UNITED STATES GEOLOGICAL EXPOLRATION OF THE FORTIETH PARALLEL.
CLARENCE KING, GEOLOGIST-IN-CHARGE.

BOTANY.

BY

SERENO WATSON,

AIDED BY

PROF. DANIEL C. EATON, AND OTHERS.

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YUCCA AND AGAVE.

The following addition to the Catalogue of the plants of Nevada and Utah is from DR. GEORGE ENGELMANN as a result of his recent study of our hitherto ill-defined and little understood species of these genera.

YUCCA, L.

Perianth cup-shaped, of six (whitish) petal-like lance-oval acutish leaves, withering-persistent, longer than the six club-shaped stamens. Stigmas 3, more or less united. Pod oblong or cylindrical, somewhat 6-sided, 3-celled, the cells incompletely 2-celled by a partition from the back. Seeds very numerous, flat, horizontal, in 6 rows, black, with the linear straight or curved embryo diagonal, as long as the albumen.—Stems woody, fibrous, very short or rising into thick columnar palm-like simple or branching trunks, bearing persistent rigid linear or lance-linear mostly sharp-pointed leaves, with smooth, rough, or filamentose edges, and terminated by an ample compound panicle (or rarely a spike) of showy pendulous flowers, opening wide in the evening and half-closed in the morning.

§ 1. EU-YUCCA. Filaments club-shaped, obtuse, papillose-pubescent, mostly shorter than the pistil, often spreading or recurved; anthers oblong or sagittate; ovary prismatic or subcylindric, obtuse or narrowed into a sort of style; stigmas elongated, bi-lobed, papillose.

* *Sarcocarpa.* Pendulous fruit fleshy and indehiscent; thick seeds somewhat rugose, with deeply lobed (ruminated) albumen.

1. Y. BACCATA, Torr. *Bot. Mex. Bound.* 221. Stems none, or short, or several feet high; leaves very thick and rigid, lance-linear, narrowed above the broad base, concave, terminating in a stout spine, with very coarse marginal fibres; flowers panicled; petals rhombic-ovate (1¼–1½′ long) or linear-lanceolate, (sometimes over 3′ long;) ovary attenuate into a style; stigmas short; fruit ovate or cylindric, long-rostrate.—From New Mexico and S. Colorado, through S. Utah, to Arizona, California and Mexico. Northward a low plant, it becomes a tree farther south; leaves 1½–2° long, 1¼–2′ wide. The edible sweet fruit are often called "Dates;" seeds variable in size, usually the largest in the genus, 5–6″ wide, 1¼–1½″ thick.

* * *Clistocarpa.* Fruit indehiscent, at last dry; seeds thickish, smooth, with the albumen entire.

2. Y. BREVIFOLIA, Eng. (*Y. Draconis*, Var. *arborescens*, Torr. *Bot. Whipp., Pac. R. R. Surv.* 4. 147.) Tree-like, at last much branched; the short narrow leaves crowded at the end of the branches, thick, very rigid, stout and sharp-pointed, not narrowed above the broad base, serrulate on the margin; panicle sessile at the end of the branches; fruit large, 4′ long, ovate, pointed.—Deserts of S. Utah, through Arizona, to S. E. California where it forms entire forests on the desert plateaus at 2–4,000 feet altitude. Often 20–30° high and 1–2° in diameter, with a thick rough bark; leaves 4–6′ or in younger specimens 10–12′ long, ⅓–½′ wide, stiffer and stouter pointed than any other in the genus. The flower when known may make it necessary to remove it from § *Euyucca.*

* * * *Chænocarpa.* Erect fruit dry, septicidally 3-valved from the apex, the valves at last again divided at tip; seed very thin, smooth, with an entire albumen.

3. Y. ANGUSTIFOLIA, Pursh. Stems none or short; leaves narrowly linear, scarcely narrowed above the broad base, rigid, spiny-pointed, nearly flat above, convex below, with very slender marginal fibres, 1½–2½° long; flowers spiked; petals broad-ovate, 1½–1⅝′ long; stigmas half as long as the ovary, sessile, erect; capsule cylindric-ovate, thick, obtuse, short-pointed; seed large, (5–7″ in diameter,) with a wide margin.

Var. β. RADIOSA, Eng. Stems several feet high; flowers in large panicles; petals narrow lanceolate, 1½–1⅝′ long.

Western plains to Texas, Colorado, New Mexico and into Utah; the variety in Central Arizona and northward to the borders of Utah. A very variable plant, which eastward toward the Mississippi and the Gulf has broader, shorter, and more flaccid leaves, (*Y. stricta*, Sims ?,) but is always recognized by the thick never constricted obtuse capsule and the large broad-margined seed, 5–7″ wide. Both forms here

noticed have very narrow leaves, the former 6″, the latter 4–5″ wide. About St. George, Utah, a form occurs with leaves only 2″ wide.

§ 2. HESPERO-YUCCA. Filaments thickened upward, acute, smooth, mostly longer than the pistil, erect; anthers didymous, broader than long; ovary oval, the slender style tipped with a broad short 3-lobed stigma, bearing numerous filiform papillæ; erect capsule loculicidally 3-valved from the apex, valves entire, undivided; seeds thin, smooth, with entire albumen.

4. Y. WHIPPLEI, Torr. *Bot. Mex. Bound.* 222. Stems none or short, prostrate; leaves few, often falcate, rigid but not thick, gradually widening toward the broad base, rough on the margin, sharp-pointed, striated, glaucous, 12–18′ long, ½′ wide or less; flowers panicled; petals lance-oval, 1½–3′ long; capsule small, ovate or obovate, obtuse; seed narrowly margined.—From N. W. Arizona to the mountains and coast ranges of S. California; it may be expected in S. Utah. Flowers very different in size, some specimens with the largest in the genus; style sometimes as long as the ovary or much shorter.

The following genus is founded on a plant from W. Texas, originally described as a doubtful *Yucca*, then as an *Aloe*, but evidently distinct from both.

HESPERALOE, ENG. *N. Gen.*

Perianth cylindric, of 6 (reddish) petal-like linear obtuse leaves, united at base, withering-persistent, the outer ones cucullate at apex; filaments from a broad adnate base, subulate-filiform, of the length of the perianth, geniculate-inflexed below the tip; anthers oblong, bifid below; ovary ovate, 3-celled, several times shorter than the filiform style; small capitate stigma exsert; capsule 3-celled, 6-valved, with 6 rows of thin black horizontal Yucca-like seeds, with a linear diagonal embryo of the length of the albumen.—Corm bearing the Yucca-like filamentose-margined leaves and a scape, with the fascicled flowers in a spike or few-branched panicle. The leaves, pollen,[1] and seeds are those of a *Yucca*, the perigon and pistil that of an *Aloe;* the filaments, being adnate at base and geniculate upwards, resemble those of an *Agave.*

HESPERALOE YUCCÆFOLIA, Eng. (*Yucca* (?) *parviflora*, Torr. *Bot. Mex. Bound.* 221. *Aloe yuccæfolia*, Gray. *Proc. Amer. Acad.* 7. 390.)

AGAVE, L.

Perianth tubular, funnelform or campanulate, persistent, 6-parted, the divisions nearly equal. Stamens 6; filaments more or less adnate to the tube, inflexed in the bud, at last exsert; anthers linear, versatile. Pod coriaceous, 3-celled, loculicidally 3-valved from the apex. Seeds many, black, flat, horizontal, in 2 rows in each cell.—Leaves thick and fleshy, mostly terminating in a spine, on the margins spiny-toothed or often cartilaginous-denticulate or rarely filamentous or entire, clustered at the base of the many-flowered scape from a thick fibrous-rooted crown or on the top of a short trunk.

A. UTAHENSE, Engelm. *N. sp.* Leaves basal, stout, very fleshy, tapering from a broad base and terminating in a long channeled spine, herbaceous on the sinuate margins between the horny flat teeth; scape bearing a dense spike of small yellowish flowers in fours or pairs; the oblong obtuse erect lobes of the perigon as long as the ovary, 3–4 times the length of the short campanulate tube; stamens from the middle of the tube, together with the style slightly exsert; anthers of the length of the lobes; capsule cylindric-ovate, acute.—About St. George, Utah, (Dr. E. Palmer, J. E. Johnson.) Leaves at base 1½–2′ wide, 5′ long, with stout broad white straight or rarely recurved spines on the margin; terminal spine whitish, nearly 1′ long; each leaf marked with the impressions of the teeth of those next to it; scape 5–6° high; flowers, ovary included, about 1′ long, tube very shallow, scarcely more than 1″ long; capsule and seeds among the smallest in the genus, the former 9–10″ long, the latter 1¼–2″ in longest diameter. Allied with *A. heteracantha*, Zucc., (*A. Poselgeri*, Salm. *A. Lecheguilla*, Torr.,) which extends from Mexico into New Mexico and Arizona.

[1] The pollen-cells of *Yucca* are globose, 0.055–0.065 mm. diam.; those of *Hesperaloe* are similar but only 0.050–0.055 mm. diam., and those of *Aloe* 0.030–0.050 mm. diam., globose when fresh, but when dry lanceolate, folded or grooved, (much like those of *Hyacinthus* and many other *Liliaceæ*,) slowly becoming globose when soaked.

THE

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TRANSACTIONS

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ACADEMY OF SCIENCE OF ST. LOUIS.

Notes on the Genus YUCCA.

By GEORGE ENGELMANN, M.D.

The stately Yuccas of liliaceous alliance and of American origin had attracted the attention of European horticulturists long before Linnaeus classed the then known species, four in number, and, indeed, three of these were based on specimens cultivated in European gardens, two of them, *Yucca aloifolia* and *Yucca Draconis*, on the elegant and very accurate figures of cultivated plants by Dillenius, published some 140 years ago. Ever since then the Yuccas have remained favorite plants in the gardens on account of their palm-like (hence *Palmilla* of the Mexicans), either rigid and pungent, or gracefully curved foliage, shooting up from the ground in pleasingly regular masses, or raised into the air on simple or branching trunks, all overtopped by immense white panicles of hundreds of glorious flower-bells.

It thus happened that these plants fell into the hands of professed horticulturists, and—perhaps because the herbaria could afford only few and very incomplete specimens—scientific botanists rather shunned them, as they did many other such plants, and notably among them the Cacti. With these they share the precious property of being easily propagated from some, perhaps a single, imported specimen; hence, the individual peculiarities of such specimens, propagated a thousand and a thousand fold in the

course of a century (for most of our cultivated Yuccas have been thus long in the hands of nurserymen), at last impress the observer with the dignity of specific characters. But the botanist finds it necessary to fall back on the organs of inflorescence and fructification as the only safe guide in such difficulties; here, however, the cultivated Yuccas leave us in the dark. They yield us flowers, to be sure, but we find the flowers so very similar in many species, and again so dissimilar in different forms of the same species, that evidently but little light can be obtained from their study. And the fruits? Unfortunately the Yuccas scarcely ever have borne fruit in European gardens. The difficulties are increased by the fact, that, as will be shown below, in their native homes these plants vary remarkably in the structure and the form of even their more important organs; and before fuller examination of native forms can be had, we must remain in considerable doubt as to the limits of species.

My attention was drawn to this genus, when, since 1842, Mr. F. Lindheimer sent several then undescribed species from Texas, and Dr. A. Wislizenus, and after him Dr. J. Gregg and Mr. A. Fendler, others from New Mexico and Northern Mexico. A few years later the botanists of the Mexican Boundary Commission and of the Pacific Railroad Exploring Expeditions added to the stock of our knowledge, and within the last decade the explorers of the botany of California and of Arizona filled up some further gaps. Within the last two years an unpretending physician of South Carolina, Dr. J. H Mellichamp, who does not even claim to be a botanist, but is imbued with arduous zeal and keen sagacity, and who lives right among the Yuccas, has wonderfully improved his opportunities, and has very greatly aided me in my investigations by specimens as well as by his observations. I may add here that also on other families of plants of his rich State, already so long and well known through the labors of a Walter and an Elliott, have his researches shed new light, as will appear in future pages of these Transactions.

Having thus been interested in the Yuccas for many years, I ever had an eye on these plants, and in my travels in Europe I neglected no opportunity to study them in the herbaria as as well as in the gardens. There I was first struck with the "fact" that "Yuccas do not bear fruit." To be sure, I had seen the fruits in the Texan and New Mexican collections, and had observed the

capsules in our St. Louis gardens; but I found none in Europe, or almost none, I should say, for in the botanic garden of Venice I gathered the pulpy pods from a large *Yucca aloifolia*, about 15 feet high. This was the only Yucca fruit seen by me in Europe, though I have since learned that in other instances also, though only exceptionally, fruit and good seed have been produced there, principally by this same species, and very rarely by others.

The question why the flowers should almost invariably fail, had been frequently discussed and various reasons suggested, such as sexual incompleteness of the flowers or impossibility of self-fertilization of plants originating from the same stock.

I had observed that all the Yuccas which came under my notice, opened their more or less pendulous flowers in the evening, and half closed them during the following day, after which they withered. The anthers were observed to open a little before the flowers did, and to expel a large-grained glutinous pollen, which did not seem to readily find its way to the stigma. And how is the stigma constituted? The conspicuously papillose termination of the pistil had always been considered the stigma, but closer examination showed its papillæ to be epidermidal appendages, corresponding to similar ones on the filaments, and entirely destitute of stigmatic functions; never did they contribute to the development of a pollen-grain occasionally adhering to them. Dr. Mellichamp's notice of a minute drop of glutinous liquid in the tube formed by the coalesence of the so-called stigmas, led me on to further experiments. That tube proved to be the real stigma, exuding stigmatic liquor, and insects (in these *night-blooming* flowers, of course, *nocturnal* insects) must be the agents which introduced the pollen into the tube. Last June, several forms of Yucca which were blooming under my windows, were carefully watched, and soon different species of beetles were found in the flowers, but not as regularly and frequently as white moths, which, usually in pairs, disported themselves in the open flowers at dusk, and were found quietly ensconced in them when closed in day-time.* The suspected insects were handed over to my friend, Mr. C. V. Riley, who thereupon took up the zoölogical part of the investigation,

*These snow-white "millers" which I have found in almost every flower examined, when closed in daytime, doubtless enter their "ivory palaces" at night, and would be quite sufficient for the purpose. DR. M.—Later, the same correspondent adds: Where I have found many moths last year, I noticed none or few this season. A few weeks later the plants were found without fruit, or with fruit bearing empty seeds.

the surprisingly interesting results of which are detailed by him in the succeeding paper.

GERMINATION.

The seeds of Yucca germinate easily, the cotyledon remaining partly in the ground * within the seed, extracting its liquified contents, and never grows into a leaf-organ; the first leaf issues from a slit in the cotyledon opposite the remnants of the seed; the succeding six or eight leaves of the first season following in $\frac{1}{2}$ order, which, in the further growth of the plant, gradually changes to the higher orders of $\frac{3}{8}$ and further. From the nodes of the very short axis, stout white rootlets break through the back of the leaves, the first one through the back of the cotyledon, opposite the first leaf, while the original radicle withers away. The Californian *Y. Whipplei* is the only one in which the axis, together with the base of the leaves, swells up into a sort of bulb.

In the second season, a stout, cylindrical secondary axis originates from the axil of one of the earliest of last year's leaves, covered with scale-like leaf-rudiments, and eventually producing from its nodes the rootlets which are to nourish the plant. This secondary axis takes a horizontal direction in all the species I could examine, especially in the different forms of *Y. filamentosa;* only in *Y. angustifolia* I have always found it to grow straight downwards, continuing this direction through, at least, the third and fourth year, and perhaps longer. Some observations seem to indicate that *Y. gloriosa* develops in a similar manner. The terminal bud of this secondary axis does not seem to form leaves as long as the primary leaf-bud continues to grow, and probably not until it has produced a flowering stem, and perhaps not even then for years. At last, however, the secondary axis branches out, if horizontal, near the surface of the soil, if perpendicular, as in *Y. angustifolia*, at a certain depth, even two or three feet, below it, forming horizontal branches, and eventually sending out leafy shoots above the surface. Some species are surrounded by such offshoots, thus forming clumps or thickets; *Y. baccata*, *Y. gloriosa*, *Y. filamentosa*, behave in this way, while *Y. angustifolia* is said to do this much more sparingly, and *Y. aloifolia* quite rarely.

* The very similar seeds of Agave have a very different development; in their germination the cotyledon grows into a leaf, bearing the remnants of the seed on its tip.

ROOTSTOCK.

While the rootlets of Yucca annually spring from the youngest part of the rootstock, and decay again after a season, the rootstock itself increases often to a large size and irregularly branched shape. We have very few data about the form of this organ; in fact, the only definite information, accessible to me, has been imparted by Mr. Lindheimer, who, with persistent zeal, has dug up from the often hard and stony soil of West Texas the different species accessible to him. He informed me that *Y. angustifolia* usually exhibits a perpendicular rootstock of a finger's thickness, and two or three feet long, "rising from" (it is evident from what is stated above, that it is rather "descending to") a long horizontal simple or branching part, one or one and a half inches thick, exhibiting many knobs and buds of future shoots. *Y. rupicola* has a rootstock consisting of a few thick, cylindric, horizontal branches, one to two feet long. The tree-like *Y. Treculiana* has few short, thick, club-shaped, horizontal branches to its rootstock, sometimes only a single, short and very stout knob, which does not seem to readily sprout out. It will be interesting to study these conditions in other species in their native localities.

The rootstock of all the Yuccas is, under the name of "Amole," an important article in a Mexican household, being everywhere used as a substitute for soap, as it is replete with mucilaginous and saponaceous matter, probably a substance analogous to the saponine of the *Saponaria* root. It is curious to learn that the negroes of the coast of South Carolina repeatedly destroyed Dr. Mellichamp's carefully observed clumps of Yuccas, in order to obtain the saponaceous rootstock. How may the knowledge of its quality have reached them? Perhaps from the West Indies.

TRUNK.

The trunk of the Yuccas either remains entirely below the surface, or it takes different degrees of development above ground. Heretofore, specific characters were partly based on such differences, but we know now that only few species are regularly and always acaulescent (*Y. rupicola*), while others, when in a perfect, or flower-bearing state, always have trunks (*Y. aloifolia* and *Y. Treculiana*, though this species was first described as stemless); a certain number, usually counted as acaulescent, under

favorable circumstances make short trunks, sometimes of only a few years' duration (*Y. filamentosa*, and still more *Y. angustifolia*), and others, again, among them most notably *Y. baccata*, are absolutely stemless near their northern limits, while the farther south we meet them, the higher and more tree-like their trunk grows.

The primary axis of the Yuccas is terminated by the inflorescence and its apex dies with it. The plant is then rejuvenated by lateral buds, either from the same axis or from the subterranean rootstock. In the first instance the buds appear about the time of the maturity of the fruit, in the trunk-bearing forms from the axils of the uppermost, in the stemless ones from those of the lowest leaves. A single subterminal bud will soon simulate the direct continuation of the main axis; several buds will produce branches in the trunk-bearing species, while in the stemless ones they will give the plant a cespitose appearance. From Dr. Mellichamp's observations, it seems that the caulescent Yuccas show certain differences in the place where the bud appears; he noticed the young bud of *Y. aloifolia*, from exactly the uppermost axil, at the base of the inflorescence, while in *Y. gloriosa* it sprung from between the uppermost and the next lower series of leaves. In a *Y. filamentosa* in my garden, I observed several buds in the axils of the highest leaves developed two years in succession, so that a short branching trunk was formed, while after the third year the vitality of this trunk seems to have died out, and the plant was rejuvenated by shoots from the subterranean rootstock. In other forms, which probably belong to the same species, I find only rarely, in very vigorous garden specimens, a bud from the uppermost axils, while almost always they branch from below the crown of leaves. But observations of this kind, relating to the biology of these plants, have been made too seldom to permit yet the deduction of general laws.

The Yucca trunk has a light fibrous wood, which exhibits distinct marks of concentric arrangement, so that in an old trunk of *Y. Treculiana*, of two and a half feet in diameter, I can count twenty layers in a space of two and a half inches, or one and a half lines to the layer; the trunks certainly grow in thickness as they get older. Another peculiarity of old Yucca trunks is their thick, corky bark; the above mentioned *Y. Treculiana*, sent by Mr. Lindheimer, has an irregular, rather scaly, dark gray bark of

a quarter or a third of an inch thickness, resembling that of some elm or willow; a trunk of *Y. aloifolia*, received from Dr. Mellichamp, is covered with a bark of the same thickness, of a deep brown color, broken up into numerous small square or angular fragments, much like that of the dogwood (*Cornus florida*). The bark of a section of *Y. brevifolia*, sent by Dr. Parry, is similar, but over half an inch thick, and still more deeply cleft. The investigations of these organizations would form a worthy subject for an experienced phytotomist.

LEAVES.

The leaves of the Yuccas are evergreen, i.e. they last at least a whole year, in the low species, or several years in the arborescent ones. They are lance-linear, abruptly narrowed above a very broad, mostly membranaceous base, and usually widening again near or above the middle (some narrowed-leaved species are not contracted below the middle), and gradually, or rarely abruptly, terminate in a horny, often sharply pointed, rarely obtuse, sometimes soft and herbaceous spine, below which the tip of the leaf is more or less concave and involute. The leaves are usually more or less thick, and more or less rigid, but we find all the transitions from the stiff and sharp pointed ("Spanish bayonet") to the soft and flaccid leaf. Their size in the different species varies from half a foot to four feet in length, and from one quarter to two and three inches in width.

The upper side of the leaf is flat (the tip excepted), or almost always more or less concave, sometimes deeply channeled, and occasionally folded or plicate. The lower side is convex, and its lower part bluntly keeled. The surfaces are smoothish or more or less rough, and this roughness is the result of the peculiar structure of the cells surrounding the stomata. The lateral walls of these cells are thickened, hard and transparent, and somewhat elevated above the general surface; especially in the true *Y. filamentosa* the edges of the upper and lower marginal cells protrude over the stoma like minute, beautifully chiseled, conchoidal shields, sometimes almost completely covering it. In *Y. brevifolia* the edges of other cells are also apt to protrude, and, besides, numberless little knobs, similar to the marginal asperities, to be described below, increase the roughness of both surfaces. I notice the same appearance on the lower surface of the leaves of the *Y. Treculiana* and *Y. canaliculata*, and, less distinctly, on *Y. gloriosa*.

The color of the leaves varies from deep or fresh green through dull green to light glaucous.

Of great interest and diagnostic importance is the edge of the leaf. In some species (e.g. *Y. aloifolia*, *Y. brevifolia*, *Y. rupicola*) it is rough, or, as it is usullay termed, serrulate, and remains unaltered through life. The teeth consist of small, irregular, isolated cartilaginous knobs, each consisting of quite a large number of colorless prismatic or clavate cells, arranged in fan-shaped or straight bundles. These are the "serrulate" or rough-edged Yuccas.

Others have "smooth-edged" leaves, (*Y. gloriosa*, *Y. Treculiana*); the edge, at first green, and often roughened with very delicate and deciduous asperities, soon becomes discolored and brittle, and in old leaves is apt to crumble off, or sometimes to detach itself in a few short fibres, thus approaching the next form.

The "filamentose," or fibrous-edged Yuccas (*Y. filamentosa*, *Y. angustifolia*, *Y. baccata*) constitute the third class. In these the fibrous system of the leaves is much stronger and tougher than in the last, and, the parenchymatous tissue soon withering on the edge, the marcescent marginal fibres detach themselves as more or less numerous, delicate, or coarse, straight, or often curled threads, of a whitish, ashy or reddish color. In the young leaf they are most conspicuous, especially near the involute point of the leaf, but in old ones they sometimes become obsolete.*

Some importance has been attached to the number of leaves, which in healthy plants precede the development of the inflorescence, and there really is a relative difference in this respect in different species; but specific characters could hardly be based on a condition which depends so much on external influences of soil, climate, etc. From Dr. Mellichamp's notes it is evident that wild plants, in good health, exhibit a great many more leaves than cultivated ones, and that the number not rarely rises above one hundred on one axis.

The diagnostic characters derived from the leaves must be adopted only with great circumspection. The characters of the edges of the leaves are the most constant and reliable ones, though the abundance, thickness, and, still more, the length of the fibres,

* A fourth form of leaves is described in the books as having marginal spines, and *Y. spinosa*, H. B. K. nov. gen. I. 289, from Mexico, is quoted as the representative of this type. But the inspection of the Berlin Herbarium proves this to be a factitious species, made up of Yucca flowers (similar to those of *Y. Treculiana*) and the spiny leaves of *Dasylirion acrotriche*.

vary considerably, even in forms of the same species. The shape of the leaf is quite variable, and more so still its color, its thickness, its stiffness, (hence its direction) and the nature of its terminal spine; broader leaves, with abundant parenchyma are apt to become plicate, while in the same species leaves of stronger fibrous structure are even. The characters derived from the roughness and the peculiar structure of the stomatic surroundings, as above detailed, are also inconstant, and therefore unreliable.

INFLORESCENCE.

The inflorescence, which terminates the axis in Yucca, usually consists of a compound raceme or panicle of different dimensions, from two to three or four feet high, with differently developed lateral branches, and, therefore, of different shape, oval, lanceolate or pyramidal, and in one species at least (the northern form of *Y. angustifolia*) reduced to a simple raceme or spike. This inflorescence is nearly sessile between the uppermost leaves, especially in the arborescent species; or it is raised on a longer or shorter scape, sometimes longer than the inflorescence itself, principally in the acaulescent forms. The scape bears reduced, bract-like leaves, those of the inflorescence itself usually becoming quite small and membranaceous, or, in some southern species, increasing in size, broad, concave and spathe-like, fleshy and discolored. The inflorescence is smooth or rough or pubescent, but no important value can be assigned to these differences. The pedicels are single or (on reduced branchlets) clustered, always distinct, but shorter than the flowers, curved, patulous, declined or pendulous, never, during the flowering period, erect.

FLOWERS.

The Yucca flower consists of a PERIGON of six oval or lance-oval segments, united at base with one another, with the stamens and with the pistil, and not articulated, so that they wither after flowering without falling off. The perigon, expanding only for one evening and night, forms a shallow cup of whitish, cream-white,† or greenish-white color, sometimes externally tinged with purple, of two to five inches in diameter; on the following morning, the fading segments conniving, the flower assumes a globose or deep bell-shape, of one and one-fourth to three inches

† The flowers of *Y. canaliculata* are described and figured in the Botanical Magazine as "straw-yellow."

in depth.‡ The three outer segments are usually narrower and often a little shorter, and more frequently tinged with green or red along the midrib and tip; the three inner ones are broader (except apparently in *Y. Guatemalensis*, where they are narrower), more petaloid, of more delicate texture and color, and, in some species, tipped with a small bunch of short white wool. They possess a certain, usually not pleasant, fragrance.

The size of the flower and even the shape of the segments is extremely variable in some of the species (*Y. baccata*, *Y. Treculiana*, *Y. rupicola*), and can scarcely be used for diagnostic purposes.

The six STAMENS, in two series, but of nearly equal length, are adnate to the base of the perigon, and always shorter than this, and mostly shorter than the pistil; only in *Hesperoyucca* they are longer than the latter. Straight in the bud, they are frequently more or less recurved and even uncinate *after* maturity, in some forms more, in others less, but I am not able to discover a specific character in this change of form.

The filaments are fleshy and club-shaped, and in the true Yuccas covered, especially upwards, with transparent one-celled papillæ or papillose hair; a minute point on the obtuse, sometimes slightly trilobed apex bears the introrse anther. In *Hesperoyucca* the filament is smooth, thicker upwards, but with an acute tip.

The anthers are comparatively small, 2½ or usually 3–4 millim. long; in exceptional cases, only in cultivated plants of *Y. angustifolia*, I have seen them 5–6 mm. long; they are sagittate or cordate at the base, rounded and entire or notched at tip, adnate on the back and two-celled; they open longitudinally just before the perigon expands, and contracting to one-third or less of their size, and curling backwards, expel the large, comparatively scarce, globose, glutinous pollen grains of 0.055–0.070 mm. diameter. The size and shape of the anthers seem to me to vary in the same species.

Hesperoyucca has smaller, deeply cordate, emarginate, somewhat didymous anthers, 1½–2 mm. long, and broader than long, bearing pollen similar to that of the other Yuccas.

The PISTIL in the true Yuccas is a cylindric or rather prismatic,

‡ It is this day-time appearance which is almost always described and figured, and which gives an erroneous impression as to the form of the well developed flower.

obscurely six-sided ovary, sometimes irregularly impressed and angled by the close application of the stamens in the bud, rarely attenuated at base; terminated by three, more or less united, stigmas, which are usually sessile, or are elevated on a style formed by the gradually attenuated upper part of the ovary. Only in *Y. Guatemalensis* the ovary is more oblong than prismatic.

The ovary consists of three carpels, opposed to the exterior perigonial lobes, forming by their connection three primary dissepiments each one bearing on two central placentæ two series of numerous flat, horizontal anatropous ovules on very short (not long, as is sometimes stated) funiculi, separated from one another by a secondary dissepiment, springing from the back of the carpel; the single ovules, however, are not separated by transverse dissepiments as Gaertner has it.

The Yuccas with thick seeds and fleshy fruit bear thicker ovules (0.3–0.4 and even 0.5 millim. thick), those with thin seeds and capsular fruit thinner ones (0.2–0.25 mm. thick), so that to some extent we may, from the thickness of the ovules in well developed flowers, guess at the section to which the plant may belong. *Y. gloriosa* and *Y. Treculiana*, however, have somewhat thinner ovules than the others of their section, and in some forms, which I class with *Y. filamentosa*, I have found them occasionally as thick as these.

The three carpels are firmly united from the centre of the ovary to beyond the middle; here a thin tube, open at the base and top of the ovary, and from this to the external surface a more or less closely compressed slit, separate them. These slits open as the fertilized ovary grows, and in the fleshy-fruited species eventually form the three inner, impressed sides of the six-sided pod.

The always glabrous ovary is either obtuse and abruptly terminated by the stigma (*Y. aloifolia*), or it is gradually attenuated into a conical or prismatic, glabrous style, sometimes as long as the ovary itself (*Y. rupicola*), which towards the tip ends in the stigmas. This style is an organ of great variability in length and thickness, and may or may not be present in forms of the same species.

Stigmas we conventionally call the terminations of the three carpels, which are distinguished from the ovary and style by their coating of transparent oval or globose epidermidal cells, which, however, as already stated, have no stigmatic function, not even

that of gathering the pollen. The three stigmas, emarginate or bilobed at the summit, are more or less united, and form a tube; they are generally erect, but in some species, especially in the true *Y. filamentosa*, they are at last patulous and even recurved. The inside of the stigmatic tube, somewhat triangular in the transverse section, with three pairs of tiny prominent ridges, corresponding to the commissures of the carpels, is coated with much smaller and less elevated, truly stigmatic cells, which exude the stigmatic liquor, under the influence of which alone the pollen can develope. The tube terminates near the upper ends of the three ovarian cells, and seems to communicate directly with them.

Hesperoyucca has an obovate ovary of a similar structure, crowned by a shorter or longer, sometimes filiform style, bearing a very peculiar, large, hood-shaped, trilobed stigma, beset with long filiform papillæ.

The color of the stigma is usually of a pearly white, while the ovary is dull or greenish-white; only in *Y. angustifolia*, I find the stigma bright green.

FECUNDATION.

