PRELIMINARY REVISION OF THE NORTH AMERICAN SPECIES OF ECHINOCACTUS, CEREUS, AND OPUNTIA.

PREFATORY NOTE.

This is the completion of the work on our North American Cactaceæ, which was begun by the preliminary revision of Cactus, Anhalonium, and Lophophora, published as Contributions from the U. S. National Herbarium, Vol. III, No. 2 (issued June 10, 1894). The occasion for such an undertaking and the opportunities for carrying it out were explained in the prefatory note to that paper. As the work progressed, however, it became more and more evident that the revision could consist only of the systematic collection of our present knowledge, based upon the study of the very inadequate material accessible in herbaria and gardens. The difficulties of the group, as regards types and nomenclature, were pointed out in the previous paper, and the undertaking would have been abandoned only that it seemed but proper to contribute to the knowledge of the group such facts as had come to light in the course of several years' study, especially as an excellent opportunity had been given to examine Dr. Engelmann's types and unpublished notes. It may be well to repeat the statement here that all known forms within the United States have been included, but only such Mexican and West Indian forms as could be personally examined. A maze of names and descriptions have been handed down in various writings, but it would be of no advantage to introduce them except as substantiated by specimens.

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4. ECHINOCACTUS Link & Otto, Verh. Preuss. Gartenb. Ver. 3, 420, t. 13 (1827).

Usually globose, but becoming oblong or even stout-cylindrical, mostly with spine-bearing ribs (sometimes represented only by vertical or spiral rows of tubercles): flower-bearing areolæ usually contiguous to the young spine-bearing areolæ and just above them, but sometimes further removed (connected with them by a short groove), and rarely even in the axil of a tubercle: ovary bearing scales which are naked or woolly in the axils: fruit succulent or dry: seeds often albuminous: embryo usually curved, with more or less foliaceous cotyledons.—*Astrophytum* Lem. (1839); *Gymnocalycium* Pfeiff. (1844); *Malacocarpus* Salm-Dyck (1850).

As the genera of *Cactaceæ* have no very definite boundaries it is to be expected that *Echinocactus* will be found merging into neighboring genera. The mamillate forms, such as *E. simpsoni*, are clearly intermediate between *Cactus* and *Echinocactus*, but are nearer the latter in what are considered the more essential characters; while the oval and cylindric forms look toward certain species of *Cereus*, though the general globose outline is well maintained. Inasmuch as the flowers are related to the nascent spiniferous areolæ the *Cactus* relationship is with the Coryphanths, among which, as has been pointed out, *Cactus macromeris* has its *Echinocactus* tendencies. The genus *Cereus* holds the same sort of relationship to the Eumamillarias, the flowers in both appearing in connection with the mature spiniferous areolæ. As shown recently by W. F. Ganong,[1] the so-called floriferous and spiniferous areolæ are simply more or less separated regions of a single pulvinus, which appears in its simple form in *Opuntia*. The same observer also calls attention to the occurrence of true but minute leaves in *Cactus*, *Echinocactus*, and *Cereus*, structures which are prominent in *Opuntia*, and have been taken to be a distinguishing mark of that genus.

* *Scales of the ovary subulate, copiously woolly in the axils: fruit dry and enveloped in wool: spines (wanting in No. 7) rigid and annulate, not hooked.*—ERIOCARPI.

– *Ribs 10 to 27, acute.*

1. Echinocactus polycephalus Engelm. & Bigel.; Engelm. Syn. Cact. 276 (1856).

Globose (15 to 25 cm. in diameter) to ovate (25 to 40 cm. high, 12.5 to 25 cm. in diameter) and cylindrical (reaching 60 to 70 cm. high and about 25 cm. in diameter), profusely branched at base: ribs 13 to 21 (occasionally 10): spines 8 to 15, very stout and compressed, more or less recurved and reddish; radials 4 to 11, comparatively slender (the

[1] Morphologie und Biologie der Cacteen.

uppermost most so), 2.5 to 5 cm. long; the 4 centrals much stouter and longer (3 to 9 cm.), very unequal, the uppermost one usually the broadest and curved upward, the lowest one usually the longest and decurved: flowers yellow: fruit globose, 16 to 20 mm. in diameter: seeds irregularly angulate and minutely tuberculate, 4 mm. long. (*Ill.* Pacif. R. Rep. iv, t. 3, figs. 4–6)—Type, Bigelow of 1854 in Herb. Mo. Bot. Gard.

Stony and gravelly ground of the desert valleys in the southern part of the Great Basin, from southern Utah and southern Nevada through Arizona to southeastern California and Sonora.

Specimens examined: UTAH (*Palmer* of 1877; *Johnson* of 1877; *Siler* of 1883): ARIZONA (*Palmer* of 1870; *Bischoff* of 1871; *Nealley* of 1891): CALIFORNIA (*Bigelow* of 1854; *Clayton* with no number or date; *Wright* of 1882; *Coville & Funston* 153, Death Valley Exped.).

The plants are simple only when young, forming at maturity bunches of 20 to 30 (or even more) cylindric heads. Dr. Merriam speaks of this species as "resembling loose clusters of cocoanuts," and as commonly called "nigger-head" in the desert region.

2. Echinocactus polycephalus xeranthemoides, var. nov.
Echinocactus xeranthemoides Engelm. MSS.

Globose and smaller (2.5 to 12.5 cm. high): ribs 13, sharp and interrupted: spines about 12 (10 to 15), straight or slightly curved; radials smaller (about 3 cm.); the 4 centrals 3 to 5 cm. long, the lowest broadest and porrect from the center of the areola.—Type, Siler of 1881 and 1883 in Herb. Mo. Bot. Gard.

Extreme southwestern Utah and western Arizona, on the Kanab plateau and southward in the region of the Colorado.

Specimens examined: UTAH (*Siler* of 1883, "Kanab Mts."): ARIZONA (*Siler* of 1881, near the Colorado "on the Kanab wash;" *Rusby* 619, of 1883, at Peach Springs; *Evans* of 1891, between Gila Bend and Yuma).

Dr. Engelmann, having only the Siler specimens, regarded this as probably a new species, which view extreme forms might justify. However, more material makes it evident that it can not be more than a variety of *polycephalus*. The two forms belong together in the desert region of the Colorado, and both have the same profusely branching habit. The variety is much the smaller form, with usually more numerous spines, which are distinguished by the very prominent broad and porrect lower central, but there are intergrading forms which obscure this distinction.

3. Echinocactus parryi Engelm. Syn. Cact. 276 (1856).

Globose or depressed, becoming 20 to 30 cm. high and 25 to 40 cm. in diameter, simple: ribs 13, tuberculate-interrupted: spines stout, more or less compressed, white; radials 8 to 11, straight or a little curved, upper slenderer, lowest wanting; the 4 centrals a little stouter and longer (3.5 to 5 cm.), lowest longest and decurved: fruit oblong. (*Ill.* Cact. Mex. Bound. t. 32, figs. 6, 7)—Type probably lost. Dr. Englemann had but a few bunches of spines, the rest of the description being made up from Dr. Parry's notes, but I have failed to find these bunches of spines in the Engelmann collection.

Desert region of Chihuahua, "southwest of El Paso toward Lake Guzman, over an area of 60 or 80 miles in extent."

The species is clearly very near *E. polycephalus*, but should be distinguished from it readily by its simple habit and white spines.

4. Echinocactus texensis Hopf. Allg. Gart. Zeit. x, 297 (1842).
Echinocactus lindheimeri Engelm. Pl. Lindh. 246 (1845).

Mostly depressed (sometimes globose), 20 to 30 cm. in diameter, 10 to 15 cm. high, simple: ribs mostly 21 (sometimes 27, and in smaller specimens 13 or 14) and undulate: spines stout and fasciculate, reddish, compressed; the exterior 6 or 7 radiant, straightish or curved, unequal, 12 to 20 mm. long in some cases, 30 to 50 mm. in others, much shorter than the solitary and stout recurved central, which is sometimes 4 to 6 mm. broad: flowers about 5 cm. long, particolored (scarlet and orange below to white above): fruit subglobose, scarlet, 16 to 18 mm. in diameter: seeds reniform and compressed, black, smooth, and shining (or minutely pitted), 2.4 to 2.8 mm. long. (*Ill.* Cact. Mex. Bound. t. 33, figs. 1–6)—Type, Lindheimer 44 in Herb. Mo. Bot. Gard.

Common from the Colorado River of Texas to the Rio Grande, extending as far west as the Pecos, and southward into the northeastern states of Mexico.

Specimens examined: TEXAS (*Lindheimer* 44, and of 1850; *Wright* of 1848 and 1849; *Bigelow* of 1853; *Hall* 234; *Nealley* of 1891, near Del Rio): TAMAULIPAS (*Berlandier* 1836): NUEVO LEON (*Wislizenus* of 1847): COAHUILA (*Gregg* of 1847): MEXICO in general (*Poselger* of 1850): also specimens cultivated in St. Louis in 1864.

According to Labouret, this is *E. courantii* Lemaire, but I have had no means of verifying the statement.

\+ + *Ribs 5 to 10, very broad and obtuse.*

5. Echinocactus horizonthalonius Lem. Cact. Gen. Nov. 19 (1839).
Echinocactus equitans Scheidw. Bull. Acad. Brux. vi, 88 (1839).
Echinocactus horizonthalonius centrispinus Engelm. Syn. Cact. 277 (1856).
Echinocactus laticostatus Engelm. & Bigel. Pacif. R. Rep. iv, 32 (1856).

Glaucous, depressed-globose or at length ovate or even cylindric with age, 4 to 20 cm. high, 6.5 to 15 cm. in diameter, simple: ribs 8 to 10 (fewer in very young specimens), often spirally arranged, the tubercles scarcely distinct by inconspicuous transverse grooves: spines 6 to 9, stout, compressed, reddish (at length ashy), recurved or sometimes almost straight, nearly equal, 2 to 4 cm. long (sometimes long and slender and almost terete, sometimes short, stout and broad); radials 5 to 8, upper ones weaker, lowest wanting; a single stouter decurved central (sometimes wanting): flowers pale-rose to purple, 6 cm. long or more: fruit red: seeds subglobose (usually looking shriveled and angular), rugose and minutely tuberculate, black, 2.5 to 3 mm. long. (*Ill.* Cact. Mex. Bound. t. 31 and 32, figs. 1–5)—Type unknown. The Wright and Wislizenus specimens in Herb. Mo. Bot. Gard. are types of *centrispinus* Engelm.

On stony ground, between the Pecos and Rio Grande in southwestern Texas and southern New Mexico, and extending southwest into Chihuahua, Coahuila, and San Luis Potosi.

Specimens examined: TEXAS (*Wright* of 1849, 1851, 1852; *Lemmon* of 1881; *G. R. Vasey* of 1881; *Evans* of 1891; *Nealley* of 1892): CHIHUAHUA (*Wislizenus* of 1846): COAHUILA (*Salm-Dyck* of 1857; *Palmer* 380, at Saltillo): SAN LUIS POTOSI (*Parry & Palmer* 272, of 1878.)

The distinction between *horizonthalonius* and *centrispinus* is an untenable one, being simply the presence or absence of the central spine. Dr. Engelmann had reached the same conclusion after examining a large amount of both living and dried material in European collections. I can not discover whether *horizonthalonius* of Lemaire or *equitans* of Scheidweiler has priority of publication. Both appeared in the same year, and hence I have retained the name in common use. Havard says that "this species, and perhaps others, under the name of 'bisagre' are sliced, candied in Mexican sugar, and kept in confectioneries."

6. **Echinocactus ingens** (Karw.) Zucc.; Pfeiff. Enum. 54 (1837).
Melocactus ingens Karw. ex Pfeiffer.
Echinocactus karwinskii Zucc. ex Labouret, not ex Pfeiffer.

Glaucescent, globose, or oblong, becoming 15 to 18 dm. high: ribs 8 (in small specimens, possibly more numerous in large ones), tuberculately interrupted and with broad sinuses: radial spines 8, reddish-brown, straight, rigid, and interwoven, 2.5 to 3.5 cm. long; central spine solitary and similar: flowers yellow, about 2.5 cm. long, and a little broader: fruit ovate, 3 cm. long: seeds reniform, black and shining, 4 mm. long.—Type unknown.

Coahuila and San Luis Potosi, to southern Mexico.

Specimens examined: COAHUILA (*Poselger*, without number or date): SAN LUIS POTOSI (*Parry & Palmer* 271; *Parry* of 1878; *Weber*): MEXICO, no State mentioned (*Palmer* of 1872).

The spine measurements are taken from small specimens. One of the largest of the genus.

7. **Echinocactus myriostigma** (Lem.) Salm, Cact. Hort. Dyck. ed. 1, 22 (1844).
Astrophytum myriostigma Lem. Cact. Gen. Nov. 4 (1839).
Cereus callicoche Gal.; Scheidw. Bull. Acad. Brux. vi, 88 (1839).

Depressed-globose, 12.5 cm. in diameter: ribs 5 or 6, very broad, covered with numerous somewhat pilose white spots, and with deep, obtuse sinuses: spines none: flowers large, pale-yellow. (*Ill.* Bot. Mag. t. 4177; Ill. Hort. t. 292)—Type unknown.

San Luis Potosi.

Specimens examined: SAN LUIS POTOSI (*Pringle* 3680): also specimens cultivated in Berlin in 1868, and at Cambridge (Mass.) in 1882.

I have been unable to discover whether the name of Galeotti or that of Lemaire has priority, as both were published in the same year. Sometimes called "bishop's hood."

* * *Scales of the ovary ovate, orbicular, or cordate, their axils almost naked: fruit scaly, never woolly.*—LEIOCARPI.

\+ *Central spines flat, stout, and annulate, the lower one more or less recurved and sometimes hooked: ribs not tuberculately interrupted.*—CORNIGERI.

++ ***Spines similar** (all stout, reddish, and annulate).*

8. Echinocactus viridescens Nutt; Torr. & Gray, Fl. i, 554 (1840).

Globose or depressed, simple or branching at base, 10 to 30 cm. high, 15 to 25 cm. in diameter: ribs 13 to 21 (fewer when young), compressed and scarcely tuberculate: spines more or less curved and sometimes twisted, reddish below, shading into greenish or yellowish above; radials 9 to 20, 1 to 2 cm. long, the lowest shortest, and robust and decurved; centrals 4, cruciate, much stouter, compressed and 4-angled, 2 to 3.5 cm. long, the lowest broadest, longest, and straightest: flowers yellowish-green, about 4 cm. long: fruit ovate or subglobose, greenish, 16 to 20 mm. long: seeds obliquely obovate, 1.6 mm. long, very minutely but distinctly pitted. (*Ill.* Cact. Mex. Bound. t. 29)—Type unknown.

Dry hills and ridges near San Diego, California; also collected on the sea beach by Schott.

Specimens examined: CALIFORNIA (*Schott*, without date or number; *Parry* of 1850; *Newberry* of 1858; *Cooper* of 1862; *Agassiz* of 1872; *Pringle* of 1882: also plants cultivated in St. Louis and Washington).

The fruit is said to have the shape and taste of a gooseberry.

9. Echinocactus cylindraceus Engelm. Syn. Cact. 275 (1856).

Echinocactus viridescens cylindraceus Engelm. Amer. Journ. Sci. ser. 2, xiv, 328 (1852).

Globose to ovate or ovate-cylindrical, simple or branching at base, becoming as much as 9 dm. high and 3 dm. in diameter: ribs 13 in younger specimens, 20 to 27 in older ones, obtuse and tuberculate: spines stout, compressed, more or less curved, reddish; radials about 12, with 3 to 5 additional slender ones at upper edge of areola, 2.5 to 5 cm. long, the lowest stouter and shorter and much hooked; centrals 4, very stout and 4-angled, about 5 cm. long and 2 to 3 mm. broad, the uppermost broadest and almost straight and erect, the lowest decurved: flowers yellow: fruit subglobose, pale-greenish, about 2.5 cm. in diameter: seeds black, larger than in the last. (*Ill.* Cact. Mex. Bound. t. 30)—Type, Parry of 1850 in Herb. Mo. Bot. Gard.

From San Felipe, California (eastern slope of the mountains), into Lower California, and eastward to southern Utah, New Mexico, and southwestern Texas.

Specimens examined: CALIFORNIA (*Parry* of 1850; *Palmer* of 1870): LOWER CALIFORNIA (*Orcutt* of 1883): UTAH (*Palmer* of 1870): NEW MEXICO (*Parry*, without number or date): TEXAS (no collector named).

10. Echinocactus peninsulæ Engelm. MSS.

Globose to cylindrical, simple, 1.5 to 15 dm. high, 1.5 to 3.5 dm. in diameter, sometimes becoming as much as 25 dm. high: ribs about 21, straight or rarely oblique: spines red; radials about 11, robust, 2 to 3 cm. long, the upper longer; centrals 4, stouter, compressed and angled, 4 to 6 cm. long, the lowest longer (even 8 cm.), more robust, hooked downward: flowers from golden-yellow to red: fruit obovate.—Type, Gabb 11 in Herb. Mo. Bot. Gard.

Lower California, from Cape San Lucas to near San Diego.

Specimens examined: LOWER CALIFORNIA (*Gabb* 11 of 1867).

The larger forms occur in gravelly soil not far from the coast, at not over 200 to 300 feet elevation; the smaller ones (globose and about 15 cm. in diameter) more in the mountains and northward. Evidently near to *emoryi*, but becoming much taller and with more numerous and unequal radials and more numerous centrals.

11. Echinocactus emoryi Engelm. in Emory's Rep. 156 (1848).

Glaucescent, globose to ovate, 3 to 9 dm. high, 3 to 6 dm. in diameter: ribs 13 to 21, obtuse and strongly tuberculate: radial spines 7 to 9, nearly equal, stout, 2.5 to 5 cm. long, erect or a little recurved, reddish, darker toward the apex, at length ashy, the laterals a little longer; a solitary central porrect or at length recurved or somewhat hooked, a little longer and stouter; all with horny tips: flowers red and tipped with yellow (dark brownish-purple outside), about 7.5 cm. long: fruit oval, 2.5 to 4 cm. long: seeds black and pitted, 2 mm. long. (*Ill.* Cact. Mex. Bound. t. 28; Cact. Whippl. Exped. t. 3, fig. 3)—Type: the Emory specimen was not found in the Engelmann collection, but the specimens of Bigelow and Schott, included in the full description of Cact. Mex Bound., are in Herb. Mo. Bot. Gard.

From the valley of the Mojave (southeastern California) to the valley of the Gila (southwestern Arizona), and southward into Sonora; also on Cedros Island.

Specimens examined: CALIFORNIA (*Bigelow* of 1854): SONORA (*Schott* 3; *Palmer* of 1869; *Pringle* of 1884): also specimens cultivated in Hort. Pfersdorf.

In the original description of the Emory plant the fruit is said to be oval and 2.5 to 3.5 cm. long, with black and pitted seeds 2 mm. long, but in all later descriptions Dr. Engelmann says that the "fruit and seed are unknown," without any explanation as to the dropping of the original statement. The Pringle of 1884, however, abundantly confirms this character, showing a fruit as much as 4 cm. long.

12. Echinocactus emoryi rectispinus Engelm. MSS.

Globose, at length cylindrical, larger: radial spines very unequal, the 3 upper ones 10 to 12.5 cm. long, the lower 3.5 to 7.5 cm. long and paler; the central very long (30 to 32 cm.), straight or slightly decurved: flower and fruit unknown.—Type, Gabb 12 in Herb. Mo. Bot. Gard.

Lower California ("vicinity of Molije on the mountain sides 1,000 feet high") and Sonora.

Specimens examined: LOWER CALIFORNIA (*Gabb* 12, of 1867): SONORA (*Palmer* of 1869).

++ ++ *Spines dissimilar, at least the lateral radials white and setaceous and not annulate (sometimes wanting in Nos. 13 and 17).*

13. Echinocactus cornigerus DC. Rev. Cact. 36, t. 7 (1826).

Globose or depressed-globose, 25 to 40 cm. in diameter: ribs about 21, very acute and wavy (not tuberculately interrupted): radial spines 6 to 10, white and comparatively slender, or wanting; centrals red and very robust, angular-compressed, with long, sharp, horny tips, the

upper 3 erect-spreading, 2 to 3 cm. long, the lower 2 weaker and declined, the central one longer, more rigid and keeled, very broad (5 to 8 mm.) and hooked downward: flowers purple, 2.5 to 3.5 cm. long: fruit ovate: seed reniform, slightly pitted, 1.5 mm. long. (*Ill.* DC. *l. c.* t. 7; Mém. Cact. t. 10)—Type unknown.

In Mexico, from Nuevo Leon southward to Guatemala.

Specimens examined: SAN LUIS POTOSI (*Parry & Palmer* 270, 273; *Pringle* 3270; *Eschanzier* of 1891): NUEVO LEON (*Bourgeau* 1183): VERA CRUZ (*Weber* of 1865): State of MEXICO (*Poselger* of 1851): MEXICO, with no State assigned (*Mallinerodt* 176).

A form with the lower central yellow and the flowers salmon is noted by Mrs. Anna B. Nickels.

14. Echinocactus wislizeni Engelm. Wisliz. Rep. 12 (1848).

At first globose, then ovate to cylindrical, 5 to 12 dm. high: ribs 21 to 25 (13 in small specimens), acute and oblique, more or less tuberculate: radial spines 1.5 to 5 cm. long, the 3 upper and 3 to 5 lower ones stiff, straight or curved, annulate, and red (in old specimens the 3 stout upper radials move toward the center and become surrounded by the upper bristly ones), the 12 to 20 laterals (sometimes additional shorter ones above) bristly, elongated, and flexuous, horizontally spreading, yellowish white; centrals 4, stout, angled, and red, 3.5 to 7.5 cm. long, the 3 upper straight, the lower one longest (sometimes as much as 10 to 12 cm.), very robust (flat and channeled above), and hooked downward: flowers yellow or sometimes red, 5 to 6.5 cm. long: fruit ovate, yellow, soon becoming hard: seeds obliquely obovate, black and rough, 2 to 2.5 mm. long. (*Ill.* Cact. Mex. Bound. t. 25, 26; Cact. Whippl. Exped. t. 3, figs. 1, 2)—Type, Wislizenus of 1846 in Herb. Mo. Bot. Gard.

From southern Utah, through eastern Arizona to the Rio Grande region about El Paso and southward into Chihuahua; also in Lower California.

Specimens examined: UTAH (*Bischoff* of 1871; *Siler* of 1875): ARIZONA (*Parry* of 1852; *Bischoff* of 1871; *Palmer* of 1873; *Rothrock* 492; *G. R. Vasey* of 1881, near Pantano; *Pringle* of 1882; *Rusby* of 1883; *Wilcox* of 1894, Fort Huachuca): NEW MEXICO (*Wislizenus* of 1846, near Doña Ana): TEXAS, region about El Paso (*Wright* of 1851; *Bigelow* of 1851, 1853; *Evans* of 1891): CHIHUAHUA (*Pringle* 211): LOWER CALIFORNIA (*Brandegee* of 1889, near San Franciscito).

Including its variety *lecontei*, the largest *Echinocactus* north of the Mexican boundary, and with its congeners known as the "barrel cactus." Young specimens may differ materially in spine characters.

15. Echinocactus wislizeni lecontei Engelm. Wheeler's Rep. 128 (1878).

Often somewhat taller (sometimes becoming 24 dm. high and 6 dm. in diameter), usually more slender, and at last clavate from a slender base: ribs somewhat more interrupted and more obtuse: lower central spine more flattened and broader, curved (rather than hooked) or

twisted, usually not at all hooked, sometimes as much as 15 cm. long: flower rather smaller. (*Ill.* Pacif. R. Rep. iv, t. 2, figs. 3–5; Cact. Mex. Bound. t. 27)—Type, LeConte 11 in Herb. Mo. Bot. Gard.

Rocky ground, from southwestern Utah and southern Nevada through western Arizona and adjacent California to Sonora and Lower California. Apparently not east of the Great Basin.

Specimens examined: UTAH (*Palmer* of 1877; *Siler*): ARIZONA (*LeConte* 11; *Bigelow* of 1854; *Newberry* of 1858; *Palmer* of 1867, 1869, 1874; *Parry* of 1881; *Pringle* of 1881; *Evans* of 1891): CALIFORNIA (*Parish* of 1880; *G. R. Vasey* of 1880): SONORA (*Palmer* of 1869): LOWER CALIFORNIA (*Brandegee* of 1889, at Boca de Las Animas, San Gregorio, and Posa de Los Dolores).

The Western representative of *E. wislizeni*, although the discovery of that form by Brandegee in Lower California indicates that the two are not geographically so distinct as was formerly supposed. In the Lower Californian specimens of *lecontei* the central spine (the prominent lower one) often becomes very broad and long and hooked, as in *cornigerus*. Among the Mexicans both *E. wislizeni* and *E. lecontei* have the reputation of being "traveler's plants," useful for allaying thirst, and the local name is variously reported as "biznaga," "bisnada," and "visnada."

16. Echinocactus wislizeni albispinus Toumey, Gard. & For. viii, 154 (1895).

Differs from *lecontei* in being oblong, and in the much fewer radials (11 in all, 2 upper and 3 to 5 lower rigid, and 2 or 3 laterals on each side flexuous), all of which (or only the flexuous ones) are whitish. (*Ill.* l. c.)—Type in Toumey Herb.

Southern Arizona and Lower California.

Specimens examined: ARIZONA (*J. W. Toumey* of 1892, near Tucson): LOWER CALIFORNIA (*M. E. Jones* of 1882.)

There can be no doubt but that this form with much fewer radial spines occurs throughout the range of *lecontei*, to which it is most closely allied. The radials are not merely reduced in number, but are remarkably diverse in character. In the Arizona specimens before me, the two upper radials are stout and annulate, colored like the centrals, but much smaller; then two flexuous laterals on each side are long and white; next the two remaining laterals on each side are rigid and red, and sometimes annulate; and the lowest spine is the shortest, slender, and almost flexuous. The large central, as in *lecontei*, has a curved horny tip (not a hooked one), and is broadly flattened above.

17. Echinocactus pilosus Gal.; Salm, Cact. Hort. Dyck. 148 (1850).

Echinocactus pilifcrus Lem.; Lab. Monogr. Cact. 186 (1858).

Globose, 15 to 45 cm. high: ribs 13 to 18, compressed, little if at all interrupted: radial spines represented by 3 slender ones at the lowest part of the pulvillus or wanting; centrals 6, very stout, at first purplish, then becoming pale-yellow, the 3 upper ones erect, the 3 lower recurved-spreading: flowers unknown, but probably like those of the variety.—Type unknown.

Coahuila and San Luis Potosi.

Specimens examined: COAHUILA (*Palmer* 375): SAN LUIS POTOSI (*Parry* 273; *Weber* of 1865, 1866): also specimens cultivated in Mo. Bot. Gard., 1883.

18. Echinocactus pilosus pringlei, var. nov.

Differs in that the radial spines are represented by 3 or 4 flexuous spines at upper edge of pulvinus and 4 or 5 at lower edge; centrals 6 or 7: flowers 3.5 to 4 cm. long, brownish-red.—Type, Pringle 154 in Herb. Gray.

Coahuila.

Specimens examined: COAHUILA (*Pringle* 154. distributed as *pilosus*).

+ + Spines dissimilar: radials subsetaceous: centrals angled or terete or sometimes flattish, generally at least one hooked at apex and often becoming much elongated.—HAMATI.

++ Central spines annulate.

19. Echinocactus hamatocanthus Muhlenpf. Allg. Gart. Zeit. xiv, 371 (1846).
Echinocactus longihamatus gracilispinus Engelm. Syn. Cact. 273 (1856).
Echinocactus hamatochroanthus Hemsl. Biol. Centr. Amer. i, 532 (1886).

Subglobose or at length ovate, 1.5 to 6 dm. high (flowering often when not more than 5 cm. high): ribs 13 to 17, often oblique, broad, and obtuse, tuberculate-interrupted: spines 16 to 20, purplish or variegated when young, at length ashy; radials 12 to 14, spreading, straight, curved, or flexuous, the upper and lower ones 2.5 to 7.5 cm. long, the laterals 5 to 10 cm.; centrals 4 to 8, angulate-compressed, the upper ones turned upwards, straight or curved or twisted, 5 to 12 cm. long, the lowest one stouter, elongated (7.5 to 16.5 cm.), hooked and often flexuous, porrect or deflexed: flowers 6.5 to 9 cm. long, yellow tinged with red (usually yellow within and red without): fruit ovate, green (?), 2.5 to 5 cm. long: seeds globose-obovate, 1.4 to 1.6 mm. long, pitted.—Type unknown.

From the Texan region of the "Great Bend" to the vicinity of Presidio del Norte and the mountains of the Limpia, but apparently not so far west as El Paso.

Specimens examined: TEXAS (*Wright* 223 of 1849, 764 of 1853; *Bigelow of* 1852).

Dr. Havard says that the ripe fruit is red, and "as delicious as that of the strawberry cactus." In this case, the "green" fruit of the collectors is simply the color of immaturity.

20. Echinocactus hamatocanthus longihamatus (Gal.).
Echinocactus longihamatus Gal.; Pfeiff. Abbild. ii, t. 16 (1843–50).
Echinocactus flexispinus Engelm. Wisliz. Rep. 27 (1848), not Salm (1850).
Echinocactus setispinus longihamatus Poselger, Allg. Gart. Zeit. xxi, 119 (1853).
Echinocactus longihamatus crassispinus Engelm. Syn. Cact. 273 (1856).

Spines much more robust; radials 8 to 11; centrals 4, angled, the lowest one flexuous and more or less hooked. (*Ill.* Cact. Mex. Bound. t. 21–24)—Type unknown.

From the "Great Bend" region of Texas southward through Chihuahua, Durango, Coahuila, and Nuevo Leon; said by Hemsley to occur in southern Mexico.

Specimens examined: TEXAS (*Nealley* of 1891; *Evans* of 1891): CHIHUAHUA (*Wislizenus* of 1847, type of *flexispinus* Engelm.): DURANGO

(*Gregg* 464): COAHUILA (*Palmer* 373, 374): NUEVO LEON (*Gregg* 197; *Pringle* 2237): also specimens cultivated in Harvard Bot. Gard., 1882; and in Mo. Bot. Gard., 1882.

21. Echinocactus hamatocanthus brevispinus (Engelm.).

Echinocactus longihamatus brevispinus Engelm. Syn. Cact. 274 (1856).

Spines more slender than in *longihamatus;* radials 8 to 11, 1 to 5 cm. long; centrals 4, terete, 3.5 to 5 cm. long, the lowest hooked and scarcely exceeding the radials.—Type unknown.

In the "Great Bend" region of Texas and westward to New Mexico.

Specimens examined: TEXAS (*Wright* of 1851): NEW MEXICO (*Nealley* of 1891).

These three forms of *hamatocanthus* simply express extreme variations, as there is the greatest variation in spine characters. The type is a Mexican one, crossing the Rio Grande at the "Great Bend," and reported as far west as El Paso in but a single case. From its occurrence in Chihuahua, however, all the forms may be expected in the El Paso region. Doubtless all the forms occur in Mexico, but I have seen *hamatocanthus* and *brevispinus* only from the Texan side of the Rio Grande.

++ ++ *Central spines not annulate.*

= *One central spine (generally the upper one) elongated and mostly white.*

22. Echinocactus uncinatus Gal.; Pfeiff. Abbild. ii, t. 18 (1843–50).

Glaucescent, globose to oblong: ribs 13, obtuse, tuberculate-interrupted: radial spines 7 or 8, 2.5 to 5 cm. long, the upper 4 or 5 straw-color, straight, flattened, the lower 3 purplish, terete, and hooked; centrals 4, the upper 3 rather stout and straight, about 2.5 cm. long, the lowest one very long, flattened, hooked at apex: flowers brownish-purple: fruit ovate, 1.5 to 2.5 cm. long: seeds much compressed, curved, smooth and shining, 1.2 to 1.4 mm. long. (*Ill.* l. c.; Cact. Mex. Bound. t. 74, fig. 9, seed)—Type unknown.

Chihuahua, Coahuila, and San Luis Potosi.

Specimens examined: COAHUILA (*Gregg* 617; *Poselger* of 1850): SAN LUIS POTOSI (*Gregg* 585): also specimens cultivated in Goebel's Gard. (St. Louis), 1845; and in Hort. Pfersdorf in 1869.

The usual reference of this name to Hopf. in Foerst. Handb. 321 (1846) is found to be a *nomen nudum*.

23. Echinocactus uncinatus wrightii Engelm. Syn. Cact. 272 (1856).

Oval, 7.5 to 15 cm. high, 5 to 8.5 cm. in diameter: radial spines 8, arranged as in the last; central spine solitary, angled, flexuous and hooked, elongated (5 to 15 cm.), erect, straw-color with dark tip: flowers 2.5 to 3.5 cm. long, dark-purple: fruit reddish: seeds curved, contracted at base, keeled on the back, tuberculate, 1.4 to 1.6 mm. long. (*Ill.* Cact. Mex. Bound. t. 74. fig. 10, seed)—Type, Wright and Bigelow specimens in Herb. Mo. Bot. Gard.

Abundant from El Paso, Texas, to the Pecos, but extending almost to the mouth of the Rio Grande, and southward into Chihuahua.

Specimens examined: TEXAS (*Wright* of 1849, 1851, 1852; *Bigelow* of 1852; *Nealley* of 1891, near Rio Grande City): CHIHUAHUA (*Pringle* 76).

Commonly in tufts of grass or hidden among low bushes, the long tuft of yellowish-white hooked central spines often difficult to distinguish from the surrounding bunches of dead grass.

24. Echinocactus polyancistrus Engelm. & Bigel.; Engelm. Syn. Cact. 272 (1856).

Ovate or at length subcylindric, becoming 10 to 25 cm. high and 7.5 to 10 cm. in diameter: ribs 13 to 17, obtuse, tuberculately interrupted: radial spines 20 or more, compressed and white, the uppermost wanting, the 4 upper ones broader and longer (2.5 to 5 cm.) and dusky-tipped, the laterals shorter (2 to 2.5 cm.), the lowest ones very short (1.2 cm.) and subsetaceous; central spines of several forms, the uppermost one (rarely a second similar but smaller one above or beside it) compressed-quadrangular, elongated (7.5 to 12.5 cm.), white with dusky tip, curved upward, the other 5 to 10 teretish or subangled, bright purple-brown, upper ones longer (5 to 9 cm.) and mostly straight, the others gradually shortening (to about 3 cm.) downward and sharply hooked: flowers red or yellow, 5 to 6 cm. long and wide: fruit pyriform, becoming almost destitute of scales: seeds large and tuberculate. (*Ill.* Pacif. R. Rep. iv, t. 2, figs. 1, 2)—Type, Bigelow of 1854 in Herb. Mo. Bot. Gard.

Gravelly hills and plains, from the Mohave desert region of southeastern California (headwaters of the Mohave) to the sage plains of western Nevada; apparently not abundant.

Specimens examined: CALIFORNIA (*Bigelow* of 1854; *Coville & Funston* 167, Death Valley Exped.): NEVADA (*Gabb* of 1867; *Shockley* 314).

The measurements of plant bodies and spines are taken from the larger southern forms of the Mohave desert. The Nevada plants are but 7.5 to 10 cm. high, with spines rarely more than 5 cm. long, the radials but 1 to 2.5 cm. Said to resemble a pineapple in general size and appearance. The number of hooked spines varies from 3 to 7 according to age and development. In the original description as given in the "Cactaceae" of Whipple's Expedition the flower characters are drawn from immature buds. Shockley's Nevada specimens are in full flower and show the lower half of the ovary to be naked, a few small rounded fimbriate sepals above, those of the limb few, larger and petal-like; petals 10, about 3 cm. long, spatulate, entire, slightly mucronate-tipped.

25. Echinocactus whipplei Engelm. & Bigel.; Engelm. Syn. Cact. 272 (1856).

Globose-ovate, 7.5 to 12.5 cm. high, 5 to 10 cm. in diameter: ribs 13 to 15 (often oblique), compressed and tuberculately interrupted: radial spines usually 7, compressed, straight or slightly recurved, 12 to 18 mm. long, lower ones shorter than the others, all white excepting the two darker lowest laterals; central spines 4, widely divergent, the uppermost one flattened, straight and white, 2.5 to 4 cm. long (1 to 2.5 mm. broad at base), turned upward in the plane of the radials (completing the circle of radials), the others a little shorter (2.5 to 3 cm.), quadrangular-compressed, dark-brown or black becoming reddish and finally ashy, the 2 laterals straight, the lowest one stouter and sharply hooked downward: flower greenish-red, 2 to 3 cm. long: ovary with few (2 to 5) scales: seeds

large (3.2 to 3.4 mm. long), black and minutely tuberculate. (*Ill.* Pacif. R. Rep. iv, t. 1)—Type, Bigelow of 1853 in Herb. Mo. Bot Gard.

Sandy soil, often half buried, valley of the Lower Colorado and Little Colorado, northern Arizona.

Specimens examined: ARIZONA (*Bigelow* of 1853; *Newberry* of 1858; *Brandegee* of 1875).

26. Echinocactus whipplei spinosior Engelm. Trans. St. Louis Acad. ii, 199 (1863).

Globose, 7.5 cm. in diameter: ribs 13: radial spines 9 to 11, 12 to 36 mm. long, the lower ones often dusky, the 2 upper ones often elongated, flattened and curved; the 4 centrals 3.5 to 5 cm. long, the uppermost one flexuous and white, the other 3 a little shorter, dusky, all or only the lowest one hooked: flowers about 2.5 cm. long: fruit oval, 12 mm. long.—Type, H. Engelmann of 1858 in Herb. Mo. Bot. Gard.

In Desert Valley, west of Sevier Lake, Utah, and abundant in southwestern Colorado.

Specimens examined: UTAH (*H. Engelmann* of 1858): COLORADO (*Brandegee* of 1875, La Plata Valley and Mesa Verde).

So far as known, *E. whipplei* is confined to the region of its original discovery (valley of the Little Colorado, northern Arizona), and *spinosior* to the deserts of southern Utah and southwestern Colorado, a considerable distance to the north. Intergrading forms may be found in the intermediate region, but until they are, the northern and southern forms seem abundantly distinct.

= = Central spines similar and none of them specially elongated.

a. Ribs obtuse: flowers small (2.5 to 3 cm. long).

27. Echinocactus brevihamatus Engelm. Syn. Cact. 271 (1856).

Globose-ovate, from a turbinate fibrous root, very dark green: ribs 13, deeply tuberculate-interrupted, the tubercles with a woolly groove extending to the base, where it expands into the flower-bearing areola: radial spines mostly 12, terete, straight, white or yellowish with dusky tips, 10 to 20 mm. long, the upper the longer; central spines 4 (rarely 1 or 2 additional ones), flattened, white with black tips, the 2 lateral ones divergent upward, straight or a little recurved, exceeding the radials, 28 to 44 mm. long, the uppermost one weaker, 16 to 20 mm. long, the lowest stoutest and darkest, porrect or deflexed, hooked downward, 18 to 20 mm. long: flowers funnelform, 24 to 32 mm. long and 18 to 20 mm. wide when fully expanded, rose-color: fruit and seed unknown. (*Ill.* Cact. Mex. Bound. t. 18, 19)—Type, Wright and Bigelow specimens in Herb. Mo. Bot. Gard.

From Eagle Pass and the San Pedro River, Texas, southward into Coahuila and Nuevo Leon.

Specimens examined: TEXAS (*Bigelow* of 1852, 1853; *Wright* 86): NUEVO LEON (*Palmer* 1080).

The strong tubercles with the axillary flower-bearing areola connected with the spine-bearing areola by a woolly groove is such a striking Coryphanth character that it suggests a much closer relationship than the present position would imply.

It still further emphasizes the fact that the generic lines in *Cactaceæ* are of very uncertain definition.

28. Echinocactus scheerii Salm, Cact. Hort. Dyck. 155 (1850).

Globose or ovate, 3.5 to 5 cm. in diameter, from a long terete root: ribs 13, deeply tuberculate-interrupted, the tubercles ovate and grooved half way down: radial spines 15 to 18 (or 11 to 13 in younger specimens), strictly radiant, 6 to 12 mm. long, about equal, setaceous and rigid, straight or a little recurved, white or straw-color with dark apex, the uppermost sometimes elongated; central spines 3 or 4, angled, brownish-black and white variegated, the upper ones straight, divergent upward, 12 to 24 mm. long, the lowest one shorter, porrect and hooked: flowers greenish-yellow, about 2.5 cm. long, much less in diameter: fruit small, green, almost naked: seeds large (about 2 mm. long), brown and minutely tuberculate. (*Ill.* Cact. Mex. Bound. t. 17)—Type unknown.

In the region about Eagle Pass, on the Rio Grande, Texas, and southward into northern Mexico.

Specimens examined: TEXAS (*Poselger* 5 of 1850; *Schott* of 1854): MEXICO, no State recorded (*Weber* of 1866).

This species is also suggestive of a very close alliance with *Cactus*. The prominent tubercles are not arranged in very evident ribs, and the woolly groove extending half way down the tubercle is suggestive of *Cactus macromeris*. The relationship becomes still more emphasized if the seeds accompanying the Poselger specimens, from which the seed description is drawn, be really those of *scheerii*. They are the only brown seeds I know in *Echinocactus*, and the cotyledons are much smaller than is usual in the genus.

b. Ribs acute: flowers large (4 to 7.5 cm. long).

