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PART V.

from Pacific R.R. Report vol IV

EXPLORATIONS AND SURVEYS FOR A RAILROAD ROUTE FROM THE MISSISSIPPI RIVER TO THE PACIFIC OCEAN.

WAR DEPARTMENT.

ROUTE NEAR THE THIRTY-FIFTH PARALLEL, EXPLORED BY LIEUTENANT A. W. WHIPPLE, TOPOGRAPHICAL ENGINEERS, IN 1853 AND 1854.

REPORT

ON

THE BOTANY OF THE EXPEDITION.

WASHINGTON, D. C.
1856.

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BY J. M. BIGELOW, M. D.

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BY W. S. SULLIVANT, Esq.

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EXPLANATION OF THE PLATES.

No. 1.

GENERAL DESCRIPTION

OF

THE BOTANICAL CHARACTER OF THE COUNTRY.

BY J. M. BIGELOW, M. D.

GENERAL DESCRIPTION OF THE SOIL AND PRODUCTIONS ALONG THE ROUTE TRAVERSED.

WASHINGTON, D. C., *August*, 1854.

SIR: In compliance with your instructions, I have the honor to submit to you a report on the forest trees, the productions of the soil, and its capacity for sustaining a civilized population, upon the railroad route near the 35th parallel, over which you had command.

Very respectfully,

JOHN M. BIGELOW.

Lieut. A. W. WHIPPLE, *Topographical Engineer, U. S. A.*,
in charge of exploration for railroad route near the 35th parallel.

SECTION I. *Napoleon, on the Mississippi, to Fort Smith, Arkansas.*—From Napoleon to Fort Smith, our way being on steamboat, I could, of course, give but a limited account, either of its forests or of its soil. The banks of the river were densely lined with timber-trees of great variety. Among the kinds observed we particularly noticed the black walnut, sweet-gum, (liquid ambar styraciflua,) pecan, white ash, three kinds of elms, five or six species of oaks, Osage orange, and sassafras, with their dark green foliage; all most luxuriant and beautiful. At Little Rock, among some of those just mentioned, we saw the American holly, (Ilex opaca,) spice-wood, and June berry, (Amelanchier canadensis.) Near Piney Point, at the Sugar-loaf mountain, as well as on our route in the Indian Territory, was found what was considered to be *Pinus mitis*, the common yellow pine of the southern States, quite different from the one in New Mexico, known there by the same common name. We also observed, in passing, witch-hazel, hop-horn beam, birch, Kentucky coffee-bean, honey-locust, black locust, sour-gum, red-bud, box-elder, mulberry, dogwood, blackberry, &c., &c., all indicating a soil of the utmost fertility. It is unnecessary to extend the list beyond the few seen from the boat, as the botany of this country has been described and is well known, having been visited by Nuttall, and other eminent naturalists and botanists.

SECTION II. *Fort Smith to Valley river.*—The range of country embraced between these two points is about four hundred and sixty miles. The western limit of this section is some distance west of the line between Texas and the Indian reservation. Consequently, it embraces

the entire limits of the Indian Territory, from east to west. It constitutes a most natural division, being in nearly its whole breadth a beautiful and fertile country, of vast agricultural capacity, and of sufficient dimensions for forming two or three large and magnificent States. The eastern portion is densely covered with timber, of the same varieties and qualities as those enumerated between Napoleon and Fort Smith. The western portion has by no means so great a variety, being mostly grassy plains, with intersections of timber along the streams, arroyos, and ravines. The celebrated "Cross Timbers" is situated along and crosses our line of survey, extending some distance north, and, according to Captain Marcy, about two hundred miles south of it.

The streams are Sans Bois creek, Gaines' creek, Topofki creek, Deer creek, False Washita, Walnut creek, Dry creek, Valley creek, &c., with their various tributaries, as also others of the Canadian and Washita rivers. Near old Fort Arbuckle, and in the vicinity of the "Cross Timbers," the scenery is most beautiful and picturesque. Belts of timber crossing the more elevated plateaux in various directions many times, at right-angles with each other, give them the appearance of vast cultivated fields, formed on a scale of great magnificence, stretching away in every direction as far as the eye can reach. The same beautiful views were noticed in the vicinity of Delaware Mount, near the centre of the Indian territory.

The first appearance of the celebrated "grama-grass" was here noticed, opposite Little river, a small branch from the north side of the Canadian, in about longitude 96° west. This important grass is found, in greater or less abundance, from this point across the continent, or as far as to the mountains of the Sierra Nevada, which, where we crossed it with our line of survey, was not far from the Pacific shore. The great importance of these western prairie grasses, of which we have several species besides this and the buffalo grass, consists in their retaining their nutritive qualities the whole year round, sustaining the life and condition of the beast of the traveller, thereby enabling them to pursue their journey at leisure at all seasons of the year. Were it otherwise, much hazard would be encountered, as it is impossible to transport forage in sufficient quantities to supply a long train over a country of such vast extension. When the tops of these grasses become dry, the stems near their roots retain their vitality and nutritive juices until the plains are again renovated with a new crop. Many of our farmers express a wish to introduce the culture of these grasses at home; but it is to be presumed, from the peculiarities of their situation, that they are only well adapted to the arid climates, where they are found in their native state.

The trees in the western portion of this region consist of several species of oak, black walnut, cotton-wood, buck-eye, elm, mulberry, and a few cedars. Helianthi, Convolvulaceæ, Euphorbiaceæ, Vernoniæ, Eupatoriæ, with shrubby and herbaceous Mimosæ, are common in this region. The Wild China, (Sapindus Marginatus,) common all over Texas, was found here. Mirabilis, (Marvel of Peru,) Evening primrose, Ambrosia, Silphium, (rosin plant,) Golden rods, &c., are abundant on the plains. American and Chickasaw plums are quite common on the banks of the Canadian and other streams, but on the plains is found a small shrub, bearing in abundance what is called prairie plums, which is probably undescribed.

A considerable number of cactaceæ, which always indicate a dry climate, begin here to make their appearance, especially when we come into what appropriately may be termed the grama-grass region. Among them I recognised Opuntia Macrorhiza, (?) having tuberous roots, which appears to be quite extensively diffused in this region. One very similar, if not the same, was detected as far east as Fort Smith. A plant nearly allied to O. Engelmanni was collected at Delaware Mount. The little *Cereus cæspitosus*, so common in lower Texas, was also found here in great abundance. We were sorry not to find a flower or fruit of this pretty little plant, which would have enabled us to solve some obscure points in the natural history of the unique and interesting tribe of plants to which it belongs. The cactaceæ have not heretofore been well studied in the United States, Dr. Engelmann, of St. Louis, being almost the only botanist who has paid any special attention to them.

The whole of this region from Fort Smith to Valley river is eminently calculated to sustain a large population. Although the soil itself, probably, is not as rich as that of Arkansas, yet the ease of raising stock, for which few other countries are better adapted, and the exemption from sickness, will greatly counterbalance this difference. Water, in most places, will be found abundant for all agricultural purposes. In some places, however, especially on the head-waters of the Washita and Red rivers, it is quite brackish, being impregnated with the salts of lime and magnesia, but not sufficiently so to prevent it from being used for domestic purposes. Should a purer kind be required for railroad uses, I presume it can be obtained from the Canadian, which appears to be much more free from mineral impregnation.

Section III. *Llano Estacado.*—It would seem proper to include in this region the space on our route between Valley river and Fossil creek, near Tucumcari hills. This is a dry, and generally timberless tract of country, extending over a distance of about one hundred and ninety miles. Over this region, and the western portions of the last, immense herds of buffaloes range at certain seasons of the year, but they evidently make no prolonged stay here; passing from the waters of the Arkansas and Canadian rivers, south, to those of Red river and its tributaries, and thence back again. If not in these days, they formerly ranged south as far as the waters of the Brazos, Colorado, and other Texan rivers, where there are vast hunting grounds for the great Comanche and Kioway tribes of Indians. The noble wild animal upon which these red men of the plains mainly subsist is already becoming greatly diminished in numbers, by the restraints of the settlements, and by the military occupancy of their grounds. Certainly the *manifest destiny* of the Indian is to disappear from the face of the earth, and become extinct, unless he conform to the usages and habits of civilized life, which at present seems quite improbable.

Along the banks of arroyos, or dry creeks, may be found a few alamos; and under the northern and eastern bluffs of the Llano Estacado, and detached surrounding hills, may be found Piñon pine, (Pinus edulis,) and two kinds of cedars. They are, probably, too much stunted and shattered by the prevailing winds to form very useful timbers. It is to be remarked, that the wind blows with tremendous force over these immense denuded plains, and this, we have reason to believe, is one great cause of the destitution of timber in this region. In confirmation of this opinion is the fact, that wherever the least shelter by a bluff or rock is afforded, the modest cedar will rear its head, thankful, as it were, for this partial protection. The stature of the tree appears to be limited to the height and amount of shelter it thus receives. The timber that may be needed for railroad purposes here, will have to be supplied from other districts each way, probably from the Indian territory on the east, and the mountains of the Pecos and Rio Grande on the west, where timber of excellent quality abounds, and from whence it can be easily procured.

Although grass is abundant, yet the scarcity of water will greatly lessen its value as an agricultural district. Very little of this indispensable element is to be found, except along the course of the larger rivers. However, during the more moist seasons of the year, sheep can be grazed, without doubt, over large tracts of this district; as in New Mexico they are driven, herded, and grazed, hundreds of miles from their usual places of abode. Sheep can be grazed a much greater distance from water than cattle or horses. So that when the country between the Eastern States and New Mexico comes to be settled, the difficulties from the depredation of Indians obviated, and security established, this country may prove highly valuable for grazing purposes.

This is more emphatically the region of cacti than the one just left on the east. The singular and rather pretty, but formidable *Opuntia arborescens*, described by Dr. Engelmann, is first found here. It extends west as far as Zuñi, and in southern Texas as low as Presidio del Norte. In this region were found several new and undescribed species, which will be described in another and more appropriate form. The piñon, or *nut pine of New Mexico*, here first makes its appearance, and is presumed to be its eastern limit, extending west as far as the Sierra

Nevada mountains of California. The real grass-leaved dasylirion was first seen here, on the bluffs of the Llano Estacado. It is identical with the one found on the San Pedro, or Devil's river, in Texas. There is another species, with the leaves and habit somewhat of a Yucca, named *D. graminifolia*, I suppose because it does *not* resemble a grass. A rosaceous shrub (*Cerco carpus*) and a shrubby oak (*Q. Emoryi?*) are also common under the bluffs. We have not now the means at hand to determine whether they are the same as occur in lower Texas and New Mexico. Eriogoneæ, another characteristic tribe of plants peculiar to dry climates, begin here to make their appearance in considerable numbers. Mentzelias and asteroid composites are also quite abundant. An Ephedra, much used as a diuretic, especially for horses, was first seen here. The genus is also common in lower Texas, where I know two or three distinct species of it.

Section IV. *Tucumcari and Pecos Valleys.*—Although the waters of these two valleys flow into the Gulf of Mexico, by widely-separated channels, yet they may well be considered in one district—being included in the space of about one hundred and seventy miles, from Fossil creek to the dividing highlands between the Rio Pecos and Rio Grande del Norte.

At Tucumcari we have a broad, beautiful, and fertile valley, abounding in most luxuriant grasses, and extending north to the Canadian, but its exact limits we had not time to explore. Although the timber is somewhat scarce, yet, ascending the hills on either side, cedars and piñon become much more abundant, and both attain a higher stature than on the Llano Estacado. Along the banks of the streams there are a few cotton-woods and box-elders of very pretty size. The Gallinos, whose outlet is south into the Pecos by narrow defiles near our line, is a beautiful, bold, clear, running stream, affording water at all seasons of the year, while the Tucumcari and Pajarito creeks, in the immediate vicinity of the Tucumcari hills, flowing north into the Canadian, will afford water doubtless nearly all the year. At any rate, when we passed, (21st September,) there was plenty, flowing in a rapid, turbid stream. The water of Laguna Colorado, which is near, or forms, the sources of these streams, is somewhat brackish.

We collected here, for the first time, specimens of another shrubby cactus, (Opuntia frutescens,) which is so abundant all over southern New Mexico and Texas, as far south as Eagle Pass and San Antonio. It is a very ornamental species, especially when loaded with its scarlet berries. On the hills in this region were found, and collected, several new mamillaria; beautiful flowering and fruiting specimens of which are now growing in the Congressional gardens, in Washington. *Opuntia Engelmanni*, which is probably the most widely spread of the whole tribe of American cactaceæ, was first detected in the rocky cañons of the Gallinos. *Fallugui paradoxa* and *Fendlera rupicola*, two beautiful shrubs, are common here; both of them common to Texas also. There are, likewise, several other Texan plants in this region, among them a *Parthenum*, *Thymophylla greggi*, and a great variety of leguminous and asteroid plants. Several species of eriogoniæ also make their first appearance here. As their geographical limits extend westwardly some distance, most of the eriogoniæ which were collected here will most probably prove to be those which are figured, and well characterized, by my excellent friend *Dr. Torrey*, in Captain Sitgreaves' report of the Zuñi expedition. As we proceed a little further west, we come to the Pecos valley, where, in addition to the piñon and cedars met with before, and already mentioned, we find pine trees of a majestic size, (Pinus brachyptera, *Engl.*,) that are as valuable for timber as almost any in the world.

The Pecos river is here clear and rapid, its waters pure and sweet, forming quite a contrast to those at the several crossings from San Antonio to El Paso, where they are always turbid, brackish, and disagreeable. Indeed, by some travellers on its lower borders, and on some maps, this river, from these circumstances, has acquired the name of Puerco, the Spanish appellation for muddy waters. There, its valley, for hundreds of miles, is a blank and dreary waste, with scarcely a shrub to relieve the eye of the traveller; here, its fertile banks are dotted with innumerable small plantations, and towns, so characteristic of New Mexico.

This river, with the Gallinos, will form a never-failing supply of water for the erection of all

kinds of mills and machinery, when the time for such wants has arrived. These considerations, in connexion with the fact of its forming a middle and connecting link between the Atlantic and Pacific shores, give it a high degree of interest at the present time. The region is large enough for a State of the first magnitude, and contains all the natural elements of self-sustenance, excepting, probably, commerce. The difficulties which alone now prevent this district, and that of the valley of the Rio Grande, from rising to its proper scale of importance, will in a great measure be obviated as soon as any Pacific railroad is established and finished. Should any other route than this be adopted, the road, either north or south, can be easily tapped, so as to diffuse its beneficial influences to this whole country. The quality of the soil, though not equal to that of the Indian territory west of Arkansas, is superior to that of the Rio Grande valley, either in New Mexico or Texas. It is probably as well adapted to sheep grazing as any other country in the world. There can be no doubt, when properly settled, and easy communications can be safely had with the great Eastern States and with California, that it will prove equal, also, to any other country, as a resort for consumptive invalids.

SECTION V. *Rio Grande Valley.*—What there is to be remarked of this valley will be brief, because it is an old and well known region, having been settled by the Spaniards about three hundred years ago. Gregg's Commerce of the Prairies gives a vivid, and generally truthful, view of this country, and its capabilities for agricultural productions. There is not time now, nor indeed is it in place, to enter into a comparative view of the adaptation of this country to consumptive invalids, with those of foreign countries, or with other places in the United States; but little is hazarded in asserting, that in no long time this, and the upper Pecos valley, will become one of the most important and eligible places in the whole world for such purposes. As soon as communications with the Eastern States and California become speedy, cheap, and regular, as well as free from the danger with which they are at present attended, and when the ordinary means and comforts of living are easily and cheaply procured, so as to come within the reach of the yeomanry of the land, a trip and sojourn to this country will form as pleasant an excursion as to any part of our country can, and many an invalid will then avail himself of the recuperative influences of this climate. The summer heat is greatly modified by the peculiar aridness of the atmosphere, which, by rapidly carrying off the perspiration before it has time to accumulate to any sensible degree, cools the surface of the body, and makes the summer truly delightful, especially to an invalid. The winter is mild, being screened from the penetrating winds of the north by intervening mountains. The terrible *norther*, so well known and dreaded by the inhabitants and travellers in lower Texas, is not known here. Many invalids who at present resort to San Antonio for their health, experience various bad effects from the sudden changes of the weather, resulting mainly from those "northers."

The width of the Rio Grande valley, at the point where we crossed it (which was at Albuquerque) from the dividing ridge between it and the Pecos, and the highlands or mountains between its waters and those flowing westward into the Gulf of California, is about one hundred and seventy miles. Its length in the Territory of New Mexico is embraced between about the thirty-second and thirty-eighth degrees of north latitude; which, with its tortuous course, would give it a length of about four hundred and thirty miles. This of course embraces a great variety of climate, independently of the effect produced by the highly elevated ranges of mountains which partly environ it on the east and west.

The soil is well adapted to the cultivation of all the finer fruits and vegetables, as well as the cereals; but it requires irrigation. Grapes, apricots, pears, and melons, are produced in the utmost perfection and abundance. The grapes, especially, are far superior to any that can be cultivated at home, in the open air. Beets, sweet potatoes, and pumpkins do equally well, if not better than in the Eastern States. But the Irish potato does not succeed, excepting in the mountainous regions. On account of the cost of irrigation, wheat and corn cannot be raised as cheaply as in the Western Atlantic States; nevertheless, by irrigation they do very well, and large quantities of both are produced.

SECTION VI. *Valley of Zuñi.*—In this region, we would embrace the scope of country between the summit of the Sierra Madre, or mountains bordering the Rio Grande valley on the west, and Mount San Francisco; the principal and pervading stream of which is the Colorado Chiquito, a tributary of the Colorado Grande, or, as it is more aptly termed, the great Colorado of the West. The general course of this valley is northwest and southeast; the extent of which (in our rapid exploration) we were unable to determine. Its width, travelled, is about two hundred and fifty miles.

At Zuñi, the Indians of the Pueblo tribes raise corn, and many other vegetables, without resorting to irrigation; but from the appearance of the soil on the bottoms of the Colorado Chiquito, it was considered by most of our party that irrigation might be necessary. In the immediate vicinity of the mountains there is evidence of an amount of moisture in the soil, which is wanting in the centre of the valley, more remote from their influence. The water of the Colorado Chiquito is sufficient to irrigate a portion of the central part of the valley, but probably not enough to make all the tillable lands available for agricultural purposes. There are many beautiful streams of water of limited extent, on both ranges of the mountains, which look into this valley from the east and the west. These streams would be sufficient for small settlements in their immediate neighborhood; but on descending into an almost unlimited arid plain, they are lost by the absorptive power of the soil, and the rapid evaporation caused by the dry atmosphere. The Rio Mimbres, in the valley of which is situated Fort Webster, southeast of the Mogoyon, (which has been made well known by the operations of the Mexican Boundary Commission) is a good example of these facts. Such is the case, also, with nearly all the mountain streams in these arid regions.

Grass throughout this whole country is very abundant, and of a most excellent quality, especially around the mountain bases, and on the more elevated plateaus. Large herds of cattle and sheep might be reared and sustained here, were it not for the depredations of the Indians. We were told by Mr. Leroux, that the wild Indians of this country, in their blind eargerness to obtain the flesh of mules, have been known to shoot one down with their arrows while a traveller was yet seated on his back, for which, in a case that he mentioned, the poor savage paid the penalty of his life.

Unfortunately, we passed this region between the 18th of November (when we crossed the crest of the Sierra Madre) and the 25th of December. At the latter date, we encamped at the base of the San Francisco mountain. This was the most unpropitious season of the whole year for the collection of herbaceous plants, and must account for the meagreness of my collections in this part of our journey.

The entire eastern, southern, and part of the western, angles of this region, are well timbered with Douglas's spruce, New Mexican yellow pine, piñon, and balsam fir. The Rocky mountain white pine (Pinus flexilis) grows on the San Francisco mountain, and no doubt on the higher peaks and ranges of the Sierra Madre and Mogoyon. Oaks and black walnut also grow here. The banks of all the streams that are crossed produced cotton-wood and mezquite—in some places in great abundance. Three kinds of cedar abound at the base of the mountains, frequently extending (in more limited quantities) down to the banks of the Colorado Chiquito, wherever the evenness of the surface appears to be broken by dry arroyos or broken banks.

On the slopes east and south of San Francisco mountain, looking into this valley, and also westwardly, are vast forests of piñon, intermingled with cedars, perfectly black in the distance, by their density. From elevated points near the southern base of Bill Williams' mountain we had extensive and beautiful views of these forests, which extended southwestwardly, apparently some fifteen or twenty miles. This one we denominated the "Black Forest." With the aid of the telescope, we could detect (*January 3d, side reconnoissance*) the camp-fires of the Tonto Indians, in several places, in the forest. We were informed by our guide, Mr. Antonio Leroux, who has had much experience, and even desperate forays, with the Indians of this neighborhood, that, at the proper season of the year, large parties of the Yampai, Tonto, Coyotero,

Garretero, and other sub-tribes of the great Apacherian race, resort here for the purpose of collecting the fruit of this pine. It probably forms one of the most important articles of their subsistence. In an economical view of this country, it should not be forgotten or overlooked.

Immediately on our entrance into this valley, (November 19th,) we found and collected a new species of Opuntia, with prostrate, nearly terete joints, entirely devoid of woody fibre; and at Zuñi, soon after, another, with a woody stem, low and prostrate, clearly distinct from O. arborescens, to which it somewhat approaches in its reticulated woody axis. Its fruit, seeds, spines, and general habit, however, separate it from that well-known and widely disseminated species. Very pretty specimens in fruit were obtained, but none in flower, which is much to be regretted. As this tribe of interesting plants was almost the only one we could find and study, at this late season of the year, our party rivalled each other in daily bringing some of them into camp that had not been before seen or collected. Sometimes one would come in ahead of the others, but more frequently several would arrive at the same time with new specimens, and then a great shout would ensue, in deciding upon the claims of priority. Lieutenant Whipple discovered the first specimen of our new *Cactodendron*, as we were pleased to call it, to distinguish it from the O. arborescens. We saw this same species afterwards growing six to eight feet high, retaining all its peculiar characteristics, with the exception of not being prostrate. While on the banks of the Colorado Chiquito, and only in that vicinity, we found a new Echinocactus, the first of this genus met with on our route, but it was neither in flower nor fruit. It is quite limited in its range, having been found only along the bottom lands of the Rio Colorado Chiquito. In the rocky ravines, soon after leaving the river bottoms, we discovered a densely aggregated Cereus, growing in large oval masses, which contained hundreds of low, ovate, fleshy stems, from one root. Our highly esteemed friend, Dr. Engelmann, has made several species of such forms of cerei, which are difficult to identify in the absence of flowers or fruit, on account of the great variety in the number, size, and color of spines in the same species. The spines in the plant just mentioned are angular, like those of Dr. Engelmann's Cer. enneacanthus; but they also very much resemble those of his Cer. polyacanthus. The cactaceæ can only be well characterized by their inflorescence, fruit, and general habit. Opuntia fragilis is very common in this valley, offering many varieties of shape, size, and color of the spines. Nearly all cactaceæ assume a red, shrivelled, drooping appearance at this season of the year, very different from what they exhibit when in vigorous growth. Cereus Fendleri, which is very common about the Pecos and Rio Grande, has nearly its western limit here, soon to be replaced by *Cer. Chloranthus*, an unpublished species of Dr. Engelmann. Among the shrubs peculiar to this part of the country is the beautiful and very aromatic Cowania Stansburiana. In Capt. Sitgreaves' reports, Dr. Woodhouse mentions having seen an *aromatic* Fallugia paradoxa in this region, which must be a mistake. It was this plant; for, although the fallugia and cowania somewhat resemble each other, the former is never aromatic and balsamic, like the latter. The cowania grows on much more elevated positions than the fallugia, and is considered by the Mexicans as a most valuable medicine; often selling at the rate of half a dollar an ounce, under the name of *alouseme*. It is highly esteemed as a styptic, and astringent in hæmorrhagic discharges. A beautiful blue-berried barberry (Berberis pinnata) is very common here, called by the Mexicans *leña amorilla*. This shrub is very different from the one at the Copper Mines, (*Santa Rita del Cobre*,) collected when I was on the Mexican boundary commission. The berries are very pleasant to the taste, being saccharine with a slight acidity. Fallugia, cercocarpus, and another thornless rosaceous shrub, probably a crætagus, is common along the arroyos and rough low places. The Obione canescens, and other species of the same genus, though not peculiar to this region, are met with here in great abundance. The former is called by Mexicans *chamizo*, and by our people *grease-wood*. It belongs to the tribe of chenopods, and we noticed that our sheep were very fond of browsing upon it, choosing it in preference to grass. It is an unsightly weed, with a sub-shrubby stem, but withal very useful when we could get no better material for fuel.

SECTION VII. *San Francisco Valley.*[1]—It is doubtful whether the name used to characterize this region is strictly proper. A part of the waters which flow southwardly into the San Francisco river, (Rio Verde,) a tributary of the Gila, and another part flowing in a westwardly direction into the Rio Colorado, are embraced in what we call the San Francisco valley. Between Leroux's springs, situated at the southwestern base of the San Francisco mountain and Cactus Pass, the western limit of this division is a space of about one hundred and sixty miles, so interesting that a volume could easily be made of the materials which are collected in it, without exhausting the subject. In general terms, we could say it was well timbered, although there were large plains situated between the hills and mountains, nearly destitute of trees.

Mounts San Francisco, Bill Williams, and Sitgreaves constitute the highest peaks of this region. They stand upon an elevated, somewhat broken plain, which is about 8,000 feet above the level of the sea. They are environed on the east and west by a large number of beatifully rounded volcanic hills, which, with the intervening forests and glades, give it the most inviting and romantic appearance we had probably seen on our route. Between this elevated plateau, extending some seventy-five miles west of Mount San Francisco, and a low range which we named the Aztec mountains, there is a wide valley, (about eighteen miles by the diagonal path in which we crossed it,) averaging some ten or fifteen miles in width. It is so densely covered with the best grama grass, that we named it "Val de China." This valley we were unable to explore except to a limited degree, for it extends northwest probably to the Colorado, and southeast to the Gila.

Partridge and Pueblo creeks, uniting in this valley from different directions, form what we suppose must be an affluent of the Rio San Francisco, constituting one of its heads and draining the valley to the south. We explored it north about forty miles, where it retained its characteristic appearance, with the exception that there seemed to be less indications of water-courses in that direction. So our attention was turned further south as the only hope of getting an easy way to the Colorado. The hills bordering this valley, especially on the west, are densely covered with cedars, pines, spruces, oaks, &c., which are sufficiently abundant to serve all the purposes of agriculture, domestic economy, and railroads. Much of the timber is of the most valuable kind, consisting of the yellow pine of this country, (Pinus brachyptera,) and the Oregon pine or Douglas spruce, (P. Douglasii,) the value of which will be more fully treated of hereafter. Besides Partridge creek, which enters this valley from the east, there is a beautiful little stream from the mountains west, entering from the opposite direction, a little further south. We named it Pueblo creek. The remains of broken pottery and the ruins of stone buildings and ancient fortifications that occur here give evidence that the country has once been inhabited by an intelligent, enterprising and warlike race of men. These remains exhibit marks of extreme antiquity.

One of the highest peaks in this range, which we named Mount Hope, is situated fifteen or twenty miles south of our explorations. It appears to be the source of the moisture of this region, and no doubt waters many such little valleys as that of the Pueblo, although we had not time to explore in that direction as far as desired.

The importance of this point is still further enhanced by the fact that from this place railroad timber, when needed, will have to be supplied westward as far as the Colorado Grande, which is distant, in a direct line, about one hundred miles; but by the route we travelled, through the valley of the Santa Maria or Bill Williams' fork, it is about one hundred and seventy miles.

My opportunities for making botanical collections in this region were about as unfavorable as on the preceding part of our journey. We passed through it from the 8th to the 31st of January. In the valley west of Aztec Pass, and between it and Cactus Pass, (25th January,) was found the first spring plant in bloom. It is one of the umbilliferous tribe, with a spindle-

[1] The name of the mountain at the head of this valley is San Francisco. The stream is usually called Rio Verde.

shaped, parsnip-like root, but much softer, sweeter, and more tender than that wholesome esculent. It is much sought after by the Mexicans, who name it *gamote*, a name that is also applied by them to the sweet potato. Mr. Leroux informed us that Indian females in this region, especially the Utahs and Pai-utes, spend much time in the early months of the year, when the root is soft and tender, in collecting it in large quantities. It is prepared by slicing, drying, and grinding on matats, and, after which, stored away for future use. They make a soup of the meal. The root becomes hard and cortical as it advances in age, and unfit to be eaten.

Besides the *grama grass*, which has been mentioned while describing the Val de China as so fine and abundant, we had a grass, peculiar to this region, called by our woodsmen "bunch grass." It was quite green, and our animals were immoderately fond of it. We were unable to secure specimens of it in flower or fruit, and therefore could not determine its name. Mr. Leroux says it is well known and prized in the great Salt Lake valley, fattening animals faster than the *grama*, but it does not afford them the same amount of strength and muscle.

A narrow filamentose-leaved Yucca was found near Picacho, and specimens of the young plants were brought home. It was not in fruit. It is quite different from the two species found east of the Rio Grande; but whether different from the one of a similar habit in Texas, can only be determined by an examination and comparison of the flower and fruit. In the waters of Partridge creek we found *Polygonum amphibium*, which, although it grows on land as well as in water, is nevertheless a sure index of the permanency of the water in its neighborhood.

In this valley we saw and collected, growing upon the piñon, a mistletoe, (*Arceuthobium*,) never before seen, and quite distinct from the one found on the other pine, (*P. brachyptera.*)

At the foot of Bill Williams' mountain, we first met the celebrated INDIAN MAGUEY, (Agave sp. undetermined.) This to the wild Indian tribes is probably one of the most important plants of the whole interior of the continent south of the 35th parallel of north latitude. It is a matter of curious interest to know how much further north it grows. We presume, however, that it will be found very little further north than our line. It flourishes on the roughest, most rocky, and apparently most inhospitable spots that can be found; and, generally, it occurs only in such places. An allied species (*Agave Americana*) is common in Mexico, and in our gardens under the title of century plant, so named from the popular notion that it blooms every hundred years. Our plant is a long time (not nearly a hundred years, however) in coming to maturity. It then blooms, bears fruit and dies, leaving many offsets which come to maturity yearly. These likewise perform their great function of fructification, and die, to give place in turn to their successors. The great value of the plant to the Indian is, that it forms a never-failing source of subsistence at all seasons of the year. At the proper season, which is about the 1st July, the stalk that bears the flower shoots up and grows with amazing rapidity. It is then very juicy, tender, and sweet, much resembling the pith of the sugar-cane; and the Indians now devote their time to preparing their *mezcal*, which will keep preserved for several months. When the time for preparing food from the flower-stock is passed, they resort to the heart or central part of the older plants that have not yet come to maturity; the most tender portions being at the base of the inner leaves. The heart can be found in different stages of development at all seasons of the year. They roast it in temporary ovens, made of earth and stones, about two days being required to cook it sufficiently. We used the juice of the plant successfully as an anti-scorbutic while on the Mexican boundary commission, my attention being first called to it by a circular from General Lawson, Surgeon General of the United States army, recommending it on the authority of Dr. Perrin, of the United States army.

Besides the trees already mentioned, we have here two or three species of cedars; one with a large, sweet, edible berry. In times of great scarcity of food, I believe this fruit is resorted to by nearly every animal in this region. Pinus edulis (piñon) grows in great abundance nearly the whole length of this district. The highlands which form spurs to the San Francisco, Bill Williams', and Sitgreaves mountains are covered with these trees; their deep green foliage

giving the forests a peculiarly dark and sombre aspect, forming a strong contrast with the surrounding grassy plains. Two very distinct species of oak occur here, one of which I have marked on the profile as *Quercus Gambellii*, of Nuttall; the other is probably new. In the deep ravines or cañons of this district we found an ash, (Fraxinus velutinus,) common also to the copper mine region, and associated with it also a cherry, which may be a new species. Willow-leaved poplar is occasionally found along the arroyos, where water has lately been standing. Among the shrubs abounding in this region are found the blue-berried barberry, a species of currant, (Ribes,) and a species of very thorny Solanaceæ, of unknown genus. A new shrub, interesting on account of its botanical affinities, was found here, belonging to the small order of Garryaceæ, natives only of western North America and the West Indies. A second species of the genus Garrya is very common about the copper mines of New Mexico, which was also detected here, but not in fruit. Which of the two, if either, is the plant of Douglas, upon which the genus was founded, we are unable at present to determine. We find great difficulty in procuring publications of American plants, in the arrangement of orders subsequent to compositæ, up to which point we have been supplied, by the indefatigable zeal and learning of those excellent co-laborers in the field of botany, Drs. Torrey and Gray, in their Flora of North America. Since the acquisition of Texas, New Mexico, and California, with their consequent explorations and discoveries, the new genera and species, in orders previously passed over, are so many and important, that a new edition is now imperatively called for, before their great work is finished.

A walnut was found in this region, collected heretofore in the region of the copper mines of New Mexico, very nearly related to the black walnut of the Eastern States. From Devil's river, in Texas, while on the boundary commission, were sent specimens and a figure of what was thought to be a new species, to Dr. Torrey, a description of which was read by him before the meeting of the American Association of the Sciences, in August, 1851, under the title of *Juglans Whippleana;* which was not published. Dr. Engelmann had previously obtained, and named it *J. ruprestris.* Dr. Torrey has published figures of both of them, in Captain Sitgreaves' report; our present plant, provisionally, a variety of that species. The differences between them, however, are greater, in my opinion, than those between the present variety and Juglans nigra; so that they may all ultimately come to be forms of one species, when still other and more closely connecting varieties are found.

A Ptelea, closely allied if not identical with the shrubby treefoil of the States, is found here. A Condalia also, which is a Rhamnaceous shrub, bearing small dark-colored berries, several species of which are eaten by Mexicans and Indians. A beautiful shrubby spiraea, or a species of some nearly allied genus, was found here.

Along the banks of Turkey creek, Pueblo creek, and the streams which we first passed after crossing Aztec Pass, we observed large quantities of willows, which is rather an unusual occurrence in this country. On the hills surrounding the Aztec mountains, for the first time, we met with the beautiful shrubby arbutus, (~~*Arctostaphylos*~~,) called by the Mexicans *manzanita;* the bark of the plant is handsomely polished, of a dark mahogany color. From this place to the Pacific, and in California, there are several species of this genus, most of them bearing an edible berry, similar to the whortleberry. In California, a most valuable timber-tree of this genus grows all along the Coast range of mountains. It bears a larger edible berry, which is much sought after by Mexicans and Indians, who know it by the name of *Madrona.* It is a beautiful tree. The wood is very hard, taking a polish equal to, and much resembling *lignum-vitæ.*

Near Bill Williams' mountain we found in considerable quantities the aggregated Cereus, noticed before; but the species cannot well be determined, on account of the want of blossom and fruit. It is very nearly allied to Dr. Engelmann's *Cereus polyacanthus*, which yields an edible fruit, called by Mexicans *pitahaya.* It is sometimes in large oval masses, densely set with formidable spines. The arborescent Opuntia, first found near Zuñi, which, to distinguish

from the true O. arborescens, we called Cacto-dendron, finds its western limits near the termination of this region. We also find here a mamillaria, very common, and the only one we saw between this point and the Rio Grande.

At the southern base of Bill Williams' mountain we found an Opuntia never before seen on our route, and from its peculiar appearance, it will doubtless prove to be a new species. It is an upright flat-jointed species, thickly beset with yellow spines, of a much lighter green color than most other species, or, indeed, any other that I have seen. Lieutenant Tidball, of our escort, kindly sketched it for me, and provisionally named it after him, to distinguish from other allied species. *Opuntia fragilis*, and *Cer. Fendleri*, also occur here. There is an Opuntia in this region, very near, if not identical with the one on the Rio Grande, with long brown spines. It is published in Plantae Fendlerianæ, by Dr. Engelmann, as *Op. phœacantha*. As we proceed westward into the neighborhood of Picacho and Val de China, the *O. Tidballii* becomes much more frequent, and we observed that it was never found on the northern and western exposures of the hills and rocky arroyos, but mostly on the southern, (as where we first found it,) and more seldom on the eastern exposures. In Cañon creek, the head-waters of Bill Williams' fork near the western extremity of this region, it grows seven or eight feet high, spreading so as to form an immense head, with upwards of one hundred joints, all branching from a single stalk. At Aztec Pass an Opuntia was found, which in the size of the joints, and appearance of the spines, was very similar to *Opuntia Engelmanni*, but, unlike this well known species, it is spreading and prostrate. Unfortunately, we could obtain no fruit of it.

Section VIII. *Santa Maria Valley.*—The space embraced within this section lies between Cactus Pass and the Colorado Grande, following the course of Bill Williams' fork, from near its sources, to the great river of the west. Cactus Pass is the last of the highlands that we cross before reaching the Rio Colorado. The distance from this point, in a direct line, to the Colorado, is only about sixty miles; but by the road we travelled, through the valley of Bill Williams' fork, it is about one hundred and thirty miles.

The timber of this valley is composed almost exclusively of cotton-wood, or *alamo*, mezquite, "green-barked acacia," of Major Emory's report, curly mezquite, (*Strombocarpa pubescens*,) two other leguminous trees, and some willows. One of the leguminous trees is the *Olneya Tesota* of Dr. Gray, in *Plant. Nov. Thurberianae*, pages 313 and 328.—1854. It was collected by Mr. Thurber on the Gila. It has very much the habit of a Robinia. The foliage of the tree is very dense and heavy, and although dark green, the leaves were sometimes crisped as though they had been bitten by frost; yet there were no evidences of frost on other tender vegetables in its vicinity. Our Mexicans were not acquainted with it, nor with the name *Tesota*. The alamos grow to a good large size, and are quite abundant. The two mezquites are rather small in this valley, seldom attaining more than fifteen or twenty feet in height. The *Tesota*, "green-barked acacia," and the other leguminous tree, grow fully as large as the mezquites, and in an economical respect, it is presumed, will prove equally useful for domestic purposes. Although willows in many places grow quite large and abundantly, yet, for anything but browsing animals in times of great scarcity of grass, and for fire-wood, they appear to be nearly useless.

