular portion 5 cm. long by 2.5 cm. broad at base), which are covered at apex with a tomentose pulvillus.

GEOGRAPHICAL DISTRIBUTION.

This curious genus is strictly Mexican, and, so far as at present recorded, is characteristic of Coahuila, but a single species (*engelmanni*) of the four or five known crossing the Rio Grande in the Great Bend.

3. LOPHOPHORA, gen. nov.

Depressed-globose, proliferous and cespitose, tuberculate-ribbed, unarmed plants: tubercles at first conical and bearing at summit a flower-bearing areola with a dense tuft or short pencil of compact erect hairs, when mature becoming broad and rounded (with the remnant of the penicellate tuft as a persistent pulvillus in a small central depression) and coalescing into broad convex vertical ribs: spine-bearing areolæ obsolete: flowers borne at the summit of nascent tubercles: ovary naked (that is free from scales, but often downy): fruit and seed unknown.

These forms have been variously referred to *Anhalonium* and *Echinocactus*, but seem to deserve generic distinction. They differ from *Anhalonium* in the entire suppression of the upper highly differentiated portion of the tubercle, in the broad and rounded development of the lower portion, and in the coalescence of the enlarged tubercles into broad vertical ribs. In fact, in young specimens, the plant appears almost smooth, with shallow furrows radiating from the depressed apex. The genus differs from *Echinocactus* in the suppression of the spine-bearing areolæ, and the naked ovary. In the examination of developing tubercles the relation to *Anhalonium* is evident. In the latter genus the young tubercle bears on the summit of its pedicel-like lower portion the tufted flower-bearing areola, the modified upper portion of the tubercle at that time appearing as a bract beneath the flower. In *Lophophora* there is the same condition of things, except that the bract-like upper portion is wanting. From this point of view it would appear that the differences between *Lophophora* and *Echinocactus* are intensified by the fact that the flower-bearing areola in the former genus is to be regarded as really lateral on a tubercle the upper part of which has disappeared. This genus occurs abundantly in southeastern Texas, extending southward into Mexico. Mrs. A. B. Nickels reports that the Indians use the plants in manufacturing an intoxicating drink, also for "breaking fevers," and that the tops cut off and dried are called "mescal buttons."

1. *Lophophora williamsii* (Lem.).

Echinocactus williamsii Lem. Allg. Gart. Zeit. XIII. 385 (1845).

Anhalonium williamsii Lem. in Forst. Handb. Cact. i. 233 (1846).

Hemispherical, from a very thick root, often densely proliferous, transversely lined below by the remains of withered tubercles: ribs usually 8 (in young specimens often 6), very broad, gradually merging above into the distinct nascent tubercles which are crowned with somewhat delicate pencillate tufts, which become rather inconspicuous pulvilli on the ribs: flowers small, whitish to rose: stigmas 4. (*Ill. Bot. Mag.* t. 4296)—Type unknown.

Along the Lower Rio Grande, Texas, and extending southward into San Luis Potosi and southern Mexico.

Specimens examined: TEXAS (*Mrs. Nickels* of 1892): SAN LUIS POTOSI (*Eschancier* of 1891): also growing in Mo. Bot. Gard. 1893.

2. *Lophophora williamsii lewinii* (Hennings).

Anhalonium lewinii Hennings, Gartenflora, 410 (1888).

A much more robust form, with more numerous (usually 13) and hence narrower and more sinuous ribs, and much more prominent tufts. (*Ill. Monats. Kakteenkunde*, October, 1891)—Type unknown.

Along both sides of the Lower Rio Grande.

Specimens examined: TEXAS (*Wm. Lloyd* of 1890, mouth of the Pecos; *Mrs. Nickels* of 1892, 1893): MEXICO (specimen collected across the Rio Grande, near Laredo, in 1894): also growing in Mo. Bot. Gard., 1893.

The extreme specific and varietal forms seem worthy of specific distinction, but abundant growing material in Mo. Bot. Gard. showed such complete intergradation that a specific line of separation was found to be impossible. The varietal form is said to be an important one in the ceremonial rites of the Indians.

GEOGRAPHICAL DISTRIBUTION.

These forms are evidently Mexican in origin, and the specimens seen are all from the Rio Grande region. They have crossed that river below the "Great Bend," and probably belong to lower-lying, more eastern Mexican provinces than do the species of *Anhalonium*. *L. williamsii* is reported from southern Mexico, but so little is known of the distribution of these plants that their eastern Mexican range is conjectural.