29. Echinocactus pubispinus Engelm. Trans. St. Louis Acad. ii, 199 (1863).

Small, turbinate, oval, 5 cm. high, 2.5 to 3 cm. in diameter: ribs 13, somewhat oblique, compressed and tuberculate-interrupted: spines velvety-pubescent, at length naked, white with dusky apex; radial spines 5 or 6 below, 9 to 12 above, 2 to 8 mm. long, the upper 1 or 2 stouter and longer, straight or curved or hooked; central spine wanting, or occasionally a single stouter, longer (10 to 12 mm.) one, erect and always strongly hooked: flowers and fruit unknown.—Type, H. Engelmann of 1859 in Herb. Mo. Bot. Gard.

Pleasant Valley, near Salt Lake Desert, Utah.

Specimens examined: UTAH (*H. Engelmann* of 1859).

The species seems never to have been rediscovered.

30. Echinocactus sinuatus Dietr. Allg. Gart. Zeit. xix, 345 (1851).

Echinocactus setispinus sinuatus Poselger, Allg. Gart. Zeit. xxi, 119 (1853).

Echinocactus setispinus robustus Poselger, *l. c.*

Echinocactus treculianus Lab. Monogr. Cact. 202 (1858).

Globose, 10 to 20 cm. in diameter, bright-green: ribs 13, oblique, acute, and tuberculate-interrupted, the tubercles shortly grooved: radial spines 8 to 12, setiform and flexible, the 3 upper and 3 lower purplish-

brown and straightish (the lower ones sometimes more or less hooked), 2 to 2.5 cm. long, the 2 to 6 laterals more slender, longer (2.5 to 3.5 cm.), often flattened, puberulent and whitish, sometimes flexuous or hooked; central spines 4, puberulent, yellowish (or purplish-variegated), the 3 upper ones slender, flattened or subangled, erect and generally straight (rarely hooked), 4 to 5 cm. long, the lowest one much stouter, flattened or even channelled, straw-color, flexuous, more or less hooked (sometimes straight), 5 to 10 cm. long: flowers yellow, 5 to 7.5 cm. long: fruit oval, green, 16 to 18 mm. long: seeds obovate or lenticular, shining and minutely punctate, 0.8 to 1.2 mm. long. (*Ill.* Cact. Mex. Bound. t. 74, figs. 11–14, seeds)—Type unknown, but probably Poselger of 1850 in Herb. Mo. Bot. Gard.

From the Rio Grande, near Eagle Pass, and the San Pedro and Pecos, Texas, westward to Arizona (near Comstock) and southward into Coahuila.

Specimens examined: TEXAS (*Wright* of 1852, on the Limpia, also 2, 223, 639): ARIZONA (*Nealley* of 1891, near Comstock): COAHUILA (*Poselger* of 1850).

31. Echinocactus setispinus Engelm. Pl. Lindh. i, 246 (1845).
Echinocactus setispinus setaceus Engelm. Pl. Lindh. ii, 201 (1850).

Subglobose, 5 to 7.5 cm. in diameter: ribs 13, more or less oblique, often undulate or somewhat interrupted: radial spines 14 to 16, setiform and flexible, 10 to 20 mm. long, the uppermost (the longest) and lowest ones yellowish-brown, the laterals white; central spines 1 to 3, setiform and flexuous, dark, 24 to 32 mm. long: flowers funnelform, 4 to 7 cm. long, yellow, scarlet within: fruit globose, fleshy and red, about 8 mm. in diameter: seeds globose-obovate and oblique, strongly tuberculate, 1.2 to 1.6 mm. long. (*Ill.* Cact. Mex. Bound. t. 20, in part)—Type, Lindheimer of 1844 in Herb. Mo. Bot. Gard.

From the Brazos River, Texas, to the Rio Grande and southward into Tamaulipas. In mesquit thickets, etc.

Specimens examined: TEXAS (*Lindheimer* of 1844, 1859; *Wright* of 1848, 1850; *Hall* 234): TAMAULIPAS ("St. Louis Volunteers" of 1846): also specimens cultivated at St. Louis in 1845, presumably from the type.

This smaller form, which happened to be described first, is the eastern lowland representative of the next, extending from the lowlands of southeastern Texas to those of northeastern Mexico.

32. Echinocactus setispinus muhlenpfordtii (Fen.).
Echinocactus muhlenpfordtii Fen. Allg. Gart. Zeit. xv, 65 (1847).
Echinocactus hamatus Muhlenpf. Allg. Gart. Zeit. xvi, 18 (1848).
Echinocactus setispinus hamatus Engelm. Pl. Lindh. ii, 201 (1850).

Ovate-globose to oblong-cylindrical, larger, becoming 10 to 20 cm. high: radial spines fewer (10 to 12), stouter, larger (12 to 32 mm.); central spine stouter, 24 to 32 mm. long, hooked: otherwise as the last. (*Ill.* Cact. Mex. Bound. t. 20, in part)—Type unknown.

Extending from San Antonio, Texas, westward to the region of Eagle Pass and El Paso and southward into Coahuila and Chihuahua.

Specimens examined: TEXAS (*Lindheimer* of 1846, near San Antonio; *Schott* of 1852, at Eagle Pass; *Bigelow* of 1852, 1854, at Eagle Pass; *Evans* of 1891, near El Paso; *Neally* of 1891, near Camp Hudson): also specimens cultivated in St. Louis in 1846, 1847, 1849, 1855, 1859.

The two forms of this well known species seem worthy of separation. Although there is much intergrading where the two ranges overlap, the extreme eastern and northern forms seem almost specifically distinct from those of the extreme west.

\- - - *Spines never hooked.*

\-- *Ribs very numerous, crowded, acutely compressed, and wavy: upper (usually radial) spine broad, thin and flat, the others teretish.*

33. Echinocactus phyllacanthus Mart.; Otto & Dietr. Allg. Gart. Zeit. iv, 201 (1836).

From globose to cylindrical, with depressed vertex, simple or proliferous, 6 to 8.5 cm. broad: ribs 40 to 55 (sometimes as few as 30), very much crowded and compressed, thin, acute, and very wavy, continuous or somewhat interrupted: radial spines 5 (sometimes 6 or 7), straight and spreading, the 2 lowest ones white, rigid, 4 to 6 mm. long, half as long as the 2 darker, angled, larger laterals, the uppermost spine thin and broad (3 mm.), channeled above, faintly annulate, flexible, grayish-pink, 15 to 25 mm. long; central spines none: flowers small, dirty white: fruit unknown.—Type unknown.

San Luis Potosi, to southern Mexico.

Specimens examined: SAN LUIS POTOSI (*Parry & Palmer* 269; *Eschanzier* of 1891): also specimens cultivated in Hort. Jacoby in 1857, and in Mo. Bot. Gard. in 1879.

The specific name refers to the thin and broad flexible "leaf-like" upper spine.

34. Echinocactus lancifer Dietr. Allg. Gart. Zeit. vii, 154 (1839).

Depressed, globose, 6 cm. in diameter, simple: ribs about 40, crowded and thin, very acute and wavy, scarcely interrupted: spines straw-color or very pale yellow; radials 7, the 4 lower ones short (5 to 6 mm.), rigid and recurved, the remaining ones annulate, angled, bulbous at base, the 2 laterals reflexed-spreading, 3 cm. long, shorter than but similar to the solitary annulate central spine (which is often flattened toward the apex), and half as long as the broad, thin, and scarcely rigid uppermost radial, which is channeled above: flowers deep rose-color: fruit unknown.—Type unknown.

San Luis Potosi.

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

35. Echinocactus spinosus Wegener, Allg. Gart. Zeit. xii. 66 (1844).
Echinocactus wippermanni Muhlenpf. Allg. Gart. Zeit. xiv, 370 (1846).
Echinocactus acifer Hopf. ex Foerst. Handb. Cact. 520 (1846).

Depressed-globose, 6 cm. in diameter, simple, densely woolly on the younger areolæ: ribs 36 to 40, oblique, crowded, thin and acute, very

wavy and tuberculate-interrupted: radial spines 14 to 22, setaceous and white, more or less rigid, 12 to 14 mm. long (upper much shorter), radiantly interwoven with those of adjacent clusters and densely covering the whole plant; central spines usually 4 (occasionally 1 to 3), grayish with dusky tips, faintly annulate, the lateral ones concave above, slightly longer than the terete lower one (which is sometimes wanting) and usually twice as long as the thin flat upper one: flowers and fruit unknown.—Type unknown.

San Luis Potosi.

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

Two forms appear in the Eschanzier collection: one with about 20 radials and 4 centrals, of which the laterals are twice as long as the upper; the other with 14 radials and 3 centrals (the lowest one wanting), of which the laterals are not twice as long as the upper. In the original *wippermanni* the radials are 18 to 22, and the centrals 1 to 3.

36. Echinocactus coptonogonus major Salm, Cact. Hort. Dyck. 156 (1850).

Depressed, from a large indurated naked napiform base, 10 to 15 cm. across the top: ribs 10 to 15, acute from a broad base, more or less transversely interrupted and sinuous: spines 3, annulate, very stout and erect from deeply sunken areolæ, reddish when young, becoming ashy gray; upper spine stoutest, erect and straight, or slightly curved upward, flattened and keeled, and occasionally twisted, 4 to 5.5 cm. long, the two laterals erect-divergent, straight, or slightly curved, terete above and somewhat quadrangular below, 2 to 3 cm. long; all from an abruptly enlarged base: flowers not seen, but said to be small and white, with purplish median lines.—Type unknown.

San Luis Potosi to southern Mexico.

Specimens examined: SAN LUIS POTOSI (*Eschanzier* of 1891): also specimen growing in Mo. Bot. Gard., 1893.

The flat top of the plant seems covered with the stout, erect and interlocking sword-like spines, the central (and uppermost) one of each cluster of three being much the largest and rising perpendicularly. The spines rise from such deep-seated areolæ that the acute rib below each areola projects between the two lateral spines like a blunt tooth. *E. coptonogonus* differs from the variety in its much smaller spines, which are five in number, the two lowest being very small and deflexed.

++ ++ *Ribs tuberculate-interrupted: spines dissimilar (one or more compressed).*

37. Echinocactus hystrichacanthus Lem. Cact. Gen. Nov. 17 (1839).

Globose-conical, very stout, 6 dm. or more in diameter: ribs acute, repand and crenate: spines reddish-brown with golden tips, annulate; radials 8 to 10, radiant, unequal, subterete; centrals 4, the lowest porrect, angular and very long: flowers and fruit unknown.—Type unknown.

From Coahuila to Vera Cruz.

Specimens examined: COAHUILA (*Thurber* of 1853; *Poselger* of 1855): VERA CRUZ (*Poselger* of 1851): also specimens cultivated in Hort. Bot. Berol. in 1869.

38. Echinocactus bicolor Gal.; Pfeiff. Abbild. Cact. ii, t. 25 (1843–50).
Echinocactus bicolor pottsii Salm, Cact. Hort. Dyck. 173 (1850).
Echinocactus pottsii Scheer; Seem. Bot. Herald, 291 (1852–57), not Salm.

Globose-ovate, stout, 3.5 to 10 cm. in diameter, sometimes becoming 29 cm. high: ribs 8, oblique and obtuse, compressed: lower radial spines and centrals variegated red and white; radials 9 to 17, spreading and recurved, slender and rather rigid, the lowest one shortest (1.5 to 2 cm.), the laterals longer (2 to 4 cm.), about equaling the 2 to 4 flat flexuous ashy upper ones; centrals 4, flat and flexuous, 3 to 6 cm. long, the uppermost thin and not longer than the erect and rigid laterals, the lowest very stout, porrect and very long: flowers funnelform, purple, 5 to 7.5 cm. long: fruit unknown. (*Ill.* l. c.)—Type unknown.

Chihuahua, Coahuila, and San Luis Potosi.

Specimens examined: CHIHUAHUA (*Wislizenus* of 1846; *Potts* of 1850; *Evans* of 1891): COAHUILA (*Palmer* 379): SAN LUIS POTOSI (*Palmer* of 1879; *Eschanzier* of 1891): "Northern Mexico" (*Poselger*): also specimens cultivated in Mo. Bot. Gard., 1881, and in Harvard Bot. Gard., 1882.

The radial spines usually number 9 to 11, but the Chihuahua specimens of Evans show 14 to 17, thus resembling *schottii*. The chief distinctive character between the two is found in the relative development of the centrals, in *bicolor* the lowest, in *schottii* the uppermost being the most prominent. In the former, also, the uppermost central is not only not more prominent than the laterals, but it is flat; while in the latter it is not only the most prominent but is carinate below.

39. Echinocactus bicolor schottii Engelm. Syn. Cact. 277 (1856).

Ovate or ovate-cylindric, 10 to 15 cm. high, 5 to 7.5 cm. in diameter: radial spines 15 to 17, straight; uppermost central broadest and longest (3 to 4 cm.), flat above and keeled below, straight or a little curved, the 3 others compressed or subterete, shorter and straight.—Type, Schott of 1853 in Herb. Mo. Bot. Gard.

"On cretaceous hills covered with chaparral," from near Mier on the Lower Rio Grande, Texas, to San Luis Potosi.

Specimens examined: TEXAS (*Schott* of 1853): SAN LUIS POTOSI (*Palmer* of 1882).

40. Echinocactus orcuttii Engelm. West Amer. Sci. ii, 46 (1886).

Cylindrical, 6 to 10.5 dm. high, 3 dm. in diameter, single or in clusters up to 18 or more, not rarely decumbent: ribs 18 to 22, often oblique: spines extremely variable, angled to flat, 1 to 7 mm. wide; radials 11 to 13, unequal, lowest and several laterals thinnest; centrals 4: flowers about 4 cm. long, deep-crimson in center bordered by light greenish-yellow: fruit globose and green, about 16 mm. in diameter: seeds (unripe) brown, tuberculate, 1.8 mm. long. (*Ill.* W. Amer. Sci. ii, 47)—Type, Orcutt of 1883 in Herb. Mo. Bot. Gard.

"Palm Valley, Lower California, 30 to 50 miles southeast of San Diego."

Specimens examined: LOWER CALIFORNIA (*C. R. Orcutt* of 1883).

41. Echinocactus limitus Engelm. MSS.

Globose and large, 3 dm. or more in diameter: ribs 21, oblique, thick and broad (compressed above), slightly interrupted: radial spines 12 to 16, about 2.5 cm. long, upper and lower most prominent, laterals occasionally somewhat twisted; central spines 4, ashy-red, finely annulate, slightly recurved, upper and lower ones flat and broad, 4 to 4.7 cm. long, lateral ones angular and shorter: flowers campanulate, purplish-brown or dusky, 3.5 to 4 cm. long and broad: fruit green.—Type, Hitchcock of 1876 in Herb. Mo. Bot. Gard.

Along the "boundary line south of San Diego, with *Agave shawii* and *Cereus emoryi*."

Specimens examined: Boundary line between California and Lower California (*G. M. Hitchcock* of 1876): also specimens cultivated at Shaw's Garden in 1876.

++ ++ ++ *Ribs deeply sulcate or tuberculate: spines similar (all flat or all terete) and interwoven with those of adjacent clusters (except in No. 49).*

= *Tubercles more or less confluent at base: flowers reddish (unless in No. 47).*

42. Echinocactus johnsoni Parry. Bot. King Surv. 117 (1871).

Oval, 10 to 15 cm. high: ribs 17 to 21, low, rounded, tuberculately interrupted, close-set, often oblique, densely covered with stoutish reddish-gray spines: radial spines 10 to 14, 1.5 to 3 cm. long, the upper longest; centrals 4, stouter, recurved, 3.5 to 4 cm. long: flowers 5 to 6.5 cm. long and wide, from deep-red to pink: seeds reticulate-pitted.—Type, Johnson of 1870 in Herb. Mo. Bot. Gard.

Near St. George, Washington County, extreme southwestern Utah, and extending into southern Nevada (about Vegas Wash, *fide* Coville), and doubtless into adjacent California (Inyo County).

Specimens examined: UTAH (*Johnson* of 1870, 1874; *Parry* of 1870; *Palmer* of 1877).

Dr. Merriam says that this species is "eaten by the Paiute Indians, who peel it as we would a cucumber."

43. Echinocactus johnsoni octocentrus, var. nov.

Central spines 8, strongly bulbous at base, the upper half red, recurved-spreading, 2.5 to 3 cm. long: flowers 3 cm. long and wide, pink.—Type, Coville & Funston 278 in Nat. Herb.

Rusting Springs Mountains, Inyo County, California.

Specimens examined: CALIFORNIA (*Coville & Funston* 278 of 1891).

This variety seems to represent the extreme western form of the species.

44. Echinocactus unguispinus Engelm. Wisliz. Rep. 27 (1848).

Depressed-globose, 10 cm. in diameter, 7.5 cm. high: ribs 21, tuberculate-interrupted: radial spines about 21, slender, white, recurved, interwoven with those of adjacent clusters, the lower ones 12 to 20 mm. long, the upper ones 24 to 30 mm. long: central spines 5 (rarely 6), stouter, longer, horny, turned upward, the upper ones 24 to 36 mm. long, the lowest one very stout, brown-tipped, curved downward,

20 to 24 mm. long: flowers (from shrivelled specimens) about 2.5 cm. long and probably pale-red: fruit unknown. (*Ill.* Cact. Mex. Bound. t. 35, figs. 6–8)—Type, Wislizenus of 1847 in Herb. Mo. Bot. Gard.

Chihuahua, about Pelayo.

Specimens examined: CHIHUAHUA (*Wislizenus* of 1847).

"The large recurved spines, especially the stoutest central one, which is of a bluish horn-color, with a brown point, and is curved and bent downward like a large fang, cover the whole surface of the plant, and give it a very pretty appearance." The fruit and seed characters of the original description were taken from fruits collected by Dr. Gregg about San Lorenzo (Chihuahua), which Dr. Engelmann at the time did not doubt belonged to this species, but which afterwards proved to belong to *E. uncinatus*. The prominent tubercles have the woolly groove characteristic of Coryphantha. This species has been referred to *intertextus*, but is probably distinct.

45. Echinocactus intertextus Engelm. Syn. Cact. 277 (1856).

Ovate-globose, 2.5 to 10 cm. high: ribs 13, acute, somewhat oblique, tuberculate-interrupted, the tubercles with a woolly grove: spine short and rigid, reddish from a whitish base and with dusky tips; radials 16 to 25, closely appressed and interwoven, the upper 5 to 9 setaceous and white, straight, 5 to 12 mm. long, the laterals more rigid and a little longer (8 to 14 mm.), the lowest stout and short (4 to 8 mm.), a little recurved; centrals 4, the 3 upper ones turned upward and exceeding the radials and interwoven with them (10 to 18 mm. long), the lower one very short (2 to 4 mm.), stout and porrect: flowers about 2.5 cm. long and wide, purplish: fruit globose, dry, about 8 mm. in diameter: seeds reniform, slightly rough and shining, about 2 mm. long. (*Ill.* Cact. Mex. Bound. t. 34)—Type, specimens of Wislizenus and Wright in Herb. Mo. Bot. Gard.

From the Pecos River, Texas, westward to El Paso and southward into Chihuahua.

Specimens examined: TEXAS (*Wright* of 1851, 1852; *Engelmann*): CHIHUAHUA (*Wislizenus* of 1846).

46. Echinocactus intertextus dasyacanthus Engelm. Syn. Cact. 277 (1856).

Ovate or conical, becoming 15 cm. high: spines slender, longer, more ashy; radials 19 to 25, setaceous and in many series, 12 to 16 mm. long, the 7 to 9 upper ones more slender, shorter, whitish, and fascicled; centrals scarcely stouter, 18 to 22 mm. long, the upper 3 exceeding the rest, the lowest one porrect and but little shorter. (*Ill.* Cact. Mex. Bound. t. 35, figs. 1–5)—Type, specimens of Wright in Herb. Mo. Bot. Gard.

From the region about El Paso, Texas, and contiguous New Mexico, southward into Chihuahua and San Luis Potosi.

Specimens examined: TEXAS (*Lindheimer* of 1844: *Wright* of 1851, 1852; *Engelmann*: *Lemmon* of 1881): NEW MEXICO (*Evans* of 1891, at Rincon; *Neally* of 1891): CHIHUAHUA (*Evans* of 1891, at Juarez): SAN LUIS POTOSI (*Eschanzier* of 1891).

Very closely resembles *Cactus dasyacanthus* and might be mistaken for it.

47. Echinocactus erectocentrus, sp. nov.

Broadly ovate and simple, with very flat base, 8 cm. high: ribs 21, oblique, tuberculate-interrupted: spines terete, rigid, interwoven; radials 14, pectinate-appressed below, spreading above, bulbous at base, 10 to 12 mm. long, the 4 or 5 lower ones shorter, with white base and pink tips; the solitary central from the upper part of the areola, longer (20 mm.), erect and slightly curved, darker: flowers yellow (?): fruit unknown.—Type in Nat. Herb. and Herb. Coulter.

Near Benson, Arizona, and also near Saltillo, Coahuila.

Specimens examined: ARIZONA (*Evans* of 1891): COAHUILA (*Weber* of 1869).

The plant is characterized by its very flat base, on which the spines are persistent even to the origin of the root, and by uniformly erect centrals. It is nearly related to *E. horripilus* Lem., to which the Webber plant has been referred, but judging by descriptions of that species, no such reference can be made on account of its much smaller spines, more numerous radials, strictly erect centrals, and always simple habit. It seems so unlikely that this species would be found at such widely-separated stations as Benson, Arizona, and Saltillo, Coahuila, that there must be a suspicion of shifted labels on the part of one of these collectors. Mr. Evans's only Mexican collections are from Chihuahua, just across the Rio Grande from El Paso, and it is barely possible that this plant should bear a Chihuahua label, but this is only suggested by the location of the Webber station.

== Tubercles distinct (as in Cactus): *flowers yellowish or whitish (in No. 50 some times shading to purple).*

48. Echinocactus sileri Engelm. MSS.

Globose: ribs 13, prominent, densely crowded, with short rhomic-angled tubercles: radial spines 11 to 13, white; central 3, black with pale base, 18 mm. long, the upper one slightly longer: flowers scarcely 2.5 cm. long, straw-colored: fruit unknown.—Type, Siler of 1883 in Herb. Mo. Bot. Gard.

Cottonwood Springs and Pipe Springs, southern Utah.

Specimens examined: UTAH (*A. L. Siler* of 1883).

49. Echinocactus papyracanthus Engelm. Trans. St. Louis Acad. ii, 202 (1863).
Mamillaria papyracantha Engelm. Pl. Fendl. 49 (1849).

Ovate, about 5 cm. high and 3.5 cm. in diameter, proliferous: ribs 8, oblique, completely broken up into tubercles, of which the lower ones are proliferous: all the spines flat, chartaceous, flexible, and silky-white; radials 8, short (3 to 4 mm.), all directed laterally or downwards; centrals 3 or 4, much longer, the 2 or 3 upper ones curved upwards, 12 to 18 mm. long, the single lower one longer (20 to 28 mm.) and broader (2 to 2.5 mm.), turned downwards: flowers 2.4 to 2.6 cm. long and slightly broader, pearly white: fruit unknown.—Type, Fendler 279 of 1847 in Herb. Mo. Bot. Gard.

"In a valley between the lower hills," near Santa Fe, New Mexico, "in loose red sandy though fertile soil."

Specimens examined: NEW MEXICO (*Fendler* 279 of 1847; *Bandelier* of 1882).

Collected but once by Fendler, and 35 years later, near the same station, by Bandelier; reported by Marcus E. Jones in *Zoe*, iii, 301 as "scarce everywhere," but with no further statement as to station. "Spines silky-white, shining, of the constituency of stiff paper." The generic relationship as yet rests only on the fact that the floral and spiniferous areolæ join at the apex of the young tubercles; otherwise the whole appearance of the plant is that of a *Cactus*.

50. Echinocactus simpsoni, Engelm. Trans. St. Louis Acad. ii, 197 (1863).

Subglobose or depressed, turbinate at base, simple, often clustered, 7.5 to 12.5 cm. in diameter: ribs 8 to 13, only indicated by the spiral arrangement of the prominent tubercles, which are 12 to 16 mm. long somewhat quadrangular at base and cylindric above: exterior spines 20 to 30, slender, rigid, straight, whitish, 8 to 12 mm. long, with 2 to 5 additional short setaceous ones above; interior spines 8 to 10, stouter, yellowish and reddish brown or black above, erect-spreading, 10 to 14 mm. long; no truly central spine: flowers 16 to 20 mm. long and nearly as broad, yellowish-green to pale-purple: fruit green and dry, 6 to 7 mm. long and almost as broad: seeds black, obliquely obovate, tuberculate, 3 mm. long. (*Ill.* Cact. Simpson's Exped. t. 1, 2.)—Type, H. Engelmann of 1859 in Herb. Mo. Bot. Gard.

In high mountain valleys and on rocky ridges, from the eastern slope of the Rocky Mountains of Colorado westward through Utah and into the mountains of Nevada.

Specimens examined: COLORADO (*Parry* of 1860, 1862; *Hall & Harbour* of 1862; unnamed collector in 1871; *Greene* 131; *Palmer* of 1877; *Martindale* of 1878; *Patterson* 211): UTAH (*H. Engelmann* of 1859; *G. Engelmann* of 1874; *Johnson* of 1883).

51. Echinocactus simpsoni minor Engelm. Trans. St. Louis Acad. ii, 197 (1863).

The whole plant, tubercles, spines, flowers, and seeds smaller.—Type, Hall & Harbour of 1862 in Herb. Mo. Bot. Gard.

Mountains of Colorado.

Specimens examined: COLORADO (*Hall & Harbour* of 1862; *Wolf & Rothrock* 54 of 1873; *H. Engelmann* of 1874).

52. Echinocactus simpsoni robustior, var. nov.

Larger in every way: tubercles much larger: exterior spines 16 to 20, 18 to 23 mm. long; interior spines about 10, 20 to 28 mm. long.—Type, Watson of 1868 in Herb. Mo. Bot. Gard.

From the Humboldt Mountains of Nevada, northward to Washington (?).

Specimens examined: NEVADA (*Watson* of 1868): WASHINGTON (*Brandegee* 793; *Tweedy* of 1882).

While the specimens of Brandegee and Tweedy seem referable to this form, the occurrence of an *Echinocactus* so far north calls for a more careful inquiry as to the really indigenous character of the material.

A peculiar monstrosity of *E. simpsoni* and its varieties is that which is styled "snake cactus" or "brain cactus." So far as it has come to my observation it is found among the mountains of Colorado, and is a modification of *E. minor*. It con-

sists of a hemispherical mass 15 cm. or more in diameter, with brain-like convolutions formed by the winding of a single ridge, bearing no resemblance to the normal plant. It is usually proliferous about the border, and I have seen develop from it the normal forms. There are also all intermediate forms between this and the type form. There occurs also a cone-like form of this monstrosity 10 to 11 cm. high, found in the same region, but apparently developed from regular *simpsoni*. I have seen, also, the same "brain" form assumed by *Cactus niveus aristatus* in specimens cultivated in Mo. Bot. Gard. It is very probable that this curious habit is far more general among *Cacti* and *Echinocacti* than shown by this record.

ECHINOCACTUS CALIFORNICUS Monville, Cat. (1846), was described from seedlings whose identity and native country are so very uncertain that no further statement can be made concerning them.

ARTIFICIAL KEY TO THE SPECIES.

The following key, based upon spine characters, may be useful in case of incomplete material. Forms found within the boundaries of the United States are printed in italics. The species and varieties are indicated only by their specific or varietal names, and the numbers refer to the serial numbers of the synoptical presentation.

** Some of the spines hooked.*

— Central spines none.

pubispinus (29).

—— Central spine solitary.

Spines annulate.

emoryi (11).

Spines not annulate.

Some radials and the central hooked.

wrightii (23), *pubispinus* (29).

Only the central hooked.

muhlenpfordtii (32).

+++ Central spines 4.

++ Some or all of the spines annulate.

Radials 8 to 11.

All the spines annulate.

peninsulæ (10).

Only the centrals annulate.

longihamatus (20), *brevispinus* (21).

Radials 12 to 14.

cylindraceus (9), *hamatocanthus* (19).

Radials 18 to 28.

wislizeni (14).

++ ++ None of the spines annulate.

Radials 7 or 8.

Only a central hooked.

chippiei (25).

Some radials and a central hooked.

uncinatus (22), *sinuatus* (30).

Radials 9 to 11.

spinosior (26), *scheerii* (28), *sinuatus* (30).

Radials 12 to 18.

brevihamatus (27), *scheerii* (28), *sinuatus* (30).

+ + + + Central spines 5 to 8.

Radials 6 to 10: centrals annulate.
cornigerus (13).
Radials 12 to 14: centrals annulate.
hamatocanthus (19).
Radials 20: no annulate spines.
polyancistrus (24).

** * None of the spines hooked.*

+ Central spines none.

Ribs 8 to 10, broad.
horizonthalonius (5).
Ribs 40 to 55, very thin and wavy.
phyllacanthus (33).

— + Central spines solitary.

Radials 5 to 9.
Ribs 8 to 10, broad.
horizonthalonius (5), ingens (6).
Ribs 13 to 21.
texensis (4), *emoryi* (11), rectispinus (12).
Ribs 40, very thin and wavy.
lancifer (34).
Radials 14 to 22.
Ribs 13.
setispinus (31).
Ribs 21.
erectocentrus (47).
Ribs 36 to 40.
spinosus (35).

+ + + Central spines 2 or 3.

Radials none: ribs 10 to 15.
major (36).
Radials 8: ribs 8.
papyracanthus (49).
Radials 11 to 13: ribs 13.
sileri (48).
Radials 14 to 16: ribs 13.
setispinus (31).

+ + + + Central spines 4.

Ribs 8.
Radials 8 to 10.
hystrichacanthus (37), bicolor (38), *papyracanthus* (49).
Radials 11 to 17.
bicolor (38), *schottii* (39).
Ribs 13 to 21.
Spines all rigid and annulate.
polycephalus (1), *xeranthemoides* (2), parryi (3), *viridescens* (8).
At least some of the radials setaceous or bristly.
lecontei (15), jonesii (16).
Spines dissimilar (one or more flattened).
orcuttii (40), *limitus* (41).
Spines similar (all flat or all terete), closely interwoven.
johnsoni (42), *intertextus* (45), *dasyacanthus* (46).
Ribs 36 to 40.
spinosus (35).

→ → → → → *Central spines 5 to 7.*

Radials 3.

pilosus (17).

Radials 7 to 9.

pringlei (18).

Radials 21.

unguispinus (44).

← ← ← ← ← ← *Central spines 8 to 10.*

Radials 10 to 14.

octocentrus (43).

Radials 16 to 30.

simpsoni (50), *minor* (51), *robustior* (52).

* * * *Spines entirely wanting.*

myriostigma (7).

GEOGRAPHICAL DISTRIBUTION.

The genus *Echinocactus* has a strong development within the United States, but has no such northern extension as *Cactus*, its extreme northern limit being in the southern borders of Colorado, Utah, and Nevada, unless we except the possible occurrence of *E. simpsoni robustior* in Washington. With more careful exploration, especially of the Great Basin region, other forms will be discovered, but as recognized in this revision, 36 are known within our borders, 15 of which are restricted to the United States. Owing to the insufficiency of knowledge no statement can be made concerning the distribution of Mexican forms, and nothing very satisfactory concerning those occurring within the United States.

No *Echinocactus* has such an east and west distribution along our borders as have some species of the genus *Cactus*, the only one approaching any such distribution being *cylindraceus*, which seems to be a Lower Californian form that has extended from southeastern California to southern Utah and southwestern Texas, although it may have an equally wide Mexican distribution. All the other species seem to have extended northward along comparatively narrow lines, and indicate in a general way their Mexican origin. Other Lower Californian forms which extend within our boundaries are: *peninsulæ*, which only reaches the southern borders of California; and *emoryi* and *lecontei*, which are also Sonoran, the former ranging northward in the lower basin of the Colorado (extreme southeastern California and adjacent southwestern Arizona), the latter extending farther northward to southern Nevada and southern Utah. The occurrence of forms in Lower California which seem best referred to *wislizeni* is somewhat puzzling, as otherwise that species has been found restricted to a much more eastern distribution, one of Chihuahuan origin. The only pure Sonoran form that reaches us, so far as recorded, is *polycephalus*, which extends northward through the lower basin of the Colorado to southern Nevada and southern Utah, an extension resembling that of *lecontei*. Types from Chihuahua and Coahuila have extended into Texas, usually ranging

eastward throughout its southern borders; *horizonthalonius*, *intertextus*, and *dasyacanthus* are confined to the very usual narrow northern extension between the Pecos in Texas and the Upper Rio Grande in New Mexico; *longihamatus*, *brevihamatus*, and *scheerii* are forms which belong to the region of the "Great Bend" of the Rio Grande; while *wrightii*, *muhlenpfordtii*, and *texensis* are found throughout the southern border of the State, the first extending from El Paso to the mouth of the Rio Grande, the second from El Paso to San Antonio, the third from the Pecos to the Colorado of Texas. The last three species, doubtless, have an equally wide east and west Mexican distribution. In opposition to this usually eastern extension of Chihuahuan and Coahuilan forms, the three following extend westward from the Pecos-El Paso region into Arizona, the first reaching southern Utah: *wislizeni*, *sinuatus*, and *erectocentrus*. From the low country of eastern Mexico *setispinus* and *schottii* reach the basin of the Lower Rio Grande, the former extending as far northward as the Brazos.

The fifteen forms said to be restricted to the United States doubtless include some that are Mexican, and the statements here made are simply based upon the present record. Naturally the region of highest northern extension shows the greatest number of these peculiar forms, and such extension has evidently been most favored by the conditions of the Colorado basin, Nevada, Utah, and Colorado, having been reached through this avenue. The most prominent northern type is *simpsoni* and its varieties *minor* and *robustior*, the species ranging through Colorado, Utah, and Nevada, *minor* being restricted to Colorado and *robustior* to Nevada, with a possible high northern extension. In the region comprising the southwestern corner of Colorado, southern Utah, southern Nevada, northern Arizona, and adjacent California, we find the largest display of forms that do not seem to have Mexican representation. In addition to the three already mentioned, there are *xeranthemoides*, *polyancistrus*, *whipplei*, *spinosior*, *pubispinus*, *johnsoni*, *octocentrus*, and *sileri*, making eleven of our fifteen forms. Of the remaining four, *hamatocanthus* and *brevispinus* belong to the "Great Bend" region of Texas; *viridescens* is a form of extreme southern California, and the peculiar *papyracanthus*, restricted so far as known to New Mexico in the neighborhood of Santa Fé. The species *orcuttii* and *limitus* are as yet recorded only from the boundary between California and Lower Calfornia; but doubtless they with *viridescens* will be found to have a Lower Californian distribution.

5. CEREUS Mill. Gard. Dict. ed. 8 (1768).

Plants of various habit (globose to cylindrical, trailing, climbing, or erect), sometimes very large, with spine-bearing ribs: flower-bearing areolæ close above fully developed spine-bearing areolæ: ovary bearing scales which are naked or woolly and often spiny in the axils: fruit succulent: seeds almost without endosperm: embryo mostly hooked,

with short or foliaceous cotyledons.—*Echinopsis* Zucc. (1837); *Cephalocereus* Pfeiff. (1838); *Cephalophorus* Lem. (1838); *Pilocereus* Lem. (1839); *Echinonyctanthus* Lem. (1839); *Echinocereus* Engelm. (1848); *Cleistocactus* Lem. (1861).

It is often perplexing to distinguish between the low forms of *Cereus* and *Echinocactus* in the absence of complete material. But the fact that the flowers of *Echinocactus* are developed just above the nascent spine-bearing areolæ, and those of *Cereus* just above the fully matured bunches of spines, results in making the flowers of the one terminal and of the other lateral. Even in the absence of flowers it is very seldom that the position and age of flower-bearing areolæ can not be easily determined.

Our information with regard to the large species of *Cereus*, even those which are of economic value throughout Mexico, is very scanty. In 1869 Dr. Engelmann visited Dr. Weber in Paris, who had collected *Cacti* extensively in central and southern Mexico, and had made a large accumulation of notes. These notes are now to be found among those of Dr. Engelmann, and although often incomplete, and even incoherent in the characterization of species, I have ventured to include them.

I. ECHINOCEREUS. *Stems oval or cylindrical: seeds tuberculate: embryo straight.*

* *Stems oval: ribs numerous (10 to 21): spines numerous (12 to 30), pectinate.*

– *Flowers green: central spines 1 to 3 cm. long; radials not crowded.*

1. **Cereus viridiflorus** Engelm. Pl. Fendl. 50 (1849).
Echinocereus viridiflorus Engelm. Wisliz. Rep. 7 (1848).

Subglobose, simple or sparingly branched, 2.5 to 7.5 cm. high: ribs 13, acute, scarcely interrupted: radial spines 12 to 18 (with 2 to 6 setaceous upper ones), straight and strictly radiant, 2 to 6 mm. long, laterals longest and reddish brown, the rest white (rarely purple); central none or a single stout, straight or curved spine (rarely a second more slender one) 12 to 14 mm. long, variegated purple and white: flowers 2.5 cm. long and wide, greenish-brown outside, yellowish-green within; petals obtuse: fruit elliptical and greenish, 10 to 12 mm. long: seeds 1 to 1.2 mm. long, tuberculate.—Type, Wislizenus 514 of 1846 in Herb. Mo. Bot. Gard.

From the Laramie Mountains of southern Wyoming, southward through Colorado to eastern New Mexico and the high plains of northwestern Texas. The most northern *Cereus*.

Specimens examined: WYOMING (*Hayden* of 1856, at base of Laramie Mts.): COLORADO (*Hall & Harbour* 69 of 1861; *Scoville* of 1869; *Greene* 132; *Martindale* of 1879; *Jones* 103): NEW MEXICO (*Fendler* 278; *Wright*, near Santa Fé; *Evans* of 1891): TEXAS (*Wislizenus* 514 of 1846; *Wright* of 1849; *Bigelow* of 1853): also specimens cultivated in Mo. Bot. Gard. in 1861; and growing in same garden in 1892 and 1893.

This and the following variety are exceedingly variable as to color of radial spines and presence of one or two centrals. Some clusters of spines may be all red, others all white, others variegated; and in the spring the bright purple and white spines are far more showy than the inconspicuous greenish flowers, the hues of color often

occurring in bands about the plant. In the Evans specimen, from Brewster County, New Mexico, the ribs are 14, the radial spines as many as 20, and the centrals 3 or 4, a form which was also seen among the plants cultivated in the Missouri Botanical Garden.

2. Cereus viridiflorus tubulosus, nom. nov.

Cereus viridiflorus cylindricus Engelm. Syn. Cact. 278 (1856), not *C. cylindricus* Haw.

Larger and becoming cylindrical, 7.5 to 20 cm. high and 2.5 to 5 cm in diameter: spines 4 to 12 mm. long; the central (when present) longer (12 to 20 mm.) and stouter: petals acute. (*Ill.* Cact. Mex. Bound. t. 36)—Type, Wright of 1851 in Herb. Mo. Bot. Gard.

Southwestern Texas, from the Pecos to the region about El Paso.

Specimens examined: TEXAS (*Wright* of 1851; *Evans* of 1891): also numerous specimens in cultivation.

3. Cereus chloranthus Engelm. Syn. Cact. 278 (1856).

Cylindrical, simple or sparingly branching at base, 7.5 to 25 cm. high, 3.5 to 5 cm. in diameter: ribs 13 to 18, somewhat interrupted: radial spines 12 to 20, laxly radiant and pectinate, setiform and white, 4 to 10 mm. long, the lower laterals longest (8 to 10 mm.) and often purplish at apex, upper ones shortest, 5 to 10 additional shorter setaceous ones above; centrals 3 to 6 (none in young plants), the two upper shorter (12 mm), divergent upward and mostly purplish, the 1 to 3 lower ones longer (18 to 30 mm.), divergent and deflexed, white: flowers 2.5 cm. long, yellowish green, always low down on the plant (usually below the middle): fruit subglobose, 1.2 cm. in diameter or less, spiny: seeds orbicular and compressed, 1.0 to 1.2 mm. in diameter, confluent-tuberculate. (*Ill.* Cact. Mex. Bound. t. 37 and 38)—Type, Wright and Bigelow specimens in Herb. Mo. Bot. Gard.

Common on stony hills about El Paso, Texas, and in adjacent New Mexico.

Specimens examined: TEXAS (*Wright* of 1851 and 1852; *Bigelow* of 1852; *G. R. Vasey* of 1881, El Paso; *Le Conte* 12; *Briggs* of 1892; *Trelease* of 1892): NEW MEXICO (*Evans* of 1891: *Nealley* of 1891): also growing in Missouri Botanic Garden in 1892 and 1893.

+ + Flowers yellow: central spines 5 to 6 mm. long: radials crowded.

4. Cereus dasyacanthus Engelm. Pl. Fendl. 50 (1849).

Echinocereus dasyacanthus Engelm. Wisliz. Rep. 16 (1848).

Ovate or subcylindric, 12.5 to 30 cm. high, 5 to 10 cm. in diameter, simple or sparingly branched at base, subcespitose: ribs 15 to 21, straight or oblique, somewhat interrupted, with crowded areolæ: spines 20 to 30, straight, rigid, stellately spreading, porrect in every direction and interlocked, ashy-gray or reddish (white in weaker plants); radials 16 to 24, laterals longest (12 to 14 mm.) and somewhat bulbous at base, upper shorter (6 to 8 mm.) and slender, lower about 10 mm. long and

stoutest; centrals 3 to 8, stouter, deflexed or porrect in every direction: flowers near the vertex, 7.5 cm. or more long, yellow: fruit subglobose and spiny, green or greenish-purple, 2.5 to 3.5 cm. in diameter: seeds subglobose, 1.2 long, strongly tuberculate. (*Ill.* Cact. Mex. Bound. t. 39, 40, 41, f. 1 and 2)—Type, Wislizenus of 1846 in Herb. Mo. Bot. Gard.