Grass in the upper portions of this valley is quite good, and sufficient to support considerable numbers of mules and stock in passing through. But in the lower portions, as we approach the Rio Colorado, grass of all kinds becomes quite scarce; mules then resort to the twigs of the willow, and the twigs and bark of the alamo, upon which they have been known to subsist the whole winter.

The water of Bill Williams' fork, in many places, flows in a bold current; but, like the Mimbres, and other streams in this country, it sinks again in the sand, sometimes within a very short distance of its head. It rises and sinks this way, alternately, until it reaches the Rio Colorado. This valley, which is generally narrow, cannot be worth much for agricultural purposes; yet there are several places where it widens, so as to form very pretty sites for settle-

ments. We passed through this valley from the 1st to the 20th February, when the weather was warm and genial, as in the month of May in the Atlantic States.

The seasons appear to be two or three weeks earlier here than at the Mojave village in the Colorado valley. We were unable to determine from observation whether the soil here can be cultivated without irrigation, because we had not time to make any experiments on this subject in our rapid reconnoissance. From the fact that the Mojave Indians, but a short distance further west in the Colorado valley, cultivate corn, wheat, beans, pumpkins, melons, and probably other culinary vegetables, without irrigation, one can have little doubt but that the same may be done also in this valley. Should this prove to be true, there are several places, especially in the vicinity of White Cliff creek, which will be of great importance on this account. The valley here spreads out to quite a wide space, and is, moreover, convenient to good timber near Aztec Pass, besides the cotton-wood and mezquite in its own immediate valley.

This may emphatically be called the region of Cacti of our route. One of the first of them that we found after entering this valley was the *Echinocactus Wislizeni* of Dr. Engelmann, called by the Mexicans "visnada," the juice of which is said to serve as a substitute for water when it cannot otherwise be procured. Instances have been known among the white trappers of this wild region, where the lives of men have been saved by this plant. On the morning of February 3, we found one of them left by the Yampai Indians, who had been on the ground the previous night. The spines were burned, and two-thirds of the inside were scooped out so as to form a sort of kettle. Mr. Leroux informed us that they scoop a space of its centre, introduce other vegetables, and with the introduction of heated stones cook the whole together. These vegetable boilers are not transported from one camp to the other, but, on account of their abundance, new ones are formed at every camping ground where they are required. A Cereus was recognised to-day, very nearly akin, if not the same, as one that is very common around El Paso, (*Cer. chloranthus Engl. ined.*,) and heretofore only known in that region. We were unable to get its flower or fruit to compare with the El Paso plant, which was much to be regretted, as the spines of these plants vary so much as to form by themselves but poor distinctive characteristics of the species. There also was found a globose mamillaria, with from one to three or four central-hooked spines. It differs from the one collected on the Pecos, by its red clavate fruit. We noticed also a new arborescent opuntia, very nearly allied to *O. arborescens*, the last of which we saw at the ruins near the Pueblo de Zuñi. This plant differs from that in having spiney fruit and a larger seed, but in other respects it resembles it very much. The beautiful scarlet-berried *Op. frutescens* was found in this region. It was collected also at Laguna Colorado, sixty miles east of the Rio Pecos, showing it to have a wider geographical range than the *O. arborescens*, which is supposed by Dr. Engelmann to be the widest diffused of all North American cacti. In addition to those already mentioned, we gathered a beautiful Opuntia, common in this region and quite different from any we had heretofore seen. It is a flat-jointed, spineless variety, growing in a handsome rosette manner, and covered with a beautiful velvety bloom or pubescence. The minute barbed bristles of the pulvilli are very annoying when handled. It is even said to be destructive to the eye if permitted to touch that delicate organ.

By far the most interesting cactus of this region, and probably of the whole world, is the *Cereus giganteus*. We saw it for the first time, in this valley, on the 4th of February, growing about forty-five feet high; but along the valley of the Gila, it is said to reach sixty feet in height. It frequently occurs from twenty-five to thirty feet high without a single branch. Among the skeletons of wood, after the fleshy parts of the plant had decayed and fallen away, we observed in the old trees a perfect net-work of the bundles of woody fibres, reticulated on a large scale, exactly after the manner of the woody fibres of the *Opuntia arborescens*. Our observations do not accord fully with the account given by Drs. Engelmann and Parry,[1] who had

[1] Silliman's Amer. Jour. of Science and Arts, Vol. XIV, Nov., 1852.

probably taken their description from younger plants, before the interlacing or anastomosing process had been carried to any considerable extent. We have seen the skeletons of young plants which exactly corresponded with their description. The fruits of many Cerei are edible, with something of the flavor and shape of a large gooseberry. They are thickly covered with sharp spines; but as soon as the fruit ripens, these can be brushed off with ease. By peeling the rind, there is left a large, sweet, delicate pulp, that will rival any gooseberry. The top of this giant Cactus, however, yields a *pitahaya*, far sweeter and more delicious than those which grow on more humble stems. The Indians collect large quantities of it by tying a fork to the little end of a long willow pole, which enables them to reach and bring down the fruit without injuring it. They make a syrup, or conserve, from the juice, which serves them for luxury, as well as for sustenance, and which can be preserved a long time. The Mexicans call the tree "suwarrow;" the Indian, "harsee;" and the syrup manufactured from the juice, "sistor." The juice of the flesh of the tree is quite bitter.

We find (February 7) a new species of Opuntia, with a reticulated woody stem, very fragile at the joints before hardening into wood, and armed with spines worse than those of a porcupine. It is called by the Mexicans, "chug." The plant is the horror of man and beast. Our mules are as fearful of it as ourselves. The barbed spines stick so fast in the flesh that the joint of the plant is separated from the main stem before the spines can be withdrawn. We found this species sometimes ten and twelve feet high, branching very fantastically, in consequence of the fragility and decay of the younger stems and joints. In a landscape by Mr. Stanley, (plate 16 of Major Emory's report,) in the foreground is the figure of a cactus, of which, in the text, no account is given. It has a faint resemblance to our plant; but Lieutenant Whipple, who has travelled and explored much in that region, is pretty confident that it represents a different species, which he has also seen. The figure is too regular in its outlines and curves to represent the peculiarly angled and irregular appearance of our plant. It is, without doubt, an undescribed species. We find here what is supposed to be *Opuntia ramossissima* of Dr. Engelmann, collected on the desert between the Colorado and San Diego by Dr. Parry. In places favorable for its growth, it is found six feet high, as robust and tree-like as the *O. arborescens* itself.

The fact that on the 7th February we collected a Draba, a Thelopodium, and a Vesicaria in full bloom, is a proof of the forwardness of the season in this valley. February 11th we collected, along the banks of Bill Williams' fork, fine specimens of a Lepidium and a Hosackia.

Section IX. *Valley of the Colorado.*—From the mouth of Bill Williams' fork to the point above where we crossed the Rio Colorado, is about sixty miles; and from thence to Soda lake, on the Mojave creek, where, at ordinary seasons of the year, water is first found, is about one hundred miles further west. Along the valley of this river, alamo, mezquite, and willow form the principal, and almost entire, kinds of trees. The Mojave Indians make use of willow twigs in the formation of their granaries, where they store away the fruit of the *Tornillo*, (curly mezquite,) and various other vegetable products, for winter consumption, or for times of scarcity. Their depositories are built in a circular form, four or five feet high, and about the same, or a little less, in diameter. After being filled with their stores, they are covered with willow bushes or reeds, over which is laid another cover of earth. The climate is so dry, they find no difficulty in thus preserving their winter grain. We passed their villages the last days of February, and found them in the possession of plenty of corn, wheat, beans, pumpkins, &c., which they gladly traded for our old worn-out clothes. They brought us one watermelon that had been preserved from last year. We travelled about sixty miles through their territory without seeing any appearance of irrigation, from which we may safely infer that they cultivate their crops without having recourse to this process. There can be no doubt, however, but that it would add very materially to the amount of agricultural productions, if irrigation were employed.

Very little grass is to be seen in this valley. Our sheep ate readily of the *Obione canescens*, (grease-wood,) which grows abundantly throughout this whole region. Our mules were very

fond of an aromatic shrub, of quite a low stature, which grows in considerable quantities on the gravelly ridges of both sides of the Colorado. It had shed its seed, but, accidentally, a few poor specimens were found—enough to determine it to belong to ambrosiæ, a sub-division of compositæ. Of this tribe there are in the Eastern States several species, of which cattle and horses are very fond.

The value of the Colorado valley, in affording subsistence to a civilized population, was considered nearly equal to that of the Rio Grande valley, which, in some respects, it a good deal resembles. The soil is better adapted to the cultivation of cereals than that of the Rio Grande, where it can only be done by the assistance of irrigation, which, in this country, is a costly process.

On leaving the valley of the Colorado, we ascended very rapidly about four thousand feet above the level of the sea, where the change of climate is very strongly marked. At the Colorado it is very warm and summer-like, while at our camp (6th March) on the northern slopes of the hills and in deep ravines there was snow. Here we met with cedar (Juniperus occidentalis) and pine, (Pinus edulis,) which, however, only greet the eye but a short distance. It may be possible that the New Mexican yellow pine (*Pinus brachyptera*) will be found in still higher points of this range in this neighborhood, but, on account of our necessarily rapid movements, we had not time to determine. In addition to the trees already mentioned, we noticed here vast quantities of the tree Yucca, called by the Mexicans *Palma*. It was seen before on Bill Williams' fork, but it is found here from twenty-five to thirty-five feet in height, and eighteen inches or two feet in diameter, with a bark on the lower part of the trunk very much resembling that of white oak. Although not good for fuel, we were sometimes under the necessity of resorting to it for camping purposes. Besides these, we saw here a variety of shrubs, the principal of which are two species of Rhus, (one of which I had never before seen,) blue-berried Berberis, Cowania Stansburiana, Fallugia paradoxa, Shrubby artemisia, Obione, and a shrubby Amygdalus or Cerasus, which very much resembles one common on Devil's river, in lower Texas. A species of Chilopsis, a bignoniaceous shrub, or small tree, with beautiful large flowers, much resembling those of a Catalpa, is frequently found in the dry ravines here, as also all over the western wilds. An undetermined species of Lycium, a solanaceous shrub, with an edible berry, was also collected here.

Besides some new cactaceæ, which will be mentioned soon, we found here several species, supposed to be peculiar to the Rio Grande valley; among them are Opuntia clavata and O. fragilis. A flat-jointed Opuntia, with long brown spines, collected before as far back as the Llano Estacado, which was considered very near *Op. phœacantha* of the Rio Grande valley, was also found on this part of our route. Also an aggregate Cereus, which cannot be distinguished, in the absence of flower and fruit, from allied species on the Rio Grande. Besides the *Echinocactus Wislizeni*, which is quite common here, we found a new species of the same genus, aggregated in large globose or ovate heads.

The fruit is crowned with the dry flower, and is thickly covered with a whitish wool; the scales are lanceolate-subulate; and the seeds pyriform, black, and rugose. The aggregated form of this plant is peculiar, and an exception to the general habit of the genus. It had already passed flowering, (March 2d,) and matured its fruit.

After crossing the dividing ridge between the Rio Colorado and Mojave creek, we saw the celebrated, but totally useless, *Larrea Mexicana*, or creosote plant, giving the surrounding scenery a most beautiful and verdant appearance. This plant is one of the most repulsive that can well be imagined. It is the surest indication of a sterile, worthless soil that can be found in the vegetable kingdom; for wherever it flourishes, little else can be found.

Section X. *Mojave Valley.*—This region extends from Soda lake to Cajon Pass, a distance of about one hundred and thirty miles. With the exception of the last twenty-five miles, it is entirely along the Mojave creek. There are beautiful grassy plains in this valley, within reach of clear, sweet, running water, where, we were told, it was a great grazing resort for those

mules, horses, and cattle, preparatory to crossing the desert of a part of the Salt Lake valley; before the California gold excitement, animals were sent from the valley of Los Angeles, and its vicinity, to Santa Fé, with profitable returns. Large herds were annually brought out to this place and grazed for that purpose. Since the revolution, stock of all kinds is in great demand, at very high rates, in California; and New Mexico, in her turn, now sends out large flocks of sheep, to supply, in part, those demands. Sometimes they are sent by the way of Salt Lake valley, and from thence, up this valley, to California. After crossing the desert of Salt Lake valley, they are generally permitted to stop here, and at the Cajon to recruit, so as to render them saleable on arriving at the settlements of California. At other times they are sent by the way of the valley of the Gila, and thence across the desert to San Diego. Our route is much more direct than either of the others, and better, too, if we may judge from our own explorations and the accounts of travellers. The enterprising Captain Aubrey would have taken his sheep over this route the present season, but for the hostility of the Mojave and other tribes of Indians who infest this region.

The stream of the Mojave is not continuous, but sinks and rises every few miles, after the manner of Bill Williams' fork, and the Rio Mimbres, in New Mexico. In some places the stream is large and bold, running with a swift current, like the Mimbres. The soil in the widened valleys is rich, and appears to be capable of cultivation without irrigation. In such case it will make a valuable territory, well suited to settlements and military posts.

The timber of the valley is much like that of the Colorado, consisting of cotton-wood, (*Populus monilifera*,) mezquite, (*Algarobia glandulosa*,) curly mezquite, (*Strombocarpa pubescens*,) and willow, (*Salix*,) of several species. On arriving at the Cajon Pass, two kinds of cedars occur; pines, three or four kinds—Oregon pine, (*Pinus Douglassii*,) piñon, or nut pine, (*P. monophylla, Torr.;*) and on the neighboring mountains, the sugar pine, (*P. Lambertiana*,) and one other species, somewhat resembling, but different from, the New Mexican yellow pine. All of these occur in great abundance, and of the best quality. Immediately on passing the crest of the Cajon, the vegetation changes like magic. Many of the shrubs being such as we had never before seen, the mountains and hills were covered and green with their perennial foliage. Among the most beautiful we found several species of Ceonothus, (represented at home chiefly by the New Jersey tea,) ornamented with bright, cerulean blue flowers, in charming contrast with the leafless waste that we had just left. We collected at this place specimens of the new remarkable genus *Fremontia*, which is described and figured in *Plantæ Fremontianæ*, (*p.* 6, *pl.* 2: 1850,) by Dr. Torrey. The whole tree has very much the habit of Hibiscus syriacus, or common Althea shrub; but, according to Dr. Torrey, it belongs to the family of Bombaceæ, and is very closely allied to the celebrated hand-tree of Mexico, (*Cheirostemon of Humboldt.*) A species of Yucca, different from the five or six other Texan and New Mexican species that we had seen before, was collected at this place. A beautiful evergreen oak, with very large cups and acorns, was first found at this pass. Not having proper books of reference at hand, it is impossible at this time to determine the species. But the acorn is the one on which the *Digger Indians*, of California, are known to subsist for a great portion of the year. When standing in an open space, it forms one of the most beautiful and graceful trees of the forest.

The Cactus tribe in this valley is not so plentiful in species or numbers as in some of the regions just described; yet we found an Echinocactus here that had not been seen before. It may be the *E. viridescens, Nutt. Var? cylindraceus*, collected by Dr. Parry "near San Felipe, on the eastern slope of the California mountains;" but in the absence of the fruit, or flower, or even a good description of the original plant itself, it is impossible to decide with certainty. Dr. Engelmann's *Mamillaria tetrancistra*, collected by Dr. Parry on the desert between San Diego and the junction of the Gila with the Colorado, was collected here, as also on Bill Williams' fork; but the long, hooked central spines vary from one to four in number.

Section XI. *Los Angeles Valley.*—From Cajon Pass to the sea, at San Pedro, is a distance of about eighty miles through a beautiful valley, requiring very little description, in consequence

of its having been long known. It was first settled by the Spaniards soon after the discovery of this part of the continent. It is well wooded and watered. We had not time to examine the timber of the mountains in this vicinity on account of our hasty march. In the preceding portion of our route we mentioned the trees seen at Cajon Pass; and as we passed down Cajon creek we saw the California sycamore, (*Platanus Mexicanus,*) alder, (*Alnus,*) of quite a respectable size, and cotton-wood; and as we proceeded on to the plains there were collected two other species of oaks which grew in great abundance; neither of them in fruit, however, at the time we passed. The base of the mountains to our right was covered with this timber.

Grass and wild oats are abundant in the valley from one end to the other. Nature has peculiarly favored this region, and adapted it to grazing, by furnishing it with a succession of plants, which come on in regular succession; so that no trouble or expense is experienced in raising cattle and horses, except for salting and keeping them tame. The first crop is called "pin-grass," (*Erodium cicutarium,*) belonging to the family of *Geraniaceæ;* the next is a crop of leguminous plants, such as Medicago, and several species of clover, (*Trifolium,*) which spring up one after another; then follow wild oats (*Avena*) and other species of grass in great abundance.

At the Cajon valley there are several species of cactaceæ, both flat-jointed and cylindrical, with a woody axis, which are somewhat different from those passed in the Colorado valley.

At Cocomungo, in this valley, we found vast and dense patches of an Opuntia, nearly akin to *O. Engelmanni,* which had the appearance of having been introduced; but whether it really is so, cannot be determined. The Spanish *Tuna,* (*Opuntia Tuna,*) which is cultivated for its fruit, forms hedges fifteen or twenty feet high. The Indians and Mexicans are very fond of the fruit, which serves them for food during its season.

At the mission of San Gabriel we saw large orchards of orange trees laden with its golden fruit, which ripens perfectly in the open air, (22d May.) We could say nothing more favorable of the climate of this delightful region. There are many other exotic plants that would succeed with very little trouble; the tea plant especially we think would do well, and deserves a thorough trial. The grapes cultivated here are said to be equal to any in the world.

No. 2.

DESCRIPTION OF FOREST TREES.

BY J. M. BIGELOW, M. D.

PINUS (Abies) DOUGLASII.—*Douglas Spruce*, or called simply *Spruce* in some regions; *Oregon Pine* about *San Francisco;* and *Hemlock* in other places.

The first place on the route where it is found is on the Sandia mountains, east of the Rio Grande, and between it and the Rio Pecos. It grows there abundantly. It next occurs on what is called the Sierra Madre, about ninety miles west of the Rio Grande, and is there also quite abundant. We again observed it, but rather sparingly, in the mountains around Zuñi.

After crossing the Rio Colorado Chiquito we come to a range of mountains, of which the most elevated and prominent peaks, near where we passed, were San Francisco, Bill Williams, and Mount Sitgreaves. Here was a belt of forty-five miles or more in width, stretching in a southeasterly direction to the Mogoyon or Sierra Blanca, probably as far as the headwaters of the Gila. At the Copper Mines, near the Gila, I found it in abundance in 1851, as well as at the Organ mountains, near Doña Ana, while connected with the Mexican boundary survey. At Aztec Pass, one hundred miles west of San Francisco, it is found again, but not so abundantly as at the latter mountain. As soon as we reached the Sierra Nevada, and along the whole Coast range as far as Los Angeles, it showed itself in the greatest abundance. It grows also in almost every mountainous region of California, from the coast to the highest range of the Sierra Nevada. On the mountains of the Sierra Madre, east and west of the Rio Grande, at San Francisco and its vicinity near the two Colorados, at the Organ mountains and those of the Mimbres near the Copper Mines, this tree grows from ninety to one hundred and twenty feet in height, and from three to six feet in diameter. In California it is found of a much larger size, frequently attaining the height of two hundred feet or more, and from six to nine feet in diameter. The wood is coarse-grained, tough, and hard—so much so as to preclude its being used as pine lumber; but it forms most excellent building timber. At San Francisco, Sacramento, and other cities of California, this timber is used almost exclusively for making plank-roads, side-walks, and piling. Probably one-fourth of the city of San Francisco is thus built on piles, driven from ten to fifteen feet into the ground. The wharves at the latter place are built exclusively of this timber.

From its abundance and widely-extended range, it will be seen that this tree will form one of the most valuable timber products of the proposed line; and, from what I have seen of its applicability to purposes of this kind, I have no hesitation in affirming that it will make railroad ties, equal, if not superior, to those of any other wood in the West. This tree has been well characterized, and a good figure of the fruit, cone, and branch given in Hooker's Flor. Boreali Americana.

PINUS (Abies) BALSAMEA.—Common name *Balsam*, or *Balsam Fir.*

It is identical with the one growing in the eastern States in such abundance. We found it only on the more elevated points of the Sandia, San Francisco, and Sierra Nevada mountains. It was not seen by us at the Cajon Pass of the Sierra Nevada, but I have no doubt it exists on the more elevated peaks of that region. Near Sonora and Downieville, in California, it grows to a great height, equalling that of the sugar and yellow pines. It forms a beautiful tree; but, from the perishable nature of the wood, it can scarcely be used for railroad purposes, except in places where it is protected from the disorganizing influences of the weather. The process of kyanization would probably have the effect to render it more valuable. It is an old and well-known species. In places where it abounds it is used for various building purposes, where not exposed to the weather, for which it is admirably adapted by its straight axis and beautiful taper. The balsam, which is an exudation from the bark, is medicinal, and held in high esteem as a remedy for burns and various other diseases.

PINUS BRACHYPTERA.—Called *Yellow Pine* in some regions, and *Pitch Pine* in others.

This is quite a different tree from either of the pines so called in the Eastern States. It is very common all over New Mexico and California. This tree is most generally associated with Douglas spruce, first making its appearance on the mountains between the Pecos and the Rio Grande. It grows abundantly about Santa Fé, in New Mexico, and was described first by Dr. Engelmann, from specimens collected by Dr. Wislizenus. Dr. Torrey (Report of Sitgreaves' Expedition, p. 173) mentions that Dr. Engelmann's *P. Macrophylla* was found at the Zuñi mountains. He says, however, it does not agree well with Engelmann's description. We found only this one so common in all that region, and suspect it is the one to which he has reference. It occurs at the Sandia and Organ mountains, east of the Rio Grande, at the Mimbres mountains, Sierra Mogoyon, San Francisco, Aztec Pass, and on the Sierra Nevada, near Mount San Bernardino. In every region of California, also, where the Douglas spruce is known to exist, this tree grows. I think, however, that it is found more abundantly in the interior of California, along the spurs and heights of the Sierra Nevada, than along the Coast range, where the Douglas spruce is the most abundant. In all these places it forms a beautiful timber tree. East of the Sierra Nevada it rises to the height of one hundred feet, with a diameter of five or six feet. On the western slopes of the Sierra Nevada, like the spruce and other pines, it grows much larger and taller. In favorable situations, it equals in height the other pines of those regions.

The wood of this tree is soft and easily worked, and varieties of it are equal in beauty and utility to the wood of any other pine. About Santa Fé, Albuquerque, Anton Chico, San Miguel, and all the towns on the upper Rio Grande, and Pecos, it forms their principal lumber. It exists so abundantly on the Mimbres, the Organ mountains, and on the mountains further east, bordering the Pecos, as to supply San Elizario, El Paso, Doña Ana, and all the lower towns of the Rio Grande, with lumber. It is also used in every part of California for building and other domestic purposes. On account of the softness of the wood, it is thought it would not answer as well for railroad ties as the Douglas spruce. The accompanying profile, on which I have attempted to illustrate the relative ranges of these trees above the level of the sea, approximates pretty nearly the truth. Although the range of this pine is very intimately associated with the Douglas spruce, yet, on reference to the profile, we shall see that it is found at a greater altitude, although the two species frequently overlap each other on the sides of mountain slopes. The Douglas spruce occupies the lower, and this species the upper portions of the mountain chains.

I am not aware that a good figure of this tree has ever been made. It was first brought to the notice of botanists and the public by Dr. Engelmann, in Wislizenus' Report, in 1848.

PINUS EDULIS.—Called *Piñon* by the Mexicans; *Nut Pine of New Mexico*, by Americans. The fruit of it is called by Mexicans *Piñones*.

In every place, from the bluffs of the Llano Estacado, about one hundred and sixty miles east of the Rio Pecos, to the Cajon Pass of the Sierra Nevada, this tree is found to be closely associated with cedars. It seldom grows large. A little west of the San Francisco mountain, and at the Cajon, it is found from forty to fifty feet high, but further east it seldom attains more than twenty-four. Its usual height, however, is about thirty feet. The timber is seldom used for domestic purposes, and I am, therefore, unable to express an opinion of its fitness for railroad lumber. The wood is tough and elastic, but with regard to its durability when exposed to the vicissitudes of the weather, I am unable to give an opinion.

From its extensive diffusion along the route, it would be of great value should it prove durable, for in other respects it would be well adapted to railroad purposes. On the other hand, should it be subject to early decay, I have no doubt but that subjecting it to the process of kyanization, as resorted to in the English railroad system, would obviate the difficulty, and prove with us, as with them, more economical in the end, although rather expensive at first. This might be the case even with our more durable species.

Its range of elevation above the sea-level is wider, and it is more extensively diffused than the species before mentioned. I have not seen it, however, on the western slopes of the Sierra Nevada above Los Angeles, nor in the upper portions of California.

The nut is sweet and edible, about the size of a hazel-nut. It is used as an article of trade by the New Mexicans of the upper Rio Grande with those below, and about El Paso. The fruit has a slightly terebinthine taste; but the New Mexicans are very fond of it. When it is considered how expensive it is to cultivate corn in those arid regions, where irrigation is necessary, one would naturally infer that an oil-nut as easily and abundantly produced as the piñon, would be an article of the first importance; and I have no doubt such will be the case when the country comes to be occupied by an enterprising and intelligent race. In the fattening of swine, this tree would receive a share of public attention. Bears and other animals, in large numbers, are known to subsist upon the fruit in those regions.

Dr. Engelmann (Bot. Sketch, Wislizenus' Report, p. 4, 1848) gave a description of this tree under the name used above, and Dr. Torrey (Sitgreaves' Report, Pl. 20) has given an excellent figure of the same. Three years previously, Dr. Torrey (Report Fremont's Exploring Expedition, p. 319, 1845) described and figured a species of pine under the name of P. MONOPHYLLUS, or the *Nut Pine of California*, which, according to Fremont, is "extensively diffused over the mountains of northern California, from longitude 111° to 120°, and through a considerable range of latitude." Dr. Engelmann, in the work previously referred to, describes another closely allied species under the title of *P. osteosperma*, the *Nut Pine of northeastern Mexico*, collected by Dr. Gregg on the battle-field of Buena Vista, with the remark, that the "cone and seeds are similar to both others," *i. e.*, *P. edulis* and *P. monophyllus*. A comparison of the two figures of Dr. Torrey, in Fremont's and Sitgreaves' Reports, will hardly fail to convince the most skeptical that they are varieties of one species;[1] and consequently, Dr. Torrey's name having the priority, will have to be retained and adopted. The principal characteristics of the three species being in the number of leaves in the sheaths, varying from one to three, they fail to be distinctive marks. In Dr. Engelmann's two species, the leaves are exactly alike in both; the only difference being in the hard and soft shell, which is scarcely sufficient for a specific separation. Indeed, the California specimens I found at the Cajon had a testa as hard as that of Dr. Engelmann's Mexican species; a fact also observed by Mr. Leroux with regard to the nut pine north of our line, on the Sierra Nevada mountains, about Walker's and Fremont's Passes. The extent of the eastern and western range of Fremont's plant is 9°

[1] See Dr. Torrey's remarks on *P. edulis*, in the Botanical Report of the Expedition.

of longitude. Mine extends from the Llano, 103°, to the Cajon, 118°, a range of 15°. I have also seen it south as far as the mountains of the Limpia, in about latitude 31° ; and Dr. Parry has collected it still further south, in the cañons of the Rio Grande, below Presidio del Norte.

PINUS FLEXILIS.—*Rocky Mountain White Pine.*

We found this tree at the Sandia mountains of New Mexico, at an elevation of about 12,000 feet above the level of the sea. Dr. Engelmann observes, that it was collected about Santa Fé by Mr. Fendler. In its cones and habit it is closely allied to *Pinus strobus*, which is the white or Weymouth pine of the North and East. On the authority of Dr. James, who first discovered this species, it is asserted that the seeds are large and edible. The piñones in use about Santa Fé, however, Dr. Engelmann remarks, are the produce of the *P. edulis*.

At an elevation of the San Francisco mountain nearly equal that of the Sandia mountain, it was found again forming a large and beautiful tree one hundred to one hundred and thirty feet in height. These are the only two localities on our route where this pine was detected. I was not high enough on any of the points of the Sierra Nevada to know whether it grows there ; but at the proper elevation, there can be little doubt that it may be found there also.

With the quality of its wood, either for lumber or for railroad ties, I am entirely unacquainted ; but from its close affinity (as before intimated) with the Weymouth pine, which is a most valuable species, I have no doubt this tree will yet prove to be one of the most important on our route.

JUNIPERUS VIRGINIANA.—*Red Cedar.*

In places along the Canadian river, near Sans Bois creek, and even as far west as Old Fort Arbuckle, this tree grows quite large, and in abundance. Large specimens of it, however, were not seen further west. Although it would be as durable as almost any other timber that could be procured, yet it is said to be too brittle for railroad ties.

On the bluffs of the Llano Estacado, and from that point west as far as the Cajon Pass, occur in many places, and sometimes in great abundance, two or three other species of cedar. Of a collection made by Dr. Woodhouse, Dr. Torrey, in the "Report of an Expedition down the Zuñi and Colorado rivers, by Captain Sitgreaves," observes "that one may be *Juniperus occidentalis*, (*Hook*,) the second *J. tetragona*, (*Schlect.*,) while the third is probably new." Mine are probably all included in his list ; and if so excellent a botanist as Dr. Torrey is in doubt in reference to the species and varieties of these plants, it would be folly in me to attempt to reduce or determine them.

The trunks of the western varieties are too short to render them of much value for timber. The berries of most of them (especially those of *J. occidentalis*, which has a large, slightly tuberculate fruit) are sweet and nutritious, affording sustenance to bears, wolves, and a variety of other animals, if not the Indian himself.

ALGAROBIA GLANDULOSA.—*Mezquit.*

Trees of this species are found considerably east of the Pecos and Rio Grande valleys, but mostly in a shrubby state. In the valleys of the Colorado Chiquito, San Maria, Colorado Grande, and Mojave, this tree grows to a considerable size. In Southwestern Texas and in the eastern regions of Mexico it is considered invaluable from its extreme durability. Fences made of this timber in that part of Texas have been known to stand in a perfect state of preservation more than fifty years. From its hardness and durability, there can be no doubt but that it would make ties equal to the lignumvitæ of tropical climates ; to which it is, indeed, closely allied botanically, belonging to the section Mimoseæ of leguminous plants.

Besides the STROMBOCARPA PUBESCENS, (Mexican *tornillo*,) a genus closely allied to Algarobia,

there are other trees of this order abounding along the valley of Bill Williams' fork, attaining the size of the mezquit; but I have not had an opportunity of determining their names. One of them is described by Major Emory, in his report, as the "Green-bark Acacia." An interesting fact respecting this tree is, that it forms a shelter for the propagation of the *Cereus giganteus* of that region. Every young cereus is protected and fostered by this tree until the cactus attains the size and hardihood that enables it to withstand the war of elements waged against it, when it ungraciously spurns its protector, ultimately destroying it, as we saw in numerous instances on our journey.

POPULUS MONILIFERA—in Spanish, *Alamo.—Cotton-wood.—Poplar.*

This tree is somewhat different from the cotton-wood of the Mississippi, which I believe is *P. angulata*. It is found east as far as the Canadian, and west until we cross the Sierra Nevada. In the Rio Grande valley it is used by the Mexicans for building. It is also employed for farming utensils, the most unique of which is their cart, or *caretta*, the wheels being made of a section of the tree. They are six or eight inches thick, and manufactured in the rudest manner. The timber is tough and hard; and although probably not as durable when exposed to the weather as some other kinds, yet I have no doubt it would answer very well for railroad ties, until a road could be formed to regions where more desirable timbers abound. It does not grow here near as tall as on the Mississippi river, but occasionally it is quite large and spreading.

QUERCUS.

Of the valuable genus of *Oaks*, we find about Fort Smith, and west as far as the Cross Timbers, all the varieties that are common to the more eastern States, all of which are well known. Besides the several species mentioned by Dr. Torrey, in Captain Sitgreaves' Report, most of which are doubtless in my collection, we found, at the Cajon Pass of the Sierra Nevada, a live-oak with a cupule an inch or an inch and a half in diameter. It is a beautiful and valuable timber tree, and doubtless it is a well-known Californian oak. It grows in various parts of California; but how widely it is diffused, I am unable to determine. It attains the height of eighty to one hundred feet, and is from two to four feet in diameter. The timber, from the character of the tree, must be valuable.

DESCRIPTIONS OF VALUABLE OR REMARKABLE CALIFORNIA FOREST TREES.

PINUS LAMBERTIANA, OR SUGAR-PINE.

This is one of the most magnificent pines of the Sierra Nevada. We first noticed its appearance at San Bernardino, not far from San Diego; and it probably follows the course of the Sierra Nevada to Oregon. At Sonora, Mokelumne Hill, Nevada City, Downieville, and every place where I visited those mountains, at an elevation of 4,000 or 5,000 feet above the level of the sea, this noble tree is found in perfection. It ordinarily attains the height of two hundred feet, and is six to ten feet in diameter. It is very symmetrical and beautiful in shape, with a slender but graceful foliage, in which characters it probably exceeds every other pine tree of California. It forms a timber equal to that of any other in the world. Its grain is so straight and even, that thousands of houses in California are weather-boarded with shingles, which are merely split, without any other expense or work. There are many mills in the vicinity of Downieville, Nevada City, Grass Valley, and Sonora, where lumber is manufactured and planed, by means of machinery, in quantities sufficient to supply vast regions in that country. Were it not that transportation is so expensive in California, the rapidly-increasing cities of San Francisco, Sacramento, and all the coast region could be supplied with lumber of a quality far superior to that brought from Oregon, with which their markets are now mainly furnished.

Professor Lindley (Vegetable Kingdom, page 228) observes of this tree and *Abies Douglasii*, that "they are probably the most valuable fir timbers of the whole family." And it will be remembered, the pine tribe stands at the head of the list of timber trees.

WELLINGTONIA GIGANTEA.

This tree is popularly known, in the district where it grows, as the "*Mammoth Washington Tree.*" At this time it probably possesses more interest than any other American tree. Our backwoodsmen have known of its existence ever since the beginning of the California gold excitement, for it grows very near a rich auriferous region, about equidistant from Sonora and Mokelumne Hill, both of which districts are much resorted to by emigrants and gold-seekers. The so-called Mammoth Grove is north of those places, near the head-waters of Calaveras and Mokelumne rivers. Dr. Randall, the worthy president of the California Academy of Natural Sciences, had his attention called to the tree several years ago, and was persuaded it possessed characters generically distinct from the redwood, (*Sequoia sempervirens,*) and sent, more than eighteen months ago, large and beautiful specimens of this tree, besides many other rare and new botanical specimens, to Drs. Torrey and Gray. Most unfortunately, the specimens were lost in the transit of the isthmus. Doubly unfortunate has it happened to us as *Americans*, because we have been anticipated, and prevented from giving it a proud American name, the WASHINGTONIA. Dr. Randall and his friends, being convinced of its being the type of a new genus, proposed to call it after our revered WASHINGTON, but not having books of reference at hand, he sent specimens (which, as before stated, were lost) to Drs. Torrey and Gray, for the purpose of having the tree described and published. In the mean time, Mr. Lobb, a seed collector for some society in Scotland, sent home enough to characterize the plant, which was done by Professor Lindley, in the London Gardeners' Chronicle. However, we must now be contented with the possession of the tree, as England must be with the empty name. From recent researches of Dr. Torry, I believe he is pretty well satisfied that this tree is not generically distinct from the redwood, and has bestowed on it the name of SEQUOIA GIGANTEA. A good generic character of this family is contained in the staminate flowers and stamens; and when these are procured and examined, this question can be satisfactorily settled.

As considerable discussion has already been had with regard to the age of this tree, I may state, that when I visited it in May last, at a section of it eighteen feet from the stump, it was fourteen and a half feet in diameter. As the diminution of the size of the annual rings of growth, from the heart or centre, to the circumference or sapwood, appeared to be pretty regular, I placed my hand midway, roughly measuring six inches, and carefully counted the rings on that space, which numbered one hundred and thirty, making the tree 1,885 years old. Since I came home, Dr. Torrey tells me he has actually counted every ring of a section of the tree, and found the number a little over 1,100. This makes a great discrepancy with Professor Lindley's account in the Gardeners' Chronicle, where it is estimated at more than 3,000 years. I believe it is asserted in the Chronicle that it must have germinated when Moses was a little boy!

A verbal or written description of the size of this tree, however accurate, cannot give one an adequate idea of its dimensions. It required thirty-one of my paces (of three feet each) to measure thus rudely its circumference at the stump. The only way it could be felled was by boring repeatedly with pump augers. It required five men twenty-two days to perform the operation. After they had succeeded in severing it at the stump, the shoulders were so broad, and the tree so perfectly equipoised, that it took the same five men two days in driving wedges with a battering-ram on one side of the cut, to throw it out of its equilibrium sufficiently to make it fall. The mere felling of the tree, at California prices for wages, cost the sum of $550.

A short distance from this tree was another of larger dimensions, which, apparently, had been overthrown by accident some forty or fifty years ago. It was hollow for some distance, and when I was there, quite a rivulet was running through its cavity. The trunk was three hundred feet in length; the top broken off, and by some agency (probably fire) was destroyed.