The fecundation of the Yucca flower, as has been stated in the introduction, is very uncertain, and evidently depends on contingencies not always attainable, so that very often in its native condition, and almost always in cultivation in Europe, these plants remain sterile. The flower can only be fertilized by the introduction of the pollen into the stigmatic tube; this at least in the capsule-bearing Yuccas, which alone I have been able to examine in the growing state, is accomplished almost always by a nocturnal insect, the *Pronuba yuccasella* (thus named by Mr. Riley and described in the next paper). Even where we are unable to observe the moth itself, its traces are manifest in the presence of its offspring, the larvæ, feeding on the maturing seeds, tunneling their rows and finally emerging through a perforation of the capsule. Wherever, therefore, we find such perforated capsules, or merely the remaining annular rim of seeds, we know that *Pronuba* has been at work. The capsules and seeds of the Californian *Hesperoyucca* also show the unmistakable traces of this or a similar insect. On an average in our gardens, as well as in the fields of the coast of South Carolina, about two-thirds of the capsules and their seeds bear the marks of these larvæ.

Of the baccate Yuccas, *Y. gloriosa* and its allies seem to bear fruit very rarely, as neither my correspondents nor I myself have thus far ever been able to obtain one; *Y. Treculiana* is abundantly fertile in its native localities, but will not fructify, as Mr. Lindheimer informs me, in the gardens of the same region; *Y. aloifolia*, however, matures its pods more readily than any other species in Europe, where our moth cannot have an agency in it. We, therefore, are forced to assume that some other mode of fecundation, or even self-fertilization, can take place with them. Occasionally, no doubt, the moth performs its functions in the flowers of this species as well as in the capsular Yuccas. Dr. Mellichamp has found its larvæ tunneling the seed rows of *Y. aloifolia*, destroying 10 to 14 seeds during its growth, and eventually emerging through the characteristic perforations of the surface. He discovered also another larva in the green pods of this species, the egg of which is evidently deposited into the rind of the ovary or young fruit, and which principally feeds on the immature pulp and only rarely attacks the growing seed. This, Mr. Riley thinks, must be the larva of a hymenopterous insect, which has, perhaps, nothing to do with the fecundation of the flower. But how may these Yuccas be fertilized without the action of the Pronuba? Probably, occasionally, and, so to speak, accidentally by other insects, or possibly sometimes by the withering and conniving segments of the flower bringing adhering clumps of pollen in contact with the stigmatic juices in the open tube. Such chances, however, seem to be slim, not to say improbable, and in this case impregnation would have to take place on the day following the opening of the flower.

It has been stated above that the quantity of pollen is small, and that the grains are large and somewhat viscid; thus, when expelled from the contracting anthers, they remain in little clumps here and there within the flowers, on the papillose filaments, or, more frequently, attached to the inner surface of the perigon. When introduced into the stigmatic tube and in contact with its secretion, its tubes are developed, and, when we carefully dissect a fertilized ovary, large bundles of straight parallel tubes are found to fill the cells and to find their way, one to almost each ovule. I have followed them, through both openings of the ovule, and found them attached with their enlarged end to the outside of the nucleus, separated from the germinal vesicle by two

layers of cells. It is probable that the minute, almost filiform, egg of the moth is carried with and between these bundles of pollen tubes as they elongate and push on into the ovarian cells and among the ovules.

As soon as fertilized the nascent fruit of the capsular Yuccas (and apparently also of Clistoyucca) becomes erect and its pedicel thickens and hardens, while the young fruit of Sarcoyucca remains pendulous, as the flower was, and as afterwards the mature fruit is, and its pedicel more flexible.

The Yuccas bloom from the early summer months to the end of the autumnal season. The first one in the latitude of St. Louis (all cultivated plants) is *Y. angustifolia*, which opens its flowers when the roses are in full bloom, from the middle to the end of May; the true *Y. filamentosa* makes its appearance next, about 10 or 14 days later; then come, one after another, different forms allied to the latter. Later than these, in July and August, *Y. aloifolia* unfolds its flowers, and *Y. gloriosa* very often, in our gardens, as well as on the coast of South Carolina, blooms in September and even in October.

FRUIT.

The fruit of the Yucca, is an oval or prismatic, more or less, distinctly six-angled, more or less completely six-celled pod, usually with a short beak, bearing six rows of horizontal seeds. This pod is either pulpy and never opens, or it is dry, and dehiscent, or it is intermediate between these extremes. Some of these conditions of the fruit were known to the older botanists; Linnæus (Syst. Nat. ed. X., 1759, n. 388) has a *capsula trivalvis*; Gaertner (Fruct. II. p. 34, t. 85; 1791) figures and describes the fruit of "*Y. Draconis*," as *bacca carnosa . . . . non secedens;* Nuttall, Gen. I., p. 218; 1818, says: *capsule opening at the summit;* but he mentions that of *Y. gloriosa* as *pulpy;* Endlicher (Gen. n. 1117; 1836) tries to reconcile the apparent discrepancies by describing the capsule as *subbaccata, demum dehiscens;* Kunth, Enum., and later botanists have followed Endlicher. In the Botanical Notes to Wislizenus' Memoir of a Tour to New Mexico, etc., 1848, p. 101, I first distinguished the Yuccas with "juiceless capsules and thin seeds" from those with "succulent fruit and thick seeds" Subsequent American botanists (Torrey in Bot. Mex. Bound. p. 221, and especially Chapman in Southern Flora,

p. 485), confirm and adopt these differences. In S. Watson's Botany of the 40th Parallel (Utah and Nevada), 1871, I have briefly characterized the four sections of Yucca, as I now understand them.

The fruit in some Yuccas is pendulous, pulpy and indehiscent, with a sort of crown or disc at base, consisting of the enlarged remnants of the perigonal segments and the stamens (*Sarcoyucca*); in another, thus far only imperfectly known, species the originally fleshy fruit eventually dries up, and constitutes a spongy pericarp, which never opens, and is apparently erect, with a disc at base like the former (*Clistoyucca*); in a third group, the erect fruit is dry and capsular, the base is contracted into a short obconical stipe; it opens with three valves corresponding with the carpels and dividing the primary dissepiments, the valves finally divide again at tip (*Chænoyucca*); in the fourth group, represented like the second, by a single species, the pod is similar to that of the last section, but opens at tip through the middle of the carpels loculicidally, the three valves remaining entire (*Hesperoyucca*).

The secondary dissepiments are usually incomplete at base and top, and, at least in one form (*Y. filamentosa*), they are often rudimentary throughout; in *Hesperoyucca* they seem to tear irregularly at the dehiscence of the capsules.

All the Yucca fruits, but more especially the capsular ones, and those of some species more than of others, are extremely variable in shape, and this seems to be caused principally by the irregular development of the seeds. When these fail near the middle, the capsule becomes constricted (very often in the true *Y. filamentosa*); when near the top, it usually is beaked (forms of *Y. rupicola*); so that definite diagnostic characters cannot be derived from these apparently so well-marked differences in the shape of the capsule. In the species just named, and in the *Y. baccata*, the beak of the fruit may also be the result of the development of an elongated style.

The substance and the surface of the capsules would also seem to afford good distinctions, for we find the capsule in some thin, membranaceous and smooth; in others, thick, ligneous, cross-wrinkled, with thick carinal and also lateral ridges, and sometimes warty; but I have observed such differences in forms of the same species, and especially in *Y. filamentosa*, which seems to

be one of the most variable species, perhaps, only because we know more of it than of the others.

SEEDS.

The seeds of the Yuccas are compressed, of a triangular-obvate or obliquely ovate, or sometimes even orbicular form, the straighter, inner margin with the indistinct raphe corresponding with the secondary dissepiment, and the angle at its base containing the hilum. They vary in size from 6–12 or 13 millim. in diameter, and 0.6–3.5 millim. in thickness. The thin black more or less opaque testa exhibits, under a strong power, elevated cells or tubercles, each with or without one or several pits or impressions; in some forms these cells appear larger and irregularly rugose, but I have, thus far, not been able to discover constant specific characters even in the seed surface.

The seeds are of three different forms, corresponding with the three kinds of fruit. The baccate Yuccas have the thickest seeds (2.5–3.5 mm.), of an uneven rugose or undulating surface, with a very narrow two-edged rim, and a deeply lobed or ruminated albumen, as already indicated by Torrey, in Bot. Mex. Bound., in the instance of *Y. baccata*; I have been able to examine only the seeds of this species, *Y. aloifolia* and *Y. Treculiana*. *Clistoyucca* has a thinner seed (2 mm.), with a little more distinct rim, and with an even albumen. All the capsular Yuccas have the thinnest seeds, (0.6–1.2 mm.) with a very distinct, narrower or wider, thin and brittle margin, and with an even albumen.

The semi-transparent, hard, almost corneous, farinaceous and oily albumen, ruminated in *Sarcoyucca*, plain in all the others, contains the straight or mostly more or less curved axil embryo which extends diagonally from the hilum, to which the short caulicle points, almost to the opposite margin, thus attaining the full length of the albumen. Only very rarely and in imperfect seeds I have seen a shorter embryo, such as Gaertner figured, and Kunth described, as being less than one-half or only one-fourth as long as the diameter of the albumen. The slit in the base of the cotyledon, under which the plumule is concealed, shows the cotyledon to be about four or five times as long as the caulicle.

MONSTROSITIES.

I have seen very few abnormal developments of Yuccas, and these only in the flowers. Tetramerous flowers with an eight-

parted perigon, eight stamens and a four-carpellary ovary and fruit, more or less regularly developed, are not quite rare in cultivated as well as wild plants. In overgrown garden specimens of *Y. angustifolia*, I have seen flowers irregularly doubled, the number of perigonal lobes increased, some of them yet bearing the traces of anthers, or filaments bearing perfect anthers, with petaloid excrescences or wings, also filaments adnate to the ovary, and some of them even tipped with the green stigma of the species. In a cultivated form of *Y. filamentosa*, the floral axis was elongated, the perigonal segments separated and increased in number, the exterior somewhat foliaceous, and bearing regular or irregular axillary flowers.

GEOGRAPHICAL DISTRIBUTION.

Yucca is a peculiarly American genus, the limits of which were said by the old botanists, Linnæus among them, to extend from Canada to Peru. It is certain, however, that no Yucca grows in Canada, and I find no evidence of any being indigenous in countries south of the Equator. The greatest development of the genus is found in Northern Mexico, and the Southern United States, to the Pacific, principally between the 25th and 35th deg. N. lat. On the eastern coast, one species, *Y. filamentosa*, extends as far north as 38°, while on the western, so much milder slope, they are not found farther than 35°, or perhaps 36°. On the western plains, the hardiest species, *Y. angustifolia*, reaches as high up as 44° or 45°. Southward, a form allied to *Y. aloifolia* has certainly been met with in Yucatan; and another species, *Y. Guatemalensis*, is said to be a native of Central America. I have seen no specimens from the West Indies, though many authorities credit these islands with *Y. aloifolia*, nor have I seen any from South America.

The capsular Yuccas represent the low, or herbaceous, northern type of the genus; all the known species belong to the United States, and only two of them (*Y. angustifolia* and *Y. rupicola*) extend beyond the Rio Grande into Northern Mexico. The baccate Yuccas are the more southern, caulescent, forms, and some of the species do not come up into our territory. The eastern and western species are entirely limited by the Mississippi, which none of them seem to cross. *Y. angustifolia* is a native of the great plains from north to south, and also extends south-

westwardly into the mountain region; *Y. rupicola* inhabits the southern portion of the plains. *Clistoyucca* and *Hesperoyucca* are southwestern types, peculiar to Arizona and California.

SYSTEMATIC ARRANGEMENT.

In the foregoing pages it has been shown that in the fruit and seed we have excellent characters for the arrangement of the species of Yucca into several very natural groups; the nature of the edge of the leaves furnishes proper subdivisions; the specific characters are based upon the differences of trunk, leaves, flowers, and also of fruit and seed.

YUCCA, *Lin.*

Perigonium patulum demum globoso-campanulatum six-partitum subpersistens; segmenta lanceolato-ovata acutiuscula; filamenta clavata multo breviora, antheræ biloculares introrsum dehiscentes parvæ; pollen globosum; ovarium tricarpellare triloculare, loculi incomplete bilocellati; stigmata 3 emarginata plus minus connata tubum stigmaticum efformantia; ovula plurima compressa horizontalia anatropa brevissime funiculata 6-seriata; fructus baccatus seu capsularis incomplete 6-locularis; semina obovato-triangularia compressa horizontalia 6-seriata nigra, embryo diagonalis albumini corneo æquilongus.

Plantæ in America tropica cis æquatorem et præcipue in boreali calidiore indigenæ; caudice arborescente elatiore vel humiliore, sæpe hypogæo; foliis in apice caudicis confertis lineari-lanceolatis crassis rigidis rarius flaccidis apice plerumque spinescentibus; panicula terminali multiflora subsessili vel in scapo bracteato elata; floribus majoribus albidis.

I. EUYUCCA: filamenta clavata obtusa papillosa pistillo plerumque breviora demum patula vel recurva, antheræ cordato-sagittatæ; ovarium prismaticum, stigmata papillosa.

A. SARCOYUCCA: fructus indehiscens baccatus pendulus; semina crassa undulata immarginata albumine lobato-ruminato. Plantæ plerumque arborescentes panicula sæpius sessili.

* Folia margine serrulato-asperata.

1. YUCCA ALOIFOLIA, *Lin.:* caule elatiore; foliis lineari-lanceolatis supra leviter concavis nunc rigidis pungentibus lævibus margine asperrimis; bracteis paniculæ subsessilis ovatæ vel oblongæ glaberrimæ minoribus triangularibus marcescentibus;

perigonii segmentis ovatis; staminibus ovarium prismaticum stigmatibus sessilibus brevibus crassis rectis coronatum nunc æquantibus demum patulis; bacca prismatica six-angulari acutiuscula.

Forma genuina: simplex vel parce ramosa; foliis crassis rigidissimis mucrone valido brunneo pungentibus.—*Y. aloifolia*, Lin. et auct. plur. *Y. Draconis?* Elliott, Bot. I. 401.

Var. β. *Draconis:* elatior, subsimplex; foliis laxioribus sæpius demum reflexis mucrone debiliore pungentibus.—*Y. Draconis*, Lin.

Var. γ. *conspicua:* e basi ramosa; foliis laxioribus supra lucidis in mucronem debiliorem virescentem excurrentibus.—*Y. conspicua*, Haw. Suppl. pl. succ. 32.

I have seen native flowering and fruiting specimens of the genuine plant only from South Carolina, whence Dr. Mellichamp has abundantly supplied fresh and dried material, and from Florida; it there grows always near the coast, often, and apparently most luxuriantly, under the direct influence of salt-water; it extends to North Carolina and to the eastern gulf States; it is also credited to the West Indies and to the eastern coast of Mexico; but on the shores of Louisiana and Texas it seems to be unknown. Var. β is said to be a native of South Carolina; var. γ was described from plants cultivated in English gardens; its native country is unknown; my description is taken from several magnificent specimens in the botanic garden of Naples, probably correctly named.

On the coast of South Carolina *Y. aloifolia* grows 6–8 or very rarely 10–12 feet high, mostly simple, sometimes, in favorable localities, with a few, often three, branches; trunk seldom more than 4 or 5, at most 6 inches in diameter, only the lowest part of the oldest ones covered with a rough dark brown bark; higher up the marks of the leaf-bases are seen, while the upper part is coated with the withered and dependent leaves themselves, persistent for years; the rigid foliage forms dense heads, the leaves, in $\frac{1}{3}\frac{3}{4}$ or even higher orders, are narrowest above the very broad base, and widest about the middle. I find them in the native specimens usually 18–24 inches long, and 1¼–2 inches wide; grown in the shade, they reach a length of 24–32 inches by 1½ inches in width; under the direct influence of salt-water on the sandy beaches of the islands near Charleston they have been

found shorter and broader than usually (18–21 by 1½–2½ inches), and it was here that the three-branched plants were observed. In cultivation the leaves are 12–21 inches long, and 1–1¼ wide. Dr. Mellichamp has sometimes, in plants growing close to the beach, seen the upper surface of leaves incrusted with a white deposit, which might be taken for saline efflorescence, but proves to be carbonate of lime, with a very delicate film of organic matter representing a cast of the epidermis cells; probably an exudation from these cells of oxalate of lime altered by oxydation.

The flowers open in July and August, and in the evening expand 3–4 inches, while in daytime they are 1½–1¾ inches deep. I find the stamens, in native as well as in cultivated plants, as long as the ovary, often as long as the whole pistil and occasionally even overtopping it. The unusually stout ovary with the short stigma is 9–11 lines long, the ovules I found 0.35–0.38 mm. thick. The pod is 2½–3 times as long as it is thick (3–4 by 1¼–1¾ inches), six-sided, the sides corresponding to the carpels more elevated, the alternate ones sharply depressed and turning purple before the rest of the fruit, which at last assumes a deep purple color inside and outside, has a sweet, not unpleasant, taste, and is much eaten under the name of Banana. It is always acutish but never rostrate, distinctly tipped with the 3-lobed stigma preserving its tube, whence the fruit is described as "perforated at the apex." The seeds, 6–7 mm. in diameter by 2½–3 in thickness, are very similar to those of all other Sarcoyuccas examined by me.

Var. *Draconis* I cannot distinguish from the last except by the leaves being said to be less crowded, longer, softer, less pungent, and somewhat flaccid and curved. It is said to come from the same region where my specimens, above described, were obtained, and may perhaps be the form with very long leaves, grown in the shade, described above. The plants, cultivated here and there under that name, may in part be *Y. Guatemalensis*, described below.

Var. *conspicua*, or at least the plant cultivated under that name in the botanic garden at Naples, differs from the type by its softer, though not pendulous, leaves, with a green scarcely pungent point. It there makes large bushes, over 20 feet high, branching abundantly from or near the base, the thickest trunks 6–9 inches in diameter. I notice that the panicles, sometimes three feet long,

are almost sessile on the older trunks, as they usually are in this section; but in vigorous young shoots they are born on a scape of nearly their own length. When I examined the plants they had not borne fruit for many years, though flowering abundantly; I learn that they have been fertile since, but have not obtained the pods.

There are other forms of serrulate Yuccas, most probably of this section, described in the books or enumerated in the catalogues of nurserymen, which are entirely unknown to me. *Y. serrulata*, *crenulata*, *arcuata*, *tenuifolia*, all named, but scarcely described, by Haworth, (Suppl. Pl. succ.) about fifty-four years ago, from cultivated, partly very young, plants, and not known now, and *Y. aspera*, *Parmentieri* and *albospica* of the catalogues, undescribed, as I believe, will probably prove in part to be forms of *Y. aloifolia*, and the names, which cannot be identified now, the original types having perhaps disappeared from the gardens, and their native country being unknown, ought to be dropped. The two following, however, of which at least their flowering state and native country are known, are believed to have a claim to specific distinction.

2. YUCCA YUCATANA, *nov. spec.:* elata, e basi ramosissima; foliis lanceolato-linearibus versus basin vix angustatis carnosis brevioribus margine tenuissime asperatis demum patulis recurvisve; paniculæ ovatæ subsessilis dense pubescentis bracteis ultimis lanceolatis albis; florum minorum segmentis ovato-lanceolatis, staminibus demum uncinato-recurvis ovario prismatico stigmatibus parvis erectis emarginatis coronato multo brevioribus.

Ruins of Nohpat, Yucatan, collected in flower, Nov. 24, 1865, by Dr. A. Schott, who, not only by his specimens, but also by notes and sketches, aided me in drawing up this description.—Habit of the plant very similar to that of the above described var. *conspicua;* about 20 feet high, branching abundantly from and near the base; leaves in the specimens before me 14–16 inches long and about 1 inch wide, thick, fleshy, smooth, but apparently not rigid, with extremely slight marginal asperities; points of leaves in my specimens broken off. Panicle densely villous, bracts fleshy, whitish; flowers spreading about 2 inches, segments 14 lines long, less than half as wide; pistil similar to that of *Y. aloifolia*, but stamens much shorter and anthers smaller. It is quite possible that this plant is already in cultivation and

may have received a name not known to me, but no accessible description agrees with it.

3. Y. GUATEMALENSIS, *Baker in Saunders' Refug. bot. V. t.* 313, *Jul.*, 1872: elata; foliis majoribus lanceolatis leviter concavis planiusculisve lævibus tenuioribus margine levissime asperatis mucrone concolore vix pungentibus demum patulis; perigonii majoris segmentis lanceolatis sursum angustatis, interioribus angustioribus longioribus; filamentis apice patentibus ovario prismatico-oblongo stylo brevissimo stigmatibusque profunde bilobis patulis coronato brevioribus.

From "Guatemala and Mexico"; flowered in the Kew Gardens in September, 1871, whence through Mr. Baker I obtained dried specimens. That plant was 8 feet high, with leaves 2½–3 feet long and 2½–3 inches wide; panicle sessile between the upper leaves, ovoid, 2–3 feet long; flowers spreading apparently 5 inches, with narrow segments (3 inches long and ¾–1 inch wide) and, an unusual case, the inner ones narrower than the outer. The most characteristic part of the flower is the ovary, which is only twice as long (¾ inch) as it is thick, and bears on a short style 3 deeply and acutely bilobed spreading stigmas; the walls of the carpels are unusually thick, the ovules themselves have the diameter of others, but are very thick (0.5 mm.) indicating very thick seeds and a pulpy fruit, which will probably be also found short and thick.

This species is said not to be rare in collections but seldom to flower; it seems that it is often taken for *Y. Draconis*, and it really resembles the typical figure of that plant by Dillenius. In the botanic garden of Rome are several fine specimens named thus, which I scarcely hesitate to refer here; they are 15–18 feet high, 1 foot in diameter at the enlarged base, not branched*; leaves 2½–2¾ feet long, 2–2¼ inches wide, much contracted above their very broad base, thin and somewhat flaccid or even pendulous, glossy on the upper surface, delicately serrulate and with a very weak point. The plants have not flowered.

** Folia margine integra.

4. YUCCA GLORIOSA, *Lin.:* caule humiliore nunc ramoso; foliis lineari-lanceolatis versus basin latam angustatis supra plano-

* Shoots have been cut off from the base! These cultivated plants are often altered in appearance by trimming and by the removal of the dead leaves, which, left to nature, would continue to cover the trunk for several feet below the living leaves.

concavis sæpius plicatis opacis fere glaucescentibus dorso asperulis pungentibus; panicula angustiore nunc pubescente pedunculata folia excedente, bracteis e basi lata lanceolatis, summis marcescentibus; staminibus ovarium prismaticum apice attenuatum stigmatibus gracilioribus coronatum subæquantibus, effœtis uncinatis.

Forma genuina: foliis latioribus rigidis rectis; panicula angusta pubescente seu glabrata.

Var. β. *plicata:* foliis latioribus tenuioribus valde plicatis exterioribus patulis; filamentis parce papillosis ovario æquilongis demum circinato-uncinatis; stigmatibus distinctis subdivergentibus basi in stylum brevem contractis.

Var. γ. *recurvifolia*: foliis debilioribus patulis recurvis, junioribus glaucis; panicula subpuberula; filamentis parce papillosis pistillum æquantibus.— *Y. recurvifolia*, Salisb.

Var. δ. *planifolia:* caule brevissimo; panicula ovata subsessili folia angustiora plana vix excedente staminibus pistillum æquantibus demum uncinatis; stigmate brevi crasso sessili.

North Carolina to Florida on sandy sea-beaches.—All the specimens I have seen came from South Carolina, and belong to the principal form. Their stem is from a few inches to 4 or 6 feet high and 4–6 inches in diameter, simple or with a few branches and even the oldest ones entirely covered with a shaggy coat of old withered pendant leaves. Leaves 2–2½ feet long and 1½–2½ inches wide, stiff, sharply pungent, very frequently longitudinally folded, the narrower ones sometimes even. The edge of the young leaf is pale and usually delicately serrulate toward the base; later it turns brown and brittle, the asperities disappear, and it is apt to crumble off or occasionally to detach itself in a few fibres. The surface of the leaf is of a dull, often pale or glaucous, green, and on the under side, especially towards the tip, rough with small asperities. The panicles—2–4 feet long, 1–1½ feet in diameter, contracted upward and downward, where the flowers often spring directly from the main axis—are raised above the leaves on a stalk of their own length or shorter, beset with herbaceous bracts, lanceolate from a broad base; ultimate bracts of same shape, small and membranaceous; panicle, or at least the pedicels, often pubescent, or nearly or quite glabrous. Flowers, as in the genus, wide open in the evening, 3½–4 inches wide, whitish, tinged externally with green or brownish or reddish

green; segments ovate, acute, or nearly lance-ovate, the inner longer and wider than the outer ones, minutely pubescent at tip (which, perhaps, is meant by Elliott's "sparingly ciliate"). Stamens often as long as the whole pistil, or at least as long as the ovary, straight at first or only patulous, but at last mostly recurved and even variously twisted; filaments in some forms scarcely papillose, in others strongly hispid; anthers deeply emarginate at tip, stigmas narrower than the prismatic ovary and much longer than wide, divided upwards and at last somewhat divergent; the ovules thinner than usually in this section, in the wild flowers examined by me 0.25–0.30 mm., in cultivated ones 0.25–0.33 mm. thick. I have not been able to obtain the fruit, which is said to be 6-angled, pulpy, and of a deep purple color, by Elliott and by Nuttall, both of whom singularly enough omit to describe the much more common fruit of *Y. aloifolia.* The seed which was sent to me is smaller and thinner than that of that species, (5.2–6.0 mm. in the longest diameter and 1.8–2.0 mm. thick) but otherwise very similar to it.—The flowering time seems to be July to October, very often, in South Carolina, in autumn.

The cultivated plants, which I have seen, scarcely differ from this form; their flowers are sometimes larger, and either whitish or cream-white, or very often externally greenish-purple; they seem to open usually in July and August, or, sometimes, later in the fall.

Y. acuminata, Sweet, and *Y. obliqua*, Haw., garden species, the native country of which is unknown, seem to belong to the typical form.

The variety which I have distinguished as var. *plicata* I have found under the name of *Y. plicata* in Mr. G. Thuret's gardens at Antibes near Nice, flowering in February and March; it has a trunk over 2 feet high, with thin but stiff, much folded leaves, 1½–2¼ feet long and 2–2½ inches wide, glaucous above, rough beneath, serrulate near the base; panicle large, flowers over 4 inches wide, externally tinged with brown-red; stamens as long as the ovary, which is contracted into a narrow neck, a sort of a style, bearing the thicker, divaricate stigmas.

Var. *recurvifolia* is the well known and commonly cultivated, elegant garden form, said to come from Georgia, where Elliott also seems to have seen it, but nobody apparently has found it since. I cannot distinguish it from the type but by the flaccid,

gracefully recurved leaves. *Y. recurva*, Haw., and *Y. pendula*, Sieb. and Carrière, are synonymous, and *Y. superba*, Haw., *Y. rufocincta*, Haw., seem not to differ. *Y. ensifolia*, Baker, Ref. bot. V. t. 317, and the smooth-leaved *Y. Ellacombii*, Baker, Gard. Chron. l. c., Ref. bot. ib. t. 318, are intermediate forms connecting this variety with the typical plant.

Var. *planifolia* is also based on a single specimen, which I found in September, 1868, in flower in the botanic garden of Genoa, under the name of *Y. glauca*. Its short trunk, long and narrow (2½ feet long, 1½ inches wide), even, not at all plicate, leaves, and especially the short stigma, which is almost as thick as the ovary and resembles that of *Y. aloifolia*, distinguish this form. Flowers whitish, smaller, 2 or 2½ inches wide; filaments as long as the pistil; anthers small, entire above; ovules only 0.26 mm. thick; fruit unknown. Could it be the *Y. glauca* of gardens?

Yucca flexilis, Carr, Rev. Hort. viii. t. 89, to which Mr. Baker refers his *Y. pruinosa*, Gard. Chron. l.c., and *Y. tortulata*, Baker, ib., may be smooth-leaved forms of *Y. gloriosa*; they are thus far only known as acaulescent, and in foliage only. Leaves of both 2–2½ feet long, 1¼ inches wide, stiff and pungent; the edges serrulate towards the narrowed base.

Yucca Boerhaavii, Baker, Gard. Ch. 1870, p. 1217: caulescens, e basi latissima lanceolato-linearibus elongatis infra vix angustatis planis lævissimis, in mucronem herbaceum mollem excurrentibus.

This plant makes a short trunk; leaves 27 inches long, about 9 l. wide, with traces of marginal denticulation; flowers are unknown.—It may be an extreme form of *Y. gloriosa*.

YUCCA DESMETIANA, *Baker*, l. c.: caulescens, foliis plurimis lanceolato-linearibus brevibus, versus basin angustiorem obsolete denticulatis crassis lævissimis in mucronem vix pungentem excurrentibus.

This little plant is cultivated in many gardens, but has, I believe, never flowered. The very fleshy purplish-green leaves are only 10–15 inches long, 6–9 lines wide, and scarcely pungent. Its native country is unknown.

5. YUCCA TRECULIANA, *Carrière*, *Rev. Hort.* vii. *p.* 280, 1858, Baker, Gard. Ch. l. c. p. 828: caule elato ramoso; foliis longissimis rigidissimis profunde concavo-canaliculatis margine brunneo serrulatis tunc integris demum parce filamentosis pun-

gentibus subtus asperrimis; panicula densiflora ovata subsessili læviuscula, bracteis inferioribus amplis ovatis seu ovato-lanceolatis pungenti-cuspidatis pergamentaceis albidis, summis ovatis seu lanceolatis albis; staminibus pistillo vix brevioribus uncinatis; ovario prismatico in stylum stigmatibus gracilibus coronatum attenuato; bacca fere cylindrica elongata rostrata.—*Y. longifolia*, Engelm. in sched. 1846; Buckley in Proc. Acad. Phil. xiv. 8, 1862.

Texas from the Matagorda Bay and the Brazos and Guadaloupe, south and southwestward into Mexico, at least as far as Saltillo, Parras and Chihuahua, on the sea beach and in the interior, on the gravelly overflowed banks of streams and on the stony declivities of their slopes; flowering in April and May.—Specimens from Texas and full notes were supplied by F. Lindheimer, Mexican ones by Dr. Wislizenus and Dr. Gregg.

This is perhaps the most magnificent Yucca known; trunks 6–15 and, even in Texas, sometimes 20–25 feet high, and 1–2 feet thick, terminating in several (sometimes 5–7) branches, each one bearing a crown of long rigid leaves, and often a panicle 2–4 feet long of something like 500 flowers. The bark of very old trunks has been noticed above; younger stems are covered with the reflexed withered foliage.—Leaves longer than in any other species, 2½–3, and very often 4 or even 4½ feet long and 2–3½ inches wide when flattened out, deeply channeled and quite semi-circular in the cross-section, thick, rigid and straight, "bright sea-green," very rough on the back, less so on the upper surface, terminated by a stout brown spine. The edge of the leaf at different stages of development partakes of the character of all the three forms, as to a less extent also do the leaves of *Y. gloriosa;* the margin of the young leaf is deep brown with a pale, cartilaginous, strongly serrulate edge; then it becomes smooth and at last is often detached in brown rough fibres.

The short peduncle or scape of the inflorescence is 1–2 inches in diameter, the panicle 2–4 feet long, much branched and dense flowered, glabrous or sometimes upwards pubescent, bearing large conspicuous bracts 4 or 5 inches long, 1–3 wide concave, fleshy or leathery, greenish outside, whitish inside, with a sharp herbaceous or brown point; the ultimate small bracts are similar, mostly ovate-lanceolate; in Mexican specimens from Parras they are thinner, oblong, obtuse, and pure white.