Common about El Paso, Texas, thence down to the canyon of the Rio Grande, and west into Arizona.

Specimens examined: TEXAS (*Wislizenus* of 1846; *Wright* of 1849, 1850, 1851, 1852, and 1857; *Bigelow* of 1852; *Miller* of 1881; *G. R. Vasey* of 1881, El Paso; *Evans* of 1891; *Trelease* of 1892): ARIZONA (*Lemmon* of 1881; *Wilcox* of 1894, Ft. Huachuca): also growing in Missouri Botanical Garden in 1892 and 1893.

The whole plant is densely covered by the innumerable ashy-gray or reddish spines. When fully ripe the fruit is said to be "delicious to eat, much like a gooseberry."

5. Cereus dasyacanthus neo-mexicanus, var. nov.

Differs in the remote areolæ (1 to 1.5 cm. apart), fewer spines (11 radials and 4 centrals), which are much stouter, 10 to 12 mm. long, radiating, scarcely (if at all) pectinate, and larger seed (1.5 mm. in diameter).—Type, Wright 366 in Herb. Mo. Bot. Gard.

Southeastern New Mexico.

Specimens examined: NEW MEXICO (*Wright* 366).

6. Cereus ctenoides Engelm. Cact. Mex. Bound. 31 (1859).

Ovate, subsimple, 5 to 10 cm. high, 3.5 to 6.5 cm. in diameter: ribs 15 or 16, usually oblique and somewhat interrupted, with crowded areolæ (2 mm. apart): spines rigid and interlocked, with bulbous base, whitish and at length ashy, 2 to 8 mm. long; radials 14 to 22, pectinate, laterally compressed and often recurved, lowest 2 to 4 mm., lateral 6 to 8 mm., uppermost 1 to 2 mm. long; centrals 2 or 3 (rarely 4), stout, in one longitudinal series, 2 to 6 mm. long: flowers 5.5 to 8 cm. long and broad, bright-yellow with a light-green center: ovary spiny. (*Ill.* l. c. t. 42)—Type, the Wright and Bigelow material in Herb. Mo. Bot. Gard.

From Eagle Pass, Texas, to the Pecos, and southward into Coahuila and Chihuahua.

Specimens examined: TEXAS (*Bigelow* of 1853, at Eagle Pass; *Wright*, at the Pecos): COAHUILA (*Bigelow* of 1853, about Santa Rosa): CHIHUAHUA (*Pringle* 254 of 1885, distributed as *dasyacanthus*.)

A specimen, probably from Oracle, Arizona (*Evans* of 1891), seems to belong with these forms, but is hardly referable to any of them. It is simple or proliferous, ovate-cylindrical, 10 to 20 cm. high, with 16 tuberculate ribs, red-tipped spines, 10 to 12 radials 6 to 10 mm. long (the upper much shorter), mostly 3 darker-red centrals, the lower one stouter and slightly deflexed equaling the radials, the 2 upper usually much shorter. It is possibly a form of *ctenoides*, but the centrals are not in one longitudinal series. There is some uncertainty also as to its station, so that this possible western extension of *ctenoides* can not be affirmed.

+++ *Flowers red: radial spines crowded.*

++ *Central spines very short (longer in* radians) *or none.*

7. **Cereus cæspitosus** Engelm. Pl. Lindh. 247 (1845).
Echinocereus cæspitosus Engelm. Wisliz. Rep. 26 (1848).
Cereus concolor Schott, Engelm. Pacif. R. Rep. iv, errata and notes, ii (1856).
Cereus cæspitosus minor and *major* Engelm. Syn. Cact. 280 (1856).

Ovate-globose to ovate-cylindrical, usually 2.5 to 5 cm. in height and diameter (rarely as much as 12.5 to 15 cm. high and 5 to 9 cm. in diameter), cespitose (often 5 to 12 heads) or sometimes almost or quite simple: ribs 12 or 13, straight, with confluent tubercles and approximate areolæ: spines white (sometimes rosy or brown), somewhat or not at all interlocked; radials 20 to 30, pectinate, straight or subrecurved, the upper and lower shorter, the lateral longer (4 to 8 mm.); centrals none, or rarely 1 or 2 very short ones: flowers rose-purple, 5 to 7.5 cm. long and broad, the tube with numerous extra-axillary pulvini bearing brown or black bristles: fruit green, ovate, 18 to 20 mm. long: seed obliquely obovate, strongly tuberculate, black, 1.2 to 1.4 mm. long, sometimes almost globose. (*Ill.* Cact. Mex. Bound. t. 43 and 44)—Type, Lindheimer 402 of 1845 in Herb. Mo. Bot. Gard.

From the Canadian and Arkansas rivers, in Indian Territory, southward through Texas east of the Pecos, and into the states of Mexico east of Chihuahua. Apparently the most eastern *Cereus*, with a western limit near the 100th meridian.

Specimens examined: TEXAS (*Lindheimer* 402 of 1845 and 1851; *Wright* of 1849 and 1850; *Smith* of 1856; *Hall* 235; *Miss Soulard* of 1883): COAHUILA (Mo. Bot. Gard. of 1890): SAN LUIS POTOSI (*Eschanzier* of 1891): also cultivated in Harvard Botanic Garden in 1846 and 1849; and in Missouri Botanic Garden in 1845 and 1846.

This species is said by Prince Salm to be cultivated in Europe under the name *Echinopsis reichenbachiana*, and to be confused with *pectinatus*. The Eschanzier material from San Luis Potosi often has 3 central spines, but *cæspitosus* is distinguished from its allies by having several lower spines much shorter and weaker than the laterals.

8. **Cereus cæspitosus castaneus** Engelm. Pl. Lindh. 203 (1850).

Differs in having chestnut-brown or reddish spines.—Type, Lindheimer of 1847 in Herb. Mo. Bot. Gard.

Southeastern Colorado to eastern Texas.

Specimens examined: TEXAS (*Lindheimer* of 1847 and 1852; *Hall* 235 of 1875, near Austin; *Trelease* of 1892): COLORADO (*Brandegee* of 1875): also cultivated in Harvard Botanic Garden in 1882.

9. **Cereus pectinatus** (Scheidw.) Engelm. Pl. Fendl. 50 (1849).
Echinocactus pectinatus Scheidw. Bull. Brux. v, 492 (1838).
Echinocactus pectiniferus Lem. Cact. Nov. 25 (1838).
Echinocereus pectinatus Engelm. Wisliz. Rep. 25 (1848).
Cereus pectiniferus Lab. Mon. Cact. 320 (1858).

Ovate-cylindrical, simple, 17 to 18 cm. high: ribs 18 to 23, tuberculate-interrupted, with approximate areolæ: radial spines 16 to 20, subrecurved, appressed-pectinate, white with rosy tip, upper and lower

shorter (4 mm.), lateral longer (8 mm.); centrals 2 to 5 (mostly 3), in a single longitudinal series, very short (1 to 2 mm): flowers purple, 7.5 cm. long and broad, with red or purple spiny bristles on tube: fruit ovate-globose, spiny: seed tuberculate. (*Ill.* Hook. Bot. Mag. t. 4190)—Type unknown.

Chihuahua, Coahuila, and southward.

Specimens examined: CHIHUAHUA (*Wislizenus* of 1847): COAHUILA (*Palmer* of 1880): NUEVO LEON (*Poselger* of 1850 and 1855).

It has been suggested that this is identical with its northern representative *caespitosus;* but *pectinatus* is always a larger plant, generally much larger, is always simple, has more numerous ribs, fewer radial spines, and constant centrals.

10. Cereus pectinatus rigidissimus Engelm. Syn. Cact. 279 (1856).

Plant 10 to 20 cm. high, 5 cm. in diameter: ribs 20 to 22: radial spines 15 to 22, subulate from a bulbous base, very stout and rigid, variegated white, yellow, or reddish, interlocking, upper 3 to 6 setaceous, laterals 12 to 16 (6 to 9 mm. long), lowest one scarcely shorter (4 mm.); centrals none.—Type, Schott 6 in Herb. Mo. Bot. Gard.

From southwestern Texas west to Arizona and southward into Chihuahua and Sonora.

Specimens examined: TEXAS (*Nealley* of 1891; *Trelease* of 1892): ARIZONA (*G. R. Vasey* of 1881, Pantana; *Lemmon* of 1882, Huachuca Mts.; *Pringle* of 1884, distributed as *pectinatus; Palmer* 447 and 475 of 1890, Ft. Huachuca, the latter distributed as *caespitosus*, and the former accompanied by seeds of *Echinocactus intertextus; J. W. Toumey* of 1892; *T. E. Wilcox* of 1894, Ft. Huachuca): CHIHUAHUA (*Wislizenus* 257 of 1847): SONORA (*Schott* 6): also growing in Mo. Bot. Gard. 1893.

Distinguished by the greater stoutness and rigidity of its radial spines and by the absence of centrals. Mr. Schott, who collected it in Sonora, in the Sierras of Pimeria Alta and westward, says that the local name is "cabeza del viejo." Apparently a very common form in southern Arizona. The spines are very variable in coloration. The plant always appears parti-colored, a pink and white, or red and yellow and white, or even a dark red with areas of dark brown, or even jet black. Some of the forms look very much like *caespitosus*, but the habit is different, and that species ranges much further east. Besides, *pectinatus rigidissimus* has stout radials, much interlocking with each other on the same rib, and with those of adjoining ribs. Pringle's Arizona specimens have remarkably long radials, the laterals reaching 15 mm., and the lowest 10 mm.

11. Cereus pectinatus centralis, var. nov.

Plant 6 to 8 cm. high: centrals usually 4, the lowest very short (3 to 4 mm.) and porrect, the upper two or three as long as the radials (sometimes longer), and recurved upward.—Type, Wilcox of 1894 in Nat. Herb.

Arizona, near Fort Huachuca.

Specimens examined: ARIZONA (*T. E. Wilcox* of 1894).

In a casual examination the short porrect central looks as if it were solitary. The variety *spinosus* has one long solitary central, and *centralis* seems to carry the same tendency further. It may be a good species. The centrals are not in a single vertical row, as usual in *pectinatus*, but are more after the pattern of *dasyacanthus*, but otherwise unlike that species.

12. Cereus pectinatus spinosus, nom. nov.

Cereus pectinatus armatus Poselger, Allg. Gart. Zeit. xxi, 134 (1853), not *Cereus armatus* Otto.

Ribs 15 or 16: radial spines 16 to 20; central solitary and longer than the radials.—Type unknown.

Near Monterey, Nuevo Leon.

13. Cereus adustus Engelm. Pl. Fendl. 50 (1849).

Echinocereus adustus Engelm. Wisliz. Rep. 20 (1848).

Ovate, 4 to 10 cm. high, 2.5 to 5 cm. in diameter: ribs 13 to 15, with oval approximate areolæ: radial spines 16 to 20, appressed, white with dark tip, the 4 or 5 upper short (2 mm.) and setaceous, the lateral and lower longer (8 to 10 mm. and 4 mm.) and stouter; centrals none: flower and fruit unknown.—Type, Wislizenus of 1846, in Herb. Mo. Bot. Gard.

In the mountains of Chihuahua, in "Cosihuiriachi."

Specimens examined: CHIHUAHUA (*Wislizenus* of 1846 in part).

This species is distinguished from its allies by its fewer ribs, broader areolæ, lowest spines much as in *pectinatus*, and no centrals.

14. Cereus adustus radians (Engelm.).

Echinocereus radians Engelm. Wisliz. Rep. 20 (1848).

Upper radials 2 to 4 mm. long, lateral 10 mm., lower 6 mm.; central solitary, much stouter, porrect, brown or black, 2.5 cm. long.—Type, Wislizenus of 1846 in Herb. Mo. Bot. Gard.

In the mountains of Chihuahua, in "Cosihuiriachi."

Specimens examined: CHIHUAHUA (*Wislizenus* of 1846 in part).

++ Central spines 8 to 50 mm. long.

15. Cereus roetteri Engelm. Cact. Mex. Bound. 33 (1859).

Cereus dasyacanthus minor Engelm. Syn. Cact. 279 (1856).

Ovate-cylindrical, 12.5 to 15 cm. high: ribs 10 to 13, tuberculately interrupted, with areolæ 8 to 12 mm. apart: spines subulate from a bulbous base, reddish with dark tip, at length ashy, 8 to 16 mm. long; radials 8 to 15 (often setaceous ones added above), lateral longer (lower 10 to 16 mm., upper 4 to 6 mm.), lowest spine shorter; centrals 2 to 5, stouter, often somewhat shorter, usually 8 to 12 mm. long (rarely one longer): flowers purplish-red, 6 to 7.5 cm. long: fruit subglobose, 16 to 20 mm. long: seed obliquely obovate, strongly and irregularly tuberculate, 1.4 mm. long. (*Ill.* Cact. Mex. Bound. t. 41, f. 3–5)—Type, Wright of 1851 and 1852 and Bigelow of 1852 in Herb. Mo. Bot. Gard.

From the region about El Paso, Texas, southward into Chihuahua and westward into Arizona.

Specimens examined: TEXAS (*Wright* of 1851 and 1852; *Briggs* of 1892): ARIZONA (*Lemmon* of 1881): CHIHUAHUA (*Bigelow* of 1852).

16. Cereus rufispinus Engelm. Pl. Fendl. 50 (1849).

Echinocereus rufispinus Engelm. Wisliz. Rep. 20 (1848).

Ovate-cylindrical, 10 cm. high and 5.5 cm. in dameter: ribs 11, with approximate areolæ: radial spines 16 to 18, interlocked and at length

appressed, 3 to 5 upper setaceous, short (2 to 4 mm.), white, lateral elongated (14 to 18 mm.), recurved and reddish, lower 8 mm. long; central solitary, much stouter, reddish and porrect, 2.5 cm. long: flowers red, with tube over 5 cm. long: fruit unknown.—Type, Wislizenus of 1846 in Herb. Mo. Bot. Gard.

In the mountains of Chihuahua, "Cosihuiriachi, mountains west of Chihuahua."

Specimens examined: CHIHUAHUA (*Wislizenus* of 1846).

17. Cereus longisetus Engelm. Syn. Cact. 280 (1856).

Ovate-cylindrical, subsimple, 15 to 22.5 cm. long and 5 to 7.5 cm. in diameter: ribs 11 to 14, distinctly tuberculate: spines setaceous, white, flexible and spreading; radials 18 to 20, straight, lower (10 to 14 mm. long) much longer than the upper (5 to 6 mm.) which are also more slender; centrals 5 to 7, the upper hardly longer than the radials, the 3 lower elongated (2.5 to 5.5 cm.), divaricate, often flexuose and deflexed: flowers said to be red: fruit unknown. (*Ill.* Cact. Mex. Bound. t. 45)—Type, Bigelow of 1853 in Herb. Mo. Bot. Gard.

Coahuila, "Santa Rosa, south of the Rio Grande."

Specimens examined: COAHUILA (*Bigelow* of 1853).

*** Stems oval: ribs fewer (5 to 13); spines few (3 to 12), longer, not pectinate.*

– Flowers purple (yellow in flavilorus).

++ Central spines usually 3 or 4.

18. Cereus engelmanni Parry, Amer. Jour. Sci. ser. 2, xiv, 338 (1852).

Ovate-cylindrical, 12.5 to 30 cm. high (sometimes reaching 45 cm.), 5 to 7.5 cm. in diameter, simple or sparingly branched at base, loosely cespitose (4 to 8 stems together): ribs 10 to 13, tuberculate, with areolæ 4 to 8 mm. apart: radial spines 12 to 14 (usually 13), slender, 6 to 12 mm. long, white with dark tip, upper (about 4) setaceous and much shorter, lateral (6) and lower (3) longer and stouter, straight or a little incurved; centrals 4 (rarely 5), straight and angled, 2.5 to 5 cm. long, cruciate, the 3 upper yellow and erect, the lower one white, porrect or deflexed: flowers purple, 5 to 7.5 cm. long: fruit ovate, fleshy, spiny (at length naked), 4 cm. long, 2.5 cm. in diameter: seed obliquely obovate, black and tuberculate, 1.2 to 1.4 mm. long. (*Ill.* Cact. Mex. Bound. t. 57)—Type, Parry of 1850 in Herb. Mo. Bot. Gard.

From Salt Lake Desert, Utah, westward to the eastern slopes of the California Sierras, and southward into Sonora, and Lower California; also on Cedros Island.

Specimens examined: NEVADA (*Shockley* 313): ARIZONA (*Bischoff* of 1871; *Mrs. Thompson* of 1872; *Coues & Palmer* 303; *Palmer* of 1878): CALIFORNIA (*Parry* of 1850, "Mountains about San Felipe;" *Palmer* of 1870 and 1876; *Lemmon* of 1878; *Engelmann* of 1880; *Parish Bros.* 165 of 1882, San Diego Co.): LOWER CALIFORNIA (*Gabb* 14 of 1867;

Palmer of 1870; *Brandegee* of 1889, San Julio): SONORA (*Schott* of 1855): also growing in Missouri Botanic Garden in 1893.

Dr. Merriam reports that this is the "most widely-diffused *Cereus* over the deserts of southern Nevada and southeastern California." Mr. Brandegee reports it from San Julio and San Pablo, Lower California.

19. Cereus engelmanni variegatus Engelm. Syn. Cact. 283 (1856).

The 3 upper central spines recurved, divaricate, black and white mottled, the lower one longer, white and decurved: fruit 1.2 to 1.6 mm. long. (*Ill.* Pacif. R. Rep. iv, t. 5, f. 4–7)—Type, Bigelow of 1854 in Herb. Mo. Bot. Gard.

From Utah and Nevada southward into Arizona and southeastern California.

Specimens examined: UTAH (*Johnson* of 1870; *Mrs. Thompson* of 1872; *Parry* of 1874; *Palmer* of 1877): NEVADA (*Gabb* of 1867): ARIZONA (*Bigelow* of 1854; *Coues and Palmer* of 1865): CALIFORNIA (*G. R. Vasey* of 1880, San Diego Co.; *Coville & Funston* 187, Death Valley Exped.; *Trelease* of 1892).

20. Cereus engelmanni chrysocentrus Engelm. Syn. Cact. 283 (1856).

More cylindrical: areolæ 12 to 14 mm. apart: upper radial spines 6 to 10 mm. long, lateral 10 to 14 mm., lower 14 to 24 mm.; the three or four upper centrals 5 to 7.5 cm. long, very stout and erect, deep golden yellow, the lower one shorter (3.5 to 6 cm.), white, flattened and deflexed. (*Ill.* Pacif. R. Rep. iv, t. 5, f. 8–10)—Type not found in the Engelmann collection, and probably lost.

Deserts of southeastern California.

Specimens examined: CALIFORNIA (*Coville & Funston* 154, Death Valley Exped.).

The whole series of *engelmanni* forms is exceedingly variable as to color, and relative length and stoutness of the central spines, and forms are frequently found intergrading between the three here recognized.

21. Cereus brandegei, sp. nov.

Size, habit, and number of ribs unknown: ribs tuberculate, with areolæ 10 to 15 mm. apart: spines at first variegated, dark and reddish, becoming more or less ashy-black; radials 10 to 16, rigid, terete, radiant, mostly uniform, 8 to 12 mm. long; centrals almost always 4, very stout and prominent, 3 to 6 cm. long, cruciate, conspicuously angled and compressed, sometimes twisted, the lowest usually the most flattened and sword-like (2 to 3 mm. broad): flowers red, 4 to 5 cm. long, with conspicuous woolly and spine-bearing areolæ over the ovary and lower part of the calyx: ripe fruit not seen.—Type in Herb. Brandegee.

Lower California, El Campo Allemand and San Gregorio.

Specimens examined: LOWER CALIFORNIA (*Brandegee* of 1889).

22. Cereus stramineus Engelm. Syn. Cact. 282 (1856).

Ovate-cylindrical tapering toward apex, 12.5 to 22.5 cm. high and 5 to 7.5 cm. in diameter, cespitose-glomerate (often 100 to 200 heads in

one hemispherical mass): ribs 8 to 13, tuberculate, with areolæ 2 to 2.5 cm. apart: radial spines 7 to 14 (mostly 8), straight or curved, white, 2 to 3 cm. long; centrals 3 or 4, elongated (5 to 8.5 cm.) and angled, straight or variously twisted, often flexuous, straw-colored (often red or brown when young), the upper divergent upwards, the lower one broader, porrect or a little deflected: flowers bright-purple, 7.5 to 10 cm. long: fruit ovate-subglobose, red, 3.5 to 5 cm. long, with bunches of elongated spines, edible: seeds obliquely obovate, tuberculate, 1 to 1.4 mm. long. (*Ill.* Cact. Mex. Bound. t. 46, 47, and 48, f. 1)—Type, Wright of 1851 in Herb. Mo. Bot. Gard.

Abundant between the Pecos and El Paso, Texas, extending eastward in the Rio Grande region, westward to the Gila, and southward into Coahuila and San Luis Potosi.

Specimens examined: TEXAS (*Parry* of 1852; *Bigelow* of 1853; *Lemmon* 304; *Tweedy* of 1880; *Woodward* of 1889, cultivated; *Trelease* of 1892): NEW MEXICO (*Wright* of 1851; *Evans* of 1891, near Juno): ARIZONA (*G. R. Vasey* of 1881, Santa Catalina Mts.; *Rusby* 620 of 1883, Beaver Head; *T. E. Wilcox* of 1894): COAHUILA (*Palmer* 368, 369, 370, 371, 372): SAN LUIS POTOSI (*Parry & Palmer* 277; *Palmer*; *Pringle* 3,495; *Eschauzier* of 1891).

A species remarkable on account of the immense masses it forms covered with long flexuous straw-colored spines. Locally, it is known as "pitahaya" and "strawberry cactus," and Dr. Havard says that the "fruit is equal or superior in quality and flavor to the best strawberry, the thin skin with few spines easily peeling off."

23. Cereus dubius Engelm. Syn. Cact. 282 (1856).

Ovate-cylindrical, cespitose, 12.5 to 20 cm. high, light-green: ribs 7 to 9, broad and tuberculate, with distant areolæ: spines white and somewhat translucent; radials 5 to 8, terete or subangular, 12 to 30 mm. long, upper often wanting; centrals 1 to 4, angled, 3.5 to 7.5 cm. long, straight or often curved: flowers pale-purple, 6 cm. long and wide: fruit 2.5 to 3.5 cm. long, green or purplish, spiny: seed obliquely globose-ovoid, confluent-tuberculate, 1.2 to 1.4 mm. long. (*Ill.* Cact. Mex. Bound. t. 50)—Type, Wright 410 in Herb. Mo. Bot. Gard.

Sandy bottoms of the Rio Grande from El Paso, Texas, downward, and southward in Chihuahua, Coahuila, and San Luis Potosi.

Specimens examined: TEXAS (*Wright* 410; *Parry*): CHIHUAHUA (*Pringle* 252): COAHUILA (*Palmer* of 1880): SAN LUIS POTOSI (*Parry & Palmer* 277).

Closely allied to *stramineus*, but not so cespitose, and spines all white.

24. Cereus acifer Otto; Salm, Cact. Hort. Dyck. 189 (1850).

Plant about 12.5 cm. high and 5 cm. in diameter, branching at base and apex, bright-green: ribs 10, repand, with areolæ 8 mm. apart: spines rigid; radials 8 to 10, radiant, pale-yellowish with reddish base, lower longer, 10 to 20 mm. long; centrals 4, stouter, purplish-brown, the 3 upper erect, the lower one very stout and subdeflexed, about 3.5 cm. long.—Type unknown, unless that cultivated in Hort. Dyck. represents it.

San Luis Potosi.

Specimens examined: SAN LUIS POTOSI (*Parry & Palmer* 278; *Parry* of 1878): also specimens cultivated in Hort. Jacoby in 1857; Hort. Dyck. in 1857; Missouri Botanic Garden in 1883.

25. Cereus flaviflorus Engelm. MSS.

Cylindrical, much branched at base and densely aggregated, forming clumps 3 to 9 dm. in diameter, branches about 30 cm. long or less and 2.5 to 5 cm. in diameter: ribs few, with areolæ far apart: spines very robust and rather irregular; radials about 10, strongly unequal; centrals 4, angled, compressed, straight, curved, or twisted: flowers yellow.—Type, Gabb 10 of 1867 in Herb. Mo. Bot. Gard.

In rocky ground, west of San Borgia, Lower California.

Specimens examined: LOWER CALIFORNIA (*Gabb* 10 of 1867).

This species closely resembles the next, and both are allied to *acifer*. The yellow flowers of this species, however, reported but not preserved by Mr. Gabb, are peculiar in the group. As the material is scanty, and the differences indicated may be specific, Dr. Engelmann's separation of the three species has been preserved.

26. Cereus sanborgianus, sp. nov.

Cylindrical, very much branched at base and densely aggregated, forming clumps 4 to 9 dm. in diameter, branches about 30 cm. long and 2.5 to 6 cm. in diameter: ribs tuberculate, with approximate areolæ: spines pale; radials 12 to 15, very slender but rigid, 7 to 20 mm. long, lower longer and stouter; centrals mostly 4 (rarely 5 to 7), cruciate, very stout, angled and straight, 3 to 6 cm. long, the lower one longest, flat (2.5 mm. broad) and deflexed.—Type, Gabb 9 of 1867 in Herb. Mo. Bot. Gard.

Rocky table lands south of San Borgia, Lower California.

Specimens examined: LOWER CALIFORNIA (*Gabb* 9 of 1867).

This species is indicated as new in Dr. Engelmann's notes, but with no name.

27. Cereus cinerascens DC. Rev. Cact. 116 (1828).

Cylindrical, simple, erect, 20 to 25 cm. high and more, 5 cm. in diameter: ribs 7 or 8, obtuse and tuberculate, with areolæ 10 to 12 mm. distant: spines about 14, white, slender but rigid; radials 10 (in young plants often 8), radiant, 12 to 18 mm. long; centrals 4 (in young plants often 1), erect-divergent, 2.5 cm. long, often somewhat brownish.—Type unknown.

Southern Mexico.

Specimens examined: S. MEXICO (*Bourgeau* 303, "mountains above Guadalupe;" *Gregg* 662).

-- -- *Central spine solitary, darker.*

28. Cereus fendleri Engelm. Pl. Fendl. 50 (1849).

Cereus fendleri pauperculus Engelm. l. c. 51.

Ovate or ovate-cylindrical, 7.5 to 20 cm. high, 5 to 7.5 cm. in diameter, simple or branching at base, cespitose, dark-green: ribs 9 to 12, straight or oblique, tuberculate, with areolæ 8 to 14 mm. apart: spines stout, very variable in length and color; radials 5 to 10 (mostly 7), straight

or curved, lowest stoutest, white and angular, 12 to 25 mm. long, next 2 almost as long (or longer), more terete, blackish above and white beneath or all blackish, then 2 white or dark or variegated, then 2 weaker, whiter, and shorter (6 to 14 mm.), often 2 more upper spines, and sometimes a slender or stout dark spine (24 to 30 mm. long) on upper edge of areola; central 1, stout and very bulbous at base, curved upward, reddish-black, teretish, 2.5 to 5 cm. long, rarely wanting: flowers deep violet-purple, 6 to 8.5 cm. broad: fruit ovate-globose, 2.5 to 3 cm. long, purplish-green, edible: seed curved, deeply and irregularly pitted, 1.4 mm. long.—Type, Fendler specimens in Herb. Mo Bot. Gard.

From Utah, southward through Arizona, New Mexico, and Southwestern Texas (extending eastward of the Pecos), into Sonora and Chihuahua.

Specimens examined: UTAH (*Ward* of 1875, at Glenwood): ARIZONA (*Coues & Palmer* of 1865; *Pringle* of 1881; *Palmer* 137, Ft. Defiance; *Rusby* 619½; *Trelease* of 1892; *Toumey* of 1892, Tucson; *Wilcox* of 1894, Ft. Huachuca): NEW MEXICO (*Fendler* 4, 62, 273, of 1846 and 1847; *Wright* 161 of 1849; *Thurber* of 1851; *Newberry* of 1858; *Palmer* 135, 137; *G. R. Vasey* of 1881, Socorro; *Rusby* 143, 144; *Evans* of 1891; *E. A. Mearns* 87 of 1892, Apache Mts.): TEXAS (*Wright* 71, 75, 228, of 1851; *Bigelow* of 1852 and 1853; *Trelease* of 1892; *Briggs* of 1892): SONORA (*Schott*): CHIHUAHUA (*Wright* 161, 228; *Bigelow* of 1852 and 1853): also cultivated in Missouri Botanic Garden in 1853.

A plant so variable in its spines that to include all the variations in a specific description is impossible. The chief distinguishing characters are the dark central very bulbous at base and curved upward, and the stout quadrangular lower radial. Pringle of 1881 from Arizona has a lower radial 2.5 to 3.5 cm. long. In his Bibliographical Index Dr. Watson suggests *Mamillaria fasciculata* Engelm.[1], as a synonym; but as that is really a *nomen nudum* it should be dropped.

29. Cereus enneacanthus Engelm. Pl. Fendl. 50 (1849).

Echinocereus enneacanthus Engelm. Wisliz. Rep. 27 (1848).

Ovate-cylindrical, obtuse, 7.5 to 15 cm. high, 3.5 to 6 cm. in diameter, simple or densely cespitose, bright-green: ribs 7 to 10, obtuse and tuberculate, with areolæ 12 to 20 mm. apart: spines stout, straight, angled, translucent; radials 7 to 12 (mostly 8), white, upper 6 to 10 mm. long, lateral 10 to 24 mm., lower 16 to 32 mm.; central 1 (often 1 to 3 additional shorter or almost equal angular ones above and diverging upward), teretish or angular or flattened, white or straw-colored or even darker, 30 to 50 mm. long: flowers bright purplish-red, 5 to 7.5 cm. long: fruit subglobose, 2 to 2.5 cm. long, greenish or purplish, edible: seed obliquely obovate, prominently tuberculate, 1 mm. or less long. (*Ill.* Cact. Mex. Bound. t. 48, f. 2–4, and t. 49)—Type, Wislizenus of 1847 and Gregg of 1847 in Herb. Mo. Bot. Gard.

From the lower Rio Grande, Texas, to El Paso, westward to Arizona and southward into Coahuila and Chihuahua.

Specimens examined: TEXAS (*Wislizenus* of 1847; *Wright* of 1851, and 1853, nos. 4, 5, 27, 28, 31, 97, 231; *Schott* 852; *Nealley* of 1891):

[1] In Emory, Rep. 156, f. 2.

ARIZONA (*Pringle* of 1881): COAHUILA (*Wislizenus* of 1847; *Gregg* 400, 616, of 1847; *Poselger* of 1853): CHIHUAHUA (*Wislizenus* 244 of 1847): also specimens cultivated in Hort. Schafer in 1857; and growing in Missouri Botanic Garden in 1893.

The species is very cespitose, with a wrinkled or withered appearance even in full growth. The central spine is very variable in size, color, and shape; the younger ones being generally terete, yellowish or brownish and at length ashy, while the mature ones are mostly triangular or flattened and white.

30. Cereus mojavensis Engelm. Syn. Cact. 281 (1856).

Ovate, glaucous, 5 to 7.5 cm. high, densely cespitose, forming large masses: ribs 8 to 12, rather obtuse and slightly tuberculate, with areolæ 12 mm. or more apart: spines stout, very bulbous at base, terete or angular, curved and interlocked, white with faintly dusky tips, becoming ashy-gray; radials 5 to 8, upper and lower weaker, 2 to 3 cm. long (upper occasionally much shorter), lateral stouter and 3 to 5 cm. long; central 1 (sometimes wanting), angular and dusky, curved upward, 3.5 to 6 cm. long: flowers deep rich crimson, 5 to 7 cm. long: fruit oblong, 2.5 to 3 cm. long: seed obliquely obovate, black and pitted, 2 mm. long. (*Ill.* Pacif. R. Rep. iv, t. 4, f. 8)—Type, Bigelow of 1854, in Herb. Mo. Bot. Gard.

From the Mohave region of California to Utah and the western border of New Mexico.

Specimens examined: CALIFORNIA (*Bigelow* of 1854; *Parish Brothers* 1167, 1243; *Trelease* of 1892): NEVADA (*Coville & Funston* 321, Lincoln Co.): ARIZONA (*Palmer* 136, Fort Defiance).

The species is easily distinguished from the nearly allied *fendleri* by the longer radial spines, the lowest of which is weakest, and the glaucous hue. The long spines are so curved and interlocked as almost to hide the body of the plant. Mr. Coville, to whom we are indebted for a description of the flower, in the Death Valley Expedition measured one large clump in the Panamint Mountains, which formed a dense oblong mat with the center elevated about 8 inches, with the greatest diameter 40 inches, the shortest 30 inches, and the unusually small and closely packed heads estimated to be about 600.

31. Cereus mojavensis zuniensis Engelm. Syn. Cact. 281 (1856).

Spines weaker, 4-angled, straight or flexuous, the younger ones straw-colored, older ones ashy; radials 8, lowest 12 to 18 mm. long, lateral 18 to 30 mm., uppermost almost as stout and long (2.5 to 3.5 cm.) as the central, which is straight or curved upward, and 3.5 to 5 cm. long. (*Ill.* Pacif. R. Rep. t. 4, f. 9)—Type, Bigelow of 1853 in Herb. Mo. Bot. Gard.

"Canyon Diablo, on the Colorado Chiquito," Arizona.

Specimens examined: ARIZONA (*Bigelow* of 1853).

Distinguished by the long and stout upper radial.

\+ + *Flowers scarlet.*

++ *Ribs 5 to 7: central spine 1 (or wanting in* paucispinus).

32. Cereus paucispinus Engelm. Syn. Cact. 285 (1856).

Ovate or ovate-cylindrical, 12.5 to 22.5 cm. high, 5 to 10 cm. in diameter, simple or sparingly branched, deep-green: ribs 5 to 7, tuber-

culate, with wide and shallow grooves, and areolæ 16 to 20 mm. apart: spines stout from a bulbous base, straight or somewhat recurved, radiant, 18 to 32 mm. long; radials 3 to 6 (rarely 7), reddish or dark, the lowest one paler, all at length blackish; central none, or very rarely a stout subangular one, 30 to 40 mm. long, reddish-black, turned upward or porrect: flowers purplish-red (when dry), broadly funnelform, 4 cm. long, with a flaring mouth 2.5 to 3 cm. across: fruit unknown: seeds obliquely obovate, tuberculate, 1.4 to 1.6 mm. long. (*Ill.* Cact. Mex. Bound. t. 56)—Type, Wright of 1849 in Herb. Mo. Bot. Gard.

On rocks and gravelly limestone hills, from the San Pedro, Texas, to the mouth of the Pecos; also found near Durango, Col.

Specimens examined: TEXAS (*Wright* of 1849): COLORADO (*Alice Eastwood* of 1890, Durango): also cultivated in Missouri Botanic Garden in 1870.

Distinguished from its allies by its few ribs and few dark spines. The specimens of Miss Eastwood supplied the first flowers recorded.

33. Cereus gonacanthus Engelm. Syn. Cact. 283 (1856).

Ovate, 7.5 to 12.5 cm. high, simple or sparingly branched at base: ribs 7 (sometimes 9), tuberculate, with large areolæ 12 to 20 mm. apart: spines stout, angular, straight, or variously curved and flexuous; radials 8, lower 16 to 24 mm. long, the rest 20 to 30 mm. long, lower and laterals quadrangular, yellow at base and often dark-tipped, uppermost one much larger than the rest, about size and character of the central, which is solitary, very stout, 6- or 7-angled, and deeply furrowed, often flexuous, 3 to 6 cm. long, 2 mm. broad: flower scarlet, about 6 cm. long: fruit and seed unknown. (*Ill.* Pacif. R. Rep. iv, t. 5, f. 2 and 3)—Type, Bigelow of 1853 in Herb. Mo. Bot. Gard.

Southern Colorado and northern New Mexico; found originally on high sand bluffs, under cedars, near Zuñi.

Specimens examined: COLORADO (*Greene* of 1873; *Engelmann* of 1874; *Brandegee* of 1874): NEW MEXICO (*Bigelow* of 1853; *Palmer* 134, Ft. Defiance).

Distinguished from *triglochidiatus* by its stouter, longer, and more numerous spines.

34. Cereus triglochidiatus Engelm. Pl. Fendl. 50 (1849).
Echinocereus triglochidiatus Engelm. Wisliz. Rep. 9 (1848).

Ovate-cylindrical or globose, 5 to 15 cm. high, 5 to 7.5 cm. in diameter, sparingly branched: ribs 6 or 7, undulate, sharp, with very shallow grooves, and areolæ often 3 cm. apart: spines 3 to 6 (mostly 3), stout, compressed and angular, loosely radiant, straight or curved, ashy-gray, the two laterals 16 to 28 mm. long, the other 12 by 16 mm. long and bent downward: flowers deep-crimson, 5 to 7.5 cm. long: fruit unknown, but said to be edible. (*Ill.* Pacif. R. Rep. iv, t. 4, f. 6 and 7)—Type, Wislizenus of 1846 in Herb. Mo. Bot. Gard.

Rocky canyons and mountains, from east of the Pecos, Texas, north-

ward into New Mexico, where it was originally discovered in the high mountains about Santa Fe.

Specimens examined: TEXAS (*Wislizenus* 510 of 1846): NEW MEXICO (*Wislizenus* of 1846; *Fendler* 274 of 1847; *Bigelow* of 1853; *Rothrock* 39; *Broadhead* of 1880; *Engelmann* of 1881; *Lt. McCauley* 574, 575): also cultivated in Mo. Bot. Gard. in 1863.

35. Cereus hexaedrus Engelm. Syn. Cact. 285 (1856).

Ovate, 10 to 15 cm. high, 5 to 6 cm. in diameter, simple or sparingly branched at base: ribs 6, obtuse, somewhat interrupted, with wide shallow groove and areolæ 12 to 16 mm. apart: spines straight, angular, rigid from a bulbous base, but slender; radials 5 to 7 (mostly 6), yellowish-red, lower shorter (10 to 20 mm.), upper often stouter and darker, 16 to 30 mm. long; central solitary, a little stouter, acutely angled, 24 to 30 mm. long, often wanting: flowers and fruit unknown. (*Ill.* Pacif. R. Rep. iv, t. 5, f. 1)—Type, Bigelow of 1853 in Herb. Mo. Bot. Gard.

On sandy hills, under cedars, about 15 miles west of Zuñi. New Mexico; apparently not discovered since.

Specimens examined: NEW MEXICO (*Bigelow* of 1853).

Allied to *paucispinus*, but distinguished by its slender and angular spines.

++ ++ *Ribs 8 to 13: central spines 2 to 7 (1 in* octacanthus)

36. Cereus octacanthus (Muhlenpf.).

Echinopsis octacantha Muhlenpf. Allg. Gart. Zeit. xvi, 19 (1848).
Cereus roemeri Engelm. Pl. Fendl. 50 (1849), not Muhlenpf. (1848).

Ovate, bright-green, 7.5 to 10 cm. high, 3.5 to 6 cm. in diameter, densely cespitose (often 5 to 12 heads from the same base), sometimes simple: ribs 7 to 9, tuberculate, obtuse, with areolæ 8 to 16 mm. apart: spines stout, terete, white (or yellowish when young) at length ashy; radials 7 or 8, 10 to 24 mm. long, upper a little shorter, lateral longest; central solitary, stouter, porrect, 20 to 30 mm. long: flower red, 5 cm. long and 2.5 cm. wide, red: fruit and seed unknown.—Type unknown.

From extreme southwestern Texas, northward and westward through New Mexico into Utah.

Specimens examined: TEXAS (*Evans* of 1891, about El Paso): NEW MEXICO (*Fendler* 272 of 1846, in part): UTAH (*Mrs. Thompson*): also cultivated in Mo. Bot. Gard. from Herb. Torr.

37. Cereus roemeri Muhlenpf. Allg. Gart. Zeit. xvi, 19 (1848), not Engelm. (1849).

Cereus phœniceus conoideus Engelm. Syn. Cact. 284 (1856).
Cereus conoideus Engelm. Pacif. R. Rep. iv, 36 (1856).

Ovate, conoid-acutish at apex, 7.5 to 10 cm. high, sparingly branched at base: ribs 9 to 11, obtuse, tuberculate, with areolæ 8 to 12 mm. apart: spines whitish or straw-color, translucent, with bulbous base; radials 8 to 12, slender and rigid, straightish, upper 4 to 10 mm. long, lateral 12 to 30 mm.; centrals 3 to 5 (usually 4), very bulbous, upper hardly longer than lateral radials, lowest quadrangular, often dusky

when young, 2.5 to 7.5 cm. long, porrect or deflexed: flower crimson, 8 to 10 cm. long, 3.5 to 5 cm. broad: fruit and seed unknown. (*Ill.* Pacif. R. Rep. iv, t. 4, f. 4 and 5)—Type unknown.

From the upper Pecos, New Mexico, westward through Arizona into southern California, and southward into Chihuahua.

Specimens examined: NEW MEXICO (*Palmer* 73 of 1869; *E. A. Mearns* 88 of 1892, Big Hatchet Mts.): ARIZONA (*Newberry* of 1858; *Coues & Palmer* of 1865): CALIFORNIA (*Parish Bros.* of 1882): CHIHUAHUA (*Pringle* 252 of 1885).

In most of the specimens I have seen the centrals are dark ashy-gray, contrasting strongly with the pale and much shorter radials.