At the distance of three hundred feet from the butt the trunk was forty feet in circumference, or more than twelve feet in diameter. Fragments of the same kind of tree, which had apparently been exposed to the vicissitudes of climate and weather the same length of time, and supposed to be from the individual tree that lies prostrate, are to be found projected in a line with the main body, one hundred and fifty feet from the top; proving to a degree of moral certainty that the tree, when standing alive, must have attained the height of four hundred and fifty or five hundred feet!! At the butt it is one hundred and ten feet in circumference, or about thirty-six feet in diameter. On the bark, quite a soil had accumulated, on which considerable-sized shrubs were growing. Of these I collected specimens of currants and gooseberries on its body, from bushes elevated twenty-two feet from the ground.

The mammoth trees are situated in a dense forest of sugar and yellow pines, balsam fir, white cedar, (*Libocedrus decurrens*, which, in its foliage, much resembles the American arbor vitæ,) and a little yew, supposed to be *Taxus canadensis*. Although it does not greatly exceed some of these in height, yet its stately and majestic bearing strikes the beholder with awe and wonder, and one almost involuntarily bows to it as the king of the forest. The bark is of a dull brown color, varying much in thickness, sometimes being fifteen inches or more. The whole number of these trees in existence, young and old, does not exceed five hundred, and all are comprised within an area of about fifty acres. Only eighty or ninety of them are of a gigantic size. Their extremely limited locality and number forcibly impressed me with the belief that the species is soon to become extinct, as is further evinced by its slow reproduction. Indeed these giants of the forest are so marked in their rusty habit from their present associates, that we can hardly view them in their present relations, except as links connecting us with ages so long past, that they seem but reminiscences of an eternal bygone. They seem to require but the process of petrifaction to establish a complete palæontological era. If Professor Lindley's estimate of its age be correct, one tree only is propagated in six years; or, if Dr. Torrey be correct, one only in two years. A remarkable peculiarity I observed with regard to their fruit cones, namely, they were in every state of development, from the germ to the ripe fruit. I was near them about the middle of May, when the ground was literally covered with their cones and seed.

The leaves are triangular and scale-like, as in the cedars, but never dimorphous or expanded into flat lamina, like many others of the same tribe of Cupressinæ, as Dr. Gray supposed might be the case. The wood is deep red, much resembling that of the celebrated redwood of the Coast mountains, so that the two trees were confounded for a long time. The value of the wood for timber is a matter of speculation merely, as it is too limited in quantity and locality to excite much interest, except, indeed, to wrest it from its apparent doom by cultivating it in plantations. Such an experiment with so noble a tree would surely be worthy an assiduous and laborious trial.

SEQUOIA SEMPERVIRENS.—*Redwood.*

This, which was long known as the *Taxodium sempervirens* of Don, is a noble and splendid ree. It is found along the Coast mountains of California, from near the region of Monterey to Russian river, above the bay of Bodega; but, whether those are its extreme limits, I am unable to learn. It does not reach into the interior of the State, and is never found at any considerable distance from the Coast range of mountains. In the neighborhood of San Francisco, amid the deep mountain gorges, I have measured fallen trees eleven feet in diameter, and paced their length two hundred feet; and I have seen others standing which appeared very much taller, but I had not the time, nor the means at hand, to measure them. I have been told, however, by men of credibility, that they grow from one hundred and eighty to three hundred feet high. It has been but lately separated from the genus *Taxodium*. The gifted, but unfortunate Douglas, was among the first to notice the peculiar gigantic forms of these trees of California, and from this fact many English botanists ascribe to him the credit of discovering the still more gigantic Washingtonia. Another reason assigned for this opinion is, that he penetrated as far

north as 38° 45′ north latitude, and saw gigantic trees, whence it is inferred he must have seen them both. But I have been assured by Dr. Randall, who was well acquainted with Douglas' botanizing localities, that he never penetrated inland while in California, much less that he visited the mountains of the Sierra Nevada; and, consequently, he could not have encountered the mammoth Washington tree.

Little has been written of the valuable qualities of the redwood for timber, it having come into general use but for a comparatively short time—that is, since the settlement of California by Americans. The wood resembles the cedar a good deal in lightness and susceptibility of polish, but it is of a slightly darker shade of red. In the rural districts, along the coast, farmers use it for making fencing rails; and it is almost certain to excite incredulity, to state the number of rails that can be made from a single tree. They are counted by thousands, as we count them by hundreds in the eastern States. For building purposes and cabinet work, it probably excels every other tree in California. In the cities and towns, where its transportation can be afforded, it takes the place of every other wood. Oregon lumber is frequently brought into the San Francisco market at a cheaper rate than it can be brought from the surrounding hills, only a few miles distant. The foliage of this tree is dimorphous, as in most of the cypress tribe; the younger and more thrifty branches having a two-ranked dilated lamina, as in the spruce, while the older ones assume the scale-like foliage of the cedar. I collected the old cones of last year's growth, but fear I failed to procure the seeds, all having already been shed.

Libocedrus decurrens.—*White Cedar.*

This tree, in California, is called "white cedar," but it is quite different from the tree of the same name in the eastern States. I presume it is so called from its having somewhat of a resemblance, in foliage and habit, to the American arbor vitæ. The fruit-cone, and the arrangement of the leaves, however, are quite different, and justify the botanist in separating it from the genus *Thuya*, to which it is closely allied. The excellent representation given by Dr. Torrey, in Plantæ Fremontianæ, (*Smithsonian Contributions to Knowledge*,) Plate 3, pp. 7 and 8, is correct, excepting that the fruit-cones are represented as being erect, whereas they are pendulous. This error probably resulted from the drawing having been made from dried specimens, rather than from nature. The tree is only to be found at an elevation of some four or five thousand feet above the level of the sea, in the Sierra Nevada mountains of California. I found it fifteen or twenty miles southeast of Sonora, on the head-waters of the Stanislaus and Tuolumne rivers, (both of which are considerable affluents of the San Joaquin,) south of 38° north latitude; and also on the head-waters of the Calaveras and Mokelumne rivers, in juxtaposition with the Washingtonia. Dr. Torrey remarks, that it ranges as high as 41° on the head-waters of the Sacramento river. In company with the Washingtonia, it appeared nearly as tall as that tree. It certainly attains a height of over two hundred feet. The timber is much sought for by farmers in that region for making rails and fencing-timber, as it is considered superior in durability to the other species of pine in the neighborhood. The wood is very light, of a dirty yellowish hue, and is thought to be more durable than redwood.

Torreya californica.—*Nutmeg tree* of California.[1]

I found this interesting tree not very far from the coast, near Tomales bay, in a deep ravine, called "the Redwoods." I am told that it grows also on the American fork of the Sacramento river. I was anxious to obtain the one from the latter locality, in order to determine whether it might not be a different species from that which grows near the coast, as the plants of the coast and Sierra Nevada mountain seldom intermingle. It has a foliage very similar to the spruce, but the fruit is very characteristic and different in appearance from any of the family in

[1] See a description of this tree by Dr. Torrey, in the New York Journal of Pharmacy, Vol. 2. It has since been described by Sir William Hooker, in the Botanical Magazine, under the name of Torreya Myristica.

America. It very much resembles the nutmeg—so much so, indeed, as at one time to deceive some pretty well informed persons, and make them believe it was not a "*wooden nutmeg*," but a nutmeg in *fact*—in quality as well as in appearance. It is a great pity that dame Nature should amuse herself by playing such pranks, and endanger the monopoly of our good Yankee friends in the manufacture of this aromatic luxury!

This tree grows from forty to fifty feet high, with very slender, drooping branches, and a thin, light foliage. The bark is smooth, somewhat resembling that of the common black mulberry, and the wood hard and firm. Very little is known with regard to its durability or fitness for timber for railroad or domestic purposes. It is closely related to the Podocarpus of tropical regions, and yews, which are common to the temperate regions of Europe and America. According to Professor Lindley, these, and kindred genera, yield "timber which is unsurpassed for durability and elasticity;" from which we may safely infer that the timber of this tree, when it comes to be known and tried, will prove to be truly valuable.

Unfortunately, we were not in California at the season for collecting the nuts, all of these having been long before destroyed by squirrels, rats, and other vermin, which are said to be exceedingly fond of them. According to the statement of Dr. Randall, the nut is too bitter and terebinthinate to be of any use in domestic economy; but no doubt it would make an excellent remedial agent in many diseases.

The true nutmeg is a native of the tropics of India and America, and widely separated from this tree in its botanical relationship.

TAXUS CANADENSIS.—*Yew.*

I much regretted being unable to obtain the fruit of this plant. It grows in the forest, with the giant Washingtonia, and also at Downieville, about a degree and a half further north. Mr. Lobb, while there, pronounced it (without seeing the fruit, however) the *Taxus baccata*, which is the European species. The tree is small, but the wood is very tough and elastic, being much prized by the Indians for making their bows. On examination of its fruit and seeds, it may turn out to be quite a distinct species from its Eastern congener.

PINUS SABINIANA.—*Sabine's pine.*

This tree is so called by Dr. Randall and other California botanists, who have paid special attention to this department of botany. From not having proper books at hand for reference, we are unable to determine by whom it was first noticed or described. It is found on the lower western slopes of the Sierra Nevada, about Sonora, Mokelumne Hill, Grass valley, and Nevada city. On ascending the mountains its place is taken by Douglas' spruce, sugar-pine, balsam-fir, white cedar, and the yellow pine, of that region. It bears a very large ovate cone, the scales of which are armed with large upturned, hooked spurs. The nut is said to be large and edible. This tree has not the erect and rigid appearance of most other pines, but is flexuous and crooked, like many deciduous-leaved trees. The foliage is also thin, of a very light green, giving it a very peculiar aspect, different from that of all other species of pine in California. The wood is tough and elastic; but with regard to its durability, when exposed to the weather, no means of determination were had, from the fact that it is seldom or never used in the districts where it grows. This results from the sugar and yellow pines being abundant, and much superior to it for lumber.

PINUS INSIGNIS.—*Seal pine.*

This pine, which I have named on the authority of Dr. Randall, is found along the Coast mountains, in the neighborhood of the city of San Francisco. It is found also on the Yuba river, in the vicinity of Nevada city. As it is not a very large tree, and neither used nor

sought for in the neighborhood where it grows, the presumption is that it cannot be very valuable. This, however, is only a negative testimony against it, for it is surrounded and associated with other trees which are much superior to it in size and beauty.

PINUS.—*An undetermined species.*

High up in the mountains east of Sonora, (almost in the snowy regions,) and also at Cajon Pass, a pine was discovered very nearly related to the yellow pine of this country, (*P. brachyptera,*) but the cone is larger and more cylindric; the scales armed with a strong recurved spine; the leaves longer, regularly in threes, and with a longer sheath. A very good figure was made of this pine by our artist, Möllhausen. It is a large tree, with a lighter-colored bark than the *P. brachyptera,* and fully as valuable for its timber. I am not certain that it is a new species.

No. 3.

DESCRIPTION OF THE CACTACEÆ.

BY GEORGE ENGELMANN, M. D., OF ST. LOUIS, AND JOHN M. BIGELOW, M. D.

MAMILLARIA, Haw.

I. EUMAMILLARIA. Englm. in Synops. Cact.

1. MAM. WRIGHTII, Englm. in Rep. of Bound. Com.: Flowers and fruit were unknown until specimens brought from the Pecos flowered in Washington. From these the following description was drawn:

"Sepalis exterioribus triangularibus obtusiusculis fimbriatis sub–13, interioribus margine petaloideis acutis sub–8, petalis (purpureis) lanceolatis acuminatis aristatis sub–12; bacca succosa majuscula purpurascente floris rudimentis coronata; seminibus obovatis basi acutis scrobiculatis nigris. ~~(Pl. I.)~~ I am not certain whether the flower is actually lateral and the germen immersed, whether, therefore, this species actually belongs to the true *Mamillariæ*, or to the subgenus *Coryphantha;* I am, on the contrary, inclined to consider at least the germen [illegible]mersed. I, nevertheless, think it best to leave this species with the *Crinitæ*, to which it seems to be so nearly allied, till more complete observations establish the contrary. The flower is about one inch long, petals and margin of inner sepals bright purple; berry large and purplish; seeds about 0.7 lines long."

High plains near the Gallinas. Hills and roeky places near Anton Chico, on the Pecos, September 25, 1853. Santa Rita del Cobre mountains, near Lake Santa Maria, Chihuahua. Wright and Bigelow, in boundary collections.

2. MAM. GRAHAMI, Englm. in Rep. B. C. Sand and gravelly banks of streams. Williams' river to the Colorado Grande, January 26, 1854.

3. MAM. PHELLOSPERMA, Englm. in Synops. Cact. (M. tetrancistra Englm. in Sillim. Jour., Nov. 1852): Living specimens of this and the preceding species have been brought to Washington, and are now growing in the Congressional garden. Few specimens only show more than one of the 4 central spines hooked. The manifestly improper name previously adopted had therefore to be altered. "I have substituted for it a name derived from the peculiar spongy or corky appendage of the seed, which greatly resembles that of the seed of *Potentilla paradoxa Nutt.*"—(Engelmann.) Sandy banks of streams, Colorado Grande and Mohave, February 4–23, 1854. The external habit of this plant very much resembles that of *M. Grahami*, and was collected in nearly the same localities.

4. MAM. MEIACANTHA, Englm. in Rep. B. C.: Distinguished from *M. applanata* by the fewer and stouter spines, central spine often wanting. Cedar plains near the Llano Estacado to the Pecos, September 23–27, 1853.

II. CORYPHANTHA. Englm. Synops. Cact.

5. MAM. NUTTALLII, Englm.: var. *γ. robustior* aculeis lævioribus radialibus sub-12, centrali robusto. The northern and Texas plants have pubescent spines.

Plains on the False Washita and Canadian, near Fort Arbuckle, August 22–29, 1853.

6. MAM. VIVIPARA, Haw.

β. NEO-MEXICANA, Englm. in Rep. B. C.: Found in many different forms, from the plains of the Canadian, in longitude 100°, to the Aztec mountains, in longitude 112° west. The forms mostly belong to the var. *β. Neo-Mexicana.* One of the specimens brought to Washington bore abnormal flowers, quite interesting in a morphological point of view. The ovary is 4–5 lines long, covered with 8-12 fimbriate sepals, (or scales,) much like the ovary of an *Echinocactus*, the ovules deformed or wanting; styles irregularly divided to the base, or nearly so, in 8-10 parts, stigmatose at the upper part; other parts of the flower normal. This plant occurs in the greatest variety of altitudes through 12 degrees of longitude. Specimens of it were collected on the top of the Sandia mountains, near Albuquerque, upwards of 13,000 feet above the level of the sea, September 4, 1853, to January 17, 1854.

ECHINOCACTUS, Link.

No specimen of this genus was found till the Colorado Chiquito was reached. From there to the California mountains five species were observed, two only of which, *E. Lecontei* and *E. Emoryi*, had before been seen any where else.

1. E. WHIPPLEI, (sp. nov.): globoso-ovatus, costis 13–15 (sæpe obliquis) interruptis tuberculatis, areolis orbiculatis approximatis; aculeis radialibus compressis albidis, infra brevioribus, supra deficientibus; aculeis centralibus 4 radiales superantibus, summo complanato recto albido ceteris plerumque longiore compresso-quadrangulatis fusco-atris, demum cinereo-rubellis, 2 lateralibus rectis sursum divergentibus, inferiore robustiore deorsum hamato; flore? bacca? seminibus oblique obovatis opacis minutim verrucoso-tuberculatis. (Plate I.)

This species was discovered on Lithodendron creek, near the Colorado Chiquito, about 90 miles west of Zuñi, in sandy plains, December 3–4, 1853. At first only dead specimens were found, afterwards young living ones were collected. It was not seen after leaving the valley of the Little Colorado. We have named this very pretty species in honor of Captain A. W. Whipple, the zealous and talented commander of this expedition.

Our plant is from 3 to 5 inches high, and 2 to 3 or 4 in diameter. The outer spines are straight or slightly recurved 6–9 lines long, the lower ones shorter than the others. The two lowest lateral spines are darker, and almost form a cross with the two upper dark central spines; the 5 other radial spines are white. The upper central spine is the longest and broadest of all, being 12–18 lines long, and ½ to 1¼ line broad at base, and mostly straight, and directed upwards almost contiguous with the radial spines, the circle of which it seems to complete. The 3 other central spines are a little shorter, 12–15 lines long, nearly equal among themselves, quadrangular compressed, often somewhat curved, dark brown or black when young, with lighter tips; afterwards reddish, and finally of an ashy color. The lowest one has a sharp recurved hook, which is whitish on the convex side of the curvature.

Among the debris of the dead specimens preserved, a number of seeds were found which no doubt belong to this species. They are large 1.6—1.7 lines long, and 1.2 lines in diameter, very little compressed at the upper part, narrowed down to an acute point below the large orbicular hilum, and sharply carinate on the lower part of the back (opposite the hilum.)

E. Whipplei evidently belongs to the section *Hamati*, found in numerous forms on the middle and lower Rio Grande; with *E. polyancistrus* it is, so far as at present known, the only representative of this section west of the Rocky mountains. It is more nearly allied to *E.*

brevihamatus Englm. from Eagle Pass, the seeds of which are as yet unknown. It is, however, easily distinguished by the arrangement of the spines; the eastern species has 11 terete radial spines all around, and 4 central ones, the uppermost one being smaller and narrower than the lower hooked one.

2. E. POLYANCISTRUS, (sp. nov.): ovatus s. demum subcylindricus, costis 13–17 obtusis tuberculatis interruptis; areolis orbiculatis s. cum areola florifera contigua minore ovatis, junioribus fulvo-tomentosis; aculeis radialibus sub-19 compressis albis, summo deficiente, superioribus latioribus longioribus apice adustis, lateralibus brevioribus, inferioribus brevissimis subsetaceis; aculeis centralibus 2–3-formibus, summo singulo (rarius binis) compresso-quadrangulato elongato albo apice adusto sursum curvato, reliquis 5–10 teretiusculis s. subangulatis purpureo-fuscis, 2 superioribus plerumque rectis (rarius uncinatis) ceteris omnibus arcte uncinatis; floribus in axillis summis solitariis; sepalis sub-25 orbiculato-ovatis abrupte acuminatis mucronatis ciliatis, petalis acuminatis aristatis, stigmatibus 9–10. (Plate II, fig. 1–2.)

On gravelly hills and sandy plains at the headwaters of the Mojave, on the eastern slope of the California Cordilleras, one day's journey before reaching the Cajon Pass. This elegant and striking species was collected March 15, 1854, with young flower buds. The plant is 4–10 inches high and 3–4 in diameter; areolæ 4 lines in diameter and (from center to center) 7–9 lines distant from one another; the younger ones covered with a reddish-yellow wool. The 4 upper radial spines 1–2, lateral ones $\frac{3}{4}$–1, and lowest $\frac{1}{2}$ inches long. The upper central spine is 3–5 inches long and $\frac{1}{2}$–$\frac{3}{4}$ line wide; sometimes a second similar, but smaller, one is seen above or beside it. All the other central spines are bright purple-brown, the upper ones longer, (2–3 or even $3\frac{1}{2}$ inches long,) the others gradually shorten, the lowest not more than $1\frac{1}{4}$–$1\frac{3}{4}$ inches long; the two uppermost brown spines are often straight, but sometimes, like all the lower ones, sharply hooked, the hooks being turned in different directions; the convexity of the hook is of a paler color. In the young or smallest specimens we find only 5 brown spines, all hooked, one in the centre of the others; in others 5 to 7 or 8 brown hooked spines are counted, one central to the others, or all in a semi-circle, the upper part of the central circle always closed by the broad white spine.

The flower buds were just forming in the axils of the half-grown spines; those glandular organs which divide the floriferous from the spiniferous areolae in *E. Setispinus*, and other species, seem to be very partially only, and incompletely developed in this species.

3. E. LE CONTEI, Engelm. in B. C. Rep.: ingens ovatus s. ovato-cylindricus, costis 20–30 compresis sub-obtusis interruptis, areolis elengato-oblongis approximatis; aculeis radialibus inferioribus superioribusque robustioribus 8–10 angulatis subannulatis plus minusve recurvatis, aculeis extimis lateralibus summisque 10–15 tenuioribus setaceis flexuosis; aculeis centralibus 4 compressis carinatis annulatis 3 superioribus sursum inferiore deorsum curvatis; floribus plurimis subcentralibus, ovario squamis 30–40 reniformibus tecto, sepalis tubi oblongis 20–30, petalis 25–30 angustis sulphureis, stylo ad medium in stigmata sub-14 linearia subacuta diviso; bacca globosa sicca squamosa floris rudimentis coronata, seminibus oblique obovatis compresis sublucidis minutissime scrobiculatis.—(Plate II, figs. 3–5.)

This gigantic species was first noticed by Dr. John L. Le Conte, on the lower Gila, where also Dr. C. C. Parry saw it. Both took it for the New Mexican *E. Wislizeni*, to which, indeed, it bears a great resemblance in habit as well as in botanical characters, but the seed that I received from the first-named gentleman at once satisfied me that I had a distinct species before me. Subsequently Dr Bigelow met with this remarkable plant, abundantly, from the Cactus Pass, at the head waters of Williams' river, down this stream to the Colorado, and west of it till *E. Polycephalus* took its place.—(Englemann.) It grows on rocky or gravelly plains and ravines, and often in crevices of perpendicular rocks, to the height sometimes of 5 feet by 2 feet diameter. The ribs are somewhat interrupted by a transverse incision between the areolae.

These areolae in the specimen before us are 8 lines long by 4 wide, and only $\frac{1}{4}$ inch distant from one another. In some specimens of *E. Wislizeni* the same closeness is observed, while in others, especially young and vigorously growing ones, they are often over one inch distant. The four principal central spines are 2–$2\frac{1}{2}$ inches long, lateral ones more quadrangular, the upper and lower ones flat and flexible; the former carinate above, the latter below. This lower one is rather the longest and $1\frac{1}{2}$–$1\frac{3}{4}$ lines broad, almost straight or somewhat curved, but never (in the specimens brought home) hooked. The other spines are $1\frac{1}{2}$–2 inches, the lowest are only about 1 inch long. Five radial spines are arranged below the four central ones and three to five above, three of which are often pushed into the centre by the flexuous bristly spines which occupy the space between the upper and lower radial ones and the uppermost part of the areola.

At the upper end of the areola, and between it and the floral areola, we meet with the same obtuse cylindric ligneous (when young, fleshy) glands which divide the spiniferous from the floral areolæ in several of our species of *Echinocactus*, 3–5 in number in the species before us, about one line long.

We had the good fortune to collect a single specimen of the fruit, (the only one found,) which is globose, $\frac{3}{4}$ inch in diameter, and, together with the persistent remains of the flower, about 2 inches long. Dr. Le Conte has noticed "a crown of yellow fruits on the plant, about 2 or $2\frac{1}{2}$ inches long." The dissection of the dead flower indicates a structure very similar to that of *E. Wislizeni;* petals apparently fleshy and narrow; stamina numerous, very few from the base, the majority from the middle and the upper thickened end of the short tube; style 10 lines long, divided nearly down to the middle into 14 sub-erect filiform stigmata; seed black, oblique-obovate, compressed, carinate on lower part of back, somewhat shining, and very lightly pitted, (under the glass,) 0.8–0.9 lines long; hilum small, oval; albumen rather small; embryo ovate, straight, with short hooked cotyledons. Mr. Schott has found this species abundantly in Western Sonora and the Gadsden purchase. The flowers are yellow, and similar to those of *E. Wislizeni*, but rather smaller; the stems are generally much higher and thick, and of a clavate shape; lower central spine sometimes almost hooked.

Echinocactus Wislizeni is distinguished by the less flattened, less flexible, stouter spines, the lower central one being channelled above and strongly hooked; by having only three lower radial spines, &c. The distinction indicated by the spines is confirmed by the shape and structure of the seeds; and thus the plants of the Colorado and of the Rio Grande are distinct representatives of the same type on both sides of the Rocky mountains.

4. E. Wislizeni, Englm. in Wisl. Rep., (Pl. III, fig. 1–2.)—This plant is very abundant in the neighborhood of El Paso, where it was first found, many years ago, by Dr. Wislizenus.

The fruit and seed of this plant were collected by Captain Whipple in the neighborhood of the *Cereus giganteus*, while engaged in surveying the Gila, on the boundary commission, in 1852. There possibly may be some doubt about its growing in that region, however, from the fact that Captain Whipple's fruits were labeled "*Cereus giganteus*," and were not collected by a botanist.

In our present expedition, when I first found a giant *Echinocactus*—*E. Le Contei*—at Cactus Pass, I was sure, in common with Drs. Parry and Le Conte, that it was *E. Wislizeni*, which I had often seen before at Doña Ana. I was most happy, however, in being able to secure even a single specimen of the fruit and seeds of that plant, by means of which, with the spines I collected, it has been identified and confirmed by the acute observations of my friend, Dr. Engelmann. It may be well to observe here, that the figure of this plant, in Major Emory's report, was made from a specimen seen on the headwaters of the Gila, near the mouth of the Azul branch, not far from Santa Rita del Cobre, or Copper Mines, and at least four degrees of longitude east of the place where first met *Ech. Le Contei*.

5. E. EMORYI, Engelm. in Emory's Report, 1848: globosus, costis 13 tuberculatis, tuberculis prominentibus obtusis distantibus; areolis ovatis; aculeis subæqualibus robustis annulatis subcompressis recurvatis s. rectiusculis fuscis versus apicem corneis, radialibus 7 (lateralibus 6, singulo inferiore breviore) s. addito summo rarius 8; centrali singulo teretiore paulo longiore robustioreque, porrecto s. demum deflexo curvato s. subuncinato. (Plate III, fig. 3.)

Collected west of the Colorado, in the valley of the Mojave, mixed with *E. Polycephalus*, and therefore not further noted. The only specimen preserved is 9 inches in diameter, sub-globose, below contracted, pear-shaped, or almost stiped.

On the lower part of the plant the areolæ are elevated on distinct ovate or sub-cylindric tubercles, which higher up become connected in 8 and on the upper part of the plant in 13 ribs; tubercles on this part of plant $\frac{1}{2}$–$\frac{3}{4}$ inch in height and diameter; areolæ $1\frac{1}{2}$ inch distant, $\frac{1}{2}$ inch long, a little less wide; the floral areolæ smaller, closely connected with the former, separated from it by 1–3 sub-globose glandular bodies, half or mostly hidden in the tomentum. Radial spines $1\frac{1}{2}$–2 inches long; the four upper lateral ones longer and stouter, the two lower ones more slender; the lowest spine the shortest, (1–$1\frac{1}{2}$ inch long,) secured like the others, or rarely hooked, similar to the shape of that spine in *E. Viridescens*.

An eighth upper radial spine, similar to the others, is sometimes observed. The stouter central spine is about 2 inches long, at the point strongly recurved, or often almost hooked. Spines of a reddish-brown color, lighter horn-colored, and somewhat transparent at tip.

This is probably the plant collected and figured by Major William H. Emory, in General Kearny's expedition to California in the fall of 1846, and then named after him. We collected only one young specimen, probably on the Lower Colorado, from which this description is taken. Mr. Schott has found the plant abundantly south of the Gila river, and it is known to extend to the Gulf of California. We procured a large specimen in San Francisco, (said to have been brought from Guaymas,) which is now flourishing in the public garden at Washington. This species has, when full grown, a height of 3 and a diameter of 2 feet, and 18–21 ribs. The large flowers are deep red, similar in form to those of *E. Wislizeni*.

6. E. POLYCEPHALUS (sp. nov.): globosus, demum ovatus cylindricusque multiceps, (e basi ramosus,) vertice dense tomentoso, costis 13–21 acutis; areolis ovato-orbiculatis junioribus tomentosissimis; aculeis 8–12 robustissimis compressis annulatis plus minus recurvatis junioribus puberulis cinereo rubellis apice nudatis rubicundis; aculeis radialibus 4–8 infimo deficiente, superioribus si extant gracilioribus; centralibus 4 robustissimis 4-angulatis compressis, superiore latiore suberecto s. sursum curvato, inferiore longiore decurvo; floribus in vertice congestis; ovario lana nivea ex axillis sepalorum 90–100 linearium demum spinescentium orta densissime vestito, sepalis tubi infundibuliformis 100–120 lineari-lanceolatis aculeato-aristatis purpurascentibus, interioribus margine petaloideis, petalis laciniato-fimbriatis herbaceo-aristatis sub-30 flavis, stigmatibus 8–11 linearibus acutis; bacca globosa sicca flore coronata, lana densa involuta; seminibus magnis irregulariter angulatis minutim (sub lente) verrucosis, opacis. (Pl. III, fig. 4–6.)

Stoney and gravelly hills and dry beds of torrents from 20 miles west of the Rio Colorado to about 150 miles westward up the Mojave; found in fruit in the beginning of March. This distinguished species is simple only when quite young; even the small globose plants show several heads from one base, and older cylindric stems have as many as 20 or 30 heads, all pretty nearly of the same size; the globose ones are 6–9 inches in diameter; the ovate heads are 12–15 inches high by 8–10 in diameter, and the largest cylindric stems seen were 2–$2\frac{1}{2}$ feet high by less than a foot in diameter. The number of ribs varies, in old specimens it is generally 21. Areolae about half an inch in diameter, and $\frac{1}{4}$–$\frac{1}{2}$ inch distant from one another; floral areolae smaller, without the ligneous glandular organs noticed in others. The spines in a young 5-ribbed living specimen before us are 7 radial and 1 central one; very soon, however, the 4 upper larger spines become central and 4 ~~lower~~ new upper spines are arranged radially; even in old

and full grown specimens sometimes not more than these 8 spines are found, the 4 upper ones (which are in this case perhaps rather improperly designated as central) stouter and cruciate, and the 4 lower ones arranged around the lower half of the areola Generally, however, 2 upper radial spines, weaker and less curved than the 4 lower ones, make their appearance; and in a few specimens before us we find 3–4 upper radial spines, the uppermost ones being quite slender.

In the field we noted as many as 15 spines occasionally, when no doubt 7 occupy the place of upper radial ones. The central spines are always very stout but very different in size; in some specimens we find them $1\frac{1}{4}$ to $1\frac{3}{4}$, while in others they are 2 to $3\frac{1}{2}$ inches long; they are nearly straight or very much curved; the upper one is often $1\frac{1}{2}$ to 2 lines wide, the lower one the longest.

The yellow flowers seem to make their appearance in February as the fruit ripens in March; the ovary and the fruit are enveloped in dense pure white cottony wool, which originates from the axis of the lower sepals and through which only the dark reddish-brown spine-like points of the sepals are visible. The incomplete description of the flowers was made from withered specimens adhering to the fruit. Tube of flower funnel-shaped, short and rapidly widening towards the upper end, naked (without free stamina) at the lower part. Petals about 1 inch long and 2 lines wide. Style 1–$1\frac{1}{2}$ inch long, stigmata 4 lines long. Fruit dry 8–10 lines in diameter, together with the remnants of the flower about 2 inches long, open at base when falling off; like the fruit of many if not most of our *Echinocacti*, seeds 2 lines long, $1\frac{1}{2}$ line broad, irregularly shrivelled, appearing rugose and angular, much like those of the nearly allied *E. ~~laticostatus~~, (horizonthalonius Lem.)*; hilum transversely oval; embryo curved, the cotyledons buried in the large albumen, accumbent, sometimes oblique.

This species is very nearly allied to *E. Parryi*, Englm. Synops. Cact. of the neighborhood of El Paso, but this latter species is depressed globose, much smaller, simple, with only 13 ribs, whiter, less flattened spines; fruit and seed are said to be the same, but unfortunately have been lost and cannot be compared; no doubt satisfactory diagnostic characters will be dicovered in the seeds; the fruit of *E. horizonthalonius* and *E. Texensis* are also similar, the latter, however, though woolly, is not dry.

Very different in flower and fruit but very similar in shape, in the many heads, numerous ribs, and stout curved annulated spines, is *E. cylindraceus*, discovered by Dr. Parry a few degrees further south on the eastern slope of the Sierra. We shall repeatedly have occasion, especially among the *Opuntiæ*, to indicate the remarkable analogies in the external form or in the more essential character of *Cactaceæ* in different geographical divisions of the southwest.

CEREUS, Haw.

Subgen. ECHINOCEREUS.

1. CEREUS VIRIDIFLORUS, Englm. in Wisl. Rep. Subnom. *Echinocereus.*

On the plains east of New Mexico, near the 100th degree of longitude, to the mountains of the Rio Grande, September 12, 1853.

2. C. CÆSPITOSUS, Englm. in Plant. Lindh. l. c. The most eastern of all our *Cerei!* and only found in the plains. It was first seen about 170 miles west of Fort Smith, near the 96th degree, about the same longitute where Mr. Lindheimer first discovered it on the Brazos, four degrees further south. Its western limit seems to be near the 100th degree, where the range of *C. viridiflorus* commences.

It may not be uninteresting to observe that this is the first time that this interesting genus has been recognized within the boundaries of the United States under the acquisition of Louisiana.

3. C. FENDLERI, Englm. in Pl. Fendl.: Seen first on the high plains 50 miles east of the Pecos, about the 105th degree, and extending from there over the mountains of New Mexico westward to the Aztec mountains, near the 113th degree. Southward it has been seen as far as El Paso.

The ovate or mostly elongated cylindric heads are simple or few together, and of a dark green color; they are characterized by the dark central spine, which is very bulbous and curved upwards, and by the lower radial spines being by far the stoutest, the lowest being 4–angular. Flower and fruit have been described elsewhere.

Var. *β.* PAUPERCULUS, with only about 6 spines, the central one assuming the place of an upper radial spine, was also found near the Pecos. It hardly deserves the designation of a distinct variety, as occasionally complete bunches of spines occur on the same plants with the depauperate ones.

4. C. MOJAVENSIS (sp. nov.): ovatus, dense cæspitosus, 10–11–costatus, glaucescens; areolis orbiculatis junioribus dense albo-tomentosis distantibus; aculeis basi bulbosis teretiusculis s. subangulatis robustis elongatis curvatis, radialibus 7–8, infimo superioribusque debilioribus, lateralibus longioribus, centrali singulo angulato sursum incurvato. (Plate IV, fig. 8.)

Var. *β?* ZUNIENSIS: dense cæspitosis 10-costatus, areolis paulo minoribus, aculeis tenuioribus basi bulbosis quadrangulatis rectis s. paulo curvatis flexuosisve, radialibus 8 infimo graciliore, summo robustiore longioreque, centrali singulo robustiore longiore recto s. sursum incurvo. (Pl. IV, fig. 9.)

Found between the Rio Colorado and Mojave creek, with *Echinocactus polycephalus* and *Opuntia erinacea*, etc., a region rich in rare *Cactaceæ*. The oval heads, 2–3 inches high, and 1½–2 inches in diameter, form dense cespitose masses much like *C. phœniceus*. The areolæ are 3 lines in diameter, 6 lines or more distant from one another. The long and very bulbous spines are curved and interlocked so as almost to hide the body of the plant. Upper and lower radial spines 9–15 lines, the uppermost one wanting or weaker than the rest; lateral spines 15-25 lines long, ashy-red when young; central spine more angled 1½–2½ inches long, dusky; all spines ashy-gray when old.

C. Zuniensis seems to form an intermediate link between this and the next species, but resembles most the former, to which for the present—not knowing flower and fruit—we doubtfully draw it as a variety. It was found near Cañon Diablo, on the Colorado Chiquito, about 120 miles west of Zuñi. Its manner of growth and whole appearance is very much like that of the Mojave species, the spines are weaker, straighter, and more angular; the principal difference consists in the stout upper radial spine, which is similar to the central spine. Young areolæ nearly 3 lines in diameter, 4–6 lines distant; lowest radial spine 6–9 lines, lateral ones 9–15, and upper one 12–18 lines long; central spine 1½–2 inches long, very bulbous at base. Young spines straw colored, old ones ashy.

C. Mojavensis seems to be nearly allied to *C. Fendleri*, (in both the spines are very bulbous at base, the central one single, angular, and curved upwards,) but the cespitose growth, glaucous color, longer radial spines, the lowest one of which is weakest, seem to distinguish it. The examination of numerous specimens *in loco*, and the flower and fruit only can decide here whether they are distinct, or forms of a single species, and this indeed is the case with all those *Cactaceæ* the flower and fruit of which are unknown to us. *C. Zuniensis* was collected December 18, 1852, and the Mojave plant March 4, 1854.

5. C. GONACANTHUS (sp. nov.): ovatus simplex s. e basi parce ramosus costis 7 interruptis, areolis magnis orbiculatis distantibus, aculeis robustis angulatis rectis s. varie curvatis flexuosisve, radialibus 8, inferioribus lateralibusque quadrangulatis flavidis basi et sæpe apice obscuris,

infimo breviore, summo elongato robusto multangulo obscuro erecto aculeum centralem similem multangulatem erecto-patentem subæquante, rarius excedente. (Plate V, fig. 2–3.)

On high sand-bluffs, covered with scattering cedars, near the natural well, about 40 miles west of Zuñi, near the 109th degree. Only seen in that locality. This species resembles, in its growth and the character of its species, *C. triglochidiatus;* it is simple or has 2 or 3 heads, 3–5 inches high; the young areolæ are very tomentose, 3–4 lines in diameter, and 6–10 lines distant from one another; the lower radial spine is 8–12, the others 10–15 lines long, pale or dirty yellow when young; the upper radial spine is much stouter and longer than the others, and resembles the central spine in shape, size, and color; in the few specimens at our disposal, we find it from $1\frac{1}{4}$ to $2\frac{1}{2}$ inches long; sometimes it assumes a more central place in the areolæ, the the two upper lateral spines almost closing above it, very rarely a small tenth spine appears above it. The central spine is $1\frac{1}{2}$–$2\frac{1}{2}$ inches long, 1 line in diameter, deeply furrowed, and 6 or 7 angled; it is longer, equal to or rarely shorter, than the upper radial spine. Both those spines are almost black or mottled yellowish and black when young, and become, with all the others, gray when old. Collected November 29, 1853.