The flowers vary from 2 to over 4 inches in expansion, and, if I may judge from the dried specimens, are remarkable for the unusually narrow, ovate-lanceolate, acuminate segments of the perigon, 1½–2 or even 2½ inches long, and about ¼ as wide, and conspicuously pubescent at tip; in the Mexican forms I find the segments more ovate and of the ordinary shape of most Yucca flowers, and only 1¼–1½ inches long. The very slightly papillose filaments, as long as the ovary and erect in the bud, soon become recurved-hooked. The prismatic ovary terminates in a slender, short or longer, style, crowned by deeply divided strongly bilobed stigmas. I find the ovules invariably thicker (0.4–0.5 mm.) than in any of the foregoing species.

The fruit is a pulpy cylindric, or rather indistinctly 6-sided, somewhat sulcate and 3-lobed, strongly rostrate berry 3–4 inches long, about 1 inch thick, of a bitter-sweetish pleasant taste, much eaten by the Indians, who roast them and peal the acrid rind off. Seeds 6–7 mm. in the longest diameter, and 3 mm. thick, very similar to those of *Y. aloifolia* but with the back less rounded.

Yucca canaliculata, Hooker, Bot. Mag. 86, t. 5201, 1860, described from a plant cultivated at Kew, with a stem 1–2 feet high, leaves 2 feet long, concave, semi-cylindric, rough on back, very probaby is not different from our plant; the flowers, in a peduncled pyramidal panicle, 4 or 5 feet high, are described as sulphur-yellow, but are stated by Baker in Gard. Chr. l. c. to be cream-white.—A specimen in Mr. Henry Shaw's Missouri Botanical Garden, thus labeled, flowered in April, 1872; its trunk is 4 feet high, the leaves 2½–3 feet long, panicle 2 feet long, 1¼ feet wide, very densely flowered; flowers 3–3¼ inches wide, segments ovate acute, outer 8–9, inner ones 9–11 lines wide; filaments strongly recurved even when the flower has barely opened; anthers very slightly notched above, with a bunch of white articulated hair, corresponding with the hair at the tip of the perigon.

Yucca glauca, Sims, as understood by Baker and figured in Refug. bot. v. t. 315, and *Y. exigua*, Baker, ib. t. 314, which can scarcely be distinguished from it, are classed with the acaulescent entire-leaved Yuccas, though the former bears a few fibres; their fruit, in Europe unknown, may possibly be capsular, of which more at the proper place. Both are characterized by the conical, attenuated stigma.

Y. orchioides, Carrière, Rev. Hort. 1861, p. 369, t. 89, as

quoted by Baker, is described as the smallest of all Yuccas; stemless like the last, with few short, soft-pointed leaves (9–10 inches long, 1 inch wide, almost flat); scape with a simple pubescent raceme only 1½ feet high, perianth 1 inch deep; native country unknown.—Could it be a dwarfed variety of some other form, possibly of the last mentioned *Y. glauca ?*

*** Folia margine filifera.

6. YUCCA BACCATA, *Torrey in Bot. Mex. Bound.* 221, 1858; *Ives' Rep. Bot.* 29.: acaulis seu plerumque caulescens; foliis anguste lanceolatis versus basin dilatatam angustatis crassis rigidissimis scabris mucrone brunneo robusto pungentibus concavis; margine filis crassioribus ornatis; panicula brevius seu longius pedunculata plerumque lævi, bracteis inferioribus amplis ovato-lanceolatis cuspidatis pungentibus pergamentaceis supra albidis, ultimis lanceolatis; staminibus demum patulis vix recurvis ovarium prismaticum fere æquantibus; stylo vario nunc elongato; bacca sæpius ovata rostrata.—*Y. crassifila*, Engelm. in sched. 1848.

Forma genuina, borealis, stolonifera; caule nullo seu breviore; foliis longioribus latioribus asperrimis rigidissimis, filis marginalibus crassis cinereis; segmentis florum magnorum angustis, stylo elongato.

Var. *β. australis:* caule elato ramoso, foliis tenuioribus lævioribus, filis marginalibus tenuioribus sæpe brunneis; segmentis florum minorum ovatis, stylo breviore.

A southwestern species, extending from Southern Colorado, *C. Thomas*, to New Mexico, *Dr. Wislizenus*, *A. Fendler no.* 849, *Ch. Wright*, *Dr. Bigelow*, and West Texas, *A. Schott*, and into Southern Utah, *J. E. Johnson*, Arizona, *Dr. E. Palmer*, California, (Los Angeles, *Capt. Russel*, Providence Mountain, *Dr. J. G. Cooper*, Monterey, *Dr. Parry*), and far into Mexico (Chihuahua, *Dr. Wislizenus*, Parras, *G. Thurber*, and Saltillo, *Dr. Gregg*).—Flowering season according to latitude from March to June, or in Northern Mexico, where with the rainy season a second spring opens, often again in August and September.

The very full series of specimens before me satisfies me as to the great variability of this species, the extremes of which are so very dissimilar. The typical plant towards its northern limits is stemless, more southwardly it makes trunks of 1 or 2 to 8 or 10

feet high, covered with the refracted dead leaves. Leaves 1½–3 feet long, 1–2 inches wide, narrowed downward, gradually attenuated into a very stout sharp or blunt brown point, channeled or quite concave, thicker than in most other species, very stiff and rough, especially on the back; on old branching plants Dr. Palmer found the leaves scarcely over 1 foot long and 1 inch wide, but very thick. The fibres are as thick as ordinary twine, and often regularly curved backward. The panicle of the stemless form is raised on a scape of almost its own length, in caulescent ones the peduncle is shorter. The exterior bracts are 4 or 5 inches long and 2 wide, similar to those of the last species, but narrower. The flowers are large, spreading 4–5 inches, segments 2½–3¼ inches long, ⅔–1 inch wide, stamens papillose-hispid, as long as ovary, rarely at last reflexed; pistil 1–2 inches in length, style slender, unusually long for the genus, in the largest flowers equalling the ovary, in others ½ or only ¼ its length; ovules about 0.4 mm. thick. The fruit is a dark purple berry, oval, "about the size and shape of a hen's egg," with a very distinct and often elongated beak, which is marked with six grooves, while the fruit itself is not angled or grooved. Some fruits, I have seen, were 3 inches long and 2 in thickness, with a beak of about half their length; one fruit from Arizona was 5 inches long, cylindric and curved. The base is protracted below the remnants of the perigon, which is not the case in the fruits of *Y. aloifolia* or *Y. Treculiana;* the pods of these three species are remarkably distinct, and always easily recognized, while the seeds themselves are very similar. The fruits are said to be "savory like dates," and are eaten fresh by whites and Indians, and cured by the latter for winter provisions. Dr. Palmer informs me that the Arizona Indians find the stewed flower-buds and flowers quite pleasant and nourishing. The seeds are often distinguished from those of the other Sarcoyuccas by their large size, 10–17 mm. in the longer diameter and 2–3 mm. in thickness; but other fruits from the same regions have seeds only 7–8 mm. long and 1.8–2 mm. thick.

Var. *β*, the southern, Mexican, form of this species, is principally distinguished by its smaller flowers, 2–3 inches wide, with ovate or lance-ovate segments 1¼–1¾ inches long and usually more than half as wide; by their short style and the somewhat thinner, less rough, leaves, with thinner, often red-brown, fibres; the panicle is sometimes pubescent. Dr. Gregg notes that it is very

abundant in the plains and valleys about Saltillo; his statement is almost incredible, and is not supported otherwise, that sometimes it reaches the height of fifty feet, with leaves 1–3 feet long, "seed said to be actively purgative." Prof. Thurber brought from Parras leaves and fruit of this species, an account of which, together with a cut, is found in Bartlett's Personal Narrative II, 491: "a plain covered with Yuccas presents a beautiful appearance when in flower in pyramidal spikes several feet in length . . . . the trees 25–30 feet high and 2–3 feet in diameter, with ten or a dozen branches"; he mentions that the fibres of the leaves are used for cordage, the trunks for palings or they are split into slabs for the covering of huts; the tender top of the stem is roasted and eaten under the name of *quiote;* the edible fruits are called *latiros.* A specimen of the latter I find oval, 2 inches long, with a beak of ½ inch; seeds small for the species. We learn in the above account that the inflorescence is pyramidal; the cut represents it as sessile or peduncled, and about 3 times as long as wide.

The Californian forms are in foliage intermediate between the northern and southern extremes; a leaf collected at Monterey and distinguished by its narrowness (less than ¾ inch wide) probably indicates the northern limit of the species.

The caulescent fibrous-leaved Yuccas, recently introduced from Mexico in European establishments, of none of which either flower or fruit is known, seem distinguished by narrower and smoother leaves, some with red, others with gray marginal fibres, but they may possibly be only forms of our species; they are *Yucca periculosa*, *Y. polyphylla*, *Y. circinata* and *Y. scabrifolia*, Baker in Gard. Chron. 1870, p. 1088, and *Y. filifera* of the gardens.

7. YUCCA SCHOTTII, *nov. spec.:* caule humiliore sæpius e basi ramoso; foliis minoribus lanceolato-linearibus rectis rigidis crassis sub-pungentibus supra concavis subtus convexis lævissimis versus basin paulo angustatis, margine filis tenuissimis rectis albidis ornato; paniculæ nuncpuberulæ sparsifloræ supra folia elatæ pedunculo et ramis flexuosis, bracteis exterioribus magnis lanceolatis; florum minorum staminibus demum uncinatis, ovario in stylum brevem stigmate brevi coronatum abeunte; bacca ovata breviter rostrata, seminibus magnis crassis.—*Y. brevifolia*, Schott in Herb.; *Y. puberula*, Torrey in Bot.Mex. Bound. 221, non Haw.

Upper Santa Cruz River in Southern Arizona, *A. Schott*, in June and July, 1855.—Trunk 2–5 feet high, crooked, covered with

a shaggy coat of dead leaves. Leaves "yellowish-green," 9–10 inches long, 6–8 lines wide; marginal fibres singularly fine and straight; panicle pubescent or glabrous, its axis not straight, as is usual in these plants, Mr. Schott expressly remarks, but variously twisted; lower bracts 4–5 inches long, 1 inch wide; the pendulous, ovate, short-rostrate berry not at all angled, about 2 inches long.—Some doubt may exist whether all the parts of specimens in Schott's, Torrey's and my own herbarium, all collected by Dr. Schott, belong together; from these specimens the leaves and flowers have been described above, while in the account of the stem and fruit I had to rely on Mr. Schott's notes, who possibly may have mixed the fruit of *Y. baccata* with the foliage of the new plant; but the leaves appear so peculiar that there can scarcely be a doubt about the distinctness of the species to which they belong.

B. CLISTOYUCCA: fructus indehiscens, erectus? demum siccatus, spongiosus; semina crassiuscula plana vix marginata, albumine integro.—Arbor elatior ramosa, panicula sesili.

* Folia serrulato-asperata.

8. YUCCA BREVIFOLIA, *Engelm. in S. Watson, Bot. King Expl.* 1871, *p.* 496: caule elato ramoso; foliis brevibus e basi lata sensim angustatis late linearibus supra planiusculis versus apicem concavis subtus convexis carinatis pungentibus rigidissimis utrumque asperrimis margine durissimo serrulatis; panicula sessili ramosa; fructu ovato obsolete 6-angulato acutato.—*Y. Draconis ? var. arborescens*, Torr. Bot. Whipp. Pac. R. Exp. iv. 147.

On the arid plateaus between the Colorado River and the South California Mountains, in latitude 34½°–36°, at an altitude of 2000–4000 feet, in patches from Southwestern Utah, Northwestern Arizona to Southern Nevada and to Southeastern California, where it is abundantly distributed on the "Palm-plains," also called "Tahichipi desert," between the Mohave River and Walker's Pass, often forming straggling forests. It was first noticed by Fremont 1844, ten years later by Bigelow, and since then by Brewer, Parry, Palmer and Johnson, and has lately even formed the object of photographic pictures. Leaves and fruit with seeds have been obtained, and young plants raised, but the flower remains unknown.

This remarkable Yucca makes considerable trees, 15–20–30 feet high; the stout rough-barked trunks, often 1–2 feet in diameter, 3–10 feet high, before they send off the long and numerous branches, of which, in a very characteristic photograph, I have counted 23 large and small ones. Leaves stiffer, harder and rougher, and perhaps shorter than in any other species, sometimes only 3–4, usually 6–8, and rarely, in young and vigorous specimens, even 10–12 inches long, 3–6 lines wide, not at all narrowed above the base, glaucous, very rough on both sides, with small but stout whitish or brown teeth on the edge, and a stout and sharp brown point. The flower is said to be small and white. A fruit before me is evidently erect, as the fragment of the branch to which it is attached indicates, oval, slightly 6-sided, pointed but not rostrate, and tipped with the well-preserved short, sessile stigmas. The fruit is light and perfectly dry, the brown somewhat spongy fragile pericarp 2–3 lines in thickness. Seeds large, 11–12 mm. in diameter, 2–2½ mm. thick, with a narrow margin and an even, not ruminated, albumen. In both the fruits, I have been able to examine, the traces of the moth *Pronuba* are apparent by the perforated rind and gnawed seeds or their empty ring-like rims.

C. CHÆNOYUCCA: fructus capsularis, erectus, septicide dehiscens, demum apice 6-valvis: semina tenuia plana, latius marginata, albumine integro.—Acaules vel vix caulescentes, panicula in scapo elata.

* Folia margine serrulato-asperata.

9. YUCCA RUPICOLA, *Scheele in Linnæa*, 23, *p.* 143, 1850: acaulis, foliis lineari-lanceolatis supra basin latiorem angustatis canaliculatis supra planiusculis subtus convexis rigidis erectis pungentibus; scapo elato infra bracteis majoribus foliaceis ornato, panicula pyramidali laxiflora bracteis parvis marcescentibus stipata; florum majorum segmentis ovatis acuminatis nunc aristatis apice nudis, staminibus rectis demum patulis ovario ipso æquilongis, stylo elongato; capsula acuta seu rostrata nunc medio constricta, seminibus angustius marginatis.—*Y. tortifolia*, Lind heimer in sched. 1846, *Y. lutescens*, Carrière l. c. vii. 579, ex-Baker.

Var. *α. tortifolia:* foliis saturate viridibus varie tortis undulatisve sæpius obliquis dorso lævibus et capsulis cum seminibus majoribus.

Var. β. *rigida:* foliis pallidis glaucis planis dorso carinatis asperatis et capsulis cum seminibus minoribus.

Western Texas in fertile soil mixed with broken up cretaceous limestone rocks, discovered by F. Lindheimer, 1845; on the plateaus west of New Braunfels, and described from his specimens by Scheele; found afterwards by the botanists of the Mexican Boundary Survey; the second or southwestern form was sent by Dr. Gregg from Mapimi in the Mexican State of Coahuila, and by Dr. Bigelow from the mountains of the volcanic district of Bufatello near Presidio del Norte on the Rio Grande.—Flowers in Texas in May and June, "after *Y. Treculiana* and before *Y. angustifolia*."

As far as my information goes this species is always stemless; a misapprehension of Lindheimer's notes must be the cause of Scheele's, and after him Baker's, ranging it among the caulescent Yuccas, with a "stem 4–7 feet high"; rootstock of few stout branches 1–2 feet long: leaves dark or bright green, opaque, narrowed above a not very broad base 1–2 feet long, ¾–1¾ inches wide with brown-red, strong serratures, mostly undulate, oblique, one side longer than the other, therefore twisted, stout, thick, sharp pointed, but not to be compared with *Y. aloifolia*. Scape 4–7 feet high, with long leafy narrow lanceolate bracts; panicle with few large "greenish-white" flowers which apparently spread 3–4½, perhaps 5 inches, and are well characterized by the very acute sometimes even aristate, when dried, strongly nerved, segments, 1½–3½ inches long, 10–14 lines wide, the inner wider than the outer; also by the erect or slightly spreading, never recurved stamens, which are of the length of the prismatic ovary; and by the slender style, which, in all the specimens seen by me, is as long as the ovary; ovules 0.2 mm. thick. Capsule 2–2½ inches long, about 1 inch thick, acute or cuspidate or rostrate, prismatic or, very often, variously constricted or distorted, often showing traces of the Yucca-moth; secondary dissepiments sometimes like those of most species, incomplete at top and bottom, but not rarely, especially in very acute capsules, entire above or nearly so. Seeds 7–8 mm. long, with a distinct but narrow margin.—This form is reported to be in cultivation in France from Mr. Trecul's seeds under the name of *Y. tortilis* or *contorta*.

Var. *rigida* looks very different indeed, with its smaller, pale, yellowish or glaucous, often rough, straight leaves, only 8–12

inches long, and 3–6 lines wide, and its small wrinkled, less pointed capsule, 1½ inches in length, and seeds only 5–6 mm. in diameter; the scape is said by Dr. Gregg to be 5–10 feet high; flowers not seen; the short beak of the fruit indicates a short style. Wright's No. 1909 from Eastern New Mexico connects both forms.

** Folia margine filifera.

10. YUCCA ANGUSTIFOLIA, *Pursh. Fl.* ii. 227: subcaulescens; foliis (plurimis) e basi latiore linearibus lævibus plerumque pungentibus; stigmatibus ovario brevioribus viridibus; capsula prismatico-ovata obtusa brevi-cuspidata, seminibus magnis late marginatis.

Forma genuina: acaulis seu breviter caulescens; foliis rigidis radiatim porrectis pungentibus; racemis plerumque simplicibus inter folia fere sessilibus; florum segmentis late ovatis e cupreo virescentibus nunc albidis; capsulis majoribus vix unquam constrictis.

Var. β. *elata:* caule altiore; foliis numerosissimis rigidis pungentibus nunc glaucescentibus filamentosissimis rare denudatis, demum refractis; panicula oblonga seu lanceolata supra folia elata; florum segmentis albidis angustioribus; capsulis ut supra. — *Y. angustifolia var. radiosa*, Eng. in King Bot. 40th par. 496.

Var. γ. *mollis:* acaulis; foliis supra basin angustatis medio latioribus mollibus vix pungentibus; racemis rarius ramosis scapo ipso bracteis brevibus lanceolato-subulatis ornato brevioribus; capsula breviori nunc cum seminibus angustius marginatis minore.— *Yucca stricta*, Sims Bot. Mag. 2222 fide Baker, Gard. Chr. l. c.

All the forms of this species are characterized by the secondary axis descending horizontally, narrow leaves, bright green stigmas and large capsules and seeds, but var. γ in many respects approaches to and forms a connecting link with the next species. They are peculiar to the West and Southwest.

The typical *Y. angustifolia* is the more northern form of the plains from Northwestern Missouri and Western Iowa west and northwestward to Colorado and New Mexico; fl. May and June, earlier than the allied species. Trunk none, or, farther south, short; leaves very stiff and sharp pointed, 1–2 or in cultivation 3 feet long, 3–6 lines wide; raceme simple or with few short branches 1 or 2 to 3 or 4 feet long almost sessile, the base hidden

between the inner leaves; flowers 1½–2½, in cultivation even 4 or 5 inches wide, usually greenish white or tinged with green-brown; lobes broadly ovate; stigma half the length of ovary; capsule usually 3 inches long, half as thick; seeds 10–12 mm. wide. In dwarf forms the leaves are sometimes only half a foot long and 1–2 lines wide.

Var. β is the southwestern form extending from West Texas to Utah, Arizona and Northern Mexico; trunk 3–5 feet high; leaves ¾–1½ feet long, 3–6 lines wide, rigid, often glaucous, with an abundance of long fibres or, rarely, almost destitute of them, (Wright, Gregg); naked part of scape about as long as the panicle, together 6–8 feet, whole plant therefore often over 12 feet high; flowers mostly white 2–2½ inches wide; capsules and seeds as large as in the type. It is not improbable that the narrow-leaved Mexican forms, doubtfully referred to p. 46, *Y. baccata*, may belong here; flower and fruit would decide.

Var. γ is found southeastward in Arkansas, Louisiana and throughout Texas, distinguished by its wider, softer, less pungent leaves, distinctly narrowed above the base, 1–1½, rarely 2, feet long, 5–8 lines wide in the middle, half as wide below; scape 2–3 ft. high, flowers usually in a raceme, ½–1 ft. in length, sometimes paniculate, 1½–2½ in. wide, greenish-white; green stigmas sometimes as long as ovary, often shorter; capsule shorter than in the other forms, 2–2¼ inches long, sometimes constricted; seeds 9–10 rarely 10–12 mm. wide. *Y. stricta*, which is referred here, is said to come from South Carolina, entirely outside of the limits of this form, which makes a transition to the next.

11. YUCCA FILAMENTOSA, *Lin.:* subacaulis; foliis lineari-lanceolatis supra basin latiorem contractis apice indurato seu molli; panicula pyramidata in scapo foliaceo-bracteato alte supra folia elata; stigmatibus elongatis nunc distinctis albidis; capsula cuspidata, seminibus angustius marginatis.

Forma genuina: sæpius breviter caulescens; foliis rigidioribus rectis mucrone nunc obtusato brevi apicatis dorso scabridis, filis marginalibus crebris plerumque circinatis; panicula ramis fere horizontalibus pyramidata densiflora scapo bracteis minoribus spatulatis instructo æquilonga seu longiore lævi; staminibus sæpe pistillo æquilongis; stigmatibus gracilibuis demum divergentibus seu recurvatis; capsula minore plerumque medio constricta, dissepimentis secundariis fere semper rudimentariis; seminibus minoribus.

a. angustifolia: foliis (plurimis) lineari-lanceolatis e medio sensim angustatis.—*Y. filamentosa*, Lin. ex Gronov. virg. 152.

b. latifolia: foliis (paucioribus) rigidioribus sursum latioribus nunc spatulatis versus apicem sæpius obtusatum abrupte mucronatum cochleato-concavis.—*Y. concava*, Haw. suppl. 34.

Var. *β. flaccida:* acaulis; foliis (pluribus), lineari-lanceolatis mollibus flaccidis demum irregulariter decurvatis refractisve glaucescentibus vix scabrellis subinermibus margine filis tenuissimis abunde ornatis; scapo bracteis brevibus spatulatis instructo paniculæ nunc puberulæ æquilongo; ovario versus basin irregulariter angulatam angustato, stigmatibus brevioribus conniventibus sursum attenuatis; capsula majore sæpius constricta angulata sursum profunde triloba, seminibus majoribus. — *Y. flaccida*, Haw. suppl. 34? Refug. bot. 5, t. 323?

Var.? *γ. bracteata:* subacaulis; foliis (plurimis) lineari-lanceolatis rigidiusculis scabrellis mucrone debili aristatis abunde filiferis, exterioribus demum nundatis laxis; scapo bracteis foliaceis majoribus infra medium latioribus sensim angustatis fere imbricato flexuoso quam panicula ramis ascendentibus pyramidata asperula seu puberula multo longiore; staminibus ovarium fere æquantibus; stigmatibus profunde divisis elongatis; capsula prismatica ovatave.

Var. ? *δ. lævigata:* subacaulis; foliis (paucioribus) lanceolato-linearibus elongatis fere planis lævibus rigide pungentibus margine mox denudatis laxis deflexis demum decumbentibus; scapo bracteis lanciformibus e medio sensim angustatis instructo quam panicula ramis ascendentibus laxifloris pyramidata lævissima multo longiore; ovario staminibus breviore stigmatibus ad basin divisis rectis æquilongo; capsula prismatica.

This most variable plant is a native of the coast region of the southeastern States from Maryland, *W. M. Canby*, to Florida, Alabama, and, according to Riddell's Cat., to Louisiana.—Numerous varieties. often difficult to class, have been described in European gardens.

Linnæus' diagnosis: *foliis lanceolatis acuminatis* together with the Hab. Virginia, points to the narrow-leaved form of what I have described as the genuine plant, as the one he and Gronovius had in view. Of this and other forms numerous specimens and full notes have been obtained from Dr. Mellichamp, of South Carolina, on which the following descriptions are based.

The genuine plant has a short trunk of 2–5 inches or a foot, (Chapm. Fl. 475), stiffer, rougher, "reed-like," dull green leaves and smaller capsules than any other variety, and blooms earlier, in S. Carolina in May, in gardens of St. Louis in the first weeks of June.—The narrow-leaved form makes tufts of 60–80 or 100 leaves, 16 or 18–20 and 22 inches long. 1–1¼ rarely 1½ inches wide, widest about the middle, tapering to a hard obtusish point, with numerous, rather thin, curly fibres. The broad-leaved variety has only 30–60 leaves, 20–24 inches long. 2–3 inches wide about the upper third, and broad to the almost obtuse blunt tip; outer shorter leaves often broad-spatulate and quite obtuse; margin with fewer, coarser, more curly threads. The scape of both forms is 4–8 or 9 feet high, stout, very soft and smooth, pale green, below with oblique, spatulate bracts, 2, rarely 3 inches long; panicle with numerous nearly horizontal dense-

flowered, branches as long or longer than the naked part of the scape. Flowers 2½–3 inches wide, white, tinged with green; stamens as long as the pistil, at last spreading, the elongated eventually recurved stigmas rather shorter than the ovary. Capsule 1½ inches long, more or less constricted, thin, smooth and papery in some localities, hard, wrinkled and longer beaked in others; secondary dissepiments mostly very incomplete, not reaching to the centre; but in a Maryland specimen, and in some cultivated ones, of the ordinary form, so that no specific character can be based on them; seeds 6 mm. diam.—Forms intermediate between *a* and *b* are found wild and in cultivation; leaves sometimes more flaccid, with fewer fibres, shorter stamens or stigmas, longer capsules, larger seeds.

The variety *flaccida* is described from plants in common cultivation about St. Louis, wild specimens I have not seen; it is doubtful whether it is Haworth's plant, which has *fila validissima*, or of the *Refugium*, with broad. involute leaves, but the short attenuated stigmas fully agree; the characters indicated in Gard. Chron. l. c., "an irregular, untidy appearance," "leaves conspicuously filiferous," "point not at all pungent," "panicle pubescent," point to our plant. — It is mostly stemless with 40 60 leaves, 20–26 inches long, 1–1¼ inches wide, thin, at first glaucous, flat, sometimes plaited, with a weak not pungent point, and numerous very thin threads, outer ones abruptly recurved or deflexed. Scape 4–6 feet high, bracts as in the last; panicle pubescent, about as long as the naked part of the scape. Flowers 2–3 inches wide, white with greenish; ovary attenuated and angular-impressed towards the base and attenuated upwards towards the short, somewhat unequal, together conical, stigmas. Capsule 2½ inches long, always constricted in the middle, angular and towards the short beak deeply trilobed; seeds 8–10 mm. long. —*Y. puberula* Haw. Phil. Mag. 1828, p. 186, Refug. l. c. t. 322 is scarcely distinct, as Mr. Baker l. c. already suggests for this as well as for *Y. flaccida*.—*Y. glauca*, Sims Bot. Mag. t. 2662, Refug. t. 315, with exactly the pistil of our plant, but leaves almost without fibres, also belongs here.

The two following forms, which may eventually prove distinct from *Y. filamentosa*, I have not been able to identify with any described species. All often grow together on the coast of South Carolina and there ever retain their characters unaltered.

Var.? *bracteata* has 50–100, usually about 70 leaves 20–24 in. long, 1–1¼ or even 1½ inches wide, with a sharp but slender and weak point, and numerous thin deciduous threads. Scape 4-6 feet high, stout, greenish bronze, almost covered with large foliaceous bracts, the lower 9–12, upper 4–6 inches long, tapering upwards; panicle contracted. scarcely half as long as the flowerless part of the scape. rough, uneven or somewhat pubescent. Flowers white with greenish, about 3 inches wide; pistil 16 lines, stamens half as long, elongated stigmas at last divaricate at tip. Capsule 1½–2 inches long with a short cusp, rarely constricted. Seeds 8 mm. wide. The rarest of the South Carolina forms, and not seen from anywhere else; fl. later than the others, in the second half of June.

Var.? *lævigata* is well characterized by its very long (30–40 inches, 10–15 lines wide), deep green, smooth, thickish, very sharp pointed leaves, only 25–50 in number; lower third attenuated into a narrow stalk, leaf therefore soon decumbent; epidermis cells 3 times as long as wide. Scape 8–10 feet high, smooth, purple below with lance-shaped bracts 6–9 inches long; panicle half as long as peduncular portion, contracted, with comparatively few, sometimes slightly pubescent branches. Flowers often in pairs, smaller than in last, 2½–3 inches wide, white with purple tinge, of a strong almost disagreeable odor, which was not noticed in other varieties; stigmas divided to the base, deeply bilobed. Capsules 1½–2 inches long; short pointed; seeds 8½–9 mm. wide. This is the most common species between Charleston and Hilton Head, on the sandy coast, but is also found on the clayey soil up the rivers; it probably extends down the coast to Florida, as I have seen a specimen from Tampa Bay, Fl., about 2 weeks after the first and as long before the last form. A transition form between this and the regular *Y. filamentosa* is cultivated in the Missouri Botanical Garden, with shorter, weaker-pointed leaves, lanciform bracts and constricted capsules.

II. HESPEROYUCCA: filamenta clavata, acuta, lævia, erecta, pistillo sublongiora; antheræ didymæ transversæ; stylus tenuis, stigma calystræforme papilloso-pilosum; capsula erecta loculicide trivalvis, valvis indivisis; semina ut in *Chænoyucca*.—Planta acaulescens, folia margine serrulato-asperata, panicula in scapo elata.

12. YUCCA WHIPPLEI, *Torrey, Bot. Mex. Bound.* 222; *Bot. Exp. Ives*, 29: subacaulis; foliis paucioribus e basi lata attenuatis lineari-subulatis sæpe falcatis carinatis rigidis pungentibus lævibus glaucis; scapo bracteis late vaginantibus sursum foliaceis pungentibus munito paniculam grandi-bracteatam lævem gerente; capsula globoso-obovata obtusa.

California, on dry rocky hills, rare north of San Francisco, abundant from Monterey to San Diego, eastward to the Cajon Pass and into northwestern Arizona; fl. in April.—Trunk none or short, sometimes prostrate between rocks, stoloniferous; leaves 10–20 inches long, 4–6 lines wide, concave only near the stout point; scape 4–12 feet high, together with the lower part of the panicle itself, beset with bracts 6–9 inches long, consisting of a broad whitish base terminating in a short rigid leaf. Flowers greenish white, spreading 2 to 4 inches; segments 1½–2½ inches long, 5–12 lines wide, outer much narrower than inner ones; anthers 1–1½ lines across; pistil 4–8 lines long; style proper slender, as long as or much shorter than the ovary; trilobed hood-like stigma 3 times as thick as style and longer than thick. Capsule less than 1 to nearly 2 inches long, frequently rough; secondary dissepiments incomplete at both ends, divided and often rent by the opening of the capsule; seeds 6½–8 or 9 mm. in diameter, with a very narrow margin.—Most of the specimens and numerous notes have been communicated by Prof. W. H. Brewer of the California State Survey.

fore led to believe that the few rare instances of yucca-fertilization in localities where *Pronuba* may be presumed not to occur, have been brought about by another insect accidentally, or by the stamens reaching an exceptional length, and the anthers being brought into contact with the stigma by the conniving of the closing petals. I have found the stamens of varying length in the flowers on the same panicle, and in some instances almost as long as the pistil."

Notes on the Genus YUCCA. *No. 2.*

By GEORGE ENGELMANN, M.D.

Since my paper on Yucca was published (pp. 17–54 of this volume) I have been enabled to make the following corrections and additions:

Page 20. The examination of more seedling Yuccas has proved that the growth of the secondary axis and the young rootstock exhibits the following forms: In *Y. aloifolia* as well as in *Y. filamentosa*, var. *lævigata*, I have found a single horizontal branch; in *Y. angustifolia genuina* and var. *elata* a single perpendicular branch directed downward, and in *Y. filamentosa genuina latifolia* all the young plants examined at the end of the second year exhibited 2–5 secondary axes directed downwards ½ to 2 inches and then abruptly bent upwards. More observations are needed about these interesting peculiarities and their constancy in each species or variety; it is possible that the nature of the soil and the mode of cultivation may have some influence on them.