38. Cereus aggregatus (Engelm.).

Mamillaria aggregata Engelm. Emory's Rep. 155 (1848).
Echinocereus coccineus Engelm. Wisliz. Rep. 9 (1848), not DC. or Salm.
Cereus coccineus Engelm. Pl. Fendl. 50 (1849).
Cereus phœniceus Engelm. Syn. Cact. 284 (1856).

Ovate or subglobose, obtuse, 3.5 to 7.5 cm. in height, 3 to 5 cm. in diameter, cespitose (mostly in dense hemispherical masses 30 to 100 cm. in diameter): ribs 8 to 11, tuberculate, with areolæ 6 to 8 mm. apart: spines slender, almost setaceous, straight, terete; radials 8 to 12, white, 6 to 12 mm. long, upper much the shorter; centrals 1 to 3, a little stouter, white or horny, 10 to 20 mm. long: flower deep-crimson, 3.5 to 6 cm. long, 2.5 to 3.5 cm. broad: fruit and seed unknown. (*Ill.* Emory's Rep. 155, f. 1; Pacif. R. Rep. iv, t. 4, f. 1–3)—Type not preserved, but Wislizenus of 1846, type of *coccineus* Engelm., and Bigelow of 1852 and 1853, type of *phæniceus* Engelm., are in Herb. Mo. Bot Gard.

From southern Colorado to Arizona and southwestern Texas, and southward into San Luis Potosi.

Specimens examined: COLORADO (*Parry* of 1867; *Greene* of 1873): ARIZONA (*Bigelow* of 1853; *Newberry* of 1858; *Coues & Palmer* 193 of 1865; *Toumey* of 1892): NEW MEXICO (*Wislizenus* of 1846; *Rusby* of 1881, Burro Mts.): TEXAS (*Lindheimer* of 1847; *Gregg* 662 of 1848; *Bigelow* of 1852 and 1853): SAN LUIS POTOSI (*Eschanzier* of 1891): also cultivated in Mo. Bot. Gard. in 1851.

The dense cespitose masses often contain 100 to 200 heads, and are "often the shape and size of a bushel basket." It is said generally to grow on naked rocks. The Eschanzier specimens, from San Luis Potosi, have uniformly 2 centrals and yellowish spines.

39. Cereus polyacanthus Engelm. Pl. Fendl. 50 (1849).

Echinocereus polyacanthus Engelm. Wisliz. Rep. 20 (1848).

Ovate-cylindrical, 10 to 25 cm. high, 6 to 10 cm. in diameter, cespitose, pale-green or glaucous: ribs 9 to 13, obtuse, tuberculate, with areolæ 1 to 2.5 cm. apart: spines stout, rigid, terete, straight, white or ashy-red, all at length ashy, very variable; radials 8 to 12, spreading, but not strictly radiating, upper 12 mm. long, lateral and lower 18 to 25 mm.; centrals 3 or 4, stouter and bulbous at base, as long as or longer than the radials (lower one sometimes 3 to 6 cm.), often variegated when

young, the 3 upper turned upward, the lower porrect or deflexed: flowers deep-red, 5 to 7.5 cm. long, profusely covering the plant: fruit subglobose, 2 to 3 cm. long, greenish-purple: seed oblique, irregularly tuberculate, 1.6 to 1.8 mm. long. (*Ill.* Cact. Mex. Bound. t. 54 and 55)—Type, Wislizenus of 1846 in Herb. Mo. Bot. Gard.

From the region about El Paso, Texas, westward into Arizona, and southward into Lower California and the mountains of Chihuahua. Doubtless also in southern California.

Specimens examined: TEXAS (*Wright* 41, 222, of 1852; *Thurber* 191,192; *Trelease* of 1892): NEW MEXICO (*Wright* 41 of 1852; *G. R. Vasey* of 1881, Socorro; *Nealley* of 1891; *Evans* of 1891): ARIZONA (*Palmer* of 1876 and 1890; *Pringle* of 1881, Santa Rita Mts.; *Rusby* 620; *Evans* of 1891; *Wilcox* of 1894): CHIHUAHUA (*Wislizenus* of 1846 and 1854; *Pringle* 253): LOWER CALIFORNIA (*Orcutt* of 1883; *Brandegee* of 1890, La Paz).

40. Cereus maritimus Jones, sp. nov.

Closely allied to *polyacanthus*, but with spines all reddish-brown at first, becoming ashy, 4 or 5 erect-spreading terete or somewhat angular stout centrals 20 to 35 mm. long, 8 to 12 much smaller and slender but rigid radiately spreading very unequal radials (upper and laterals 8 to 10 mm., lower 4 to 6 mm.), and red flowers 3 to 4 cm. long.—Type in Herb. Jones.

Lower California.

Specimens examined: LOWER CALIFORNIA (*Jones* of 1882, Encenada; *Orcutt* of 1885, Todos Santos Bay; *Brandegee* of 1889, El Rosario).

41. Cereus pacificus (Engelm.).

Cereus phæniceus pacificus Engelm. West Amer. Sci. ii, 46 (1886).

Cylindrical, 15 to 25 cm. high, 5 to 6 cm. in diameter, cespitose in dense cushions 30 to 60 cm. in diameter (50 to 100 stems in each): ribs 10 to 12, obtuse, with shallow intervals: spines at first gray and more or less reddish-tinged, finally becoming ashy; radials 10 to 12, 5 to 10 mm. long, no upper ones (or occasionally a minute spine); centrals 4 or 5, widely divergent, the lowest largest, 20 to 25 mm. long: flowers deep-red, the floriferous areola spiniferous: fruit spinose.—Type, Orcutt specimens in Herb. Mo. Bot. Gard.

Lower California and adjacent islands.

Specimens examined: LOWER CALIFORNIA (*Orcutt* of 1883 and 1886, Todos Santos Bay; *Brandegee* of 1889, Magdalena Island and Comondu Cliffs, of 1890, Sierra de la Laguna, of 1893, San Pedro Martio).

But a few plants were found in bloom, January 26, 1883, by Mr. Orcutt, whose notes concerning them were first published in *The West American Scientist*,[1] but since then abundant material has been collected by Mr. Brandegee. The spine we have called the uppermost central, by some might be considered an uppermost radial, the great irregularity of the spines in position making possible different interpretations.

[1] ii, 46.

* * * *Stems short-cylindrical, 4- to 6-ribbed, jointed, procumbent: flowers purple.*

42. Cereus berlandieri Engelm. Syn. Cact. 286 (1856).

Subterete, jointed, very branching, spreading and procumbent, with erect branches, joints or branches 3.5 to 15 cm. long, 2 to 2.5 cm. in diameter: ribs 5 or 6, with distinct conical tubercles and areolæ 8 to 12 mm. apart: radial spines 6 to 8, setaceous, white, radiant, 8 to 10 mm. long; central solitary, yellowish-brown, 10 to 25 mm. long: flowers purple, 5 to 10 cm. long: fruit ovate, green, nearly dry, densely covered with mottled bristles, 18 mm. long: seed obovate-subglobose, strongly tuberculate, 1 mm. long. (*Ill.* Cact. Mex. Bound. t. 58)—Type, Berlandier 2423 in Herb. Mo. Bot. Gard.

Southeastern Texas; found originally on the Nueces.

Specimens examined: TEXAS (*Berlandier* 2423; *Wright* 993; *Haege* of 1866): also cultivated in Breslau Bot. Gard. in 1866; in Harvard Bot. Gard. in 1871 and 1882; in Mo. Bot. Gard. in 1845, and growing in same garden in 1892 and 1893.

Very closely allied to *C. pentalophus* DC., but Salm cultivated both species and considered them distinct.

43. Cereus procumbens Engelm. Pl. Fendl. 50 (1849).

Subterete or 4- or 5-angular, very branching and diffuse, joints or branches much contracted at base, 1.2 to 10 cm. long, 12 to 16 mm. in diameter: tubercles distinct, 8 to 10 mm. apart, in 4 or 5 rows: spines slender, rigid, dark-tipped; radials 4 to 6 (mostly 5), white, radiant, 2 to 4 mm. long; central solitary, stouter, dark, directed upward, 4 to 6 mm. long, often wanting: flower delicate-purple, over 7.5 cm. long: fruit ovate, green, 12 to 16 mm. long: seed lenticular, lightly verrucose, 0.8 to 1.0 mm. in diameter. (*Ill.* Cact. Mex. Bound. t. 59, f. 1–11)—Type, "St. Louis Volunteers" of 1846 in Herb. Mo. Bot. Gard.

On the Rio Grande below Matamoras, Tamaulipas.

Specimens examined: TAMAULIPAS ("St. Louis Volunteers" of 1846): also cultivated in Harvard Bot. Gard. in 1848, 1871 and 1882; growing in Mo. Bot. Gard. in 1893.

* * * * *Stems very slender-cylindrical, 8-ribbed, erect: flowers rose-color: roots tuberous.*

44. Cereus poselgeri, nom. nov.

Cereus tuberosus Poselger, Allg. Gart. Zeit. xxi, 135 (1853), not Pfeiff. Enum. 102 (1837).

Very slender from a tuberous root, terete, woody below, thickened upward, sparsely branching, weak, erect or reclined, joints or branches 30 to 60 cm. long, 8 to 16 mm. in diameter: ribs 8, scarcely prominent, with small crowded areolæ: spines minute and setaceous; radials 9 to 12, white, straight and appressed, hardly 2 mm. long; central solitary whitish or brown-tipped or all brown or black, appressed upward, 4 to 6 mm. long: flowers rose or purple, 5 cm. long and broad: fruit nearly dry, covered with long wool and black and white bristles: seed obliquely obovate, confluently tuberculate, 0.8 mm. long. (*Ill.* Cact. Mex. Bound. t. 59, f. 12)—Type, Poselger of 1853 in Herb. Mo. Bot. Gard.

Dry, rocky ridges, among supporting shrubs, on both sides of the Lower Rio Grande.

Specimens examined: TEXAS (*Poselger* of 1853): COAHUILA (*Siler* of 1889): also cultivated in Goebel's Gard. in 1859; Mo. Bot. Gard. in 1863; Meehan's Gard. in 1869.

The most slender of the *Echinocerei*, connected with the globose and ovate forms through *berlandieri* and *procumbens*. Always grows among shrubs which support its weak and otherwise decumbent stem. The lower part of the stem is scarcely as thick as a quill, and the tuberous root is globular, 1 to 3 cm. in diameter.

II. EUCEREUS. *Stems cylindrical: seeds smooth or pitted: embryo curved.*

* *Not arborescent.*

** *Tall (6 to 30 dm.), slender: ribs 3 to 7.*

*** *Flowers white.*

45. Cereus monoclonos DC. Prodr. iii, 464 (1828).

Stem columnar, 12 to 30 dm. high: ribs 6 to 8, obtuse, compressed: spines short and brownish, radiant, some of them very rigid and 3.5 cm. long: flowers white, 15 cm. long.—Type unknown.

A West Indian species, extending into Florida.

Specimens examined: FLORIDA (*Curtiss* of 1882): also growing in Mo. Bot. Gard. in 1893.

In the Kew Index this species is referred to *C. peruvianus*,[1] but we have had no opportunity of comparing it with that species.

46. Cereus marginatus DC. Rev. Cact. 116 (1828), not Salm (1850).

Stem simple or branching at apex, erect, dark-green, 5 to 7.5 cm. in diameter: ribs 5 to 7, obtuse, with acute intervals, woolly through the whole length on account of the confluent areolæ: spines 7 to 9, short (4 to 6 mm.) and conical, rigid, grayish (younger ones purplish-black, the central scarcely distinct from the rest): flower brownish-purple, slender-tubular, 3.5 cm. long: fruit globular and spiny.—Type unknown.

From San Luis Potosi southward throughout Mexico.

Specimens examined: SAN LUIS POTOSI (*Weber* of 1865; *Parry & Palmer* 275; *Parry* of 1878; *Pringle* 2678): also cultivated in Hort. Pfersdorff in 1869.

The stem is often covered with a woody crust, and the woolly confluent areolæ are often double. It is said to be frequently used for hedges in southern Mexico.

47. Cereus geometrizans Mart. Pfeiff. Enum. 90 (1837).

Stem erect, simple, bluish, 10 cm. in diameter: ribs 5 to 9 (mostly 5 or 6), obtuse, repand-tuberculate, with broad intervals and areolæ 3 to 3.5 cm. apart: spines 3 to 6, unequal, stout, blackish and at length ashy; lateral radials longest (8 to 10 mm.), lowest shorter (4 to 6 mm.), uppermost 1 or 2 (often wanting) very short (2 mm.), sometimes all very short; central solitary, very long and stout, often angular, sometimes

[1] Mill. Gard. Dict. ed. 8, no. 4.

wanting: flowers 2 cm. high, 3 cm. broad, pinkish-white (in dried specimens).—Type unknown.

From San Luis Potosi southward throughout Mexico.

Specimens examined: SAN LUIS POTOSI (*Poselger* of 1850; *Parry & Palmer* 274; *Parry* of 1878; *Pringle* 3743): also cultivated in Hort. Pfersdorff in 1869.

Pringle's specimens are in flower, and from them the above description of the flower is taken. The radials are also shorter than in the original description as given above, varying from 3 to 5 mm. in length, with the stout central about 3 cm. long. The radials are always 5 in the specimens examined, their broad bases in contact, forming a regular hexagon, with the spine that would form the uppermost angle wanting and replaced by the floriferous areola. The broad base of the very stout solitary central is in contact with the bases of all the radials, completely filling up the space. In one case observed the central was but 8 mm. long and the radials very minute.

48. Cereus greggii Engelm. Wisliz. Rep. 18 (1848).

Cereus pottsii Salm, Cact. Hort. Dyck. 208 (1850).

Cereus greggii transmontanus Engelm. Syn. Cact. 287 (1856).

Stem slender, erect, 6 to 12 cm. high, 18 to 25 mm. in diameter, from a very large tuberous root (often 15 to 25 cm. long and 10 to 15 cm. in diameter); branches erect, reddish or dark-green: ribs 3 to 6 (usually 4 or 5), acute, with crowded areolæ: spines abruptly subulate from a bulbous base, very short (1 to 2 mm.) and sharp, blackish at length ashy; radials 6 to 9, subrecurved, the lowest slenderer and longer; centrals 1 or 2 (when 2 they are in the same vertical plane and divergent upward and downward): flowers whitish or ochroleucous, 15 to 20 cm. long, 5 to 6 cm. broad: fruit ovate, attenuate at base and acuminate, 2.5 to 3.5 cm. long, 2.5 cm. in diameter, bright-scarlet, fleshy and edible: seeds obliquely obovate, rugose, black, 2.5 to 3 mm. long. (*Ill.* Cact. Mex. Bound. t. 63-65)—Type, Gregg 222 and 599 in Herb. Mo. Bot. Gard.

From southwestern Texas (Pecos and westward), westward through southern New Mexico into Arizona, and southward into Chihuahua and Sonora. In gravelly or hard clayey soil.

Specimens examined: TEXAS (*Wright* 347, 513, of 1852; *Bigelow* of 1852; *Parry* of 1853; no date or collector, foothills near Alpine): NEW MEXICO (*Evans* of 1891): ARIZONA (*Bendire* of 1872; *Engelmann* of 1880; *Pringle* 10; *Toumey* of 1892, Tucson; *Trelease* of 1892): CHIHUAHUA (*Gregg* 222, 599).

This very characteristic species seems to be scattered and rare throughout its range. A single slender stem usually arises from the enormous root, but sometimes there may be many stems.

49. Cereus pitajaya (Jacq.) DC. Prodr. iii, 466 (1828).

Cactus pitajaya Jacq. Enum. Pl. Carib. 23 (1763).

Cereus undulosus DC. Rev. Cact. 46 (1829).

Cereus laterirens Salm, Cact. Hort. Dyck. 336 (1834).

Cereus variabilis Pfeiff. Enum. 105 (1837), not Engelm. (1850).

Stem simple or branching at base, subercct, green or glaucescent, 3.5 to 7.5 cm. in diameter: ribs 3 to 5, obtuse and repand, with areolæ 8 to 16

mm. apart: spines straight and rigid; radials 6 to 8, white, yellowish or blackish, the 3 highest more rigid, 16 to 20 mm. long, the lower 4 or 5 more slender, 6 to 8 mm. long; centrals 1 or 2, 12 to 25 mm. long.—Type unknown.

A common and widely distributed species of the West Indies, southern Mexico, Central America, Peru, and Brazil.

Specimens examined: CUBA (*Wright* 2624).

A very variable species, the joints being very long and quadrangular, and ovate and triangular on the same plant; the areolæ sometimes with whitish and sometimes with brownish tomentum; the spines sometimes short and white, and sometimes elongated, rigid and fuscous. The north Mexican form referred to this species by Dr. Engelmann is *Cereus princeps* Pfeiff.

50. Cereus princeps Hort. Wuerzb.; Pfeiff. Enum. 108 (1837).
Cereus variabilis Engelm. Pl. Lindh. 205 (1850), not Pfeiff. (1837).

Stems erect, 9 to 30 dm. high, 5 cm. in diameter, 3- or 4-angular, and with distant areolæ: spines 4 to 6, stout and radiant, unequal, the larger 25 to 35 mm. long, the central deflexed: flower long-tubular, 17.5 to 20 cm. long, 13.5 to 15 cm. broad: fruit oval, spiny, 5 to 7.5 cm. long, 5 cm. in diameter, scarlet and with luscious red pulp: seeds obliquely obovate, smooth and shining, 3 to 3.4 mm. long. (*Ill.* Cact. Mex. Bound. t. 60. f. 5 and 6)—Type unknown.

On the Mexican side of the lower Rio Grande.

Specimens examined: TAMAULIPAS (*St. Louis Volunteers* of 1846; *Poselger* of 1850; *Schott* of 1853): also cultivated in Mo. Bot. Gard. in 1849, 1859, 1867, 1870, 1871, and 1873; also in Harvard Bot. Gard. in 1872.

Probably to be found on the Texan side of the lower Rio Grande. The young shoots are said to have 8 ribs and more numerous slender spines; and in some of the cultivated specimens the spines become much longer than in the description.

51. Cereus palmeri Engelm. MSS.

Stems branching, 3- or 4-angled, 12 to 15 dm. high: spines in greenish-brown bunches: fruit greenish-yellow, its areolæ bearing 5 to 8 short stout spines.—Type, Palmer 70 of 1869 in Herb. Mo. Bot. Gard.

Sonora.

Specimens examined: SONORA (*Palmer* 70 of 1869).

This very brief and unsatisfactory diagnosis was drawn by Dr. Engelmann from a few scraps and notes, a diagnosis that I have no means of supplementing. Dr. Palmer's notes further state that the "branching plant is weighed down by the heavy fruit."

++ ++ *Flowers purple.*

52. Cereus striatus Brandegee, Zoe, ii, 19 (1891).

Stems weak, quadrangular, becoming terete, very sparingly branched above, ash-color, about 10 dm. high and 2 to 6 mm. in diameter: ribs or striations 9, flat and slightly raised above the flat greener intervals, with areolæ about 6 mm. apart: spines about 9, soft, closely appressed, either light-colored or brown; sometimes perfectly black, 1 to 3 mm. long: flowers purple, 10 to 12 cm. long, the elongated tube bristly: fruit

obpyriform, 3 to 4 cm. long, 2 to 2.5 cm. in diameter, bright-scarlet and spiny: seeds angular, black, minutely pitted.—Type, Brandegee 243 in Herb. Brandegee.

San Jose del Cabo, Lower California, and northward beyond San Ignacio; also on Carmen, Magdalena, and Santa Margarita Islands.

Specimens examined: LOWER CALIFORNIA (*Brandegee* of 1889, San Joaquin, Magdalena Bay, Santa Margarita Island; also 243 of 1890, San Jose del Cabo; *Palmer* of 1890, Carmen Island).

Mr. Brandegee says that the weak stems, no thicker than straws, are supported by bushes, and being of the same ashen hue as the bushes are concealed until in flower or fruit; and that the spines are so soft that the plant can be easily handled. The local name is "pitahayita," from the resemblance of the flowers and fruits to those of *gummosus*, which is "pitahaya."

53. Cereus cochal Orcutt, West Amer. Sci. vi, 29 (1889).

Trunk stout, 3 dm. or more high before dividing into numerous stout branches, these repeatedly forking so as to give to the whole plant (growing 12 to 30 dm. high) a graceful "candelabra shape": ribs 4 to 8, obtuse, with wide shallow intervals and areolæ 2 to 2.5 cm. apart: spines few, stout, straight and compressed, grayish or black; radials mostly 5, 15 to 20 mm. long; central solitary, more robust, laterally compressed, about 18 to 25 mm. long: flowers purplish-green, 2 to 3 cm. long: fruit the shape and size of an olive, not spiny, red (frequently grayish or yellowish-brown).—Type, in Herb. Orcutt.

Lower California.

Specimens examined: LOWER CALIFORNIA (*Gabb* 8 of 1867; *Brandegee* of 1889, Comondu and San Pablo).

This species was collected by Gabb in 1867, and is described as a new species in Dr. Engelmann's manuscript notes as *C. gabbii*. In 1886, however, Mr. Orcutt discovered it and published the name as above, being the Mexican and Indian name of the plant. Mr. Orcutt says that it is "abundant among the hills of Lower California, from Todos Santos Bay southward to the Rosario and San Fernando missions, or further." The short woody trunk is said to be often 3 dm. in diameter, the long branches 6 to 20 cm. in diameter.

54. Cereus eburneus (Link) Salm, Observ. Botan. 6 (1822).
Cactus eburneus Link, Enum. ii. 22 (1822).

Stem erect, simple, glaucous: ribs 7 to 10, obtuse and very glabrous, with ashy, naked, somewhat remote areolæ: spines subulate, rigid, ivory-white with black tip (purplish when young); radials 8 to 10, radiant, 8 to 10 mm. long, lowest smallest; central 1 (rarely 3 or 4), 18 to 22 mm. long: flowers purplish: fruit unknown.—Type unknown.

In the West Indies, and from San Luis Potosi southward through Mexico and Central America into Chile. Reported originally from Mexico in "22° lat., at altitude of 6–8000 ft."

Specimens examined: CUBA (*Wright* 2620): SAN LUIS POTOSI (*Parry & Palmer* 276).

++ *Procumbent, 3 to 12 dm. long.*

+ *Ribs 3.*

55. Cereus grandiflorus (L.) Mill. Dict. ed. 8, no. 11 (1768).
Cactus grandiflorus L. Sp. Pl. i, 467 (1753).

Creeping, diffuse, pale-green, with very long and flexuous climbing 5- to 7-angled branches 12 to 20 mm. in diameter, with white bristly areolæ 10 to 15 mm. apart: spines short, 4 to 6 mm long; radials 4 to 8, scarcely pungent, yellowish or white; centrals 1 to 4, equaling in length the white bristles: flowers white and fragrant, 15 to 20 cm. broad.—Type unknown.

In the West Indies and Sonora, though doubtless with a much more southern Mexican extension. On rocks and decayed trees.

Specimens examined: SONORA (*Schott* of 1859 and 1865): also cultivated in Hort. Francofurt. in 1825; in Hort. Genéve in 1859; in Goebel's Gard. in 1860; in Harvard Bot. Gard. in 1864, 1865, 1882.

Long cultivated in gardens as the "night-blooming cereus," and made to vary widely.

56. Cereus nycticalus Link, Verh. Preuss. Gartenb. Ver. x, 373 (1834).
Cereus pteranthus Link, Otto & Diet. Allg. Gart. Zeit. ii, 209 (1834).

Suberect, very long-jointed, radicant, 15 to 25 mm. in diameter; joints various, some subcylindrical with 4 or 5 series of areolæ, others 4- to 6-angular: ribs when young acute, later obtuse, with areolæ 8 to 20 mm. apart: spines 1 to 4, very small (2 to 4 mm.) and rigid, sometimes with white setæ 4 to 6 mm. long, often deciduous: flowers white and fragrant, 17.5 cm. long. (*Ill.* l. c. t. 4)—Type unknown.

Credited in general to Mexico, but no definite station known.

Specimens examined: cultivated in Greeve's Gard. in 1859; in Goebel's Gard. in 1860; in Harvard Bot. Gard. in 1871; in Mo. Bot. Gard. in 1862, and growing in same garden in 1893.

57. Cereus napoleonis Graham in Hook. Bot. Mag. t. 3458 (1836).
Cactus napoleonis Hort. ex Graham, l. c.
Cereus triangularis major Pfeiff. Enum. 117 (1837).

Suberect, long-jointed: joints triquetrous with flat sides, slender, 30 cm. or more long, 20 to 25 mm. in diameter: ribs acute, undulate, with areolæ 12 to 16 mm. apart and scarcely tomentose: spines 3 or 4, subulate, unequal, straight, black, 8 to 16 mm. long, the lowest mostly longest; sometimes a few white setæ: flowers snowy white, 20 cm. long and 15 cm. broad: fruit bluish, spiny, 10 cm. long and 8 cm. in diameter. (*Ill.* l. c.)—Type unknown.

Tamaulipas and southward in Mexico, and in the West Indies.

Specimens examined: TAMAULIPAS (*Poselger* of 1850, at Tampico): also cultivated in Harvard Bot. Gard. in 1882.

58. Cereus compressus Mill. Gard. Dict. ed. 8, no. 10 (1768).
Cereus triangularis Haw. Syn. 180 (1812), not (L.) Mill. (1768).

Suberect, bright-green, branching, the branches scandent, radicant, triquetrous with one face nearly flat and the other two deeply sulcate;

joints broad, over 30 cm. long, 5 to 7.5 cm. broad, sometimes twisted, the younger ribs compressed as if winged, with almost naked areolæ 2.5 cm. apart: spines 2 to 4, blackish, rigid, subrecurved, 2 to 4 mm. long, lowest longest: flowers white, 20 cm. broad: fruit naked, scarlet, "size and form of a goose's egg."—Type unknown.

In Key West and the West Indies, and extending in Mexico from Vera Cruz to the Isthmus of Darien.

Specimens examined: VERA CRUZ (*Bourgeau* 2488, region of Orizaba): ISTHMUS OF DARIEN (*Schott* of 1858): also cultivated in Hort. Monaco in 1857 and 1858: in Koenig's Gard. in 1866; in Harvard Bot. Gard. in 1871, 1873, 1882; growing in Mo. Bot. Gard. in 1893.

Climbing over bushes and rooting at the joints. The surface of the older joints is often covered with a woody crust, and the very old ones become altogether woody.

++ ++ Ribs 7 to 12: spines few (8 to 12).

59. Cereus boeckmanni Otto; Salm, Cact. Hort. Dyck. 217 (1850).

Tall, bright-green, subcylindrical, 18 to 20 mm. in diameter, with elongated flexuous and radicant branches: ribs 7, sinuate-repand, with areolæ 12 to 16 mm. apart: spines very small (scarcely 1 mm.) and rigid, the 3 upper brown, 3 lower gray, and the solitary central brown: flower and fruit unknown.—Type unknown.

"Northern Mexico."

Specimens examined: NORTHERN MEXICO (*Lindheimer* of 1873).

60. Cereus gummosus Engelm. Zoe, ii, 20 (1891).

Prostrate and assurgent, 3 to 12 dm. long, 7.5 to 10 cm. in diameter, dull purplish-green: ribs (in young branch) 7 to 9, tuberculate, with sharp narrow intervals and prominent areolæ 18 to 20 mm. apart: spines stout and rigid, from a strongly bulbous base, black; radials about 12, the laterals longest (6 to 12 mm.), the lowest smallest; centrals 3 to 6, stout, angled and compressed (sometimes quite flat), 18 to 35 mm. long, often with 2 very small additional ones above: flowers 10 to 12.5 cm. long, purple: fruit subglobose, 6 to 8 cm. in diameter, spiny, bright-scarlet with purple pulp ("color of ripe watermelon"), acid and pleasant: seeds obliquely obovate, compressed and keeled, rugose and pitted, 2.5 mm. long.—Type, Parry specimens in Herb. Mo. Bot. Gard.

Lower California, especially abundant in the "Cape Region."

Specimens examined: LOWER CALIFORNIA (*Parry*, with no date or station; *Miss Fish* of 1882, Sanzal; *Brandegee* of 1889, San Pablo and Magdalena Island, also of 1890, San José del Cabo).

This species seems to have been noted first by Brandegee in his Plants of Baja California, 162 (1889), where it is said to be the "pitahaya" of southern Lower California, the fruit of which is held in high esteem. It is also said that the bruised stems are used for stupefying fish. Dr. Parry's notes, with the original specimens (described by Englemann in manuscript in 1882), state that "the internal cellular tissue is bright-yellow in dried-up trunks, changing to a dense resinous gum, which is ground up and mixed with oil for varnish; also used as pitch for calking boats." This fact suggested the specific name.

61. Cereus flagelliformis (L.) Mill. Dict. ed. 8, no. 12 (1768).
Cactus flagelliformis L. Sp. Pl. i, 467 (1753).

Creeping or pendent, slender and very branching, cylindrical, 16 to 20 mm. in diameter, branches 3 dm. long or more: ribs 10 to 12, tuberculate, with areolæ scarcely tomentose and 6 to 8 mm. apart: spines short (4 to 6 mm.) and rather rigid; radials 8 to 12, stellate and reddish-brown; centrals 3 or 4, a little larger, brown with golden tip; young spines all red: flowers funnelform, crimson, 6 to 7.5 cm. long: fruit globose, 12 mm. in diameter, reddish and bristly, the pulp greenish-yellow ("with the taste of a prune").—Type unknown.

From Chihuahua and the West Indies southward; widely distributed in Tropical America, and frequently seen as an ornamental plant.

Specimens examined: CHIHUAHUA (*Wislizenus* 227 and 248): also cultivated in Mo. Bot. Gard. in 1854; in Goebel's Gard. in 1863; in Harvard Bot. Gard. in 1867.

++ ++ ++ *Ribs many (15 to 21): spines numerous (20 to 50).*

62. Cereus emoryi Engelm. Amer. Jour. Sci. ser. 2, xiv, 338 (1852).

Prostrate, cylindrical, 6 to 12 dm. long, with ascending or erect branches 15 to 25 cm. high and 3.5 to 5 cm. in diameter: ribs 15, tuberculate, with acute intervals and areolæ 6 to 8 mm. apart: spines straight, slender and rigid, yellow, interlocked; radials 40 to 50, very slender and stellately porrect; central solitary, stouter and much larger: flowers greenish-yellow, 3 to 6 cm. broad: fruit globose, very spiny, 3.5 cm. in diameter: seeds obovate, acutely keeled, shining and very minutely tuberculate, 2.4 to 2.8 mm. long. (*Ill.* Cact. Mex. Bound. t. 60, f. 1–4)—Type, Parry of 1850 in Herb. Mo. Bot. Gard.

On rocky hills, etc., from southern California (about Los Angeles and San Diego) southward into Lower California, and on the adjacent islands (San Clemente, Santa Catalina, Cedros).

Specimens examined: CALIFORNIA (*Parry* of 1850; *Cooper* of 1862; *Childs* of 1862; *Brewer* 248; *Agassiz* of 1872; *Hitchcock* of 1875; near San Diego, no collector noted, in 1876); LOWER CALIFORNIA (*Gabb* 4 of 1867; *Pringle* of 1882; *Brandegee* of 1889, El Rosario).

Grows in thick masses, covering patches 30 to 60 dm. square. The Gabb specimens show four central spines, but only the lower one is long.

63. Cereus mamillatus Engelm. MSS.

Stems aggregated, branching at base, the branches cylindrical, 25 to 30 cm. long and 3.5 to 6 cm. in diameter: ribs 20 to 25, oblique, strongly compressed, broken up into hemispherical tubercles: spines short and bulbous at base; radials 10 to 25, 3 to 12 mm. long, the lower ones the more robust and longer; centrals 3 or 4, 10 to 25 mm. long, the lowest longest and deflexed: flower and fruit unknown.—Type, Gabb 16 in Herb. Mo. Bot. Gard.

"On mountain sides in gravelly loam, south of Moleje," Lower California.

Brandegee

Specimens examined: LOWER CALIFORNIA (*Gabb* 16 of 1867).

Branching from a common base, but rarely more than a dozen stems together; never so crowded as many of its allies.

64. Cereus alamosensis, sp. nov.

Cylindrical, height and habit not known, with sharp irregular ribs and a solid woody axis: areolæ prominent, about 2 cm. apart, hemispherical and densely covered with short reddish-brown wool (like pile on velvet), from which arise the ashy spines: radials 15 to 18, slender but rigid, rather unequal, radiantly spreading, straight or curved, 10 to 20 mm. long; centrals usually 4, much stouter and longer, the 3 upper erect or divergent, the lowest (usually largest and often somewhat flattened) porrect to deflexed, all more or less angular, sometimes teretish, 2.5 to 3.5 cm. long: flowers red, funnelform, about 4 cm. long: fruit unknown.—Type, Palmer 335 in Nat. Herb.

Near Alamos, Sonora.

Specimens examined: SONORA (*Palmer* 335 of 1890).

65. Cereus bradtianus, sp. nov.

Cylindrical, becoming 12 dm. high, the branches about 12 cm. long and 4 cm. in diameter: ribs 9, obtuse, slightly if at all tuberculate, with circular areolæ 10 to 15 mm. apart and bearing more or less persistent grayish tomentum: spines numerous, white and translucent, rigid and spreading in every direction; radials 15 to 18, slender, somewhat unequal, more or less radiant, 10 to 12 mm. long; centrals 5 to 7, stouter, often subangular, quite unequal (usually 1 or 2 especially prominent), 15 to 30 mm. long: flowers yellow: fruit spiny.—Type in Herb. Coulter.

Plains of Coahuila.

Specimens examined: COAHUILA (*Anna B. Nickels* of 1895).

The bright white spines on the vivid green body give the plant a striking appearance. Mrs. Nickels writes that the plant "sometimes covers a half-acre of ground, and seems to propagate by falling over on the ground and rooting all along the stem from which new plants sprout." Mrs. Nickels requests that the species be named for Mr. Geo. M. Bradt, editor of "The Southern Florist and Gardener," of Louisville, Kentucky.

66. Cereus eruca Brandegee, Pl. Baja Calif. 163 (1889).

Prostrate, stout, simple or slightly branched, 6 to 12 dm. long, 7.5 to 16 cm. in diameter, rooting from the under surface of the older growth, generally in patches of 20 to 30: ribs 13 to 21, with prominently pulvinate areolæ 4 to 15 mm. apart: spines stout, straight, ashy, stellate and interlocked; radials 1 to 3 cm. long, terete; centrals 5 to 8, stouter, angled and somewhat flattened, the lowest one much flattened (often 3 mm. wide at base), keeled beneath, longer (3 cm. or more), and strongly deflexed: flowers 10 to 12.5 cm. long, said to be yellow: fruit globular, 5 cm. in diameter, somewhat spiny, dull-red, acid and pleasant, with purple pulp: seeds very rough. (*Ill.* l. c. t. 7)—Type, Brandegee of 1889 in Herb. Brandegee.

On sandy plains along the coasts of Lower California, and on adjacent islands, but perhaps not in the Cape Region.

Specimens examined: LOWER CALIFORNIA (*Gabb* 6 of 1867, on west coast, "from Soledad to Ballenos Bay;" *Brandegee* of 1889, Magdalena Bay, also of 1890, Soledad and Todos Santos).

A plant of very curious and uncouth habit, densely covered with rigid, ash-colored interlacing spines, continually dying at the harder end and rooting on the under surface, creeping over and accommodating itself to every obstacle, often in large masses covering many square yards. Gabb says it "looks from a distance like a lot of firewood thrown at random on the ground;" and Brandegee, that "the manner of growth, with uplifted heads and prominent reflexed spines, gives the plants a resemblance to huge caterpillars." Brandegee reports it as occurring from San Gregorio to below Santa Margarita Island, and as common on Magdalena Island and about San Jorge. The local name is "chilenola" or "chirinole," and the latter appears as the specific name given to Gabb's specimens in Engelmann's manuscript notes. The fruit much resembles in form and color that of *gummosus*, the well-known "pitahaya" of Lower California.

* * *Arborescent, 3 to 18 m. high.*

\+ *Simple at base.*

67. Cereus giganteus Engelm. Emory's Rep. 159 (1848).
Pilocereus engelmannii Lem. Ill. Hort. 9, Misc. 97 (1872).

Erect, cylindrical, attenuate toward base and apex, 7.5 to 18 m. high, 3 to 6 dm. in diameter, simple, or with a few erect branches shorter than the main stem (candelabriform): ribs 12 to 15 below, 18 to 21 above, triangular, with obtusish edge and with deep triangular acute intervals, straight, often almost obliterated in older parts, and generally spineless, with prominent areolæ about 2.5 cm. apart: spines straight, very bulbous at base, lightly sulcate or subangular, white or straw-color, at length ashy (or dark); radials 11 to 17, setaceous and white, the lower and upper shorter (12 to 25 mm.), the laterals (especially the lower) stouter and longer (25 to 35 mm.), sometimes a few additional setaceous ones at upper edge; centrals 6, stout, whitish, with blackish base and reddish tip, the 4 lower ones cruciate, straight or decurved, 4 to 6 cm. long (the lowest one very long and stout and usually deflexed), the 2 upper shorter (30 to 35 mm.) and divergent upward: flowers ochroleucous or whitish, 7.5 to 12.5 cm. long, 7.5 to 10 cm. broad: fruit oval or pyriform, 6 to 7.5 cm. long and 3.5 to 5 cm. in diameter, green and reddish tinged, with crimson pulp, at length 3- or 4-valved: seeds obliquely obovate, black, smooth and shining, 1.4 to 1.8 mm. long (*Ill.* Cact. Mex. Bound. frontispiece and t. 61, 62; Rep. Bot. U. S. Dept. Agr., 1891, t. 7). Type not found in the Engelmann collection.

In rocky valleys and on mountain sides, from the middle Gila (Emory), Arizona, southward through the Lower Colorado region into Sonora (back of Guaymas).

Specimens examined: ARIZONA (*Giles* of 1850; *Thurber* 1, 689, of 1852; *Bigelow* of 1853; *Palmer* of 1867 and 1876: *Pringle* of 1881 and 1884; *Wright* of 1882; *Evans* of 1891; *Trelease* of 1892): CALIFORNIA (*Wright* 149): SONORA (*Schott* 1; *Parry* of 1852).

The best known of the arborescent forms. The young plants are globose for several years. Called "pitahaya" by the Californians; but this name seems to be applied to all large columnar *Cacti* with edible fruit. Known by the natives as "suwarrow" or "saguaro." The hard pericarp of the fruit bursts into three or four irregular valves, which spread and become recurved, and being lined with crimson pulp, look like red flowers. Preserves and molasses are made from the fruit.

The specimens of Evans from Casa Grande, Arizona, were at first thought to represent a new species, but were finally referred to *giganteus*. The ribs are 15, the spines are dark (almost black) and unusually slender, the radials 8 or 9, and the centrals 4 or 5.

68. Cereus pecten-aboriginum Engelm.; Watson, Proc. Amer. Acad. xxi, 429 (1886).

Erect, solitary, becoming 6 to 9 m. high and 3 dm. or more in diameter, with erect branches: ribs 10 or 11, with densely tomentose finally glabrate areolæ: spines 8 to 12 (mostly 10), very stout, straight, ash-color tipped with black; radials spreading or reflexed (12 mm. long or less); the solitary central (rarely 2 or 3) and sometimes the 2 uppermost radials larger (12 to 35 mm.) and erect or ascending or porrect, compressed or angular: flowers white, 5 to 7.5 cm. long: fruit globose, 6 to 7.5 cm. in diameter, dry and densely hairy and spiny: seeds 4 mm. long, black and shining.—Type, the Palmer specimens in Herb. Mo. Bot. Gard.

Stony mountain sides, from southwestern Chihuahua westward through Sonora and common throughout the Cape region of Lower California and adjacent islands.

Specimens examined: CHIHUAHUA (*Palmer* of 1885): SONORA (*Palmer* of 1869, 1874, and 1890): LOWER CALIFORNIA (*Brandegee* 244): also cultivated in Hort. Berol. in 1886, and in Kew Gard.

The plant was first made known to Dr. Engelmann by a specimen of the brushes made from the fruit, obtained by Dr. Palmer in 1869 from the Papajo Indians at Hermosillo in Sonora, and hence the specific name. The fruit is covered with stiff yellow spines and forms balls 15 cm. in diameter, often many of them growing close together and crowding the tops of the branches. The Indians, who call the plant "cardon" or "hecho," grind the seed to mix with meal, and use the bristly covering of the fruit as a hair-brush. This and *pringlei* are both known as "cardon," and form characteristic forests in the Cape region of Lower California. The *pecten-aboriginum* is more graceful than *pringlei*, has sharper ribs, and the whole plant has a purplish tinge.

69. Cereus pringlei Watson, Proc. Amer. Acad. xx, 368 (1885).

Erect, very stout, becoming 6 to 15 m. high, 6 to 12 dm. in diameter, irregularly branching above the base: ribs 13 (rarely more), with contiguous areolæ, which become spineless on older portions: spines on younger areolæ terete, the radials nearly erect, more or less unequal (12 to 18 mm.) and ash-color, the solitary central (sometimes 2 or even more) twice longer; on older areolæ about 15, dark, flattened, mostly wide-spreading, about 2.5 to 5.5 cm. long and deciduous: flowers white, tinged with green or purple, 6 to 8 cm. long: fruit globose, 5 cm. in diameter, densely tomentose and spiny: seeds obliquely oblong-ovate, black and shining, 3 mm. long.—Type, Pringle of 1884 in Herb. Gray.

Northwestern Sonora and Lower California (especially abundant in the Cape region) and adjacent islands.