6. C. TRIGLOCHIDIATUS, Englm. in Wisl. Report, Sub-Echinocereo: In rocky cañons at the Rio Gallinas, east of the Pecos, and from there to the Sierra Madre, near Mount Taylor; not noticed farther west; always with few branches, or nearly simple. Major Brooks, the commandant of the fort at Santa Fé, informed me that the fruit of this species is edible, like many other allied species. Collected September 28, 1853.

7. C. HEXAËDRUS, (sp. nov.): ovatus, simplex seu e basi parce ramosus; costis 6 obtusiusculis subinterruptis, sulcis latis superficialibus, areolis orbiculatis distantibus; aculeis tenuioribus rectis rigidis subangulatis basi bulbosis, radialibus 5–7 e flavido rubellis, inferiore breviore, summo sæpe robustiore, centrali robustiore longiore acute-angulato juniore fuscato, sæpe deficiente. (Plate V, fig. 1.)

On sandy hills, under cedars, about fifteen miles west of Zuñi. Few heads 4–6 inches high, 2–$2\frac{1}{2}$ in diameter, with six obtusish ribs, separated by wide and shallow grooves. Areolæ tomentose when young, only $1\frac{1}{2}$ line in diameter, 6 or 8 lines distant. Spines slender, but stiff; quite bulbous at base; lower ones 5–10, upper ones 8–15 lines long; mostly 6 radial spines, without a central one, the uppermost being the stoutest, longest, and darkest one, but smaller where a central spine is present. In a single instance, we found 7 radials, and in another one 2 compressed central spines; central spine usually 12–15 lines long. From the nearly allied, more southern *Cereus paucispinus*, Engl. MSS., this northwestern form is principally distinguished by the slender and angular spines. But as of neither of them we know the flower and fruit, we cannot form definite conclusions as to their specific distinction. These forms and *C. triglochidiatus* have a smaller number of ribs than any other species of this section. Collected November 28, 1853.

8. C. PHOENICEUS, Englm. in Synop. Cact., *E. coccineus;* Englm. in Wisl. Rep. non De C. nec Salm. (Pl. IV, fig. 1.) Found from the Upper Pecos to Albuquerque and Santa Fé, also five degrees further west, on the San Francisco mountains. The specimens perfectly agree with the description given in Wislizenus's report. The numerous heads, 2–3 inches high, about 2 inches in diameter, form dense cespitose masses, often one foot or more across. Areolæ 3–4 lines distant, large; spines slender, almost setaceous, with very slightly bulbous base, 8–12 radial ones, 3–6, 1–3 central ones 5–10 lines long; upper radial spines much shorter than lower ones.

The following form seems very distinct, especially in its manner of growth; but we have seen intermediate forms which seem to indicate the necessity of uniting both. Such questions, however, can only be solved satisfactorily by careful examination of flower and fruit, which are as yet unknown, and by extensive observation of these plants in their native wilds.

9. SUB-SPECIES C. CONOIDEUS: ovatus versus apicem conoideo-acutatus parce e basi ramosus, costis 9–11 tuberculatis, areolis orbiculatis s. subovatis junioribus albo-tomentosis, aculeis basi bulbosis, radialibus 10–12 tenuibus rigidis rectiusculis, summis brevibus, lateralibus inferioribusque longioribus, centralibus 4, (rare 3–5,) superioribus radiales vix superantibus infimo multo longoire 4–angulato sæpe complanato porrecto s. deflexo. (Plate 4, fig. 4–5.)

On rocky and mountainous localities on the Pecos, *Cer. Roemeri*, Muhlenpf., not Englm., from the San Saba, in Texas, seems to agree well with our plant, but the description is not full enough to decide about their identity.

Heads 3–4 inches high, single or few, of unequal height together; remarkable on account of their conical or acutish shape uniformly observed. Areolæ 4-6 lines distant; spines white or straw colored, larger central one often dusky when young; radial spines slightly bulbous at base; upper ones 2–5 lines, lateral ones 6–15 lines long, and lower ones hardly a little shorter; central spines very bulbous; upper ones not much longer than the lower radial ones; lower central spine sharply quadrangular, mostly compressed, often deflexed and curved, 1–3 inches long.

On the San Francisco mountains, a specimen was collected with 11 ribs, 8–9 radial spines, (4–12 lines long,) the uppermost shortest, and 3–4 reddish-gray central spines, very bulbous at base, the lowest longest (12–20 lines long) and angular. In superficial appearance, this plant resembles *C. Mojavensis*, but it must be referred here, and seems to indicate a range of this form through seven degrees of longitude.

A specimen from Anton Chico, on the Pecos, seems to unite *C. conoideus* with *C. phœniceus*. Areolæ more distant than the latter; spines longer; 3 central spines, lower one somewhat curved and angular. Collected September 28 and December 18, 1853.

10. C. ENGELMANNI, Parry, var. ~~and~~ VARIEGATUS: ovato-cylindricus simplex s. parce e basi ramosus 12-costatus, areolis orbiculatis approximatis, aculeis exterioribus sub-13 gracilibus rigidis albis apice sphacelatis adpressis lateralibus longioribus, summis deficientibus; aculeis centralibus 4 cruciatis (raro 5) plus minus curvatis infimo elongato angulato albo decurvato, ceteris brevioribus teretiusculis nigris corneisque variegatis; floribus ex axillis areolarum vetustiorum inferiorum; bacca ovata sicca pulvillis numerosis setas tenues albidas plurimas gerentibus stipata; seminibus obovato-subglobosis compressis rugoso-tuberculatis opacis. (Plate V, fig. 4–7.)

Var. β? CHRYSOCENTRUS, cylindricus parce e basi ramosus 10–12-costatus, areolis magnis; aculeis radialibus 12–14 albis superioribus setaceis brevibus, inferioribus longioribus robustioribus angulatis compressis rectis s. paulo incurvis, centralibus 4, superioribus rigidis robustis basi bulbosis angulatis rectiusculis elongatis, erectis vitellinis, inferiore angulato compresso albo recto paulo breviore deflexo; floribus ex inferiore plantæ parte; bacca ovata pulvillis paucis aculeos setosos longiores albos gerentibus stipata. (Plate V, fig. 8–10.)

On the Cactus mountains and at the head of Williams river, degrees 113½ longitude. Heads 4–9 inches high, single or few, not more than 4–6 together; areolæ 2–4 lines distant; radial spines 3–5 lines long, upper central spines 3 or sometimes 4, black on the upper, and horn-colored on the lower side and towards the point, 1–1½ inches long, lower central white, 1½–2 inches long. Position of fruit on lower half of plant much like that of *C. chloranthus*, *E.* ~~ined~~, only 6–8 lines long, crowned with the remains of the (red?) flower. Seed 0.6–0.7 line long compressed, tubercles sometimes irregularly confluent and leaving pits between the ridges, lower part of the back with a smooth carina, hilum oval.

Var. β CHRYSOCENTRUS, named after its deep golden-yellow spines, is, probably, not specifically distinct, though the straighter, stouter, and less divergent spines give it a very peculiar appearance. It was found where *C. variegatus* disappears on the lower part of Williams' river, and was seen from there to the Mojave creek, and up that stream to the Sierra Nevada. Stems 5–10 inches high, areolæ 6–7 lines distant, young ones 2½–3 lines in diameter. Upper radial spines 3–5, lateral 5–7, and lower ones 7–12 lines long; the latter flattened and often curved up.

Upper central spines 3 or sometimes 4, 2–3 inches long, bulbous and angular at base, terete above; lower central spine 1½–2½ inches long, flattened. Spines on fruit 3–8 lines long, fewer and stouter than in the other form.

Cereus Engelmanni, Parry, has been found abundantly by Mr. A. Schott on the lower Gila; a specimen brought home evidently seems to unite them, and consequently *C. variegatus* and *C. chrysocentrus* are to be considered forms of it.

I am acquainted with the *habitus* of about 15 or 16 species of the subgenus ECHINOCEREUS. All of them are of low growth, (I write of those only with which I am acquainted,) never more than 12, seldom more than 8, and often less than 5 inches in height. All, also, are more or less cespitose, or branching from the root; some of them slightly, others very much so. *Cereus viridiflorus, chloranthus, dasyacanthus, ctenoides, cæspitosus, longisetus, Fendleri, gonacanthus, hexædrus, paucispinus*, and *Engelmanni*, grow in small irregular tufts, or masses, some of the joints or stems being much taller than others. Some of them, such as *C. viridiflorus, dasyacanthus, ctenoides, cæspitosus*, and *Fendleri*, are often nearly simple, or having but few branches; while others, such as *C. chloranthus, longisetus, gonacanthus, hexædrus, paucispinus*, and *Engelmanni*, have usually 8–20 joints. *C. polyacanthus, phœniceus*, and *enneacanthus* are much branched, and grow in somewhat flattened masses, sometimes with a circular outline, but not always, all the joints being of nearly an equal height. *C. stramineus* always forms a dense hemispherical mass, of a perfectly regular contour—the central joints being the oldest and longest—9–12 inches high, gradually subsiding towards the circumference of the mass until the extreme outer stems are not more than 2 inches high. *C. Mojavensis* often grows similarly, but I have also seen it in much broader masses, containing 500–800 heads or joints; in such cases it is always flattened on the top. Where this state occurs, the central joints are as high as in the hemispherical masses, but the hemispheric contour is destroyed by the longitudinal extension of the joints, forming masses sometimes 4 or 5 feet in diameter. *C. phœniceus* and *C. conoideus*, two forms which Dr. Engelmann has united into sub-species, are quite different in their manner of growth. *C. pheniceus*, as stated above, grows in irregular flattened masses, while *C. conoideus* has the more elevated and somewhat hemispherical shape of *C. stramineus*. On account of the unfavorable season of the year (October—March) during our journey through regions of these cacti, we were unable to procure the flower or fruit of any of these plants. In our friendly correspondence with Dr. Engelmann, I insist that *C. phœniceus* and *C. conoideus* are distinct species, and (from analogy only) I assume that when the flower of *C. conoideus* is obtained, it will be found to be a *purple*, while that of *C. phœniceus* is *crimson*. Time and observation, however, are the only decisive arbiters of such controversies.

Subgen. EUCEREUS.

Of *Cereus* proper only one species was seen, viz:

11. CEREUS GIGANTEUS, Englm.: Williams' river to the Colorado of the west, February 4 to February 22, 1854. This is the most northern true *Cereus* that we have, being found as high as latitude 34°, while *Cer Greggii* and *Emoryi* are found only a little above latitude 32°. This plant has a considerable range, extending south, from this place to near latitude 28° in the vicinity of Guaymas Sonora. The fruit under the Mexican name of *Pitajaya*, pronounced Pit-a-zi-ah or Pit-ai-yah, is a great source of sustenance to the Mexicans and Indians of the regions where it grows. Conserves and molasses, or syrup, are made from them which are preserved during the winter season for future use. They are very pleasant to the taste in a fresh state. As the fruit grows near the top of the tree at an altitude of 25 to 50 feet and being very large and pulpy, if permitted to ripen and drop to the ground, they burst and are almost rendered unfit for use. The Indian mode of collecting them is to take a long light pole, make a fork at the top by tying a short piece to it, by which they contrive to bring them within reach. Birds and every kind of animal and insect that can reach them are so fond of them that many

of them are thus destroyed. My friend, Mr. Schott, of the Mexican boundary, who has lately returned from that desolate but rather interesting region, informs me that still further south this interesting plant is replaced by another not so large—but still a great cactus. This is very probably the one collected by Mr. Thurber, described and named by Dr. Engelmann, in Silliman's Journal, *Cer. Thurberi*. The pitajaya of this species, according to Mr. Schott, is the principal support of the Papige Indians. It is much larger, sweeter, more juicy than that of the *Cer. giganteus*. The color of the pulp is also of a much brighter red.

In consequence of the remote and unhospitable region of this curious and interesting cactus, our acquaintance with it became very gradual. Dr. Englemann thinks that Baron Von Humboldt, in his work on New Spain, must have had reference to this plant, but this is quite uncertain because no characteristics are given of his cacti (organos del Lunal) except size and edible fruit, and many other large species of both cerei and opuntiæ are long and well known to yield them. In 1846, Major Emory first collected seeds and made figures of it which, on being presented to Dr. Engelmann, he was ~~unable~~ enabled to pronounce it a true *Cereus* and at that time very appropriately named it. Subsequently, (winter and spring of 1852,) Dr. Parry, under Major Emory, visited that region, collecting spines, wood, &c., and making copious notes on the ground, enabled Dr. Engelmann to give a good diagnosis of it. Still Dr. Parry was unable to procure the flower or fruit on account of the lateness of the season. It was reserved for Mr. Thurber, who repassed this region in the summer of 1852, to collect complete specimens, and Dr. Engelmann, in a subsequent number of Silliman's Journal, has given a complete description of it. (Vide Amer. Jour., Vol. XVII, 2d series, March, 1854.) To the several excellent accounts given of this tree by Dr. Engelmann, little of interest can be added. As noticed by Drs. Parry and Engelmann, the number of ribs at the base is about 12, and they "increase upward, by bifurcation and addition," to the largest circumference of the tree, which is about 15–18 feet from the ground, and where also usually the few branches are given off. Here the ribs sometimes number 30, and from this point upward they decrease in number to 18–20. The wood at the base of old specimens becomes a perfect hollow cylinder, and from thence upward to the first branches, instead of being solid it becomes a reticulated net-work of bundles of wood continuing the hollow cylinder as is seen on a smaller scale in the wood of *Opuntia arborescens*. These trees in abundance give the landscape a very peculiar appearance, and from their novelty and entire dissimilarity to any others, at first is not only curious but pleasing, but as the eye becomes accustomed to it, a gradual transition takes place in ones feelings and from being pleasing they at last become monotonous and repulsive. This feeling, however, may be somewhat accounted for by the surrounding sterility of the land. As far as the eye can reach in the vallies or on the mountains, little else but rocky boulders and the stately yet awfully sombre aspect of the cereus giganteus can be seen.

OPUNTIA, Tourn.

Subgenus 1. PLATOPUNTIA, Englm.

1. OPUNTIA ENGELMANNI, Salm. At Delaware, about 170 miles west of Fort Smith, a specimen of this plant was observed about four feet high. This seems to be the northern limit of a species which is widely spread from lower Mexico to the mouth of the Rio Grande, and on both sides of that river, northward and southward. In the southern regions it grows much taller than in the north.

2. OP. ENGELMANNI, β? CYCLODES: erecta, articulis orbiculatis, pulvillis remotis tomento griseo setisque stramineis rigidis inæqualibus instructis; aculeis subsingulis rectis validis compressis stramineis basi fuscis deflexis, adjectis sæpe 1–2 inferioribus brevioribus pallidioribus; bacca globosa late umbilicata, seminibus late undulato-marginatis. (Plate ~~VIII, fig. 1.~~ XXII. f. 1–9

About the mouth of the Gallinas into the Pecos, near Anton Chico, New Mexico; collected in fruit in September. Plant 4 feet high; joints orbicular, or even transversely oval, about 7 inches in diameter; pulvilli 1 inch apart, large, with a semi-circle of large, coarse bristles, 3–4 lines long at the upper edge, and a single stout spine, $1\frac{1}{4}$–$1\frac{3}{4}$ inch long, on the upper pulvilli, often with 1 or 2 additional ones, 4–9 lines in length. Flower not seen. Fruit globose, 1–$1\frac{1}{4}$ inch in diameter, of a purple color. Seed 2.0–2.3 lines in diameter, with a broad and thick acutish undulate rim. The circular joints with fewer spines, and the small globose fruit with large seeds, distinguish this form from *O. Engelmanni*, as it usually appears further south.

3. Op. occidentalis, (sp. nov.): erecta patulo—ramosissima, caule demum lignoso terete corticato, articulis grandibus obovatis rhomboideisve, pulvillis remotis griseo-tomentosis, setis flavis s. flavo-fuscis gracilibus confertis, aculeis 1–3 validis compressis angulatis rectis deflexis divergentibusve, uno alterove ad articuli marginem superiorem erecto, albidis corneisve subannulatis basi flavo-fuscis cum adventitiis 1–2 gracilioribus pallidioribus deflexis; flore flavo intus aurantiaco, ovario obovoto pulvillis fusco-villosis vix fulvo-setosis sub-25 notato subinde parce aculeolato, sepalis (extus rubellis) 10–12 dilatato-obovatis cuspidatis, petalis (8?) obovatis obtusis subintegris; bacca obovata late umbilicata succosa, seminibus majoribus irregularibus undulato-marginatis, crenulatis. (Plate VII, fig. 1–2.) XXII. 10

On the western slope of the California mountains, from QuiqualGungo, east of Los Angeles, to San Pasquale and San Isabel, northeast of San Diego, (A. Schott,) at an elevation of 1,000 to 2,000 feet, in immense patches, often as large as half an acre. Flowers in June. Stout ligneous stems, with innumerable branches, sometimes over one hundred joints, spreading far, and then often bent to the ground; joints 9–12 inches long, 6–8 inches wide; pulvilli $1\frac{1}{2}$–2 inches distant, with slender and closely set (much more so than in *O. Engelmanni*) bristles, only 2–3 lines long on the upper part of the pulvillis; spines 1–$1\frac{1}{4}$, smaller ones $\frac{1}{2}$–$\frac{3}{4}$ inch long. Flower yellowish and orange, deeper colored inside at the base, 3–$3\frac{1}{2}$ inches in diameter; ovary $1\frac{1}{2}$ inch long, not one inch in diameter; pulvilli pretty equally distributed over it, (not as much congregated toward the top as in *O. Engelmanni*;) sepals short and unusually broad; petals only 9 or 10 lines wide by 15 lines in length, rounded, and not emarginate in my specimen, nor mucronate. Fruit 2 inches long, $1\frac{1}{4}$–$1\frac{1}{2}$ inches in diameter, "very juicy, but of a sour and disagreeable taste." Seeds $2\frac{1}{2}$–$2\frac{3}{4}$ lines in diameter. The young plants, raised from the seeds which we brought home, fail to exhibit the very hairy pulvilli which all the young of *O. Engelmanni* show; they bear only the numerous bristly spines seen in most young *Opuntiæ*, at least of this section.

To Mr. A. Schott, who has considerably enriched our knowledge of the vegetation of the countries along the boundary line and in the Gadsden purchase, is due the credit of having discovered the flower of this plant, heretofore unknown, and of many valuable notes about its general habits.

The plant mentioned in Silliman's Journal, November, 1852, (Dr. Parry's collections,) as being common "on the hill-sides and plains near San Diego," and which Mr. Schott seems to have also found "on the sea-beach near San Diego," may be a form of *O. Engelmanni*, as suggested in the above publication; or it may be a naturalized wild state of *O. Ficus-indica*, which is cultivated about the missions there. Enough material has not been obtained to decide about it. At all events, it seems to be distinct from the plant of the western mountain slopes.

4. Op. chlorotica, (sp. nov.): erecta grandis, caule demum lignoso terete, cortice cinereo-fulvo, aculeis flavis numerosissimis fasciculatis armato; articulis orbiculato-obovatis magnis pallide flavo-virescentibus s. subglaucis; pulvillis subremotis griseo-tomentosis, setis stramineis difformibus exterioribus brevioribus tenuioribus subæqualibus confertis, interioribus uniseriatis robustioribus longioribus; aculeis in pulvillis inferioribus 1–3, in superioribus 3–6 inæqualibus stramineis plus minus compressis (nec acute angulatis) plerisque deflexis, interiore breviore

subinde erecto; flore flavo, ovario tubercula pulvilli-gera conferta sub-50 gerente; sepalis tubi sub-20 oblanceolatis cuspidatis, petalis sub-10 obovato spathulatis, obtusis mucronatis, stigmatibus 8 patulis; bacca obovata tuberculosa profunde umbilicata. (Plate VI, figs. 1–3.)

On both sides of the Colorado, from the San Francisco mountains to the headwaters Williams' river, sometimes called "Bill Williams' fork," and to the Mojave creek. The only erect, flat-jointed *Opuntia* in this section of country, 4–5 and sometimes even 7 feet high, forming large bushes, on one of which upwards of one hundred joints were counted. The large trunks have a scaly, grayish, or light-red brown bark; the pulvilli are not obliterated on it, as they are on *O. Engelmanni*, but are largely developed, 4–6 lines in diameter, pulvinate, densely covered with a thick brown tomentum, surrounded by numberless straw-colored bristles, 4 lines in length, and bearing 20–30 or more yellow, compressed spines, often 1–2 inches in length, stellately radiating in every direction, and covering and shielding the whole surface of the stem. The only *Opuntia* which I find described as having a similarly armed stem is *O. Karwinskiana*, Salm., which is said to have 18–20 gray spines on the oldest pulvilli.

Joints 8–10 inches long by 6–8 wide, always of a very pale glaucous, or rather more yellowish green color, which is strikingly characteristic, even at a distance, and which has procured our name for the plant; pulvilli about 1 inch apart, strongly pulvinate; bristles two-fold and distinct, the upper and outer, and by far the most numerous ones are shorter and thinner, and cover the upper semi-lunar area of the areola; inside of them is a semi-circular row of stouter and longer bristles, 4–6 lines long, which unite with the outer and shorter spines of the outer and lower margin of the areola. This arrangement is most distinct on the upper and more fully developed pulvilli; among our *Opuntiæ* it is only seen again, as far as known, in the obscure *O. dulcis* from Presidio del Norte. Spines proper 1–1½ inches long, pale straw color, with faint transverse markings, hardly darker at base; shorter spines 4–9 lines long.

The description of the flower was drawn from an old withered specimen gathered in winter; it seems pale yellow, between 2 and 3 inches in diameter; sepals and petals remarkably narrow, the latter about 1 inch long, and not half as wide. The ovary and fruit (all the specimens found were sterile) are quite tuberculous; pulvilli crowded, bearing brown wool and short, yellow bristles. Specimens of sterile fruit seen 1¼–1½ inches long.

5. Op. procumbens, (sp. nov.): prostrata, articulis orbiculato-obovatis grandibus pallide viridibus, pulvillis remotissimis griseo-tomentosis, setis flavis robustis valde inæqualibus, aculeis validis 2–4 subinde (in articulis vetustioribus?) 7–9 compressis angulatis inæqualibus, stramineis s. pallidioribus versus basin obscurioribus, sæpe rufis fuscisve, deflexis. (Plate VII, figs. 4–5.)

Arizona

From the San Francisco mountains to the Cactus Pass, at the head of Williams' river, in rocky localities. Joints 9–13 inches long, 7–9 broad, prostrate, always on edge; pulvilli 1½–2 inches apart; bristles 2–4 lines long, comparatively stout; spines 1–2 inches long; no flower or fruit seen. Very similar to *O. Engelmanni;* but prostrate, with even more distinct pulvilli, and stouter and often more numerous spines.

6. Op. angustata, E. & B.: prostrata s. adscendens, articulis elongato-obovatis versus basin sensim angustatis suberectis; pulvillis remotis griseo-tomentosis, setis fulvis gracilibus; aculeis paucis (2–3) validis compressis albidis s. stramineis, versus basin rufis s. fulvis, adjectis sæpe infra 1–2 debilioribus, omnibus deflexis; bacca obovata, tuberculata rubella, late profundeque umbilicata pulvillis 24 stipata, seminibus magnis subregularibus late marginatis. (Plate VII, figs. 3–4.)

From the foot of the Inscription rock, near Zuñi, to Williams' river, and westward as far as the Cajon Pass of the California mountains. Prostrate in the first and last-mentioned localities, but sub-erect in the bottoms of Williams' river. Joints 6–10 inches long, and at the upper third 3–4 inches wide, gradually narrowed downwards, rounded above; pulvilli over 1 inch

apart, oblong, quite strongty pulvinate, 3 lines long, bearing slender brown bristles; spines in the specimens collected east of the Colorado sharply angular, pale straw colored or whitish, brownish only at the very base, 1—1½ inch long; sterile fruit obovate-subglose, 1–1¼ inch long, with large pulvilli crowded toward the upper end of the fruit, covered with grayish-brown wool and bright brown bristles. The specimen from Cajon Pass has brighter colored spines, with the lower half red brown, not so angular; some erect spines, at the upper end of the joint, almost terete. On this specimen a ripe fruit was collected, from which the above description has been taken; it is 1½ inch long, nearly one inch in diameter, with the wide and flat umbilicus immersed about half an inch; pulvilli on tubercular elevations about 14 on the upper part of the fruit, and 10 along the rim; seeds 3 lines or more in diameter, much compressed, with the broad rim almost curled. Some of the seeds have germinated, and the young plants grow vigorously.

This plant cannot be confounded with any others of our species; some southern *Opuntiæ* have similar, or even more elongated joints, but are erect and almost unarmed, such as *O. stricta*, *O. tuberculata*, *O. lanceolata*, *etc.* *O. polyantha* from South America, seems to be similar, but has smaller and more spiny joints, etc.

7. Op. phæacantha, var. major E. in Pl. Fendl. Mem. of American Acad. IV, page 52.

Near Zuñi.—As both Mr. Fendler and ourselves failed to collect the fruits of this form, it remains doubtful whether it has been justly referred here, or whether it is more closely allied to *O. Camanchica*.

Op. Mojavensis, E. & B.: prostrata, articulis grandibus suborbiculatus, pulvillis remotis, setis grandibus fulvis, aculeis 2–6 validis compressis acute angulatis elongatis plus minus curvatis, fuscis versus apicem pallidioribus annulatis, adjectis infra 1–3 minoribus tenuioribus pallidis; bacca pulvillis 20–25 fusco-setosis stipata. (Plate IX, fig. 6–8.)

On Mojave creek; at the time it was considered identical with the following species, and no further notice taken of it; only a few fragments were brought home, together with a sterile fruit. Spines 1–2½ inches long, stout, bright-brown; fruit 1¾ inch long, oblong; pulvilli crowded towards the upper end. It is possibly a distinct species, but the material too incomplete to permit us more than merely to indicate it.

8. Op. Camanchica (sp. nov.): articulis adscendentibus majusculis obovato-orbiculatis pulvillis remotis orbiculato-ovatis tomentum griseum setasque paucas stramineas fulvasve (in pulvillis terminalibus demum elongatis rigidiores) gerentibus plerisque armatis; aculeis 1–3 s. ad marginem pluribus compressis fuscis s. atro-fuscis versus apicem pallidioribus superioribus elongatis suberectis ceteris deflexis gracilioribus. flore? Bacca ovata late umbilicata atro-rubente succosa pulvillis remotis obsoletis seminibus majusculis irregularibus angulatis late marginatis (Plate IX, fig. 1–5.)

On the Llano Estacado, at the base of the hills, in rather fertile soil, from the easten slope of that elevated plain to the Tucumcari hills, near the upper course of the Canadian river. A large plant, spreading extensively, with large rounded joints 6–7 inches long by 5½–7 wide; pulvilli about 1¼ inch remote; bristles dirty-yellowish, greenish or brown, inconspicuous, except at the upper edge, where they often become elongated and stouter; only the lowest pulvilli are spineless, the others bear 2–3 and the marginal ones 3–6 spines; larger ones 1½–2 and in some specimens almost 3 inches long. Flower unknown; fruit very characteristic, distinguishing this species from the nearly allied *O. phœacantha*. It is oval, not narrowed or constricted at base; 1½–2 inches long, 1–1¼ inch in diameter, with a large flat umbilicus ¾–1 inch in diameter, considerably resembling the fruit of *O. Engelmanni*; of a deep-red color and a very sweet juicy pulp. Seeds 2¼–3 lines in diameter, very irregular, angular and often twisted, with sides impressed, mostly with a broad and thick acute or obtuse rim deeply notched at the hilum.

9. Op. TORTISPINA (sp. nov.): prostrata, articulis majusculis adscendentibus obovato-orbiculatis, pulvillis subremotis stramineo s. fulvo-setosis; aculeis 3–5 majoribus compressis angulatis subinde canaliculatis sæpe spiraliter tortis, albis basi apiceque sæpe corneis, adjectis infra aculeolis 2–3 gracilibus albis; flore ———; bacca ovata areolis sub-20 parvulis notata, late umbilicata, seminibus mujusculis regularibus crassis. (Plate VII fig 2–3. XXIII. 1–5

On the Camanche plains, near the Canadian river, east of the plateau of the Llaño Estacado. Similar in growth to the more western *O. Camanchica*. Joints rounded, 6–8 inches long; pulvilli 1–1½ inches apart; bristles short, except on the edges, where they are 2–3 lines long, but rather slender; spines more numerous than in any other of our species, with juicy fruit, often 6–8, lower smaller ones ⅓–1 inch, larger ones 1½–2½ inches long, entirely white or yellowish horn-colored at base and tip; on the upper areolæ one erect spine, the others spreading in different directions, lower ones deflexed. Fruit similar to that of last species, large, oval, not contracted at base, perhaps less juicy and with a somewhat smaller and deeper umbilicus, 1¾–2 inches long, 1–1¼ in diameter. Seeds 2–3 lines across, thick and quite regular, with a very slight indentation at the hilum.

I had observed that sometimes 2 plants are produced from the same seed; this I found to be the case occasionally with *Opuntia occidentalis, Engelmanni* and *dulcis*, one of the young plants always much larger and more vigorous than the other. In examining different seeds of this speceis, I succeeded in finding one with two embryos (see figure), one spirally coiled around the other, both together appearing like one large one. Pl. XXIII. f. 4–5

10. Op. RAFINESQUII, Engelm.: diffusa, radice fibrosa, articulis mediis s. majusculis obovatis s. suborbiculatis per-viridibus; foliis subulatis elongatis patulis, pulvillis sub-remotis albido-s. griseo-villosis setas graciles rufas demum elongatas gerentibus plerisque inermibus; aculeis paucis plerumque solum marginalibus validis teretibus rectis albidis sæpe basi apiceque rufescentibus erectis s. patulis, singulis s. uno alterove graciliore deflexo adjecto; floris alabastro conico acuto, ovario clavato pulvillis 20–25 griseo-villosis rufo-setosis instructo; sepalis tubi sub-13 oblanceolatis acuminatis, interioribus late petaloideo-marginatis cuspidatis; petalis 10–13 late obovatis eroso-denticulatis sub-marginatis sulphureis basi intus miniatis, stigmatibus 7–8 erectis adpressis flavo-albidis; bacca ovata basi angustata clavata subnuda pulposa purpurascente, umbilico infundi buliformi immerso; seminibus subregularibus compressis, margine plerumque lato compresso sub-acuto. Var. *microsperma*: subinermis, seminibus minoribus regularibus angustius marginatis. (Plate XII, fig. 3–5.) XXIII. 7–8

In sterile, sandy, or rocky (consisting as well of sandstone as of limestone) localities in the Mississippi valley, Illinois, Missouri, Arkansas, and north to Wisconsin, east to Kentucky, and south, probably, to Louisiana and Texas; westward it has not been found west of the western boundary of Missouri and Arkansas. Flowers in May and June; fruit ripens in the same season, but remains on the plant till the following spring. Joints rather large, orbicular 3–4 inches in diameter, or obovate, 4–5 inches long by 3 in width; a small variety with orbicular joinsts only 2 inches in diameter occurs on sandstone rock in southern Missouri. The color of the plant is dark or fresh-green. Leaves 2½–4 lines long, diameter about one-fourth of the length; pulvilli 9–12 lines apart with short whitish or grayish wool, and bright red-brown bristles conspicuous even in the youngest joints. Spines rarely none, generally few in var. *microsperma*, sometimes disappearing entirely in fertile soil in gardens, etc.; mostly only on the upper part or the edge of the joint, single or rarely 2–3, 9–12 lines long, rather stout, white with a darker tip and sometimes also darker base. Flowers 2½–3½ inches in diameter, sulphur-yellow, mostly with a red centre. Fruit 1½–2 inches long, less than half that in diameter, narrowed at base, the seminiferous cavity not extending to the base; umbilicus funnel-shaped, but with shallow bottom, much wrinkled and scarred; naked by the disappearance of the bristles of the pulvilli, and edible, somewhat acid or sweetish. Seeds 2½ lines in diameter,

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Opuntia vulgaris is figured Pl. X. f. 1–2 & Pl. XXIII f. 13
to compare with O. Rafinesquii

hardly more than one line in thickness; rim rather narrow, thick, but acutish. Var. *Microsperma* has seeds only 0.8 or 0.9 line in diameter, more compressed, with quite a narrow rim.

This species has, by western botanists, generally been considered identical with the eastern *O. vulgaris*. Riddell mentions it as occurring in Kentucky and Illinois, Torrey & Gray in their Flora do not give any locality in the Mississippi valley; but Rafinesque had already observed it in Kentucky, and, in his usual careless manner, had indicated 3 species: *Cactus humifusus*, (which growing, "from New York to Kentucky and Missouri," probably comprised both *O. vulgaris* and our species,) *O. cæspitosa*, from Kentucky and Tennesse, and *O. Mesacantha*, from Kentucky to Louisiana. As it seems impossible from his incomplete descriptions to make out what he meant by three different names, and as we know only one species in those States of the Mississippi valley, I take the liberty of discarding those names and of substituting the name of the author for the western species. It is not improper to state here that Rafinesque's vague and partly erroneous descriptions have found their way into Seringe's Bulletin, 1831, page 216, into the Linnæa, vol VIII, into Pfeiffer's Enumeratio Cactearum, page 146, and into other works, but with the substitution of Nuttalls for Rafinesque's name as authority; the "rounded joints" have, in these works, been taken for "globose" or "cylindric" joints, and our plant has been classed with the *Opuntiæ glomeratæ* from Chili and Mendoza.

A large form of *O. Rafinesquii* was collected near Fort Smith, on the western border of Arkansas; further west, where no true *O. Rafinesquii* has been found, several forms were met with, which, though they exhibit some distinctive characteristics, are, perhaps, not sufficiently different to constitute distinct species. The flowers of most of them are unknown as well as the leaves, but fruit and seeds were carefully preserved, which not only furnish important characters, but also the means to propagate, cultivate, and further to study them. We append them as sub-species.

1. RADICE FIBROSA.

a. O. CYMOCHILA: diffusa, articulis orbiculatis, pulvillis subremotis griseo-tomentosis stramineo s. fulvo-setosis, plerisque armatis; aculeis 1–3 robustioribus elongatis teretibus s. subcompressis tortisque albidis basi saepe rufescentibus, patulis deflexisve, additis saepe 2–3 gracilioribus radiatim deflexis; flore? stigmatibus 8; bacca obovata umbilico plano s. parum depresso pulvillis 20–24 griseo-tomentosis parce setulosis, demum nudatis; seminibus irregularibns angulosis; margine undulato acuto. (Plate XII, fig. 1–3.) XXIII. f. 10–12

On the Camanche plains east of the Llaño Estacado, near the 100th degree of longitude, and from there to Tucumcari hill, 80 miles east of the Pecos. Joints $2\frac{1}{2}$–3 inches in diameter, orbicular or very slightly obovate; pulvilli 6–8 lines apart; the very light yellowish-brown bristles numerous, and conspicuous only on the older joints; only the lowest pulvilli of a joint unarmed, upper ones with 2–5 spines, 2 or 3 larger ones, often reddish-brown at lower half, 1–2 inches long, lower, smaller, paler ones 3–9 lines long. Fruit oval, 1–$1\frac{1}{4}$ inches long, about 10 lines in diameter, purplish, pulpy, sweet, and edible, less contracted at base than *O. Rafinesquii;* seed remarkably irregular and twisted, $2\frac{1}{2}$ lines in diameter, with a wavy or twisted very sharp rim, whence the name which indicates the undulated border.

The orbicular joints, the numerous spines, the oval not clavate fruit, and curiously twisted seed, seem to distinguish this form sufficiently from *O. Rafinesquii*, but these characters may not be sufficiently constant or important to constitute specific difference. The characters of *Opuntiæ* are not yet sufficently studied to permit us to form satisfactory conclusions about their diagnostic importance; so we find a form collected on the Sandia mountains, near Albuquerque, which, in habit and appearance, does not differ from the common form of *O. Rafinesquii*, but which has the seeds of *O. cymochila:*

O. CYMOCHILA, *β.* MONTANA: articulis orbiculatis majoribus inermibus s. margine superiore solum aculeatis; pulvillis remotis stramineo-setosis; aculeis singulis binisve validis albidis

infra fuscis; bacca obovata subclavata seminibus irregularibus acute undulateque marginatis. Joints 3–4½ inches in diameter, pulvilli 9–12 lines apart, spines 12–18, smaller ones 4–6 lines long, on some plants entirely wanting. Fruit 1½ inches long, much contracted at base, with a much depressed, almost funnel-shaped, umbilicus. Seeds cannot be distinguished from those of the plant of the plains.

b. O. STENOCHILA: prostrata articulis obovatis, pulvillis remotis stramineo-setosis superioribus solum armatis; aculeis singulis albidis patulis, 1–2 minoribus deflexis sæpe adjectis; bacca obovata clavata pulposa, umbilico lato parum immerso, seminibus regularibus crassis anguste obtuseque marginatis. (Plate XII, fig. 4–6.) t. XXII. f. 9

At the cañon of Zuñi. Joints 4 inches long and 3 wide, flaccid or often lying flat on the ground, (in November;) pulvilli 12 lines apart, small, with yellowish or greenish bristles; larger spines 1–1¼ inches long, smaller ones less than half as long; fruit green or pale red, very juicy; 1½ inches long, but sometimes much enlarged, even more juicy, and 2–2½ inches long and 1 inch in diameter above, long clavate towards the base. Seeds quite characteristic, about 2½ lines in diameter, 1½ line thick, regular, with a very narrow and somewhat obtuse rim, whence the name.