Page 26. The bunch of white wool is always present at the tip of the perigonial lobes, but is very slight and short in some, and longer and more copious in other species; the hairs constituting it consist of single or sometimes of several cells.

Page 27. *Yucca Treculiana* has, as is also stated on p. 43, very thick ovules, and thus *all* Sarcoyuccas have such ovules and can by them be readily recognized even in the flower and where the fruit remains unknown. *Y. gloriosa* with its thin ovules does not belong to this section at all, as will be shown below.

Page 28. The stigmatic tube does communicate directly with the three ovarian cells, but the passage closes immediately after the night of flowering.

Page 29. I have seen the vestiges of the moth, or rather its larva, in all the Sarcoyuccas as well as in all those with dry pods; but fruits which show no trace of the larva may be seen more frequently in the former than among the latter. This does not indicate that all may not have been fertilized by the action of the moth, but in such cases either no eggs were laid or they may have aborted.

Observations made last year by Mr. Riley and myself have proved that the filiform flexible egg of the moth is not deposited with the pollen into the stigmatic tube, but that the mother introduces it through a puncture in the side of the ovary directly into one of the cells just between two ovules, both of which at once begin to swell up to three or four times the thickness of the healthy ovules, and are thus preparing the sustenance of the young larva, which feeds on one or usually on both of them until able to attack the meanwhile more or less developed young seeds joining the former. In a few cases I have seen the very young larva at a place where four ovules, two from each side, meet, and here all four were prematurely enlarged.

Page 31. See below an account of the fruit of the *Clistoyucca*.

Page 34. At the end of the character of *Yucca* add: floribus majoribus pendulis nocturnis albidis nunc virescenti seu purpuruscenti colore tinctis olentibus.

Page 36. Southerners object to the remark, that the fruit of *Y. aloifolia* is "much eaten"; I should say that it is edible, and I am informed that on the coast of Florida this species makes almost impenetrable thickets in which bears have their passages and no doubt their lairs, and in the fruit of which they delight.

Page 37. *Y. aspera* and *Y. albospica* are erroneously introduced here; for their proper place see below.

Page 38. *Y. gloriosa* does not belong to *Sarcoyucca*, where, relying too much on the statements of others, I had placed it. Dr. A. Schott, who has repeatedly been mentioned by me as a close observer of Yuccas in the Southwest, was fortunate enough last autumn to discover a specimen loaded with fruit, growing in the open ground in the congressional garden at Washington. A photographic view was taken and specimens of the fruit and ripe

seed were gathered, which latter have already germinated. The fruit is a pendulous, dry, leathery, not opening capsule or berry, of deep brown color, with (as the ovules, described p. 40, indicated) thin seeds; the species therefore belongs to *Clistoyucca*, the character of which section will have to be slightly modified. Those botanists who described the fruit as pulpy must have confounded it with that of *Y. aloifolia*, as indeed seedsmen in Europe also have done, whose wrongly-named seeds, raised in Italy or Sicily, I have on page 40 erroneously described as those of *Y. gloriosa*.

The best formed fruits, seen by me, were, before full maturity, 3 inches long, 1 inch in diameter, prismatic, cuspidate, the 3 wider sides forming the back of the carpels and opposite the outer segments of the flower, and 3 alternate sides, corresponding to the commissures, only half as wide as the others, depressed and separated from the others by 6 prominent ridges. The fruit at this stage is altogether like a small fruit of the *Y. aloifolia*, only more pointed. At maturity its parenchyma dries up, the texture becomes leathery and the markings less distinct. Fruits infested by larvæ are often smaller, constricted about the middle or variously twisted. In such fruits the rains of a wet autumn are apt to penetrate through openings made by the larvæ, and cause the germination of the seeds in the closed pod —Seeds 7–8 mm. in the longest diameter, 1–1¼ mm. thick, with an entire albumen; differing from the seeds of the capsular Yuccas only by the entire absence of a wing-margin.

Page 41. *Y. Treculiana* and *Y. canaliculata* are synonymous; if, as it is said, no sufficient character accompanies the name given by Carrière in 1858, and if the first description of *Y. Treculiana* was published by Herincq, 1863, in the *Horticulteur Français*, then Hooker's name of *Y. canaliculata*, published with description and figure in 1860, would have precedence. — Fruits lately obtained from Southwestern Texas are 3–4½ inches long and 1–1¼ in diameter, pointed but scarcely rostrate, somewhat less distinctly six-angled than those of *Y. aloifolia*. Seeds 7–8 mm. wide, 2–3 mm. thick, the smallest ones the thickest.— *Yucca aspera*, Regel, Gartenfl., is the same, to judge from a specimen cultivated here; *Y. gigantea*, Lem. Rev. Hort. 9 (1860), p. 222, fide Baker Gard.

Chron. l. c., would, from the size of the leaves (4½ ft. long), have to be referred here, if the leaves were not said to be glabrous and shining.

Page 47. The character of *Clistoyucca* is to be modified as follows:

> Fructus indehiscens, pendulus (in altera specie erectus?), demum siccatus; semina tenuiora, plana, vix marginata, albumine integro. — Plantæ caulescentes, altera arborescens, panicula sessili vel pedunculata.
>
> * Folia serrulato-asperata.

YUCCA BREVIFOLIA, *Engelm.:* pericarp spongy (erect?) seeds thicker. — Dr. Parry has just sent a specimen, which shows the panicle to be ovate, dense-flowered; bracts wide and membranaceous, much like those of *Y. Treculiana* (as are also the flowers), the lower ones 2 inches wide, 3-4 inches long, tapering into a herbaceous serrulate point; the upper ones 1 inch long, oblong obtuse, of thinner texture, white; segments of perigon 2¼–2½ inches long, narrow; ovary attenuated into a short style, ovules 0.4 mm. thick.—In Southern Utah in flower about the end of April.

** Folia margine integra, etc.

YUCCA GLORIOSA, *Lin.:* pericarp leathery, pendulous; seeds thinner.

Page 50. *Y. constricta*, Buckley, Proc. Phil. Ac., 1862, page 8, seems to belong to *Y. angustifolia*, var. *elata*, and *Y. aibospica* of European gardens to var. *mollis* of the same.

Page 51. *Y. filamentosa:* numerous specimens from South Carolina, Georgia, and Alabama, prove that the varieties are difficult to keep apart. Even the most marked forms of *genuina latifolia* have sometimes large, not contracted, capsules, with nearly complete secondary dissepiments and large seeds. As thus the characters, by which I have tried to distinguish the *forma genuina*, prove to be uncertain, this arrangement of the different forms will have to be abandoned; we may simply distinguish them as var. *angusta* (preferable to *angustifolia* on account of the species of that name), var. *lata*, etc. *Y. filamentosa* seems confined to the low country of the Southeastern States and not to penetrate into the interior more than perhaps 100 miles, while *Y. gloriosa* and *aloifolia* appear to be strictly sea-side plants. The westernmost specimens of *Y. filamentosa* I have seen came from the western

border of Alabama; but it is said to grow also in Mississippi and Louisiana.

Var. *flaccida:* the contracted panicle is usually shorter than the peduncular part of the scape.

Var. *lævigata* I have now also seen in cultivation, remarkable for the narrow, smooth, flaccid or even prostrate leaves; the tall (6–9 feet high) scape purplish-brown; the narrow panicle three times as long as wide, about as long as the peduncular part of the scape; flowers and young fruit with purplish tinge; secondary dissepiments of large capsule very incomplete, or almost wanting; in the wild plant they are nearly perfect.

Page 54. *Y. Whipplei* does not occur north of Monterey; it abounds near San Luis Obispo, whence Dr. W. W. Hays has sent seeds and living plants.

The following synopsis exhibits at a glance the arrangement of the species and their geographical distribution:

YUCCA, Lin.

Sarcoyucca.

1. *Y. aloifolia*, Lin., southeast and south.
2. *Y. Yucatana*, Eng., south.
3. *Y. Guatemalensis*, Baker, south.
4. *Y. Treculiana*, Carr., southwest.
5. *Y. baccata*, Torr., southwest.
6. *Y. Schottii*, Eng., southwest.

Clistoyucca.

7. *Y. brevifolia*, Eng., southwest.
8. *Y. gloriosa*, Lin., southeast.

Chænoyucca.

9. *Y. rupicola*, Scheele, southwest.
10. *Y. angustifolia*, Pursh, west and southwest.
11. *Y. filamentosa*, Lin., southeast.

Hesperoyucca.

12. *Y. Whipplei*, Torr., southwest.

Notes on AGAVE.

By GEORGE ENGELMANN, M.D.

Just as the Yuccas among the Liliaceous plants, of which I have treated in a former paper (vol. 3, p. 17 & 210), the Agaves present among the Amaryllidaceæ a peculiar, gigantic, and sometimes tree-like development, not otherwise found in these families. Like the Yuccas, they are confined to the new world; but, unlike them, which are represented by only about a dozen species, of a more or less uniform and unmistakable character, the Agave type branches out in perhaps a hundred (or 180 or 200, if we dare trust the catalogues of nurserymen) species, of greatly diversified appearance.

The botanical investigation of the Agaves meets with the same difficulties as that of the genus above mentioned in connection with them, the Yuccas, and as the Cacti, or, to use a term more of horticultural than botanical significance, but sanctioned by the authority of no less a name than that of the elder DeCandolle, the *Plantes grasses*. They have, for the most part, been long in cultivation, the individuals being propagated with their individual peculiarities by suckers, and very rarely by seeds. Many of them have never bloomed in Europe, and many that did bloom have not been studied by competent botanists; of a large number, their native country is unknown, and the travelling horticultural collectors have paid more, or only, attention to marketable plants than to botanically-instructive specimens. Moreover, most of these plants are so clumsy and so difficult to properly preserve for the herbarium that travellers have shunned them; so that even the standard herbaria contain mostly only very scanty and incomplete material.

In the old United States only a single representative of the genus was known, the *Agave Virginica*, a rather small and inconspicuous plant, if compared with the extensive development the genus attains in Mexico and further south, in the number of species as well as in the bulk of individuals. But on our southwestern border lands, the same region where the Cacti become a leading feature of the Flora, the botanists of the U. S. and Mexican Boundary Commission, twenty to twenty-five years ago, dis-

covered a greater development of the genus, and Prof. Torrey in his Botany of that Boundary (published in 1859) was able to indicate five other species; his account, however, owing to an insufficiency of material, is meagre and to some extent erroneous. As far as I am informed, nothing has been added to our knowledge of these plants in the sixteen years elapsed since his publication; but in the last few years a quantity of new material has been gathered, and, being placed at my disposal, has enabled me to make a more thorough study of the genus.

The Agaves are American plants, some of which became known to Europeans since the discovery of America, and especially since the conquest of Mexico: the great *Agave Americana* is said to have been already in cultivation in Europe as early as the year 1561; from the similarity of the spinous leaves they were considered forms of the Aloes of the old word, and the name "Aloe" has in popular language stuck to them to this day. Linnæus was the first to distinguish them, and in his Hortus Upsalensis (1748), p. 87, he established the genus *Agave*, and enumerated the characters by which "these American plants" are readily known from the true "Asiatic and African Aloes." He adds that he has "named them *Agave*, because that word indicates something grand and admirable." It is interesting to observe how even at that early date, when botanical geography was not yet born, the geographical domains of these different groups of plants struck the discriminating mind of Linnæus as something remarkable and characteristic.

The AGAVEÆ were first recognized as a distinct tribe by R. A. Salisbury,* who united in his 12th order of *Sarmentaceæ* Yucca (with a "pericarpium superum") and Agave, Polyanthes and others (with a "pericarpium inferum"), thus recognizing the great resemblance of these plants, which we now place in different but parallel families, just on account of the relation of the ovary to the other parts of the flower.

Other botanists† have appended them to the *Amaryllidaceæ*, but it must be confessed that they have only the inferior‡

* Genera of Plants, ed. 1866, p. 77.

† Endlicher, gen., p. 181; Kunth, Enum. 5, p. 818.

‡ In *Agave* the ovary is truly and entirely inferior, but the closely allied *Polyanthes* shows a partly (about ¼) superior ovary.

ovary in common with the true bulbiferous Amaryllidaceæ, distinguished by a naked scape and an involucral spathe. The numerous horizontally-flattened black seeds, mentioned already by Salisbury as being common to Yucca and Agave, are not found in the true Amaryllis family; nor do these possess the filiform embryo which diagonally traverses the whole length of the albumen. Other interesting differences are found in the valvate æstivation of the Agaveæ and in their commissural* stigmas.

TRUNK.

The majority of the Agaves are acaulescent and monocarpic; the short subterranean trunk continues to grow for years† until vigorous enough to evolve the flowering stem, a continuation of its axis, and dies after bearing fruit. During its growth a wreath of numerous thick, fleshy, white root-fibres is developed every spring from its lower part, while the lowest, oldest part of the trunk dies and rots away. This is the case at least in *Agave Virginica*. A few Agaves have persistent trunks, sometimes of considerable dimensions; these produce flowers repeatedly, just as the caulescent Yuccas do, from axillary branches, after the terminal bud of the main axis has fulfilled its destiny and died. These secondary branches are initiated by a pair of short and clumsy, strongly carinate leaves, which may be considered as representing bud-scales (*Niederblaetter*), as I noticed in vigorous specimens of *A. Boucheana*, Jacobi, and *A. chlorocantha*, Salm, in the Berlin botanic garden, 1869.

In the acaulescent Agaves the subterranean trunk dies entirely, or for the greater part; but in *A. Americana*, and probably in the majority of the species, it first emits from the axils of decaying leaves numerous offshoots, which grow into separate young plants and thus propagate the individual. In *A. Virginica* it produces sessile lateral buds, which grow up, still adhering to the persistent part of the old trunk, a sort of corm, giving to the plant

* Stigmas formed by the *commissures* of the carpels, therefore alternating with these, a comparatively rare case. The common form is the carinal stigma, formed by the tip of the carpel itself or its carina, therefore opposed or rather superimposed to the carpel, while the true Amaryllidaceæ have an imbricate æstivation and carinal stigmas, and so have Yucca and perhaps all Liliaceæ.

† In *A. Americana*, in its home, eight to fifteen or more years; under more unfavorable circumstances, in cultivation in colder countries, much longer, even, it is said, fifty or a hundred years, whence the name *century-plant*.

eventually a cespitose appearance. Polyanthes behaves just in this manner.

The subterranean trunk of most (or all?) Agaves contains, like that of Yuccas and many other plants of these families, a great deal of mucilage,* which, mixed with water, has detergent qualities to a considerable degree; these "roots" and the whole plants thus used are known to the Mexicans by the name of *Amole*. Another use is made of the trunk, when, before flowering, it has developed a large quantity of saccharine matter, for nourishment; and not only the trunk of Mexican Agaves, but also that of the larger Arizona species, is thus eaten, after baking, under the name of *Mezcal*, and is said to be a very savory dish. The name *Maguey* is more commonly used for the plant itself.

LEAVES.

The leaves of the Agaves are sessile with a broad sheathing base, from linear to lanceolate or even ovate, the broader ones contracted above the base, and widened again upwards. They are thick and fleshy, sometimes soft, but usually of a firmer texture, rarely quite tough and hard; in some species (only in the first group) they decay at the end of the season, but in most Agaves they are persistent for years.

The margin of the leaf usually bears hard and dark-colored straight or hooked or variously flexed spiny teeth; sometimes it is denticulate with minute, pale teeth; rarely it dissolves, Yucca-like, into threads; in our *A. parviflora* it combines the teeth on the lower half with the fibres on the upper half of the leaf; very seldom the edge of the leaves is entire; in some species the whole margin of the leaf bearing the spines becomes dry, hard and horny, and is eventually, together with the spines, detached from the leaf (*A. heteracantha*). It is not well-known whether the spines, so much relied on to characterize the different forms, are sufficiently constant; it seems, at least, that an extensively cultivated form of *A. rigida*, of Yucatan, has lost its spines, and produces them only occasionally and very sparsely; in the allied genus *Fourcroya*, leaves with and without marginal spiny teeth are of common occurrence.

* The suggestion made (p. 21) that the rootstock may contain saponine, has not been verified by chemical analysis.

The point of the leaf forms a soft herbaceous bristle, or usually a hard and pungent spine, of different shapes, round, or compressed sideways, or flattened on the upper surface, or concave, or channelled; and these characters seem to be constant and of specific value.

The tissue of the leaf of most Agaves contains innumerable extremely tough fibres, which, in some of the species with sufficiently long leaves, afford, when freed from the surrounding parenchyma, valuable textile material, usually called *Pita*, in general use in their native countries, and even exported. *A. Americana* furnishes a coarser Pita, *A. rigida*, and its cultivated varieties are the source of the finer Sisal hemp; other species, e.g. *A. heteracantha*, are locally used for the same purposes.

INFLORESCENCE.

The flowering stem or scape shoots up from the centre of a rosette of leaves, continuing the main axis; it bears numerous bractlike leaves (*Hochblaetter*), generally triangular from a broad base, often attenuated into a slender tip, smaller as they reach up into the inflorescence. All the vigor of the plant, all the nourishment accumulated in the massive leaves and in the succulent trunk, are used and exhausted in the production of the inflorescence. It is well-known that *A. Americana* is extensively cultivated in Mexico, principally for the immense quantity of saccharine juice prepared in its leaves for this purpose. When the flowering scape shows the first signs of development, the terminal bud and the innermost leaves are removed, when in the basin thus formed the liquid collects and is dipped out; on an average about a gallon a day, for two or three months in succession, from a single plant 150 to 300 gallons in all. From this juice the fermented (*pulque*) and distilled (*mezcal*) liquors are prepared which are so generally used all over Mexico. The juice which is extracted before the plant prepares to bloom is acrid and not copious.

The flowering stems are in the different species from 3 to 20, and, it is said, even 30 feet high, and from a few lines to 3–5 inches in diameter, together with those of the allied Fourcroyas, the tallest flowering stems known.

The flowers are articulated on (usually extremely) short, per-

sistent pedicels, bearing one or two small bracts. The inflorescence itself shows three different forms, and, according to these, the numerous species of this genus naturally are distributed in three different sections.

The first section, *Singuliflorœ*, to which our *A. Virginica* belongs, bears single flowers in a simple, generally slender spike, never crowded as the spikes of the next section are; each flower is borne in the axil of a bract on a short pedicel, which is distinguished by a single lateral bractlet. This bractlet is normally sterile, but in monstrous inflorescences may produce secondary and tertiary flowers, which, however, can always be distinguished from those of the next section by never appearing in pairs.*

The second section, *Geminiflorœ* (gen. *Littœa*, Tagliab., *Bonapartea*, Willd., non Ruiz & Pav.), comprises the species which produce flowers in pairs, crowded into a more or less dense spike. From the axil of each primary bract a short or rarely longer (e.g. *A. Utahensis*) peduncle originates, bearing two opposite lateral bracts (sometimes pushed somewhat towards the main axis), and in their axils the flowers on two short (rarely, e.g. in *A. attenuata*, Hort. Cels. Paris, 1869, longer) secondary pedicels with bractlets of the third order directed owards the primary bract. These bractlets occasionally bear a second pair of flowers with lateral bractlets of the fourth order, directed inward, and in the axils of these occasionally (*A. attenuata* rudimentary flower-buds are seen. An internal perigonal lobe of the flowers of the primary pair is directed backwards and outwards, towards the margin of the primary bract, and an external lobe towards the bractlet. In rare instances the primary peduncle does not ter-

* I have a plant of this species growing, brought from the woods in this vicinity, which produces its irregularly crowded flowering spikes every year in the same manner. The lateral bractlet usually bears a second flower on a similarly bracted pedicel; this second bractlet stands either on the dorsal (towards the principal bract) or on the ventral (towards the main axis) side of the little inflorescence; a third flower, if present, is not coeval nor opposed to the second one, but later and higher up, and usually on the upper or inner side of the second flower; if the antholytic development, which then is often combined with fasciation, proceeds, parts of the primary flower may become more or less detached and again bear incomplete axillary flowers. — It may here be remarked that the flower of the Singuliflorœ is so placed in regard to bract and axis, that an external lobe of the perigon and one carpel are turned towards the bract, and an internal lobe and the commissure of the other two carpels towards the axis. That abnormal stock, however, produces sometimes towards the tip of the spike flowers without a pedicel and without a lateral bractlet; in these one external lobe and one carpel are turned towards the axis.

minate abruptly, as usual, but is continued into a bristle between the flowers (*A. mitis* in H. Bot. Berlin), and may even bear a third, median, flower, if the description of the inflorescence of *A. lophantha* by Jacobi (Ag. p. 202) is to be relied on; the flowers are there said to be ternate, the pedicel of the middle one being 1 line longer than those of the lateral ones.*

The species of the third section, *Paniculatæ*, are distinguished by a branching inflorescence, a panicle, in which more or less crowded bunches of flowers are borne on the end of secondary or tertiary branches. I have not been able to examine fresh inflorescences or their development, but, judging from dried fragments, the flowers seem originally to appear in pairs, usually with secondary and tertiary flowers unsymmetrically developed from their pedicels, and at last clustered, sometimes 20 or 30 or more together, so that their relative position can not be unravelled.

FLOWERS.

The flowers of the Agaves are thick and fleshy, often of lurid, greenish, yellowish, or brownish colors; rarely brighter, yellow (*A. deserti*), or orange (*A. Antillarum*). They consist of an inferior ovary, bearing the style, and a not articulated, subpersistent perigon, with the stamens.

The perigonal tube, straight, or often somewhat curved, is either short, campanulate, sometimes quite shallow, or longer, funnel-shaped, or even cylindric, or rather triangular-prismatic. The lobes form two trimerous verticils, each of valvate æstivation, the thicker exterior ones covering the broader thinner margins of the interior ones, leaving only a prominent, tapering middle part free. The lobes are generally oblong or linear-oblong, shorter or longer than the tube, flat or often channelled and including the filament, concave at the obtuse tip, which is sometimes thickened, and usually bears a short, whitish beard; they are erect or patulous, or sometimes at last reflexed.

The six stamens are more or less adnate to the tube, in some

* Some forms are described so as to leave us in doubt in regard to their inflorescence, e.g. *A. horizontalis*, Jacobi, with a spike consisting of clusters of 3-8 flowers in the axil of each bract; others are said to have 1-3 or 4-5 flowers together. All these probably belong to the Geminifloræ, with a greater normal or, perhaps, monstrous development of flowers. It is to be hoped that in future botanists or amateurs will be more precise in their appreciation of these characters.

species free from near its base, in others adnate up to the base of the lobes (an important character which has often been neglected); the outer stamens are usually placed a little higher than the inner ones. In the bud the filaments are always doubled up,* geniculate, and straighten out when the flower opens, and almost always become much longer than the perigon; in a few species they do not exceed the length of the lobes. The filaments are generally attenuated from a broader base and terminate in a thin point, on which they bear the large and conspicuous linear,† nearly quadrangular, somewhat introrse, 4-celled, versatile anther, attached near or a little below the middle; in *A. Virginica* the filaments are thickened upwards, almost clavate. The globose, or elliptic, delicately reticulated pollen-cells have, on an average, a diameter of 0.06 to mostly 0.08 or even 0.11 mm.

The ovary consists of three carpels, opposite the outer perigonal lobes, forming three cells, in each of which two vertical rows of flat, horizontal, anatropous ovules spring from the central placentæ. The stout, somewhat triangular, tubular style rises to the height of the anthers and sometimes above them, but its length is variable and does not seem to be always characteristic. The stigmatic part is thickened, clavate, or somewhat capitate, and is divided into three carinal‡ lobes, which at last open somewhat, or especially in the first section, expand horizontally, and are often emarginate or even obcordate; after expansion they (at least in *A. Virginica*) exude a viscid liquid—whether stigmatic, or only intended to allure insects, has not been ascertained.

The flowers of Agave—I speak particularly of *A. Virginica*, the only one I have been able to observe in its development, but I suspect that the same holds good in all the species—are vespertine or nocturnal and proterandrous. They open late in the afternoon or in the evening, and, while the filaments straighten out and elongate, the anther-cells burst and emit the large pollen grains, and on the following morning are found withering and empty. The style at this period usually does not yet exceed the perigon (in *A. maculosa* it is much shorter), and its lobes are

* Even the short filaments of *A. maculosa* are thus geniculate. (See p. 301, note.)

† The curved anthers spoken of in some descriptions can only refer to effete and withing ones.

‡ See page 293, note.

firmly closed; but now it begins to elongate and attains its functional maturity 48 hours after the anthers have opened, which by this time have mostly fallen off.*

The Agave flowers are odorous, some of them, like *A. Virginica*, of the sweetest fragrance, resembling tuberose, though not so overpowering; others are more or less fetid. These odors are most fully developed, as is also the case in the tuberose, in the evening and at night, indicating undoubtedly the design of attracting vespertine insects to assist in pollenization. But whether insects aid in this process, or the higher-placed flowers drop their pollen from the just bursting anthers on the opening stigmas of the lower and older ones, has not been ascertained.

The fruit is always an erect, dry, 3-celled capsule, globose or even depressed, or ovate, oblong and sometimes prismatic, obtuse at base or contracted into a sort of a stipe, obtusish at tip or acute or rostrate, opening above, generally about the upper third or half only. The numerous horizontal seeds are flat, black, semi-orbicular or obliquely orbicular with a shining or opaque surface, which, magnified 100 or 150 diameters, shows the epidermal cells flat and scarcely distinct from one another, or with distinct, somewhat elevated cell-walls; or they are slightly depressed, giving the seed a pitted appearance, or rarely elevated and tubercular. The areæ of these cells are very minutely dotted or pitted.

The filiform, cylindric, or slightly compressed embryo is as long as the hard, whitish, semi-transparent, farinaceous and oily albumen. In germination the seed-shell is elevated above the ground on top of the largely developed foliaceous cotyledon, contrary to the behavior of Yucca, where the husk enclosing the small and soon decaying cotyledon remains buried in the ground. (See Notes on Yucca, 3, p. 20.)

Some species bear no fruit, but, in place of the withered flower, or probably in the axil of its bractlet, a bud or bulblet appears, which grows to a considerable size and will eventually sprout and propagate the plant. All the so-called viviparous Agaves

* In figures of Agave flowers we not rarely meet with bursting anthers and a fully elongated style in the same flower; which I suppose is factitious, and not founded on correct observation.

belong here. Some species, *A. Ixtli*, Karw., in the garden of the late Mr. Thuret of Antibes, bears both capsules and bulblets; and so appears to do *A. sobolifera* (*A. vivipara*, Lam.) None of our species possess this peculiarity.

The native country of the Agaves is preëminently Mexico; in the southwestern parts of the United States, mostly in Arizona, 13 species are found; but only one of these extends to the 39° and even 40° N. Lat., while in California the northern limit of the Agaves is about 34°. A few species seem to be natives of the West Indies, and a few more may be peculiar to South America. The Agaves said to come from the East Indies, St. Helena, and other parts of the old world, are propably all forms of *A. Americana* originally brought there from America.

I now proceed to the enumeration of the species of the territory of the United States, and of a few undescribed or imperfectly known foreign Agaves of which I possess sufficient material.

AGAVE, *Lin.*

Perianthium superum tubulosum vel campanulatum, subregulare, subpersistens, limbo 6-fido, laciniis valvatis. Stamina 6; filamenta tubo plus minus adnata, in alabastro inflexa, demum plerumque longe exserta; antheræ lineares versatiles. Ovarium inferum, triloculare, ovulis anatropis horizontalibus in loculo singulo biseriatis; stylus apice incrassato trilobus. Capsula coriacea, loculicide trivalvis; semina 6-seriata numerosissima, planocompressa, nigra; embryo axilis, longitudine albuminis cornei.

Plantæ Americanæ, præcipue Mexicanæ, acaules vel caulescentes, sæpius giganteæ; foliis crassis sæpissime aculeato-dentatis spinoso-mucronatis.

I. SINGULIFLORÆ.

Flores e bractearum axillis singuli, laxe spicati.

The species of this section have a more herbaceous character than those of the two others; they are stemless, with softer, probably always annual leaves, not contracted above the base, with marginal asperities more than teeth, and a terminal bristle more than a spine. They are the *Herbaceæ* and *Subinermes* of authors, which, however, include some species of the next section. Only about a dozen species are known, three of them within our

domain. The spikes are slender, the flowers fragrant, the stigmatic lobes wide-spreading.

1. AGAVE MACULOSA, *Hook. Bot. Mag.* 1859, t. 5122: foliis e caudice subterraneo crasso cylindrico lanceolato-linearibus concavis undulatis demum recurvatis glaucis lurido-maculatis cartilagineo-denticulatis; spicæ laxifloræ bracteis lanceolato-subulatis; ovario ovato-lanceolato brevi, lobis lineari-oblongis erecto-patulis tubo gracili subcylindrico sursum parum ampliato plerumque multo brevioribus, staminibus fauci ipsæ insertis lobos vix æquantibus stylum plerumque superantibus, stigmatibus demum patulis obcordatis; capsula oblonga longe cuspidata basi in stipitem contracta.—*A. maculata*, Engelm. in Bot. Mex. Bound. 1859, p. 214, non Regel; *A. Virginica*, Torr. ibid., non al.

Var. β. BREVITUBA: lobis perigonii tubo magis ampliato fere æquilongis, antheris longioribus.

Along the Rio Grande from below El Paso to Matamoros, Wislizenus, 1847; Bigelow, Schott, 1850–52: the variety below El Paso, Wright, No. 1095.—Fl. May and June.—The caudex, somewhat different from the allied species, is a black cylindric stock ½–¾ inches thick and 4–6 inches long, bearing thick white radical fibres at the base. Leaves ½–1 foot long, as many inches wide, concave, flexuous, at length recurved; scape 2–4 feet high, spike 6–12 inches long: fragrant purplish-green flowers, about 2–2½ inches long; ovary 3–4 lines, tube 1 inch and lobes 7–9 lines long, filaments* and anthers as long as lobes. The stigma is remarkable on account of the deep emargination, almost bilobation, which form is only indicated in other Agaves, but is distinct in Polyanthes. The firmer texture of the capsule (1½ inches long, ½ inch thick), and its stipe and beak, further characterize this species. Seed 2–2½ lines wide, thicker than usual in this genus, marked by a flat reticulation.

2. AGAVE VIRGINICA, *Lin.*: acaulis; foliis late seu oblongo-lanceolatis concavis undulatis flexuosis demum recurvis læte viridibus herbaceo mucronatis margine asperatis; perigonii ovario

* This is one of the few Agaves with stamens so short that they may be called *included*; they occur in all three sections. It is not impossible that superficial investigation has classed several of these American plants with the Asiatic genus *Polyanthes*; but they have —at least this one has—an entirely inferior ovary and filaments doubled up in the bud, both of which characters are wanting in Polyanthes. Kunth (En. 5, p. 48) already suggests this in regard to *Polyanthes Mexicana*, Zucc.

ovato multo longioris tubo angusto sensim ampliato lobis lineari-oblongis erectis bis terve longiore, filamentis inferiori tubi parti adnatis sursum clavatis perigonium vix duplo superantibus, stigmatibus suborbiculatis demum patentibus; capsula tricocca subglobosa retusa breviter stipitata.

Var. β. TIGRINA: robustior; foliis majoribus pulchre purpureo-maculatis; staminibus imo tubo adnatis; capsulis depresso-globosis.

Lusus POLYANTHUS: spica densiflora floribus in glomerulos paucifloros congestis sæpius antholyticis.