Specimens examined: SONORA (*Pringle* of 1884): LOWER CALIFORNIA (*Palmer* 418, on San Pedro Island; *Brandegee* of 1889, San Gregorio, San Luis, Santa Margarita Island).

Stouter, but not so high as *gigantens*, with numerous branches starting within 6 to 9 dm. of the ground. The flowers are not clustered at summit, but are scattered along the ribs for 6 to 9 dm. below the top. The average height is about 7.5 m., with a circumference of 18 to 21 dm. below the branches. This species and *C. pecten-aboriginum* form the great "cardon" forests of Lower California. Brandegee describes one of these forests, made up chiefly of *C. pringlei*, that "covered the ground almost entirely for miles, so that when looking down upon it not even a bush is visible." The dead wood is much used for fuel and other purposes, and the seedy fruit is an article of food.

70. Cereus tetazo Weber, MSS.

Stout, branching, 10 to 15 m. high: flowers greenish-white, 6 cm. long, in clusters of 10 to 20 from the youngest areolæ and without any wool: fruit irregularly dehiscent, exposing the ripe pulp.—Type, Weber specimens in Herb. Mo. Bot. Gard.

At Zapatalan, Jalisco.

Specimens examined: JALISCO (*Weber* of 1864 and 1869).

Dr. Weber's manuscript notes are among those of Dr. Engelmann, but neither they nor the material are sufficient for any fuller diagnosis than that given above. Both Weber and Engelmann indicated their belief that this was a new species. Weber further remarks that the flowers are eaten as a salad, and the fruit is dried in large quantities. The specific name probably represents the local name. The species is closely related to if not identical with *C. pecten-aboriginum*.

71. Cereus calvus Engelm. MSS.

Erect and spreading, simple or more or less branched, the branches ascending or erect: ribs 20 or more (younger ones obtuse and almost naked), with areolæ acute at both ends, densely woolly, about 10 mm. apart and connected by a broad woolly groove: spines all erect, short (2 to 12 mm.) and sharp, irregularly arranged and numerous; radials 12 to 15, especially the upper ones weak; centrals 3 to 6, somewhat stouter and longer; all at length deciduous: flowers short, lateral near the apex: fruit globose, 2.5 cm. in diameter, loosely covered with light yellowish-red spines.—Type, Gabb 2 in Herb. Mo. Bot. Gard.

Sandy soil, from Cape San Lucas, Lower California, northward.

Specimens examined: LOWER CALIFORNIA (*Gabb* 2 of 1867).

The spines are very soon deciduous, never persisting longer than the second year, whence the popular name "cardon pelon" or "bald cereus." It may be a form of *pringlei*, and at any rate, with the next species, it forms a part of the "cardon" flora so characteristic of the Cape region of Lower California.

72. Cereus titan Engelm. MSS.

Erect, simple or more or less branched, branches ascending or erect, 6 to 15 m. high, and sometimes 6 dm. in diameter: ribs 20 or more, the younger acute, with approximate areolæ connected by a woolly groove: spines sharp and rigid, bulbous at base; radials about 12 and radiant;

centrals 3 or 4, stouter but hardly longer: flowers short, lateral toward the apex: fruit globular, large ("size of an orange"), red and armed with numerous reddish-brown spines, bursting into 4 segments when ripe.—Type, Gabb 1 in Herb. Mo. Bot. Gard.

In sandy soil, from Cape San Lucas to San Quintin, Lower California.

Specimens examined: LOWER CALIFORNIA (*Gabb* 1 of 1867).

This may be a form of *peeten-aboriginum*, but with our present information they are sufficiently kept apart. Another "cardon."

73 Cereus weberi, sp. nov.

Plant about 10 m. high, with a regular candelabra form of branching (two main branches each producing near the base two other branches, all ascending), branches and main stem of same diameter, angled and glaucous: areolæ 3 to 5 cm. apart: spines stout, bulbous at base; radials 10 or 11, 2 to 5 cm. long; central solitary, 6 to 10 cm. long, laterally compressed, sometimes a little deflexed: flowers lateral, white, 8 to 10 cm. long: fruit "as large as a small orange," covered with small scales bearing axillary wool and spines.—Type, Weber material in Herb. Mo. Bot. Gard.

"A few miles south of Tehuacan," Puebla, Mexico.

Specimens examined: PUEBLA (*Weber* of 1864).

The specific name originally proposed by Dr. Weber was *candelaber*, but there is a *Cereus candelabrius* in the European gardens, described at some time before 1840. Dr. Engelmann notes this as "a most peculiar plant." The seed is sold in market in Tehuacan, etc., and is ground and mixed with tortillas.

74. Cereus queretarensis Weber, MSS.

Tree-like, much branched, 6 to 8 m. high: flowers 10 to 12 cm. long: ovary covered with triangular fleshy scales which arise from a tubercle and bear axillary wool and spines: fruit densely covered with bunches of dark-yellowish or brownish spines bulbous at base.—Type, Weber specimens in Herb. Mo. Bot. Gard.

In the vicinity of Queretaro, Mexico, and cultivated along roadsides and fence rows.

Specimens examined: QUERETARO (*Weber* of 1864).

While our information concerning this species is scanty it may be sufficient to lead to its recognition in the original locality.

\+ + *Branched at base.*

\+ + *Spines similar.*

75. Cereus thurberi Engelm. Amer. Jour. Sci. ser. 2, xvii, 234 (1854).

Erect or ascending, fasciculate-jointed, 5 to 15 stems from same root, becoming 3 to 4.5 m. high, lower joints 6 to 9 dm. long, upper joints 15 to 18 dm. long and 10 to 15 cm. in diameter, branches curved inward: ribs 13 or 16, very slightly prominent, with shallow intervals and areolæ 25 to 30 mm. apart: spines 7 to 16, slender and rigid or almost setaceous, straight or flexuous, reddish-black at length ashy, very unequal (10 to 36 mm. in same bunch), irregularly fascicled; radials 8 to 10 (5 to

20 mm.), sometimes wanting above; centrals 3 to 6, larger and longer (2 to 3 cm.): flowers greenish-white, 6.5 to 7.5 cm. long: fruit globose, 3.5 to 7.5 cm. in diameter, spiny at length naked, olive-color with crimson pulp ("like a large orange and of delicious taste"): seeds obliquely obovate, keeled on back, shining and minutely tuberculate, 1.8 to 2 mm. long. (*Ill.* Cact. Mex. Bound. t. 74, f. 15)—Type, Thurber 2 and 367 in Herb. Mo. Bot. Gard.

From southwestern Arizona southward throughout Sonora and Lower California (especially in the Cape region).

Specimens examined: ARIZONA (*Vasey* of 1875; *Evans* of 1891, at Casa Grande): SONORA (*Thurber* 2 and 367; *Schott* 2; *Palmer* of 1869; *Pringle* of 1884): LOWER CALIFORNIA (*Gabb* 3 of 1867; *Brandegee* of 1889, Purissima and San Estaban).

The "pitahaya dulce" of the natives.

76. Cereus hollianus Weber, MSS.

Branching from base, 4 to 5 m. high and stout, dark-green: ribs 10 to 12, acute, often oblique, with areolæ 2 to 3 cm. apart: radial spines about 12, irregular, 1 to 1.5 cm. long; centrals 3, the lower one 5 to 10 cm. long and deflexed: flowers near the summit, white, 10 cm. long: fruit "as large as a goose egg," dark purplish-red, bearing wool and spines.—Type, Weber specimens in Herb. Mo. Bot. Gard.

Common about Tehuacan, Puebla.

Specimens examined: PUEBLA (*Weber* of 1864).

Important for its wood, which forms long straight rods used for poles in hedges and vineyards.

77. Cereus flexuosus Engelm. MSS.

Rather large, branched at base and straggling, the branches elongate (12 to 24 dm. and 7.5 to 10 cm. in diameter), flexuous (often deflexed), and diffusely branched: ribs 6 to 8, with deep intervals and remote areolæ: spines stout and angular, black at length ashy, annulate; radials usually 8 to 10 and radiant, 1 to 2 cm. long, the lowest slenderer; centrals 1 to 4, much stouter and erect, 2.5 to 4.5 cm. long: flower unknown: fruit globose: 2.5 to 5 cm. in diameter, dark-red and spinose, acid.—Type, Gabb 5 in Herb. Mo. Bot. Gard.

Rocky or sandy ground, from Cape San Lucas to near Rosario, Lower California.

Specimens examined: LOWER CALIFORNIA (*Gabb* 5 of 1867).

The plant is large, dark-green, and very straggling, the elongated branches arising from the base and afterward sending off lateral branchlets, often forming impenetrable thickets. The local name is "pitahaya agre."

++ ++ *Spines on fertile branches long-setaceous or hair-like.*

78. Cereus schottii Engelm. Syn. Cact. 288 (1856).

Erect or ascending, with numerous stems from the same base, often forming dense thickets, yellowish-green, 24 to 30 dm. high, with 2 to

4 joints 10 to 12.5 cm. in diameter, ascending at base and curved outward at top when mature: ribs 4 to 7 (mostly 5), with areolæ remote on sterile joints and crowded on floriferous ones: spines on sterile joints stout and short (6 to 8 mm.), consisting of 4 to 6 dusky radials and a single shorter dusky central; on floriferous joints 10 to 25, setaceous and flexuous, declinate and as if pendulous (forming a reddish-gray beard), the longer 2.5 to 10 cm.: flowers somewhat hidden in the beard, 3.5 to 4 cm. long: fruit globose, 6 to 8 mm. in diameter, with scarlet pulp: seed obliquely obovate, shining, 2 to 2.4 mm. long. (*Ill.* Cact. Mex. Bound. t. 74, f. 16)—Type, Schott 855 in Herb. Mo. Bot. Gard.

From southern Arizona to the Cape region of Lower California, Sonora, and San Luis Potosi.

Specimens examined: ARIZONA (*Schott* of 1856): SONORA (*Schott* 855; *Pringle* of 1884): LOWER CALIFORNIA (*Gabb* 7 of 1867; *Palmer* of 1870; *Brandegee* of 1889, San Gregorio and Comondu): SAN LUIS POTOSI (*Eschanzier* of 1891).

A variety of local names are reported, such as "zina," "sina," "sinita," "hombre viejo," "cabeza viejo," the latter names referring to the resemblance of the long fine white spines at the top of the plant to a gray head. Often used to make fences.

79. Cereus sargentianus Orcutt, Garden and Forest, iv, 436 (1891).

Closely related to *schottii* and possibly a form of it: stems in clumps of 8 or more, the sterile ones 6 to 15 dm. high and 5- or 6-angled, the fertile ones 30 to 45 dm. high and erect: spines on sterile stems much longer (6 to 18 mm.) and stouter, more numerous (10 or more), and areolæ closer together; the long flexuous spines of the fertile stems about 50 in a cluster: flowers 2.5 cm. long: fruit red, spineless, edible, much larger than in *schottii*. (*Ill.* l. c. 437)—Type in Herb. Orcutt. Lower California.

Specimens examined: LOWER CALIFORNIA (*Brandegee* of 1890, Cedro).

Mr. Orcutt reports it also from San Quintin. Confused with *schottii* and called by the same local names.

The following West Indian species were examined, and are added as likely to be found in Mexico.

80. Cereus royeni armatus Otto; Salm, Cact. Hort. Dyck. 46 (1850).
Cereus armatus Otto; Pfeiff. Enum. 81 (1837).

Erect, pale-green, and scarcely glaucescent, 5 to 7.5 cm. in diameter, with 7 or 8 subcompressed ribs, broad intervals, approximate woolly areolæ, and 8 to 17 unequal, divergent, yellowish, rigid, and slender spines, 6 to 10 mm. long, in an erect-spreading cluster: flowers about 3 cm. long.

Specimens examined: CUBA (*Wright* 2621).

81. Cereus pellucidus Pfeiff. Enum. 108 (1837).

Suberect, 20 to 30 dm. high, 2.5 to 3.5 cm. in diameter, branching at base, pellucidly green, 5-angled, with younger ribs acute (almost membranaceous), older ribs obtuse and inflated below areolæ which are 8 to

10 mm. apart, straight yellow spines, of which 7 to 9 are radiant (6 to 8 mm.) and 1 central (10 to 25 mm.), and elongated flowers (17 to 20 cm.).

Specimens examined: CUBA (*Wright* 2623).

82. Cereus eriophorus Hort. Berol. in Pfeiff. Enum. 94 (1837).

Stem simple, erect and columnar (becoming 6 m. high and 3.5 cm. in diameter), tapering at summit and jointed, with 8 to 10 obtuse and repand ribs, acute intervals at length obsolete, areolæ 24 to 28 mm. apart, 9 to 12 needle-shaped white and black-tipped spines (8 to 16 mm. long), of which 8 to 10 are radial and spreading and 1 or 2 central, and large white funnel-form flowers (15 to 22.5 cm. long) with calyx-tube covered with long wool.

Specimens examined: CUBA (*Wright* 207, 2624, of 1865): also cultivated in Haege & Schmidt Gard. in 1873; and in Harv. Bot. Gard. in 1882.

ARTIFICIAL KEY TO THE SPECIES.

The following key is based upon spine characters and may be of service in case of incomplete material. Forms found within the United States are italicized; the species and varieties are indicated only by their specific or varietal names, and the numbers refer to the serial numbers of the synoptical presentation.

** Central spines none.*

← Radial spines 3 to 6 (12 to 35 mm. long).

paucispinus (32), *triglochidiatus* (34).

← ← Radial spines 12 to 20 (2 to 12 mm. long).

viridiflorus (1), *tubulosus* (2), *rigidissimus* (10), adustus (13).

← ← ← Radial spines 20 to 30 (4 to 9 mm. long).

cæspitosus (7), *castaneus* (8), *rigidissimus* (10).

** * Central spine solitary.*

← Radial spines 2 to 10.

Radials 1 to 2 mm. long.

poselgeri (44), *greggii* (48), striatus (52), boeckmanni (59).

Radials 2 to 4 mm. long.

procumbens (43), nycticalus (56), compressus (58).

Longest radials from 6 to 10 mm.

Central spine 4 to 10 mm. long.

marginatus (46), grandiflorus (55), armatus (80).

Central spine 10 to 25 mm. long.

berlandieri (42), geometrizans (47), eburneus (54), pellucidus (81).

Longest radials from 12 to 16 mm.

aggregatus (38), napoleonis (57), pecten-aboriginum (68), tetazo (70).

Longest radials from 16 to 20 mm.

pitajaya (49), cochal (53), flexuosus (77), eriophorus (82).

Longest radials 25 to 100 mm.
Spines white.
dubius (23), *enneacanthus* (29), *mojavensis* (30), *octacanthus* (36).
Spines straw-color or yellow.
zuniensis (31), *gonacanthus* (33), *hexaedrus* (35).
Spines dusky or variegated.
fendleri (28), princeps (50), *schottii* (78), sargentianus (79).

+ + Radial spines from 10 to 15.

Radials 2 to 6 mm. long.
viridiflorus (1), *poselgeri* (44).
Longest radials 10 to 12 mm.
tubulosus (2), *aggregatus* (38), pecten-aboriginum (68), tetazo (70).
Longest radials 15 to 18 mm.
pringlei (69).
Longest radials 25 to 100 mm.
enneacanthus (29), weberi (73), *schottii* (78), sargentianus (79).

+ + + Radial spines from 15 to 20.

Longest radials 6 to 10 mm.
viridiflorus (1), spinosus (12), radians (14).
Longest radials 12 to 18 mm.
tubulosus (2), rufispinus (16).
Longest radials over 20 mm.
schottii (78), sargentianus (79).

+ + + + Radial spines more than 20.

emoryi (62), *schottii* (78), sargentianus (79).

** * * Central spines 2 to 4.*

+ Radial spines 10 or less.

Radial spines 1 to 2 mm. long.
greggii (48).
Radial spines 4 to 12 mm. long.
aggregatus (38), maritimus (40), grandiflorus (55), flagelliformis (61).
Longest radials 16 to 20 mm.
roetteri (15), acifer (24), flaviflorus (25), cinerascens (27), pitajaya (49), *thurberi* (75), flexuosus (77), eriophorus (82).
Longest radials 25 to 30 mm.
stramineus (22), *dubius* (23), *roemeri* (37), *polyacanthus* (39).

+ + Radial spines 10 to 15.

Radial spines 5 to 10 mm. long.
chloranthus (3), brandegei (21), maritimus (40), pacificus (41), flagelliformis (61).
Radial spines 10 to 15 mm. long.
neo-mexicanus (5), *engelmanni* (18), *variegatus* (19), *chrysocentrus* (20), brandegei (21), *aggregatus* (38), mamillatus (63), hollianus (76).
Radial spines 15 to 20 mm. long.
roetteri (15), sanborgianus (26).
Radial spines more than 20 mm. long.
stramineus (22), *roemeri* (37), *polyacanthus* (39).

+ + + Radial spines 15 to 20.

Radial spines 5 to 10 mm. long.
chloranthus (3), *ctenoides* (6), pectinatus (9), *centralis* (11), brandegei (21).

Radial spines 10 to 20 mm. long.

dasyacanthus (4), brandegei (21), mamillatus (63), alamosensis (64).

\+ + + + *Radial spines more than 20.*

dasyacanthus (4), *ctenoides* (6), mamillatus (63).

* * * * *Central spines more than 4.*

\+ *Radial spines 10 or less.*

roetteri (15), *roemeri* (37), maritimus (40), *thurberi* (75).

\+ + *Radial spines 10 to 15.*

Radial spines 5 to 10 mm. long.

chloranthus (3), maritimus (40), pacificus (41).

Radial spines 10 to 20 mm. long.

roetteri (15), sanborgianus (26), gummosus (60).

Radial spines more than 20 mm. long.

roemeri (37), *giganteus* (67).

\+ + + *Radial spines 15 to 20.*

Radial spines 5 to 10 mm. long.

chloranthus (3), pectinatus (9), *centralis* (11).

Radial spines 10 to 15 mm. long.

dasyacanthus (4), longisetus (17), bradtianus (65).

Radial spines more than 20 mm. long.

giganteus (67).

\+ + + + *Radial spines more than 20.*

dasyacanthus (4), ernea (66).

GEOGRAPHICAL DISTRIBUTION.

So far as now known there are twenty-nine species of the genus *Cereus* represented within the borders of the United States, one of which is a West Indian form extending into Florida, and ten are peculiar to our flora. The genus is a very large and diversified one in Mexico, ranging in habit from small globose forms through cylindrical ones and climbers to the huge arborescent forms of the "cardon" forests of Sonora and Lower California. In the United States the genus is not represented north of the mountains of southern Wyoming or east of Indian Territory, except in the case of the Florida species referred to. As in the case of the genera already considered, our species appear but as outliers of the large Mexican flora. So uncertain is our knowledge of the latter that no attempt is made to include its species in this discussion.

Omitting *monoclonos*, a West Indian species of EUCEREUS which occurs in Florida, the two great groups of the genus are represented in the United States by twenty-eight species, twenty-three belonging to ECHINOCEREUS, and five to EUCEREUS. The EUCEREUS group is

eminently Sonoran, and its arborescent forms, three in number (*giganteus*, *thurberi*, and *schottii*), are strictly confined to the desert region of the Lower Colorado, chiefly upon the Arizona side in the region of the Gila River; but they are merely the northern representatives of the large display of giant forms found in Sonora and Lower California. Of the nonarborescent forms of EUCEREUS, but two are included in our flora, one (*emoryi*) being a Lower Californian type extending into southern California, and the other (*greggii*) a Sonoran and Chihuahuan type extending into Arizona and as far east as the Pecos River in Texas, by far the most eastern of our EUCEREI. It will be seen that there are no species of EUCEREUS peculiar to the United States.

The relatively larger display of the ECHINOCEREI in the United States is probably to be partially explained by their low compact forms, simulating in a perplexing way those of *Cactus* and *Echinocactus*. Out of the twenty-three species of our flora but two are really cylindrical, one (*poselgeri*) a form occurring on both sides of the Lower Rio Grande and so weak and slender that it uses shrubs for a support; the other (*berlandieri*) also a form of southeastern Texas, originally found on the Nueces, apparently peculiar to the United States, and with its short cylindrical body forming a transition between the cylindrical and more compact forms. The remaining twenty-one species form our dominant *Cereus* flora, and of these but nine are peculiar, so far as now known, to the United States. These twenty-one species are easily thrown into three groups: (1) the pectinate forms; (2) the purple-flowered nonpectinate forms; and (3) the scarlet-flowered nonpectinate forms. The first contains seven species, the second six species, the third eight species.

The pectinate forms are characteristically eastern in their display and have the greatest northern extension, *viridiflorus* reaching the mountains of southern Wyoming. Their Mexican origin is also more in the direction of Coahuila and Chihuahua than of Sonora. Of the seven species represented, three are peculiar to the United States (*viridiflorus*, *chloranthus*, and *dasyacanthus*). Of these three forms only *viridiflorus* has a northern range, extending from the mountains of southern Wyoming through Colorado to the borders of eastern New Mexico and northwestern Texas, but it is represented in the El Paso region by its cylindrical variety, *tubulosus*. In the case of the two other species, *chloranthus* has a very restricted range, being confined to the El Paso region, while *dasyacanthus*, occurring in the same region, extends westward to Arizona. It is more than probable that both of these species will be found in Mexico. The closely associated *ctenoides* is also a form of southwestern Texas, which has come from Coahuila and Chihuahua. Another species of Chihuahuan origin, occurring in the El Paso region but extending westward to Arizona, is *roetteri*. The strongest pectinate type, however, is exhibited by the species *pectinatus*, which is common to Chihuahua and Sonora, but is repre-

sented in our flora by its variety *rigidissimus*, one of the most common of Arizona forms and extending to southwestern Texas, and the variety *centralis*, also an Arizona form. This same *pectinatus* type is represented at the east by *cæspitosus*, the most eastern of our CEREI, reaching the Canadian and Arkansas Rivers in Indian Territory, and apparently not occurring west of the Pecos, its Mexican extension being in the States east of Chihuahua.

The purple-flowered nonpectinate species, six in number, range from the Salt Lake Desert of Utah on the north to the eastern slopes of the Californian Sierras and the middle Rio Grande on the south, their Mexican connections extending from Lower California to Coahuila. But one of them (*mojavensis*) is peculiar to our flora, occurring in the desert regions of southeastern California, Arizona, and southern Utah. Four of the species reach Texas: *dubius* in the Rio Grande bottoms from El Paso downward, with no western extension, but with a Mexican extension into Chihuahua and Coahuila; *enneacanthus* all along the Lower Rio Grande and to El Paso, with a similar Mexican extension, but reaching Arizona on the west; *stramineus*, common in the Pecos and El Paso region, extending down the Rio Grande, west to Arizona, and south into Coahuila; and *fendleri*, a Sonoran and Chihuahuan type, which stretches through Arizona to Utah and east to southwestern Texas. The dominant species of the group, however, *engelmanni*, is far western in its distribution, extending from Lower California and Sonora along the eastern slopes of the Californian Sierras and through Arizona and Nevada to the Salt Lake Desert of Utah. Two strong varieties of this species are peculiar to our flora: *variegatus*, occurring with the species within our borders, and *chrysocentrus*, confined to the deserts of southeastern California.

The scarlet-flowered nonpectinate species, eight in number, contain five peculiar to our flora, but these five are species of no great abundance, and one of them (*hexaedrus*) has never been rediscovered. The three remaining species, which are the dominant ones, are all common to the Chihuahua region, and extend from the El Paso region to southern California. Of the five species restricted to the United States, *gonacanthus* is the most northern and the most removed from the Mexican flora, occurring in southern Colorado and northern New Mexico; *hexaedrus* is the least known, having been found but once, and then near Zuni, New Mexico; *paucispinus* inhabits the narrow belt between the San Pedro and Pecos rivers of Texas, a range, however, which specimens recently received from Durango, Colorado, will modify; *triglochidiatus* ranges from east of the Pecos in Texas northward into New Mexico; while *octacanthus* has the most extended range, reaching from the El Paso and Pecos region of Texas northwestward through New Mexico into Utah. The three species of wide range and Mexican representation are: *aggregatus*, extending from southern Colorado through eastern Arizona and southwestern Texas to San Luis Potosi; *roemeri*,

ranging from the Upper Pecos in New Mexico to southern California, and extending southward into Chihuahua; and *polyacanthus*, most abundant of all the group, extending from El Paso to southern California and southward into the mountains of Chihuahua on the east and Lower California on the west.

Taking our species of *Cereus* as as a whole, therefore, they may be broadly thrown into two geographical groups, the El Paso forms and the Arizona forms, the former, containing about two-thirds of the species, and of Chihuahua origin, the latter of Sonoran origin.

6. **OPUNTIA** Mill. Gard. Dict. ed. 7 (1759).

Plants with flat or cylindrical more or less tuberculate joints: leaves conspicuous but caducous, each with an axillary "pulvinus" which is usually clothed with soft wool intermixed with barbed bristles at the upper edge and usually bearing spines at the lower edge: flowers developed from the bristle-bearing part of the pulvinus, with rotate corollas: ovary covered with the caducous leaves bearing axillary wool and often bristles and spines: fruit dry or succulent: seeds large, usually flattened and discoid, often margined: cotyledons foliaceous, curved about the endosperm. *Consolea* Lem. (1862); *Tephrocactus* Lem. (1868); *Ficindica* St. Lag. (1880).

The most difficult of our genera on account of its exceedingly ill-defined specific lines. Little more is attempted in the following pages than a tentative presentation of our material, and little more can be done until numerous forms have been studied under cultivation.

I. PLATOPUNTIA. *Joints flat, more or less round: spines never sheathed: seeds with prominent margin.*

* *Petals small, subulate, suberect: stigmas 1 to 3, acute.*

1. **Opuntia stenopetala** Engelm. Syn. Cact. 289 (1856).

Prostrate, with large thick joints 15 to 20 cm. broad: pulvini 3 to 3.5 cm. apart on surface of joint, but very crowded at margin, with much dirty-white wool and short dark-brown bristles: spines 1 to 3 (often with 1 to 3 smaller ones added), 3.5 to 5 cm. long, curved deflexed or spreading, compressed, reddish-black with lighter tip: flowers orange, its pulvini very woolly: sepals and petals numerous, linear-subulate and suberect: style undivided at apex: ovary 18 mm. long: fruit unknown. (*Ill.* Cact. Mex. Bound. t. 66)—Type, Gregg 295 in Herb. Mo. Bot. Gard.

"Battlefield of Buena Vista, south of Saltillo" (Gregg).

Specimens examined: COAHUILA (*Gregg* 295 of 1848; *Weber* of 1865–1866).

The Mexican *O. grandis* has similar flowers, but is an erect plant, with few white spines and two or three acute stigmas.

** * Petals broad, obovate or obcordate: stigmas usually 5 to 10, obtuse.*

– Fruit succulent: margin of seed mostly narrow.

.. Joints glabrous.

(1) *Suberect: spines numerous, colored: fruit small, subglobose.*

2. Opuntia strigil Engelm. Syn. Cact. 290 (1856).

Suberect, pale-green, about 6 dm. high, with the obtuse or subacute joints ovate, obovate, or orbicular, 10 to 12.5 cm. long and 8.5 to 10 cm. broad: pulvini prominent, crowded (8 to 12 mm. apart), whitish-woolly when young, soon with pale-yellow bristles, all spiniferous: spines 5 to 8, radiant, red or reddish-brown, yellowish toward tip, 6 to 16 mm. long, toward margin of joint, with 1 or 2 stouter longer (nearly 2.5 cm.) erect, spreading, or deflexed ones (deep-brown to light reddish-brown to yellow): fruit subglobose, about 12 mm. in diameter, red: seeds thick, obtusely and narrowly margined, 3 mm. in diameter. (*Ill.* Cact. Mex. Bound. t. 67)—Type, Wright 374 in Herb. Mo. Bot. Gard.

In crevices of limestone rocks, between the Pecos and El Paso, Texas.

Specimens examined: TEXAS (*Wright* 374 of 1851, 1852; *Nealley* of 1891).

(2) *Erect or procumbent: joints large: spines (when present) few, stout, compressed, mostly colored: fruit large, mostly ovate.*

A. Unarmed.

3. Opuntia ficus-indica (L.) Mill. Diet. ed. 8, no. 2 (1768).
Cactus ficus-indicus L. Sp. Pl. i, 468 (1753).

Erect and proliferous, 12 to 18 dm. high, with cylindrical trunk which becomes woody with age: joints thickish, elliptical or obovate, 10 to 45 cm. long: pulvini immersed, distant, not spinose or rarely with a minute solitary spine: flowers yellow, 7.5 to 10 cm. in diameter: fruit bristly, obovate, red within, edible.—Type unknown.

Throughout the West Indies (extending into southern Florida) and Tropical America, and cultivated south of the Rio Grande under the name "nopal castillano."

Specimens examined: CUBA (*Wright*, 1860–64): CANARY ISLANDS (*Bourgeau* 1239).

Probably the most ancient cactus in gardens. In the Kew Index it is suggested that this species is identical with *O. tuna*, which seems to be very probable.

4. Opuntia lævis, sp. nov.

Joints light-green, elongate-obovate, 30 cm. long and 10 cm. wide, gradually narrowed below, obtusely pointed above: pulvini small, oval (3 to 4 mm. long), 2.5 to 3.5 cm. apart, gray-tomentose, with numerous short pale bristles, unarmed: flowers yellow, tinged with red, about 6 cm. broad: stigmas slender, 8: fruit somewhat pyriform, 5 to 6 cm. long, deeply umbilicate, bearing about 40 pulvilli: seed very irregular, 4 to 5 mm. in diameter, with thick acute undulate margin.—Type, Pringle of 1881 (distributed as *O. angustata*) in Herb. Coulter.

Arizona.

Specimens examined: ARIZONA (*Pringle* of 1881; *Palmer* 93, 95; *Coues & Palmer* 247; *Vasey* 247).

Besides the spineless character, the seeds are about half as large as those of *O. angustata*, to which species it has been referred.

B. Spines yellow (sometimes red in O. lindheimeri).

i. *Stem erect.*

5. Opuntia tuna (L.) Mill. Dict. ed. 8, no. 3 (1768).
Cactus tuna L. Sp. Pl. i, 468 (1753).
Opuntia bonplandii H. B. K. Nov. Gen. & Sp. vi, 69 (1823).

Erect and proliferous, 9 to 12 dm. high, with oval or elliptical joints 10 to 20 cm. long: pulvini distant, with a grayish tomentum, bearing above a fascicle of brownish-yellow bristles and below 4 to 6 rigid stout or subulate unequal spreading yellow spines (longest 2.5 to 3.5 cm. long): flowers yellow or reddish-yellow, 7.5 to 10 cm. in diameter: fruit somewhat pyriform, large and edible.—Type unknown.

Throughout tropical America, and extensively cultivated.

Specimens examined: FLORIDA KEYS (*Binmar; Canby* of 1869): CUBA (*Wright* of 1860–64): SAN LUIS POTOSI (*Parry & Palmer* 279; *Webber* of 1866): VERA CRUZ (*Parry* of 1877): NICARAGUA (*Wright* of 1853–56): PANAMA (*Schott* 3): CANARY ISLANDS (*Bourgeau* 263): also specimens cultivated in Mo. Bot. Gard. in 1862, 1870, 1876, and growing in 1893; also specimens from South Carolina (*Tourney* of 1846; *Mellichamp* of 1871), presumably cultivated; also Hort. Vindob. 837.

This species is so extensively cultivated and naturalized that it seems impossible to define its natural range. In Southern California it is cultivated for fences and naturalized about the old missions, where it is called "tuña." In Lower California and Mexico it is also extensively cultivated.

6. Opuntia triacantha (Willd.) DC. Prodr. iii, 473 (1828), not Sweet, Hort. Brit. 172 (1827).
Cactus triacanthos Willd. Enum. Suppl. 34 (1813).

Erect and proliferous, with oval to oblong joints: pulvini somewhat crowded, with yellowish bristles and usually 3 (4 to 1) stiff divaricate spreading or reflexed whitish spines, the upper 3 to 5 cm. long, often twice as long as the two lower ones: flowers reddish, 2.5 cm. in diameter.—Type unknown.

Throughout Tropical America.

Specimens examined: CUBA (*Wright* 1860–64): ANTIGUA (*Wullschlogel* of 1849): cultivated in Hort. Modena.

The spines of this species are much weaker (as well as fewer) than those of *O. tuna*. According to the Kew Index *O. triacantha* Sweet[1] is *O. curassavica* Mill.,[2] a south Mexican and South American plant, which we have not seen, but which is certainly not the species described above.

7. Opuntia lindheimeri Engelm. Pl. Lindh. 207 (Jan. 1850).
Opuntia engelmanni Salm, Cact. Hort. Dyck. 235 (1850).

Erect, 12 to 18 dm. high, with a stem at length woody and terete (15 cm. in diameter) bearing a grayish cracked and unarmed bark, and large pale-green obovate or orbicular-obovate joints (in larger specimens 30 cm. long by 22.5 cm. broad): pulvini remote (3 to 3.5 cm. apart), with sparse yellow rigid strongly unequal bristles, and few spines (in upper pulvini mostly two or three) 2.5 to 3.5 cm. long, strongly

[1] Hort. Brit. ed. 1, 172.

[2] Gard. Dict. ed. 8, no. 7.

compressed or angular, straight or curved deflexed or variously divergent, straw-colored or horny, with reddish base or entirely red, and one or two additional lower ones 1.2 to 1.8 cm. long (slenderer, paler, often wanting): flowers yellow, red within, 6 to 7.5 cm. broad: fruit obovoid-globose (rarely pyriform), 5 cm. long and 3.5 cm. broad, purplish, with bright-purplish insipid or nauseous pulp: seeds somewhat irregular, mostly narrow-margined, 3 to 4 mm. in diameter. (*Ill.* Cact. Mex. Bound. t. 75, f. 1–4)—Type, Lindheimer 1722 of 1845 in Herb. Mo. Bot. Gard.

Along the whole Mexican border, from the Canadian River and mouth of the Rio Grande to the Pacific and adjacent islands, and southward into Chihuahua and Coahuila.

Specimens examined: TEXAS (*Lindheimer* 1722 of 1845; *Wright* 329, 437, 473, of 1852; *Bigelow* 117 of 1852; *Tweedy* of 1880): NEW MEXICO (*Bigelow* 91; *Evans* of 1891, Lordsburg; *Mearns* of 1892, Grant Co.): ARIZONA (*Palmer* 81, 95, 477; *Rusby* of 1883, Oak Creek; *Evans* of 1891, Tucson; *Toumey* of 1892, Tucson): CALIFORNIA (*Wislizenus* 223; *Rothrock* 10, Santa Cruz Island; *G. R. Vasey* of 1880, San Bernardino): COAHUILA ("St. Louis Volunteers" of 1846): also cult. in Mo. Bot. Gard. 1853, 1861, 1862, and growing in 1893.

A stout, coarse looking plant of wide range and variation. This and apparently all other Platyopuntias are indiscriminately spoken of as "nopal" and "tuna," the former name being applied to the joint, the latter to the fruit. The spines are variously colored, being frequently a deep-red, or entirely white, or variegated. Evans's specimens from Lordsburg not only have deep-red spines, but also ovate joints. The four following forms have been suggested as varieties, and they may prove constant enough.

8. Opuntia lindheimeri dulcis (Engelm.).

Opuntia dulcis Engelm. Cact. Mex. Bound. 48 (1856).

Lower (6 dm. high) and more spreading, with smaller joints (15 cm. long), very numerous bristles, mostly twisted deflexed pale (almost white) spines, ovate sweet fruit, and smaller regular seeds. (*Ill.* Cact. Mex. Bound. t. 75, f. 5–7)—Type, Mexican boundary collections of Bigelow and Wright in Herb. Mo. Bot. Gard.

Along the middle Rio Grande, near Presidio del Norte, etc.

Specimens examined: TEXAS (*Bigelow* of 1852–54; *Wright* of 1852): also growing in Mo. Bot. Gard. 1893.

9. Opuntia lindheimeri occidentalis (Engelm.).

Opuntia occidentalis Engelm. & Bigel. Pacif. R. Rep. iv. 38 (1856).

Opuntia engelmanni occidentalis Engelm. Pacif. R. Rep. iv, errata, iii (1856).

Erect and spreading, 12 dm. high, forming large thickets, with joints as large as in the species, pulvini more remote and with very fine close-set bristles, one to three white (dusky at base) deflexed or divergent spines, very juicy but sour fruit, and larger (5 to 6 mm. broad) seeds with crenulate margins. (*Ill.* Pacif. R. Rep. iv, t. 7, f. 1, 2; t. 22, f. 10)—Type, Schott of 1854 and 1855 in Herb. Mo. Bot. Gard.

Very abundant in southern California west of the coast mountains; also found near Laredo, Texas.

Specimens examined: CALIFORNIA (*Schott* of 1854 and 1855; *Engelmann* of 1880; *Nevin* of 1881): TEXAS (*Nealley* of 1891, at Laredo): also cult. at Mo. Bot. Gard. 1876, and growing 1893.

Dr. Merriam reports this variety as abundant throughout the San Bernardino plain, and immense patches of it 40 miles east of Los Angeles. The habit of growth, very fine bristles, and larger seed serve to distinguish it from the species.

10. Opuntia lindheimeri cyclodes (Engelm.).

Opuntia engelmanni cyclodes Engelm. Syn. Cact. 291 (1856).

About 12 dm. high, with orbicular joints 15 to 18 cm. in diameter, mostly solitary straw-colored (dusky at base) straight and deflexed spines, small globose fruit 2.5 to 3.5 cm. in diameter, and seeds 4 to 5 mm. broad with broadly undulate thickish margins. (*Ill.* Pacif. R. Rep. iv, t. 8, f. 1; t. 22, f. 8, 9)—The type could not be found in the Engelmann collection.

From El Paso, Texas, to the Upper Pecos and Stein's Pass in New Mexico.

Specimens examined: NEW MEXICO (*Evans* of 1891, Stein's Pass): TEXAS (*Evans* of 1891, El Paso).

11. Opuntia lindheimeri littoralis (Engelm.).

Opuntia engelmanni littoralis Engelm. Bot. Calif. i, 248 (1876).

Joints often larger (3 to 4.5 dm. long), with pulvini closer together, longer and more slender spines, and smaller seeds.—Type, Tittum and Mallinckrodt of 1874 in Herb. Mo. Bot. Gard.

Coast of southern California and the adjacent islands (reported from San Miguel, Santa Rosa, Santa Cruz, and Santa Catalina).

Specimens examined: CALIFORNIAN ISLANDS (*Tittum & Mallinckrodt* of 1874; *Rothrock* of 1875, Santa Cruz).

12. Opuntia chlorotica Engelm. Syn. Cact. 291 (1856).

Opuntia tidballii Bigel. Pacif. R. Rep. iv, 11 (1856), *nomen nudum*.

Erect, 12 to 21 dm. high, forming large bushes, with stems at length woody and terete with scaly grayish or light-brown bark and completely covered with very numerous straw-colored bristles and yellow spines; joints orbicular-obovate, pale glaucous, 15 to 20 cm. long and 20 to 25 cm. broad: pulvini about 2.5 cm. apart, with very numerous unequal bristles, and 3 to 6 (1 to 3 in lower pulvini) unequal angular pale straw-colored mostly deflexed spines 2.5 to 5 cm. long (the interior shorter and erect, 8 to 18 mm. long): flowers yellow, 5 to 7.5 cm. broad: fruit large (about 4 cm. long), ovate: seeds small (2.5 by 3.5 mm.), whitish, subreniform, thick, with obtuse margin. (*Ill.* Pacif. R. R. iv, t. 6, f. 1–3)—Type, Bigelow of 1853 and 1854 in Herb. Mo. Bot. Gard.

Western Arizona and southeastern California, and extending into the Charleston Mountains, Nevada.

Specimens examined: ARIZONA (*Bigelow* of 1853 and 1854; *Palmer* of 1877): CALIFORNIA (*Bigelow* of 1854; *Parish* 1419, San Felipe).

The species is readily recognized by the very spiny trunk and very pale broad joints. The large and sometimes spreading bushes often bear 100 or more joints

The arrangement of the bristles is somewhat peculiar, the upper and outer ones (by far the more numerous) being shorter and thinner and covering the upper part of the areola, and within these a semicircular row of stouter and longer bristles, which join the outer and shorter spines of the outer and lower margin of the areola.

13. Opuntia tapona Engelm. MSS.

Joints obovate, 20 to 25 cm. long: pulvini abont 5 cm. apart, with short marginal bristles and 2 (rarely more) pale rather stout compressed spines 1 to 1.5 cm. long: fruit elongated clavate, stipitate, densely tuberculate, dark-purple, 5 to 6 cm. long, sterile so far as seen.—Type, Gabb 20a in Herb. Mo. Bot. Gard.

Sandy soil, especially southward in Lower California.

Specimens examined: LOWER CALIFORNIA (*Wm. M. Gabb* 20a, in 1867, near Loreto).

The name refers to a fancied resemblance of the fruit to a bottle-stopper (*tapone*).

14. Opuntia larreyi Weber, MSS.

Plant only 9 to 12 dm. high, with large orbicular glaucous joints: fruit "as large as a goose egg," juicy, purple, and with purple pulp: seeds small, "much like those of *O. ficus-indica*."—Type unknown.

A Mexican species, found by Dr. Weber in cultivation about Queretaro, and pronounced by him the most delicious of all the fruits he had tasted. Known as "camuessa."