In the same neighborhood another plant was found with ~~similar seed, but~~ smaller, more rounded, and somewhat more spinous joints, fruit less clavate, smaller, seeds similar, but a little smaller.

2. RADICE TUBEROSA.

c. O. FUSIFORMIS: diffusa s. adscendens, radicibus fusiformibus elongatis, irregulariter incrassatis; articulis suborbiculatis majusculis, foliis elongatis subulatis patulis pulvillis subremotis griseo villosis, setas elongatas virescente-fuscas gerentibus, plerisque s. solum superioribus armatis; aculeis 2–3 gracilibus inæqualibus deflexis s. patulis, albidis; floris minoris flavi (basi rubelli?) ovario pulvillis 25 stipato, stigmatibus 8, bacca ovata basi vix clavata demum nudata, pulposa rubella, umbilico immerso subinfundibuliformi; seminibus subregularibus crassis majusculis acute marginatis. (Plate XII, fig. 7–8.) t. XXIII f. 6

Cross-timbers longitude 97°–99°; west of the region inhabited by *O. Rafinesquii*, and east of that of *O. cymochila;* also collected by Dr. Wislizenus in the same longitude, but farther north on Cow creek and the Little Arkansas, (on the road from Independence to Santa Fé,) and by Dr. Hayden, of the United States army, on the Missouri, below the Big Bend. Fl. in May. Roots form elongated tubers, attenuated at one or both ends ½–1 inch in diameter; joints 4 or even 5 inches in length; leaves 2½–3½ lines long, pulvilli 9–12 lines apart, with numerous stout yellowish-brown bristles, often 2 lines long, spines 1 or 2, 1–1¼ inches long, with a smaller one of half the length, more slender than in most other allied forms. Flowers 2–2½ inches in diameter, yellow apparently with red base, smaller and with fewer sepals than *O. Rafinesquii*, but the same number of stigmata. Fruit 1½ inches long, umbilicus ½ inch wide; seed rather larger and thicker than in *O. Rafinesquii*, 2¾ lines in diameter and 1½ thick. The description of the flower is from the specimens collected by Dr. Wislizenus.

O. MACRORHIZA, Engl., of Texas, also belongs here as another tuberous rooted form in the wide circle of *O. Rafinesquii*.

11. O. BASILARIS (sp. nov.): humilis, articulis obovatis s. subtriangularibus glaucescentibus pubescentibus adscendentibus e basi proliferis, fere rosulatis; foliis subulatis minutis erectis rubellis tomentum axillare vix superantibus; pulvillis subconfertis fulvo-tomentosis setas gracillimas demum numerosissimas breves fulvidas et subinde aculeolos setiformes caducos gerentibus; floris purpurei; ovario obovato pubescente pulvillis plurimis (40–60) confertis fulvo-tomentosis instructo, sepalis 20-25 exterioribus oblanceolatis acuminatis, interioribus late obovatis cuspidatis, petalis sub-10 obovato-orbiculatis retusis s. obcordatis sæpe tenuiter mucronatis,

stigmatibus 8 brevibus in capitulum conicum congestis; bacca (sicca?) breviter obovata late umbilicata, seminibus magnis crassis subregularibus. (Plate XIII, fig. 1–5 & XXIII. 14)

On hills and in ravines from the Cactus Pass down the valley of Williams river to the Colorado, and to Mojave creek; Mr. Schott met with it on the lower Gila; and both he and Mr. Albert H. Campbell obtained the beautiful purple flowers of this plant in April and May, 1855. The habit of this plant is very different from any other of our *Opuntiæ*, as the stout obovate or often fan-shaped or sometimes almost obcordate joints originate from a common base form a kind of rosette, resembiing somewhat an open cabbage head. Among thousands of specimens observed, none deviated from this peculiar manner of growth, none was proliferous in the shape of the other elliptic *Opuntiæ*. Joints 5–8 inches long, ½ inch in thickness, minutely pubescent; leaves only 1 line in length, slenderly subulate, smaller than any other of our species; next in size are the leaves of *O. Missouriensis*, *O. fragilis*, and *O. filipendula;* the largest leaves are produced by the cylindric *Opuntiæ*, some of which have them 10 lines long.

Pulvilli somewhat immersed, 4–6 lines apart. Flower of a beautiful and rich purple color, about 2½ inches in diameter, ovary nearly 1 inch long, crowded with 40–60 elevated areolæ, with light brown wool and brighter brown bristles; filaments not very numerous, leaving the inner base of the tube naked; stigmata about 2 lines long, or less, apparently green. Fruit seems to be perfectly dry, short and thick; seeds 3 lines in diameter, nearly 2 lines thick, with a rather narrow but very thick rim, regular or sometimes quite irregular.

12. O. HYSTRICINA, (sp. nov.): diffusa, articulis obovato-orbiculatis, compressis, pulvillis subconfertis magnis griseo-tomentosis setas pallidas rutilasve gerentibus, omnibus armatis, aculeis 5–7 inferioribus gracilioribus brevioribus albidis deorsum radiantibus, superioribus 5–8 elongatis validioribus angulatis sæpe tortis flexuosisve, 3–4 deflexis albidis, uno alterove longissimo, ceteris 2–4 superioribus patulis suberectisve sæpe basi s. ad medium fuscatis; flore ——, bacca obovata subclavata, umbilico parum immerso planiusculo, pulvillis 25–30, inferioribus inermibus, superioribus confertis aculeolos paucos gerentibus; seminibus maximis irregularibus late crasseque marginatis. (Plate XV, fig. 5–7. & XXIII. 15)

This beautiful species was found abundant from the Rio Grande westward to the San Francisco mountains, mixed with *O. Missouriensis*, to which it is nearly allied. The specimens before us were obtained at the Colorado Chiquito and on the San Francisco mountains. Joints 3–4 inches long and nearly as broad. Pulvilli 5-6 lines apart, unusually large; lower radiating spines 4–9 lines, the others 1½–3 and even 4 inches long, irregularly arranged as we generally find it in this species. We notice many specimens where 3 or 4 larger spines are placed above the lower short radiating ones, the uppermost one of them is usually the longest; somewhat above these are 2–4 other spines, the lower one of which is the darkest and often not much shorter than the one just mentioned, the others are shorter and whitish or dark only at the base. The bristles are yellowish in some and brown in other specimens; sometimes we find short pale and longer darker bristles together. The fruit is 1 inch long and half as thick, with a very shallow umbilicus; only the upper larger pulvilli bear 4–6 spines (2–5 lines long,) the lower ones on the contracted part of the fruit are very small, distant, and unarmed. Seed among the largest in this genus 3½ lines in diameter, the thick and broad rim acutish. The name indicates the porcupine-like armature of this species.

13. *O. Missouriensis*, D. C.: prostrata, radice fibrosa; articulis obovatis suborbiculatisve tuberculatis compressis laete viridibus adscendentibus, foliis subulatis minutis patulis, pulvillis subconfertis albo s. griseo-tomentosis stramineo—setosis omnibus armatis; aculeis in pulvillis inferioribus gracilioribus paucioribus, in superioribus 5–10 exterioribus minoribus radiantibus albidis, 1–5 interioribus robustis teretiusculis longioribus patulis, rarius suberectis, albidis s. rufescentibus; floribus sulphureis basi intus sæpe aurantiacis, ovario obovato subgloboso, pulvillis 25–35 albo tomentosis aculeolatis instructo; sepalis tubi sub-13 exterioribus oblanceolatis,

interioribus obovatis cuspidatis petaloide-marginatis, petalis sub-13 obovato-orbiculatis emarginatis s. obcordatis crenulatis sæpe mucronulatis; stigmatibus sub-8 viridibus in capitulum globosum s. conicum confertis; bacca ovata s. subglobosa, umbilico parum depresso, pulvillis 25–35 albo tomentosis setis albidas stramineas s. rufescentes aculeolosque numerosos breves s. elongatos gerentibus; seminibus magnis plerumque irregularibus late subacuteque marginatis. (Plates XIV and XV, fig. 1–10 and 1–4.)

This variable species extends from the country north of the Upper Missouri river to the regions south of the Canadian and of Santa Fé, latitude 48° 35′; and from longitude 99° east of Fort Pierre, on the Missouri, to 112° on the San Francisco mountains. It has not been found south of Albuquerque, along the Rio Grande, nor in the Salt Lake valley, Utah, as far as at present known. Flowering in May, fr. same fall. Nuttall discovered this common western species on the Upper Missouri in 1811, and described it under the name of *Cactus ferox;* he noticed "8–10 greenish stigmata" and the "dry spiny fruit." The deep purple fruit, as large as a hen's egg," attributed to our species on the authority of Dr. James, by Torrey and Gray, in their Flora, perhaps belongs to our *O. Camanchica*; it certainly cannot belong to *O. Missouriensis.*

It forms large spreading masses, much dreaded by travellers and their animals. Joints mostly suborbicular, 2–4 inches long, and 2–3½ wide, light green, somewhat tuberculated from hemispherical elevations which bear the leaves and pulvilli, 4–6 lines apart; leaves 1½–2 lines long, hardly more than ½ line in diameter at the base, nearly twice as long as the wool in their axills; numerous small white spines radiating downwards and laterally, sometimes a few rather longer ones obliquely upwards, mostly 3–6 lines long, rarely more elongaged; central spines in the Missouri specimens mostly 1, rarely 2; in the southern ones, often 2–4, 1–1½, or even 2 inches long, terete or somewhat angular, white, or mostly with a reddish base when young, or entirely brown red, with lighter tips. On the lower pulvilli the stouter spines are mostly wanting; in some Missouri specimens, I find few and weak spines on the upper, and none at all on the lower part of the joints; in other plants, from the same region, all the pulvilli are nearly equally armed with 5 weaker (2–3 lines long) lower deflexed, and 5 inner stouter (4–6 lines long) spreading spines. Flowers 2–3 inches in diameter, ovary, with subulate sepals, similar to the leaves, spines already present, but not as long and stiff as in the fruit. Petals yellow towards the base, or sometimes almost entirely rose-colored, orange, or brick-colored, sometimes only the margin remaining yellow. Exterior filaments much the longest, deep red; interior ones paler, shorter; pistil pale yellowish, thickened below the middle, as in almost all the species of this genus; stigmata united into a small subconic head.

Fruit ovate, or sometimes globose, umbilicus shallow, spines on the pulvilli numerous, 6–12, usually short, 1–4, sometimes 6 lines long. Seeds about 3 lines in diameter, sometimes larger, in one form much smaller, mostly irregular, twisted, angular, much compressed, with a broad and thick but rather acutish rim. Embryo of different shapes, conform to the shape of a seed, always with a small albumen.

The following forms, we think, must be included under this species, though the whole history of most of them is not known; some of them may not even be constant varieties.

α. RUFISPINA: articulis orbiculatis s. transversis, setis parcis rufescentibus, aculeis radialibus 6–8 albidis rufo-variegatis, interioribus validis fuscis apice pallidioribus, 2–4 deflexis, singulo patulo s. suberecto robustissimo; bacca ovata.—(Plate XIV, fig. 1–3.

This is the ~~shortest~~ form of our species, and greatly deserves Nuttall's original name ferox; It was collected on rocky places on the Pecos; Dr. Hayden has also sent it from the Yellowstone, and it no doubt is met with in all the intervening territory. Joints 2–3 inches in diameter, pulvilli 4–5 lines apart; bristles fewer, but longer and darker than in other forms; central spines 1¼–2 inches long; fruit 1 inch long, half as thick, with shallow umbilicus, about 30 pulvilli, spines on the upper ones 4–6 lines long. Seeds 2½–3 lines in diameter.

β. PLATYCARPA: articulis obovato-orbiculatis, setis parcis stramineis, aculeis exterioribus

5–10, inferioribus albidis, superioribus robustioribus rufescentibus, centrali subsingulo robusto fusco patulo s. deflexo; bacca depresso-globosa, umbilico lato plano, pulvillis sub-25 aculeolos 5–10 breves gerentibus.—(Plate XIV, fig. 4.)

Sent from the Yellowstone by Dr. Hayden. A stout form; joints 3 inches long, $2\frac{1}{2}$–$2\frac{3}{4}$ wide; pulvilli 4–6 lines apart, the dirty yellowish bristles visible only on the older joints. Central spine single, or only on vigorous specimens on the upper pulvilli 2, mostly brownish, deeper colored on the margin. Fruit 8–9 lines long, umbilicus, of the same diameter, spines only 1–3 lines long, deflexed. Seed 3 lines in diameter, rim rather narrower than in the first-mentioned form.

γ MICROSPERMA: articulis ut in præcedente; stigmatibus 5; bacca ovata, umbilico parum depresso, pulvillis, 20–30 setosis et breviter aculeolatis, seminibus anguste acuteque marginatis. (Plate XIV, figs. 5–7.)

On the Missouri, about Fort Pierre; brought down 10 years ago by the fur traders. Very similar to the last form in the general appearance; also with only 1, or at most 2, central dark spines; flowers only with 5 stigmata, otherwise same as the one described above; fruit short, oval, with 10–20 very short spines on the numerous pulvilli; seed only 2 lines in diameter, more regular, thicker in proportion, with a narrow and acute rim. It might be supposed that these characters were important and constant enough for a specific difference, if we did not know the great variability in this genus, and if we did not find among Dr. Hayden's plants seeds of intermediate shape and size.

δ SUBINERMIS: articulis elongato-obovatis, pulvillis subremotis, inferioribus inermibus, superioribus aculeos paucos breves gerentibus.

Brought from the Upper Missouri by Dr. Hayden; remains constant in three years cultivation. Joints $3\frac{1}{2}$–5 inches long, half as wide, gradually narrowed down at base; leaves entirely similar to those of the common form; pulvilli 6–9 lines apart; spines entirely wanting, or on the upper pulvilli 2 or 3 short and slender ones, rarely one or the others more robust, $\frac{1}{4}$–$\frac{1}{2}$ inch long; flowers not seen.

ε ALBISPINA: articulis late obovatis, setis stramineis, aculeis omnibus albis gracilioribus, exterioribus 6–10 setaceis, interioribus in pulvillis superioribus 1–3 robustioribus elongatis deflexis s patulis; bacca ovata, seminibus magnis. (Plate XIV, figs. 8–10.)

Sandy bottoms and dry beds of streamlets on the Upper Canadian, 250 miles east of the Pecos; on the Sandia mountains, near Albuquerque; also, on the Upper Missouri. This was the first form of this species met with in travelling up the Canadian; the stouter and more compact forms were found further west, in higher elevations. Joints 3–4 inches long, $2\frac{1}{2}$–3 wide; pulvilli 4–6 lines apart; spines all ivory white, rarely with a yellowish tinge, larger ones $1\frac{1}{4}$ inch long; fruit with very shallow umbilicus, and very slender and short spines; seed 3–$3\frac{1}{2}$ lines in diameter, irregular, rim broad acutish. A form from the Sandia mountains with pulvilli more remote; spines longer, more slender, some of them flexuous; seems to unite this with the next variety.

ζ TRICHOPHORA: articulis ovatis, pulvillis confertis parce albo-tomentosis setas stramineas demum albidas breves gerentibus, omnibus armatis; aculeis 10–18 setiformibus albis, exterioribus 8-12 brevioribus radiantibus, interioribus longioribus deflexis, rarius singulo suberecto; pulvillis in articulis vetustioribus lignosis confertissimis setas numerosas aculeosque 15–25 capillaceos elongatos flexuosos gerentibus; bacca ovata, umbilico parum immerso pulvillis 35–40 albo-tomentosis stramineo-setosis fasciculum aculeolorum 12–18 plerumque deflexorum gerentibus; seminibus maximis valde compressis irregularibus latissime acuteque marginatis. (Plate XV, figs. 1–4.)

Only on the volcanic rocks about Santa Fé, and on the Sandia mountains. The hoary appearance of the older joints is very characteristic, and reminds one strongly of *Pilocereus senilis*. These hairs are from a few lines to 2 or $2\frac{1}{2}$ inches in length, and of the appearance and about as

fine as an old man's beard. The older joints become thick and of a solid ligneous substance; younger joints 4½ inches long, 2½ inches wide, or larger; pulvilli 4–5 lines apart; exterior spines 3–6 lines, interior ones 9–18 lines long. Fruit ovate, 10 lines long, 7 in diameter; very slender and numerous spines, 3–6 lines long. Seeds, with those of *O. hystricina*, the largest known to us, 3½ lines in diameter, sometimes larger; rim large, almost of the tickness of the seed itself. This is, perhaps, a distinct species, and must be further studied.

14. O. SPHÆROCARPA, (sp. nov.): diffusa articulis orbiculatis transversisve tuberculatis; pulvillis confertis albo-tomentosis, setas stramineas breves gerentibus, plerisque inermibus, summis solum et marginalibus aculeos 1–2 reflexos s. patulos, adjectis subinde 1–3 brevioribus gerentibus; bacca globosa, umbilico minore plano, pulvillis sub-25 tomentosis setosis vix aculeolatis, seminibus mediis acute marginatis. (Plate XIII, figs. 6–7.) & XXIV. 3

On the eastern declivity of the Sandia mountains, near Albuquerque. Joints in the specimen before us 3 inches wide, less in length, strongly tuberculated; pulvilli 4–5 lines apart; spines on the upper lateral pulvilli mostly single, deflexed, ½ inch long; on the middle or lower ones none; on the uppermost and marginal ones mostly 2, rarely 3 lines long, reddish brown, with darker tip; 1–3 smaller additional spines, 2–4 lines long also reddish. Fruit perfectly globose, 9 lines in diameter; umbilicus 5–6 lines wide; pulvilli bristly, but only the upper ones with one or a few small spines. Seeds 2½ lines in diameter, very irregular, with a rather narrow, but sharp rim.

The arrangement of the spines is so different from any form of *O. Missouriensis*, which always shows the numerous slender radiating spines, and always has spiney fruits, that we feel obliged to separate this plant as a distinct species. The seeds brought home by the expedition have germinated, and are growing vigorously.

15. O. ERINACEA, (sp. nov.): diffusa adscendens; articulis tumidis ovatis s. teretiusculis, pulvillis confertissimis ovato-orbiculatis albo-tomentosis demum stramineo-setosis omnibus armatis; aculeis 3–5 gracilibus elongatis e cinereo-rubellis 1–3 superioribus brevioribus sursum porrectis, centrali longior patulo vel declinato, ceteris deflexis, additis 2–4 minoribus inferioribus; bacca ovata umbilico infundibuliformi pulvillis 30–40 setas stramineas et aculeolos 12–20 gerentibus; seminibus magnis subregularibus late acuteque marginatis. (Plate XIII, fig. 8–11.) & XXIV. 4

West of the great Colorado near the Mojave creek; joints 2–2½ inches long, 1–1½ inches wide, and about ½–¾ inch thick, sometimes elongated, almost cylindric, densely covered with the large white pulvilli, which are only 2–3 lines apart, and numerous reddish-gray spines with red points bristling hedgehog-like (whence the specific name) in every direction. Spines 6–14 or in old joints even 20 lines long, with smaller ones, very slender, flexible, but stiff. Young plants cylindric, covered with bunches of 15 or 20, or more, white hair-like spines. Bristles dirty-yellow even in young joints present, in old ones densely crowded, and 2–3 lines long; in a dead flower a 6-parted stigma was noticed. Fruit 1–1¼ inches long, about ½ an inch in diameter, with a deep funnel-shaped umbilicus; pulvilli crowded, prominent, white-tomentose with yellowish bristles and numerous, mostly deflexed, spines, 3–6 lines long. Seed nearly 3 lines in diameter, much compressed, more regular than in the three foregoing species.

15. O. BRACHYARTHRA, (sp. nov.): prostrata s. adscendens, articulis ovatis s. orbiculatis tumidis saepe subglobosis, tuberculatis; pulvillis confertis magnis albo-tomentosis parce setulosis plerisque armatis; aculeis 3–5 albidis s. fuscatis patulis; 1–2 validioribus sursum versis, caeteris minoribus minimisqe subdeflexis; floris parvi ovario subgloboso, pulvillos 12–15 tomentosos setosos superiores aculeolatos gerante, sepalis tubi exterioribus obovatis cuspidatis stigmatibus 5. (Plate XII, fig. 9.)

At the foot of the inscription rock near Zuñi under pine trees, only seen in that single locality. A singular looking plant with short tumid joints (10–15 lines long, 10–12 wide and

nearly the same in thickness) one growing on the top of the other so as to resemble, somewhat, a jointed finger. In the absence of ripe fruit we are unable, with certainty, to class this species; the shape of the joints and the somewhat spinulose fruit seem to bring it very near to *O. fragilis*, and it may possibly be a small and compact form of this species, though the appearance is very different; on the other hand the subglobose joints seem to refer it to the section *Glomeratæ*, Salm.

Pulvilli 2–4 lines apart, large, white or when old grayish tomentose with very few short yellowish bristles, even in the old joints; spines 9–12 lines long, rather stout, terete, often with 1 or 2 short ones not more than 1–2 lines long. No ripe fruit was found (Novr.) which is also often the case with *O. fragilis*, but many remains of flowers with globose-ovate fleshy sterile red ovaries, 3–4 lines long, some of them becoming larger and probably proliferous, generally only some of the upper pulvilli bear a few short spines. The flower seems to have been about 1 inch in diameter, with about 5 sepals, 8 or 9 petals, and style with 5 stigmata.

O. FRAGILIS, Haw., the seed of which we give a figure of, (pl. XXIV, fig. 5,) grows on the upper Missouri and Yellowstone and probably down to Santa Fé. The joints are small, ovate, compressed or turned, or even terete, 4 larger spines on the upper fully developed pulvilli cruciate, the upper one suberect, stouter and longer than the others, mostly yellowish-brown; on the lower margin 4–6 small white radiating spines; bristles few. Fruit apparently somewhat fleshy, getting dry much later with 20–28 pulvilli, almost naked, only the upper ones with a few short spines; seeds few, large, regular.

Subgen. 2. CYLINDROPUNTIA, Engelm.

§ 1. *Clavatæ.*

XXIV. 6

17. O. CLAVATA, E. in Wisl. Rep. (Plate XXII, fig. 1–3.) Found from Santa Fé to Albuquerque, where Wislizenus and Fendler had already collected it, and no where else. A remarkable and well characterized species, the type of this section. We add to the characters previously published, (Wislizenus' Report note 12, and Plantæ Fendlerianæ in Mem. Am. Acad. vol. IV, page 49,) that the leaves are long and subulate, 2–2½ lines long; the broadest spines were 1½ lines wide; fruit 1½–1¾ inch long, lemon-yellow, almost covered with 30–50 hemispherical pulvilli, which bear innumerable white slender bristles, spreading ray-like in every direction. Seeds large for this section, and, as in all the allied species, transverse or broader than high; 2¼–3 lines in the longest diameters, rostrate, somewhat angular; commissure (which in the cylindric and clavate opuntiæ replaces the rim of the flat-jointed ones), impressed, linear or a little wider; cotyledons in several seeds examined by me oblique.

18. O. PARRYI, E. in Sillim. Journ., Nov., 1852: Articulis ovatis basi clavatis, tuberculis oblongo-elongatis, pulvillis albo-tomentosis setas paucas rigidas gerentibus; aculeis angulatis scabris rubello-cinereis, interioribus validioribus sub-4 triangulato-compressis, exterioribus 5–8 angulatis supra infraque divergentibus, extimis 6–10 gracilibus rigidis radiantibus; bacca ovata basi clavata pulvillis sub-40 setosissimis stipata; seminibus regularibus latius commissuratis. (Plate XXII, fig. 4–7. XXIV. 7

On the gravelly plains 30 miles west of the Colorado, near the Mojave river; southward to the eastern slope of the California mountains near San Felipe, Dr. Parry. Joints 2½–3 or 4 inches long, 1¼ inch in diameter, attenuated not only below but also somewhat above in the specimen before us. Tubercles about 9 lines long, pulvilli small, bristles few, coarse and long. Spines very numerous in 3 series; the 4 inner ones 12–16 lines long, ½–¾ lines broad, the lower one somewhat flattened, the others triangular; the next series consists usually of 2–3 upper ones and 3–5 lower ones, angular, more slender and shorter than the first, 4–8 lines long; the third or external circle consists of 6–10 bristly slender spines, 3–4 lines long, some above, but

most of them lateral or inferior. Young spines reddish-grey with paler margins, older ones ashy. Fruit 1½ inch long; seed rather regular, 2–2½ lines in the transverse diameter, less than 2 lines high, not beaked, commissure broader and more distinct than in any other of this section examined by us. Cotyledons in all the seeds examined oblique.

This discription refers to the plant brought by the expedition from the Mojave river. Several years before Dr. Parry had described a plant discovered by him "on the hills and plains about San Felipe on the eastern slope of the California mountains," which had been named after the discoverer. We presume that both plants were identical, but have to remark that Dr. Parry's plant is much larger, having joints of 4–8 inches in length, with tubercles 6–12 lines long, spines whitish, half an inch long; he describes the flowers as 1½ inch in diameter, greenish-yellow with green stigmata. Fruit not mentioned. Further investigation will be necessary to clear up those doubts.

From *O. clavata* (which grows 8 or 9 degrees east and on much greater elevation) the Mojave species is distinguished by the shape of the joints, the color, much narrower, more numerous spines and the smaller more regular seeds, with the broad commissure.

§ 2. *Cylindricæ.*

19. OPUNTIA DAVISII, (sp. nov.): caule dense lignoso ramosissimo divaricato adscendente, articulis junioribus erectis elongatis, basi attenuatis; tuberculis oblongo-linearibus prominulis, setis stramineis tenerrimis; aculeis interioribus 4–7 subtriangularibus rufis apice pallidioribus, vagina straminea laxa fulgida indusiatis divergentibus s. deflexis, aculeis gracilioribus inferioribus 5–6; bacca ovata pulvillis sub-25 setas stramineas aculeolosque paucos gerentibus; umbilico lato. (Plate XVI, fig 1–4.)

Common on the upper Canadian, eastward and westward of Tucumcari hills, near the Llano Estacado. A very much branched shrubby, somewhat procumbent, plant, with erect joints, about 18 inches high; wood dense and hard; joints 4–6 inches in length, and half an inch or more in thickness; tubercles not very prominent, 7–8 lines long; very slender bristles, forming a thick brush at upper end of pulvillus; interior spines 1–1¼ inches long, covered with a very loose glistening membranaceous sheath, which makes the plant an object of remark for a long distance; lower spines 3–6 lines long. All the fruits seen on the route were sterile, and most of them elongated, 1–1¼ inch long; on many pulvilli 1–4 sheathed spines were observed, which possibly are peculiar only to the sterile and proliferous fruits.

We have named this well-marked and pretty species after our enlightened Secretary of War, Colonel Jefferson Davis, under whose auspices the expeditions for the exploration of a proper route for the Pacific railroad were organized, and were enabled to accomplish so much, not only for this specific object, but also for the elucidation of the natural history of this hitherto almost unknown country.

20. O. ECHINOCARPA, (sp. nov.): caule reticulato-lignoso, erectiusculo, ramis numerosis patentissimis subinde pene decumbentibus, articulis ovatis basi clavatis, tuberculis ovatis prominentibus confertis; setis paucis stramineis; aculeis albidis stramineo s. albido-vaginatis, majoribus sub-4 cruciatis, cetera minoribus 8–16 undique radiantibus; floris flavi (?) ovario pulvillis 30–40 villosis subaculeolatisque confertis stipato, sepalis sub-13, exterioribus ovatis acutis; interioribus obovatis mucronatis, petalis sub-8 obovatis obtusis s. subemarginatis denticulatis, stigmatibus 6; bacca globoso-depressa s. hemispherica, late profundeque umbilicata pulvillis sub-40 aculeolos vaginatos elongatos 8–12 gerentibus dense stipata, floris rudimento subpersistente coronata; seminibus subregularibus s. angulatis, crassis, late commissuratis, cotyledonibus parallelis. (Pl. XVIII. f. 5–10 XXIV. f. 3)

In the Colorado valley, near the mouth of Williams' river. Mr. Schott found a stouter form further south. The more northern plant forms a low shrub 6–18 inches high, spreading, and

often partially prostrate; the cylindric tubular wood is reticulated with short meshes. Joints 1–2½ inches long, less than 1 inch thick, tubercles not more than 4 or 5 lines long; bristles few and rather coarse; spines 12–20; the 4 larger ones are somewhat central, 9–12 lines long; the others radiating from 4–9 lines long; the smaller ones, as in all these *Opuntiæ*, hardly vaginate. Flower described from a withered specimen found attached to a fruit, to which it somewhat adhered, but perhaps held more by the long intricate spines than by an organic attachment. Flower 1½–1¾ inches in diameter, apparently yellow, which is uncommon among the *Cylindric Opuntiæ;* petals about 9 lines long and three broad, stigmata about 2 lines long. The fruit is very peculiar, and with the seed, characterizes this species well. The wide umbilicus on the shallow fruit gives it the appearance of a saucer, and the seeds find their place more around the edge of the umbilicus than in the body of the fruit. Spines on fruit from 4–10 lines long. Seed 2 lines or more in diameter, with a broader commissure than any of the allied species, cotyledons always in all the specimens examined regularly accumbent or parallel; the only species, so far, where this regularly is the case; albumen unusually large.

O. Serpentina, from San Diego, is very nearly allied to our species, but seems sufficiently distinct by its elongated cylindric joints and different growth.

21. O. Bigelovii, *Englm.:* caule arborescente erecto crasso reticulato-lignoso, ramis erectis adscendentibusve numerosis congestis, inferioribus demum refractis, articulis ovatis s. ovato-cylindricis tumidis læte s. pallide viridibus fragilibus; tuberculis subhemisphericis depressis confertis; pulvillis immersis ovatis setas pallidas penicillatas et aculeos 6–10 robustiores pallidos stramineo-vaginatos, 3 deflexos, ceteros divergentes et 6–10 graciliores inferiores radiantes gerentibus; ovario tuberculis plurimis stipato parce aculeolato; bacca ovata profunde umbilicata tuberculata pulvillos immersos 60–70 setigeros inermes s. aculeolis 3-4 vaginatis gerente; seminibus parvis.—(Plate XIX, fig. 1–7.)

On Williams' river, a branch of the Colorado; 10-12 feet high, stem ½ inch in diameter; skeleton forming a large hollow tube, much reticulated with numerous small roundish or somewhat rhombic meshes in 13 or 21 spiral rows. Branches forming a dense head; younger joints erect, adpressed very fragile, often shaken off by the wind and covering the soil around, taking root everywhere, or sticking to the clothes of the passers-by like burrs. The joints on the older part of the stem are often persistent and reflexed, becoming withered and brown. Joints 2–6 inches long, 1–2 inches in diameter, light fresh green, covered with the small almost hemisherical, and not very prominent, tubercles, which are 3–4 lines long, and arranged mostly in 13 spirals; the areola is immersed at the apex of the tubercle, and surrounded by an elevated paler or almost whitish ridge, having the appearance of 2 lateral glands. Larger spines about 1 inch long. Flower or complete fruit not seen; an ovary or young fruit before me is clavate, 1 inch long, and has a few spines on the pulvilli; some empty (sterile?) fruits brought home are oval 1½–1¾ inches long, 1 inch in diameter, strongly tuberculated, and spineless; others again are even larger, with more numerous tubercles, and the pulvilli beset with 3–6 sheathed spines 4–7 lines long. These are evidently undergoing a change into joints; proliferous seeds, said to be small, but most unfortunately the specimens were lost, so that we were unable to compare them with those allied species found further south, (*O. fulgida,*) and on the Pacific coast, (*O. prolifera.*) Our plant is distinguished from these forms by its short tubercles, immersed pulvilli, and large tuberculated and somewhat spiny fruit.

[I have thought proper to consecrate this remarkable species, so conspicuous in its desert wilds, to my colaborer Dr. J. M. Bigelow, through whose intelligent exertions and indefatigable assiduity so many new Cactaceæ, described in this report, have been discovered and brought [illegible]—G. E.]

O. Whipplei, (sp. nov.): caule erecto s. rarius patulo s. subprocumbente, reticulato-lignoso, divaricato ramoso; articulis cylindricis; tuberculis ovatis confertis, pulvillis pulvinatis

parce tomentosis vix setosis; aculeis brevibus cinereo s. stramineo vaginatis, 1—4 majoribus divaricatis, inferiore longiore deflexo, minoribus 2–8 solum ad inferiorem pulvilli marginem deflexis s. undique radiantibus; flore rubro, ovario ovato tuberculato pulvillis 20–30 tomentosis setas stramineas et aculeolos paucos mox deciduos gerentibus stipato; sepalis tubi sub-8 orbiculatis cuspidatis, petalis 8–10 spathulatis cuspidatis; bacca subglobosa leviter tuberculata subcarnosa flava inermi; umbilico infundibuliformi; seminum subregularium commissura lineari.

α. LÆVIOR humilior, aculeis brevioribus paucioribus, seminibus minoribus.

β. SPINOSIOR elatior aculeis plurimis longioribus, seminibus majoribus. (Plate XVII, fig. 1–4.)

From the elevated country about Zuñi to the head of Williams's river, at first seen only 8–15 inches high, subprostrate, afterwards 20–30 inches, and sometimes even 5–6 feet high. Var. *β.* was found by Mr. A. Schott south of the Gila river, and he also discovered the flower of this plant, which, like the flowers of all the other new species, remained unknown to us, unless winter remains were picked up here and there. Ligneous skeleton tubular, with small meshes, dense at base of stem; joints elongated, 2–4 inches to a foot long, $\frac{1}{2}$ or $\frac{3}{4}$ of an inch in diameter; tubercles ovate or sometimes almost rhombic, about 5 lines long; spines very variable in number, sometimes only with 1 larger and 2 or 3 smaller ones; in other instances, especially in Var. *β.*, with 12 or 14; spines 3–9 lines long, bristles few, generally only on older joints; flowers $1\frac{1}{4}$–$1\frac{1}{2}$ inches in diameter; ovary 6–9 lines long with 20 or 25 pulvilli; fruit about 1 inch long, a little less in diameter, somewhat fleshy and sweet, with 25–35 not very prominent tubercles; seeds with linear or almost linear commissure, $1\frac{1}{2}$–$1\frac{3}{4}$ lines in diameter; cotyledons regularly incumbent or sometimes oblique. The seeds of *β.* are 2 lines in diameter.

This is easily distinguished from all the allied species of the slender elongated branches, the short, crowded tubercles, and the short spines. We have dedicated this *Opuntia*, characteristic of the desert mountains under the 35th degree, between the Rio Grande and the Colorado, to Captain A. W. Whipple, the commander of the expedition who, by his zealous and liberal cooperation, afforded every facility in his power in the various collections of natural history. (Plate XVII, fig. 5–6, and Plate XVIII, fig. 4.)

23. O. ARBORESCENS, *Englm.* found first 200 miles east of the Pecos, and from there abundantly as far west as Zuñi, where other cylindric *Opuntiæ* take its place. In this region it does not grow higher than 5–8 feet, and can scarcely be called arborescent; it is always well characterized by the verticillate often somewhat pendulous branches, the cristate-tuberculate spineless fruit, and the smooth seeds with a distinct and broadly linear commissure. Seeds of specimens collected at Zuñi smaller than others, only $1\frac{1}{2}$ line in diameter.

24. O. ACANTHOCARPA, (sp. nov.): caule arborescente erecto reticulato-lignoso, ramis adscendentibus divaricatis, articulis cylindricis tuberculatis pallide virescentibus; tuberculis oblongo-linearibus pulvillis ovato-orbiculatis breviter tomentosis vix setosis, aculeis numerosis s. plurimis (8–25) stramineo-vaginatis undique porrectis, stellatis; bacca subglobosa late umbilicata tuberculata; pulvillis 12–15 tomentosis parce setosis aculeolis validis 8–10 munitis; seminibus magnis mutangulis late commissuratis. (Plate XVIII, fig. 1–3.)

On the mountains of Cactus Pass, about 500 miles west of Santa Fé. Stout, stem 5–6 feet high, wood forming a hollow reticulated tube, solid at base; branches few, never verticillate, separating at acute angles; joints 4–6 inches long, 1 inch in diameter, tubercles 9–10 lines long; pulvilli in some with one central and 6 or 8 exterior spines, in others with 3–7 interior and 10–20 exterior stellately radiating spines. Central spines 1–$1\frac{1}{4}$ inch, exterior 4–10 lines long, with a yellowish or brownish sheath. Fruit 1 inch long with a large but not deep umbilicus, and 12–15 rather shallow tubercles; spines of fruit stout, 3–6 lines long, stouter and more crowded toward the top of the fruit. Seeds unlike any other of our *Opuntiæ*, $2\frac{1}{2}$–3 lines in diameter, with rather broad commissure, often spongy on the margin, and on the sides with many even or concave faces separated by sharp ridges.

This peculiar species cannot be confounded with any other, but comes, in the arrangement of spines, nearest to *O. arborescens*, from which it is easily distinguished by its manner of growth, its elongated tubercles, and especially the much less tuberculated and spiny fruit, and the peculiar seed.

25. *O.* TESSELATA, Englm.: caule frutescente erecto s. diffuso, dense lignoso, ramosissimo, ramis divaricatis, articulis gracilibus teretibus, plano-tuberculatis cæsiis, tuberculis 5–6-angulatis confertissimis depressis, planiusculis; pulvillo lineari tomentoso vix setis paucis deciduis instructo, inermi s. medio s. versus basin aculeo elongato porrecto s. subdeflexo albido flavido s. fulvo vagina laxa basi constricta flava s. e flavo fulva indusiato, singulo s. rarissime binis; aculeis paucis brevibus setaceis infra sæpe adjectis; floris purpurei ovario obovato s. clavato pulvillis 30–50 villoso-tomentosis inermibus s. parce aculeolatis dense stipato; sepalis tubi sub-8 obovato-orbiculatis cuspidatis, petalis 5 late obovato-orbiculatis emarginatis; filamentis exterioribus latioribus persistentibus, stigmatibus 5 brevibus ovatis adpressis; bacca ovata basi apiceque contracta sicca pulvillis villosis aculeolatissimis confertissimis stipata, floris rudimentis coronata; seminibus subregularibus margine spongioso crasso parum prominente cinctis. *O. ramosissima*, E. in Sill. Journ., November, 1852. (Plate XXI, figs. 1–7.