On dry hills and in open woods from Maryland and Virginia southward and westward to Missouri and Texas, but not on the western plains or in West Texas, nor on the Rio Grande; the variety in salt-marshes on the coast of South Carolina, Dr. Mellichamp.—Fl. June to August, according to latitude.—This species was first known through Clayton's collection, who described it as "Aloe from Virginia," and makes mention of its fragrant flowers and deciduous leaves; from his specimens and notes it was published by Gronovius in his Flora Virginica, 1739, and through him became known to Linnæus, who in 1751 (Amœn. Acad. 3, p. 22) referred it to his new genus Agave.

Leaves mostly ½–1 foot long, 1½ or 2 inches wide; in a form from Houston, Texas, the leaves are lance-linear and not more than half as wide; marginal teeth extremely small, consisting of single projecting epidermis cells, or larger, $\frac{1}{20}$ to (rarely) ¼ line long, and then consisting of innumerable short cells, not sharp-pointed, but rough, like the small serratures of some Yuccas, only less rigid. Scape altogether 3–5 feet high, of which the spike measures 1 or 1½ feet. Flower, including ovary but excluding stamens—as I always measure Agave flowers—1–1¼ inches long, with the stamens ½ or rarely 1 inch longer; anthers 6–6½ lines long. Capsules 7–9 lines long, a little less wide; seeds 2–3 lines wide, lightly reticulated, with depressed, minutely dotted areas.

Var. *tigrina* is larger and more robust; leaves tapering to a point or abruptly cuspidate, 1–1½ feet long, 2½–3 inches wide, beautifully mottled; the purple color is produced by a clear purple liquid contained in a single layer of small flattened cells between the transparent epidermis cells and the large parenchymatous cells filled with chlorophyll and often with rhaphides;

capsule 8–9 lines wide, less high; seeds over 4 lines wide. This variety has retained its peculiarities in cultivation with me.

Of the sport with crowded, often antholytic flowers, and with a tendency to fasciation, I have before spoken (p. 296, note).

3. AGAVE VARIEGATA, *Jacobi, Hamb. Gart. Zeitg.* 21, p. 459; *Agav.* p. 180; *Saunders Refug. Bot.* v. t. 326: acaulis; foliis late lanceolatis undulatis margine asperato denticulatis; perigonii tubo late infundibuliformi ovario oblongo paulo longiore lobos ovato-oblongos patulos demum reflexos longitudine æquante seu eis paulo breviore, filamentis superiori tubi parti adnatis longe exsertis, stylo demum stamina superante; capsula oblonga cuspidata.

On the lower Rio Grande near Mier and Matamoros, Dr. J. Gregg, May, 1847.—Leaves (before me) 9–10 inches long, 1½–2 inches wide; edge similar to that of the last, but teeth often sharper and curved upwards; scape "3–5 feet high"; flowers in Dr. Gregg's specimen about inch apart, in the axil of a broad triangular bract, 4 lines long, upwards smaller. Flowers 1½ inches long; ovary, tube, and lobes, of nearly equal length, 6 lines, or tube a little shorter and lobes a little longer; stamens inserted about ⅔ or ¾ up the tube, not at the base of the lobes, and about 2 inches in length; anthers ½ inch long; style slender, at last often longer than the stamens; only capsule seen 10 lines long and 6 wide; seeds unusually oblique (always?), 2½ lines in longest diameter.

I refer this plant from the Rio Grande with some hesitation to Jacobi's and Saunders' *A. variegata*, the stamens of which are said to be inserted "in the throat," whatever that may mean; the leaves of this plant, which is said to be "probably" from Mexico, and which has repeatedly flowered in Europe, are mottled with lurid blotches, of which in my dried specimen no trace is visible. I have not the means to ascertain whether any of the older names, such as *A. brachystachys*, Cav., or *A. polyanthoides*, Hort., refer to this same plant; the former, however, seems to be a larger plant, with larger "entire" leaves; *A. saponaria*, Lindl., is certainly also similar, but, if the figure in Bot. Reg. 25 t. 55 is to be relied on, is well-distinguished by having a prismatic flowertube. The insertion of stamens in the tube is not mentioned by Lindley,

nor is it scarcely ever spoken of in any descriptions, nor indicated in the figures.

II. GEMINIFLORÆ.

Flores e bractearum axillis bini oppositi, dense spicati.

The species appertaining to this section. 40 or 50 in the books, 4 of which belong to our F ora, are usually stouter, sometimes with a short trunk, leaves rarely soft and almost herbaceous, but perhaps always perennial, often tough and sometimes the toughest in the whole genus; their margin is most variable, entire, or with small pale cartilaginous teeth, or filamentose, or with stout, horny, brown spines. — Together with the first section they constitute the *Agavæ spicatæ* of some authors; others, who have principally regarded the growth and foliage of cultivated plants, have scattered them in various groups, mixed with the species of the next section.

* Folia margine serrulato-aspera.

4. AGAVE FALCATA, *n. sp.*: acaulis; foliis e basi lata linearibus rectis seu plerumque falcatis rigidissimis supra planis concavisve (siccatis) dorso carinatis margine serrulato-asperatis apice in spinam fere triangularem supra planiusculam excurrentibus; scapo et spica bracteis e basi latiore subulato-filiformibus marcidis deciduis stipato; ovario lobisque perigonii ovatis erecto-patulis eo æquilongis tubo multo (ter) brevioribus; staminibus medio tubo vel ultra insertis perigonium fere duplo superantibus; stylo gracili apice trilobo.

Saltillo, Buena Vista, and apparently all over that northern part of Mexico, abundantly collected by Drs. Wislizenus and Gregg in 1846–48; flowering in the latter part of May, and again in July and August, probably at different seasons, as many Mexican plants do, stimulated to development by a few rains or even a single heavy one. — As the plant is common in a region often traversed by collectors, it seems strange that it should not have become known and been brought into cultivation long since; but I can find no description to which I might refer here, unless it be the *A. Californica*, Hort. Kew, of which I find a notice in Jacobi's Agave, App. p. 47; but I strongly suspect that this refers to no Agave at all, but to *Yucca Whipplei*.

Leaves hard and rigid, finely serrulate, 6–15 inches long, sheathing base 1–1½ inches wide, soon contracted to the width of 3–5 or 6 lines, tapering to the point, the sharp brown spine of 6 lines in length, triangular, nearly flat above, with two sharp lateral and one obtuse carinal edge; leaves usually falcate, rarely straight. Scape "3–8 feet high," bearing arid filiform bracts of 2 inches or more in length, smaller in the inflorescence. Flowers crowded on very short knobby pedicels, 12–15 lines long, ovary and lobes each 2½–3, tube 6–7 lines long, and at the throat nearly 3 lines wide; filaments inserted just above the middle of the tube, reaching about 1 inch above the perigon; anthers 7 lines long. Fruit not collected.

** Folia margine filamentosa.

5. AGAVE SCHOTTI: acaulis; foliis e basi lata linearibus rectis seu subfalcatis rigidis supra planis concavisve dorso convexis seu (siccatis) carinatis margine abunde filiferis apice in spinam robustam teretem fuscam excurrentibus; pedicellis brevibus, ovario et lobis perigonii patulo-erectis lineari-oblongis æqualibus tubo anguste infundibiliformi multo brevioribus, staminibus superiori tubi parti adnatis paulo exsertis; stylo robusto staminibus demum æquilongo.—*A. geminiflora?* var. *Sonoræ*, Torrey, Bot. Mex. Bound. 214.

Sierra del Pajarito in Southern Arizona; fl. August; collected only by the late Dr. Arthur Schott, 1855, to whose memory I have dedicated this species in consideration of long years of friendship and of the valuable services to science rendered by him in many arduous exploring expeditions in the arid southwestern wilds, as well as in the primeval tropical forests of the isthmus and on the plains of Yucatan.

According to the discoverer, this as well as the next is one of the *Amole* or soap-plants. Leaves 6–12 inches long, 3–4 lines wide, terminating in a perfectly terete spine 3 lines long; margin splitting into numerous extremely fine whitish fibres. Scape 5–6 feet high; spike rather looser-flowered than in the last; primary and secondary pedicels about 1 line long; flower 1½ inches long, ovary as well as narrow lobes about 5 lines, the gradually widening tube 8 or 9 lines long, and bearing the filaments (8 lines long and reaching scarcely more than 1 line beyond the lobes) 1½ lines

below the throat; anthers 5–6 lines long, large for the flower; no fruit seen.*

6. AGAVE PARVIFLORA, *Torrey, Bot. Mex. Bound.* 214: parvula, acaulis; foliis rosulatis terræ adpressis e basi lata vaginante dentata lineari-lanceolatis margine infra bruneo-dentato sursum in filamenta brevia crassa alba soluto, spina terminali rigida supra plana; scapo elatiore, pedicellis brevissimis; floribus geminis seu subquaternis parvis, ovario oblongo perigonio duplo breviore, tubo profunde campanulato lobis oblongis erectis bis longiore, filamentis basi tubi insertis subinclusis; capsula pisiformi subglobosa breviter cuspidata.

On various sierras in the Pimeria Alta in Southern Arizona, in fl. & fr. in July, A. Schott.—The leaves of this prettiest and smallest of all Agaves are, together with the broad, sheathing base, not quite 3 inches long: base 1 inch wide and a little longer; blade 1¾ inches long, 4 lines wide, somewhat contracted above the base; spines 2 lines long, at last gray. On its lower third or half the leaf-margin bears very small, but rigid, sharp teeth, and higher up separates into a few short, stout, white filaments—the only instance of this combination, I believe, in the whole genus. Scape 4–5 feet high. Flowers 6, ovary over 2, tube 2½, and lobes 1¼ lines long, with stamens and style about 4 lines in length and scarcely reaching beyond the lobes of the perigon; anthers 3, capsule 4–5, and seeds 1¾ lines long.

*** Folia margine aculeato-dentata.

7. AGAVE HETERACANTHA, *Zucc. in Act. Leop. Car.* 16, 2, 675; *Kunth, En.* 5, 836: subcaulescens; foliis crassis rigidis lineari-lanceolatis in margine corneo demum soluto aculeos complanatos uncinatos gerentibus, spina terminali valida subterete versus basin leviter exarata; scapo et spica bracteis e basi triangulari subulatis marcidis demum deciduis ornato; floribus in pedicellis brevissimis binis, perigonio ovario oblongo longiore,

* Dr. Gregg collected near Ocotillo, direction of Tepic, in Western Mexico, leaves of a plant which he says bears a scape 5–6 feet high, and which, like many narrow-leaved Agaves and Yuccas, was called *Palmilla* by the natives; unfortunately no flowers came along, but, as it seems to be an undescribed Agave, it may be designated as A. ANGUSTISSIMA: leaves "2–3 feet long," 2½–3 lines wide, convex on the back, filamentose on the margin, narrowed into a short (2½ lines), stout, triangular, brown spine. It seems allied to *A. filamentosa*, Salm, which, however, has much shorter and wider leaves. The form of the terminal spine precludes its being taken for a Yucca.

lobis lineari-oblongis erecto-patulis tubum campanulatum brevissimum multoties superantibus, filamentis basi loborum insertis perigonio fere duplo longioribus; capsula ovata s. oblonga plus minus cuspidata.—*A. Poselgeri*, Salm, in Bonplandia 7, 92; Jacobi, Agav. p. 40; *A. Lechuguilla*, Torr. Bot. M. B. 213.

On the Rio Grande from El Paso down the river, Wright, 682, 1432, 1907; southward to Parras, Saltillo, and further, Gregg, Wislizenus; Karwinski, Poselger. Fl. in May.—I have ventured to unite the different forms under the oldest (Zuccarini's) name, the more so, as I was able to compare the original specimen in the Munich botanical garden, where I found it in flower in August, 1869. Whether several other garden-forms, described under different names, all characterized by soluble corneous leaf-edges, belong here, or constitute distinct species, can be decided only when their flowers become known. Zuccarini's typical specimen has leaves 18 inches long and 2½ inches wide, with a spine 1½ inches long, the spiny teeth straight or curved up or down, whence the specific name; scape 6 feet high; flowers only 1 inch long (ovary 5, perigon 7, tube over 1½, filaments 15 lines long from base of tube); no fruit was matured, but many bulbilli were sprouting from the top of the scape. Gen. Jacobi (Ag. app. p. 14) describes a specimen which flowered at Brussels with perigon divided to the base, most probably inaccurate, as no Agave is known with such a flower.

Our plant grows in mountainous and rocky localities, is called *Lechuguilla* ("Lecheguilla" in the Mex. Bound. Bot. is a misprint), and its rootstock *Amole;* the leaves furnish excellent but rather coarse fibre, and the rootstock is used as soap and is a "savory food" when roasted; trunk 4–6 inches high; leaves (before me) 10–20 inches long and 1–1½ inches wide, margin and its teeth dark red-brown, at last fading to ash-color and becoming detached from the leaf, but adhering long to the terminal spine; teeth 9–12 or 15 lines apart, below smaller and straight, upward larger (1½–2 or even 3 lines long) and strongly uncinate, not irregular, as in the original specimen; terminal spine 7–9 lines long, slightly grooved on lower third or fourth. Scape 6–10 feet high, its bracts from 2 inches down to ½ inch long, deciduous, so that in the flowering spike little of them is seen. The flowers before me indicate two forms, one with a slender ovary, 7–9 lines long,

larger flower (perigon 9–10, tube 1–1½, anthers 6 lines long), and oblong, strongly cuspidate capsule, about 1 inch long and half as wide; the other form has a shorter ovary, 5–7 lines long, smaller flower (perigon 7–8, tube ½–1 line long), and rather shorter anthers, capsule shorter, 8 lines long and 6 wide, with a short abrupt point. Both forms seem to ocur in all the localities mentioned, and certainly belong together. I have been particular in describing them, because we rarely have occasion to study numerous and varying specimens of these plants, but must be generally satisfied with poor fragments, so that it is difficult to ascertain the amount of variation within the species.

8. AGAVE UTAHENSIS, *Engelm. in S. Watson's Bot. 40th Parall.* p. 497: acaulis; foliis crassis glaucis e basi lata attenuatis in spinam validam infra carinatam supra usque ad apicem late exaratam excurrentibus, margine aculeis rectis validis albidis dentato; bracteis scapi elati e basi lata subulatis marcescentibus; floribus (minoribus flavis) pedunculatis binis vel sæpius quaternis, ovario oblongo perianthio subbreviore, tubo late campanulato abbreviato lobis oblongis erectis ter quaterve breviore medio stamina limbum paulo excedentia gerente; capsula oblonga breviter cuspidata.

Southern Utah, about St. George, etc., extending into Arizona, Dr. E. Palmer, J. E. Johnson, F. Bischoff.—Leaves 6–12 inches long, 1–1¾ wide, not contracted above the wider base, very thick and rather hard, strongly marked with the impressions of the margins of the adjoining leaves; terminal spine about 1 inch long, pale or white in the specimens before me, with a darker base and tip, almost triangular in the cross-section; lateral spiny teeth 1½–2 lines long and as wide, white with a darker base. Scape, together with the dense spike of 1–2 feet in length, 5–7 feet high; peduncles and pedicels distinct, in fruit often 3 lines long, ultimate ones shorter. Flowers scarcely 1, perigon about ½ inch long, lobes three times or more the length of the shallow and wide tube, which bears the stamens in the middle, not at the base of the lobes as many short-tubed Agaves do; filaments less than ¾ inch long, about 2 or 3 lines longer than the lobes; anthers 5–6 lines long; capsule 10–14 lines long, 4–5 wide; seeds 1½–2 lines wide, marked with flat punctate areæ.

III. Paniculatæ.

Flores ad apices ramorum inflorescentiæ congesti paniculati.

These are the typical Agaves, of which 20 or more forms are enumerated, with stout, often very large, fleshy leaves, almost always with spiny marginal teeth and strong spiny tips, a stout and high scape bearing a paniculate inflorescence, the branches of which are usually ½–2 feet long or even more, stout, vertically compressed, and naked up to the base of the branchlets or pedun cles. Most of them are stemless, some have trunks several feet high, but none grow as large as some Yuccas do. Among them we find the economically and commercially most important Agaves, especially *A. Americana* and *A. rigida*.

* Tubus perianthii lobis multoties brevior.

† *Stamina tubi basi inserta.*

9. Agave Newberryi, *n. sp.:* acaulis; foliis e basi latiore sensim angustatis lanceolato-linearibus rigidis integris apice aculeo fusco semitereti supra canaliculato armatis; scapo gracili, paniculæ angustæ racemiformis ramulis remotis bracteis lanceolatis breviusculis fultis abbreviatis paucifloris; perigonii tubo campanulato brevissimo, lobis oblongis, staminibus infimo tubo adnatis.—*Agave, n. sp.?* Torrey in Bot. Ives Exp. p. 29.

Peacock Spring, Northwestern Arizona, west of the San Francisco Mountains, between them and the Colorado River, over 4,000 feet alt., discovered, when just beginning to bloom, March 31, 1858, by Dr. J. S. Newberry on Lieut. Ives' Expedition, and named for him in commemoration of his services to Botany in this and other western explorations. — This very peculiar plant, of which we unfortunately know so little, is so different from the other paniculate Agaves known to me, that their connection seems to be altogether artificial; but for the present I can not do better than to place it between them and the last section, to which the small stature and the form of the leaves seem to approximate it, though the inflorescence is clearly a contracted, short-branched panicle.

Leaves 7–10 inches long, at base ¾ inch wide, with entire, cartilaginous margins,* terminating in a sharp, semi-terete or almost

* Possibly a horny tooth-bearing edge, such as we find in *A. heteracantha*, may have broken off, but no traces of such remain in the only extant specimen.

triangular, dark colored spine, grooved on the upper side, and about ½ inch long. Scape 8 feet high, flowers in a long, loose raceme or contracted panicle; bracts lanceolate, about ½ inch long; branchlets 1–3 inches apart, 1–2 inches long, bearing 2–5 (not opposed) flowers. The whole flowerbud, just about opening, nearly 1 inch long; prismatic ovary equal to perigon; tube very short, only ⅕ or ⅙ of the lobes; short stamens, which, when fully developed, probably will not be much longer than the perigon, from near the base of the tube; anthers 4½–5 lines long.

†† *Stamina tubi fauci inserta.*

10. AGAVE DESERTI, *n. sp.:* acaulis; foliis crassis glaucis supra basin latissimam aculeato-dentatam leviter contractis ovato-lanceolatis sursum sensim attenuatis in spinam gracilem elongatam compressam ad medium anguste canaliculatam excurrentibus, margine sursum corneo obscuro infra herbaceo aculeis uncinatis flexuosis fuscis armato; scapo graciliore bracteis distantibus foliaceis lanceolato attenuatis dentatis stipato, ramulis paniculæ superioribus erectis, pedicellis fasciculatis longiusculis; floris flavi ovario subprismatico perigonium fere æquante, tubo infundibuliformi brevissimo lobis oblongis erecto-patulis quater s. quinquies breviore, staminibus loborum basi insertis ipsis lobis duplo longioribus; capsula oblongo-prismatica breviter cuspidata.

Eastern base of the Southern California mountains and in the adjoining deserts. Fl. in June, but occasionally, as most of these plants do, at other seasons.—The then Lieut. Emory,* in the adventurous expedition to California in the fall of 1846, was the first to discover this species in Valcitron, southeast of San Felipe. A few years later Dr. Parry found it "on the arid hills and valleys" in the same region, and drew up a full description, but did not collect any specimens. Since then it was lost sight of until within this year, when horticultural collectors again brought it into notice. My specimens were obtained from Mr. G. N. Hitchcock of San Diego and Dr. E. Palmer.

* In his Notes on a Military Reconnoisance, Washington, 1848, p. 104, he says under date of Nov. 29: "We rode for miles through thickets of the centennial plant and found one in full bloom. The sharp thorns terminating every leaf were a great annoyance to our dismounted and wearied men.... A number of plants were cut by the soldiers and the body of them used as food." A few flowers were saved and are now in the late Dr. Torrey's herbarium.

The plant is one of the smaller of this section; leaves densely clustered around the base of the stalk, ascending and erect, thick, fleshy, deeply concave, very glaucous, 6–12 inches long, ½–2 wide, contracted above the very broad base, which is edged with sharp, straight, pale teeth, wider above the middle and terminated by an unusually long (1–2 inches) and slender, laterally compressed spine marked with a deep narrow groove half-way up; the hard and horny, dark colored edge of this spine extends down to about the middle of the leaf, bearing the crowded, strong, hooked teeth (2–3 lines long); below the middle the teeth-bearing margin is herbaceous. The stalk is, according to Dr. Parry, 4–10 feet high, 1–2 inches thick below. The flattened branches of the panicle, almost horizontal below, longest (2–3 inches) in the middle and nearly erect upwards, divide into not very compact clusters of forked pedicels, 2–3 lines in length, the ultimate ones shorter, bearing a profusion of bright yellow flowers. Prismatic ovary a little shorter than the perigon and scarcely contracted at top; perigon 10–11 lines long, tube only 1½–2 lines long and wide, lobes about 9 lines long and 2½ wide; filaments inserted at base of lobes, about twice their length; anthers as long as lobes; capsule 1¾ inches long, 6–7 lines wide, pointed; seeds 2½ lines in diameter.

11. AGAVE PARRYI, *n. sp.*: acaulis; foliis ascendentibus rectis supra basin dilatatam vix angustatis ovato-lanceolatis versus apicem attenuatis spina valida supra planiuscula medio leviter carinata decurrente terminatis, margine aculeis distantibus minoribus rectis seu paulo deflexis armato; scapo valido bracteis magnis foliaceis triangularibus integris imbricato; paniculæ ramis robustis horizontalibus seu vix ascendentibus apice flores numerosissimos breviter pedicellatos ochroleucos gerentibus, ovario prismatico perigonium fere æquante, tubo brevi infundibuliformi lobis lineari-oblongis erecto-patulis duplo breviore, staminibus summo tubo adnatis longe exsertis, stylo sæpe demum stamina excedente; capsula ovata brevissime cuspidata, seminibus majusculis.—*A. Americana*, β? *latifolia*, Torr. Bot. Mex. Bound. p. 213, pro Emoryi planta; *A. Mescal*, C. Koch, Wochenschr. 1865, p. 94 (ex Jacobi), and *A. crenata*, Jacobi, Agav. p. 229, quoad plantam neo-mexicanam.

Western New Mexico to Northern Arizona, and perhaps eastward to the mountains below El Paso, apparently not south

of the Gila River; fl. June and July.— The botanical history of this species is similar to that of most of the larger Agaves, the material for whose definition must be gathered piecemeal and from many different sources. Oct. 19, 1846, a fruiting specimen was collected near the "Copper Mines" by Lieut. Emory, in the California expedition (see p. 310), l. c. p. 59, now preserved in the Torrey herbarium and mentioned in the Mex. Bound. Botany as a short and broad-leaved form of *A. Americana.* In 1865 Dr. E. Coues sent flowerbuds from Fort Whipple, which seem to belong to this species. In January, 1868, Dr. C. C. Parry, then on a railroad surveying expedition, again found it and collected seeds, which I distributed in Europe as *A. Parryi;* the young plants, raised from them, are now advertised in nursery catalogues, but no description has yet been published. Then Mr. F Bischoff, of Lieut. Wheeler's expedition of 1871, brought capsules and seeds home. The first who, collecting foliage, flowers, and fruit, enabled me to connect all these scattered fragments, was Dr. J. T. Rothrock, Surgeon and Naturalist of Lieut. Wheeler's Southwestern Expedition of 1874. He met with the plant in "Rocky Cañon" and as far north as Camp Apache in Northeastern Arizona. Why Koch and Jacobi should have referred the short notes of Torrey to a plant which they found in cultivation in Europe, is unknown to me; Jacobi's description does in nowise agree with our plant, as the margin of the leaves is nearly straight and not "deeply crenate," etc.

Leaves erectish or the outer ones patulous, 10–12 inches long, 3–3½ inches wide, somewhat concave as all Agave leaves are, rather abruptly acuminate and terminating in a very robust spine, 1 inch long, flattened above, with two sharp lateral angles and a slight ridge in the middle; from this spine a horny, brown margin runs down the leaf-edges for 1 inch or more and to the uppermost teeth. Teeth 6–12 lines apart, comparatively small, only about 1½ lines long, straight, or slightly curved up on upper, and smaller and curved back on lower part of leaf. Scape 8–12 feet high, 1–2 inches thick, bearing numerous large (2 inches wide at base, and twice as long, smaller upwards), triangular, closely adpressed bracts, herbaceous, with scarious brown margins and sharp points. Panicle itself, in well-developed plants, about 3 feet long, and 1 foot in diameter, the stouter branches considerably

flattened, ¾ inch wide, 6 inches long; ultimate pedicels usually 2–3 lines long. Flowers over 2 inches, the perigon 12–14 lines long, tube 4–4½ lines long and wide, lobe 9–9½ lines long and 2 wide; stamens inserted at the base of the lobes, the inferior a little lower than the exterior ones; filaments 1¾ inches, anthers 10 lines long; style often at last longer than stamens. Capsule wider in proportion to its length than in any other of our species belonging to this section, about 1¾ inches long and half as wide; seeds 4 lines wide, with flat, punctulate, strongly marked reticulation, visible under a strong glass.

12. AGAVE ANTILLARUM, *Descourt. Flor. med. Antill.* 4 *tab.* 284 (1827): subcaulescens; foliis late lanceolato-linearibus elongatis, margine aculeis parvis distantibus rectis recurvisve fuscis armato, spina terminali valida fusca terete basi solum anguste canaliculata; scapo sub-10-pedali; paniculæ ovatæ ramis horizontalibus, pedicellis longiusculis dense fasciculatis; florum (aurantiacorum) ovario perigonio longiore, tubo late infundibiliformi lobis lineari-oblongis erecto-patulis ter quaterve breviore, staminibus basi loborum insertis longe exsertis; capsula ovato-prismatica cuspidata basi in stipitem brevem contracta.

San Domingo, Parry & Wright, U. S. Expl. Exp., Feb. 1871, in flower.—The unusual color of the flower and the native country of the plant make it almost certain that this is Descourtil's plant, and I adopt his, the oldest, name, even if Grisebach's (Flor. West Ind. p. 582) suggestion should prove true, that it might be identical with *A. sobolifera*, Salm, hort. 1834 (*A. vivipara*, Lam., non Lin.) This plant is also reported to come from San Domingo and Jamaica, but to have greenish or yellowish-green flowers (Jacobi, Ag. 122) and to bear capsules as well as bulblets, whence the names; but none of our botanists seem to have observed such proliferation, which in other allied Agaves and in a Fourcroya were duly noticed. The measurements taken by them in San Domingo of a "medium specimen" are: height of leaf-bearing trunk 2 feet, length of leaf 30–36, greatest width 4½ inches; scape 8–10 feet high, at base 2½ inches thick, length of lower branches of the panicle 9, of middle 12, and upper 3 inches; nearly 100 flowers on the strongest branches.

A single leaf before me is 3 feet long and 3½ inches wide, the terminal spine 9 lines long, a narrow groove occupying only ¼ of

its length; marginal teeth 6–12 lines apart, only 1 or at most 1½ lines long, hard and sharp, deep brown. The flowers are reported as having a yellowish-green tube; limb and filaments and the anthers, before opening, are orange. The flowers before me belong to two forms, one with longer (1 inch) pedicels and larger flowers, the other with smaller flowers on shorter (3–5 lines) pedicels. The ovary of the former is 16–18, the tube 4, and the lobes 10–11 lines long; filaments not twice as long as lobes; anthers 11 lines long. The ovary of the smaller flower is 15, tube 2, lobes 7–8 lines long, and the exsert part of the filament longer than the whole perigon; in the former the stamens are inserted a little below the base of the lobes, in the latter at the very base itself. The capsule of the latter is 1½–1¾ inches long and 7–8 lines wide; seeds 3 lines wide.

** Tubus perianthii lobis brevior vel æqualis; stamina medio tubo inserta.

† *Tubus lobis brevior.*

13. AGAVE SHAWII, *n. sp.:* subacaulis; foliis perviridibus erecto-patulis supra basin dilatatam vix denticulatam paulo contractis ovatis acutis spina valida late excavata acuminatis, margine corneo fusco vix solubili aculeis subcontiguis maximis sursum curvatis vel varie flexi sornato; scapo valido bracteis foliaceis triangularibus toto imbricato; ramis paniculæ horizontalibus seu superioribus adscendentibus apice glomerulum florum subsessilium compactum foliaceo-involucratum gerentibus; ovario prismatico perigonio vix breviore, lobis lineari-oblongis suberectis tubo late infundibuliformi medio stamina paulo exserta gerente duplo longioribus, stylo stamina superante sæpius arcuato; capsula prismatica acuta.

On the arid hills which overlook the sandy strand of the Pacific in the southwest corner of California, where the boundary is marked by the initial monument, this fine species, growing together with *Cereus Emoryi*, was discovered by Dr. Parry in 1850, and a full description made; from his memoranda Messrs. Parker and Hitchcock of San Diego re-discovered it a few months ago and supplied me with most instructive photographs and excellent specimens; last summer Dr. Palmer collected it with immature fruit, and in November the above named gentlemen found it in full bloom and sent fresh bunches to St. Louis. This

is the short history of a remarkable species, which will flourish, highly esteemed by amateurs as one of the most striking and beautiful Agaves, and commemorate, among all who love horticulture in other climes, the name of Henry Shaw, already so highly esteemed in St. Louis as the founder and donor of the "Missouri Botanical Gardens," grand at present, and promising a future as useful as it will be magnificent.

The trunk of this species is short and globose or more elongated, 8–12 inches long, but all covered with its very regularly (in $\frac{8}{13}$) arranged, broad, deep green leaves, forming masses nearly 2 feet in diameter, set off by the large, bright, red-brown spines. Leaves 8–10 inches long, 3½–4½ wide, with a distinct brown horny margin, which bears the unusually large, very close-set, flat spiny teeth, straight, or mostly curved up or rarely downwards,or flexuous, the largest (near the middle) 6 lines long and half as broad; in old leaves the margin with a few of the spines adhering, is often partially detached, but not as regularly as e.g. in *A. heteracantha.* The stalk, 2–2½ inches thick, 8–12 feet high, is almost entirely covered with large (4–5 inches long by 2 wide) triangular bracts, foliaceous with brown scarious margins and tipped with a spine. The branches of the broad oval panicle are very stout (4–8 or 9 inches long, 1–1¼ thick) flattened above, and bear at the end a most compact cluster of 30–50 flowers surrounded by large foliaceous fleshy bracts, 1–2 inches wide, 2–3 long, which form a sort of involucre; the whole, after the flowers have fallen and only the short truncate closely-packed pedicels are seen, interspersed with subulate bracts, 1–2 inches in length, simulates the receptacle of some large Composita, 2–3 inches in diameter.

Flowers 3–3½ inches long, greenish-yellow; prismatic ovary 1¼–1½, perigon 1⅞–2 inches long, tube outside 8–9, inside 6–7 lines long, lobes 12–14 lines long, outer a little longer and 3½, inner shorter, 4 lines wide. Stamens, inserted in the middle of the tube, only about ½ inch longer than perigon; anthers 14 lines long; pollen grains oval, 0.09–0.12 mm. in longest diameter, beautifully marked. Style,* in the numerous specimens before me, curved

* A triangular channel penetrates the style to near its base, where, by salient angles meeting in the centre, the cavity is divided into three tubes, which lead to the ovarian cells, somewhat obstructed, however, about the neck of the ovary by loose cellular tissue.

and ½–¾ inch longer than the filaments, apparently already considerably lengthened when the stamens begin to unfold. Capsules cuspidate but not stipitate, 2½–2¾ inches long, not quite 1 inch in diameter, forming a densely packed radiating cluster, 6 inches in diameter; seeds 4 lines wide.