15. Opuntia palmeri Engelm. MSS.

Joints oval, smooth (not tuberculated), pale glaucous, 20 to 25 cm. long by 15 to 20 cm. broad: pulvini 2.5 to 3 cm. apart, with pale brownish or gray persistent wool, a few very slender straw-colored bristles, and slender flattened or compressed straw-colored spines 2.5 to 3 cm. long (5 to 7 on upper pulvini with some smaller additional ones, 1 to 3 on lower pulvini), erect or spreading, or the upper ones (from upper part of pulvinus) mostly deflexed.—Type, Palmer of 1877, in Herb. Mo. Bot. Gard.

Near St. George, Utah.

Specimens examined: UTAH (*Palmer* of June, 1877).

16. Opuntia pycnantha Engelm. MSS.

Erect, with ovate-orbicular compressed scarcely tuberculate joints 12.5 to 15 cm. long by 12.5 cm. wide, armed with densely interwoven mostly deflexed spines: pulvini approximate (6 to 8 mm. apart), with fulvous wool (becoming dusky), and weak bristles (at length elongated and very numerous): spines in younger joints 3–7, pale straw-color (at length ashy), 6 to 25 mm. long, all deflexed; in older joints more numerous (as many as 20), longer and more rigid; flowers and fruit unknown.—Type, Agassiz of 1872 in Herb. Mo. Bot. Gard.

Magdalena Bay, Lower California.

Specimens examined: LOWER CALIFORNIA (*Prof. L. Agassiz*, Magdalena Bay, collected on the Hopler expedition in 1872; *Brandegee* of 1889, Magdalena Island).

The above description was drawn up by Dr. Engelmann from the Agassiz material. Brandegee's specimens supply a good joint, a flower, and ripe fruit, enabling me to supplement the description. The joint is 22 by 14 cm., the pulvini very large and prominent and close together, sometimes even in contact. The fulvous wool gradually becomes darker until it is black, and encircling it above there is usually a more or less prominent tuft of bright-yellow bristles. The single withered flower is small and greenish yellow. The fruit is evidently juicy, globose or obovoid, strongly tuberculate, closely set with the pulvini bearing dark wool, and yellow bristles and spines, about 4.5 cm. in diameter. The seeds are discoid and beaked, somewhat irregular, with thick margin, 3 to 3.5 mm. broad. The spines are terete.

17. Opuntia pycnantha margaritana, var. nov.

Pulvini not so prominent, with more grayish wool, reddish bristles, dark-red more rigid and more or less angular and compressed spines.—Type in Herb. Brandegee.

Santa Margarita Island.

Specimens examined: LOWER CALIFORNIA (*Brandegee* of 1889).

Mr. Brandegee also notes that the flowers are red.

ii. *Stem procumbent.*

18. Opuntia procumbens Engelm. Syn. Cact. 292 (1856).

Prostrate, with the large pale-green orbicular-obovate joints always on edge, 15 to 30 cm. long by 15 to 22 cm. broad: pulvini 2.5 to 5 cm. apart, with long (3 cm.) tomentum, yellow rigid strongly unequal bristles, and 2 to 5 (sometimes 7 to 9) compressed-angular unequal deflexed spines 1 to 5 cm. long (lower ones shortest) and straw-color or paler, darker towards the base, often reddish or reddish-brown: fruit ovate, 3.5 cm. long: seeds 3 to 4 mm. in diameter, with broad irregular margins. (*Ill.* Pacif. R. Rep. iv, t. 7, f. 4, 5).—Type, Bigelow of 1854 in Herb. Mo. Bot. Gard.

In rocky places, from El Paso, Texas, to northwestern Arizona.

Specimens examined: ARIZONA (*Bigelow* of 1854): TEXAS (*Evans* of 1891, El Paso).

The original Arizona range is "from the San Francisco Mountains to Cactus Pass at head of Bill Williams River." The El Paso specimens are smaller than the more western ones, but otherwise there seems to be no difference.

19. Opuntia rubrifolia Engelm. MSS.

Prostrate, with thick ovate joints 12 to 15 cm. long by 10 cm. broad, not tuberculated: leaves spreading, somewhat recurved, reddish, 8 to 10 mm. long: pulvini 2 to 2.5 cm. apart, with brownish-gray persistent wool and numerous yellowish bristles (especially on the upper edge): spines at lower edge of pulvinus, mostly 2 or 3, slender, angular, and often twisted, 2.5 to 6 cm. long, often a few additional smaller ones, all deflexed (almost appressed): flowers and fruit unknown.—Type, Palmer 3 in Herb. Mo. Bot. Gard.

St. George, Utah.

Specimens examined: UTAH (*Palmer* 3).

20. Opuntia angustata Engelm. Syn. Cact. 292 (1856).

Prostrate or ascending, with elongated obovate joints (narrowed toward the base and rounded above) 15 to 25 cm. long or more and 7.5 to 10 cm. broad: pulvini over 2.5 cm. apart, with grayish wool, slender yellowish-brown bristles, and 2 or 3 (often 1 or 2 weaker ones added below) stout angular deflexed spines 2.5 to 5 cm. long, straw-colored or white, yellow or red toward the base: fruit obovate subglobose, broadly and deeply umbilicate, tuberculate and bristly, reddish, 2.5 to 3.5 cm. long: seeds about regular, with broad almost curled margins, 6 mm. or more in diameter. (*Ill.* Pacif. R. Rep. iv, t. 7, f. 3, 4; t. 22, f. 11)—Type, the Bigelow specimens in Herb. Mo. Bot. Gard.

From New Mexico to the mountains of southern California.

Specimens examined: NEW MEXICO (*Bigelow* of 1853): ARIZONA (*Bigelow* of 1854): CALIFORNIA (*Bigelow* of 1854).

21. Opuntia angustata comonduensis, var. nov.

Joints semiobovate (one side straight, as if an obovate joint had been divided in the median line), tapering below as in the species, but with greatest diameter near the middle and tapering above, 20 cm. long, 4.5 to 7.5 cm. broad: spines terete: flower 5 cm. long, yellowish, with reddish tinge outside: fruit at last neither tuberculate nor spiny, but with prominent woolly and bristly pulvini, pyriform, about 4 cm. long: seeds smaller, 3.5 to 4 mm. broad.—Type in Herb. Brandegee.

Comondu, Lower California.

Specimens examined: LOWER CALIFORNIA (*Brandegee* of 1889).

The spines are most prominent along the curved margin and above, some pulvini becoming spineless, until in one specimen the whole joint is unarmed except a few pulvini. In his discussion of *augustata*[1] Dr. Engelmann remarks that while specimens east of the Colorado have sharply angular spines, the one that he had from the California mountains had spines not so angular, and some of them were almost terete. This Lower Californian variety has all the spines distinctly terete. As Dr. Engelmann's description of the fruit was drawn from a single specimen, it is probable that there was no evidence that the tubercles eventually disappeared.

C. Spines reddish or blackish.

22. Opuntia macrocentra Engelm. Syn. Cact. 292 (1856).

Ascending, 6 to 9 dm. high, with large suborbicular thin often purplish joints 12.5 to 20 cm. long and 10 to 17.5 cm. broad: pulvini 2 to 2.5 cm. apart, with grayish wool, slender short yellow bristles, uppermost and marginal ones alone armed, the lower without spines: spines 1 or 2 (rarely more), 5 to 7.5 cm. long, straight or variously flexed, reddish-black, paler upward, often annulate, upper terete, lower a little shorter and compressed or channelled: flowers yellow, 7.5 cm. broad: fruit ovate, 3 cm. long: seeds much twisted, 4 to 4.5 mm. broad, broadly and obtusely undulate margined. (*Ill.* Cact. Mex. Bound. t. 75, f. 8)—Type, the Wright specimens in Herb. Mo. Bot. Gard.

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[1] Pacif. R. Rep., iv [pt. 1], 39.

Sandy ridges in southwestern Texas to Arizona and extending southward into Chihuahua.

Specimens examined: TEXAS (*Wright* of 1851–52; *G. R. Vasey* of 1881, El Paso; *Evans* of 1891, Sierra Blanca; *Trelease* of 1892; *Woodward*): NEW MEXICO (*Evans* of 1891, Lordsburgh): ARIZONA (*Wilcox* of 1894, Fort Huachuca): CHIHUAHUA (*Pringle* 235, a spineless form distributed as *O. rufida*).

The thin joints and long nearly black spines characterize the species. The Chihuahuan specimen of Pringle is spineless and has smaller pinkish flowers (5 cm. broad); however, spiny and spineless joints are sometimes found on the same plant. Vasey's material has spines more grayish than usual and bristles more reddish-brown, being unusually suggestive of *mesacantha*.

23. Opuntia phæacantha Engelm. Pl. Fendl. 51 (1849).

Opuntia phæacantha nigricans Engelm. Syn. Cact. 293 (1856).

Opuntia phæacantha brunnea Engelm. l. c.

Diffuse, ascending, with obovate thick glaucous or sometimes purplish joints 10 to 17.5 cm. long and 6 to 11 cm. broad: pulvini 2.5 to 3.5 cm. apart, with grayish wool and slender yellowish or brownish bristles, mostly armed: spines 2 to 5, straight, reddish-brown to blackish, paler upwards, 2.5 to 6 cm. long, the upper one teretish and porrect, the rest shorter, unequal, more or less angular or compressed, deflexed: fruit cuneate-pyriform, much contracted at base, with a broad and shallow umbilicus, scarcely pulpy, 3 to 3.5 cm. long: seeds very variable, 4 mm. broad or smaller. (*Ill.* Cact. Mex. Bound. t. 75, f. 9–15)—Type, the Fendler specimens in Herb. Mo. Bot. Gard.

Sandy ridges from the El Paso region of Texas to the Rio Grande, near Santa Fe, New Mexico, and eastern Arizona, and southward into Chihuahua.

Specimens examined: NEW MEXICO (*Fendler* of 1846–47, along Rio Grande near Santa Fe): ARIZONA (*Parry* of 1867): TEXAS (*Wright* of 1851–52, in valley near El Paso; *Evans* of 1891, in same locality): CHIHUAHUA (*Wislizenus* 249).

The flowers described in Pl. Fendl. and subsequent writings as those of this species prove not to belong here. In Watson's Biblographical Index *O. polyantha* Haw. (*Cactus polyanthus* Sims) is referred here. In the Missouri Botanical Garden in 1893 there were growing plants of *polyantha* from South America, evidently that species as figured in the Botanical Magazine,[1] and not at all our *phæacantha*. *O. polyantha* much more resembles *O. tuna*.

24. Opuntia phæacantha major Engelm. Syn. Cact. 273 (1856).

Joints much larger, 12.5 to 15 cm. and even 20 cm. broad, with more remote pulvini, and shorter fewer paler spines.—Type, Fendler of 1846 in Herb. Mo. Bot. Gard.

Mountains near Santa Fe, New Mexico.

Specimens examined: NEW MEXICO (*Fendler* of 1846; *Bigelow* of 1853).

This variety is characterized in Plantæ Fendlerianæ, but without name.

[1] liii, t. 2691.

25. Opuntia camanchica Engelm. Syn. Cact. 291 (1856).

Prostrate and extensively spreading, with ascending obovate-orbicular joints 15 to 17.5 cm. long by 13.5 to 17.5 cm. broad: pulvini about 3 cm. apart, with few greenish or yellowish-brown bristles, mostly armed: spines 1 to 3 (or marginal ones 3 to 6), compressed, reddish-brown to blackish-brown, paler at tip, 3.5 to 7.5 cm. long, the upper one elongated and suberect, the rest deflexed: fruit oval, with broad umbilicus, deep red, sweet and juicy, 3.5 to 5 cm. long: seeds angular, with broad thick acute or obtuse margins and deeply notched at the hilum, 4 to 6 mm. broad. (*Ill.* Pacif. R. Rep. iv, t. 9, f. 1–5; t. 22, f. 12–15)—Type, Bigelow of 1853 in Herb. Mo. Bot. Gard.

In rather fertile soil "at base of hills," from southern Colorado through western Texas, New Mexico, and Arizona.

Specimens examined: COLORADO (*Engelmann* of 1881): TEXAS (*Evans* of 1891, near El Paso): NEW MEXICO (*Bigelow* of 1853): ARIZONA (*Palmer* of 1869; *Evans* of 1891; *Trelease* of 1892).

This species is reported from the Llano Estacado, on the Upper Canadian, as a large and extensively spreading plant.

26. Opuntia tortispina Engelm. Syn. Cact. 293 (1856).

Prostrate, with ascending orbicular-obovate joints 15 to 20 cm. long: pulvini 2.5 to 3.5 cm. apart, with yellowish bristles: spines 3 to 5, white, angular, and channelled, often spirally twisted, 3.5 to 6 cm. long, with 2 to 4 more slender ones (1 to 2.5 cm. long) added below: flowers sulphur-yellow, 6 to 7.5 cm. broad: fruit ovate, with broad umbilicus, 4.5 to 5 cm. long: seeds orbicular, regular, and but slightly notched at hilum, 4 to 6 mm. broad. (*Ill.* Pacif. R. Rep. t. 8, f. 2, 3; t. 23, f. 1–5)—Type, Bigelow of 1853 in Herb. Mo. Bot. Gard.

From the plains of the Platte, Nebraska, to those of Indian Territory and northern Texas.

Specimens examined: NEBRASKA (*H. Engelmann* of 1858): INDIAN TERRITORY (*Bigelow* of 1853).

27. Opuntia mojavensis Engelm. Syn. Cact. 293 (1856).

Prostrate, with suborbicular joints: pulvini remote, with large yellow bristles: spines 2 to 6, stout and annulate, acutely angular and compressed, more or less curved, reddish-brown, paler toward tip, 2.5 to 6 cm. long, 1 to 3 smaller slenderer pale ones added below: fruit oblong, 4.5 cm. long. (*Ill.* Pacif. R. Rep. t. 9, f. 6–8)—Type, Bigelow of 1853 in Herb. Mo. Bot. Gard.

"On the Mohave, west of the Colorado," California.

Specimens examined: CALIFORNIA (*Bigelow* of 1853).

(3) *Ascending: joints rather small: spines few, terete or scarcely angular, slender, flexible, pale: fruit smaller than in* (2).

28. Opuntia tenuispina Engelm. Syn. Cact. 294 (1856).

Diffuse or ascending, about 3 dm. high, with obovate bright-green joints attenuate at base and 7.5 to 15 cm. long by 5 to 10 cm. broad: pul-

vini 1 to 2.5 cm. apart, with slender short bright reddish-brown bristles: spines 1 or 2, elongated (3.5 to 7.5 cm.), white (sometimes dusky at base and apex), teretish, straight, slender, flexile, suberect or spreading (in upper pulvini the upper one porrect and the rest deflexed), and 1 to 4 shorter (1 to 3 cm.) white inferior ones: flowers yellow, 6 to 7.5 cm. broad: fruit oblong, with deep umbilicus, 2.5 to 3 cm. long: seeds very irregular, with narrow margin and deeply notched hilum, 3 to 4 mm. broad (*Ill.* Cact. Mex. Bound. t. 75, f. 14)—Type, the Wright specimens in Herb. Mo. Bot. Gard.

Sandy ridges on the Rio Grande from El Paso, Texas, northward into adjacent New Mexico.

Specimens examined: NEW MEXICO (*Wright* of 1852, Doña Ana): TEXAS (*Wright* of 1851–52, El Paso): also cult. in Mo. Bot. Gard. 1870.

29. Opuntia setispina Engelm.; Salm, Hort. Dyck. 239 (1850).

Ascending, with small suborbicular glaucous joints not over 5 cm. long: pulvini crowded (6 to 8 mm. apart), with yellowish bristles: spines 4 to 10, very slender (like the bristles), 1 to 3 longer (2.5 to 3.5 cm.) and subangular, 3 to 7 shorter and more or less deflexed: flowers and fruit unknown.—Type, Wislizenus of 1846 in Herb. Mo. Bot. Gard.

"Pine woods in mountains west of Chihuahua."

Specimens examined: CHIHUAHUA (*Wislizenus* of 1846).

30. Opuntia filipendula Engelm. Syn. Cact. 294 (1856).

Ascending from a long thick tuberiferous root, 1.5 to 3 dm. high, with orbicular or obovate or oblanceolate thin bluish glaucous joints, 3.5 to 7.5 long by 2.5 to 5 cm. broad: pulvini 8 to 12 mm. apart, with white wool, greenish-yellow very slender numerous penicillate bristles (becoming very conspicuous), with or without spines: spines (if present) white, 1 or 2 elongated setaceous deflexed ones (not rarely subangular and twisted) 2.5 to 5 cm. long, and 1 or 2 smaller lower ones: flowers purplish, 6 cm. broad: seeds very thick, with narrow but thick and obtuse margins, 3.5 to 4 mm. broad. (*Ill.* Cact. Mex. Bound. t. 68)—Type, the Wright specimens in Herb. Mo. Bot. Gard.

Alluvial bottoms of the Rio Grande from the Pecos to El Paso, Texas, and southward into Chihuahua.

Specimens examined: TEXAS (*Wright* of 1852; *Schott* of 1855): CHIHUAHUA (*Pringle* 147; *E. A. Mearns* of 1892, "Mesquite Spring").

(4) *Procumbent or ascending: joints rather small: spines stout, subterete, white or dusky, or none: fruit clavate.*

31. Opuntia mesacantha Raf.; Seringe, Bull. Bot. Gen. 216 (1830).
Opuntia cespitosa Raf. l. c.
Opuntia rafinesquii Engelm. Syn. Cact. 295 (1856).
Opuntia vulgaris rafinesquii Gray, Man. ed. 2, 136 (1856).
Opuntia vulgaris in part of Amer. authors, not Haw.

Diffuse, from a fibrous root, with obovate or suborbicular very green joints 7.5 to 12.5 cm. long bearing elongated subulate spreading leaves 6 to 8 mm. long: pulvini 1.8 to 2.5 cm. apart, with slender reddish-

brown bristles, mostly unarmed: spines (when present) few, mostly only marginal, stout, terete, straight, erect or spreading, whitish (often reddish at base and apex), 1.8 to 2.5 cm. long, single, or 1 or 2 smaller deflexed ones in addition: flowers sulphur-yellow (often with red center), 6 to 8.5 cm. broad: fruit clavate, naked, with funnel-shaped umbilicus, 3.5 to 5 cm. long (less than half that in diameter), with acid or sweetish purplish pulp: seeds almost regular, compressed, with rather narrow and thick but acutish margins, 5 mm. broad (*Ill.* Pacif. R. Rep. iv, t. 10, f. 3–5; t. 23, f. 7, 8)—Type unknown.

Sterile, sandy or rocky soil in the Mississippi valley from Minnesota and Wisconsin to Kentucky, Missouri, Louisiana, and Texas; apparently not found west of the western boundary of Missouri and Arkansas.

Specimens examined: WISCONSIN (*Hale* of 1861, in part): ILLINOIS (*Engelmann* of 1833–34; *Hall* of 1861, sandy barrens of Mason Co.; *Hayden* of 1862; *Coulter* of 1894, growing): ARKANSAS (*Bigelow* of 1853): KANSAS (Hitchcock of 1893, sandhills near Manhattan): also cult. in Goebel's Gard. 1845; Mo. Bot. Gard. 1856; Harvard Bot. Gard. 1871; Meehan's Gard. 1885.

An exceedingly variable species, the principal varieties being described under the nine following forms.

32. Opuntia mesacantha grandiflora (Engelm.)

Opuntia intermedia Engelm. Pl. Lindh. 206 (1850), not Salm (1834).

Opuntia rafinesquii grandiflora Engelm. Syn. Cact. 295 (1856).

Somewhat ascending, with larger joints (12.5 to 15 cm. long), pulvini 2.5 cm. apart, very slender bristles, almost no spines, large flowers (11 to 12.5 cm. broad, red in center), and elongated fruit 6 cm. long. (*Ill.* Pacif. R. Rep. iv, t. 11, f. 2, 3)—Type, Lindheimer of 1847 in Herb. Mo. Bot. Gard.

On the Brazos, Texas.

Specimens examined: TEXAS (*Lindheimer* of 1847).

33. Opuntia mesacantha parva, nom. nov.

Opuntia rafinesquii minor Engelm. and Bigel. Pacif. R. Rep. iv, 41, name p. 55 (1856), not *O. minor* C. Muell.

Orbicular joints but 5 cm. in diameter, spineless or with a few on the upper margin. (*Ill.* Pacif. R. Rep. iv, t. 11, f. 1)—Type, Engelmann of 1845 in Herb. Mo. Bot. Gard.

Sandstone rock in southern Missouri.

Specimens examined: MISSOURI (*Engelmann* of 1845): also growing in Mo. Bot. Gard.

34. Opuntia mesacantha microsperma (Engelm.).

Opuntia rafinesquii microsperma Engelm. Syn. Cact. 295 (1856).

Almost unarmed, with more compressed smaller seeds (1.6 to 1.8 mm. broad) having narrower margins.—Type cult. in Mo. Bot. Gard. 1854 and preserved in Herb. Mo. Bot. Gard.

With the species.

Specimens examined: cult. in Mo. Bot. Gard. 1854, with no locality.

35. Opuntia mesacantha cymochila (Engelm.).

Opuntia rafinesquii cymochila Engelm. Syn. Cact. 295 (1856).

Opuntia rafinesquii cymochila montana Engelm. and Bigel. Pacif. R. Rep. iv, 42 (1856).

With orbicular mostly armed joints 6 to 8.5 cm. broad, pulvini 1.2 to 1.6 cm. apart, straw-colored or yellowish bristles, 1 to 3 stout white (often reddish-brown at base) subcompressed or twisted spreading or deflexed spines 2.5 to 5 cm. long (often 2 or 3 smaller deflexed ones added), short obovate fruit 2.5 to 3 cm. long, and irregular twisted undulate-margined seeds 5 mm. broad. (*Ill.* Pacif. R. Rep. t. 12, f. 1–3; t. 23, f. 10–12)—Type, the Bigelow specimens in Herb. Mo. Bot. Gard.

From Kansas to southwestern Texas, Arizona, and Utah.

Specimens examined: KANSAS (*Hall* of 1870): TEXAS (*Bigelow* of 1852; *V. Bailey* of 1892, Washburn): NEW MEXICO (*Bigelow* of 1853; *Evans* of 1891, Stein's Pass and Deming): ARIZONA (*Palmer* 302; *Wilcox* of 1894, Ft. Huachuca): UTAH (*Watson* 434).

36. Opuntia mesacantha stenochila (Engelm.).

Opuntia rafinesquii stenochila Engelm. Syn. Cact. 296 (1856).

Prostrate, with obovate joints 10 cm. long by 7.5 cm. broad, pulvini 2.5 cm. apart and only the upper ones armed, yellowish or greenish bristles, solitary white spine 2.5 to 3 cm. long with sometimes 1 or 2 smaller deflexed ones added, long obovate-clavate green or pale red very juicy fruit 3.5 to 6 cm. long and with a broad umbilicus, and regular thick very narrow and obtuse-margined seeds 5 mm. broad. (*Ill.* Pacif. R. Rep. iv, t. 12, f. 4–6; t. 23, f. 9)—Type, Bigelow of 1853 in Herb. Mo. Bot. Gard.

"Cañon of Zuñi, western New Mexico."

Specimens examined: NEW MEXICO (*Bigelow* of 1853).

37. Opuntia mesacantha macrorhiza (Engelm.).

Opuntia macrorhiza Engelm. Pl. Lindh. 206 (1850).

Opuntia rafinesquii macrorhiza Engelm. Syn. Cact. 296 (1856).

Opuntia rafinesquii fusiformis Engelm. l. c. 297.

Prostrate or ascending, with elongated fusiform irregularly thickened root, orbicular-obovate very green joints, most or only upper pulvini armed, yellowish-brown bristles, 1 to 3 stout or slender white or variegated spreading or deflexed spines 2.5 to 3 cm. long (often 1 or 2 additional slender deflexed ones), flowers 5 to 7.5 cm. broad, ovate (scarcely clavate) fruit green or pale-purple, 3.5 cm. long, and thick almost regular acute-margined seeds 5.5 mm. broad. (*Ill.* Cact. Mex. Bound. t. 69; Pacif. R. Rep. iv, t. 12, f. 7, 8; t. 23, f. 6)—Type, Lindheimer of 1843–45 in Herb. Mo. Bot. Gard.

From the "Big Bend" of the Missouri River to the Guadalupe River of Texas and Arizona; in sterile rocky places.

Specimens examined: TEXAS (*Lindheimer* of 1843–45, 1850, 1872; *Wright* of 1852; *Parry* of 1869; *Hall* of 1872): ARIZONA (*Bigelow* of 1853, on Deer Creek): KANSAS (*Wislizenus* of 1846, type of *fusiformis;*

Kellerman of 1888): ARKANSAS (no collector given, but cult. in Mo. Bot. Gard. from White River, near Fayetteville).

38. Opuntia mesacantha greenii, var. nov.
Opuntia greenii Engelm. MSS.

With fibrous roots, orbicular-obovate deep-green joints, numerous short reddish-brown bristles, upper pulvini armed with 1 to 3 spines (upper one straight, stout, terete, 2.5 to 3.5 cm. long, lower ones mostly smaller, paler and deflexed), which are brownish-red at base or entirely so, ovate spineless fruit 3 cm. long with rather shallow umbilicus, and irregular seeds with broad rather acute margins and 6 mm. broad.—Type, Greene of 1870 in Herb. Mo. Bot. Gard.

From Colorado to Arizona.

Specimens examined: COLORADO (*E. L. Greene* of 1870, Golden City; *C. S. Sheldon*, Ft. Collins): ARIZONA (*Toumey* of 1892, Grand Cañon and Williams; *Wilcox* of 1894, Ft. Huachuca).

39. Opuntia mesacantha oplocarpa, var. nov.
Opuntia oplocarpa Engelm. MSS.

Joints orbicular, deep-green, 7.5 to 8.5 cm. in diameter: pulvini with a penicillate tuft of long brown bristles at upper end, all armed except the lower ones: spines mostly 2, rather stout and straight, the upper one reddish-brown (especially toward the base), stouter, erect or porrect. the lower one paler (or even white), deflexed and usually weaker: fruit clavate, with broad and shallow umbilicus, rather dry, spineless (or nearly so), brownish-red, 5 cm. long: seeds wavy-twisted.—Type, Greene of 1870 in Herb. Mo. Bot. Gard.

Colorado to southwestern Texas.

Specimens examined: COLORADO (*E. L. Greene* of 1870. Golden City): TEXAS (*G. R. Vasey* of 1881, El Paso).

This certainly belongs to the maze of forms under *mesacantha*, and possibly may be referred to some of those described above. The seeds and orbicular joints suggest *cymochila*, but the prominent tufts of long brown bristles, the fewer spines, and the decidedly larger distinctly clavate unarmed fruit seem to justify separation for the present. The Vasey material has larger joints (about 12 cm. broad), and its spines are not always in pairs. Often there are three spines, two equally prominent brown upper ones and a lower and weaker deflexed white one, and even two or three very weak ones in addition appressed at lower edge of pulvinus. These characters are suggestive of *cymochila*, but the larger joints and prominent reddish-brown bristles are quite distinctive. The two varieties *greenii* and *oplocarpa* are very near each other, and aside from the seed characters are to be distinguished by the shape of the joints, by the fact that the former has its 1 to 3 spines only on the upper pulvini, and the latter, with its spines mostly in pairs, has all the pulvini armed except the lowest ones. In both, the upper reddish porrect or ascending spine or spines and the lower pale deflexed one are quite characteristic.

40. Opuntia mesacantha vaseyi, var. nov.

Approaches *oplocarpa*, but joints narrow and rather elongate-obovate (16 by 10 cm.), very large pulvini, the 2 or 3 spines (occasionally another short, slender one added) all reddish-brown (occasional trace of yellow-

ish) and unequal (15 to 30 mm.), those on the face of the joint usually in pairs and deflexed, those on the margin apt to be in threes and erect-spreading, fruit dark-red and spineless (about 5 cm. long), and seeds (4.5 to 5 mm. broad) with conspicuous thick somewhat irregular margin.—Type in Nat. Herb.

Western Arizona.

Specimens examined: ARIZONA (*G. R. Vasey* of 1881, Yuma; *H. H. Rusby* of 1883, Ft. Verde).

41. Opuntia fusco-atra Engelm. Syn. Cact. 297 (1856).

Diffuse, with orbicular-obovate tuberculate joints 6 to 7.5 cm. long: pulvini 12 to 18 mm. apart, with numerous short reddish-brown bristles, only the lower unarmed: spines mostly solitary, stout, suberect, brownish-black, 2.5 to 3 cm. long, often one shorter deflexed one added: flowers yellow, 7.5 cm. broad: fruit and seed unknown. (*Ill.* Pacif. R. Rep. iv, t. 11, f. 4)—Type, Lindheimer 33 of 1842 in Herb. Mo. Bot. Gard.

"Sterile places in prairies west of Houston, Texas."

Specimens examined: TEXAS (*Lindheimer* 33 of 1842).

The stout brown (or above almost black) spines, and thick bunches of unusually stout brown bristles on small joints, give a characteristic appearance to the species.

42. Opuntia opuntia (L.).

Cactus opuntia L. Sp. Pl. i, 468 (1753).
Opuntia vulgaris Mill. Dict. ed. 8, no. 1 (1768).
Cactus humifusus Raf. Ann. Nat. i, 15 (1820).

Diffuse and prostrate, with a fibrous root: joints obovate or suborbicular, thick, bright or pale green, 5 to 10 cm. long by 5 to 6 cm. broad, bearing ovate cuspidate mostly appressed leaves 4 to 5 mm. long: pulvini subremote, with few short greenish-yellow bristles, mostly unarmed: spines very rare, when present, solitary, stout, variegated, suberect, less than 2.5 cm. long: flowers pale-yellow, 5 cm. broad: fruit obovate-clavate: seeds regular, thick, with thick margins, 5 mm. broad.—Type unknown.

From the southeast coast of Massachusetts to Georgia and Florida; apparently only in the low countries east and southeast of the Alleghanies.

Specimens examined: MASSACHUSETTS (*Sprague*, at Leyden): NEW YORK (*Hex. & Maier* of 1852): NEW JERSEY (*Torrey & Gray* of 1846; *Hex. & Maier* of 1854; *Meehan* of 1876; *Martindale* of 1876): DELAWARE (*Canby* of 1861): VIRGINIA (*Vasey* of 1878, Ft. Monroe): SOUTH CAROLINA (*Mellichamp* of 1871): also cultivated in numerous gardens.

This species is distinguished from *mesacantha* (which only grows west of the Alleghanies and with which it has been confused) by its smaller size, paler color, small pulvini, usual absence of spines, smaller flowers, and especially by its short thick more or less appressed leaves.

43. Opuntia pes-corvi Le Conte; Chapm. Fl. 145 (1860).

Prostrate and diffuse, bright-green, with small ovate or obovate swollen and often teretish fragile joints 2.5 to 7.5 cm. long and half as thick: pulvini 8 to 16 mm. apart, with few very short slender and pale bristles, the lowest unarmed: spines 1 to 3, straight and slender, rigid, often compressed at base and twisted, dusky, 2.5 to 3.5 cm. long: flowers yellow, 3.5 to 4 cm. broad: fruit obovate, bristly, rose-purple, with shallow umbilicus, fleshy, 12 to 14 mm. long: seeds very few (1 or 2), narrowly and obtusely margined, 4 mm. broad.—Type unknown.

Barren sands, coast of Georgia and Florida.

Specimens examined: FLORIDA (*Chapman* of 1856 and 1860; *Hitchcock* of 1890): also cult. in Harv. Bot. Gard., 1871; Mo. Bot. Gard., 1882.

Evidently very near *O. opuntia*, and possibly only a small thick-jointed variety.

++ ++ Joints pubescent: erect or procumbent.

(1) *Flowers yellow: spineless plants.*

44. Opuntia microdasys Lehm. Ind. Sem. Hamb. 16 (1827).
Opuntia pulvinata DC. Rev. Cact. 119 (1828).

Erect-spreading, 6 to 12 dm. high: joints oblong-obovate or orbicular, pubescent, bright-green, 5 to 7.5 cm. long by 3.5 to 5 cm. wide: leaves minute: pulvini 12 to 16 mm. apart, with yellow wool and numerous very slender yellow bristles, spineless: flowers yellow: fruit unknown.—Type unknown.

From Coahuila to southern Mexico.

Specimens examined: COAHUILA (*Gregg* 284 of 1847; *Palmer* of 1880; *Pringle* 3592): also growing in Mo. Bot. Gard., 1893.

45. Opuntia rufida Engelm. Syn. Cact. 298 (1856).

Erect-spreading, 6 to 12 dm. high, much branched: joints broadly obovate or suborbicular, pubescent, pale-green, 5 to 15 cm. long: leaves long acuminate, 5 mm. long: pulvini crowded, with penicillate tufts of very numerous slender reddish-brown bristles, spineless: flowers yellow, 6 cm. broad.—Type, Bigelow and Gregg specimens in Herb. Mo. Bot. Gard.

On the Rio Grande (on rocks and mountains) about Presidio del Norte, Chihuahua, southward to the valley of the Nazas, Durango.

Specimens examined: CHIHUAHUA (*Bigelow* of 1852, about Presidio del Norte): DURANGO (*Gregg* 634, valley of the Nazas).

Differs from *O. microdasys* in its more rounded and larger joints, longer leaves, and reddish-brown bristles.

(2) *Flowers red.*

46. Opuntia basilaris Engelm. Syn. Cact. 298 (1856).

Low, with obovate or triangular glaucescent minutely pubescent ascending joints 12.5 to 20 cm. long and proliferous (almost rosulate) from the base: leaves minute, 2 mm. long: pulvini 8 to 12 mm. apart,

depressed, with yellow wool, very slender and short at length very numerous reddish-brown bristles, and caducous bristly spines (but no spines proper): flowers rich-purple (reported as sometimes white), 6 cm. broad: fruit short-obovate, with broad umbilicus, dry, pubescent: seeds large, thick, subregular, with rather narrow but very thick margin, 6 to 10 mm. broad. (*Ill.* Pacif. R. Rep. t. 13, f. 1-5; t. 23, f. 14)—Type, the Bigelow, Schott, and Campbell specimens in Herb. Mo. Bot. Gard.

From southern Utah and Nevada (Silver Peak region) southward through western Arizona and southeastern California into Sonora.

Specimens examined: UTAH (*Gabb* of 1867): ARIZONA (*Bigelow* of 1854; *Schott* of 1855, on the Lower Gila; *Campbell* of 1855; *Newberry* of 1858; *Palmer* of 1869; *Rusby* of 1883; *Toumey* of 1892, Yuma): CALIFORNIA (*Schott* 2 of 1855; *Hayden* of 1858; *A. E. Janvier* of 1873, Ehrenberg; *Palmer* of 1876; *Weber* of 1877; *Engelmann* of 1880; *G. R. Vasey*, Whitewater; *Nevin* of 1882; *Trelease* of 1892).

Dr. Merriam says that this species is one of the commonest cactuses of the Sonoran deserts. Its apperance is quite characteristic, a large number of joints of different shapes (obovate, fan-shaped, obcordate, emarginate, elongated or almost oblanceolate) issuing from the base at nearly the same point, forming a sort of rosette "resembling somewhat an open cabbage head."

47. Opuntia basilaris ramosa Parish, Bull. Torr. Club, xix, 92 (1892).

"Spreading, the joints freely branching above; joints and fruit glabrous"—Type, in Herb. Parish.

Dry washes and gravelly benches of the Colorado and Mojave deserts.

Specimens examined: CALIFORNIA (*Parish Bros.* of 1882, Whitewater).

Mr. Parish has called attention to the fact that this is the common form of the species in southern California, and says that only near the summit of the Cajon Pass has he seen plants branching at the base. If this be true, doubtless many of the specimens referred above to *basilaris* are *ramosa*, but there seems to be no way of separating them by the characters of single isolated joints. It is probably also true that this very abundant cactus will be found throughout its range to show both habits of branching, which must give rise to plants of very different appearance. The specimen cited above as having been examined shows but a single joint, but the joint and fruit are glabrous. I doubt whether the pubescent character will hold, as I have a glabrous joint with pubescent fruit.

48. Opuntia treleasii, sp. nov.

Erect, diffusely branching: joints orbicular to obovate, fleshy, with terete base, 15 to 25 cm. long: pulvini not depressed, with long (5 cm.) dense dirty-yellow bristles: leaves on young shoots 5 mm. long, spreading (more than twice as long as those of *basilaris* and darker-red): flower and fruit not seen.—Type, growing in Mo. Bot. Gard. 1893, from collection made by Trelease in 1892.

At Caliente, in the Tehachapi Mountains, California.

Specimens examined: CALIFORNIA (*Trelease* of 1892).

This species is near *O. basilaris*, but differs in its rounder more fleshy joints (terete below), pulvini not depressed (in *O. basilaris* there is a depression for the pulvinus with a furrow on either side in the general surface), yellowish bristles, and especially in its much larger leaves.

+ + *Fruit dry and spiny: seed with very broad margin: diffuse and very spiny.*

++ *Joints compressed, suborbicular.*

49. Opuntia hystricina Engelm. Syn. Cact. 299 (1856).

Diffuse, with obovate-orbicular compressed joints 7.5 to 12.5 cm. long: pulvini 10 to 12 mm. apart, with closely set yellowish or brownish bristles, all armed: spines 10 to 15; the upper 5 to 8 (rarely 1 to 8) stoutish but flexile, angular, twisted or flexuous, erect, spreading or deflexed, whitish or brownish, 3.5 to 10 cm. long; the lower 5 to 7 more slender, radiant downward, white, 8 to 18 mm. long: flowers yellow or purple, 5 to 7.5 cm. broad: fruit obovate, with very shallow flattish umbilicus, 2.5 cm. long: seeds irregular, black, with broad and thick acutish margins, 7 mm. broad. (*Ill.* Pacif. R. Rep. t. 15. f. 5–7; t. 23, f. 15)—Type, Bigelow of 1853 in Herb. Mo. Bot. Gard.

Extending from the western side of the Rio Grande, in New Mexico, to southeastern California and Nevada.

Specimens examined: NEVADA (*H. Engelmann* of 1859; *Watson* 436, Regan's Valley): ARIZONA (*Bigelow* 124 of 1853; *Newberry* of 1858; *Palmer* of 1870, and 474 of 1890, Ft. Huachuca; *Toumey* of 1892, Grand Canyon): CALIFORNIA (*Palmer* 4 of 1876; *Parish Bros.* 168 of 1882; *Parish* of 1891; *Trelease* of 1892).

This species may fairly stand as the southwestern representative of *O. polyacantha*, from which it differs in its longer and more numerous gray or reddish spines, longer yellow bristles, and usually smaller flowers.

50. Opuntia polyacantha Haw. Suppl. Pl. Succ. 82 (1819).

Cactus ferox Nutt. Gen. i, 296 (1818), not Willd.

Opuntia media Haw. l. c.

Opuntia missouriensis DC. Prodr. iii, 472 (1828).

Opuntia missouriensis elongata Salm, Cact. Hort. Dyck. 67 (1850).

Opuntia missouriensis rufispina Engelm. Syn. Cact. 300 (1856).

Prostrate, forming large spreading masses: joints light-green, orbicular, tuberculate, 5 to 10 cm. (rarely 10 to 15 cm.) long: leaves minute, 3 to 4 mm. long: pulvini 8 to 12 mm. apart, with reddish-brown bristles (fewer but longer and darker than in other forms), all armed: spines 8 to 15; the 5 to 10 (generally 6 to 8) exterior ones radiant, setiform, whitish or reddish variegated; the 3 to 5 interior ones stout, reddish-brown (paler-tipped), 3 to 5 cm. long, 2 to 4 of them deflexed, the other one spreading or suberect and very stout: flowers yellow (orange within) or sometimes purple: stigmas 5 to 8: fruit ovate, dry and spiny, with shallow flat umbilicus, 2.5 cm. long: seeds irregular, large (5 to 6 mm. broad). (*Ill.* Pacif. R. Rep. t. 14, f. 1–3)—Type unknown.

Principally on the plains, but also in the mountains to the south, from the Upper Missouri and Washington to the Canadian River (Ind.

Terr.), the Upper Pecos (New Mex.), and Utah (throughout the Salt Lake Basin and the foothills of the Wahsatch).

Specimens examined: MONTANA (*Canby* 140 of 1883): COLORADO (*Farwell* 1062): NEW MEXICO (*Bigelow* of 1853, on the Upper Pecos, type of *rufispina*).

The extreme polymorphism of this species has resulted in a maze of bewildering forms impossible to classify. The form known as *rufispina* (*Cactus ferox* Nutt.) is the typical one, as described above and as illustrated by the specimens cited above. In addition to the five rather distinct varieties described below there is a large number of what may be called miscellaneous forms, not exactly typical, but not departing from the type sufficiently to be set apart as varieties. These miscellaneous forms, so far as examined, are as follows:

WASHINGTON (*Lyall* of 1860; *Suksdorf* 314): OREGON (*Cusick* 1389; *Spalding*, at Clearwater): MONTANA (*Hayden* 1854 and 1859): SOUTH DAKOTA (*Hayden* 1853 and 1855): NEBRASKA (*Hayden* of 1855; *Rydberg* of 1891, Phelps and Deuel Cos.): NEVADA (*Watson* of 1869; *Corille & Funston* 1981): UTAH (*Palmer* 4): COLORADO (*Hall & Harbour* 68, 183; *Hall* of 1862; *Greene* 36 of 1873; *Jones* 504): INDIAN TERRITORY (*Hall* of 1869, Canadian River): NEW MEXICO (*Bigelow* of 1853; *Rothrock* 6 of 1874, Santa Fe): also cult. in Hort. Salm-Dyck. 1847; in Harv. Bot. Gard. 1871; growing in Mo. Bot. Gard. 1893.

51. Opuntia polyacantha platycarpa (Engelm.).

Opuntia missouriensis platycarpa Engelm. Syn. Cact. 300 (1856).