Valley of the Lower Colorado, and from thence to the California mountains; first discovered by Dr. Parry in the Colorado desert, afterwards found by Dr. Bigelow from the valley of Williams' river to 70 miles east of Cajon Pass, in the California mountains. The flower was first noticed by Mr. A. Schott, in western Sonora, towards the Lower Colorado. Fl. May to September. Stems 2–6 feet high, mostly branching from the base below, 1–3 inches in diameter, covered with a dark-gray scaly bark; wood of young branches reticulate, very soon becoming solid, but even then the reticulated structure remains visible in the different layers of wood. Annual layers not as distinct as the medullary rays, but more so than in *O. frutescens;* in a stem of near 2 inches diameter we counted 35 annual layers, 8 or 9 of which belong to the alburnum; branches numerous and slender, of an ashy or grayish green color, younger ones 3 or 3½ lines in diameter, well characterized by the remarkable flattened tubercles, which, by closely crowding together, become 5 or 6 angular, diamond-shaped; the areola is linear, extending down to the middle of the tubercle; its short tomentum usually extends upwards between the next adjoining tubercles. Tubercles 2½–3 lines long, and a little less in diameter. Spines 1½–2 inches long, usually from the middle or at least above the base of the pulvillus, generally only on the upper tubercles of each year's growth, which gives the whole plant a singular appearance, showing the fasciculate spines at some, and having no spines at all on other parts of the apparently homogeneous branches. Sheath contracted at base, and firmly adhering to the spine, loose and saccate above. Small bristly spines at the base of the pulvillus, 2–3, sometimes even 5 in number, 1–4 lines long. Flower purple, about 6 lines in diameter, lowest part of the tube naked. Fruit 9–10 lines long, resembling much the fruit of the *Clavate Opuntiæ* in shape, being contracted above, with a narrow and deep umbilicus, and retaining the dead remains of the flower, of which the broad, scale-like exterior filaments are most conspicuous; pulvilli large and woolly, almost entirely covering the fruit, and beset with 30 to 50 reddish-brown, bristly, flexuous spines, 2–3 lines long. Seeds few, regular, nearly or quite 2 lines in diameter,

26. O. VAGINATA, Englm.: caule frutescente erecto dense lignoso, ramis virgatis demum teretibus junioribus tubercula oblongo-elongata subprominentia gerentibus læte viridibus; foliis subulatis pulvillis orbiculatis magnis breviter albo-tomentosis, setarum straminearum penicillo brevi, aculeis ex imo pulvillo singulis elongatis corneis s. fuscis laxe stramineo s. aurantiaco-vaginatis, adjectis subinde supra aculeis minoribus 1–2; bacca ovata tuberculata pulposa flava pulvillos 15–20 majusculos albo-tomentosos setosos gerentibus, umbilico angusto immerso, seminibus subregularibus marginatis. (Plate XX, fig. 1.)

About Albuquerque, where Dr. Wislizenus had already collected it in 1846; apparently extending into Mexico, as Dr. Gregg collected what seems to be the same species about San Luis Potosi. Shrub 3–5 feet high; lower part of stem 1–1½ inch thick, covered with scaly, light-yellowish-brown bark; older branches smooth terete, younger ones 3–4 lines in diameter, strongly tuberculated; tubercles 6–9 lines long; leaves slender, about 3 lines long, and apparently somewhat persistent, as they are sometimes found adhering, though withered, even to fruit-bearing branches, which, of course, are over a year old. The same, though to a less extent, is sometimes seen in *O. frutescens*. Pulvilli unusually large; bristles in the young ones forming a small but distinct bunch at the upper edge of the areola, but disappearing on the older joints, contrary to the usual occurrence, when the bristles become stouter and more numerous in older joints. Spines 1–2½ inches long, dark, with very loose and glistening sheaths; second or smaller spine sometimes lateral, but usually above the principal one, not below it, as in most others. Flower unknown. Fruit ovate, 8 or 9 lines long, the pulvilli often bear 2–5 obtuse bodies, almost hidden in the tomentum, apparently glandular, but of a fibrous structure. Seeds, 12–15 in each fruit, about 2 lines or a little more in diameter, commissure broad, prominent, forming a distinct, somewhat spongy, rim. (See plate XX, fig. 1, and plate XXIV, figs. 13–15.) In Dr. Wislizenus' report, the long-spined form of *O. frutescens* was confounded with this species. It is possible, however, that *O. vaginata*, as described here, may be a stouter, tuberculated form of *O. frutescens*, with lighter colored, tuberculated fruit, and larger seed.

27. O. FRUTESCENS, Engelm. This well known species was observed from Laguna Colorado, 60 miles east of the Pecos, to Williams' river, a branch of the great Colorado, always with the same characters. The bark is scaly, almost papery, with a silvery reflection; the wood shows the medullary rays very distinctly, especially 5 of them; much less the annual layers. Fruit deep scarlet, smooth, with small, sometimes almost obliterated pulvilli, 5–9 lines long; seeds 5–10, about 1½ lines in diameter, with a narrow and often acute margin. The forms collected on the expedition belong to var. *α. longispina;* the var. *β. brevispina* has been observed only in Texas and northeastern Mexico. (See Plate XX, fig. 2–5, and Plate XXIV, fig. 16–19.)

EXPLANATIONS OF THE PLATES OF CACTACEÆ.

PL. I. ECHINOCACTUS WHIPPLEI, E. & B.: fig. 1, whole plant; fig. 2, bunch of spines of the usual size; fig. 3, same, uncommonly large and broad; fig. 4, same, lateral view; fig. 5, same, very young; fig. 6, seed—*a* natural size, *b* magnified 8 diameters, *c* part of the surface still more magnified to exhibit the tuberculated appearance.

PL. II, Fig. 1–2. ECHINOCACTUS POLYANCISTRUS, E. & B.: 1, upper part of a rib with older and younger bunches of spines, the youngest one with a flower bud in the axil; 2, one of the largest and most fully developed bunches of spines.

FIG. 3–5. ECHINOCACTUS LE CONTEI, E.: 3, part of a rib, with 2 bunches of spines; 4, a single bunch of spines from another specimen; 5, seed—*a* natural size, *b* magnified 8 diameters, *c* part of the surface still more magnified to exhibit the oval pits.

PL. III, Fig. 1–2. ECHINOCACTUS WISLIZENI, E.: 1, side view of a bunch of spines; 2, seed—*a* natural size, *b* magnified 8 diameters, *c* part of the surface still more magnified to exhibit the reticulation. This species, collected by Captain Whipple on the Gila, and common about El Paso, on the Rio Grande, has been introduced here to show those characteristics which distinguish it from the nearly allied *E. Le Contei*, on the foregoing plate.

FIG. 3. ECHINOCACTUS EMORYI, E.: two bunches of spines on part of a rib.

FIG. 4–6. ECHINOCACTUS POLYCEPHALUS, E. & B.: 4, part of a rib, with 3 bunches of short, stout, and straightish spines; 5, a young bunch of spines of unusual dimensions and much curved, with a woolly fruit in the axil; 6, seed—*a* natural size, *b* magnified 8 diameters, *c* part of the surface more magnified to show the warty appearance, *d* seed after the removal of the outer integument, embryo, together with a considerable quantity of albumen in the endopleura, *e* embryo curved with accumbent cotyledons.

PL. IV, Fig. 1–3. CEREUS PHŒNICEUS, E.: 1, upper part of a head bearing a flower; 2, a bunch of spines of the usual size; 3, part of a rib, with 3 bunches of spines from an uncommonly large form.

FIG. 4–5. CEREUS PHŒNICEUS, subsp. CONOIDEUS, E. & B.: 4, upper part of a head; 5, part of a rib, with 2 bunches of spines.

FIG. 6–7. CEREUS TRIGLOCHIDIATUS, E.: 6, upper part of a large head, with a flower; 7, part of a rib of another specimen, with smaller curved spines.

FIG. 8. CEREUS MOJAVENSIS, E. & B.: part of a rib, with 3 bunches of spines.

FIG. 9. CEREUS MOJAVENSIS, E. & B., var. ZUNIENSIS: part of a rib, with 2 bunches of spines.

PL. V, Fig. 1. CEREUS HEXAEDRUS, E. & B.: upper part of a head.

FIG. 2–3. CEREUS GONACANTHUS, E. & B.: 2, part of a rib, with two bunches of spines; 3, another fascicle of spines; the 3 bunches of spines show all a different proportion of the central and the upper radial spines.

FIG. 4–7. CEREUS ENGELMANNI, var. VARIEGATUS, E. & B.: 4 and 5, two bunches of spines, showing a different arrangement of central spines; 6, fruit; 7, seed—*a* natural size, *b* magnified 8 diameters, *c* part of the surface still more magnified to show the irregular tuberculation.

FIG. 8–10. CEREUS ENGELMANNI, var. CHRYSOCENTRUS, E. & B.: 8, part of two ribs, with numerous spines; 9, a single bunch of spines; 10, fruit, sterile and perhaps not fully developed.

PL. VI, Fig. 1–3. OPUNTIA CHLOROTICA, E. & B.: 1, joint with a flower. The flower reconstructed from a withered specimen collected in January; 2, sterile and probably unde-

veloped fruit; 3, fragment of the bark of the lower part of the plant, with several large bunches of spines.

Fig. 4–5. Opuntia procumbens, E. & B.: 4, part of a joint; 5, larger bunch of spines from another specimen.

Pl. VII, Fig. 1–2. Opuntia occidentalis, E. & B.: 1, joint of the usual shape and size; 2, fruit.

Fig. 3–4. Opuntia angustata, E. & B.: 3, a large and less spinous joint with a sterile degenerate spinous fruit; 4, a smaller, more spinous joint with a full grown ripe fruit.

Pl. VIII, Fig. 1. Opuntia Engelmanni, var. cyclodes, E. & B.: with ripe fruit.

Fig. 2–3. Opuntia tortispina, E. & B.: 2, fragment of a joint with fewer spines and ripe fruit; 3, part of a more spiny joint.

Pl. IX, Fig. 1–5. Opuntia camanchica, E. & B.: 1, a joint with shorter and lighter colored spines; 2, a joint with larger and darker spines; 3, fragment of a joint with more numerous and crowded spines; 4 and 5, ripe fruit of the smaller and largest size.

Fig. 6–8, Opuntia mojavensis, E. & B.: 6, a younger bunch of spines · 7, another from the oldest part of the plant; 8, a sterile and degenerate fruit.

Pl. X. Fig. 1–2. Opuntia vulgaris, Mill.: 1, a young joint with leaves, the older one has a single spine and bears a flower bud; 2, a single leaf magnified 4 diameters. The figures of this species have been introduced to exhibit the diagnostic characters and its difference from the next species.

Fig. 3–5. Opuntia Rafinesquii, E.; 3, an older joint with a flower and a bud, and a younger half-grown joint with leaves. This represents the spinous form common in Illinois, Missouri, and Arkansas. 4, an older joint of the variety with few spines, bearing numerous fruits of different shapes, as they often occur in the same plant; 5, two leaves of different sizes magnified 4 diameters.

Pl. XI, Fig. 1, Opuntia Rafinesquii, var. minor, E.: the larger joint spineless, the upper one spiny on the margin.

Fig. 2–3. Opintia Rafinesquii, var. grandiflora, E.: 2, a joint with flower; 3, fruit.

Fig. 4. Opuntia fuscoatra, E.: a joint with a young fruit just after flowering, fragment of an older, very bristly, joint visible.

Pl. XII. Fig. 1–3. Opuntia cymochila, E. & B.: 1, a joint; 2, a single bunch of spines; 3, ripe fruit.

Fig. 4–6. Opuntia stenochila, E. & B.: 4, a joint; 5 and 6, a smaller and large fruit.

Fig. 7–8. Opuntia fusiformis, E. & B.: 7, a joint; 8, a fruit.

Fig. 9. Opuntia bracayarthra, E. & B.: a whole plant with two withered flowers.

Pl. XIII. Fig. 1–5. Opuntia basilaris, E. & B.: 1, a joint somewhat shrivelled as it appears in winter; a late young joint near its base appears more plump and fresh; 2, flower; 3, style; 4, undeveloped sterile fruit; 5, a whole plant reduced in size to show the singular manner of growth.

Fig. 6–7. Opuntia sphærocarpa, E. & B.: joint and fruit.

Fig. 8–11. Opuntia erinacea, E. & B.: 8, joint of the usual shape, (only partly finished;) 9 and 10, bunches of spines; 11, fruit.

Pl. XIV. Fig. 1–3. Opuntia Missouriensis, var. rufispina, E. & B.: 1, a joint, (only partly completed;) 2, a very full bunch of spines; 3, fruit.

Fig. 4. Opuntia Missouriensis, var. platycarpa, E.: fruit.

Fig. 5–7. Opuntia Missouriensis, var. microsperma, E.: 5, joint (unfinished) with flower; 6, bunch of spines; 7, fruit.

Fig. 8–10. Opuntia Missouriensis, var. albispina, E. & B.: 8, joint (unfinished); 9, bunch of spines; 10, fruit.

Pl. XV, Fig. 1–4. Opuntia Missouriensis, var. trichophora, E. & B.: 1, part of an old stem

showing the thickness and hairy spines, upper younger joints (unfinished); 2, bunch of spines from a younger joint; 3, same from an older part of the plant; 4, fruit.

FIG. 5–7. OPUNTIA HYSTRICINA, E. & B.: 5, a joint (unfinished); 6, a large bunch of spines; 7, fruit.

PL. XVI. OPUNTIA DAVISII, E. & B.: 1, a branch showing the structure of the older parts, an older and young joints with two fruits; 2, a tubercle with its bunch of spines, the membranaceous sheaths partly torn, showing the spine itself; 3, a degenerate sterile spiny fruit in its transition to a branch, as it is often seen in this species and others, especially cylindric Opuntia; 4, the whole plant reduced.

PL. XVII, Fig. 1–4. OPUNTIA WHIPPLEI, E. & B.: 1, a branch of the more common form of the plant covered with ripe fruit. At (*a*) the fruit is undeveloped, probably not different from the ovary of the flower, only more shrivelled; 2, branch of a larger specimen, spines more numerous, fruit larger; 3, a single bunch of spines of this specimen; 4, whole plant reduced.

FIG. 5–6. OPUNTIA ARBORESCENS, E.: 5, a stout branch with numerous spines and large fruit; 6, a bunch of spines of same.

PL. XVIII, Fig. 1–3. OPUNTIA ACANTHOCARPA, E. & B.: 1, an older branch with fruit; 2, a young branch; 3, whole plant reduced.

FIG. 4. OPUNTIA ARBORESCENS, E.: whole plant reduced.

FIG. 5–10. OPUNTIA ECHINOCARPA, E. & B.: 5, a branch of the plant densely covered with the sheathed spines; 6, 7, and 8, bunches of spines; 9, fruit, side view; 10, same, top view.

PL. XIX. OPUNTIA BIGELOVII, E.: 1, a single joint; 2 and 3, tubercles, with bunches of spines; 4, young undeveloped fruit; 5, an apparently full-grown fruit, sterile, and perhaps degenerating into a branch; 6, part of the ligneous skeleton, forming a wide tube, and showing in the reticulated structure the traces of the tubercles and branches; 7, an entire plant reduced; on the left of the main stem is a younger shoot, with vigorous erect joints.

PL. XX, OPUNTIA VAGINATA, E.: 1, an older joint bearing two fruits, and a young vigorous shoot.

FIG. 2–3. OPUNTIA FRUTESCENS, E., var. LONGISPINA: from Williams' river of the Colorado; 2, a branch with fruit; 3, lower part of the trunk, with some roots; the sections show the structure of the dense wood.

FIG. 4–5. OPUNTIA FRUTESCENS, E., var. BREVISPINA: 4, a branch with fruits, most of them sterile, one producing young branches from its upper areola; 5, a flower.

PL. XXI. OPUNTIA TESSELATA, E.: 1, a branch with fruit *a*, *a*, and a withered flower *b*; 2 and 3, flowers as they probably are, reconstructed from withered specimens; 4, a small joint magnified so as to show distinctly the appearance of the tubercles and areolæ; 5, part of the stem with a section of the wood above and a fracture below, so as plainly to show the ligneous structure; the bark of the younger branches exhibits the tesselated surface, while in the older trunk it is lost in the irregular scales; 6, ligneous skeleton of a young branch; 7, a whole plant reduced.

PL. XXII, Fig. 1–3. OPUNTIA CLAVATA, E: 1, joint with a ripe fruit; 2, one of the upper bunches of spines; 3, part of the central spine magnified 4 diameters.

FIG. 4–7. OPUNTIA PARRYI, E: 4, joint with ripe fruit; 5, bunch of spines, side view; 6, another one, front view; 7, part of the central spine magnified 4 diameters.

The remaining figures of this, and all of the two following plates represent seeds and their details of almost all the *Opuntiæ* described in this report. Fig. *a* represents a side view of the seed, natural size; *b*, same, four times magnified, as are all the following figures; *c*, posterior view; *d*, anterior view; *e*, vertical section of seed, exhibiting the position and proportion of the embryo and the albumen; *f*, embryo and albumen coated by the endopleura, after the removal of the testa; *g*, lateral view of embryo. The other letters *h*, *i*, *k*, etc., will be explained wherever they occur.

FIG. 8–9. Seeds of OP. ENGELMANNI, var. CYCLODES.

FIG. 10. Seed of OP. OCCIDENTALIS: One of the embryos, *g*, shows the cotyledons in an oblique almost incumbent position.

FIG. 11. Seed of OP. ANGUSTATA.

FIG. 12–15. Seeds of OP. CAMANCHICA, of different sizes and shapes.

PL. XXIII, Fig. 1–5. Seeds of OP. TORTISPINA: 1–3, seeds of different sizes and shapes; 4, two embryos in one seed; *g–h*, different views of both embryos together as they lay in the seed; *i*, interior layer, and *k*, exterior smaller embryo; 5, germination of a double embryo; two young plants from one seed, the larger one still bearing the shell of the seed.

FIG. 6. Seed of OP. FUSIFORMIS.

FIG. 7–12. Seeds of OP. RAFINESQUII, and some of its varieties and sub-species; 7, usual form from Missouri, (see pl. X, fig. 3;) *h*, *i*, *k*, germination in different stages of development; *l*, seedling with three cotyledons.

FIG. 8. Small seed from the fruit represented on pl. X, fig. 4.

FIG. 9. OP. STENOCHILA.

FIG. 10–12. OP. CYMOCHILA: 10 and 11, different forms of the usual variety; 12, seed of the variety *montana*.

FIG. 13. Seed of OP. VULGARIS.

FIG. 14. Seeds of OP. BASILARIS: An irregular and a very regular one from the same fruit.

FIG. 15. Seed of OP. HYSTRICINA.

FIG. 16–19. Seeds of different forms of OP. MISSOURIENSIS: 16, var. RUFISPINA 17, var. PLATYCARPA; *h*, seedling of same; 18, var. ALBISPINA; 19, var. TRICOPHORA.

PL. XXIV, Fig. 1–2. OP. MISSOURIENSIS: 1, var. with smaller fruit and seeds from the Upper Missouri; 2, var. MICROSPERMA. (See pl. XIV, Fig. 5–7.)

FIG. 3. Seed of OP. SPHÆROCARPA.

FIG. 4. Seed of OP. ERINACEA: The embryo, *g*, shows considerable obliquity of the cotyledons.

FIG. 5. Seed of OP. FRAGILIS: From the Yellowstone river.

FIG. 6. Seed of OP. CLAVATA: The embryo, *g*, oblique.

FIG. 7. Seed of OP. PARRYI: Embryo, *g*, nearly accumbent.

FIG. 8. Seed of OP. ECHINOCARPA: One of the seeds quite regular, the other irregular; embryo, *g*, *g*, always regularly accumbent; *h*, and *i*, seedlings with the very narrow and thick cotyledons crossing each other, one of them bearing the shell of the seed.

FIG. 9–10. Seeds of OP. WHIPPLEI: 9, seed of the plant represented Pl. XVII, fig. 2, seed larger, commissure perfectly linear, cotyledons oblique; 10, seeds of the other specimen, Pl. XVII, fig. 1, seeds smaller, of different shapes, commissure a little wider, cotyledons oblique, in *i* somewhat separated; in *k* three cotyledons, of which *l* is a transverse section, *h*, seedling with very narrow and long cotyledons.

FIG. 11. Seeds of OP. ACANTHOCARPA, of different shapes all from one fruit.

FIG. 12. Seeds of OP. ARBORESCENS, of different shapes belonging to the plant, figured Pl. XVII, fig. 5, smaller than those sent by other collectors, embryo *g*, regularly incumbent.

FIG. 13–15. Seeds of OP. VAGINATA: 13–14, seeds of different sizes from the plant, Pl. XX, fig. 1., the smaller one is empty and perhaps not fully formed; 15, seed of the same species collected in Mexico by Dr. Gregg. Cotyledons regularly incumbent.

FIG. 16–19. Seeds of OP. FRUTESCENS: 16, var. LONGISPINA from the Llano Estacado (Pl. XX, fig. 2); 17, same from Mexico, Dr. Gregg; 18, same from Williams River branch of the great Colorado; 19, var. BREVISPINA, from Texas, Lindheimer. In all these the cotyledons of the embryo are regularly incumbent.

FIG. 20. Seeds of OP. TESSELATA: embryo oblique or almost accumbent.

All the figures are of natural size unless the contrary is expressly stated. They were drawn with the greatest accuracy, partly from living and in part from dried specimens, by Mr. Paulus

Roetter of St. Louis, under the personal superintendence of Dr. Engelmann. The drawings made on the spot by Mr. H. B. Möllhausen, the artist of the expedition, greatly aided the work and were made use of, and even partly copied, especially in the plates exhibiting the Cylindric Opuntiæ.

Corrections.

The reader will please correct the disagreably large number of typographical errors, only the more important of which are enumerated in the subjoined list; the balance and especially the numerous and annoying errors of punctuation he will not fail himself to discover. Many citations of figures, omitted in their proper places, will be found in the „Explanations“.

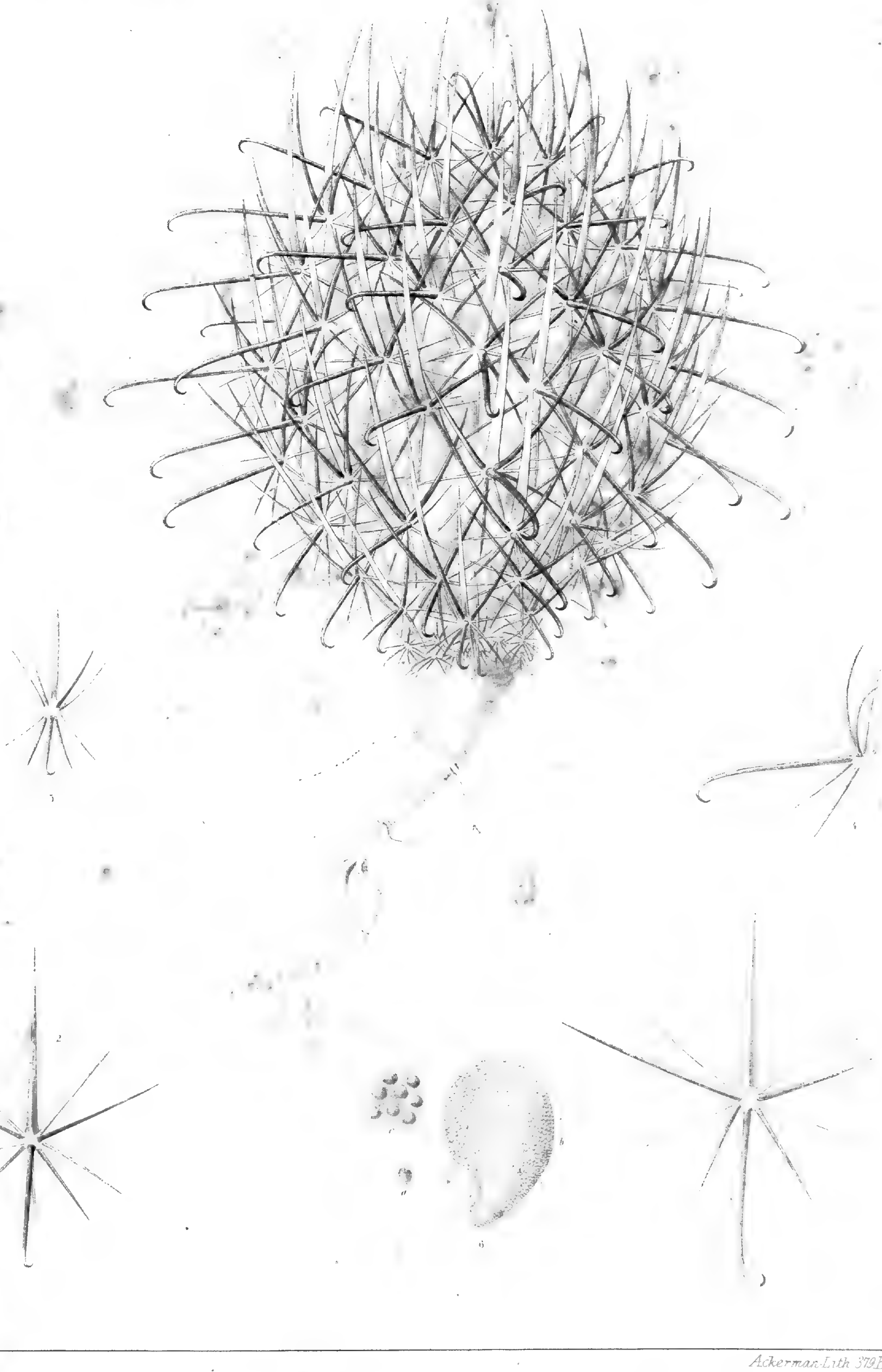
Page 27 line 12 omit *(Pl. I)*
– – – 15 for *immersed* read *emersed*
– 28 – 20 – *globosa–* r. *globoso–*
– – – 21 – *orbiculatus* r. *orbiculatis*
– – – – after *radialibus* add 7
– 29 – 11 for *arcete* r. *arcte*
– – – 13 – *Plate I* r. *Plate II*
– – – 32 – *ovato,* r. *ovato–*
– – – 33 for *interruptus* r. *interruptis*
– – – – – *radalibus* r. *radialibus*
– – – 40 – *Plate I* r. *Plate II*
– 30 – 27 – *higher and* r. *higher than*
– 31 – 28 – *cylindricusque* r. *cylindricusve*
– – – 45 after 2–2$^1/_2$ add *feet*
– 32 – 14 for *axis* r. *axillæ*
– – – – – *spinulose* r. *spinescent*
– – – 20 omit after *off* the ;
– – – 22 – *laticostatus*
– 33 – 6 after *bulbous* add *at base*
– 34 – 5 for *species* r. *spines*
– 35 – 41 – *ined.* r. *in R.B.C.–Fruit*
– 36 – 26 omit *into subspecies*
37 – 14 for *unable* r. *enabled*
– – – 41 – *Mexico* r. *New–Mexico*

Page 39 line 32 for *VII* r. *VI*
– – – 37 – *distinct* r. *distant*
– – – 43 after *stipata* put ;
– 40 – 13 for *one* r. *our*
– – – 14 – *structa* r. *stricta*
– – – 15 – *tuberculatus* r. *tuberculata*
– – – 34 after *gracilioribus* put ;
– 41 – 5 for *Pl. V* r. *Pl. VIII*
– – – 28 – *marginatis* r. *emarginatis*
– – – 32 add *Pl. X fig.* 3–5. *Pl. XXIII fig.* 7–8.
– 43 – 16 omit *similar seed, but*
– – – 45 for *purpureis* r. *purpurei*
– 44 – 7 – *originate* r. *originating*
– – – 21 after *armatis* put ;
– – – 23 – *flexuosisve* put ,
– – – 46 – 5–10 omit ,
– 45 – 1 for *petaloide–* r. *petaloideo–*
– – – 13 – *spring* r. *spiny*
– – – 23 after *young* add *or*
– – – 36 – *smaller* add ;
– – – 41 – *transversis* add ;
– – – 44 for *shortest* r. *stoutest*
– 46 – 20 add *Pl. XXIV fig.* 1
– – – 35 for 1–$^1/_4$ r. 1$^1/_4$

Page 46 line 40 for *stramineis* r. *stramineas*
- - - 43 after 25 add *nonnullos*
- - - 44 - *immerso* add ;
- 47 - 34 - *ones* add ;
- - - 44 - *parvi* omit ;
- 48 - 16 for *turned* r. *tumid*
- 49 - 40 - *ceteri* r. *cæteris*
- - - 44 - *stipata floris,* r. *stipata, floris*
- 50 - 13 - *all* r. *in all*
- - - 23 - *aculeolos . . . vaginatos* r. *aculeolis . . . vaginatis armatos*
- - - 25 - $^3/_4$ *inch* r. 3–4 *inches*
- - - 39 - *joints; proliferous seeds,* r. *proliferous joints; seeds*
- 51 - 4 - *deciduous* r. *deciduos*
- - - - after *stipato* add ;
- - - 6 - *infundibuliformi* add ;
- - - - add *Pl. XVII fig.* 1–4, *XXIV fig.* 9–10.
- - - 8 for 1–4 r. 2
- - - 27 this whole reference belongs to the next species.
- - - 35 after *divaricatis* add ;
- - - 39 for *muetangulis* r. *multangulis*
- 52 - 3 omit *and* after *tuberculated*

Page 52 line 6 for 5–6 *angu-* r. 5–6–*angu-*
- - - 9 - *laxi* r. *laxa*
- - - 12 after *cuspidatis* put ;
- - - 14 for *aculeo–latissimus* r. *aculeola-tissimis*
- - - 21 - *base below,* 1–3 r. *base; below* 1–3
- - - 42 add *cotyledons often accumbent.*
- - - 45 for *penicilla paro* r. *penicillo parvo*
- - - 48 - *gerentibus* r. *gerente*
- 53 - 24 after *smooth,* put *with*
- 54 - 27 for *sub, sp.* r. *subsp.*
- - - 42 omit *to be*
- 55 - 14 for *an, docwded* r. *and crowded*
- 56 - 1 - *joints (unfinished)* r. *joint unfinished*
- - - 25 - *left* r. *right*
- - - 32 - *areola* r. *areolæ*
- - - 34 after *are* put ;
- 57 - 14 for *fruit* r. *form*
- - - 35 - *XXII* r. *XVII*

Plate IV for *Bigelovii* r. *Mojavensis,* twice.
- XXIII fig. 2–4 for *tortisperma* r. *tortispina*
- - fig. 10 omit *Op. vulgaris.*



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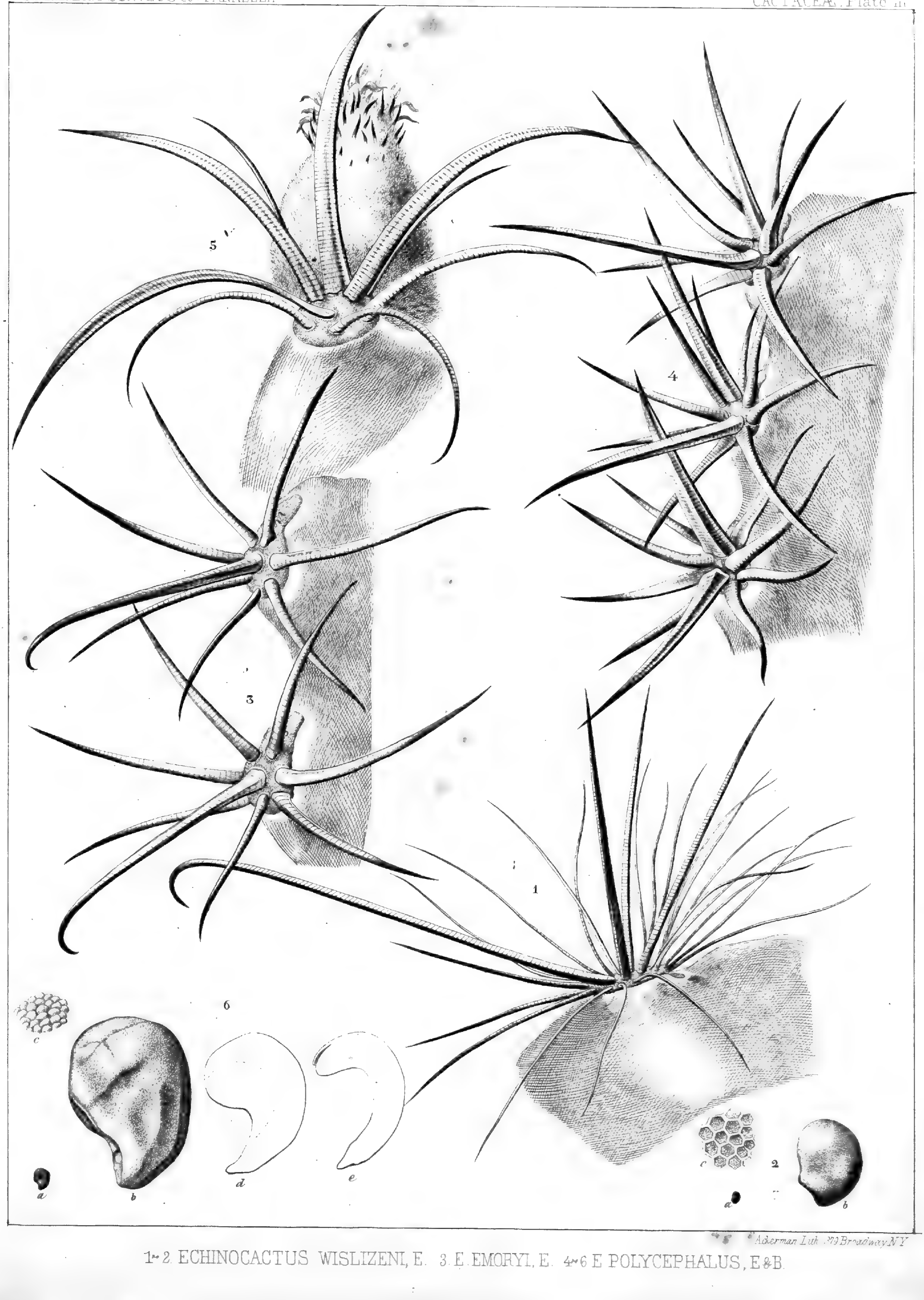
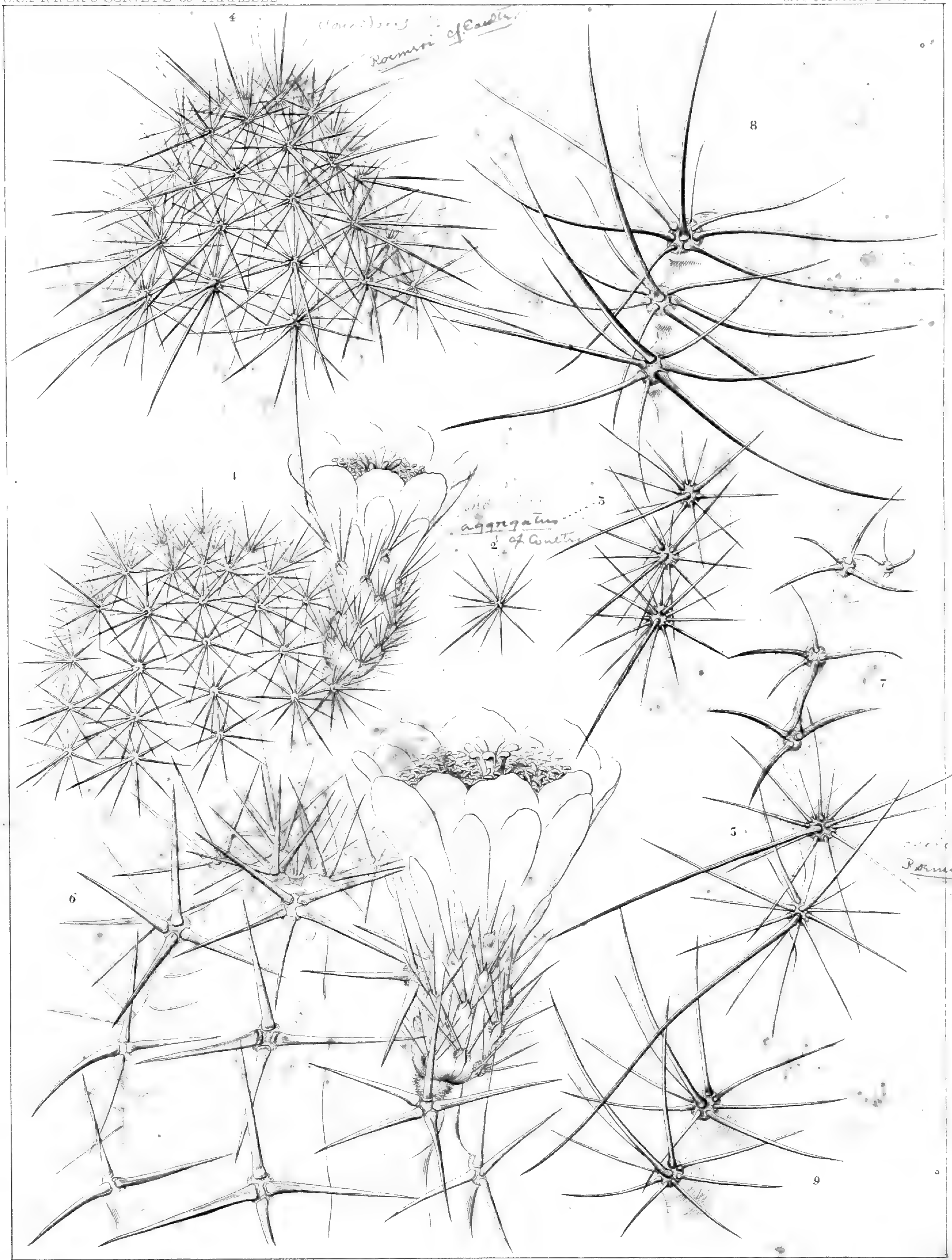
ECHINOCACTUS WHIPPLEI E & B.