†† *Tubus lobis vix brevior vel æqualis.*

14. AGAVE RIGIDA, *Mill. Dict. ed.* 8, 1768: caulescens; foliis lanceolato-linearibus glaucescentibus, margine aculeis distantibus rectis parvis fuscis dentato, spina terminali valida terete sæpe torta basi ipsa solum paulo excavata in marginem corneum decurrente; scapo elato foliaceo-bracteato, paniculæ ovatæ capsuligeræ viviparæque ramis horizontalibus ramulosis fasciculos florum laxiores bracteis triangularibus brevibus stipatos gerentibus; ovario perigonio paulo breviore, staminibus medio tubo infundibuliformi lobis paulo breviori vel supra medium insertis longe exsertis stylo demum æquilongis.—*Fourcroya rigida*, Haw. Syn. 74, Kunth en. 5, 843; *A. angustifolia*, Haw. Saxif. 35; *A. Ixtli*, Karw. ap. Salm, Hort. Dyck. 304; Jacobi Ag. 95.

Var. LONGIFOLIA: foliis multo longioribus glaucis, aculeato-dentatis, spina terminali non decurrente.

Var.? SISALANA: foliis multo longioribus viridioribus margine integris seu pauci-dentatis, spina terminali non decurrente.—*Agave Sisalana*, Perrine, vide infra.

The original plant was, according to Miller, brought from Vera Cruz; my specimens, on which the above diagnosis is based, were collected in Yucatan by Dr. Schott. Dr. Perrine forty, and Dr. Schott ten years ago, studied in Yucatan this interesting plant, its different forms and economical uses, and left us accounts of it, the former in Senate Doc. 300, Washington, Mar. 12, 1838; the latter in the Report of the Agricultural Department at Washington for 1869. Both agree that there is a common native species in Yucatan, called *Chelem* by the aboriginal inhabitants; but from time immemorial a number of varieties, all characterized by much longer leaves, and one also by the absence of marginal spines, and differing among themselves in the quantity and quality of their fibre, have been cultivated by the natives of Yucatan, and are a staple product of that country to this day, furnishing the well-known Sisal hemp. The people know them as *Jene-*

quen (Schott) or *Henequen* (Perrine), and distinguish, as Dr. Schott reports, the *Yaxci* (Yashki) as furnishing the best quality and the *Sacci* (Sacqui) with the largest quantity of fibre; *Chucumci*, larger than the last, produces coarser fibre; *Babci* has fine fibre but in smaller quantity; *Citamci*, with small narrow leaves and poor fibre, stands probably nearest to the wild plant. Dr. Perrine mentions another variety, *Istle*, evidently the *Ixtli* of Karwinski, as furnishing a fine fibre called *Pita*. These plants yield a return of leaves when four or five years old, and may last 50 or 60 years under proper management; the flowering scape is cut off as soon as 4 feet high, when, evidently, axillary branches continue the growth of the plant, which is thus kept so long alive by being prevented from flowering.

The trunk of the wild plant of Yucatan — which I refer with little doubt to Miller's old *A. rigida* — is 1-2 feet high, leaves 1½–2 feet long and as many inches wide, contracted above the broader base and widest about the middle; lateral teeth ¾ or even 1 inch apart, mostly straight, from a broad base 1–2 lines long, rather unequal, with smaller ones interspersed, dark brown; terminal spine 1 inch long, 1¾ lines in diameter, straight, or often somewhat twisted, terete, scooped out at base but not channelled, dark red-brown, a dark corneous margin extending down the leaf-edge for several inches and bearing the uppermost teeth. Scape 12–15 feet high; flowers pale yellowish-green, 2¼–2½ inches long, perigon 16, tube 6–7, lobes 9–10 lines long; stamens inserted about the middle of the tube, "blood-red upwards," 1 inch longer than the perigon; anthers 10–10½ lines long; styles at last as long as stamens.

A. Ixtli, which in 1872 flowered in the gardens of the late Mr. Thuret at Antibes, is entirely similar, flowers of the same dimensions, anthers a little larger (11½ lines long); capsules, which grow with the bulbs on the same panicle, oval, over 2 inches long, 1¼ wide, very short stipitate; seeds uncommonly large, 4½ lines high, with a ventral hilum (in many other Agaves I find the hilum more basal, a character which may be of some value). I believe this is the first time that the flowers of the Ixtli have been described; they identify the plant with the old *A. rigida*, or at least the above-described Chelem. *A. Karwinskii*, Zucc. is probably the same thing.

With the name of *longifolia* I designate the variety known as *Sacci* and extensively cultivated in Yucatan; it is principally distinguished by its much longer spiny leaves, 4–5½ feet long, 3–4½ inches wide; flowers very similar to those of the wild plant, but filaments greenish. *A. fourcroides*, Jacobi, Ag. 107, probably belongs here, and *A. elongata*, Jacobi, 108, I would also refer to this form if the description did not expressly mention a channelled terminal spine.

Agave Sisalana is the name that Dr. Perrine gave to the plant known to the natives of Yucatan as *Yaxci*, the most valuable of the fibre-producing Agaves, and which was introduced by him into South Florida some thirty-five or forty years ago, during his efforts to acclimatize commercially valuable tropical plants in that almost tropical portion of our territory, efforts which were aided by Congress by a large grant of land, but which were destroyed, together with his own life, during the subsequent Indian wars. With this Agave, however, he has been successful, as it is now fully naturalized, and is quite abundant at Key West and the adjacent coast. Dr. Parry found it there in full bloom in February, 1871, and gives the following description of it: trunk short, leaves pale green but not glaucous. 4–6 feet long and 4–6 inches wide, generally smooth-edged, but here and there bearing a few unequal, sometimes very stout and sharp teeth; terminal spine stout, often twisted, purplish-black; scape 20 or 25 feet high, panicle 8 feet long and half as wide; one of the largest plants examined had 35 branches in the panicle, the largest (near the middle) 2 feet long, upper and lower ones shorter. The flowers are slightly larger than those described, with a shorter, thicker ovary, stamens inserted a little higher up in the tube. The plants bore no fruit, but produced an abundance of buds, by which they propagate themselves and from which this interesting form has been multiplied in this country and in Europe.

If this plant is, as is most probable, only a cultivated variety of *A. rigida*, it is of the greatest importance for the study and the understanding of the Agaves, indicating, as it does, the extent of variation which they may undergo. It shows that the size of leaf and scape, or color of leaf, are of no great specific value, and also that the presence or absence of spiny teeth on the margin is not an unalterable character, not any more than the

cartilaginous margin decurrent from the terminal spine. The presence of a trunk, the proportions of the leaf (in *A. rigida* and all its varieties the length equals 12–14 times the width), probably the form of the terminal spine, the character of the inflorescence, and, above all, the form and proportions of the flower and its parts, remain constant, and perhaps also the proliferous character of the inflorescence of some species.

15. AGAVE PALMERI, *n. sp.*: acaulis; foliis lanceolatis sursum attenuatis in spinam gracilem teretem ultra medium canaliculatam excurrentibus, margine aculeis inæqualibus sæpius recurvis flexuosisve atro fuscis dentato; florum albidorum pedicellis bracteis abbreviatis carnosis fultis; ovario perigonio æquali seu paulo longiore, tubo lobis vix longiore stamina longe-exserta medio vel paulo supra gerente; capsula gracili prismatica brevi-cuspidata in stipitem contracta, seminibus minoribus minute verruculosis.

In the mountains of Southern Arizona Dr. Schott collected the flowers in 1855: in 1869, Dr. E. Palmer, who during ten years has made Arizona and the adjacent regions the field of his explorations, and for whose services to botany in that district this species is named, gathered more complete specimens and seeds; and last year, 1874, Dr. Rothrock, of Lieut. Wheeler's expedition, brought very fine specimens found there at an altitude of 6,300 feet.—Fl. July and August.

This species seems to take in the southern part of Arizona the place of *A. Parryi* of the northern part of that territory, and is used there for the same purpose; it is easily distinguished from it by its longer and narrower leaves, the much less deeply divided perigon, and the slender capsule and small seeds.—Leaves 10–20 inches long, 2–2½ wide, slightly contracted above the base, long pointed; terminal spine 8–14 lines long, deeply channelled to above the middle, decurrent with brown, horny margins about 2 inches; lateral teeth ½–¾ inch apart, 1½–2 lines long, often interspersed with smaller ones, straight, or usually hooked, or often, especially the lower ones, flexuous. Scape 8–12 feet high (bracts not noticed by the collectors); branches of the panicle repeatedly and loosely ramified, ultimate pedicels crowded, about 1 line long. Flowers 1¾–2 inches long; perigon 10–12 lines long, whitish; filaments, anthers, and style, purple; lobes usually a little shorter than the tube, exterior ones strongly cucullate and much thick-

ened at the apex, interior shorter, broader and thinner; nectariferous part of tube, below the insertion of the stamens 2½–3 lines long, a little longer than upper part of tube; exsert part of filaments about the length of perigon, anthers 8 lines long; capsules slender, 18–24 lines long, 7–8 wide; seeds among the smallest of this section 2½ lines in the longest diameter, easily distinguished by the minute tubercles, 0.01 line wide, which, different from other Agave seeds, cover the surface.

16. AGAVE WISLIZENI: acaulis; foliis ovatis supra basin paulo angustatis medio latissimis acutis, spinæ subflexuosæ supra late exaratæ margine acutiusculo decurrente, dentibus rigidis atrofuscis superioribus majoribus distantibus rectis, inferioribus parvis confertis subdeflexis; panicula laxiflora; ovario perigonium et tubo lobos fere æquante, staminibus ultra medium tubo adnatis longe exsertis; capsula gracili prismatica utrumque acuta nec stipitata, areolis seminum planis punctulatis.—*A. scabra*, Salm, Bonpl. 7, 89; Jacobi, Ag. 88.

This interesting species was discovered by Dr. A. Wislizenus on the celebrated march of Doniphan's corps through Northern Mexico, on the Nazas River near San Sebastiano, in the southeast corner of the State of Chihuahua, not far east of Parras, May 10, 1847, in fl. and fr. Living shoots were sent by me to Prince Salm and seeds to different European correspondents, among others to Prof. A. Braun of Freiburg. Two years later Gen. v. Jacobi obtained some of the young plants raised from these seeds in the botanic garden of that university and afterwards communicated them to Prince Salm, who described them (1858) under the inappropriate name *A. scabra*, though, as the General expressly states, they are perfectly smooth on both sides.* As thus the published name is inadmissible, I deem it proper to substitute for it that of the discoverer of this and so many other interesting plants of Northern Mexico.

Jacobi describes his specimens (then 16 years old, and, as he thinks, full grown) as 8 inches high and 15 in diameter, rosulate and somewhat squarrose, with broad, nearly rhombic and almost flat leaves, 5 inches long, 3½ wide, pale grayish-green, teeth distant

* *Agave asperrima*, Jacobi, is one of the few rough ones, and the only hairy one known, I believe, is *A. pubescens*, lately described by Regel. This species, obtained from Mexico and flowered at St. Petersburg, is one of the smaller ones and seems to belong to the first section.

and curved downwards. The leaf of the wild plant, now before me, is 8 inches long and 4 wide, terminal spine very stout, 10–11 lines long, decurrent about the same distance; arrangement of marginal teeth quite peculiar, the uppermost ones the largest, 1½–2½ lines long from a broader base, straight, almost black and very rigid, 6–8 lines apart; teeth below the upper third smaller and closer set, and below the middle only 2–3 lines apart, less than 1 or only ½ line long and strongly curved downwards. Scape 12 feet high, branches of the panicle loosely ramified, branchlets 3–6 inches long, pedicels 1–2 lines long; flowers in small clusters, 3–6 or 8 together, 2½ inches long, perigon half as long, divided to the middle; stamens inserted about ⅔ from the base of tube, exsert about ¾ inch above lobes; anthers 10–10½ lines long. Capsule 18–22 lines long, 7–8 wide, similar to that of last species but not stipitate; seeds 2¾ lines in diameter, cells of the surface, under the microscope, flat, punctulate.

I have a flower and a capsule of Agaves differing from any above described, and thus perhaps indicating two other species; but as the material is too incomplete to characterize them, I only indicate them here for further investigation.

AGAVE SP. "Common on mountain-sides in the Wild Rose Pass on the Limpio," West Texas, Chas. Wright, No. 1906; flowers only, collected June 11, 1851, referred by Torrey in Bot. Bound. 213 to *A. Americana*. Flower not quite 3 inches long, perigon equal to ovary, divided to the middle; stamens inserted about ⅔ up the funnel-shaped tube, reaching 14 lines above the lobes; anthers 10 lines long.—Could it belong to the last described species, which was found 300 miles further south?

AGAVE SP. Dragoon Mountains, Southeastern Arizona, Capt. Chas. Bendire, U. S. A. A capsule and seeds only, with the verbal information that the leaves are about 3 feet long and 4 inches wide, and the scape nearly 20 feet high. The capsule is ovate-prismatic, 2 inches long, 10 lines wide, strongly cuspidate, at base obtuse; seeds 3½ lines in longest diameter, apparently minutely pitted.—It is not probable that this could be a form of *A. Americana*, as that species has, I believe, always a stipitate capsule and larger seeds with flat, punctulate areæ.

ADDITIONAL REMARKS.

The highest trunks of cultivated Agaves which I find noticed are 3–4 feet high and 3–4 inches in diameter; the thickest one was 14 inches through, but less high. I have met with no account of the size they may attain in their native country.

The scape of *A. Americana* is said to measure sometimes 36 feet in height.

The flowers of Agave are always more or less erect and of a coarser, calycine texture, while those of Yucca are pendulous and corolline.

NOTICE TO BOTANISTS.

I wish to direct the attention of botanists, who have the opportunity to observe the development of these plants, to the following questions:

At what hour of the day do the anthers of the different species burst and begin to shed their pollen, when do they become entirely effete, and in what state is then the style? How long afterwards and when does the style of the same flower attain its full development, and when and how much do the stigmatic lobes open or spread, and when does the stigmatic liquid fill the cavity of the style and cover the inside of the lobes?—I have above given an account of these physiological processes in *A. Virginica;* the only reference to them in literature which I can find is made by Jacobi, Ag. 310, where he says of an Agave of the second section, that the full development of the style and the separation and partial spreading of its lobes takes place only after the stamens have faded, which, as far as it goes, fully coincides with my observations. His further remark, that the stamens are not inflexed in the buds of that species (*A. Goeppertiana*), is unquestionably erroneous. Of the floral development of the Agaves of the third section nothing at all seems to be known.

I wish also to direct the attention of observers to the time and nature of the secretion of honey in the lower part of the flower-tube.

The inflorescence of those Agaves of the second section which are said to bear 1 or 3 or 6–8 flowers in a fascicle requires further investigation.—A careful examination of the young (forming) inflorescences of the third section will disclose the true nature of their arrangement.

Another point which claims the attention of observers, is the place and time of the formation of bulblets in the proliferous Agaves.

ERRATA.—P. 293, note, l. 3 from "while" to end of paragraph should be carried and added to the paragraph ending in "stigmas" at l. 8, top of page.

P. 304, l. 4 from bottom, strike out "to."

P. 314, l. 21, for "flexi sornato," read "flexis ornato."

beds of sandstone. I have also observed the sandstone resting on porphyry, and have also seen beds of sandstone, or conglomerate, resting on porphyry, or on granite.

We feel ourselves inclined to regard the granite as the older, the porphyries as of more recent formation.

Pleasant Hill, Mo., March, 1876.

Addition to Dr. Engelmann's Article on AGAVE, p. 291–322.

Additions and corrections have accumulated in the interval between printing and publication.

Page 293. The words of the first note, line 3, "while" to the end of the sentence "liliaceæ" should be carried up into the text and added to the first paragraph, line 8, ending with the word "stigmas."

Page 294. It requires further and extensive observations in the field and in the garden to ascertain the limits of variability of the edges of the leaf and its aculeate-toothed margins. Cultivators have already discovered considerable latitude in this respect in plants raised from seeds from the same parent.

Page 302. Var. *tigrina* does not grow *in* salt-marshes, but was found by Dr. Mellichamp, "in one spot only, on a tongue of partly brackish land, extending out into the salt-mud and marsh, under dwarfed live-oaks, Cassine, and saw-palmetto, on the decayed shells, mixed with sand and earth, of what seems to be an old Indian oyster-heap"!

Page 304. *A. falcata.* The lately introduced *A. Hystrix* of the Belgian nurseries may have to be referred to this species; native country and flowers, as usual, unknown.

Page 305. *A. Schottii* (better than *Schotti*, as printed). It is proper to add that *A. geminiflora*, Gawl., the *Bonapartea juncea* of the gardens, is a very different plant, and has nothing to do with *Schottii*, except that both belong to the same section of the genus.

Page 310. *A. deserti.* In characterizing the foliage, I was led into the too common mistake of adopting the individual charac-

ters of a single individual as those of the species. Full grown leaves are at least 15–20 inches long, and 2–3 inches wide above the base. The terminal spine is compressed and narrow-grooved only in the young, not fully developed leaf; in the adult it is terete-triangular with a wide and shallow excavation above.—The locality is Vallecito, not "Valcitron."

Page 314. *A. Shawii.* To the liberality of Mr. Henry Shaw we are indebted for the fine photographs of this species which grace this number of our Transactions. They were taken by Mr. J. C. Parker of San Diego, last January. Plate 2 represents a group of these plants on the *mesa* near the coast of the Pacific, which is seen in the distance; one specimen is in full bloom, others flowered in November and are now bearing fruit sparingly. Decaying old plants are seen around, and young ones sprouting. The phyllotactic arrangement of the short broad leaves is beautifully displayed; the bright spiny teeth appear almost white from the effect of reflected light. The scape is conspicuously covered by the broad, triangular, imbricated bracts. The figures are about one-twenty-fourth of the natural size, or half an inch to the foot.

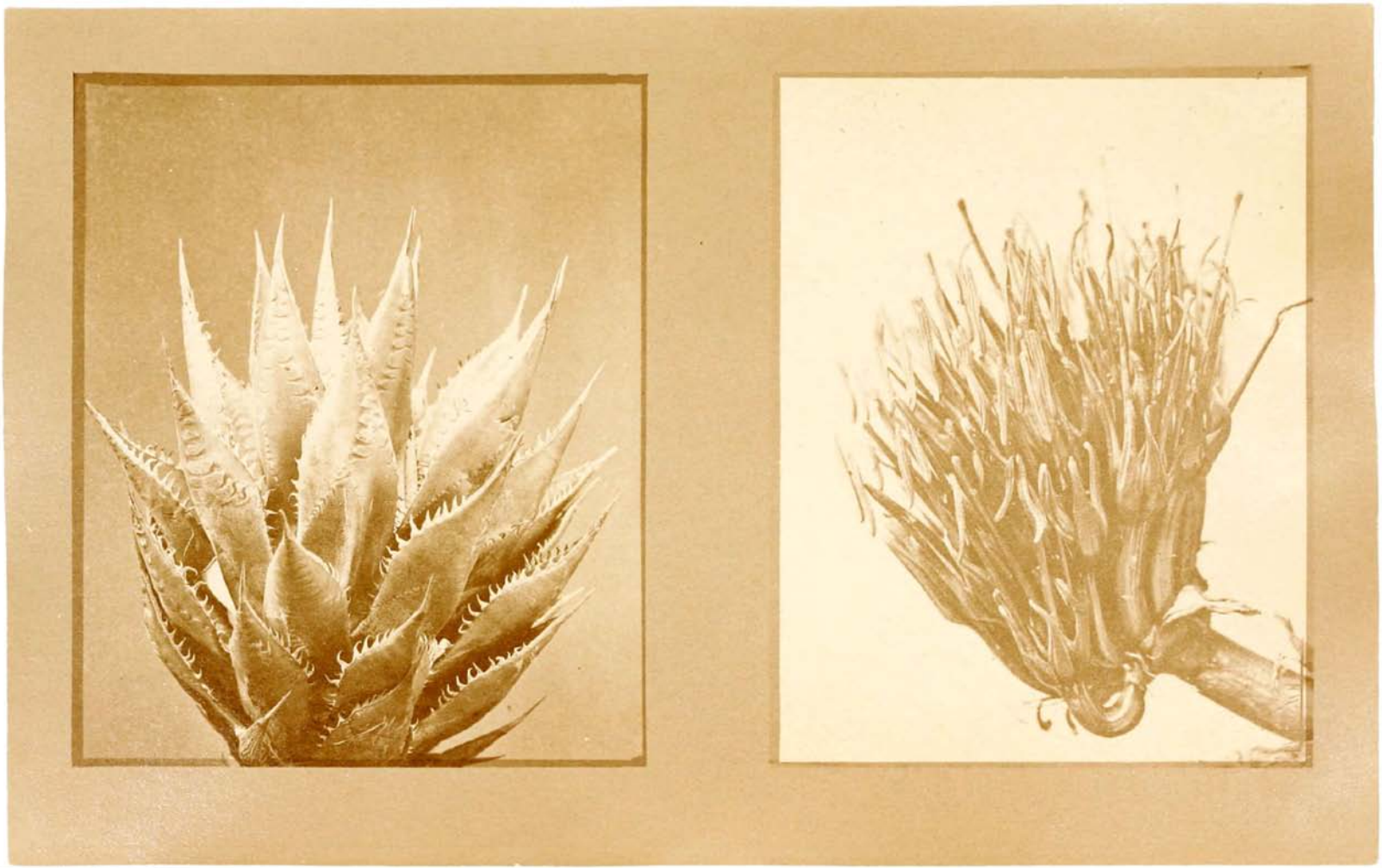
Plate 3 shows, in Fig. 1, a young plant; its leaves are more deeply concave than they are later, and therefore seem to be narrower; the teeth and their impressions on the adjoining leaves are remarkably well developed. One-fourth of natural size.—Fig. 2 is a cluster of flowers, exhibiting a densely compacted mass, unfortunately not distinct enough in its details; but the outlines of the cluster, the enveloping bracts, the very long, mostly vertical, anthers, and the exserted styles, are well rendered. It is two and a half times less than the natural size.

Page 322, line 1. In the Berlin botanic garden an *Agave attenuata* is cultivated which has a trunk 6 feet high; it is said to have grown 4 feet within the last 18 years.

Addition to the Article on YUCCA, p. 17 *of this Vol.*

Page 47. *Y. brevifolia* has sessile, densely-flowered panicles; flowers greenish-white, inconspicuous, and fetid. Fl. in April and May.—It is remarkable that at least in Southeastern Nevada,

Parker, Photographer, AGAVE SHAWII, Engelm. *San Diego, Cal.*



Parker, Photographer, *San Diego.*

AGAVE SHAWII. Engelm.

north of the great bend of the Colorado River, where Messrs. Johnson and Parry have repeatedly examined numerous plants, no fruit has ever been found.

Page 54. *Y. Whipplei* has now become quite familiar through living specimens and beautiful photographs. From the latter we learn that the scape is imbricately covered with conspicuous, broad, at last patulous or drooping bracts, and that the panicle is densely flowered, narrow, spike-like, almost lanceolate.

About the Oaks *of the United States.*

By Dr. George Engelmann.

We have quite a large number of oaks in the United States, which for more than a hundred years have attracted the attention of botanists, and we thought we knew them pretty well, i.e. we thought we could distinguish, limit, and group the species. That may have been so, to a great extent, in the old States; but when the Rocky Mountains came to be explored, and the regions west of them, new forms were discovered, and often on single specimens, and not rarely on imperfect ones, species were founded and incompletely described, so that now a straight, clear path through such intricacies is difficult to find.

A striking example of the deceptive polymorphism of these western oaks is furnished by the common Rocky Mountain scrub-oak. This interesting species grows on the foot-hills of the eastern slope of the mountains of Colorado, sparingly near Denver, scarcely north of that city, but abundantly southward, about the Pike's Peak region, and thence extends through New Mexico eastward into Texas and westward through Utah and Arizona into Southern California. The centre of distribution perhaps, at all events the classical locality of this species, are the mountains above Cañon City in Southern Colorado.

In the valley and on the mountain slopes about this place the oak thickets abound, 6–8 ft. high, single trees occasionally 4 or 6 inches thick and rising up to 12 or 15 feet, rarely higher. The leaves are 3–4 inches long, broadly obovate, deeply lobed, sometimes pinnatifid, underneath stellate-pubescent; the broad lobes obtuse

The Flowering of Agave Shawii.

By Dr. GEORGE ENGELMANN.

In May, 1876, Mr. Shaw received from San Diego, Cal., through the kind offices of Messrs. Hitchcock and Parker, a full-grown specimen of the fine species named for him. In June the new, innermost, leaves became more slender and their marginal teeth smaller. Early in July the flowering stalk began to rise. Regular measurements of its growth were made by Mr. Gurney, the superintending gardener, at 7 o'clock A.M. and at 7 P.M., from July 8th to September 5th. I have divided this period of 60 days into 6 decades, and have added the mean temperature and the fall of rain (at my station, 3 miles northeast of the garden) of each decade. The ollowing table exhibits these data:

	AMOUNT OF GROWTH IN TEN DAYS.				
1876.	7 P.M.–7 A.M.	7 A.M.–7 P.M.	Total.	Mean Temp.	Rainfall.
July 8–17	2¾ in.	2 in.	4¾ in.	82°.8	1.26 in.
" 18–27	3 "	2¼ "	5¼ "	77°.4	1.03 "
" 28–Aug. 6	4¾ "	3¾ "	8½ "	69°.1	0.72 "
Aug. 7–16	7 "	4½ "	11 "	78°.3	1.51 "
" 17–26	5 "	4 "	"	79°.1	2.21 "
" 27–Sept. 5	4¾ "	3 "	7¾ "	72°.6	1.71 "
July 8–Sept. 5	27¼ in.	19½ in.	46¾ in.		

The table shows that the night-growth (including the morning hours) was in every decade larger than the day-growth, and in the whole period surpassed it by 16 p. ct., the former amounting to 58, the latter to 42 p. ct.

It is further seen that the largest advance was made about the middle period, or from the 3rd o the 5th, and mostly in the 4th decade. After Sept. 5th the growth diminished rapidly, about the end of the month the head began to swell, and 3 months later the first blossoms opened.

The table also proves that the temperature of each decade did not have any material effect on the growth of the stalk; in the warm weather of the first two decades it grew much less than in the cooler 3rd period.

The largest growth in 24 hours, 1½ inches, took place in the 4th decade, Aug. 10th–11th, mean temp. 78°; while on Aug. 18th, with mean temp. 84°, the growth is marked only ½ inch, and Aug. 23rd and 25th, mean temp. 85°. it amounted to 1 inch and ¾ inch respectively.

The quantity of rain had apparently little or no immediate effect, as it was pretty evenly distributed through the whole period.

The full-grown scape measured 54 inches to the base of the panicle, which, when fully developed, was itself 21 inches long and a little wider, and consisted of 19 branches, the lowest ones the longest, somewhat S-shaped, and horizontal, with the end turned up.

About newyears the lower branches of the panicle, which thus far had formed a pointed club covered by the large bracts, began to straighten out, while the upper ones with their bracts yet formed a large cone. The first flowers opened on the lowest branch on Feb. 5th; the innermost ones of each cluster developed first, the others flowering in quick succession, so that all the flowers of a bunch were in bloom within about three days. Two or three weeks later the plant may be said to have been in fullest bloom, though the lower clusters were passed and the uppermost not yet open. These last flowered about March 18–20th, so that the flowering period (at this season and in a greenhouse) occupied from six to seven weeks.

Abundant opportunity was afforded to study the gradual development of the flowers (see also p. 298). I have, on Plate IV., represented these various phases by a series of figures carefully drawn from nature.

The bud bursts in the morning or in the middle of the day (Fig. 4); the bent filaments begin to straighten out, the still closed anthers commence to protrude, the top of the style has not yet reached the tip of the perigonial lobes. Only thus far the perigon and its lobes are fresh, exhibiting their fullest development.

In the evening of the same day the filaments are straightened out above the perigon, the anthers begin to open at the upper and lower ends, as Fig. 6 shows, and then all along their commissures; the style has not yet reached the length of the filaments, but the perigonial lobe are already withering at tip.

On the 2nd day the anthers are shrivelled, though quantities of pollen remain adhering to them; the perigon withers more; the style in the morning is still shorter than the filaments, but in the evening has exceeded their length somewhat; the stigmatic lobes remain entirely closed.

On the 3rd day these changes go on gradually and slowly. (Fig. 7.)

On the 4th the style is 2 inches onger than the perigon, the lobes of which are wilted and twisted, while the filaments also wither; in the evening the stigmatic lobes begin to separate and exude some moisture. The color of the flower, which at first was greenish and sulphur-yellow, now is of a deeper dirty yellow.

On the 5th day the style has reached its full development, 2¼–2¾ inches longer than the wilted perigon; the filaments are drooping, the anthers shrivelled, much pollen yet adhering to them; the stigmatic lobes have separated and are covered with a large drop of sweet, glutinous stigmatic liquid, which causes the pollen grains that drop into it to develope their long tubes (Fig. 8).

The drop of stigmatic fluid remains fresh and full for another and often even a third day, and then gradually dries up; the functions of the flower are ended wi h the fertilization of the ovules.*

I have not yet made mention of the abundant secretion from the nectariferous lower part (all the part below the insertion of the stamens) of the perigonial tube. During the several days in which the flowers were open the whole tube was filled to the brim with a sweetish watery liquid, of a slightly nauseous odor. I am not aware that such a secretion has before been observed in Agave flowers, and would now consider it as an abnormal phenomenon, originating under artificial circumstances, had not others, whose attention I had directed to such secretion, noticed the same in other species. Prof. C. S. Sargent, of Cambridge, Mass., saw it in an *A. yuccæfolia* which bloomed there last winter under glass, but could not find it in two specimens of the same species which in September flowered in the open air. Of greater importance, because made on a wild plant on its native mountains, is the observation of the Rev. E. L. Greene, who found last summer in

* Buds or flowers that are kept for a while separated from the plant such e.g. as are sent fresh by mail, become distorted, the ovary swells, the style lengthens, but the perigon and stamens wither even if not yet fully developed.

Southwestern New Mexico the large paniculate *Agave Parryi* so loaded with this liquid that it actually rained on him when he knocked on the stalk, or when the wind shook the panicle. South European botanists, who have numerous cultivated species and especially the naturalized *A. Americana* at their disposal, are in a position to investigate and experiment upon this curious physiological fact. Our *A. Virginica* exudes only a small quantity o honey in the base of the tube, but nothing like such a watery abundance.

EXPLANATION OF PLATE IV.

Fig. 1. Diagram of the flower. Three exterior lobes of the perigon cover the thin margins of the 3 interior ones; 6 stamens opposed to the lobes; 3 carpels opposed to the 3 exterior lobes, each with two series of ovules; in the centre the stigma, its 3 lobes alternating with the carpels.

Fig. 2. Top of the flower-bud, showing one interior between two exterior lobes.

Fig. 3. The same, inside, exhibiting the broader hood of the inner lobe between the longer and narrower outer ones, all of them downy below the tip.

Fig. 4. An opening bud in the forenoon of the first day; the filaments begin to straighten, raising the anthers, appa rently in irregular order, above the perigon; style quite short.

Fig. 5. Section of the same, with style and filaments cut off; the perigon is seen in full development before it begins to wither; insertion of the filaments in the middle of the tube, the inner one slightly lower than the outer ones.

Fig. 6. Flower fully open on the first evening: filaments straight; anthers opening at the upper and lower end; style not yet of the length of the filaments.