Joints elongated-obovate to obovate-orbicular, 7.5 to 12.5 cm. long: pulvini 12 to 18 mm. apart, with few straw-colored bristles, the lower ones sometimes unarmed, or upper with few spines (sometimes only 6 to 12 mm. long), or with exterior spines, as in the species, and mostly one stout spreading or deflexed reddish-brown interior one: fruit depressed-globose, with a remarkably large and flat umbilicus, 16 to 18 mm. long. (*Ill.* Pacif. R. Rep. iv, t. 14, f. 4)—Type, the Hayden specimens of 1853–54 from Nebraska and Montana in Herb. Mo. Bot. Gard.

In the Upper Missouri region, from Idaho and Montana to Utah, Colorado, and Nebraska.

Specimens examined: IDAHO (*MacDougal* 280): MONTANA (*Hayden* of 1854): UTAH (*Watson* 434 of 1869, Parley's Park; *Hayden* of 1871; *Ward* 187, 443): COLORADO (*Parry* of 1869): NEBRASKA (*Hayden* of 1853–54).

52. Opuntia polyacantha borealis, nom. nov.

Opuntia missouriensis microsperma Engelm. & Bigel. Pacif. R. Rep. iv, 16 (1856), not *mesacantha microsperma* Engelm.

Joints and spines as in *platycarpa:* fruit ovate, with depressed umbilicus, shortly spiny: seeds smaller, 4 mm. broad, with narrow and acute margin. (*Ill.* Pacif. R. Rep. iv, t. 14, f. 5–7; t. 24, f. 1, 2)—Type, the "Fur traders" specimens of 1847 in Herb. Mo. Bot. Gard.

From British Columbia to Oregon and South Dakota.

Specimens examined: BRITISH COLUMBIA (*Macoun* 5): OREGON (*Drake & Dickson* of 1889): SOUTH DAKOTA ("Fur traders" of 1847; *Hayden*): also cult. in St. Louis Gard. 1847.

53. Opuntia polyacantha albispina (Engelm. and Bigel.).

Opuntia missouriensis albispina Engelm. and Bigel. Pacif. R. Rep. iv, 46 (1856).

Joints broadly obovate: bristles straw-colored: spines 6 to 12, all ivory-white and more slender, 2.5 to 3 cm. long, the outer 6 to 10 setaceous, the inner (in upper pulvini) 1 to 3 stouter, elongated, deflexed or spreading: flowers 7.5 to 8.5 cm. broad: fruit ovate, with very shallow umbilicus: seeds irregular, with broad and acutish margin, 6 to 7 mm. broad. (*Ill.* Pacif. R. Rep. iv, t. 14, f. 8–10; t. 23, f. 18)—Type, Bigelow of 1853 in Herb. Mo. Bot. Gard.

"Sandy mountains, near Albuquerque," New Mexico, is the original station; reported also from western Utah, and now found in Indian Territory.

Specimens examined: NEW MEXICO (*Bigelow* of 1853): INDIAN TERRITORY (*M. A. Carleton* of 1891).

The Carleton specimens seem certainly to represent this lost variety, which will doubtless be recognized over a wide area, but which may not stand as a worthy variety.

54. Opuntia polyacantha watsoni, var. nov.

Joints smaller, creeping, orbicular, 5 cm. broad: pulvini much crowded (6 to 8 mm. apart), bearing darker bristles: spines all dark; outer 3 or four from the lower edge of the pulvinus (sometimes 1 or 2 added above) setaceous, 4 to 5 mm. long; inner 1 to 3 stouter, much longer (10 to 36 mm), deflexed (except on margin of joint): stigmas 10: fruit clavate, 2.5 to 3 cm. long, strongly tuberculate and cristate, deeply umbilicate, with few spines: seeds with broad margin and prominently notched at hilum.—Type, specimens cited below in Herb. Mo. Bot. Gard.

From Nebraska and Wyoming to Colorado, Utah, and New Mexico.

Specimens examined: NEBRASKA (*Hayden* of 1853): WYOMING (no collector recorded, at Alden): COLORADO (*French* of 1874): UTAH (*Watson* 435 of 1869, Wahsatch Mts.): NEW MEXICO (*Fendler* of 1846–47, near Santa Fe).

55. Opuntia polyacantha trichophora (Engelm.).

Opuntia missouriensis trichophora Engelm. Syn. Cact. 300 (1856).

Joints ovate: pulvini crowded, with straw-colored at length whitish, bristles, all armed: spines 10 to 18, white, setiform and capillary flexuous (in old joints very numerous, 15 to 25); the outer 8 to 12 shorter and radiant, the inner longer and deflexed, rarely a single suberect one: fruit ovate, 20 mm. long by 14 mm. broad: seeds very large (7 mm.), strongly compressed, broadly and acutely margined. (*Ill.* Pacif. R. Rep. iv, t. 15, f. 1–4; t. 23, f. 19)—Type, Bigelow of 1853 in Herb. Mo. Bot. Gard.

New Mexico (about Santa Fe and Albuquerque) and Texas (in the El Paso region); on volcanic rocks.

Specimens examined: NEW MEXICO (*Bigelow* of 1853; *G. R. Vasey* of 1881, Socorro): TEXAS (*Trelease* of 1892): also growing in Mo. Bot. Gard. 1893.

The hoary appearance of older joints is very characteristic, "like an old man's beard." Vasey's excellent specimens help to a better understanding of this variety, which may deserve to rank as a species. The white outer radiant spines are 6 to 12 mm. long; the inner ones whitish or reddish-yellow, becoming grayish and much elongated and capillary, becoming as much as 6 or 7 cm. long and appearing in dense tufts on old joints, looking like a covering of coarse hair.

56. Opuntia sphærocarpa Engelm. Syn. Cact. 300 (1856).

Diffuse, with orbicular strongly tuberculate joints 7.5 cm. broad: pulvini 8 to 10 mm. apart, with short, straw-colored bristles, mostly unarmed (only the uppermost and marginal ones bearing spines): spines 1 or 2, reddish-brown, deflexed or spreading, 12 to 25 mm. long, often 1 to 3 shorter (4 to 8 mm.) ones added: fruit perfectly globose, with a small flat shallow umbilicus, scarcely spinulose, 18 mm. in diameter: seeds very irregular, with narrow but acute margin, 5 mm. long. (*Ill.* Pacif. R. Rep. iv, t. 13, f. 6, 7; t. 24, f. 3)—Type, Bigelow of 1853 in Herb. Mo. Bot. Gard.

"Mountains near Albuquerque," New Mexico.

Specimens examined: NEW MEXICO (*Bigelow* of 1853).

57. Opuntia sphærocarpa utahensis Engelm. Trans. St. Louis Acad. ii, 199 (1863).

Prostrate and diffuse, with orbicular-obovate thick joints 5 to 7.5 cm. broad (younger often globose-obovate), pulvini 12 to 16 mm. apart, spines none or on upper pulvinus smallish or rarely one straight stout white one, yellow flowers 7.5 cm. broad, obovate fruit 2.5 cm. long (half as wide), with deep umbilicus, and seeds 4 to 5 mm. long.—Type, H. Engelmann of 1859 in Herb. Mo. Bot. Gard.

"Utah Basin (pass west of Steptoe Valley)" is the original locality, and that of Hayden is not recorded.

Specimens examined: UTAH (*H. Engelmann* of 1859; *Hayden* of 1876): also cult. in Mo. Bot. Gard. 1876.

++ ++ Joints tumid, ovate.

58. Opuntia rutila Nutt.; Torr. & Gr. Fl. i, 555 (1840).
Opuntia erinacea Engelm. Syn. Cact. 301 (1856).

Ascending and diffuse: joints swollen, ovate or teretish, 5 to 10 cm. long by 2.5 to 7.5 cm. broad (sometimes elongated and almost cylindrical): pulvini very crowded (4 to 6 mm. apart), with white wool, and at length straw-colored bristles, all armed: spines 3 to 5, slender, reddish-gray, 1 to 4 cm. long (1 to 3 upper shorter and erect, central one longer, spreading or declined, the rest deflexed, sometimes larger ones flattened and often twisted), 2 to 4 smaller ones added below: flowers rose-red or paler: fruit ovate, dry and spinulose, with a deep funnelform umbilicus, 2.5 to 3 cm. long: seeds large (6 mm. broad), much compressed, with broad acute margins. (*Ill.* Pacif. R. Rep. iv, t. 13, f. 8–11; t. 24, f. 4)—Type of *O. rutila* unknown, of *O. erinacea*, Bigelow of 1854 in Herb. Mo. Bot. Gard.

From Green River, southwestern Wyoming (the original Nuttallian

station), through Utah and Nevada into Arizona and southeastern California.

Specimens examined: UTAH (*Watson* of 1868; *Palmer* of 1870 and 1877, Fillmore to St. George; *Johnson* of 1870; *Ward* 188; *Bailey* 1939): NEVADA (*Shockley* 274; *Bailey* 1959, 1989; *Coville & Funston* 1941): ARIZONA (*Palmer* of 1870): CALIFORNIA (*Bigelow* of 1854, near the Mojave; *Coville & Funston* 2013, 2014).

The numerous reddish-gray spines with red points bristling hedgehog-like in every direction give a very characteristic appearance. Dr. Merriam says of it: "Species with enormously long and slender spines, not found in California except on the Panamint Mountains."

59. Opuntia arenaria Engelm. Syn. Cact. 301 (1856).

Ascending and diffuse, 1.5 to 3 dm. high, spreading 6 to 9 dm.: roots stout, creeping horizontally, elongated and often stoloniferous, far spreading in the loose sand: joints obovate, thick and swollen or subcompressed, or teretish, shining-green, strongly tuberculate, 3.5 to 7.5 cm. long by 2.5 to 5 cm. broad: leaves minute: pulvini 6 to 10 mm. apart, with sparse white wool, and numerous bristles (especially on old joints), which are pale when young and tawny when old, almost all armed: spines 3 to 10; the upper 1 to 4 stouter, whitish or reddish-brown, often subangular, 2 to 3.5 cm. long (the uppermost one stouter and porrect, the rest shorter and divergent or deflexed); the lower 2 to 6 shorter (4 to 12 mm.), setaceous and radiant, white: flowers sulphur-yellow, 5 to 6 cm. broad: fruit oblong-ovate, contracted at top, dry and spinose, with a deep funnelform umbilicus, 2 to 3 cm. long: seeds irregular, with broad thick margin, 5 to 6 mm. long. (*Ill.* Cact. Mex. Bound. t. 75, f. 15)—Type, the Wright specimens in Herb. Mo. Bot. Gard.

Sandy bottoms of the Rio Grande near El Paso, Texas, and adjacent New Mexico.

Specimens examined: TEXAS (*Wright* of 1851, 1852, and 1854; *Schott*): NEW MEXICO (*Fendler* 7, 150, 153): also cult. in Mo. Bot. Gard. 1855.

Allied to *fragilis*, but distinguished by the larger more tuberculate joints, smaller pulvini with more numerous bristles, longer slenderer spines, and spinose fruit

60. Opuntia fragilis (Nutt.) Haw. Suppl. Pl. Succ. 82 (1819).
Cactus fragilis Nutt. Gen. i, 296 (1818).

Subdecumbent, with small ovate subcompressed or subglobose (even terete) scarcely tuberculate shining green joints variable in size and shape (fruit-bearing ones compressed, 3.5 to 5 cm. long by 2.5 to 3 cm. broad, the others smaller and more tumid): pulvini large, 8 to 12 mm. apart, with white wool, and very few short whitish bristles (on old joints a little more abundant, coarser, and straw-colored): spines 1 to 4 (mostly 4 and cruciate), the uppermost one stout, angular, suberect or porrect, yellowish-brown, 12 to 20 mm. long, the others weaker (6 to 16 mm.), paler, spreading or radiant, and 2 to 6 additional slender white radiant ones below 4 to 8 mm. long: flowers pale-yellow, about 5 cm. broad: fruit ovate, almost naked, with funnelform umbilicus,

about 2.5 cm. long: seeds few, large (6 mm.), with broad and thick obtuse corky margin. (*Ill.* Pacif. R. Rep. iv, t. 24, f. 5)—Type unknown.

From British Columbia southward through Minnesota and Montana to Wisconsin, Kansas, Colorado, and Utah; fertile prairies or sterile places.

Specimens examined: BRITISH COLUMBIA (*Dawson* of 1885): MINNESOTA (*Dawson* of 1884): WISCONSIN (*Hale* of 1861, in part, Baraboo bluffs): MONTANA (*Canby* of 1883): NEBRASKA (*Hayden* of 1854): KANSAS (*Fisher* of 1893, Ellsworth): COLORADO (*Parry* of 1864): UTAH (*Engelmann* of 1858; *Watson* 437, Utah Valley): also cult. in Mo. Bot. Gard. 1855; growing in same garden in 1893.

Dr. Engelmann says that this species is very common on sterile prairies at the base of the Rocky Mountains, but that it is rarely found in flower and still more rarely in fruit. It propagates chiefly by the extremely brittle joints which even the wind breaks off and carries about.

61. Opuntia fragilis brachyarthra (Engelm.).

Opuntia brachyarthra Engelm. Syn. Cact. 302 (1856).

Prostrate or ascending, with swollen tuberculate joints, pulvini 4 to 8 mm. apart, 3 to 5 stouter whitish or brownish terete spines 18 to 25 mm. long (1 or 2 spreading or suberect, the rest deflexed), flowers about 2.5 cm. broad, and somewhat spinulose fruit. (*Ill.* Pacif. R. Rep. iv, t. 12, f. 9)—Type, Bigelow of 1853 in Herb. Mo. Bot. Gard.

Southern Colorado and northern New Mexico.

Specimens examined: COLORADO (*Greene* of 1871): NEW MEXICO (*Bigelow* of 1853, near Santa Fe).

The other New Mexican station is "under pine trees, Inscription Rock, near Zuñi." It is a question whether this form should stand as a distinct variety, but its more constantly swollen tuberculate joints, more crowded pulvini, more numerous and stouter and terete spines, smaller flowers, and more spinulose fruit may serve to indicate it. "The short and tumid joints resemble the joints of a finger."

Among Dr. Weber's manuscript notes the four following *Platopuntia* forms are characterized, but the information concerning them is so meager that I do not venture to publish his names.

OPUNTIA sp. "Cultivated from Venado southward to San Luis Potosi under the name 'tuna chaveña.' A tall plant, bearing a sweet, pleasant-tasted fruit which is much brought to market. Flowers red. Fruit the size of an egg, wine-red; pulp reddish. Seed large, much compressed."

OPUNTIA sp. "Cultivated about San Luis Potosi under the name 'tuna blanca.' Plant high (3 m.?), quite spiny. Fruit very large, ovoid, with whitish pulp. Cultivated for the fruit, which is much esteemed, but not so frequently as 'cardona.' Could it be a form of *ficus-indica?* But the seed is much larger than that of the Italian forms of that species."

OPUNTIA sp. "A tall, large-jointed species, with slender acicular spines. Fruit ovoid, spineless, with a larger rather flat umbilicus with circular wrinkles, and apparently numerous (perhaps 35 or 40) circular

areolæ. Seed remarkably small. Erect, 9 to 12 dm. high." This may be *O. strigil.*

OPUNTIA sp. "A very tall (27 to 36 dm.), large-jointed, erect plant, with numerous spines (lower ones and especially central ones deflexed), and ovoid fruit which is red inside and out. Known as 'cardona,' and most commonly cultivated in and about San Luis Potosi. Abundantly eaten fresh and mashed and dried in a paste or cheese-like form; also the purple juice expressed and drunk with water like orangeade."

II. CYLINDROPUNTIA. *Joints cylindraceous, more or less tuberculate: seeds not margined* (except in ** ⊢ ⊢).

* *Low plants with short clavate joints and without a firm woody skeleton: larger spines angular-compressed and without sheaths* (*exc.* clavellina *and* tunicata): *flowers yellow* (*exc.* pulchella), *large: fruit dry and very bristly.*

⊢ *Spines short* (3 to 20 mm).

62. Opuntia bulbispina Engelm. Syn. Cact. 304 (1856).

Prostrate, in spreading masses 6 to 12 dm. in diameter, with fusiform roots: joints small (18 to 24 mm. long and 12 mm. in diameter), ovate (scarcely clavate), fragile, often proliferous from apex, with ovate tubercles 6 to 12 mm. long: pulvini scarcely bristly: spines teretish, scabrous, bulbous at base; interior 4 cruciate, 8 to 12 mm. long (the lower the longer); exterior 8 to 12 radiant, 3 to 6 mm. long: flower and fruit unknown. (*Ill.* Cact. Mex. Bound. t. 73, f. 5, 6)—Type, Gregg of 1848 in Herb. Mo. Bot. Gard.

From New Mexico to Coahuila.

Specimens examined: NEW MEXICO (*Nealley* of 1891): COAHUILA (*Gregg* of 1848, near Perros Bravos, Saltillo).

In Watson's Bibliographical Index and in the Kew Index this is made a synonym of *tunicata*, but it differs in almost every respect, having no sheaths, much shorter spines, and small and much shorter joints.

63. Opuntia parryi Engelm. Amer. Journ. Sci. ser. 2, xiv, 339 (1852).

Prostrate, with ovate joints (clavate at base) 6 to 10 cm. long and bearing oblong elongated tubercles 18 mm. long: pulvini with few rigid brownish bristles: spines very numerous, in three series, angular, scabrous, reddish-gray (at length ashy); interior about 4, stouter, triangular-compressed, 24 to 32 mm. long; the next exterior 4 to 8, divergent, angular, 6 to 16 mm. long; the most exterior (but mostly lateral or inferior) 6 to 10 slender, rigid, radiant: fruit ovate, clavate at base, very spiny, 3.5 cm. long: seeds regular, beakless, with broader commissure than usual, 4 to 5 mm. in diameter. (*Ill.* Pacif. R. Rep. iv, t. 22, f. 4–7)—Type not found in the Engelmann collection.

Gravelly plains of the Mojave, southeastern California.

Specimens examined: CALIFORNIA (*Bigelow* of 1853).

Distinguished from *O. clavata* by the shape of the joints, the bristles, the slenderer darker more numerous spines, and the smaller more regular beakless seeds. Dr. Parry's original specimen was collected near San Felipe.

64. Opuntia clavata Engelm. Wisliz. Rep. 11 (1848).

Low cespitose plant, forming dense spreading level-topped masses 6 to 12 dm. in diameter and with ascending branches: joints shortly clavate, bright-green, 2.5 to 7.5 cm. long and 2.5 cm. thick, with ovate tubercles 12 to 16 mm. long, and subulate leaves 4 to 5 mm. long: pulvini large and closely approximate, with white rigid bristles: spines white and scabrous; interior 4 to 7, flattened, 12 to 30 mm. long, the upper one triangular and erect, the lower ones broader (broadest 3 mm.), striate above and keeled below, deflexed; exterior 6 to 12, more slender, 4 to 16 mm. long, radiating in every direction: flowers yellow, 5 cm. broad: fruit elongate-clavate, deeply umbilicate, lemon-yellow, 3.5 to 4 cm. long and 2.5 cm. in diameter, almost covered with white slender radiating bristles: seeds beaked, 5 to 6 mm. in diameter, with impressed linear commissure. (*Ill.* Pacif. R. Rep. iv, t. 22, f. 1–3; t. 24, f. 6: Cact. Mex. Bound. t. 73, f. 5, 6)—Type, Wislizenus and Fendler specimens of 1846 and 1847 in Herb. Mo. Bot. Gard.

In the region about Albuquerque and Santa Fe, New Mexico; also in southern Nevada, and presumably to be found in adjacent Utah and Arizona.

Specimens examined: NEW MEXICO (*Wislizenus* of 1846, near Albuquerque; *Fendler* 275 of 1846 and 1847, near Santa Fe; *Bigelow* of 1853; *Rothrock* 92, El Rito; *Vasey* 173): NEVADA (*Coville & Funston* 430).

65. Opuntia pulchella Engelm. Trans. St. Louis Acad. ii, 201 (1863).

Small, cespitose, 7.5 to 25 cm. high, the main stem erect: joints obovate-clavate, lightly tuberculate, 2.5 to 7.5 cm. long: pulvini crowded: upper spines from white to nearly black, straight, 8 to 36 mm. long, a single one longer, flattened, porrect or deflexed); the others radiant and very short (1 to 3 mm.): flowers bright purplish-red or deep rose-red, 3 to 3.5 cm. broad: fruit clavate, about 2.5 cm. long, with numerous flexible not barbed bristles: seeds thick and round, 4 mm. in diameter, with broad, flat commissure.—Type, H. Engelmann of 1859 in Herb. Mo. Bot. Gard.

Western and southern Nevada and adjacent Arizona; presumably in southeastern California.

Specimens examined: NEVADA (*H. Engelmann* of 1859, Walker River; *Gabb* of 1867, Walker River; *Watson* 438, Monitor Valley; *Lieut. Wheeler* of 1872; *Lemmon* 943; *Shockley* 319): ARIZONA (*Bischoff* of 1871).

Remarkable in this group for its purple flowers.

← ← *Spines long* (2.5 to 6 cm.).

66. Opuntia grahami Engelm. Syn. Cact. 304 (1856).

Prostrate, with thick fusiform roots: joints short-clavate, bright-green, ascending, 3.5 to 5 cm. long, with oblong tubercles 12 to 14 mm. long: leaves ovate, 4 mm. long: pulvini with white wool, and bristles at length very numerous, elongated and rigid: spines slender, scabrous, reddish, at length ashy brown; interior ones 4 to 7, teretish or quad-

rangular or rarely compressed, stouter, spreading, 3.5 to 5 cm. long; exterior ones 4 to 6 and much smaller: flowers yellow, 5 cm. broad: fruit ovate, very spiny: seed beakless, 5 to 5.5 mm. in diameter, with indistinct linear commissure. (*Ill.* Cact. Mex. Bound. t. 72)—Type, Wright specimens of 1851 in Herb. Mo. Bot. Gard.

Sandy bottoms of the Rio Grande near El Paso, Texas, and downward.

Specimens examined: TEXAS (*Wright* 10, 40, 539, of 1851; *Evans* of 1891; *E. A. Mearns* of 1892, El Paso).

67. Opuntia emoryi Engelm. Syn. Cact. 303 (1856).

Prostrate and spreading, 15 to 45 cm. high: joints cylindrical with clavate base, glaucous, ascending and curved, 10 to 15 cm. long and 2.5 to 3.5 cm. in diameter, with oblong-linear elongated (2.5 to 3.5 cm.) closely approximated tubercles: pulvini with few rigid bristles: spines very numerous, pitted or roughened, reddish-black or brown, at length ashy; interior ones 5 to 9, stouter, triangular, compressed, porrect or deflexed (upper ones only suberect), 3.5 to 6 cm. long, 1.5 to 2 mm. broad; exterior ones 10 to 20, in many series, radiating in every direction, the exterior gradually smaller and less angular, the upper slenderer and teretish, the lower more rigid and compressed: flowers yellow, reddish without, 5 to 6 cm. broad: fruit ovate, clavate at base, yellow, very bristly and spiny, 5 to 6 cm. long: seeds irregular, 4.5 to 6.5 mm. in diameter, with mostly an indistinct transverse commissure. (*Ill.* Cact. Mex. Bound. t. 70–71)—Type, specimens of Wright and Bigelow in Herb. Mo. Bot. Gard.

Arid soil, from the El Paso region of Texas westward into Arizona and southward into Chihuahua and Sonora.

Specimens examined: TEXAS (*Evans* of 1991): NEW MEXICO (*Wright & Bigelow*, at Copper Mines; *G. R. Vasey* of 1881, Socorro): ARIZONA (*Schott* 8 of 1758): CHIHUAHUA (*Bigelow* 43 of 1852).

68. Opuntia schottii Engelm. Syn. Cact. 304 (1856).

Prostrate, with short-clavate ascending joints 5 cm. long and bearing elongated tubercles 16 to 18 mm. long: pulvini with few bristles: spines very scabrous, reddish (broader ones with white margin); interior about 4, cruciate, 3.5 to 5 cm. long; upper triangular and erect, the rest plane above and convex beneath, the lower broader; exterior 8 to 10, slender and radiant, very unequal, 8 to 18 mm. long: fruit obovate-clavate, somewhat spiny: seeds beaked, angular, 4 mm. in diameter, with linear, indistinct commissure. (*Ill.* Cact. Mex. Bound. t. 73, f. 1–4)—Type, specimens of Schott and Wright in Herb. Mo. Bot. Gard.

On arid hills, between the San Pedro and Pecos, Texas.

Specimens examined: TEXAS (*Wright* of 1849; *Schott* 853; *Weber* of 1866).

Distinguished by its broad and very rough dirty-red spines and scanty bristles.

69. Opuntia schottii greggii Engelm. Cact. Mex. Bound. t. 73, f. 4 (1859).

Tubercles longer (20 to 24 mm.): spines stout, somewhat less rough and more slender, 12 to 15, some borne on upper margin of pulvinus; the 4 centrals triangular, much less rough, 2.5 to 4 cm. long; the 8 to 12 exterior ones of very different sizes. (*Ill.* l. c.)—Type, Gregg of 1848 in Herb. Mo. Bot. Gard.

San Luis Potosi.

Specimens examined: SAN LUIS POTOSI (*Gregg* of 1848).

This form is described by Engelmann in Synopsis Cactaceæ (1856) and in Cactaceæ of the Mexican Boundary, but with no name, the name being first given in explanation of plates in the latter work.

70. Opuntia invicta Brandegee, Pl. Baja Calif. 163 (1889).

Low and branching, about 3 dm. high: joints 10 cm. long and 4 to 7.5 cm. thick: radial spines 6 to 10, slender and radiant, 6 to 10 mm. long (sometimes longer); central spines 10 to 15, very stout and rigid, quadrangular or flattened, strongly striate, ashy at base with lighter tips, spreading in every direction, 2.5 to 4.5 cm. long: flowers yellow, abundant, 5 cm. broad: fruit covered with reddish spines: seeds 2 mm. in diameter.—Type in Herb. Brandegee.

Common about San Juanico and north to El Campo Aleman, Lower California.

Specimens examined: LOWER CALIFORNIA (*Brandegee*).

It is difficult in this species to distinguish exactly the line between centrals and radials, as they somewhat intergrade. The species is an uncertain one, and may be a *Cereus*, but it groups well enough with *O. schottii* to be retained at present in *Opuntia*.

71. Opuntia clavellina Engelm. MSS.

Stems frutescent, about 9 dm. high: joints slender, clavate, 5 to 10 cm. long and a little over 1 cm. in diameter, with elongated tubercles: spines 3 to 6, stout, 1 to 3.5 cm. long, with straw-colored or brown sheaths, the central one longer and porrect: flowers yellow: fruit clavate, short, tuberculate.—Type, Gabb 22 and 23 in Herb. Mo. Bot. Gard.

On volcanic tables, western slope of the peninsula, near Mission Purissima, Lower California.

Specimens examined: LOWER CALIFORNIA (*Gabb* 22, 23).

72. Opuntia tunicata (Lehm.) Pfeiff. Enum. 170 (1837).
Cactus tunicatus Lehm. Ind. Sem. Hort. Hamb. 17 (1827).

Suberect, very branching, 3 dm. high and 2.5 to 3.5 cm. in diameter: joints dusky-green, clavate, almost terete, 16 to 20 mm. in diameter, with short leaves and depressed tubercles: pulvini with white wool: spines 6 to 9 (almost wanting in some localities) from lowest part of pulvinus, 4 to 6 upper ones larger, 2.5 to 5 cm. long, 2 or 3 lowest short (8 to 12 mm.), all white and with a subpellucid sheath.—Type unknown.

Throughout Mexico and the West Indies and southward through South America to Brazil.

Specimens examined: COAHUILA (*Gregg* of 1848–49): SAN LUIS POTOSI (*Gregg* of 1848; *Parry* of 1878; *Parry* and *Palmer* 282; *Bourgeau* of 1880; *Eschanzier* of 1891): MEXICO, with no state given (*Bourgeau* 304 of 1865): CUBA (*Wright* of 1860–64): also growing in Mo. Bot. Gard. 1893.

This very widely distributed species is also reported in Mexico from Sonora and Raza Island (in northern part of the Gulf of California).

* * *Stems more or less erect, much branched: joints mostly cylindrical: woody skeleton solid or tubular and reticulated: larger spines terete and sheathed: flowers purplish (mostly yellow in* + ++).

\+ *Wood mostly reticulate-tubular: joints thick, with distinct tubercles: spines numerous.*

++ *Diffusely branched: joints subclarate: flowers mostly yellow: fruit dry and spiny.*

73. Opuntia ciribe Engelm. MSS.

Short, robust, and arborescent, densely branched, rarely more than 9 dm. high, but very compact: joints obovate, 5 cm. long and 3 cm. in diameter, with crowded angular obovate tubercles 6 mm. long: pulvini sparsely if at all bristly: large spines 3 to 5, pale-yellow, sheathed, 12 to 16 mm. long; 4 to 6 small dark bristly unsheathed ones on lower part of pulvinus: flowers yellow: fruit tuberculate like the joint. Type, Gabb 24 in Herb. Mo. Bot. Gard.

Lower California, "from Comondu and Loreto northward beyond Rosario."

Specimens examined: LOWER CALIFORNIA (*Gabb* 24).

74. Opuntia davisii Engelm. Syn. Cact. 305 (1856).

Stem spreading and somewhat procumbent, with dense wood and divaricate branches, 4.5 dm. high: joints attenuate at base, rather slender, 10 to 15 cm. long (younger ones erect), with oblong-linear tubercles 14 to 16 mm. long: inner spines 4 to 7, subtriangular, divergent, reddish-brown, in a loose straw-colored sheath, 2.5 to 3.5 cm. long; lower ones 5 or 6, slender, 6 to 12 mm. long: flower yellowish?: fruit ovate, spiny, 2.5 cm. long or more. (*Ill* Pacif. R. Rep. iv, t. 16.)—Type, Bigelow of 1853 in Herb. Mo. Bot. Gard.

From northwestern Texas through New Mexico and southern Colorado to southern California.

Specimens examined: TEXAS (*Bigelow* of 1853, "Staked Plains;" *Mensebach* of 1879 and 1882): NEW MEXICO (*Rusby* 145): COLORADO (*Brandegee* of 1875): ARIZONA (*Palmer* 303 of 1870, Bear Springs): CALIFORNIA (*Parish* of 1880): also cult. Mo. Bot. Gard. 1877 and 1882; and growing 1893.

75. Opuntia echinocarpa Engelm. Syn. Cact. 305 (1856).

A low shrub 1.5 to 4.5 dm. high, with reticulate-woody stem, erectish or partially prostrate, with numerous very spreading branches: joints ovate, clavate at base, 2.5 to 6 cm. long, less than 2.5 cm. thick, with prominent ovate crowded tubercles 8 to 10 mm. long: pulvini with few

coarse straw-colored bristles: larger spines about 4, cruciate, whitish, in a straw-colored or whitish sheath 18 to 24 mm. long; smaller ones 8 to 16, hardly sheathed, radiating in every direction, 8 to 18 mm. long: flowers greenish-yellow, 3.5 to 4 cm. broad: fruit dry, depressed-globose or hemispherical, broadly and deeply umbilicate, very spiny: seeds subregular or angular, thick, 4 mm. in diameter or more, with broad commissure. (*Ill.* Pacif. R. Rep. iv, t. 18, f. 5–10; t. 24, f. 8.)—Type, specimens of Bigelow and Schott in Herb. Mo. Bot. Gard.

From southern Utah and southern Nevada through northern and western Arizona and southeastern California into Sonora.

Specimens examined: UTAH (*Palmer* 187; *Johnson*, at St. George; *Bailey* 1960 of 1891): ARIZONA (*Bigelow* of 1854, near mouth of Williams River; *Schott* 7, at Ft. Yuma; *Parry* of 1881; *Toumey* of 1892, Banning and Yuma): CALIFORNIA (*Hitchcock* of 1875; *Engelmann* of 1880; *Parry* of 1881; *G. R. Vasey* of 1881, Whitewater).

This is said to be the common arborescent *Cylindropuntia* of the Mojave desert region and the deserts of southern Nevada. The hemispherical fruit, with broad and deep umbilicus, is often described as "saucer-shaped." The spines are sometimes very short.

76. Opuntia echinocarpa robustior, nom. nov.

Opuntia echinocarpa major Engelm. Syn. Cact. 305 (1856), not *phaeacantha major* Engelm.

Taller (12 to 15 dm. high), with elongated (20 to 25 cm.) joints attenuate at base, oblong linear tubercles 12 to 18 mm. long, slender penicillate bristles, longer and fewer spines (the 4 central ones 2.5 to 4 cm. long, only 4 to 8 smaller radiant ones), looser sheath and fruit globose or clavate at base.—Type not found in the Engelmann collection.

Along the Lower Colorado in Arizona and California, and southward into Sonora.

Specimens examined: ARIZONA (*G. R. Vasey* of 1881, Yuma): CALIFORNIA (*Newberry* of 1858; *Lemmon* of 1878; with no collector given in 1880; *Parish Bros.* of 1882).

77. Opuntia echinocarpa parkeri (Engelm.).

Opuntia parkeri Engelm. MSS.

Taller (9 to 15 dm. high), with erect branches, longer (10 cm.) joints, crested tubercles 18 mm. long, light yellowish-brown spines in sheaths of similar color (about 6 smaller radiant ones), depressed globose or oval less spiny fruit with flat or funnelform umbilicus, and irregular seeds (6 mm. in diameter) with narrow twisted commissure.—Type, C. F. Parker of 1879 in Herb. Mo. Bot. Gard.

San Diego County, California, east side of mountains facing desert.

Specimens examined: CALIFORNIA (*C. F. Parker* of 1879).

78. Opuntia echinocarpa nuda, var. nov.

Spines slender, short and numerous, reddish-brown, often with lighter tips, the larger ones (1 to 1.5 cm. long) with brownish-yellow sheaths: flowers greenish-yellow, about 3 cm. high and 2 cm. broad: fruit obo-

vate, about 2 cm. long, with broad shallow umbilicus, almost if not entirely spineless (occasionally a few spines persisting for a time): seeds almost regular, but slightly compressed, 3.5 to 5 mm. broad, with a straight but hardly broad commissure.—Type in Herb. Brandegee.

Lower California, near San Gregorio.

Specimens examined: LOWER CALIFORNIA (*Brandegee* of 1889).

79. Opuntia serpentina Engelm. Amer. Jour. Sci. ser. 2, xiv, 338 (1852).

? Cereus (?) *californicus* Torr. & Gr. Fl. i, 555 (1840), not *Opuntia californica* Engelm. Emory's Rep. 157 (1848).

Somewhat erect (7.5 to 12.5 dm. high) or prostrate, diffuse, with elongated, subverticillate, divaricate ascending branches: joints elongated-cylindrical, 15 to 30 cm. long, 2 to 3 cm. in diameter, with prominent ovate tubercles: pulvini with whitish bristles: spines 7 to 15, light-yellowish or rusty, sheathed, 6 to 18 mm. long, upper ones stellate-divaricate, lowest ones deflexed: flowers greenish-yellow, reddish outside, cup-shaped, 3.5 cm. broad: fruit subhemispherical, with broad and deep umbilicus ("saucer-shaped"), dry, long-woolly and very spiny, yellowish-brown, about 18 mm. long: seeds thick, irregular, with narrow commissure.—Type not found in the Engelmann collection.

On dry hillsides near the seacoast about San Diego, California.

Specimens examined: CALIFORNIA (*Schott* of 1854; *Hitchcock* of 1875; *Engelmann* of 1880; *G. R. Vasey* of 1880, San Diego): LOWER CALIFORNIA (*Brandegee*, Magdalena Bay): also cult. Mo. Bot. Gard. 1876.

The Lower Californian specimens have 20 or more spines, all stellately spreading with no special lower one deflexed. The fruit is 3 to 4 cm. long, and the seeds 2 to 3 mm. broad, light brown.

80. Opuntia bernardina Engelm. Bull. Torr. Club, xix, 92 (1892).

A loosely branched shrub several stemmed from the base, erect with ascending or erectish branches, rather slender, 6 to 15 dm. high, with reticulate wood: joints cylindrical, 7.5 to 30 cm. long, with slender elongated oblong tubercles 2.5 to 3 cm. long (very prominent on younger joints, shorter and less marked on older ones): pulvini with a dense row of very short dark more or less persistent bristles at upper edge, and spreading often recurved leaves 4 to 8 mm. long: spines yellow; the sheathed ones 4 or 5, 1 to 3 cm. long, the lowest longest and mostly deflexed; and 4 appressed short (6 to 12 mm.) slender radial ones mostly on lower edge of pulvinus: flowers greenish-yellow tinged with brownish-red outside, 2.5 to 4 cm. broad: fruit ovate, deeply umbilicate, tuberculate (each tubercle with a single short spine), less than 2.5 cm. long, at length dry: seed flat, 6 mm. broad, with a channelled commissure and conspicuous persistent funiculus.—Type, Parry of 1851, G. Engelmann of 1880 and 1882, and Parish 814 in Herb. Mo. Bot. Gard.

Dry hills and mesas in the San Bernardino plain, California, northward through Cajon Pass, and in Santa Clara Valley.

Specimens examined: CALIFORNIA (*Parry* of 1851; *Parker* of 1874;

G. Engelmann of 1880 and 1882; *G. R. Vasey* of 1881; *Parish* 814; *Trelease* of 1892).

The common *Cylindropuntia* of the San Bernardino Valley. Apparently it does not extend to the coast region or the desert.

81. Opuntia tesajo Engelm. MSS.

With very short woody stem, and growing in little clumps 3 dm. or less in diameter: joints slender and not distinctly tuberculate: flowers simple, bell-shaped, yellow.—Type, Gabb 26 in Herb. Mo. Bot. Gard.

"Among rocks, especially toward the west coast and in the more central portions," Lower California.

Specimens examined: LOWER CALIFORNIA (*Gabb* 26 of 1867).

Certainly a very meager description, but as full as the material justifies and possibly sufficient for subsequent identification.

++ ++ Arborescent: joints tumid and fragile: tubercles depressed; flowers purple: fruit mostly sterile and proliferous.

82. Opuntia prolifera Engelm. Amer. Journ. Sci. ser. 2, xiv, 338 (1852).

Stem 9 to 30 dm. high, 5 to 17.5 cm. in diameter, with reticulated woody cylinder, and numerous horizontal very divaricate branches: joints ovate or ovate-cylindrical, tumid, fragile, congested toward apex of branches, very green, lower at length refracted and brown, 7.5 to 15 cm. long and 3.5 to 5 cm. in diameter, with obovate-oblong tubercles 12 mm. long: pulvini tomentose, and the older with fine straw-colored bristles: spines 8 to 10, very variable, always with large loose sheaths which are light yellowish or rusty, 2.5 to 3.5 cm. long, one being subcentral and the rest stellate-spreading, the lower shorter (12 to 16 mm.): flowers dark-red, salverform, 3.5 cm. broad: fruit clavate, obovate or subglobose, deeply umbilicate, strongly tuberculate like the joints, nearly always abortive and usually proliferous: seeds large, regular, 6 mm. broad, with broad prominent commissure.—Type not found in the Engelmann collection.

Dry hills in southern California and adjacent Arizona, and extending into Lower California (San Ignacio and northward) and the adjacent islands (Guadalupe, Santa Catalina, San Clemente).

Specimens examined: CALIFORNIA (*Gabb* 21 of 1867; no collector given of 1874; *Parker of* 1876; *Engelmann* of 1880; *G. R. Vasey* of 1880, San Diego): ARIZONA (*Trelease* of 1892, at Benson): also cult. in Meehan's Gard. 1879.

Mr. Schott's notes describe this species as "on arid hills about San Diego, near dry beds of streams, forming impassable and extensive thickets which are like unapproachable coral reefs." Mr. Brandegee notes that in Lower California it is "sometimes almost spineless."

83. Opuntia fulgida Engelm. Syn. Cact. 306 (1856).
Opuntia fulgens Engelm. Bot. Calif. i, 250 (1876).

Stem erect, flexuose, 15 to 36 dm. high, 15 cm. in diameter, with reticulate wood and few divaricate branches: joints ovate or ovate-

cylindrical, tumid, glaucous, congested at apex of branches, 7.5 to 20 cm. long, often 5 cm. in diameter, with ovate-oblong hardly prominent tubercles 12 to 14 mm. long: pulvinus woolly, with pale straw-colored bristles: spines 5 to 9, about equal, with loose lustrous sheaths, porrect-stellate (completely hiding the surface of young joints), 2.5 to 3 cm. long: flowers small, purple, cup-shaped, less than 2.5 cm. broad: fruit ovate, with flat umbilicus, fleshy, spineless but with large white tomentose pulvini, 2.5 to 3 cm. long, becoming dull-purple, oftenest sterile and fasciculately proliferous: seeds much compressed and very angular, beaked, with narrow commissure, 2 to 3 mm. broad (or with beak often 4 mm.). (*Ill.* Cact. Mex. Bound. t. 75, f. 18)—Type not found in the Engelmann collection.

From southern Nevada through Arizona and the mountains of western Sonora and Lower California.

Specimens examined: NEVADA (*Coville & Funston* of 1891, Cottonwood Springs): ARIZONA (*Palmer* 100 and 104 of 1867; *Bischoff* of 1872; *Parry* of 1881, Tucson; *Rusby* of 1883, Peach Springs; *Evans* of 1891, Tucson; *Toumey* of 1892, Tucson): SONORA (*Schott* 8; also a Pringle photograph): LOWER CALIFORNIA (*Brandegee* of 1889, Calamuget and Magdalena Island): also growing in Mo. Bot. Gard., 1893.