1–2. ECHINOCACTUS POLYANCISTRUS, E. & B. 3–5 ECHINOCACTUS LECONTEI. E.



Ackerman Lith. 379 Broadway N.Y.

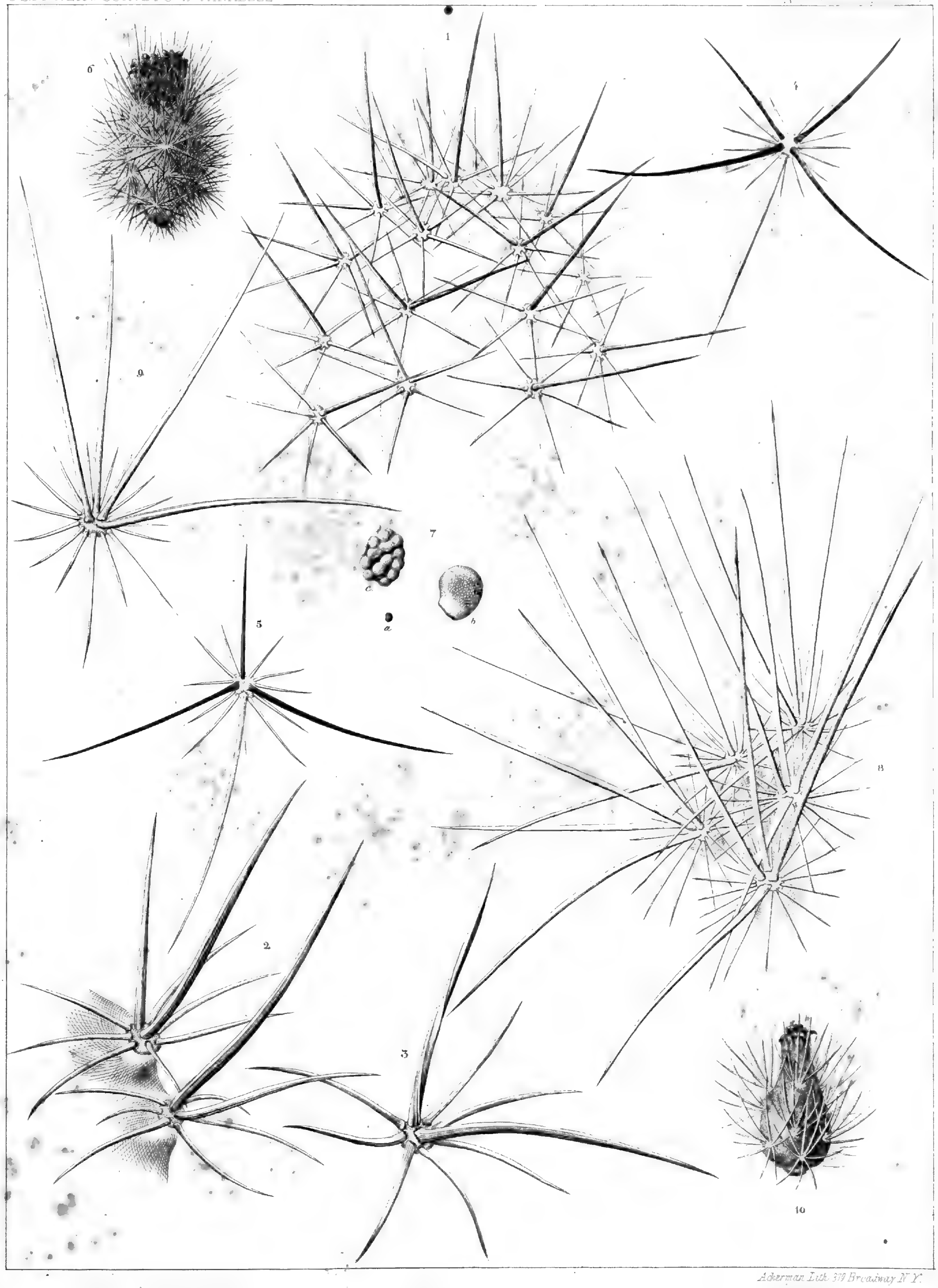
1-2. ECHINOCACTUS WISLIZENI, E. 3. E. EMORYI, E. 4-6 E. POLYCEPHALUS, E & B.



Ackerman Lith 379 Broadway N.Y.

1-3. CEREUS PHŒNICEUS, E. 4-5. CEREUS CONOIDEUS E. & B. 6-7 CEREUS TRIGLOCHIDIATUS, E.

8. C. ~~BIGELOVII~~ 9. C ~~BIGELOVII~~ β. ZUNIENSIS



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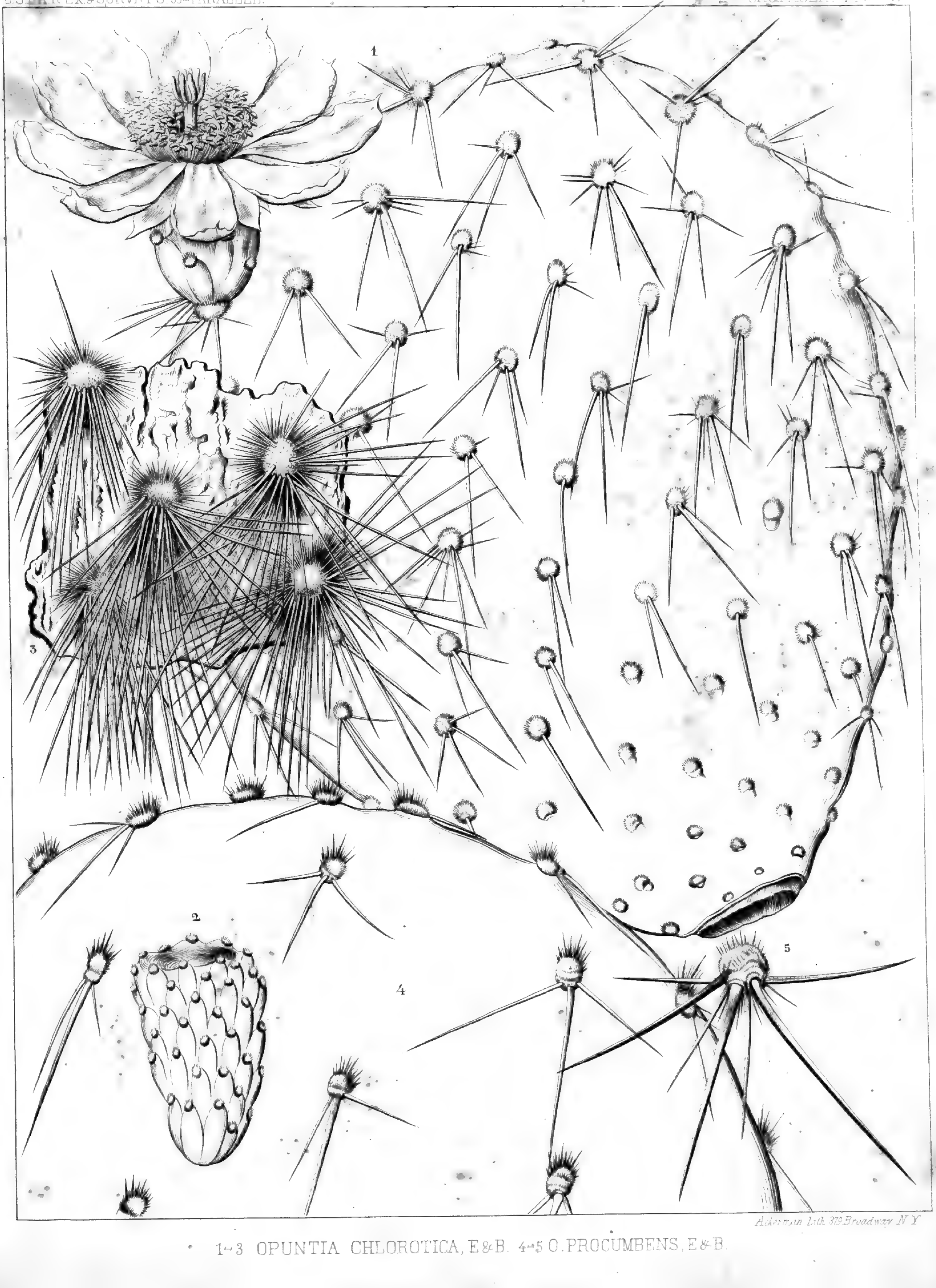
1. CEREUS HEXAEDRUS E&B. 2–3 C. GONACANTHUS E&B. 4–7. C ENGELMANNI, var VARIEGATUS.
8–10. var CHRYSOCENTRUS



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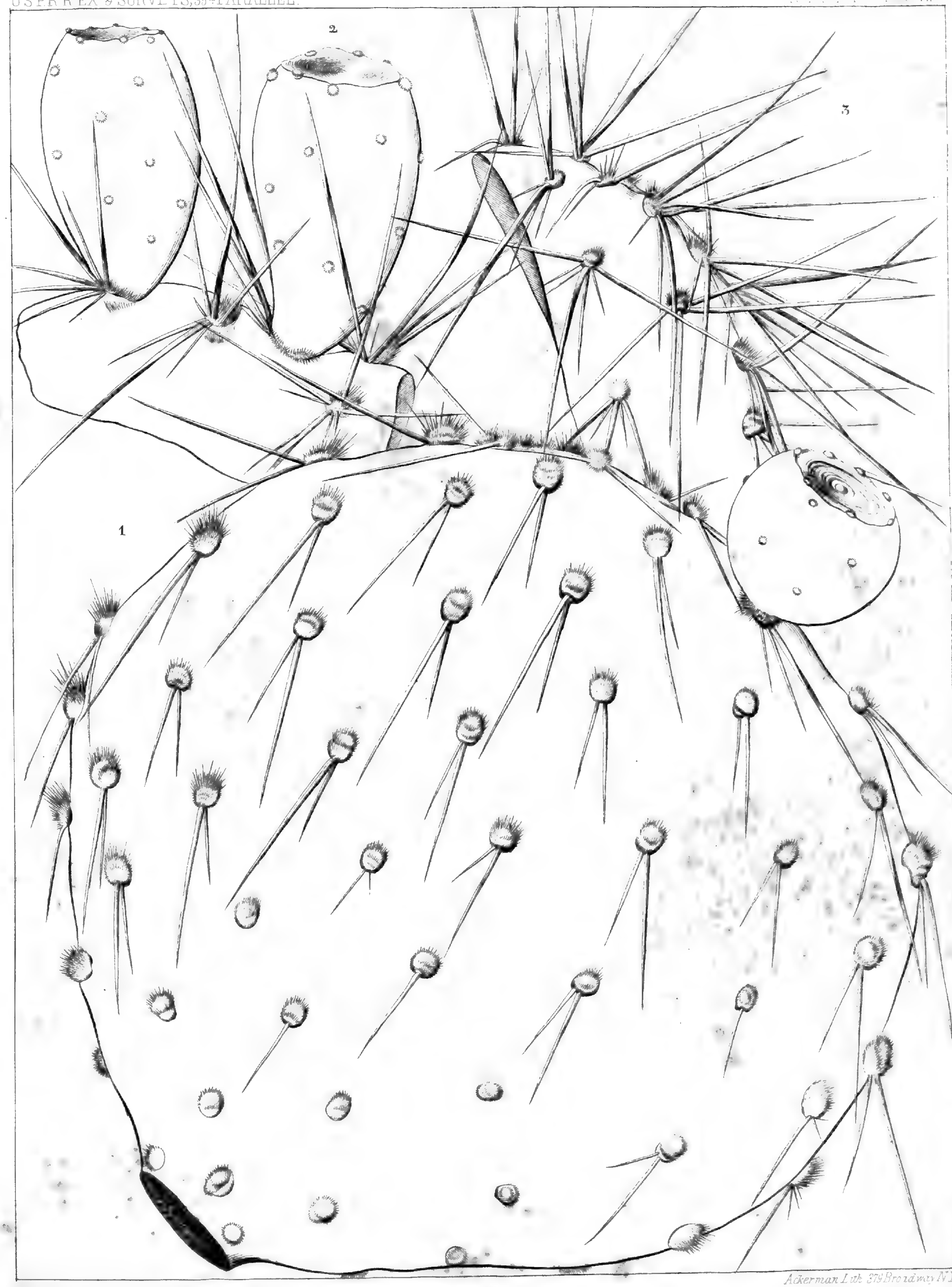
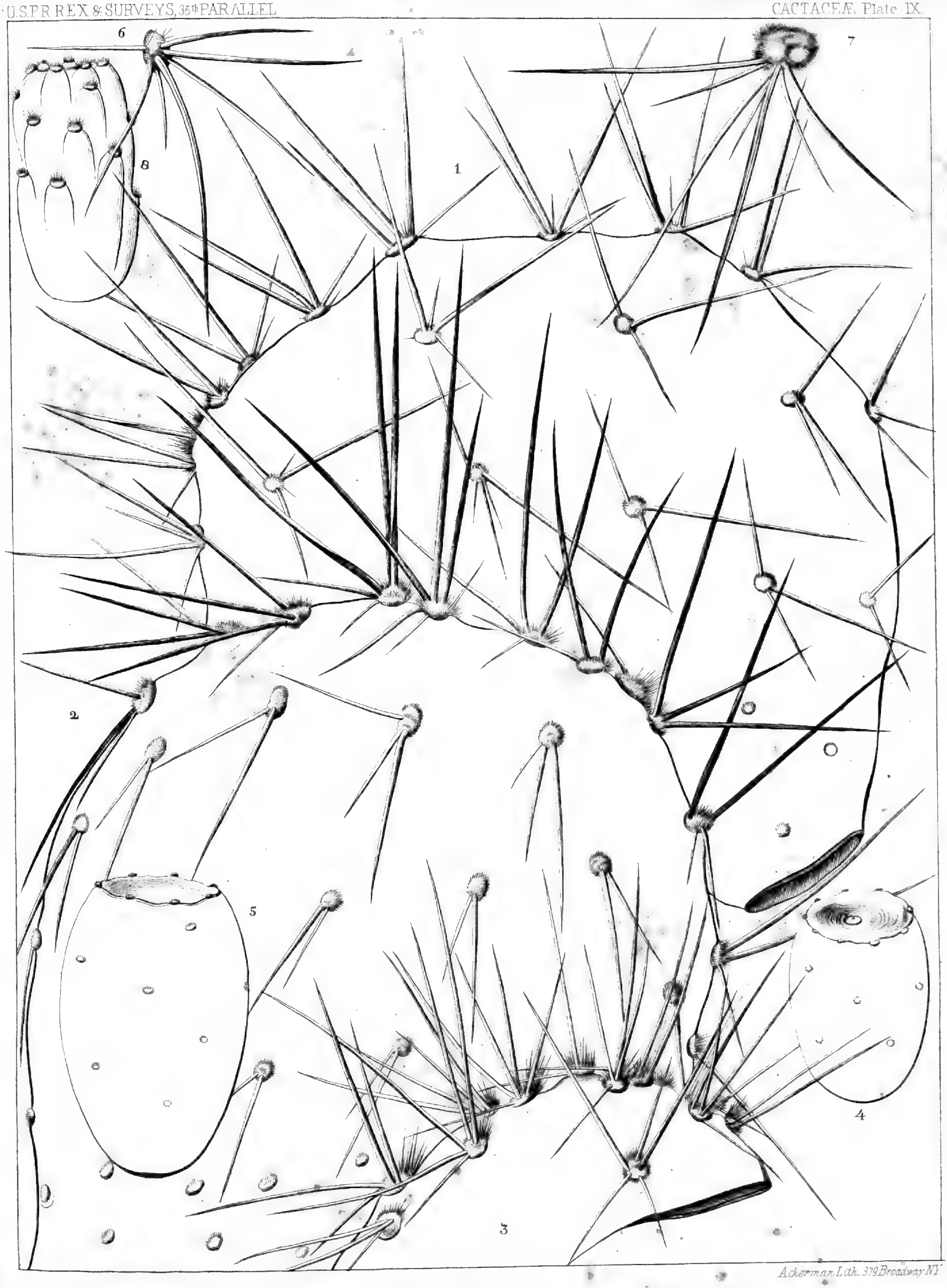
1–3 OPUNTIA CHLOROTICA, E&B. 4–5 O. PROCUMBENS, E&B.

1-2. OPUNTIA OCCIDENTALIS, E & B. 3-4. O. ANGUSTATA, E & B.



1. OPUNTIA ENGELMANNI *var* CYCLODES. E.&B. 2–3. OPUNTIA TORTISPINA E.&B.



1–5, OPUNTIA CAMANCHICA, E & B. 6–8, OPUNTIA MOHAVENSIS, E & B.

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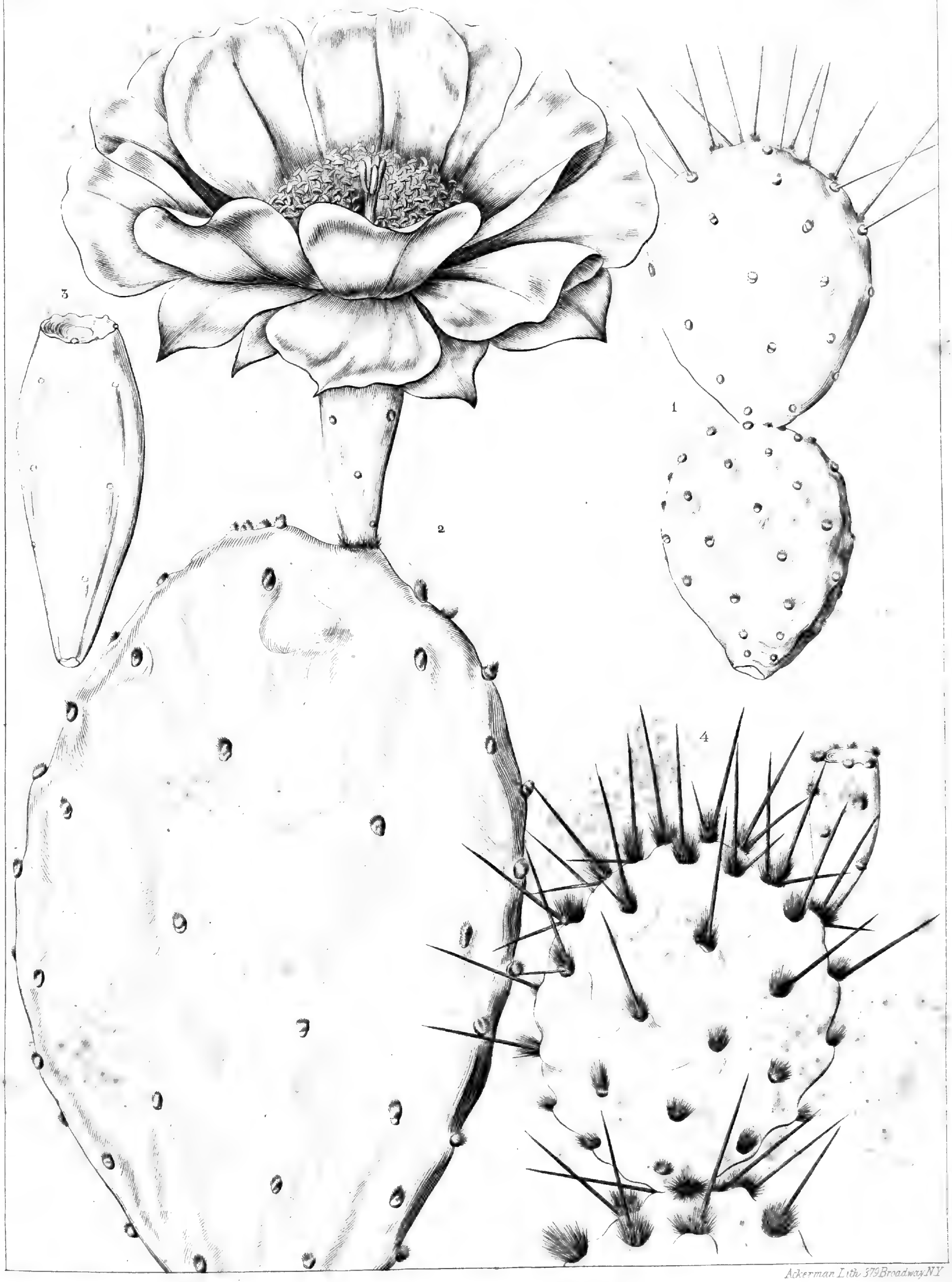
1-2 OPUNTIA VULGARIS. Mill. 3-5 OP. RAFINESQUII, E



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1, OPUNTIA RAFINESQUII, *minor*, E. 2-3. OP. RAFINESQUII, *grandiflora* E.
4, OPUNTIA FUSCO-ATRA, E.

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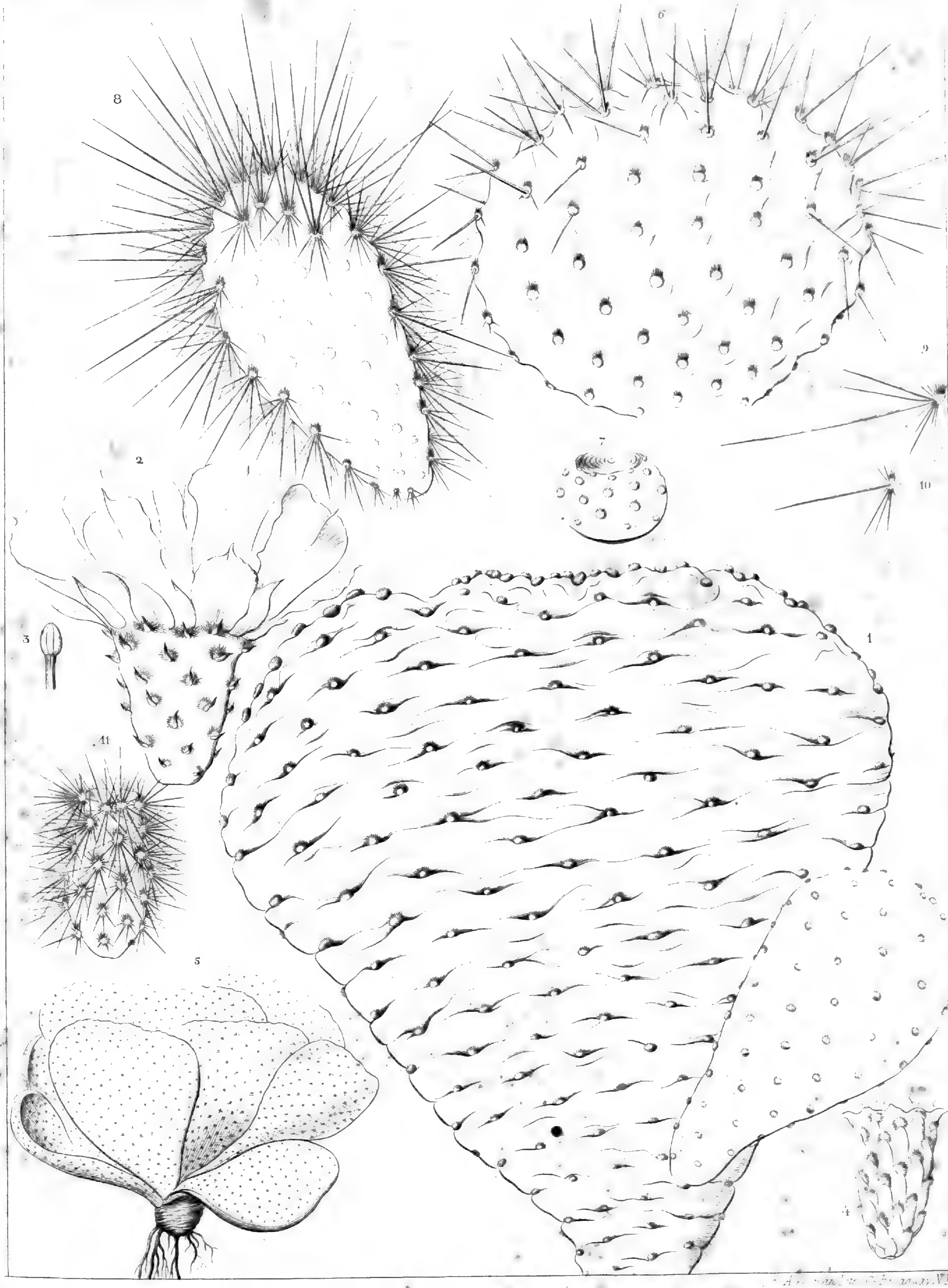
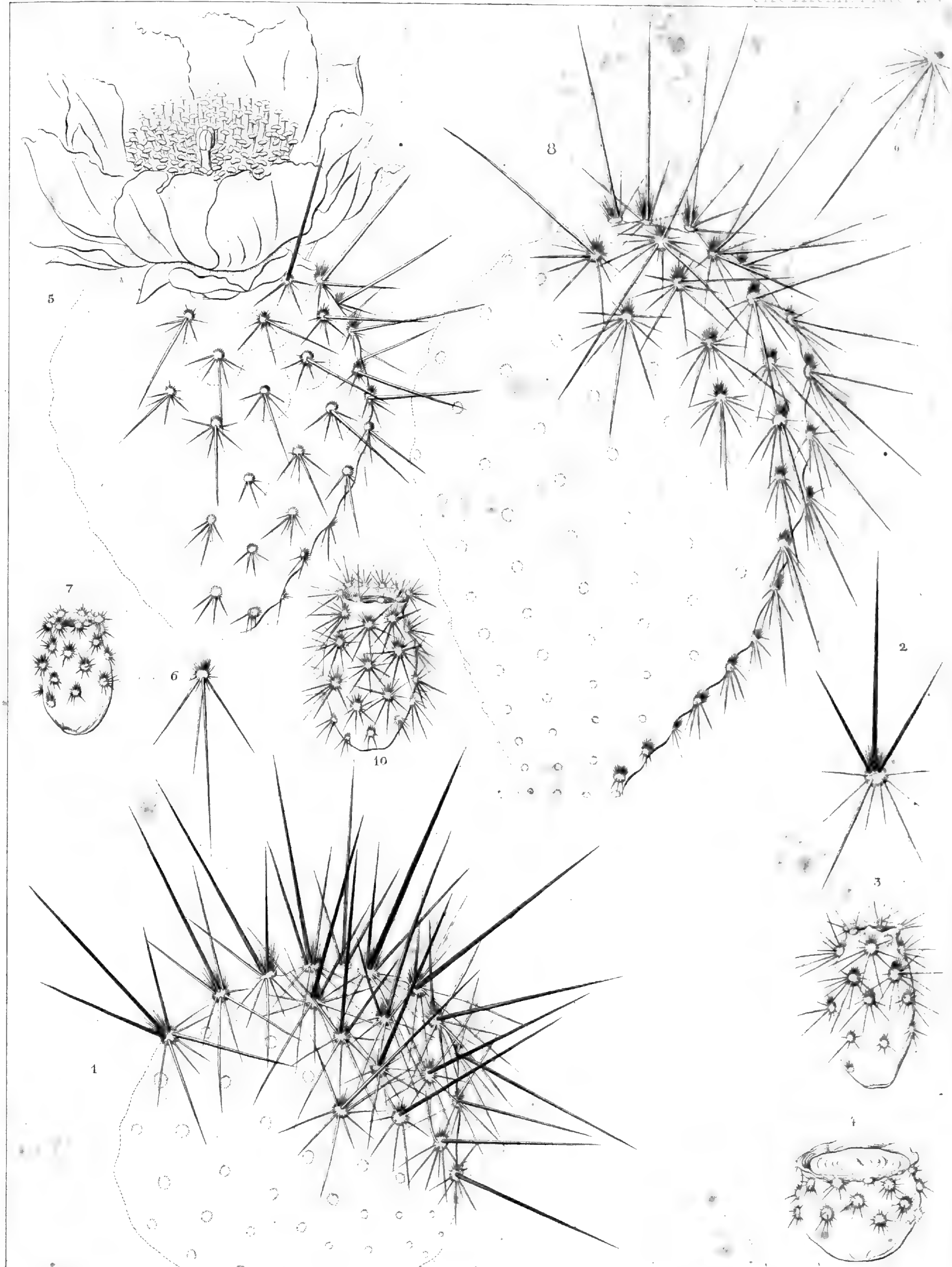
1–3, OPUNTIA CYMOCHILA, E & B. 4–6. OPUNTIA STENOCHILA, E & B. 7–8. OPUNTIA FUSIFORMIS, E & B.
9, OPUNTIA BRACHYARTHRA, E & B.



1–5 OPUNTIA BASILARIS, E&B. 6–7 OPUNTIA SPHEROCARPA, E&B.
8–11 OPUNTIA ERINACEA, E&B.



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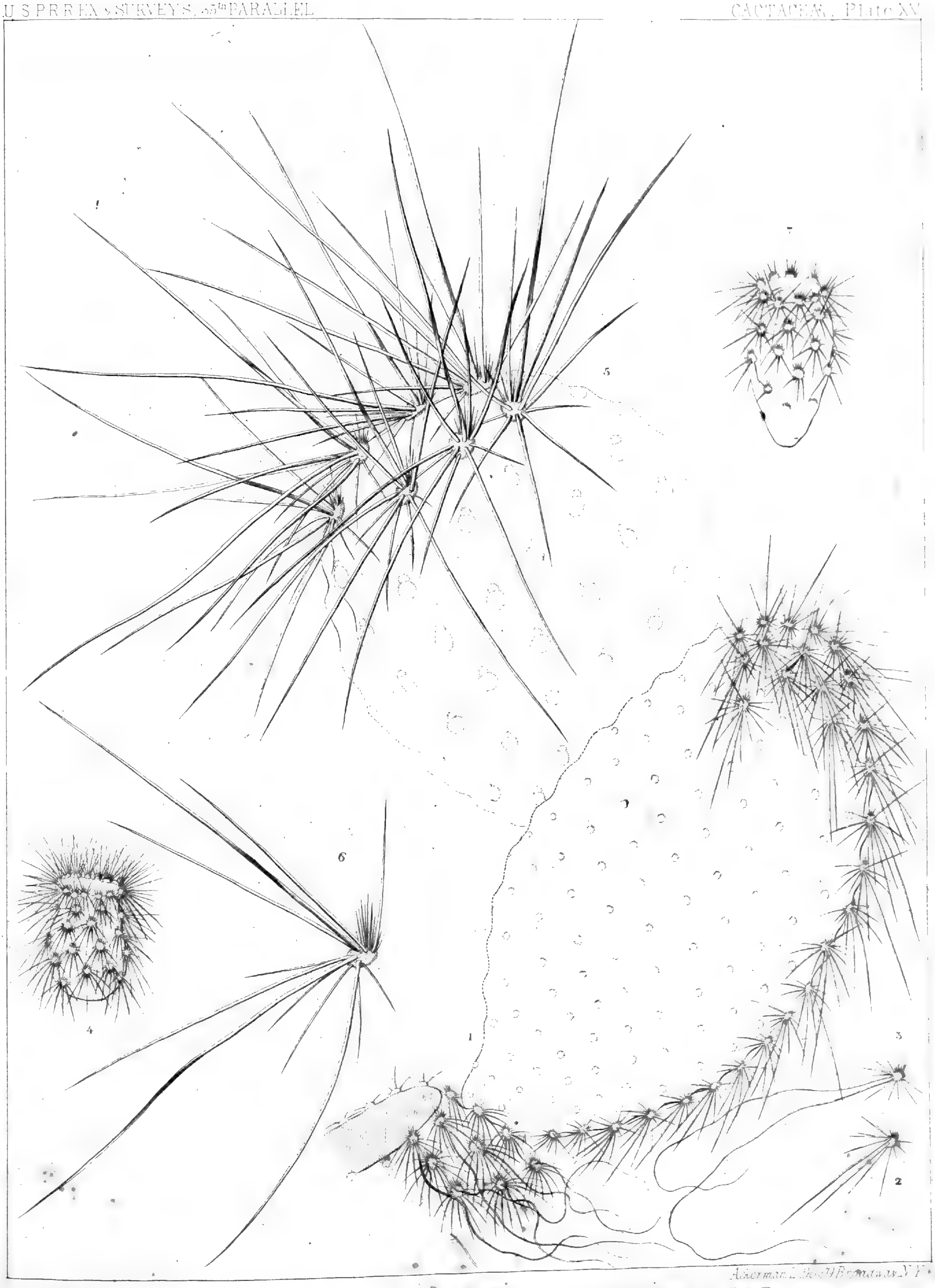
OPUNTIA MISSOURIENSIS, D.C.

1-3, *var.* RUFISPINA. 4. *var.* PLATYCARPA. 5-7. *var* MICROSPERMA. 8-10. *var* ALBISPINA.



1-4. OPUNTIA MISSOURIENSIS. DC. var TRICHOPHORA E & B.
5-6 OPUNTIA HYSTRICINA, E & B.

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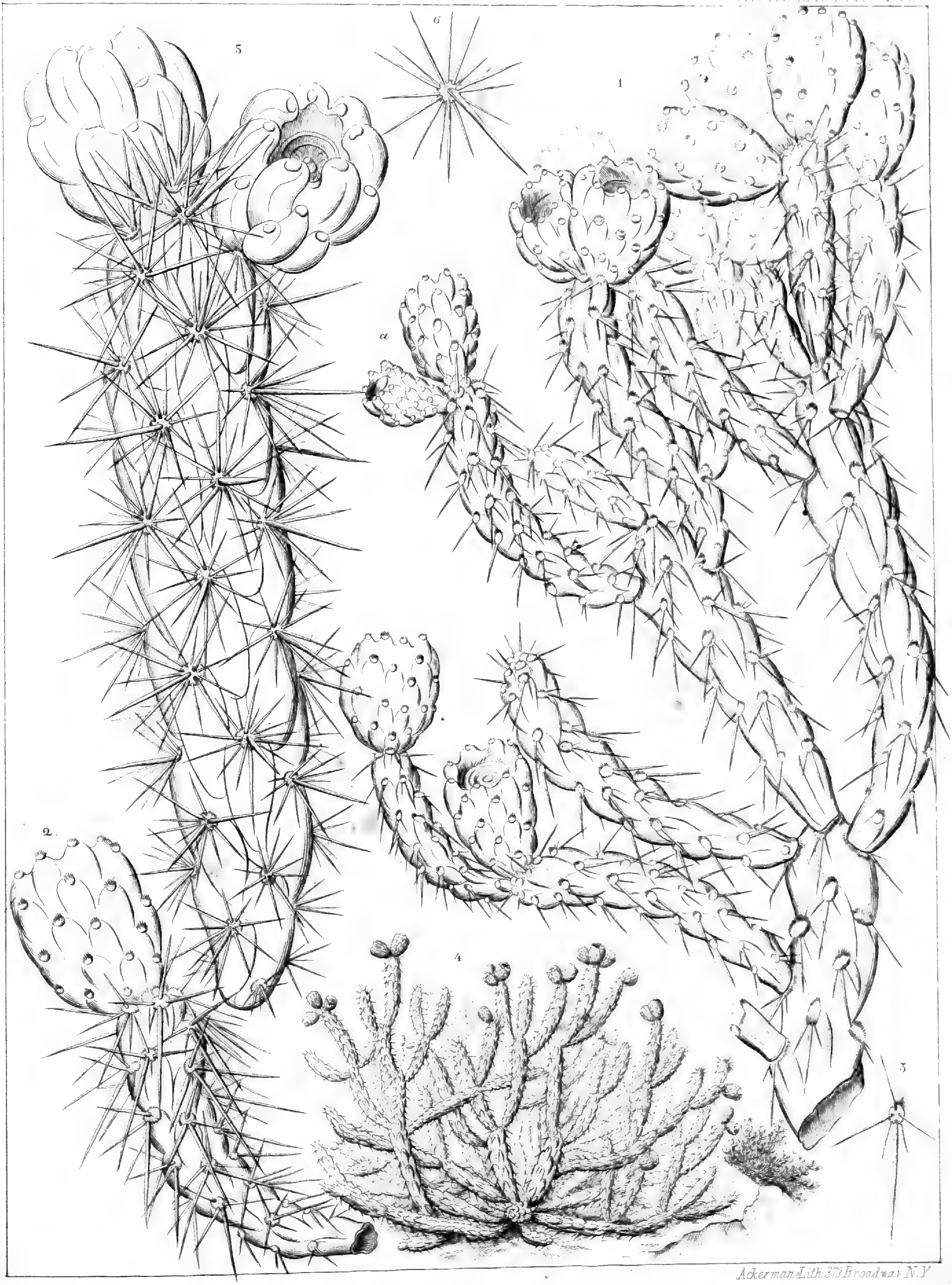
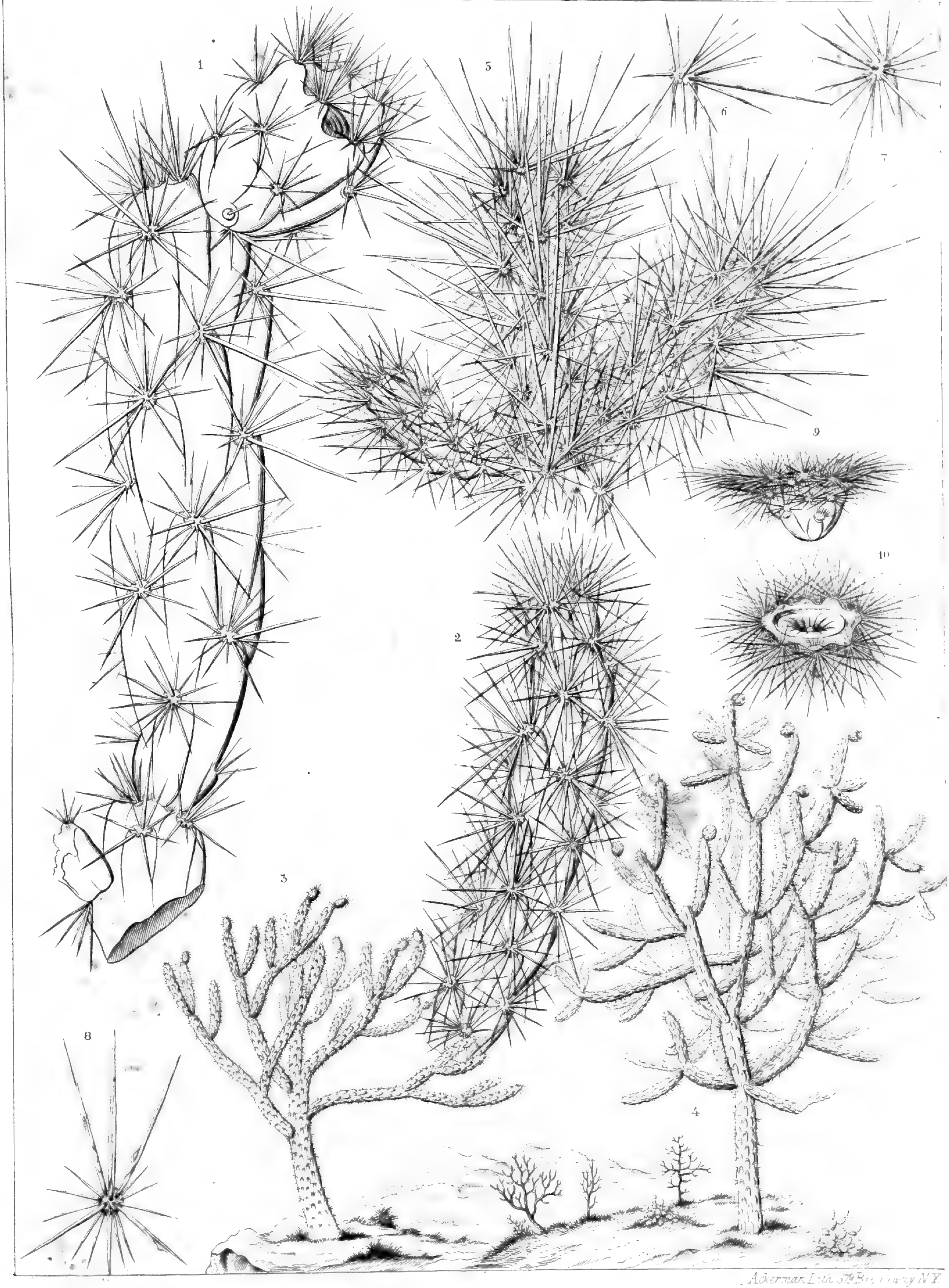
OPUNTIA DAVISII E. & B.