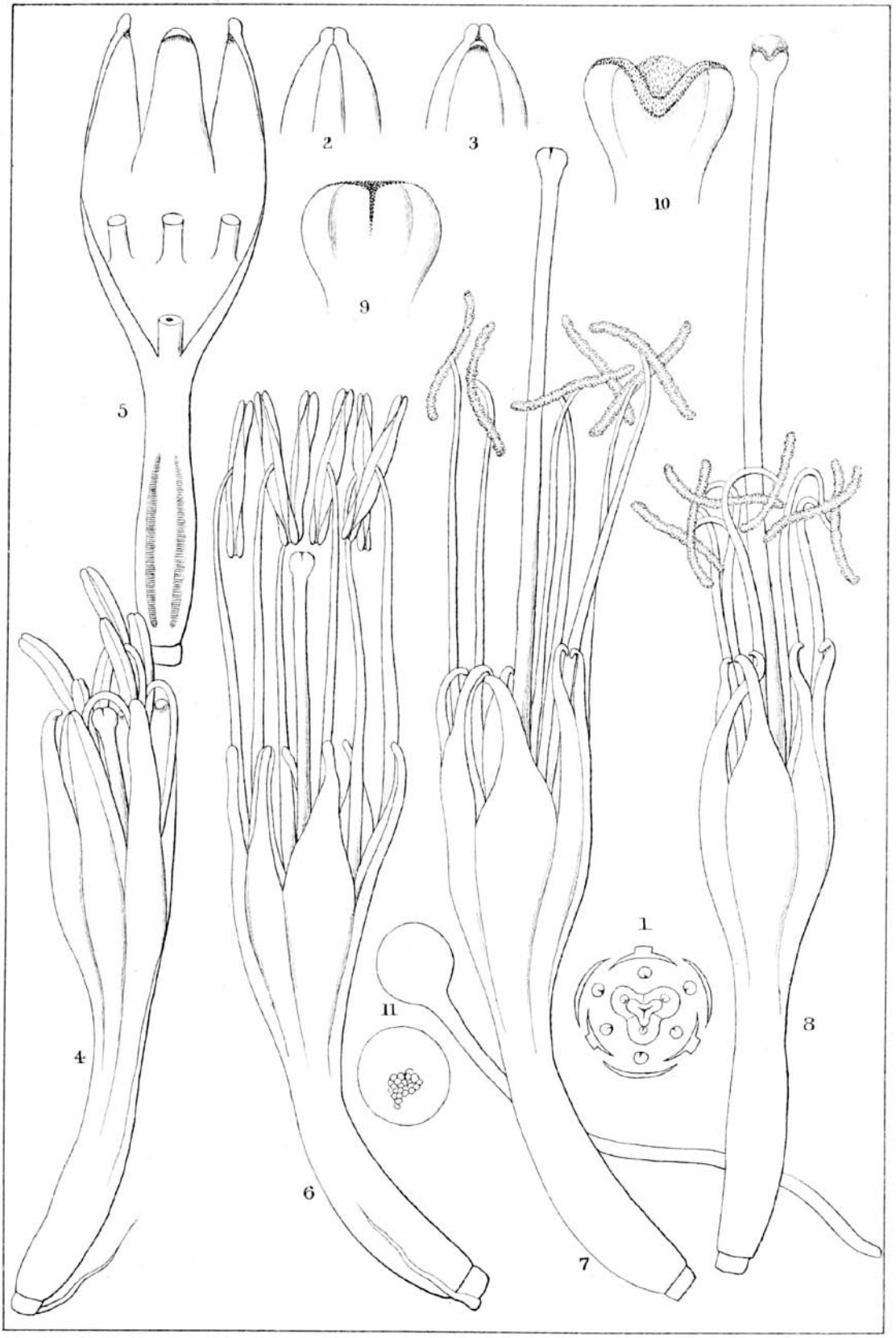
Fig. 7. Flower on the third day: anthers and perigon shrivelling, filaments yet erect; style of nearly full length; stigma yet closed.

Fig. 8. Flower on the fifth day: perigon and filaments wilted; style fully developed, stigmatic lobes separated and bearing a large drop of glutinous liquor.—All these figures in natural size.

Fig. 9. Stigma closed.

Fig. 10. Same with expanded lobes, both magnified 4 times.

Fig. 11. Pollen grains magnified 100 times: one intact, slightly elliptic; the other, developing its tube and somewhat contracted.



A. Gast & Co. lith.

Agave Shawii.

ERRATA.

CORRECTIONS AND ADDITIONS.

Page 24, line 33. Mr. Baker gives 150–180 as the number of leaves of *Y. recurvifolia.*

" 26, " 5. They are *always* thus tipped, much more sparingly in some species than in others; hair usually 1-celled, sometimes articulated.

" 27, " 20. The ovules of *Y. Treculiana* are among the thickest of any.

" 28, " 11. Read "does" for "seems to."

" 29, " 8. Dr. Engelmann found the pods of *Y. aloifolia*, *Treculiana*, *baccata*, and *brevifolia*, perforated and the seeds eaten by the larvæ.

" 32, " 17. Read "2.0" for "2.5."

" 33, " 23. They reach nearly to the same northern latitude.

" 34, " 27. Add to "floribus," "pendulis."

" 42, " 22. Leaves of young plants nearly flat, whence discrepancies in descriptions.

" 46, " 2. Dr. Wislizenus ascribes to them the same height.

" 26. They rather belong to or near *Y. angustifolia;* only the fruit will decide.

" 48, " 33. Read "subnudis" for "nudis."

Yucca spinosa, HBK. n. gen. i. 289, is made up of the flower of a Yucca and the leaves of *Dasylirion acrotriche*. (See p. 24, note.)

Yucca acaulis, HBK. ib., is a *Fourcroya*.

Yucca? parviflora, Torr. Bot. Mex. Bound. 221, constitutes the genus *Hesperaloë*, Engelm. King Bot., 40th par. 497.

" 81, " 14. Strike out the "a."

" 121, " 3d from bottom, for "ɯ" read "ʇ."

" 349, " 12, for "*scoparius*" read "*furcat.*"

" 351, ¶ 3, line 1, after "*Globe-Democrat*" add "correspondent from St. Joseph."

" 382, line 3d from below, read "Wheeler's" for "Whipple's"; other errata in this article are corrected on p. 387 and farther on.

" 390, " 11th " " " "Pluk." for "Pluck."

" 428, " 15, read 22h. instead of 22d.

" 430, " 2, " 24^5 " 24.

" 432, " 3, " $+412$ " -412.

" 433, " 2, " $+692$ " -692.

" 434, " 2, " $+715$ " -715.

" 435, " 5, " $+6+8+759$ " -6.

" 436, " 3, " $+38+40+791$ " -38.

" 448, " 4 from below, read "were" instead of "was."

" 450, " 13, read "—43" instead of "—41."

THE

BOTANICAL GAZETTE;

A PAPER

OF

BOTANICAL NOTES.

EDITED BY
JOHN M. AND M. S. COULTER.

Volumes V and VI.

CRAWFORDSVILLE AND LOGANSPORT, INDIANA.

1880—1881.

Pinus laxa; he obtained it from both Carolinas; Prof. Gray himself had already collected it in 1842 on Bluff Mountain, N. C., in foliage only; and last year Mr. A. H. Curtiss again met with it "on Pinnacle Mountain, N. C., a long ridge commencing about 8 miles south of Hendersonville, probably 3–4000 feet high, where in groups of only few trees it occupies slopes near the summit, and even cliffs, while *T. Canadensis* abounds in the ravines of the same region; both species are cultivated side by side at the entrance of Mr. Middleton's place at Flat Rock, 3 miles from Hendersonville, where their branches interlock and their differences are strikingly exhibited." I have not seen any young shoots of this species and therefore can not say whether their leaves are spinulose-denticulate as they are in young plants of the two other North American species. These may be distinguished thus:

T. Canadensis: leaves of the mature tree smaller (4–7 lines long), obtuse with 5 or 6 series of stomata on each side of the keel below, destitute of any strengthening cells; scales of cone in 5/8 order, orbicular oblong with broad truncate bracts; wing very broad at base, tapering, scarcely longer than the seed which shows 2–3 large oil vesicles.

T. Mertensiana has larger leaves, with two bands each of 7–9 series of stomata; strengthening cells few on the edges and very sparse on upper and lower side of leaf; cones 6–12 lines long (not 1½ inches as sometimes stated), scales oblong, mostly a little narrowed in the middle, bracts slightly cuspidate; seeds smaller, with few oil vesicles, wings twice as long as the body of the seed.

YUCCA MACROCARPA, n. sp. Trunk several (1–4) feet high; leaves spreading, sharp pointed, concave, with entire margins; panicle subsessile with lanceolate. white, fleshy bracts; flowers not seen; fruits cylindrical not marked by any ridges, obtuse, pale yellowish, pulpy (4–6 inches long, 6–7 in circumference); seeds thick and large (5–6 lines wide, 1–1¼ lines thick), rugose-runcinated.

In ravines of the Santa Rita Mountains south of Tucson, Arizona. — Evidently closely allied to *Y. baccata*, Torr., which is found from Southern Colorado all along through Arizona to Southern California; distinguished from it by the the absence of fibres on the leaf-edges (I have rarely seen on one or the other this fibre detached from the edge, just as we find it sometimes in *Yucca gloriosa*, and *Y. canaliculata*, which ordinarily have entire edges), by the smaller, narrow bracts, and the obtuse, not rostrate fruit. The fruit is of the color of a yellow apple, rather pulpy, of a pleasant sweetish acidulous taste.

JUNCUS RUGULOSUS, n. sp. Pale green, transversely rugose and rough, stems 2–4 feet high from a stout running rhizoma, very weak, leafy; leaves septate; panicle lax, decompound, 6–8 inches long and wide; heads with hyaline bracts, 3–5–8-flowered; sepals linear-lanceolate very acute, nearly equal, the outer carinate 1-nerved, the inner 3-nerved; stamens 6, much shorter than sepals, linear anthers shorter than filaments; capsule exceeding the calyx, lanceolate, acute, 3-angled, 1-celled; seeds acute at both ends but not caudate, reticulate.

THE

BOTANICAL GAZETTE.

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1882—1883.

the others converted into a mass of wood-mould held together only by the bark, that there one willingly avoids going forward on an unbroken path. If that must be done, the progress made is small, and there is constant danger of breaking one's bones in the labyrinth of stems. Nearly everywhere the fallen stems are covered, often concealed, by an exceedingly luxuriant bed of mosses, while on the other hand tree-lichens, probably in consequence of the dry inland climate of Siberia, occur sparingly. The pines, therefore, want the shaggy covering common in Sweden, and the bark of the birches which are seen here and there among the pines is distinguished by an uncommon blinding whiteness."—*Nature*.

Some Notes on Yucca.—YUCCA ELATA: Trunk 3 to 5 feet or more high, leaves linear rigid sharp pointed, filamentose on the white margins; with white oval acute or acuminate bracts as long as the pedicels; flowers white, segments ovate acute, ovary attenuated into a whitish style; capsule cylindrical-ovate obtuse short-cuspidate; seeds large, ½ inch wide narrowly wing-margined.—*Y. angustifolia*, var. *elata*. Engelm. Notes on Yucca p. 50. *Y. constricta*, Baker, Yuccoideæ p. 229; not Buckley.

Deserts of Arizona probably extending into southern New Mexico and Mexico. Altogether one of the most stately Yuccas, distinguished from the closely allied *Y. angustifolia*, with which I had formerly united it by its distinct trunk, which is usually 3 to 5 feet, but which I have seen even 10 or 11 feet high, and 3 to 7 inches thick, and especially by its long flowering scape, 3 to 7 feet, naked below, and bearing a much branched panicle often 5 feet long; flowers spreading, 3½ to 4 inches wide, while those of the allied species are more globose, mostly of greenish color, with broadly oval concave segments, with a green stigma; capsule similar to that of *angustifolia*, seeds of same size as in that species but with a narrower margin. Young specimens flower before they make a trunk and they look much like *Y. angustifolia* but can always be distinguished by the naked scape and by the characters of the flower.

Yucca constricta, Buckley, appears to be a form of *Y. angustifolia* with a short trunk; the constricted capsules ascribed to it are not normal but occasionally occur in all species of Yucca.

YUCCA MACROCARPA, Engelm. 6.224 of this journal, has now been found by C. G. Pringle in flower; the panicle is densely pubescent; flowers about 2½ to 3½ inches wide with broadly oval acutish segments. *Y. baccata* has a glabrous panicle and larger flowers with narrow tapering segments. *Y. Schottii*, Engelm., Yucc. 46, from Arizona, is known only from Schott's notes and very poor specimens and has never been identified since. Its panicle is likewise pubescent; its leaves short, narrow and very thick, with few thin fibres. It may possibly be a small-leaved form of *Y. macrocarpa*, which also shows a few thin fibres on the leaves. Both are recommended to the study of observers.—G. ENGELMANN.

ENGINEER DEPARTMENT, U. S. ARMY.

REPORT

UPON

UNITED STATES GEOGRAPHICAL SURVEYS

WEST OF THE ONE HUNDREDTH MERIDIAN,

IN CHARGE OF

FIRST LIEUT. GEO. M. WHEELER,
CORPS OF ENGINEERS, U. S. ARMY,

UNDER THE DIRECTION OF

BRIG. GEN. A. A. HUMPHREYS,
CHIEF OF ENGINEERS, U. S. ARMY.

PUBLISHED BY AUTHORITY OF THE HONORABLE THE SECRETARY OF WAR,

IN ACCORDANCE WITH ACTS OF CONGRESS OF JUNE 23, 1874, AND FEBRUARY 15, 1875.

IN SEVEN VOLUMES, ACCOMPANIED BY ONE TOPOGRAPHICAL AND ONE GEOLOGICAL ATLAS.

VOL. VI.—BOTANY.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1878.

ments, which are united about one-third their length; style cleft half-way down into linear divisions; seeds (*immature*) oval or nearly round, margined, on a funiculus longer than their diameter.—PLATE XXVI. Natural size. Fig. 1. Stamen, seen from outside. Fig. 2. The same, seen from inside the flower. Fig. 3. Style. Fig. 4. Flower, with perianth removed. Fig. 5. Mature capsule. All except the first enlarged about 5 diameters.

This handsome species (238) I discovered at Willow Spring, Arizona, at an altitude of 7,195 feet; grows in damp places. There are indications of its presence elsewhere in Arizona, and allied species are found in Mexico.

AMARYLLIDEÆ.

BY DR. GEORGE ENGELMANN.

AGAVE UTAHENSIS, Engelm., Bot. King's Report, 497; Engelm. Agav. in Trans. Acad. St. Louis, 3, 308.—Stemless; leaves suberect, or outer ones spreading, lanceolate, tapering from a broad base, concave, 6–12′ long, 1–2′ wide, not constricted above the base, very thick, hard, glaucous and rough, terminating in a long (1 inch) pale spine, with broad whitish teeth on the margin; flowering stalk 5–7° high, with a spike-like raceme of yellow flowers each 1′ long, in pairs, or often in clusters of 4, on distinct pedicels; lobes 3 times longer than the funnel-shaped tube, which bears the stamens in the middle; filaments and style not much longer than the perigon; capsule oval subcylindric, about 1′ long.

Northern Arizona, Bischoff, to Southern Utah.

AGAVE PARRYI, Engelm. Agave, *l. c.* 311. (*A. Americana*, var. *? latifolia*, Torr. Bot. Mex. Bound. 213.)—Stemless; numerous short and broad (9–12′ long and 3–3½′ wide) leaves crowded around the base of the stalk pale, glaucous, with small, almost black, spiny, straightish teeth, and with a dark, horny margin toward the cuspidate tip, which terminates in a robust, somewhat triangular, black spine 1′ in length; stout scape 8–12° high, bearing a large, branched panicle of cream-colored flowers over 2′ in length; perigon deeply 6-parted; lobes twice as long as tube, which bears the long-exsert stamens in its throat; capsule broadly oval, sessile; seeds larger than in either of the other species.

Western New Mexico and Northern Arizona; Rocky Cañon, Rothrock (274), in 1874. Parry, Bischoff, only fruit. Dr. Rothrock's observations and very complete specimens enabled me to give a connected account of this species, of which fragments only had been known for many years. Rev. Mr. Greene noticed the abundant secretion of a sweetish liquid filling the tube, which has also been observed in other species. The rootstock is used as a substitute for soap by the natives, under the name of Amole, much like that of Yucca, and, when roasted, is considered a great delicacy, named Mezcal.

AGAVE PALMERI, Engelm. Agave, *l. c.* 319.—Stemless; leaves lanceolate, 10–20′ long by 2–2½′ wide, attenuate into a slender, terete, narrowly channelled, brown spine; marginal teeth flexuous or recurved, dark brown; scape as in the last; panicle loosely branched; flowers 2′ long; perigon whitish, lobes a little shorter than tube, stamens from its middle, and, together with anthers and style, long exsert, purplish; capsule cylindric, stipitate; seeds small, roughish.

Camp Bowie, Arizona, Rothrock (496), 1874; Palmer, in Southern Arizona. Similar to the last, but readily distinguished by its longer, narrower leaves and the other characters enumerated. Used for the same purposes as the last.

ALISMACEÆ.

TRIGLOCHIN PALUSTRE, L.—South Park, Colorado (952).

TRIGLOCHIN MARITIMUM, L.—Alkaline plains of South Park and San Luis Valley, Colorado (942, 951).

NAIADEÆ.

POTAMOGETON GRAMINEUS, L., var. HETEROPHYLLUS, Fries.—South Park, at 10,000 feet elevation (961). No mature fruit.

POTAMOGETON PERFOLIATUS, L., var. LANCEOLATUS, Robbins?—Twin Lakes, Colorado (960).

POTAMOGETON MARINUS, L.—Twin Lakes and San Luis Valley, Colorado (955).

POTAMOGETON PECTINATUS, L. (959).

NAIAS MAJOR, Roth.—Huntington Valley, Nevada.

34TH CONGRESS, 1st Session. } SENATE. { Ex. Doc. No. 108.

REPORT

ON THE

UNITED STATES AND MEXICAN BOUNDARY SURVEY,

MADE UNDER

THE DIRECTION OF THE SECRETARY OF THE INTERIOR,

BY

WILLIAM H. EMORY.

MAJOR FIRST CAVALRY AND UNITED STATES COMMISSIONER.

VOLUME II.

WASHINGTON:
A. O. P. NICHOLSON, PRINTER.
1859.

UNITED STATES AND MEXICAN

BOUNDARY SURVEY,

UNDER THE ORDER OF

LIEUT. COL. W. H. EMORY,

MAJOR FIRST CAVALRY, AND UNITED STATES COMMISSIONER.

BOTANY

OF THE BOUNDARY,

BY

JOHN TORREY.

high. Leaves 12–15 inches long and 1–1½ inch wide, thick, rounded underneath and somewhat channelled above, terminating in a stout spine, the margin armed with short strong hooked prickles, which are usually reversed. Scape 6–10 feet long, the upper part pretty thickly covered with flowers, which are mostly in pairs (the lowest in threes) and arise from very short (1–2 lines) forked peduncles or branches. Bracts lanceolate from a broad clasping base, 2 lines long, deciduous. The perianth above the ovary is about an inch long, white with a tinge of yellow, and the segments are narrowly-oblong. Stamens and style much exserted. Stigma clavate, obtuse, obscurely 3-lobed. Capsule about an inch long and half an inch in diameter, erect, obtusely triangular, with a short abrupt acumination. Seeds in a double series, semiorbicular, compressed vertically, black and shining. We cannot identify this species among those described by *Kunth* and later writers. The fibres of the leaves are used for making coarse ropes, bagging, etc.

AGAVE GEMINIFLORA, *Gawl. in Brand's Jour. Sc.* 1, *t.* 1? var. SONORÆ: foliis angusto-linearibus elongatis crebris superne concavis, subtus rotundatis, apice terretibus convolutis in spinam terminalem excurrentibus, margine filamentosis; spica longissima, floribus per paria approximatis; perigoniis (uncialibus) tubuloso-infundibuliformibus.—Sierra del Pajarito, Sonora, August; *Schott.* Leaves all radical, 6–12 inches long and 3–4 lines wide; the margin splitting off into very fine white threads and entirely destitute of spines or serratures. Scape (including its spike) 5–6 feet high. The flowers in pairs on very short erect stalks. The perianth above the ovary is about an inch long, with a somewhat funnel-form tube, and narrowly oblong segments, which are at first a little spreading, but afterwards erect. Stamens and style exserted and the linear anthers, as usual, very large for the size of the flower.

AGAVE PARVIFLORA (n. sp.): acaulis; foliis lineari-lanceolatis basi valde dilatatis infra medium margine catilagineo-denticulatis, ultra medium filamentosis; spica elongata; pedunculis brevissimis dissitis 2–4-floris; perianthiis (vix semiuncialibus) subcampanulatis, laciniis breviovatis; capsulis subglobosis.—On various sierras of Pimeria Alta, Sonora; *Schott.* Leaves all in a radical cluster, 2½–3 inches long and about half an inch wide, thick, much dilated at the base; the margin below the middle furnished with minute but evident cartilaginous teeth, while on the upper half the margin bears rather stout white threads; the spiny tip is not more than 2–3 lines long. Scape 4–5 feet long; the clusters of flowers more scattered than in the last species. Only the withered persistent flowers were collected. These when soaked were scarcely half an inch long and whitish with a tinge of rose-color. Stamens and style exserted. Capsule 4–5 lines long and of nearly the same diameter. Seeds as in the last species. This is possibly A. filifera, *Salm-Dyck*, a species of which the flowers and fruit are not described.

AGAVE VIRGINICA, *Linn.; Michx. Fl.* 1, *p.* 187; *Kunth, Enum.* 5, *p.* 833. Hills on the Rio Grande from El Paso down to Laredo, April—August. (No. 683 and 1905, *Wright.*)

I subjoin a description, by Dr. Engelmann, of a species of Agave found at Eagle Pass on the Rio Grande, (probably collected by Mr. Schott,) of which there are no specimens in the collections: Dr Bigelow

AGAVE MACULATA (Engelm.): radice crassa cylindrica nigra; foliis radicalibus lanceolato-linearibus longe acuminatis subtus convexis supra profunde concavis recurvatis glaucis maculis atro-virentibus notatis, margine albido cartilagineo-dentatis apice acutis nec spinescentibus; scapo basi foliis paucis instructo; floribus in spicam simplicem dispositis brevissime pedicellatis; tubo corollæ superne vix ampliato, laciniis lineari-oblongis rotato-patentibus.—Eagle Pass on

the Rio Grande. Root 6–8 lines in diameter, 4–6 inches long, black, with long thick white fibres. Leaves 4–6 inches long, ½ an inch wide, deeply channelled, but not carinate, very glaucous, the dark greenish brown blotches more distinct on the upper than the lower surface. Scape 1½–2 feet high. Spike about 6 inches long, with 12–15 flowers. Bracts subulate, longer than the pedicel, which is about one line long and articulated in the middle. The flowers, which are of musky not disagreeable odor, are about 20‴ long; ovary 6‴, tube 9‴, the limb about 6‴. Laciniæ of the perianth at first green, afterwards on both sides (with the filaments) of a dirty purplish color Evidently near A. revoluta, *Klotzsch;* but that species has smooth-margined leaves; limb of the perianth equal to the tube; stamens free in the tube and longer than the limb. To Polyanthes Mexicana, Zucc. (which Kunth in Enum. 5, p. 847, says, is probably a species of Agave) it is still more nearly related, but that has leaves entire on the margin, with reddish dots; flowers white, in pairs and sessile, the tube 18 lines long, segments only 3–4 lines long. Capsule (immature) ovate oblong obtusely triangular. Nothing is said of the fragrance of the flowers.

BROMELIACEÆ.

TILLANDSIA RECURVATA (*Linn.; Le Conte in Ann. Lyc. N. York*, 2, *p.* 132): cæspitosa; foliis subdistichis filiformibus teretibus anguste canaliculatis cinereo-lepidotis recurvatis; pedunculis folio longioribus unifloris glabriusculis; bracteis 2–3 acuminatis calyce longioribus.—On trees, near the Rio Coleto, Texas; *Thurber.* On oaks and grape vines, Los Moros; *Bigelow.* Lower Rio Grande; *Schott.* San Fernando, Mexico; *Berlandier*, No. 818. The specimens are all in fruit, and the peduncles mostly one-flowered.

TILLANDSIA USNEOIDES, *Linn.; Ell. Sk.* 1, *p.* 379; *Le Conte, l. c.* On trees, western Texas, not found on the Rio Grande above the mouth of the Pecos.

DASYLIRION TENUIFOLIUM (n. sp.): caudice brevissimo; foliis linearibus gramineis planis vix rigidulis nitidis margine spinuloso-scaberrimis; panicula elongata, ramis simplicibus distantibus sublaxifloris, basi subnudis; pedicellis flore sublongioribus; fructibus membranaceis, lobis carinatis vix alatis; seminibus oblongo-obovatis. Among rocks, borders of the Sabinal river; *Wright*, (No. 1919.) Stony places on the high plateau of the upper Guadalupe, Texas; *Lindheimer.* Caudex short and almost subterranean. Radical leaves about a foot long, 2–2½ lines wide, bright green and shining on both sides, much thinner in texture than in any other species of this genus, those of the scape gradually smaller. Stem or scape (including the panicle) about 3 feet high. Branches of the panicle 2–3 inches long. Flowers solitary or somewhat fasciculate. Perianth scarcely a line and a half in diameter. Ovary 3-celled, with 2 erect ovules in each cell; stigmas 3, oblong, sessile. Fruit rather broader than long, 3-lobed, one or two of the seeds commonly abortive. Seed minutely reticulate-rugose. Remarkable for the thin leaves and long naked panicle.

DASYLIRION GRAMINIFOLIUM, *Zucc. Pl. Nov. v. Min. Cog. fasc.* 4, *p.* 225, *t.* 1. Hill sides and table land, western Texas, New Mexico, Chihuahua, and Sonora, westward to the Colorado. Neuvo Leon; *Berlandier*, (No. 3211. No. 694, *Wright.* No. 70, 212, 212, 419, and 549, *Fendler.*) Caudex 3–5 feet high, the upper part clothed with the long spiny-serrated recurved leaves. Scape 6–8 feet high. Flowers in a long dense panicle of close spikes, which are subtended by broadly lanceolate clasping foliaceous spathes. The male flowers with a sterile ovary, and the female with sterile anthers. Bracts and bracteoles broadly ovate, acuminate

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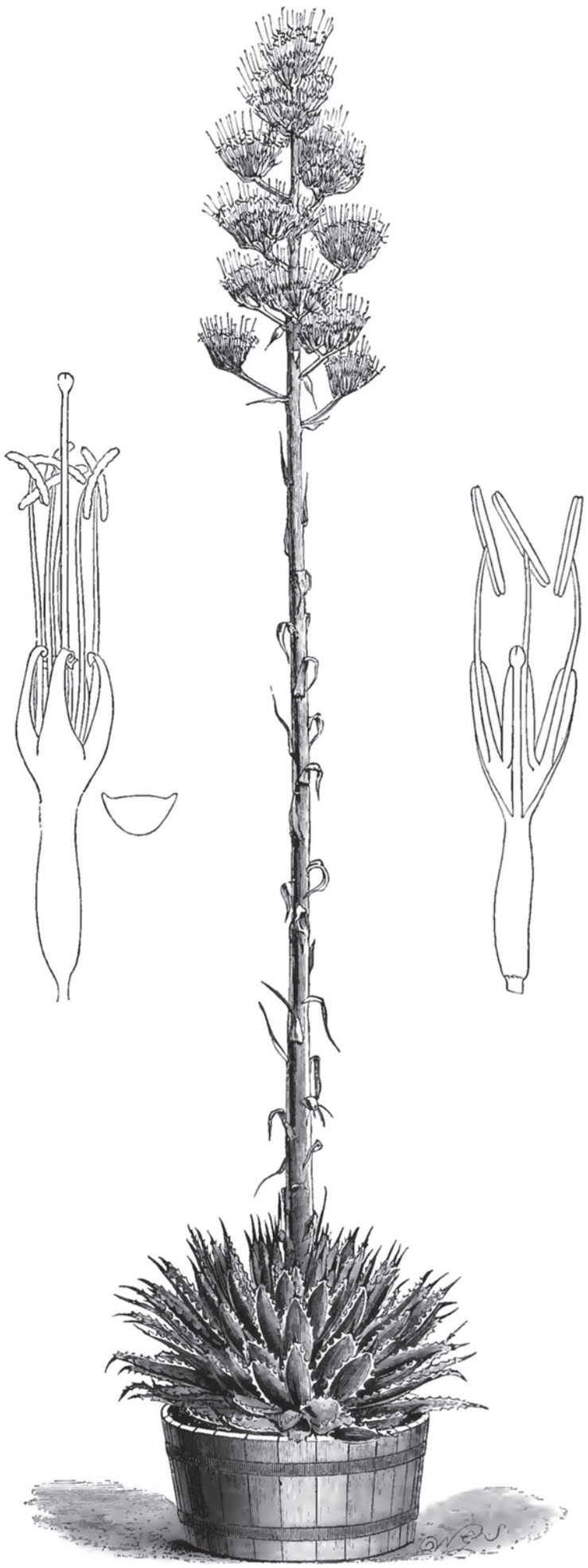

Fig. 39.—Agave parryi.

small hole prepared for it. It then undergoes a second burning or boiling, when it is ready for use. Mr. Wild very much doubts if such care as this is taken; he is more inclined to believe that deeper and larger cuts are made and fire used to promote the flow of resin. He adds:—"It is evident that the inhabitants have been accustomed to do what they pleased in the forests, and that no rational management has ever been in vogue." As regards the formation of new plantations, Mr. Wild proposes, for the supply of fuel, but principally for sanitary considerations, that a plot of 100 acres be planted or sown with Eucalyptus globulus at short distances from each of the chief stations. In this case he would try a simple ploughing and broadcast sowing. He concludes his report as follows:—

"The cultivation of the Mulberry for sericulture, and of the Carob and Olive for the bean and fruit they produce, should be encouraged among the inhabitants of the plains and lower hills. Seedlings of the Eucalyptus globulus might with advantage be distributed free, or at a very small cost, to the inhabitants of the larger towns and villages, not only as a sanitary measure, but also with regard to the improvement of the general appearance of such towns. I feel sure the people would gladly receive plants of this description, and would take great care of them."

AGAVE PARRYI (Fig. 39).

We have had here in May Agave Parryi in bloom. The specimen was sent to Mr. Shaw's garden from Arizona a year ago, and developed its flowering-stalk during winter. I enclose to you a photograph, and if you think it worth while to reproduce it in the *Gardeners' Chronicle* I would direct your attention to the very long exsert styles, which in the photograph are very indistinct. It was interesting to find most of the flower bunches open at the same time, presenting with their (at a distance) deep yellow flowers quite a gorgeous appearance. The stalk is about 8 feet high, 7 inches in circumference at base, the panicle is 2½ feet high, and 1 foot in diameter, and consists of about sixteen branches. The leaves are well characterised by the semiterete or somewhat triangular terminal spine, nearly flat, or slightly keeled above. They are about 10 inches long and 3 inches wide. *George Engelmann, St. Louis, Mo.*

Foreign Correspondence.