Very conspicuous on account of its shining spines, and hence called "vela de coyote," or "candle of the wolf." With a more arborescent form than *bigelovii*. The upper joints do not detach readily and hence propagation by joints must be rare. According to Parry, also, the proliferous fruits do not seem to develop plants. Brandegee notes in his Lower California specimens that the flowers are sometimes "light-yellow with reddish tinge," and sometimes the spines are hardly equal.

84. Opuntia fulgida mamillata (Schott).

Opuntia mamillata Schott; Engelm. Syn. Cact. 308 (1856).

More tree-like, with a distinct trunk and dense top, 15 to 18 dm. high: joints 7.5 to 10 cm. long, 3.5 cm. in diameter, with prominent ovate tumid tubercles ("like those of *Mamillaria*"): pulvini with very short bristles, or none: spines 4 to 6, slender, short (6 to 18 mm.), mostly deflexed, with straw-colored sheaths: seeds scarcely beaked, smaller and with narrower commissure.—Type, Schott 6 in Herb. Mo. Bot. Gard.

Southern Arizona and Sonora.

Specimens examined: ARIZONA (*Palmer* 105 of 1867; *Engelmann* of 1880): SONORA (*Schott* 6).

Dr. Engelmann's manuscript notes indicate that he had come to the conclusion that *mamillata* could not be regarded as specifically distinct from *fulgida*.

85. Opuntia bigelovii Engelm. Syn. Cact. 307 (1856).

Erect and arborescent, 30 to 36 dm. high, 7.5 to 10 cm. in diameter, with reticulated wood, numerous erect or ascending branches congested and forming a dense head, the lower at length refracted and brown: joints ovate or ovate-cylindrical, tumid, bright or pale green, fragile, 5 to 15 cm. long and 2.5 to 5 cm. in diameter, with depressed-hemispherical crowded tubercles 6 to 8 mm. long: pulvini immersed, with a

penicillate tuft of pale bristles: stouter spines 6 to 10, pale straw-colored and in lustrous whitish sheaths, 1 to 2.5 cm. long, usually 2 or 3 deflexed and the rest divergent; slenderer ones 6 to 10, lower and radiating, 8 to 14 mm. long: flowers purple, 2.5 to 4 cm. broad: fruit ovate, deeply umbilicate, tuberculate, unarmed or with a few spines, fleshy and greenish, 2.5 to 5 cm. long: seeds small and very irregular. (*Ill.* Pacif. R. Rep. iv, t. 19, f. 1–7)—Type, Bigelow of 1854 in Herb. Mo. Bot. Gard.

From southern Nevada southward through western Arizona and southeastern California, into Lower California.

Specimens examined: NEVADA (*Bailey* of 1891): ARIZONA (*Bigelow* of 1854, Williams River; *Schott* of 1855; *Parry* of 1880, on the Colorado): CALIFORNIA (*Parry* of 1876; *Engelmann* of 1879; *Parish* of 1880 and 1882, San Bernardino; *G. R. Vasey* of 1881, Whitewater; *Trelease* of 1892): LOWER CALIFORNIA (*Brandegee* of 1889, Purissima and Comondu).

Distinguished from *fulgida* and *prolifera* by its short tubercles, immersed pulvini, and large tuberculate somewhat spiny fruit. The young joints are very fragile. The tuft of bristles is borne at the notched tips of the imbricate tubercles. The spines are variable as to number and direction, ranging from the numbers and directions given in the above description to a single sharply deflexed spine. The seeds seem sometimes quite regular and discoid, 3 to 4 mm. broad.

++ ++ ++ *Frutescent or arborescent: joints cylindrical: tubercles mostly prominent and crested: flowers purple.*

(1) *Fruit not spiny.*

86. Opuntia whipplei Engelm. Syn. Cact. 307 (1856).

Stem erect, rarely spreading or subprostrate, 2 to 18 dm. high, with reticulate wood and divaricate branches: joints cylindrical, 5 to 30 cm. long, 1 to 2 cm. in diameter, with ovate crowded tubercles 10 mm. long: pulvini sparsely woolly and scarcely bristly: spines short, with ashy or straw-colored sheaths, 1 to 4 larger ones divaricate (the lower longer and deflexed), 6 to 18 mm. long, 2 to 8 smaller ones at lower margin, deflexed or radiating in every direction: flowers red: fruit subglobose, with funnelform umbilicus, lightly tuberculate, unarmed, yellow, somewhat fleshy and sweet, about 2.5 cm. long: seeds regular, 3 to 3.5 mm. broad, with linear commissure. (*Ill.* Pacif. R. Rep. iv, t. 24, f. 9, 10)—Type, specimens of Bigelow and Wright in Herb. Mo. Bot. Gard.

From southern Utah and Nevada through New Mexico and Arizona to southern California, Sonora, and Lower California.

Specimens examined: UTAH (*Palmer* of 1877, St. George; *Parry* of 1881, *Bailey* of 1879–81, Santa Clara Creek): NEW MEXICO (*Wright* of 1849; *Bigelow* of 1853; *Carleton* 385 of 1891): ARIZONA (*Bigelow* of 1853–54; *Palmer* of 1867 and 1870; *Bischoff* of 1871; *Engelmann* of 1880; *Lemmon* of 1881; *Pringle* of 1881, San Xavier Mission; *Parry* of 1881; *Rusby* 623 of 1883, Prescott; *Newberry* of 1888; *Evans* of 1891; *Toumey* of 1892, Tucson; *Wilcox* of 1894, Ft. Huachuca): CALIFORNIA (*Agassiz*, San Diego): LOWER CALIFORNIA (*Palmer* 161 of 1890, Raza Island).

87. Opuntia whipplei spinosior Engelm. Syn. Cact. 307 (1856).

Taller (small trees 18 to 30 dm. high), with rhombic tubercles, mostly longer (12 to 18 mm.), much more numerous (commonly 12 to 14) stellate-porrect and mostly radiant spines, cup-shaped flowers 3 to 3.5 cm. broad, and larger seeds (4 mm.). (*Ill.* Pacif. R. Rep. iv, t. 17, f. 1–4)—Type, Schott 5 of 1855 in Herb. Mo. Bot. Gard.

Southern Arizona.

Specimens examined: ARIZONA (*Schott* 5 of 1855; *Pringle* of 1881; *Vasey* of 1881; *Toumey* of 1892, Phœnix and Tucson; *Wilcox* of 1894, Ft. Huachuca).

In giving the range Schott notes "from Gila River south to Santa Cruz River and Tucson and further east." The flowers are sometimes more or less yellow-tinged.

88. Opuntia arborescens Engelm. Wisliz. Rep. 6 (1848).

Cactus cylindricus James, Cat. 182 (1825); not *Cereus cylindricus* Haw. Syn. 183 (1812).

Cactus bleo Torr. Ann. N. Y. Lyc. ii, 202 (1828), not HBK.

Opuntia exuviato-stellata Lem.; Lab. Monogr. Cact. 492 (1845); but this is only *Opuntia stellata* Salm, ined.

Arborescent and erect, northward 15 dm. high, southward becoming 60 to 90 dm. high, 12.5 to 25 cm. in diameter, with verticillate, horizontally divaricate or pendulous very spiny branches: joints verticillate (mostly in 3s or 4s), cylindrical and very green, 5 to 15 cm. long, less than 2.5 cm. in diameter, with prominent elongated compressed-cristate tubercles 14 to 18 mm. long, and terete elongated spreading leaves 12 to 20 mm. long: pulvini with short wool, but scarcely bristly: spines 8 to 30, terete, horny or reddish-brown, in straw-colored sheaths, porrect in every direction, 1 to 8 interior ones longer (16 to 28 mm.), more loosely sheathed, the central subdeflexed, the exterior ones weaker, closely sheathed, 8 to 16 mm. long, all sometimes very short: flower purple, 6 to 7.5 cm. broad: fruit globose or hemispherical, 2.5 cm. in diameter, variously umbilicate (dependent on prominence of upper tubercles), prominently cristate-tuberculate, unarmed, dry or nearly so, yellow; seeds regular, smooth, 3 to 4 mm. broad, with narrow commissure. (*Ill.* Pacif. R. Rep. iv, t. 17, f. 5, 6; t. 18, f. 4; t. 24, f. 12; Cact. Mex. Bound. t. 75, f. 16, 17)—Type, Wislizenus of 1846 and Fendler of 1847 in Herb. Mo. Bot. Gard.

From central Colorado southward through Texas, New Mexico, and Arizona into Chihuahua and Sonora and far southward.

Specimens examined: COLORADO (*Parry*, Canyon City; *Pringle* of 1881, Trinidad; *Alice Eastwood* of 1890, Durango; *Mrs. S. B. Walker* of 1894, Canyon City): TEXAS (*Wright* of 1851–52; *G. R. Vasey* of 1881, El Paso; *Evans* of 1891): NEW MEXICO (*Wislizenus* 307 of 1846; *Fendler* 277 of 1847, Santa Fe; *Wright* 354, 390, 399; *Bigelow* of 1853–54; *Bolander* of 1872; *G. R. Vasey* of 1881, Socorro; *Mrs. Sumner* 1002; *Carleton* of 1891; *Evans* of 1891, Lordsburg; *Mearns* of 1892, Carrizallilo Mts.): ARIZONA (*Emory* of 1848; *Coues & Palmer* of 1865; *Bis-*

choff of 1871; *Lemmon* 305; *Palmer* 800; *Rothrock* 101, 584; *Pringle* of 1881; *Vasey* of 1881; *Palmer* of 1890, Ft. Huachuca; *Nealley* of 1891, Silver City; *Wilcox* of 1894, Ft. Huachuca; *Dr. Loew*, Chloride): SONORA (*Thurber* 336): COAHUILA (*Palmer* 377 of 1880): also cult. in Mo. Bot. Gard. 1862, growing in 1893.

A Mexican species of wide range and extending northward to the plains of Colorado, covering extensive tracts. Nealley's specimens, from Silver City, Arizona, have shorter perpendicular and subercct central spines, shorter than the radials. Vasey's from El Paso have tubercles 25 to 30 mm. long, which so separate the bunches of spines that the joints have not their usual spiny appearance. Palmer 377 from Coahuila was distributed as *imbricata*, and I doubt not that much Mexican *arborescens* has been mistaken for that species. The 1 or 2 white spines of *imbricata*, as well as its clavate joints, should easily distinguish it from *arborescens*, although it is very doubtful whether it deserves specific separation.

89. Opuntia imbricata (Haw.) DC. Prodr. iii, 471 (1828).
Cereus imbricatus Haw. Rev. 70 (1812).

An irregular branching shrub 9 to 15 dm. high, with trunk often 7.5 cm. in diameter, branching above, solitary or forming thickets: joints more or less clavate, with prominent compressed-cristate tubercles, and elongated subulate leaves: pulvini with straw-colored wool: spines 1 or 2, white, setaceous or rigid, sheathed: flowers rose-colored, crowded near the summit of late branches: fruit depressed-globose, umbilicate: seed thick, irregular, 3 to 3.5 mm. in diameter. (*Ill.* Cact. Mex. Bound. t. 73, f. 7, 8)—Type unknown.

From Coahuila and San Luis Potosi to southern Mexico.

Specimens examined: COAHUILA (*Palmer* 370 of 1880; *Parry & Palmer* 281): STATE OF MEXICO (*Gregg* 568, 677, 684, 685 of 1849): ZACUALCO (*Bourgeau* 264 of 1865–66): MEXICO, with no state indicated (*Wright* of 1847): also cult. Gard. Montpel. 1126.

Very closely related to *arborescens*, and possibly only a small sparsely armed form of it, but in the absence of type material or even complete material it is for the present kept separate.

90. Opuntia versicolor Engelm. MSS.

Arborescent, with spineless trunk 5 to 7.5 cm. in diameter, irregularly much branched: joints cylindrical, 12 to 18 cm. long or more, about 1.5 cm. in diameter, with linear rather prominent tubercles (when young) 1 to 2.5 cm. long, soon flattening and disappearing on older branches, and round-ovate cuspidate leaves: pulvini with short gray wool, and usually a small cluster of bristles at upper edge: spines 4 to 13 on young joints, 15 to 20 on older ones, stellate, reddish-brown, with straw-colored sheaths (close and soon disappearing), the inner 1 to 4 usually deflexed and unequal (6 to 13 mm.), the radials shorter: flowers yellow, 2 to 2.5 cm. broad: fruit becoming clavate, 2 to 2.5 cm. long, at length reddish or yellowish and apparently dry: seeds irregular, angular, about 5 mm. broad, with narrow commissure.—Type, specimens of Parry, Pringle, G. Engelmann, and Miller, in Herb. Mo. Bot. Gard.

Neighborhood of Tucson and Benson, Arizona, on mesas and foothills.

Specimens examined: ARIZONA (*Parry* of 1880 and 1881; *G. Engelmann* of 1880; *Pringle* of 1881; *Miller* of 1881: *Nealley* of 1891; *Toumey* of 1892, Tucson).

This species has been distributed under this name ever since 1881, but I have been unable to find any published description. Toumey's specimens have much shorter, more prominent, and more crowded tubercles than usual.

91. Opuntia molesta Brandegee, Pl. Baja Calif. 164 (1889).

Stems few, sparingly branched, 12 to 18 dm. high: cylindrical joints 15 to 20 cm. long and 2.5 cm. in diameter, with few not prominent tubercles: spines 5 to 9, of which 1 to 3 are 2.5 to 5 cm. long, the rest less than 1.2 cm. long, all reddish-brown to blackish, the 2 upper large ones divaricate, the lower one porrect or deflexed, the small and apparently naked ones usually at lower edge of pulvinus and deflexed: flower purple, 5 cm. broad: fruit obovate, juicy, 2.5 to 4 cm. long, not tuberculate or spiny, but with remnants of the woolly pulvini: seeds very irregular, with a swollen, warty look, the narrow commissure in a deep furrow, 5 to 8 mm. in diameter.—Type in Herb. Brandegee.

San Ignacio, Lower California.

Specimens examined: LOWER CALIFORNIA (*Brandegee* of 1889).

Mr. Brandegee says that the long spines are sometimes not present. Their sheaths are straw-color to brownish, very loose and bladdery, giving the spines a massive look when unbroken.

92. Opuntia calmalliana, sp. nov.

Habit and height unknown: joints cylindrical, 1 to 2 cm. in diameter, glaucous, with linear-oblong crested (mostly distinct) tubercles 20 to 25 mm. long: pulvini densely covered with yellowish wool, and with a penicillate tuft of whitish bristles at upper edge: spines usually 4, the upper one stout and porrect, reddish with yellowish tip (as are all the spines), 2 to 2.5 cm. long (occasionally 1 or 2 short upper ones added), the usually 3 (sometimes 4) lower ones more slender and sharply deflexed, 1 to 1.5 cm. long (occasionally one of them longer): flowers apparently purple: ovary covered with very prominent woolly pulvini which are more or less bristly and spiny, but ripening into a smooth juicy obovate fruit: seeds discoid and beaked, irregularly angular, with broad commissure, about 4 mm. broad.—Type in Herb. Brandegee.

Calmalli, Lower California.

Specimens examined: LOWER CALIFORNIA (*Brandegee* of 1889).

This species is closely related to *molesta*, but its spines are different, though on the same general plan, and its seeds are very different.

(2) *Fruit more or less spiny.*

93. Opuntia thurberi Engelm. Syn. Cact. 308 (1856).

Erect and frutescent: joints slender-cylindrical (12 mm. in diameter), with oblong-linear tubercles 18 mm. long: pulvini with short yellow wool and scarcely any bristles: spines 3 to 5, short (6 to 16 mm.), dusky,

with straw-colored or yellowish sheaths, laterally divergent, the lowest one stoutest and deflexed: flower salverform, dull brick-red, 3.5 cm. broad.—Type, Thurber 373 in Herb. Mo. Bot. Gard.

"Near Bacuachi, Sonora."

Specimens examined: SONORA (*Thurber* 373).

94. Opuntia acanthocarpa Engelm. Syn. Cact. 308 (1856).

Erect and arborescent, stout, 15 to 18 dm. high, with reticulate wood, and few alternate (never verticillate) ascending divaricate branches: joints cylindrical, 10 to 20 cm. long, 2.5 cm. in diameter, with oblong-linear tubercles 18 to 20 mm. long: pulvini with short wool and scanty bristles: spines 8 to 25, stellate-porrect in every direction, with straw-colored or brownish sheaths, the inner (1 to 7) 2.5 to 3 cm. long, the outer (6 to 20) 8 to 20 mm. long: flowers copper-color and small: fruit depressed-subglobose, broadly umbilicate, tuberculate, with rather few but stout spines, 2.5 cm. long: seeds sharply angular, 5 to 6 mm. broad, with broad commissure. (*Ill.* Pacif. R. Rep. iv, t. 18, f. 1–3; t. 24, f. 11: N. Am. Fauna, no. vii, t. 7, 8)—Type, Bigelow of 1854 in Herb. Mo. Bot. Gard.

From southwestern Utah and southern Nevada southward through Arizona and southeastern California into Sonora.

Specimens examined: ARIZONA (*Bigelow* of 1854; *Palmer* (numerous numbers) of 1867; *Engelmann & Palmer; Rusby* 622 of 1883, Peach Spring; *Smart* 245; *Toumey* of 1892, Tucson): CALIFORNIA (*Coville & Funston* 1943, Death Valley Exped.): SONORA (*Thurber* 4, near "Bacuacha"): also growing in Mo. Bot. Gard., 1893.

Among Toumey's specimens is one with spineless fruit, but evidently this species. In such a case the flowers and seeds are necessary to separate it from *arborescens*.

+ + Wood dense: joints slender, obscurely tuberculate: spines single (or 1 or 2 smaller ones added above): seeds more or less margined.

95. Opuntia kleiniæ DC. Rev. Cact. 118 (1828).

Opuntia wrightii Engelm. Syn. Cact. 308 (1856).

Erect and shrubby, 6 to 12 dm. high, 2.5 to 3.5 cm. in diameter below, with few ascending branches: joints cylindrical, slender, 8 mm. in diameter, with elongated depressed tubercles 14 to 18 mm. long, and elongated subulate spreading leaves 10 mm. long: pulvini with white wool and very slender penicillate bristles: the single spine (rarely 1 or 2 smaller divergent ones added above) porrect or a little deflexed, 16 to 20 mm. long, reddish to ashy, with straw-colored deciduous sheaths: flowers brick-red, 2.5 to 3 cm. broad: fruit obovate, about 1.5 cm. long.—Type unknown.

From the Pecos region of Texas to El Paso, and southward through Coahuila and Sonora to southern Mexico.

Specimens examined: TEXAS (*Wright* of 1851 and 1852; *Parry* 49; *Evans* of 1891): COAHUILA (*Palmer* 376): also cult. in Mo. Bot. Gard. 1862 and 1881, and growing in 1893.

96. Opuntia arbuscula Engelm. Syn. Cact. 309 (1856).

Erect and arborescent, 21 to 24 dm. high, the smooth green trunk 10 to 12.5 cm. in diameter, very capitate-branching at apex (top formed by numerous slender divaricate branches): joints lightly tuberculate, the ultimate ones 5 to 7.5 cm. long, 8 mm. in diameter, with oblong-linear depressed (flat and indistinct) tubercles 12 mm. long: pulvini with white wool, and few very slender penicillate bristles: the single spine (or sometimes 2 side by side) porrect, at length deflexed, with straw-colored or yellow sheath, 18 to 25 mm. long, rarely 1 or 2 shorter and lower deflexed ones added: flowers greenish-yellow tinged with red, 3.5 cm. broad: fruit "bristly."—The type specimens are those of Schott ("on desert heights, near Maricopa village, on the Gila"), but they could not be found in the Engelmann collection.

Deserts of Southwestern Arizona and southward into Sonora.

Specimens examined: ARIZONA (*Emory* of 1846; *Engelmann* of 1880; *Parry* of 1881; *Pringle* of 1881, mesas near San Xavier Mission; *Evans* of 1891, Tucson; *Toumey* of 1892, Mesa City; *Wilcox* of 1894, Fort Huachuca).

The Evans specimen contains fruit which is elavate, strongly tuberculate and bristly, with funnelform umbilicus, 2 to 2.5 cm. long. It is immature, so that no color is indicated, and probably not the full size. This species is often confused with the *leptocaulis* forms, but its dense, stouter, almost interlocking apical branches, its long flat tubercles, and its yellowish sheathed spines separate it easily. There is great variation in spine characters, the following forms occurring: naked (spines probably deciduous); one spine (the common form); 2 equal spines side by side; 2 prominent spines and 1 or 2 smaller ones; 3 or 4 spines, all alike but only 5 to 15 mm. long, making a short spiny-looking joint. Some of these forms might have been separated as varieties, but almost all of them, certainly the most diverse ones, have been found on different branches of the same plant. The pulvini are apt to be quite bristly, and the wool is oftener dirty-white than bright-white.

97. Opuntia leptocaulis DC. Rev. Cact. 118 (1829).
Opuntia fragilis frutescens Engelm. Pl. Lindh. 245 (1845).
Opuntia frutescens Engelm. Wisliz. Rep. 28 (1848).
Opuntia frutescens brevispina Engelm. Syn. Cact. 309 (1856).
Opuntia leptocaulis brevispina Watson, Bibl. Index, 407 (1878).

Erect and frutescent, 9 to 15 dm. high, 2.5 to 3.5 cm. in diameter, with light-gray scaly bark and erectish branches ("like pipestems"): joints cylindrical, 4 to 6 mm. in diameter, with indistinct tubercles 6 to 10 mm. long, the young joints sessile: the mostly single spine slender, 8 to 12 mm. long, in a close sheath: flowers greenish or sulphur-yellow, 14 to 20 mm. broad: fruit obovate, smooth, often proliferous, not tuberculate, deep-scarlet, fleshy, 10 to 18 mm. long: seeds few, white, compressed, with narrow and often acute margin, 3 mm. in diameter. (*Ill.* Pacif. R. Rep. iv, t. 20, f. 4, 5; also t. 24, f. 16–19)—Type unknown.

Common from northern Mexico, throughout Texas, and westward to Arizona; also extending to southern Mexico,

Specimens examined: TEXAS (*Lindheimer* of 1845; *Wislizenus* of 1847;

Thurber of 1850; *Wright* of 1851 and 1852; *Hall* of 1872, near Austin): NEW MEXICO (*E. A. Mearns* of 1892, Grant Co.): ARIZONA (*Trelease* of 1892; *Toumey* of 1892, Tucson): COAHUILA (*Gregg* 125 and 438; *Palmer* of 1880): SAN LUIS POTOSI (*Parry and Palmer* of 1878): also growing in Mo. Bot. Gard. 1893.

The Lindheimer form described in 1845 is the form with short spines, and is the characteristic form of Texas and northeastern Mexico. The original *leptocaulis* form was described from Coulter's collection, made further south in Mexico.

98. Opuntia leptocaulis stipata, nom. nov.

Opuntia frutescens longispina Engelm. and Bigel. Pacif. R. Rep. iv, 56 (1856), not *O. longispina* Haw. Philos. Mag. 109 (1830).

Young joints stipitate: spines stouter, longer (2.5 to 5 cm.), and in loose sheaths. (*Ill.* Pacif. R. Rep. iv, t. 20, f. 2, 3)—Type, specimens of Bigelow, Wright, and Thurber in Herb. Mo. Bot. Gard.

From the Colorado River of Texas to the Colorado of the West and southward into Sonora, San Luis Potosi, and Lower California.

Specimens examined: TEXAS (*Bigelow* of 1853; *Wright* 421; *Lindheimer* 1872; *Berlandier* 195, 1455, 1828; *Reverchon* 342, Brownwood; *G. R. Vasey* of 1881, El Paso; *Carleton* 410 of 1891, Oldham County; *Evans* of 1891): NEW MEXICO (*Wright* of 1851; *Bigelow* of 1853): ARIZONA (*Bigelow* of 1854; *Schott* of 1855; *Palmer* 93, 98; *Rusby* 146 of 1883, San Francisco Mts.; *Toumey* of 1892, Tucson; *Wilcox* of 1894, Ft. Huachuca): SONORA (*Thurber* of 1851): SAN LUIS POTOSI (*Parry & Palmer* 280): LOWER CALIFORNIA (*Brandegee* of 1889, San Gregorio, Enrique, Agua Dulce): cult. in Mo. Bot. Gard. 1881; also growing in same garden in 1893.

99. Opuntia leptocaulis vaginata Watson, Bibl. Index, 407 (1878).

Opuntia vaginata Engelm. Wisliz. Rep. 16 (1848), in part.

Joints 6 to 8 mm. in diameter, with rather distinct tubercles 12 to 18 mm. long: the large spines 2.5 to 6 cm. long, dark (mostly black), with very loose glistening yellowish or brownish sheaths, and 1 or 2 smaller ones added: fruit tuberculate, yellow: seed 4 to 5 mm. in diameter. (*Ill.* Pacif. R. Rep. iv, t. 24, f. 1; t. 24, f. 13–15)—Type, specimens of Wislizenus in Herb. Mo. Bot. Gard.

From southwestern Texas to Arizona, and southward into Coahuila and San Luis Potosi.

Specimens examined: TEXAS (*Wislizenus* of 1837 and 1846; *Lindheimer* of 1851; *Wright* 421): NEW MEXICO (*Wislizenus* of 1846; *Wright* 1851–52; *Bigelow* of 1853; *E. L. Greene* of 1880): ARIZONA (*Lemmon* 303): COAHUILA (*Gregg* 753): SAN LUIS POTOSI (*Gregg* 568): also cult. in Mo. Bot. Gard., 1850.

The mostly solitary very long spines are porrect, standing out on every side of the slender stems like great thorns. The leaves are usually quite persistent.

100. Opuntia ramosissima Engelm. Amer. Journ. Sci. ser. 2, xiv, 339 (1852).

Opuntia tessellata Engelm. Syn. Cact. 309 (1856).

Very bushy from a stout trunk (2.5 to 7.5 cm. in diameter) with dark

gray scaly bark, 6 to 20 dm. high, with numerous slender divaricate branches: joints slender cylindrical, 6 to 7 mm. in diameter, covered with crowded and depressed-flattened 5- or 6-angled ashy gray tubercles 5 to 6 mm. long: pulvini with wool, but scarcely bristly, unarmed or with a single (rarely double) elongated (3.5 to 5 cm.) porrect or somewhat deflexed spine (rarely a few additional minute ones), which is whitish and yellow to reddish and brown, and in a very loose yellow sheath (contracted at base and firmly adhering to the spine, loose and saccate above): flowers purple, 1 to 2 cm. broad: fruit ovate (contracted at base and apex), with narrow and deep umbilicus, dry and tuberculate, bristly, 18 to 20 mm. long: seeds few, somewhat regular, with thick spongy margin, 3.5 to 4 mm. broad. (*Ill.* Pacif. R. Rep. iv, t. 21, f. 1–7)—Type not found in the Engelmann collection.

Deserts of the Colorado from southern Nevada through southeastern California and western Arizona into Sonora.

Specimens examined: ARIZONA (*Schott* of 1856; *Parry* of 1867; *Bischoff* of 1871; *Palmer* of 1876; *Toumey* of 1892, Yuma): CALIFORNIA (*Parry* of 1852; *Bigelow* of 1854; *Cooper* of 1861; *Wright* of 1882; *Parish Bros.* 170 of 1882, San Bernardino Mts.; *Trelease* of 1892): SONORA (*Schott* of 1855; *Pringle* of 1884, sandy plains, near Gulf of California).

The original name *ramosissima* (1852) was considered an unsuitable one in a section in which all the species are branching; it was therefore changed to *tessellata* (1856), referring to the curious crowded and angular flattened tubercles. The spines are crowded together at the upper end of each year's growth, and these with their yellow shining sheaths surmounting very slender branches covered with scale-like tubercles give the plant a striking appearance. The spines have a wide range of coloration, since they may be not only whitish to yellow (the usual colors), but having always a yellowish tip, they may be ashy-gray or deep reddish-brown, or even black below or sometimes a combination of all of these colors.

** * * Stem erect but weak and using a support, branching and woody: spines none: flowers yellow.*

101. Opuntia rotundifolia Brandegee, Zoe, ii, 21 (1891).

Erect and slender, weak and branching, 20 to 30 dm. high, supported by bushes, with a cylindrical woody stem only, 1 to 1.5 cm. in diameter: joints 6 to 10 cm. long. with fleshy round ovate leaves 2 to 3 cm. long and wide: pulvini remote. with gray wool, numerous retrorsely barbed, usually reddish-brown, bristles 3 to 5 mm. long, and no spines: flowers yellow, about 4 cm. broad: fruit slender-clavate, bristly, about 5 cm. long and 4 to 6 mm. in diameter: seeds few, whitish and flattened, densely covered with white hairs (somewhat deciduous with age).—Type in Herb. Brandegee.

"Not uncommon at low elevations in the Cape Region," Lower California.

Specimens examined: LOWER CALIFORNIA (*Brandegee* of 1890, San José del Cabo).

The specimens I have examined are presumably a part of the type material. They consist of naked terete stems 3 to 5 mm. in diameter, with the small tomentose

areolæ averaging about 2 cm. apart; and a package of fragmentary material. The remarkable broad fleshy leaves are very much shrunken, but in their shriveled state measure 10 to 17 mm. long and wide. Mr. Brandegee has seen "the whole plant covered with a mass of thick green leaves, amongst which a few yellow flowers were visible." Such leaves are naturally suggestive of *Peireskia*. The single flower in the material before me is small, about 2 cm. high and broad, but it may be quite immature and is certainly much shrunken. I have not seen the remarkable hairy seeds.

ARTIFICIAL KEY TO THE SPECIES.

It seems impossible to make a satisfactory artificial key for *Opuntia*, as the species are separated, poorly at best, by a variety of characters. The following attempt may be of some service. The numbers refer to the serial numbers of the synoptical presentation:

I. Joints flat and more or less round.—Platopuntias.

* *Spineless.*

Mexico.
microdasys (44), rufida (45).
Florida and tropical America.
ficus-indica (3).
Atlantic States.
opuntia (42).
Southwestern United States.
Joints obovate.
laevis (4), basilaris (46), utahensis (57).
Joints obovate to orbicular.
filipendula (30), mesacantha (31), treleasii (48).

* * *Spiny.*

Florida and Georgia.
pes-corvi (43).
Mexico.
stenopetala (1), setispina (29).
Lower California.
tapona (13), pycnantha (16), comonduensis (21).
Western United States.
Joints neither obovate nor orbicular.
Spines yellow or straw-color.
tuna (5), palmeri (15), rubrifolia (19), fragilis (60).
Spines white or whitish.
trichophora (55), brachyarthra (61).
Spines reddish or brownish.
rutila (58), fragilis (60), brachyarthra (61).
Joints orbicular.
Spines mostly 1 to 3.
Spines reddish-brown (at least some of them).
macrocentra (22), oplocarpa (39), sphaerocarpa (56).
Spines whitish (perhaps reddish at base or apex).
filipendula (30), mesacantha (31), cymochila (35).
Spines straw-colored.
cyclodes (10).
Spines mostly 4 to 15 and dark.
strigil (2), mojavensis (27), hystricina (49), polyacantha (50), watsoni (54).

Western United States—Continued.

Joints obovate.

Spines straw-colored.

lindheimeri (7), chlorotica (12), procumbens (18), angustata (20).

Spines white or whitish (sometimes dusky at base or apex).

Spines mostly 1 to 3.

Longest spines not exceeding 3.5 cm.

dulcis (8), occidentalis (9), mesacantha (31), stenochila (36), macrorhiza (37).

Longest spines about 5 cm.

angustata (20), filipendula (30).

Spines mostly 4 to 10.

Longest spines not exceeding 3.5 cm.

albispina (53), arenaria (59).

Longest spines 6 to 10 cm.

tortispina (26), tennispina (28), hystricina (49).

Spines reddish or brown to black.

Spines mostly 1 to 3.

Longest spines not exceeding 3.5 cm.

lindheimeri (7), greenii (38), vaseyi (40), fusco-atra (41).

Longest spines 5 to 7.5 cm.

procumbens (18), phæacantha (23), camanchica (25).

Spines mostly 4 to 15.

Longest spines not exceeding 3.5 cm.

strigil (2), arenaria (59).

Longest spines about 5 cm.

procumbens (18), platycarpa (51), borealis (52).

Longest spines 6 to 10 cm.

phæacantha (23), camanchica (25), hystricina (49).

II. Joints cylindraceous, more or less tuberculate.—Cylindropuntias.

* *Spineless.*

ramosissima (100), rotundifolia (101).

* * *Spiny.*

– *Spines without sheaths.*

Longest spines not exceeding 1 to 3.5 cm.

bulbispina (62), parryi (63), clavata (64), pulchella (65).

Longest spines 5 to 6 cm.

grahami (66), emoryi (67), schottii (68), invicta (70).

– – *Spines with sheaths.*

Mexico.

tunicata (72), imbricata (89), thurberi (93).

Lower California.

clavellina (71), ciribe (73), molesta (91), calmalliana (92).

Southwestern United States.

Spines mostly 5 to 20.

Fruit spiny.

Longest spines not exceeding 2 to 2.5 cm.

echinocarpa (75), serpentina (79).

Longest spines 3 to 3.5 cm.

davisii (74), bernardina (80), acanthocarpa (94)

Fruit not spiny.

Longest spines not exceeding 1.5 to 2.5 cm.

bigelovii (85), whipplei (86), versicolor (90).

Longest spines 3 to 3.5 cm.

prolifera (82), fulgida (83), arborescens (88).

Spines mostly solitary.

Longest spines not exceeding 1 to 2.5 cm.

kleiniæ (95), arbuscula (96), leptocaulis (97).

Longest spines 5 to 6 cm.

stipata (98), vaginata (99), ramosissima (100).

GEOGRAPHICAL DISTRIBUTION.

The genus *Opuntia* is far more largely represented in the United States than any other genus of *Cactaceæ*, extending into British Columbia and to the Atlantic Seaboard and displaying a maze of forms in the Southwestern States. This is specially true of PLATOPUNTIA. The great uncertainty as to the species of *Opuntia* is probably accountable for the large enumeration of them peculiar to our flora. Numerous forms have never been recognized a second time, and others are kept distinct from each other and from Mexican forms when they should doubtless be merged. In almost every unvisited locality "new species" are found so freely that no confidence can be placed in our conception of specific lines in this genus. The following discussion is based upon the presentation of the previous pages, but it should be understood that it must be largely modified by a fuller understanding of the genus.

The two sections, PLATOPUNTIA and CYLINDROPUNTIA are so distinct from each other that they will be considered separately.

CYLINDROPUNTIA, with 28 forms enumerated as belonging to our flora, but 11 of which are restricted to the United States, does not extend north of central Colorado or east of Texas. It is preeminently a Sonoran and Lower Californian type, and 25 of the 28 forms occur in the desert region of western Arizona and southern California. Of the 17 forms in common with the Mexican flora 15 are now traced into Sonora and Lower California, and the others certainly will be. Further exploration of those Mexican States will doubtless reduce the number of species now enumerated as peculiar to our flora. The 11 forms regarded at present as endemic are distributed as follows: *echinocarpa parkeri*, *serpentina*, and *bernardina* in southern California, and doubtless of Lower Californian origin; *whipplei spinosior* and *versicolor* in southern Arizona, certainly to be found in Sonora; *parryi*, *clavata*, and *pulchella* more isolated in southern Nevada and adjacent regions; *davisii* extending from southern California to southern Colorado and northwestern Texas; and *grahami*, a low-ground species, found along the Rio Grande bottoms from El Paso downward, and *schottii*, found as yet only in Texas between the San Pedro and Pecos, the two species of our endemic Cylindropuntias which do not indicate a lower Californian or Sonoran connection.

The seventeen Cylindropuntias in common with Mexico are, with two exceptions, all found in the desert regions of southern California and Arizona, some of them extending into Nevada, others further eastward into Utah and Colorado, and some reaching Texas. They occur in two types, the more robust and more spiny forms (such as *echinocarpa*, *proli-*

fera, *fulgida*, and *arborescens*), and the more slender and less spiny forms (of which *leptocaulis* may be taken as a representative). Exclusive of varieties, there are nine representatives of the former group and four of the latter. In the first series, *bulbispina* has as yet been reported only from New Mexico, extending southwestward into Coahuila. The remaining eight species are massed in Arizona and extend beyond it as follows: *prolifera* only into adjacent California, occurring in the Lower Californian flora; *fulgida* and *bigelovii*, both Sonoran and Lower Californian in origin, extending not only into adjacent California, but reaching southern Nevada; *echinocarpa*, *whipplei*, and *acanthocarpa* having the same extension into California and Nevada, but also reaching southern Utah; *emoryi* and *arborescens* not extending westward or directly northward of Arizona, but stretching eastward to southwestern Texas, the latter being the only one of the group to reach Colorado. Of the four slender and less spiny species *kleiniæ* has been reported only from southwestern Texas, but its occurrence in Sonora as well as Coahuila would indicate a wide Mexican range and the great probability that it occurs in Arizona. In the case of the other three species *arbuscula* is found only in southwestern Arizona; *ramosissima* extends into adjacent California and southern Nevada; while *leptocaulis*, the most common species, extends eastward from Arizona into Texas, even as far as the Colorado River.

PLATOPUNTIA is represented in our flora by 51 forms, one of which (*tuna*) is a tropical American form extensively introduced by cultivation, notably in southern California. Of the remaining 50 forms, 44 are described as endemic, but 5 being regarded as identical with Mexican forms. It is hard to avoid the conclusion that this is more an expression of our ignorance of the Mexican forms and of specific limitations than of a fact. Three species occur east of the Appalachians: *ficus-indica*, reaching Florida from the tropics; *pes-corvi*, a curious endemic species of Georgia and Florida; and *opuntia*, the common coast species from Massachusetts to Florida. The remaining 47 forms are characteristic of our western flora, but 10 of them ranging north of Colorado or east of Indian Territory. Just as Arizona is the center of our display of Cylindropuntias, so western Texas and adjacent New Mexico are the special home of Platopuntias, 29 of the 47 forms occurring there. PLATOPUNTIA is characterized by the development of three very strong types which display a bewildering maze of forms, viz: *lindheimeri*, *mesacantha*, and *polyacantha*. The species *lindheimeri*, of Mexican origin, ranges through our southern border, from the Gulf to the Pacific, while two of the varieties, *occidentalis* and *littoralis*, are confined to southern California, and the other two, *dulcis* and *cyclodes*, belong to Texas, the latter reaching into adjacent New Mexico. The two other types, *polyacantha* and *mesacantha*, are far wider in their distribution. The type *polyacantha* is not found in the Arizona-California-Nevada region, but ranges far north, extending from Texas into

British Columbia, this and *fragilis* being the only PLATOPUNTIA forms north of our border. The species *polyacantha* extends from Indian Territory and northern New Mexico through Utah to Montana and Washington; *borealis* is the most northern variety, ranging from South Dakota and Oregon into British Columbia; *platycarpa* extends from Utah and Colorado to Idaho and Montana and eastward to Nebraska; *watsoni* extends from New Mexico to Utah, Wyoming, and Nebraska; *albispina* extends from New Mexico to Utah and Indian Territory; while the peculiar *trichophora* is confined to the El Paso region of Texas and adjacent New Mexico. It would seem that in this case a strong type has spread far northward and has been extensively modified. In the case of *mesacantha*, however, we find our most variable type. It is easy to define at least nine varieties of it, but there still remain numerous forms unworthy of varietal rank and still not strictly typical. Its range is wider even than that of *polyacantha*, occupying the Arizona region and extending east of the Mississippi, in fact closely represented on the Atlantic by *opuntia*, but, so far as known, not extending into British Columbia. The species *mesacantha* ranges from Texas to Minnesota, extending eastward into Indiana and Kentucky, its variety *microsperma* accompanying it. The variety *macrorhiza* has the most northwestern extension, reaching the "Big Bend" of the Missouri from Texas and Arizona. The form *cymochila* has a range second in extent only to *macrorhiza*, touching the species in Kansas and reaching Utah and Arizona to the west. The remaining six varieties are far more restricted: *parva* in southern Missouri; *grandiflora* on the Brazos in Texas; *oplocarpa* in western Texas and Colorado; *greenii* in Colorado and Arizona; *stenochila* in western New Mexico; and *vaseyi* in western Arizona. The only other far northern species is *fragilis*, which begins at the south in southern Colorado and adjacent New Mexico and Utah, and extends northward into Montana and British Columbia, and eastward to Kansas and Minnesota. The species *tortispina* has an eastern range along the plains, extending from northern Texas to Nebraska. The remaining 23 forms are purely southwestern, as follows: *fusco-atra* is a form of eastern Texas; *strigil*, *filipendula*, *tenuispina*, and *arenaria* belong to the El Paso region; *sphærocarpa* and *phæcantha major* are restricted to New Mexico; *palmeri*, *rubrifolia*, and *sphærocarpa utahensis* are forms of Utah; *lævis* is peculiar to Arizona; *mojavensis* and *treleasii* are restricted to southern California; *chlorotica*, *basilaris*, and *rutila* belong to the desert region of southern California, Arizona, Nevada, and Utah; *angustata* and *hystricina* extend from southern California to New Mexico, the latter also reaching Nevada; *procumbens* and *camanchica* extend from Arizona to the El Paso region of Texas, the latter also reaching southern Colorado. The total enumeration of Platopuntias in the southwest shows 20 forms in Texas, 17 in New Mexico, 14 in Arizona, 11 in southern California, 11 in Utah, and 7 in Colorado. But 4 species are reported as yet from Nevada, but this is evidently entirely inadequate.