Ackerman Lith 379 Broadway N.Y

1-4 OPUNTIA WHIPPLEI, E&B. 5-6 OP. ARBORESCENS, E.



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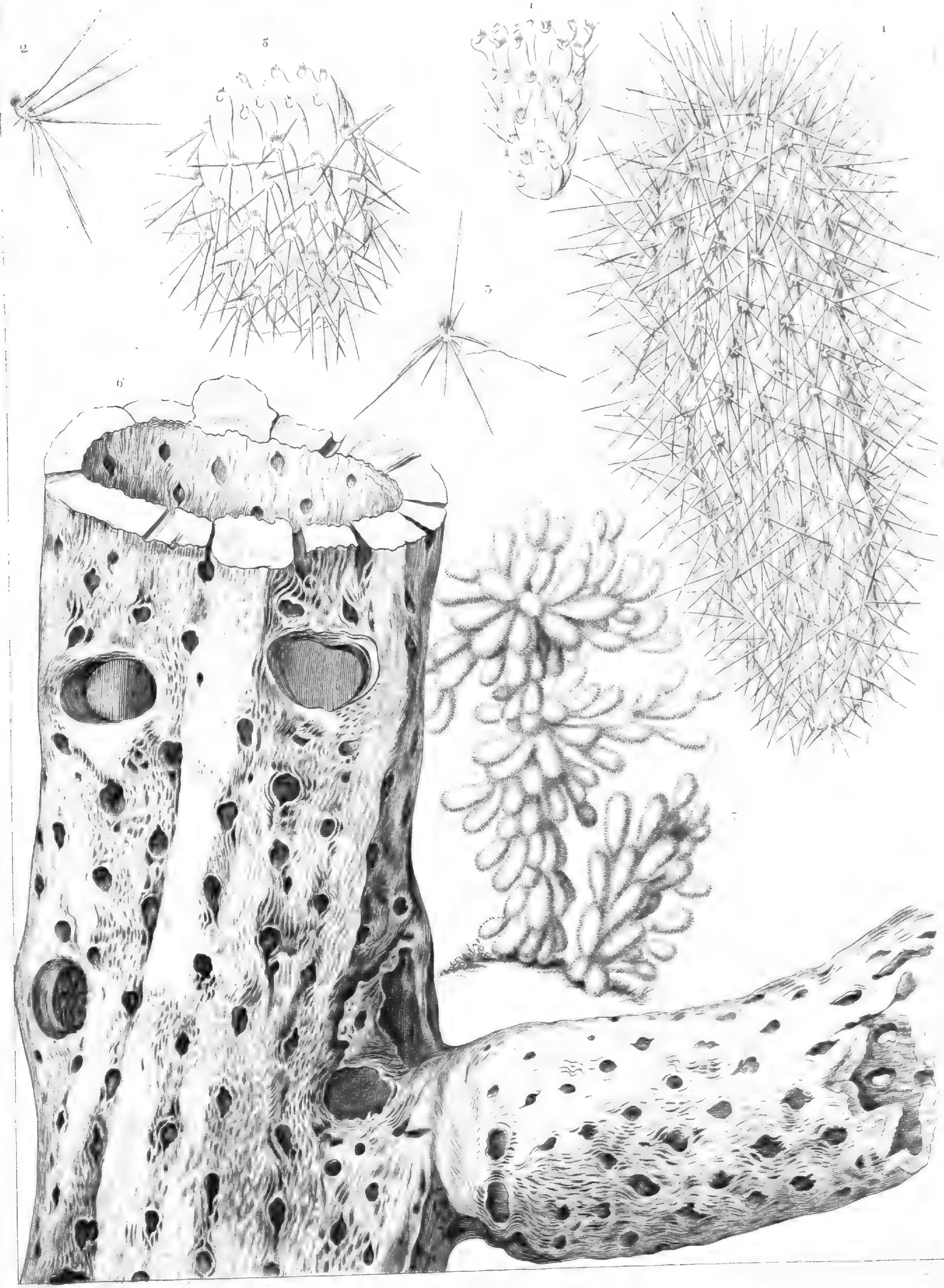
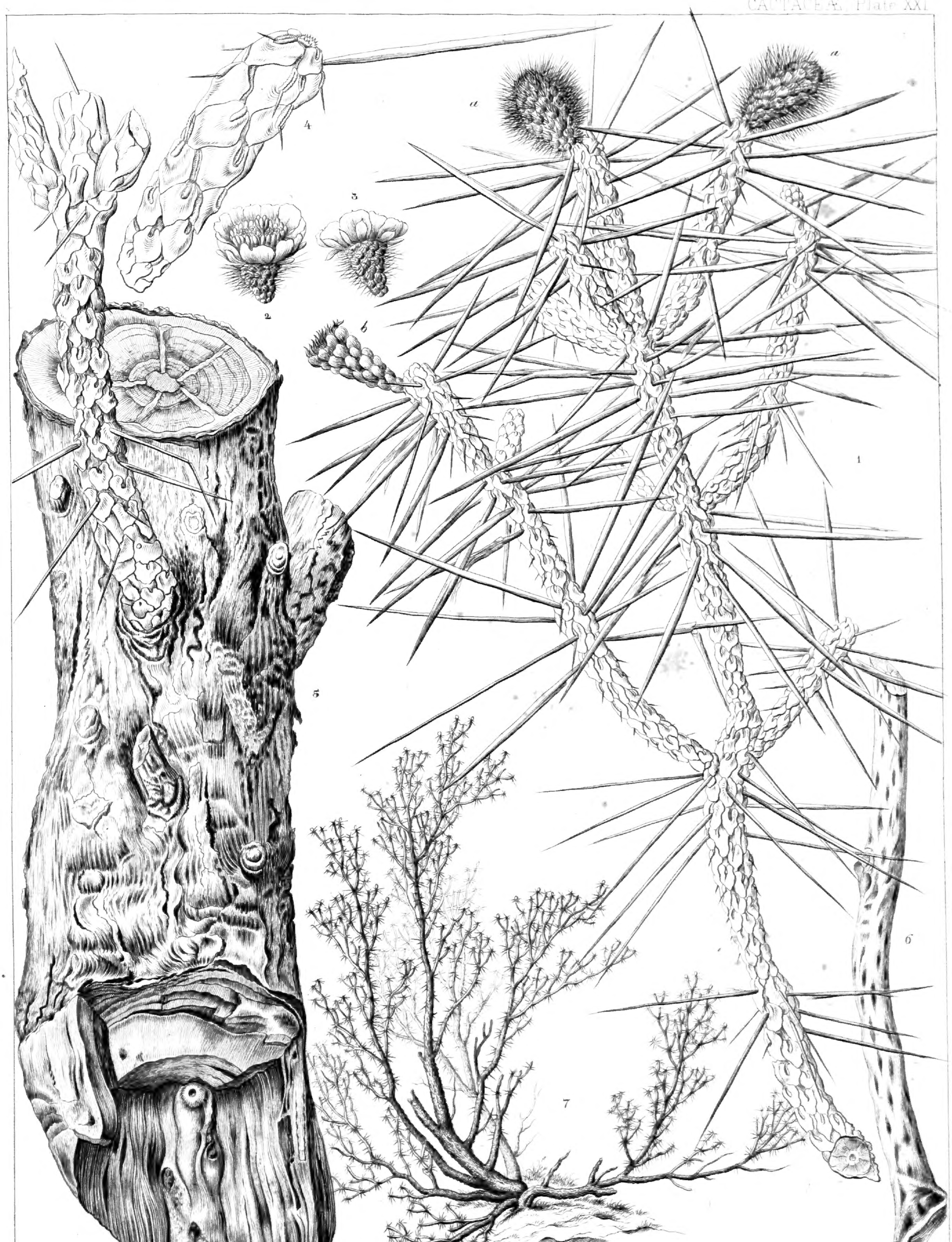
1-3. OPUNTIA ACANTHOCARPA, E. & B. 4, OP. ARBORESCENS, E. 5-10. OP. ECHINOCARPA, E. & B.



OPUNTIA BIGELOVII. E

1. OPUNTIA VAGINATA, E. 2-5. OPUNTIA FRUTESCENS, V.
2-3 *var.* LONGISPINA. 4-5. *var.* BREVISPINA.



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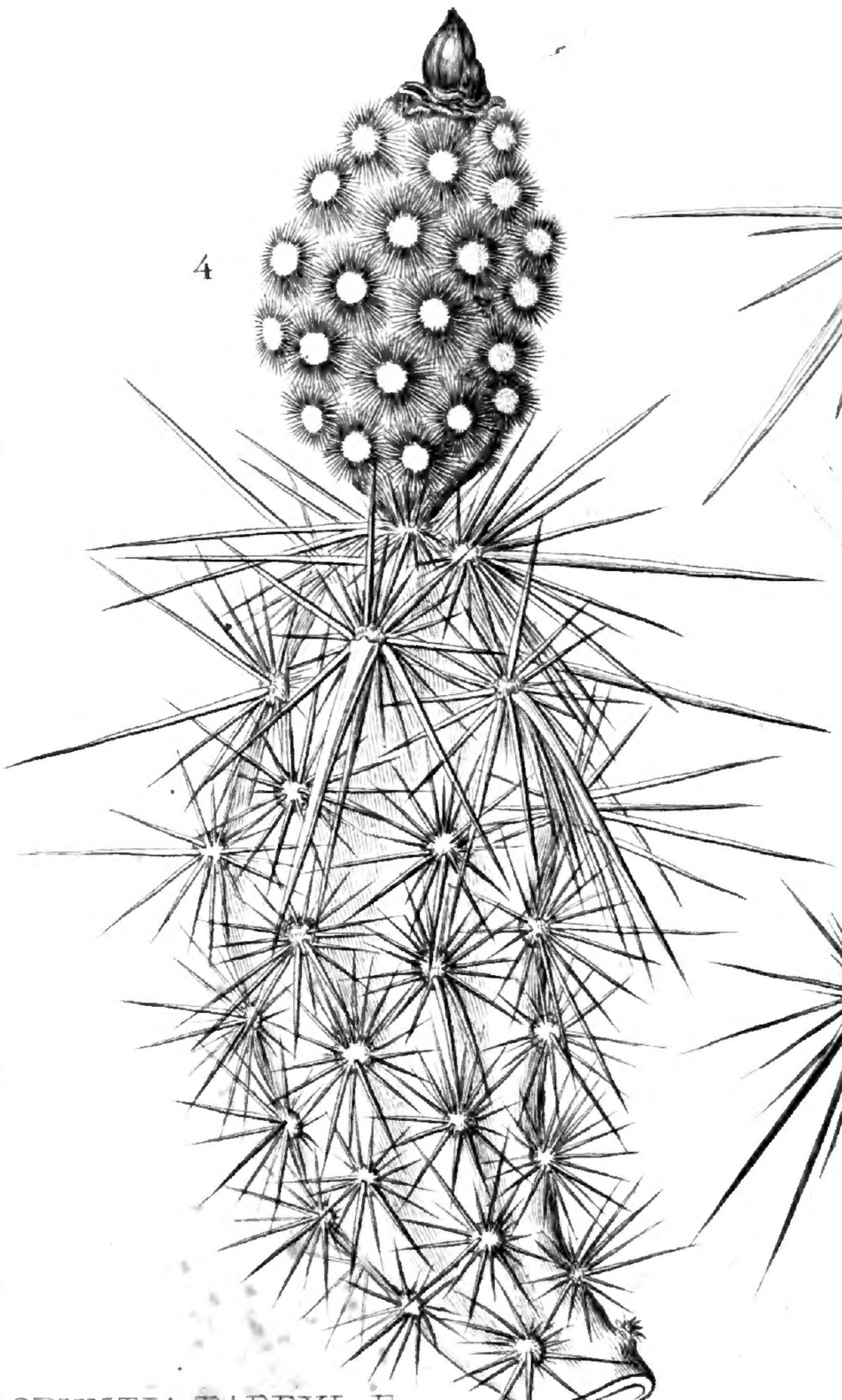
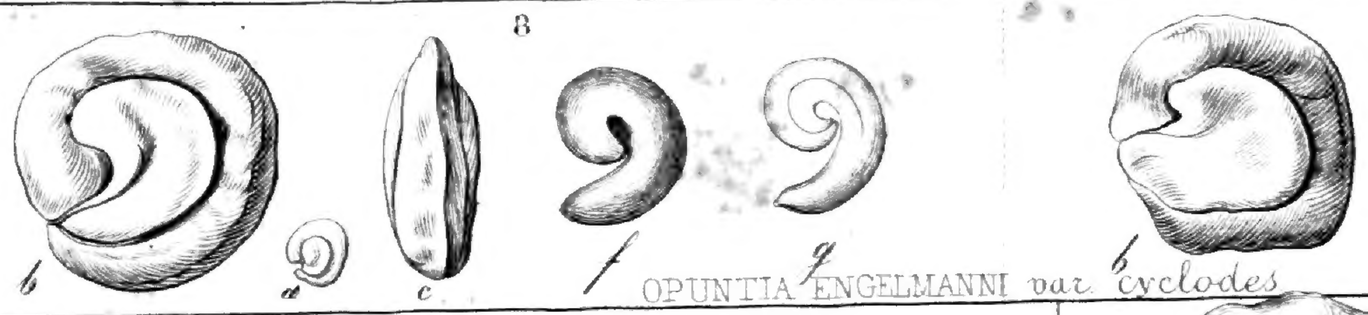
OPUNTIA TESSELLATA. E.

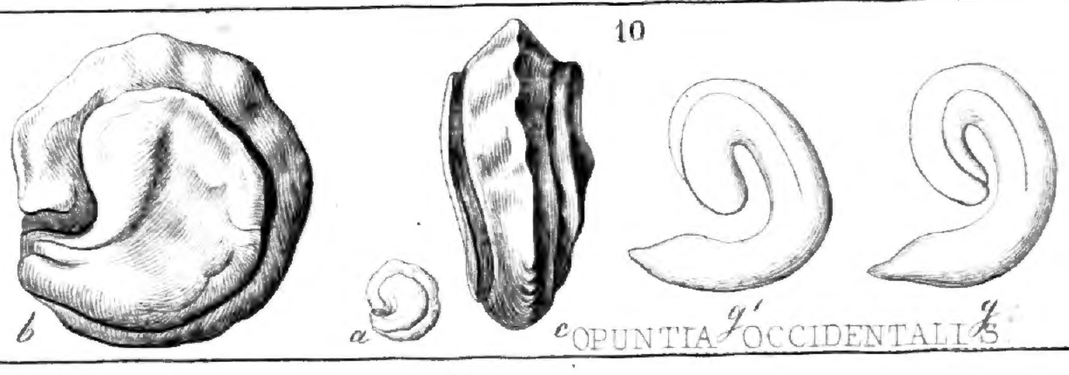


OPUNTIA PARRYI. E.

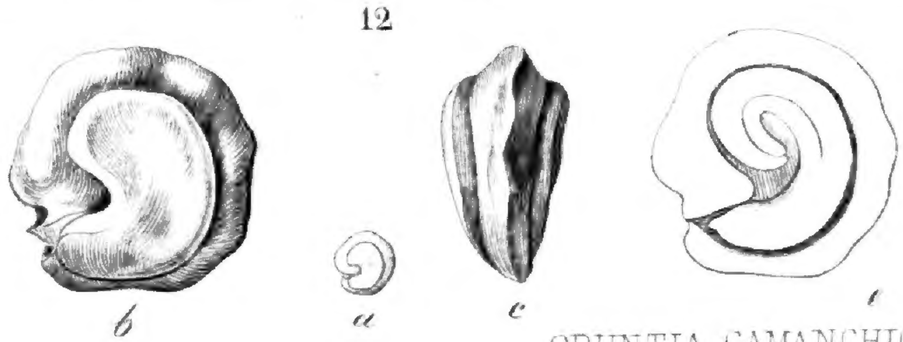
OPUNTIA CLAVATA. E



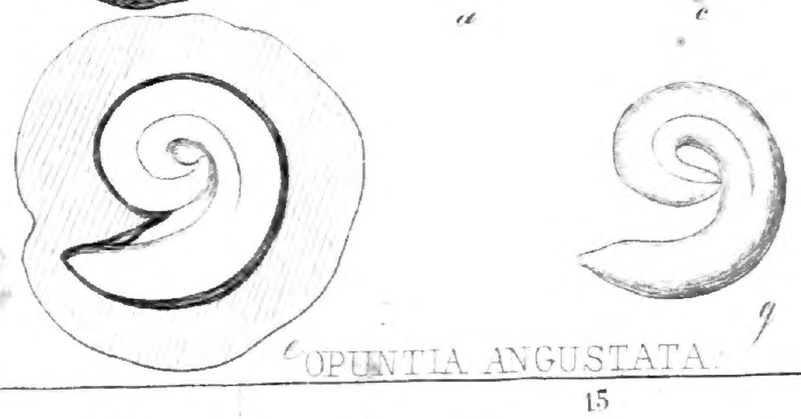
OPUNTIA ENGELMANNI var cyclodes



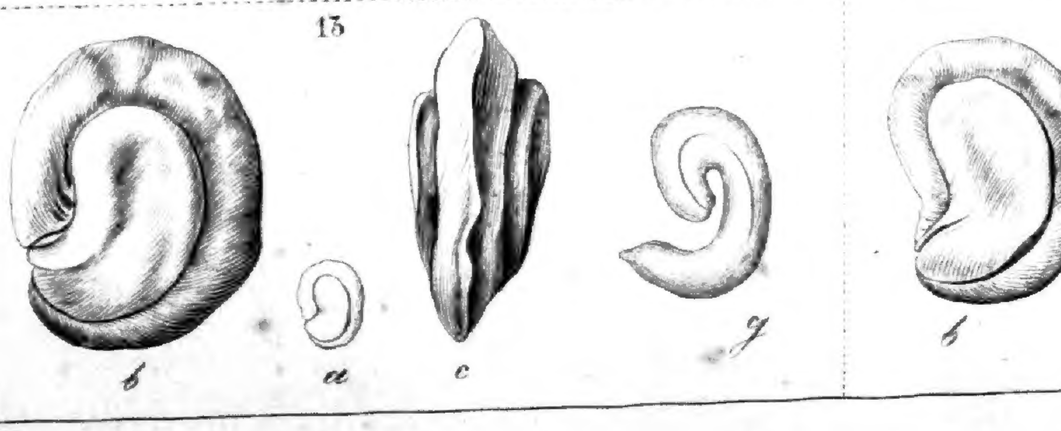
OPUNTIA OCCIDENTALIS



OPUNTIA CAMANCHICA



OPUNTIA ANGUSTATA.



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OP. TORTISPINA.

OP. FUSIFORMIS.

OP. RAFINESQUII.

OP. STENOCHILA.

OP. VULGARIS

OP. CYMOCHILA

var montana

OP. VULGARIS.

OP BASILARIS

OP HYSTRICINA

var rufispina

OP MISSOURIENSIS. var platycarpa

var albispina

var trichophora

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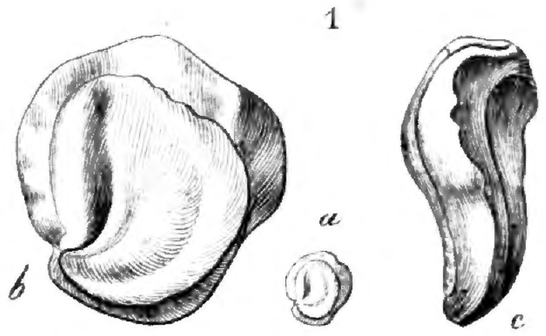
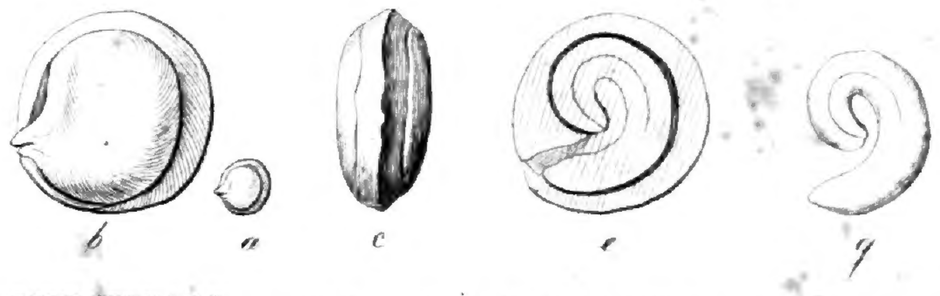
1



OP. MISSOURIENSIS, *var. microsperma.*

2



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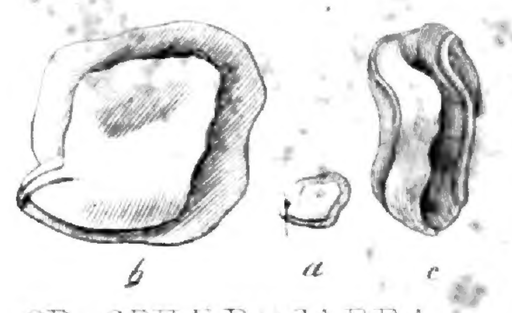
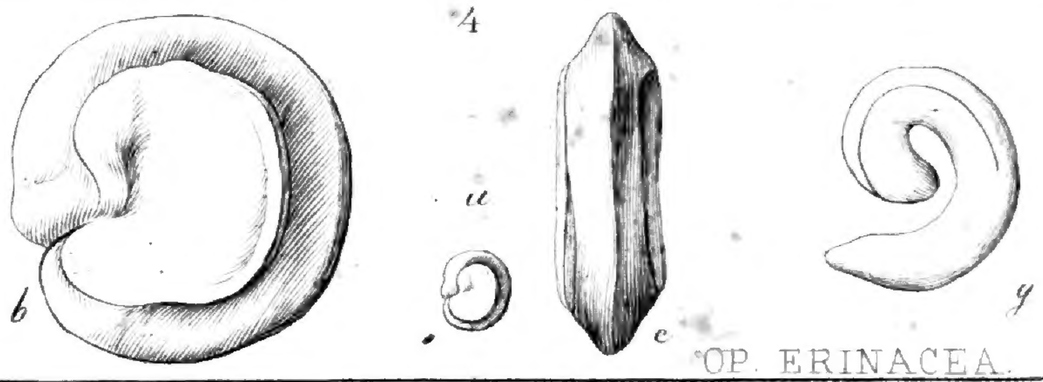


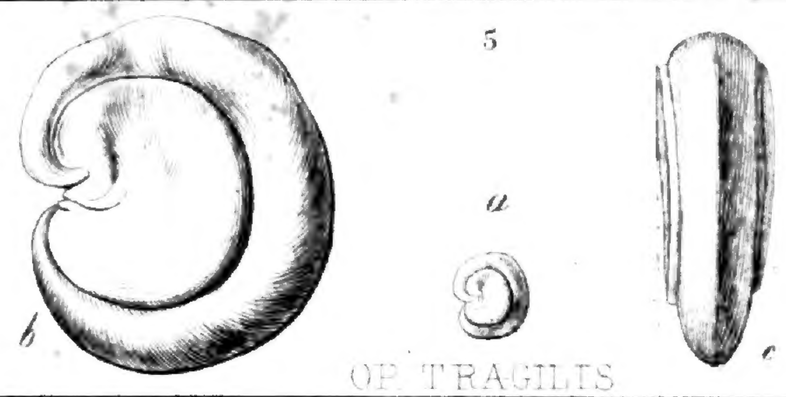
OP. SPHÆROCARPA.

4



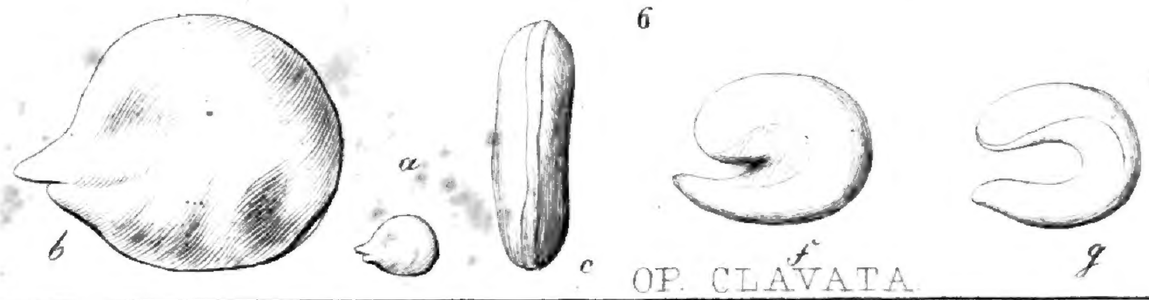
OP. ERINACEA.

5



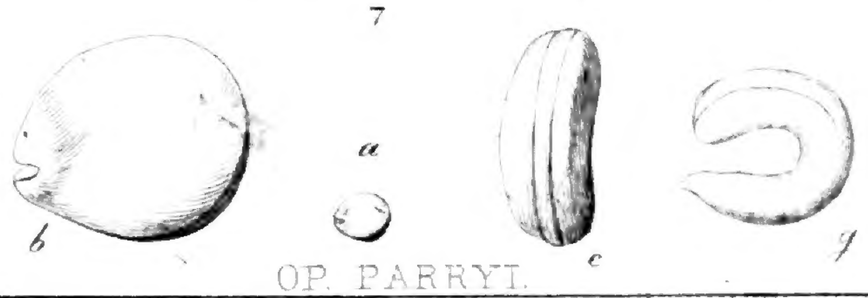
OP. TRAGILIS

6



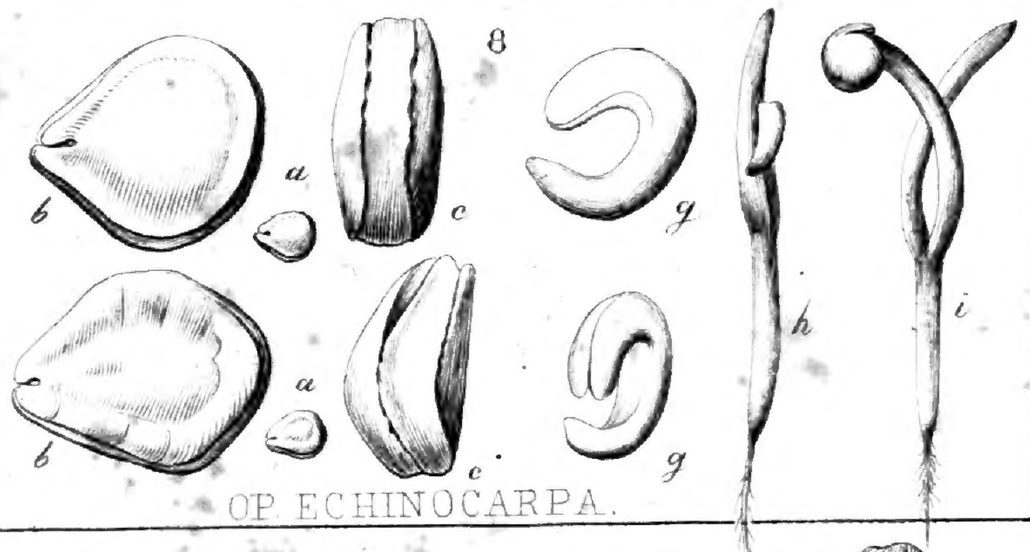
OP. CLAVATA.

7



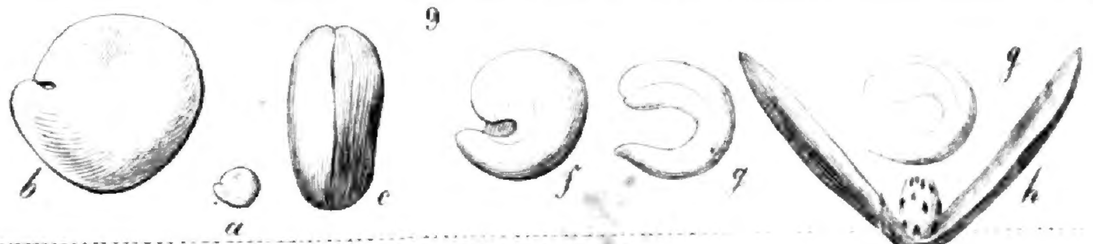
OP. PARRYI.

8



OP. ECHINOCARPA.

9



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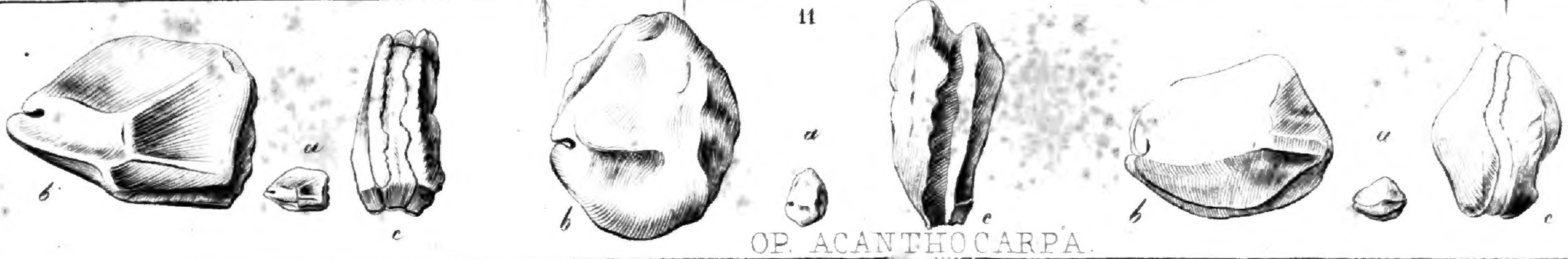
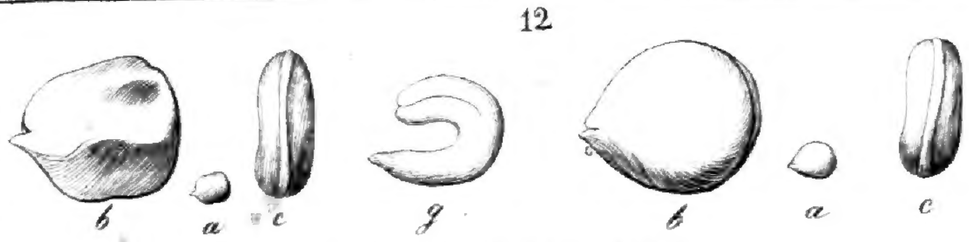
OP. WHIPPLEI

11



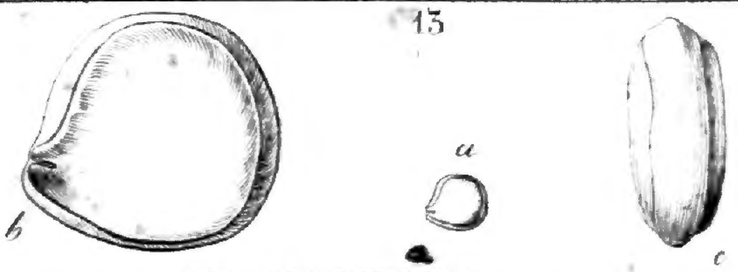
OP. ACANTHOCARPA.

12



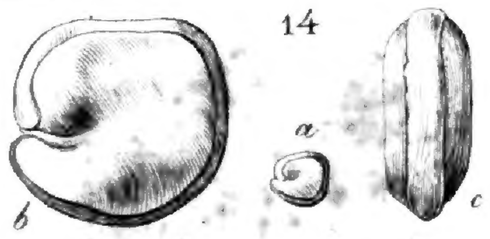
OP. ARBORESCENS.

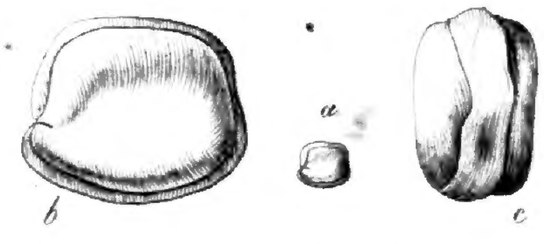
13



OP. VAGINATA

14



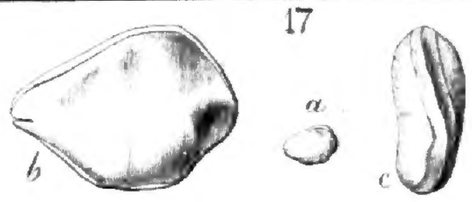


15

16

OP. FRUTESCENS

17



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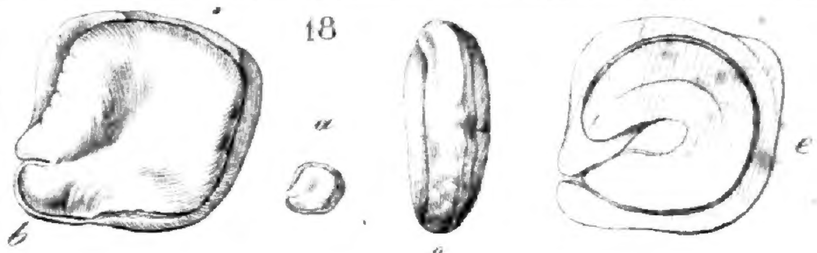
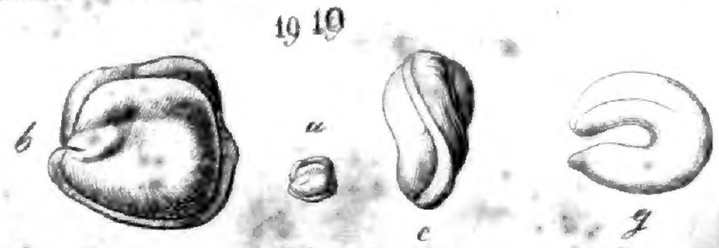


19 19



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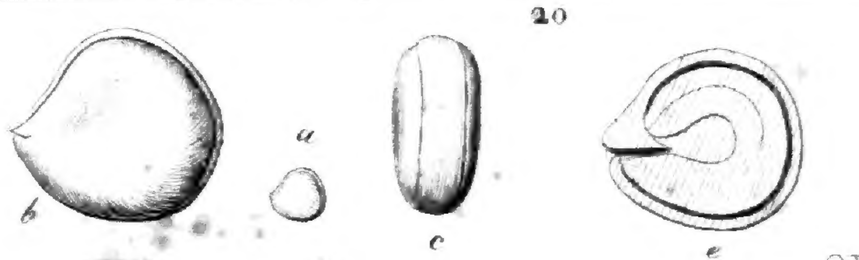

OP. TESSELLATA.

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