Klausenburg, Hungary.—The winter was comparatively mild. In other years in February the thermometer generally goes below freezing point; here, however, at noon this year it nearly always stood above freezing point. February 16, + 13° C.; February 17, + 16° C.; February 22, + 12° C.; February 24, + 13° C.; February 25, + 17° C. The evenings were also average. February 11, 17, 18, 22, and 23, + 6° C.; February 16 and 25, + 9° C. There was but little rain or snow this month, altogether 22 mm. The number of days on which snow fell was two, one day with both snow and rain, four days of rain. March was similar to that of other years; all three daily observations indicated, as a rule, more than average, but on March 14 all the readings were below average (7 A.M., 5° C.; 2 P.M., 2° C.; 9 P.M., 4° C.), until March 19, when some snow fell. April was fine and warm: on April 18, at 2 P.M., + 25° C.; towards the end of the month it was cooler, but for years the last few days of April and the first of May have been cool. May here does not deserve the name "beautiful," as I who have been here seven years can testify. The greenhouse plants could not be turned out on May 12, 13, 14, the stove plants on May 25. In June the thermometer stood at 2 P.M. at 27°—29° C., seldom under 25° C., and only three times in the month it fell to below 20°, but there was much rain from the 12th to the 19th daily, and indeed on June 15 there fell 38 mm.; June 16, 27 mm.; June 19, 24 mm.; June 7 and 24 likewise, 24 mm.; and in the whole month, 169.6 mm., which is 4.7 mm. more than in the first six months of 1878. In the year 1878 the rain of these six months measured 164.9 mm., and then the last eight days of June were without rain. Much rain also fell in the first half of July, altogether 71.5 mm.; on July 6, 27.5 mm.; and then it gradually became cooler, + 12° C., + 9° C.; but on July 7, at 2 P.M., + 17° C.; July 8, + 27° C.; July 9, + 30° C.; and then often over,

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AGAVE (LITTÆA) VICTORIÆ-REGINÆ, T. MOORE.

ACAULESCENT; leaves 100 to 250 in a compact rosette, ovate-lanceolate, concave, 6—8 inches long, 2—2½ inches wide above the slightly dilated base, ¼ to (towards the base) 1 inch thick, rigid, dull green, with white markings, and a horny, entire, at last detached border, which terminates in a rigid, often twisted, blackish spine, usually bearing a few teeth at its base, often with a similar horny border on the dorsal keel, similarly terminating in one or two teeth at the base of the terminal spine (which thus appears two- or three-crested); scape, 8—10 feet high, 1 inch thick; flowering-spike about one-third of its length, very dense, bearing in the axil of each bract three short-pedicelled flowers; flowers about 2 inches long; ovary over ½ inch; tube broadly funnel-shaped, only ½ line long, perigonial lobes oblong-linear, 8 lines long; filaments inserted at the base of the lobes, more than twice as long as these, and rather exceeding the style, which bears three orbicular, at last spreading, stigmas; capsule about 9 lines long, oblong, cuspidate; seeds, 2 lines long.—*Gard. Chron.* n.s., iv., p. 485, with woodcut (fig. 137); *Flore des Serres*, xxi., p. 169, with woodcut, Baker, in *Gard. Chron.*, vii., p. 528.—*A. Consideranti*, Carrière, in *Rev. Hort.* 1875, p. 429, fig. 68.

In coarse gravelly soil on steep hills near Monterey, Northern Mexico, flowering in autumn according to Dr. E. Palmer, who gathered fruiting specimens in February last. The largest plant which he sent to St. Louis has a diameter of 2 feet, a height of 14 inches, and bears about 250 leaves, 7 to 8 inches long and 2 to 2½ wide. The leaves of the older plants bear white streaks, which seem to correspond with and are probably produced by the pressure of the adjoining leaves, but other wavy, transverse marks on the leaves of younger plants can scarcely thus be accounted for. The inflorescence is that of a very dense-flowering Littæa, the flowers with an extremely short perigonial tube. The great morphological interest consists in the regularly (at least in my specimen) tri-flowered bunches, the third flower occupying the centre between the two normal twin flowers of this section; this is probably the primary flower, which in most or in all other Littæas is entirely absent, or is in a few species only indicated and represented by a bristle. Where I have seen more than two flowers in a Littæa (*e.g.*, often in A. utahensis) the third and fourth flowers are axillary to the bracts of the first and second one. *G. Engelmann, St. Louis, U.S., May*, 1880.

FIG. 137.—AGAVE VICTORIÆ-REGINÆ.

Home Correspondence.

Preparations for Strawberry Potting.—We are now upon the advent of a new year in Strawberry forcing. No interval of rest for the weary gardener between gathering the last crops from the present season's plants and the preliminary preparations that weather and other circumstances press upon our notice as being indispensable in laying a good foundation for another year. Runners are both early and abundant upon young plants which were planted out of small pots last August, while there is not a score of runners upon forced plants which were planted upon trial early last April. We have, therefore, favourable prospects before us. Layering Strawberry runners is an uninviting piece of business, unless the workman has an interest in his work. It is best, therefore, to select nimble fingers as well as willing ones to execute the work if it is to proceed quickly and satisfactorily. All materials should be got in readiness beforehand, pots (large or small 60's) should be clean washed, and soil chopped down small enough to work conveniently into the pots. A piece of fibry turf with the fine earth shaken out of it will answer for drainage in the small pots. Then fill them with the prepared compost consisting of loam and a dash of horse-droppings, and put a thin covering of sifted leaf-mould on the surface of the soil in each pot to peg the runner upon, in order that it may take root quickly at the joint, and stop growth beyond the latter by pinching. Plunge the pots between every alternate row of plants, so that they may be easily reached with water, and if it can be arranged to have plants for producing runners near to a good supply of water, where a boy with the assistance of a hose-pipe can attend to their daily requirements in dry weather, it will be something saved in labour. Varieties.—A selection of suitable varieties is one of the most important points bearing upon success in Strawberry forcing. Identical varieties behave so differently under different conditions of soil and climate, that it requires the experience of a season or two to enable one to eliminate from the list such kinds as are not free croppers, or that inherit constitutional infirmities which appear to develope in some instances and to disappear altogether in others under circumstances already indicated. For the North of England half a dozen good kinds would be Vicomtesse Héricart de Thury, La Grosse Sucrée, Underhill's Sir Harry, President, Sir Charles Napier, and either Dr. Hogg or James Veitch, the former being the best cropper and the latter carrying off the palm in point of size. Six sorts for the South of England would be Keens' Seedling, Vicomtesse H. de Thury, Underhill's Sir Harry, President, Sir C. Napier, and Dr. Hogg. The best all-round Strawberry for forcing in this climate after the month of March is undoubtedly President, and for late crops Sir Charles Napier is one of the first in cultivation, but although a free cropper it wants skill to give it that brilliant gloss which is indicative of superior management. Hence we often

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of the Rose, but the Pelargonium creates disturbance, for it is now demonstrated as clearly as daylight that these at least will make exhibition plants as rich and beautiful at Christmas as at any time of the year. But flower shows are largely contingent upon horticultural enthusiasm and pecuniary considerations, and if the enthusiasm of growers would urge them to have flower shows in mid-winter, fortunately the pecuniary conditions prevent the realisation of their desires. No one imagines that any such exhibition would be a success, and the public would deliberately refuse to admit that any such floral display in mid-winter was real. Whilst, however, we may so far rejoice that there is no prospect of flower show seasons becoming converted into one perpetual, never-ceasing period, we may none the less exhibit some pride in the contemplation of the fact that horticulturists, having so far availed themselves of the potent forces of Nature, can give us flowers in myriads, beautiful and varied, even whilst the earth is locked in hard frost and cold reigns triumphant.

To moralise over the general results which flow from the now almost universal holding of flower shows is to exhaust a well-worn theme. Perhaps the less we attempt to demonstrate the elevating tendencies of floral displays the less likely shall we be to get a fall. It would be idle to assume that the prospectuses which usually precede the formation of local flower shows convey the exact facts. The truth is more nearly found in the desire local growers may have to publicly display their products, of which they may have good reason to be proud, and, not least, to secure some tangible prizes. Putting aside as too theoretical for present consideration, the possible moral effect upon the denizens of a locality, at least no question remains as to the good effect that flower shows have upon local horticulture, and upon not only the humble plodding gardener of a district, but also upon those sections of the little community (and they are important ones) known as amateurs and cottagers.

Here flower shows do very much practical good, for they both teach and stimulate to better work and higher cultural results. Some few employers—not very wise ones it is true—are apt to think that the gardener who gives his mind to the culture of plants or flowers for exhibition, of necessity will and does neglect the growth of other less pretentious products. No conclusion could be more at variance with facts, for it is almost universally found that the man who under flower show stimulus strives to do some things better than he previously has, will carry that same desire to excel into all the garden products he may grow; as well as in thus growing better things for show, he presents his employer with better products for his gratification. Without doubt the balance of good is a long way in favour of flower shows, although they are still defective for educational purposes.

New Garden Plants.

POLYSTICHUM VESTITUM GRANDIDENS, *n. var.*

FRONDS lanceolate or ovate, with a narrowed and extended apex, bipinnate; pinnæ very unequal, in the narrower fronds generally cuneate or obovate, sometimes oblong, inciso-dentate, sometimes abortive; in the broader fronds with the more perfect parts furnished with obliquely ovate-oblong acute auricled, bidentate pinnules, the auricles and basal pinnules often undeveloped, and the narrower apex of the fronds with cuneate or obovate pinnules as in the lanceolate fronds; stipes and rachis densely clothed with dark brown scales, ovate and lanceolate at the base, becoming smaller upwards, the rachis proliferous at the apex.

This Fern, which we have recently received from Mr. D. Anderson, gardener at Singleton Park, Kendal, is quite the counterpart of the British P. angulare grandidens in all but the proliferous apex. Like that form of our native species, which is one of the most elegant of its unsymmetrical varieties, the plant before us is remarkable for the sharp deep toothing of the pinnules, which are in some cases wedge-shaped or obovate in outline, and seldom have the normal oblong acute auricled form, which nevertheless is occasionally developed upon those fronds which come nearest to the full normal growth. Even in these fronds, or parts of fronds, the development of the spiny-pointed teeth is far beyond the average.

We learn from Mr. Anderson that the plant is a seedling from P. vestitum proliferum, which was raised by him about seven years ago, and that it has retained its characteristics up to the present time. It is a remarkably elegant greenhouse evergreen Fern, distinct in character, the most striking feature being the preponderance of the round-ended pinnules, with the margins deeply incised or cut up into long spiny-pointed conspicuous teeth, whence the name grandidens. The pinnules on the younger less mature fronds are even more strikingly fissile; while as they become more mature and fertile the dental development is less strongly marked. *T. Moore.*

AGAVE BRACTEOSA, *S. Watson in Herb.*

(See figs. 138, 139.)

Acaulescent, with 10—15 lanceolate or broadly linear, fleshy, greyish-green, irregularly spreading leaves recurved at the tip, 18—22 inches long, tapering from a width of 1½ inch near the base gradually to an herbaceous point without becoming wider in the middle; ¾—½ inch thick below, slightly concave; margin serrulate with minute rather obtuse cartilaginous teeth about $\frac{1}{20}$—$\frac{1}{10}$ line in length. The flowering stalk was 37 inches high, 17 inches of which formed a dense spike of flowers; the whole stalk closely beset with spreading or recurved bracts 5—6 inches long, subulate-filiform from an oval base. Flowers in pairs, their short pedicels with conspicuous membranaceous bracts, about half as long as the ovary. Flowers (fig. 138) only about 1 inch long; ovary as well as perigon only ½ inch long each; the latter divided nearly to the base, tube being only ½ line deep; lobes oblong-oval, spreading; stamens inserted in the throat, four times as long as the lobes; style at last longer than stamens; anthers 4 lines in length when fresh.

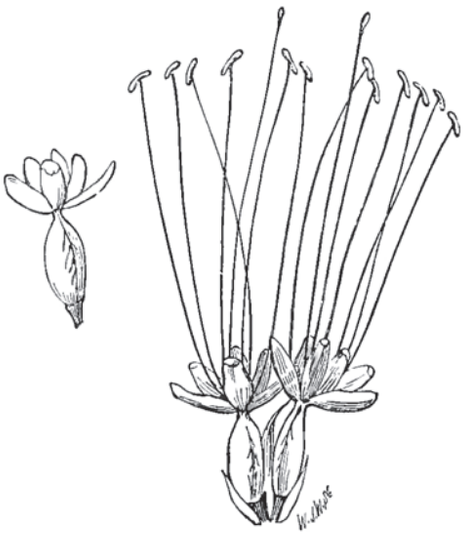

FIG. 138.—AGAVE BRACTEOSA.

The minutely serrulate, narrow, but yet fleshy leaves, the numerous flexuous or recurved bracts of the stalks, the very conspicuous membranaceous bracts on the pedicels, and the small size of the flowers with the very long filaments, contribute to make this one of the most curious species of the genus. It was found in the same locality, near Monterey, where Agave Victoriæ Reginæ was collected. Dr. Palmer discovered this Agave, which flowered last year in the Cambridge, U.S., Botanical Garden, where Mr. S. Watson named and figured it. It seems to be allied to A. pruinosa, Lem. (see Baker, Monog. in *Gard. Chron.*, Dec. 15, 1877), at least in the consistency and the margination of the leaves, while in other respects it may stand nearer to A. yuccæfolia. *G. Engelmann.*

GRAMMATOPHYLLUM ELEGANS, *n. sp.**

A very elegant Grammatophyllum, imported from the South Sea Islands by Mr. B. S. Williams. The pseudobulb is in the way of that of Grammatophyllum multiflorum, Lindl., to judge from a sketch kindly sent. The peduncle is erect, a foot high, with seven stately flowers. Sepals oblong, very rounded, sepia-brown, with light yellow margins; petals much smaller and narrower, of the same colour; lip pallid ochre, with brown anterior margins, hairy on the disc; column whitish, with two sepia-brown lines under the fovea. I had very great difficulty in deciding whether it is a variety of Grammatophyllum Fenzlianum or a distinct species. The very blunt sepals, the totally distinct colours, the great irregularity of the sepals and petals, the distinct shape of the lip, and last, not least, the mostly shorter pedicelled ovaries, made me prefer establishing a species. *H. G. Rchb. f.*

CŒLOGYNE OCELLATA (*Lindl.*) BODDAERTIANA, *n. var.*

This is a good typical Cœlogyne ocellata, Lindl., but, strange to say, the very curious and deep colour of the lip is totally washed away, so that an exceedingly meritorious albino is the result. I had never had any information about such a plant till I got it, in April last, from Mons. le Professeur Boddaert van Cutjem, of Ghent (Rue Guillaume Tell et Avenue de Courtrai), who is known as one of the most intelligent and enthusiastic Orchidists of our day, and whose name it very justly bears. *H. G. Rchb. f.*

LÆLIA AMANDA, *n. hyb. nat.*?

A very fine Lælia, but no doubt a hybrid, to judge from the very unequal pollinia, which suggests a Cattleya parentage. A very good pencil sketch shows thin fusiform bulbs, which are said to be 5—7 inches in length. The cuneate ligulate blunt acute leaves, which are equal to two-thirds of the length of the bulbs, are said to be tinted with red underneath when young. The fine flowers stand in pairs, the common peduncle exceeding the small narrow spathe. Ovary purple and green. Sepals and broader petals oblong, ligulate, rather acute, wavy, lightest rose with a very obscure greyish hue outside of the sepals and darker tinted nerves on the inner side of the petals. Cordiform base of the lip enveloping the base of the column, with rounded side laciniæ going out into angulate antrorse lobes and with a tranverse oblong emarginate wavy short middle lacinia, separated by an exceedingly short isthmus; longitudinal keel and base of the side nerves prominent on the disc of the lip, where there is a very rich purple nervation, a very great charm. Anterior laciniæ of the lip and lateral angles of the finest richest dark purple. Side of lateral laciniæ light purple. Column light, rosy at middle of the back, white at the top and base, with dark purple in front. This came in excellent order from Mr. W. Bull. I must acknowledge with most agreeable surprise and thanks, that a very good, quite satisfactory sketch of the plant with measurements, &c., arrived at the same time. Usually this is the subject of a long correspondence. What were the parents? There is no difficulty in thinking of Cattleya intermedia from the nature of the lip. The other parent may have been Lælia crispa. *H. G. Rchb. f.*

CRINUM HILDEBRANDTII. — This species was sent from Dr. Kirk, Japan, about four years ago, under the name of Crinum sp. It is now flowering in the Orchid-house at Kew, where it is very conspicuous. The flowers are borne in an erect umbel, while the long linear white segments recurve in an elegant manner. Like several others of this rather extensive genus it has the fault of losing its leaves when in flower; but this defect may be compensated by standing it amongst other plants.

* *Grammatophyllum elegans*, n. sp.—Affine Grammatophyllo Fenzliano: sepalis oblongis obtusis; tepalis angustioribus obtusis, labelli trifidi disco pilosi laciniis lateralibus triangulis antrorsis; lacinia mediana cuneato retusa emarginata, carinis pauci angulatis per discum. Flores speciosi brunnei, ochraceo marginati. Labellum ochraceum, antice brunneo prætextum. Columna albida lineis duabus brunneis sub forveâ. Ex Oceania imp. dom. B. S. Williams, London. *H. G. Rchb. f.*

† *Lælia amanda*, n. hyb. nat ?—Pseudobulbis fusiformibus monophyllis seu diphyllis; foliis cuneato oblongo ligulatis acutis; pedunculo uni seu bifloro spatham angustam superante; sepalis ligulatis acutis; tepalis oblongo ligulatis acutis undulatis labello supra basin columnæ adnato, basi cordato, dein dilatato, antice trifido, laciniis lateralibus semirotundis antice antrorsum angulatis, lacioia mediana ab isthmo brevissimo transversa, dilatata, emarginata, crispula; nervis longitudinalibus lateralibusque, disci carinatis elevatis; polliniis inæqualibus. Col. exc. Bull. *H. G. Rchb. f.*

FIG. 139.—AGAVE BRACTEOSA. (SEE P. 776.)

INDIAN TEA.

IT is remarkable that whilst Tea is so universally used in England the public should know so little about it, and be, therefore, such indifferent judges as to what they should look for as the signs of a good article. There is a mistaken notion still abroad that "flowery Pekoe" is made of the white, Camellia-like blossom from the bush, and that several species are cultivated to produce the various qualities of Teas. Many of your readers may feel an interest in learning something concerning the Kangra Valley Tea district and the method of cultivation, picking and making of the Tea there grown. The exhausted leaves from their teapots will then guide them in their future purchases; when they have learned that in carefully made and honestly packed Tea there are no sticks or other incongruous matter, but simply the leaf of the curled, dried Tea, which has opened and expanded in the water to something like its pristine state.

All the kinds of Tea, which are described as Pekoe, Orange Pekoe, Pekoe Souchong, &c., are picked at the same moment, from the same stem, from the same bush. The barely developed little leaf, covered with a delicate down, which is just unfolding on the top of the spray, is to produce the finest Tea; the first perfect, but still tender leaves, the next; and the broader ones, lower down, the Bohea, or coarse Tea. These leaves are all manufactured together into Tea, as we shall see presently; and the best Tea to drink is, perhaps, the liquor derived from the mass as it stands. But the different sized leaves are all laboriously sorted by hand, after manufacture, before they are exported to the English market, to meet the requirements of the trade and in accordance with the China mode. These carefully sorted leaves have to be mixed again to make a Tea for actual use, such, for example, as Pekoe Souchong, which is, perhaps, the best mixture; and some of the finest Tea goes to make coarse China Teas drinkable and fit for the market. The coarse Teas from the Kangra Valley are sold in India and are not exported to England, where we get the mass of our Tea concentrated, as it were, by this removal of all leaves of scanty strength and flavour.

THE KANGRA TEA PLANTATIONS.

These lie along the slopes of the North-West Himalayas, nestling at the feet of grand mountains of from 10,000 to 16,000 feet high, and comprising, between the Ravee and the Sutlej, 8000 square miles of country. The district of Kangra proper, leaving out the sub-division of Kúlú, and the highly picturesque native states of Mundi, Sookêt, and Chumba, extends from the Beas, where the natural watershed divides it from the Hoosbiarpore district, to the boundary of the Mundi State, near Byjnath, on the one side, and to Noorpoore on the other. It is in this lovely valley that most of the European Tea-planters have settled, and made around them comfortable homes and homesteads, which remind the sun-scorched visitor from the plains of India of far-off English farms.

At the upper part of the valley, and lying opposite to a huge gorge in the mountains, from which the planters obtain their daily supply of ice in the summer, lies Palumpore, the head-quarter station of the Tea district, with its Government offices, rest-house, dispensary, planters' club, and beautiful little church. Talumpore, which is 4000 feet above the sea-level, enjoys an excellent climate for eight or nine months in the year; during the other months the heat and rains are somewhat disagreeable, although admirably adapted to the growth of Tea. The beautiful little station is situated on a series of gently sloping knolls of green turf, thickly studded with Cheel trees (Pinus longifolia), and has the universal Kangra background of mighty mountains. The place is greatly indebted to the exertions of Sir Douglas Forsyth, who did a great deal for it and its immediate neighbourhood whilst he was the Commissioner of the district. His attempt to establish an annual fair at Palumpore, to induce traders from Yarkand and other distant provinces of Central Asia to open up trade with British India, is matter of history; and the causes of its failure are written in the records of the diplomatic offices of England and Russia.

When land has been selected and purchased (no easy tasks in a district where by a mistake in the settlement a great portion of the waste, or uncultivated lands suitable to Tea were given to the natives, and where the bargains have for the most part to be

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the very existence of the town was threatened. The communal authorities at length determined to dispose of their property in numerous small lots, in part on perpetual leases, to the no small advantage of their finances. But the principal benefit that has accrued is that the mountain slopes are now covered with woods of Pines (Pino marittimo), that the rains no longer cause the Toira to swell, and that the town of Varazze is safe from inundations.

PLANT PORTRAITS.

AËRIDES JAPONICUM, Lind. and Rchb. f., *Illustr. Horticole*, t. 461.—Flowers upwards of an inch in diameter; segments white, barred and mottled with reddish-violet; lip stalked, cordate-acute at the anterior part.

AGAVE UNIVITTATA, Haworth, DC.; Baker, in *Bot. Mag.*, t. 6655.—Leaves sword-shaped, spine-toothed, with a central whitish band; flowers in dense erect spikes. See *Gard. Chron.* 1877, p. 369, fig. 58.

APPLE SCHOOLMASTER, *Florist*, t. 574.—An Apple derived from the seed of a Canadian kind, and propagated by Mr. Laxton. Fruit large, conical, yellowish-green, speckled with russet. Flavour sharp and agreeable. October to January.

ANTHURIUM HYBRID var., *Garten Zeitung*, Nov.—A hybrid between A. pedatoradiatum and A. leuconeurum, with cordate, ovate acute or palmately-lobed (not sect) leaves intermediate between those of the parents.

CŒLOGYNE PANDURATA, Lindley; Moore, in *Williams' Orchid Album*, t. 63.—A Bornean species, with large green flowers, the lip marked in the centre with blackish blotches and stripes.

CRASSULA GRACILIS, Hort., *Revue de l'Hort. Belge*.—A dwarf hardy form, with dense heads of scarlet sweet-scented flowers.

ENCEPHALARTOS VILLOSUS, Lemaire; Dyer, in *Bot. Mag.*, t. 6654.—Male and female cones. See *Gard. Chron.*, vol. i., 513; iii., 400; vi., 708; vii., 21; xiii., 181.

ERICAS, *Florist*, November.—Five of Mr. Turnbull's lovely hybrids, all with umbellate elongate tubular flowers, dilated at the base, contracted at the throat:—1, Mooreana ×, glossy crimson-red, with a black throat; 2, Douglasii ×, blush-pink, with a black throat; 3, Lady Dunglas, flowers white; 4, Lady Mary Scott, white, with faint red lines along the tube; 5, Countess of Home, glossy crimson, with a black rim.

GRAPE KECHMISHALI, *Revue Horticole*, Nov. 1.—Said to differ from Frankenthal (Black Hamburgh) only in the circumstance that the leaves turn red before falling, while the leaves of Frankenthal turn yellow.

HELICONIA (?) AUREO-STRIATA, *Illust. Horticole*, November, tab. 464.

HUERNIA OCULATA, Hook. f., *Bot. Mag.*, t. 6658.—A Stapelia-like plant from Damara Land, with erect, angular-furrowed branches, the angles spinose, dentate; flowers campanulate; limb of the corolla violet-purple; throat white.

IMANTOPHYLLUM MINIATUM VAR. MARTHA REIMERS, *Garden*, October 21.—The finest variety of this very striking plant.

KERCHOVEA FLORIBUNDA, E. Morr., *Belgique Horticole*, June, 1882.—A new genus of Cannaceæ, with the habit of Thalia. The bracts and flowers are rose-coloured, in loose panicles.

MASDEVALLIA IGNEA, Rchb. f.; Moore, in *Williams' Orchid Album*, t. 62; *Gard. Chron.* 1872, 545, f. 149.

ODONTOGLOSSUM ROEZLII, Rchb. f.; Moore, in *Williams' Orchid Album*, t. 64.—Remarkable for its very large flat flowers, with narrow oblong white segments, with a magenta blotch at the base, and a very large suborbicular white lip, with a yellow blotch at the base.

PAPAVER PAVONINUM, C. A. Meyer, *Gartenflora*, t. 1095.—A Central Asiatic Poppy, similar to P. umbrosum.

POTHUOVA NUDICAULIS, L., VAR. GLABRIUSCULA, Regel, in *Gartenflora*, t. 1096.—Leaves strap-shaped, obtuse, channelled, spine-toothed, flowers in greenish-yellow in terminal spikes, with crimson bracts. West Indies.

ROSE RÊVE D'OR, *Journal des Roses*, December.—Tea Rose, raised by Ducher, of Lyons. It is very hardy, and a rapid grower. Leaves dark green, flowers full yellow, some of the petals with a coppery sheen at the back.

SCHISMATOGLOTTIS LONGISPATHA, *Illust. Horticole*, tab. 466.—Borneo.

SONERILAS, *Illustration Horticole*, November.—A large plate representing six varieties:—1. Countess of Flanders; 2. Madame Alfred Marne; 3. Madame Charles Heine; 4. Madame Legrelle; 5. Madame Secrétan; 6. Princess Mathilde.

STATICE SUWOROWI, Regel, *Gartenflora*, t. 1095.—An annual species from Western Turkestan, with sinuately lobed leaves, and close spikes of pale lilac flowers. Allied to P. plantaginiflora.

VANDA PARISHII MARRIOTTIANA, Rchb. f.; Moore, in *Williams' Orchid Album*, t. 61; *Gard. Chron.*, xiii., 743; xv., 726.—Sepals and petals mauve outside, bronzy-brown suffused with magenta inside.

AGAVE HETERACANTHA (*Zucc.*) FORMA GLOMERULIFLORA.

THE investigations of Dr. V. Havard of the medical service of the U.S. Army have brought out some interesting morphological facts in regard to this species, which may teach us a lesson about the variability of characters taken from the inflorescence of Agaves. The species (or the form which is known as A. Poselgeri) is abundant in the mountain regions of West Texas and along the Rio Grande between El Paso and Presidio, and has there usually narrow leaves ¾ to 1½ inch wide, and a foot or less long, and an inflorescence of geminate flowers, but occasionally some more vigorous specimens are found with much larger leaves over 2 inches wide; others bear the flowers in clusters instead of pairs, three to six, and even ten, in number, on stout, flattened peduncles, ½ to ¾ inch long, which seem to form an approache to the paniculate character. The figure (fig. 6) represents a cluster of ten capsules, mostly denuded of the remnants of the flowers, and the diagram shows their arrangement. *G. Engelmann, St. Louis, Mo., October*, 1882.

FIG. 6.—CAPSULES OF AGAVE. (SEE TEXT.)

A WILD DOUBLE OXALIS.

ALTHOUGH the genus Oxalis is a very large one, containing over 200 species, and many of them are in cultivation, yet so far as I can discover there is but one species known having double flowers, and that is a yellow flowered species, viz., O. cernua. But in the Kew herbarium is a specimen of an Oxalis with double purple flowers, which I identified as a double-flowered form of O. semiloba of Sonder (the same species that has now become naturalised in Spain and is becoming somewhat of a pest there). This specimen was sent by Mr. J. M. Wood from Inanda, Natal, and upon asking him if the plant was truly wild, Mr. Wood sent the following reply, "This was gathered at Itafamasi in a damp corner, and near a mealie field.* There is no European dwelling within 12 miles or more, as it is about the centre of the Inanda native location, and the natives never cultivate flowers. I have asked them about it and they know it as a wild plant, but that it is rare. It has certainly not escaped from cultivation, as the nearest place from which such a plant could have come is Durban, which is at least 25 miles away." This is interesting, first because double flowers in a state of nature are comparatively rare, and secondly, that although Oxalis is a genus of which numerous species are in cultivation, and have been for a very long time, and have, moreover, attractive and showy flowers, yet there only appears to be one double-flowered form previously known, as above stated, and even that may not be a creation of the gardener, since in the *Flora Capensis*, vol. i., p. 349, it is stated, of O. cernua, that "it varies with double flowers," which I take to mean that it occurs with double flowers in a wild state, and if this is so, it is still more remarkable that both the double-flowered species now known of this genus originated in a wild state. The double-flowered form of O. semiloba here noted, appears to be the first recorded of the purple flowered series. If it can be introduced it will no doubt make a showy greenhouse plant, as in all probability the flowers, being double, will last for a long time. It is one of the bulbous species, with trifoliolate, glabrous, bright green leaves, the leaflets being triangular-obcordate; the peduncle is several flowered, and the flowers bright rose-purple. *N. E. Brown.*

THE NEW ROCKWORK AT KEW.

THE want of a rockwork at Kew, of sufficient dimensions to meet the requirements of the place, had for some time been a matter of comment. This is not to be wondered at in these days of flower gardening, when popular feeling dictates that a rockery for alpine plants is an inseparable adjunct to any well-regulated garden, whether public or private. Several small detached pieces existed previously, but which were quite inadequate for the purpose, and altogether too insignificant to merit the title in a place of such national interest and wide-spread popularity, where thousands of the London public, by road, rail, or steamer, all through the spring, summer, and autumn months, make it their common destination. The old rockery proper has existed for a considerable number of years, undergoing demolition and reconstruction, according as fancy suggested or some new idea preponderated. At length steps were taken by some of the leading amateurs of the country, and the First Commissioner was memorialised by them on the subject, with the result that their petition was granted, and the authorities speedily commenced operations. The death of Mr. Joad, of Wimbledon, placed in the possession of the nation his unique collection of herbaceous and alpine plants, many of which have naturally found a place in the new rockery. Having agreed upon a site, the work was commenced in February last. It occupies a piece of ground running parallel between the herbaceous ground and the new range of Heath, stove, and Orchid-houses, admirably situated both for the convenience of the public and the management of it. The boundaries being defined, the soil was removed to the depth of several feet, and heaped on either side in broad undulating ridges and mounds. The subsoil consists of almost pure sand, which still forms the preponderating element in the body of the work. The whole consists of a series of winding banks, running almost due north and south, and measuring along the centre somewhat over 500 feet.

The material for building consists of stones of various nature and geological interest, obtained from a distance partly, the largest consignment being from Cheddar, in Somersetshire. The botanist may recognise several British plants transported with the stones and thriving admirably, as Asplenium Trichomanes, A. Ruta-muraria, Scabiosa Columbaria, Thymus Serpyllum, Poterium Sanguisorba, and others. A great quantity of stones from various parts of the ground have also been utilised, consisting of sandstone, limestone, Bath, Portland, and granite, with a few blocks of artificial construction. Three of the principal curves have been faced with tree roots of ponderous dimensions, obtained from woods in the pleasure-ground. Against the theory of their harbouring vermin, it may be argued that by vigilance and promptitude

* Mealie or Mealies, the name by which Maize or Indian Corn is known in South Africa.